ALTER

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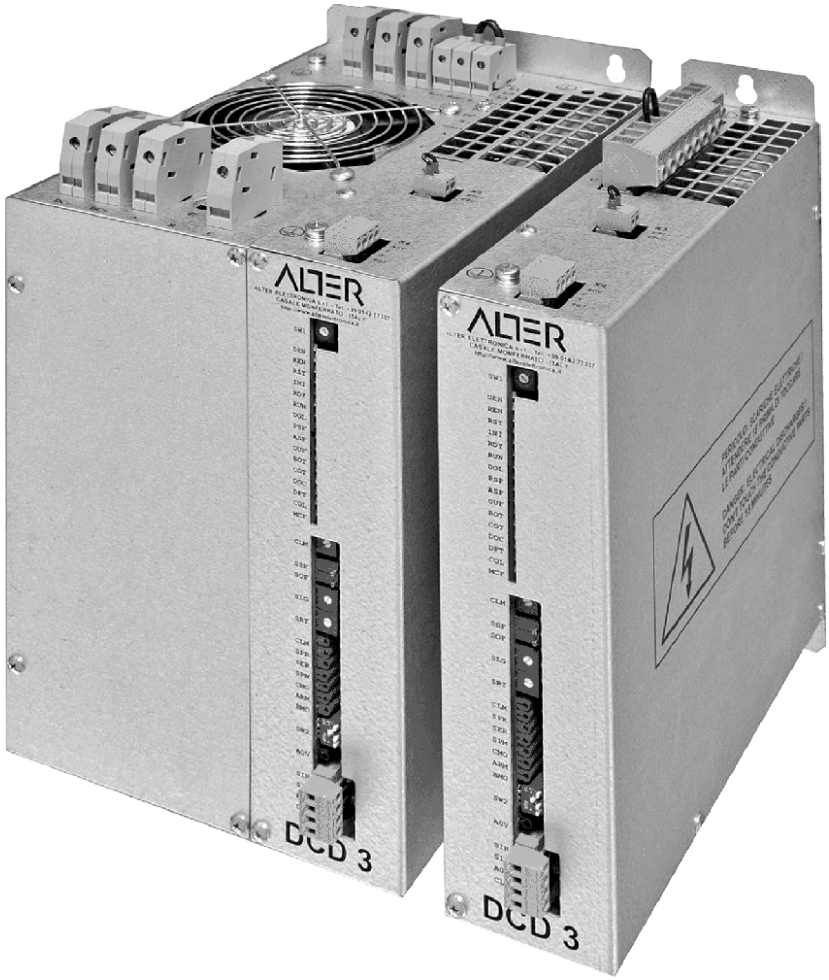



# DCD 3

## 4 Quadrants D.C. Motor Drive Series PWM

Instruction book: 91/107 - Revision 0.2 - Date: 10/18/2012
Compatible with Firmware V0.0

# Chapter 1 - Index

## Table of Contents

# Chapter 2 - Safety and standards

## Recall to the safety standards

The converter model DCD3 is designed and built according to the standards recalled on the paragraph "Reference documents and standards" at page 6 of this chapter and they satisfy the demanded requirements for the marking CE. About the safety it put in evidence:

1. That it has relatively defined to a situation that could bring to damages to the people or to the equipment or to the operated system and not to the operation of the driver (you also see paragraph 9.2 of the standards recalled on point 7. of the paragraph "Reference documents and standards" at page 6).
2. That for the safety it is necessary that the integrator of the driver (PDS: see paragraph "Recall of some definitions" at page 9), the technician and the end user not only follow the prescriptions contained on this instruction book but also observe the standards safety specifications of the operated machine, particularly how much prescribed on the standards EN 60204-1, recalled at point 9. of the paragraph "Reference documents and standards" at page 6).

Please to see here following the meaning of some used symbols.

WARNING ! This symbol recalls the attention to a situation of danger that could also bring to **serious damages** to the people (**also potentially lethal**) or to irreparable breakdowns to the equipment or to the operated system. This is the level of more important alarm. It's **absolutely** necessary to follow the instructions underlined with the symbols under brought.

WARNING !

**Dangerous voltage:** it signals the situations of danger owed from electric voltages.

WARNING !

**Generic danger: i**t signals the situations of danger owed to different causes from the electric voltage.

## Safety general standards

### Preliminary advice

Some instructions are brought about the general character safety, informing that other instructions, specific for the converter model DCD3, they are brought on the chapter 3 from page 9.

### Operation of installation, start-up and maintenance

WARNING !

Only qualified personnel have to operate during the installation, the possible breakdowns search and, generally, for whatever type of intervention in the drive.

This personnel has to own the special documentation furnished by ALTER, particularly this instruction book.
For any reason the unqualified operator has to operate on the terminal block of the converter. Besides it is necessary that the converter be previously disconnected from mains, as specified on the paragraph "Specific indications for the converters model DCD3" at page 11.

## Power-supply sectioning device


WARNING !

Since the converter has built for being embedded on an electrical cabinet, containing eventually also other equipments, the **sectioning device for the command manual feeding**, required by EN 60204-1 §s 5.3.1, can be that common to the whole electrical cabinet and it owes - in every case - must be inserts **at the builder of the machine**.

## Stop function


WARNING !

**The stop functions,** as prescribed on EN 60204-1 §s 9.2.2, particularly **the 0 category stop, must be realized by the builder of the machine,** in how much inherent to the logic of machine, that obviously differs according to the type of machine and following the instructions contained in this instruction book.

## Emergency stop


WARNING !

Also **the emergency stop**, according to EN 60204-1 §s 9.2.5.4, must be made according to the specific characteristics of the operating machine and therefore **the builder of the machine must realize it**.

## Unintentional starting and uncontrolled running


WARNING !

The motor connected to a drive type DCD3 can be started and stopped utilizing the commands performed by the operator (see paragraph X11 at page 23). **If it is necessary to manually act on a mover controlled by the motor**, to satisfy the safety conditions for the operator, it is necessary not only to stop the motor by the command of the converter, but also to **insulate the converter from the feeder line**. In fact the motor can to run without any command but only by cause of fault of the electronic components or other accidental causes (breakdown on mains or on the cables e/o connections, etc.). For the same causes, during the normal operation the converter would be able not to run as described in this instruction book and could be happen that the motor is fed by electric quantity not checked and therefore also the speed and the direction of rotation of the motor are uncontrolled. **The user owes therefore to predispose additional protection e/o safety systems** suitable to prevent damages to people or things.

# Reference documents and standards

Here following are recalled the principals standards, to which we make reference on this instruction book. On the text the calls are brought among square parenthesis.

1. Community directive 89/336/CEE dated May 3rd 1989 regarding the Electromagnetic Compatibility and following changes 92/31/CEE and 93/68 / CEE.
2. Legislative Decree dated December 4th 1992, n° 476 "Putting into effect of the directive 89/336/CEE of the Board dated May 3rd 1989, in subject of approaching of the laws of members States regarding the electromagnetic compatibility, modified by the directive 92/31/CEE of the Board dated April 28th 1992."
3. Legislative Decree dated November 12th 1996, n° 615 "Putting into effect of the directive 89/336/CEE of the Board dated May 3rd 1989, in subject of approaching of the laws of members States regarding the electromagnetic compatibility, modified and integrated by the directive 92/31/CEE of the Board dated July 22nd 1993 and by the directive 93/97/CEE of the Board dated October 29th 1993". (abrogative, paragraph excepted 2 of the article 14, of the legislative decree of which to the [2]).
4. Directive 73/23/CEE dated February 19th1973, concerning the approaching of the laws of members States regarding the electric material destined to be used within some limits of voltage, integrated by the Directive 93/68/CEE dated June 29th 1993.

5. Law October 18th 1977, n° 791 "Putting into effect of the directive of the Board of the European Communities (n.73/23/CEE) regarding the safety guarantees that it has to possess the electric material destined to be used within some limits of voltage."
6. Legislative Decree dated November 25th 1996, n° 626 "Putting into effect of the directive 93/68/CEE in subject of CE marking of the electric material destined to be used within some limits of voltage."
7. Standards CEI EN 61800-1, 2000-05, classification CEI 22-19, "Electric Drives for speed varying Part 1: General prescriptions and rated specifications of low voltage drives for D.C. Motor."
8. Standards CEI EN 61800-3, 1996-09: "Electric drives for speed varying Part 3: Product Standards regarding the electromagnetic compatibility and to the specific test methods", classification CEI 22-10, emission 2861.
9. Standards CEI EN 60204-1, 1998-04, classification CEI 44-5, "Safety of the machinery. Electric equipment of the machines. Part 1: General rules."
10. Standards CEI EN 60146-1-1 "Semiconductors Converters - General prescriptions and mains commutation converters. Part 1-1: Specifications for the fundamental prescriptions."
11. Standards CEI EN 60146-1-3 "Semiconductors Converters - General prescriptions and mains commutation converters. Part 1-3: Transformers and Reactors."
12. Standards CEI 301-1, 1997-10, Classification CEI 301-1, Electric Drives - Dictionary (bilingual).

# Conformity to the CEE directive and CE marking

# Advice

The converter model DCD3 is CDM (see paragraph “Recall of some definitions“ at page 9) and therefore they are utilized together with a D.C. motor to constitute a drive (PDS). The PDS is, in turn, integrated in the electric equipment. The phenomenon EMCs are particularly sensitive to the conditions of the plant, what length of the connections, shielding and connections to the PE and to the earth.
The conformity of the converter model DCD3, listed on the Table 1 at page 13 and the relative CE marking, placed on the converter, for how much it concern to the **EMCs directive**, of which to the documents [1], [2], and [3] mentioned at page 6, ago reference to the standards [8], with the following precise statements:

- The drive type DCD3, since are CDM, they are commercialized in condition of **narrow distribution** (see at paragraph “Recall of some definitions“at page 9); this implies that the builder of the drive, and/or the electrical cabinet and/or the installer and/or the builder of the machine and/or the final user they are competent people about EMC.
- The drive type DCD3 can be applied both in "**first environment**" that in "**second environment**" (see at paragraph “Recall of some definitions“at page 9). In the case of application in first environment it is necessary to install a filter to the three-phase supply of the converter, as specified on Table 1 at page 13.
- The drive type DCD3, since they are components of a PDS, they are sold to be included as a part of an apparatus or system or installed system; therefore the operational conditions of the CDM inside the PDS, and therefore of an apparatus, system or installed system, **they have to follow, in subject of EMC, how much prescribed and/or recommended on this instruction book, particularly on the Chapter 3 (from page 9).**
- For how much required by the directives "Low Voltage", according to the documents [4], [5] and [6], the drives type DCD3, make reference to the standards [7], [10] and [11], however applicable

## Declaration of conformity and CE marking

*The ALTER Elettronica S.r.l. it declares that, under the conditions specified on this document, particularly at the previous paragraph, the converters (CDM) model DCD3, specified on the Table 1 at page 13, result in conformity, to the community directives EMC [1], understood the last changes with the relative Italian legislation [2] and [3] , with the Low Voltage directives community [4] understood the last changes with the relative Italian legislation [5] and [6].*
*The applicable standards references are brought at page 6.*
*Therefore the CE marking, placed on the converters (CDM) model DCD3, attest the conformity both to the EMC directive and to the Low Voltage directive.*

## Application of other CEE directives

The converters are not subject to other CEE directives, over those suitable at page 6. They exist nevertheless, for application motives, calls on other directives; particularly to comply to how much in demand on the article 4 of the **Machines Directive 89/392 CEE and following changes 91/368/CEE, 93/44 CEE, 93/68 CEE, Italian legislation of Putting into effect D.P.R. n°**

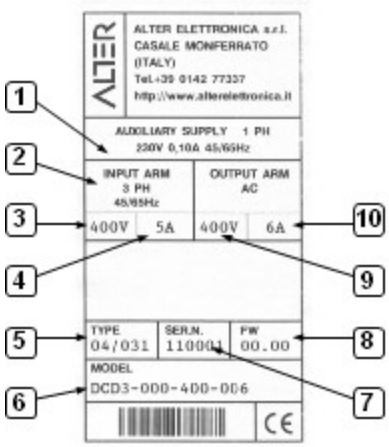
**459 dated July 24th 1996.**
Bring here him following the declaration of the manufacturer (known also as "Declaration of Incorporation").

## Declaration of the manufacturer

*The ALTER Elettronica S.r.l., to the goals than in demand on the Machines Directive (DM) 89/392 and following changes, with the relative Italian legislation D.P.R. 459 of 1996-07-24, declare that the drives type DCD3 must be installed according to the instructions contained on this instruction book and must not to run as long as the machines in which will be incorporated has not been declared conforming to the DM directive here mentioned.*

# Rating plate and information for technical support

## Rating plate of the converter




1) Service supply technical data .
2) Three-phase supply frequency range.
3) Three-phase voltage supply.
4) Three-phase max. current (rated) input.
5) Converter type.
6) Converter model (see code table on page 40).
7) Series number (unique for each type of converter).
8) Firmware version of the converter.
9) Max. output voltage of the converter.
10) Max output current (Rated) of the converter.

## Informative notes

It is recommended to note: the model of the converter, the serial number, the setting values read on the TP and predispositions. These data are used for ordering parts, and to calibrate a new drive in case of replacement

**Sales information, technical advice and application are available at the following numbers:**

| | |
|---|---|
| **MAIL:** | **ALTER ELETTRONICA S.r.l.**<br>Via EZIO TARANTELLI, 7 (Zona Ind.le)<br>15033 CASALE MONFERRATO (AL)<br>ITALY |
| **PHONE:** | +39 0142 77337 |
| **FAX:** | +39 0142 453960 |
| **E-MAIL:** | info@alterelettronica.it |

On the Website Http://www.alterelettronica.it are available all the information about the products and updated editions of instruction books.

Product specifications and contents of this manual may be changed without notice. We recommend to check in the appropriate sections of the website any changes in specifications and updates of this instruction book.

**ALTER ELETTRONICA S.r.l. assumes no responsibility for inaccuracies or errors in this instruction book.**

# Chapter 3 - Guide for the installation

## Purpose and destination

This guide is also furnished in observance to how much prescribed on the paragraph 4.3 of the standards about the EMC (Electromagnetic Compatibility) of the electric drives to vary the speed [8].

Purpose of this guide is that to furnish to the technician, to the builder of the machine and to the final user of the drives type DCD3 information as required by the CEE Directives in vigor **in subject of Electromagnetic and Safety Compatibility for the so-called Low Voltage materials**. Particularly prescriptions and indications are recalled regarding the EMC to the various operators that utilize the drives type DCD3 to realize installations including speed varying drives by d.c. motor. With reference to this, we recall the attention on the fact that is necessary, for the performer of the drive, to **coordinate the content of this guide with the EMC guide of the builder of the motor**, that is joined to DCD3 drive type.

## Recall of some definitions

The specific terms, regarding the electric drives, utilized on this instruction book, they have been defined on the standards [8] and on the dictionary [12] and it is referred to such documents. For some terms, that have a remarkable value from the technical-contractual point of view, the definitions are brought.

ELECTRIC DRIVE (PDS): an electric drive is systems that convert electric energy into mechanics, by power electronic equipments, according to a command function (and according to an established program).
A drive consist of:

- A POWER SUPPLY, CONVERSION AND CONTROL MODULE, (**CDM**) that it includes the whole drive with the exception of the motor and the sensors placed on the motor; particularly it includes a CONVERSION AND CONTROL MODULE (**BDM**) and its possible extensions as the supply module or some auxiliary ones (for example: fan). The BDM includes the functions of conversion, control and self-protection. In the practice the CDM has often called, shortly, **CONVERTER**.
- A MOTOR UNIT.

NOT NARROW DISTRIBUTION: marketing modality in which the supply of the equipments doesn't depend from the competence of the client or of the user about EMC for the utilization of drives. This involves restrictive limits of emission according to the essential requirements of EMC protection.

NARROW DISTRIBUTION: marketing modality in which the builder limits the supply of the equipments to suppliers, clients or users that, separately or jointly have technical competence of the requisite regarding the EMC for the application of drives. For economic motives, the interested parts should guarantee the essential requisite of EMC protection, for the specific installation, choosing suitable categories of emission, through measurement "on site" at the real conditions to the contour and through exchange of exchange of technical specifications.

FIRST ENVIRONMENT: environment that include the home purposes. It directly includes also the connected industrial uses, without input transformers, to low voltage mains that feed buildings assigned to home purposes.

**2.2.6**
SECOND ENVIRONMENT: environment that includes all the different industrial purposes, not those connected to low voltage mains that feed buildings assigned to home purposes.

## Indications for installation

### General indications

We essentially report on these paragraphs the particular dispositions of installation concerning the electromagnetic compatibility, both as phenomenon of emission that can disturb other equipments, and both as immunity from the electric noise. The measures to be adopted, that they are recommended on this instruction book, are useful very often in all cases.

Very particular cases accepted, the **converters DCD3** are placed inside a metallic cabinet (so-called electrical cabinet), that con-

tains also electric equipments of various type (other electronic power converters, contactors, transformers, inductors, etc.)

**The motor** or, better, the motor unit (because they can also exist other accessories what a tachogenerator, an electric fan, a brake, etc.) it is located on the machine, to a certain distance from the electrical cabinet.

They exist therefore, in reality, two separate types of plant: what refers to the wiring of the electrical cabinet and the real definitive plant that the technician realizes at the final client**.**

## Installation of the converter inside the electrical cabinet

The drives type DCD3, have **IP20** degree of protection (see at paragraph “General technical characteristics“ at page 14). To comply with how much prescribed on the § 4.4.6 "Contaminating" of the EN 60204-1 (1998) standards it is necessary, that they be situated, by the builder of the machine, in a suitable case, according to the required protection degree. Of rule they will have placed therefore inside a cabinet; **to satisfy EMC standards the cabinet has to be metallic made by iron plate** having thickness at least 1 mm.

It is important that inside the electric cabinet all the panels are connected among them by mechanical connections that introduce **low electric impedance at high frequencies**. This can be made, for example, adding fastening screws, using galvanized surface panels or cadmium plated rather than painted or removing the paint under the connection points, using special metallic EMC gaskets.

The **components' layout** inside the electrical cabinet, both in terms of positioning and in terms of distances, must be performs with the criterion to minimize the mutual influences regarding the electromagnetic noises of the equipments. Generally the transformers, the inductors, the contactors, because of their coils, they can produce high electric field at close distance

**The wiring of the power circuits** must be physically separated from the wiring of the control circuits (signal circuits); the power circuits must carefully be shielded from the signal circuits; this is made utilizing some metallic raceways inside the electrical cabinet, metallic sheath or shielded cables, also for power connection.

Particular attention must be put on the **wiring of the signal circuits**, for motives about electromagnetic immunity. Is necessary therefore that the **connections of the signal circuits** of the converter, both input and output, **are made using twisted pair cables and carefully shielded.** The shield must be connected to ground on the converter side, as illustrated on paragraph “X11“ at page 23) of this instruction book and, where it is necessary, also to the ground connection of the interested peripheral.

All the equipments, for which **additional devices** are prescribed to conform them to the EMC standards, must be provided of such devices, placed according to the prescriptions of the manufacturer; particularly the good rules recalls to place the **spikes limiting devices** in parallel to the a.c. coils of the contactors, the **diodes** in parallel to the d.c. coils of relay or contactors, the **filters** against the conducted H.F. electrical noises placed on the three-phases power input of some converters, when is prescribed.

**The shielding of the cables** have to finish the nearest possible to the terminal block; if the connection of the shield is prescribed to ground or, in some cases, to the earth, it must possibly be made by some special cable-head that let a 360° contact between the shield and the ground, in absence of this, by connections as short as possible and having a suitable cross section area.

WARNING !

**To disconnect the converter from the circuit under electric test**, before making resistance or isolation tests and/or applied voltage test.
The not compliance of this prescription can seriously damage the converter.

## Complete electric plant

As we have previously said, we report there to the plant in the final installation of the machine. For some types of machines the electrical cabinet is physically connected to the machine and therefore, in practice, the electric plant "on site" is reduced to the connection of the machine to mains.
Usually, nevertheless, the electrical cabinet is found to a certain distance from the machine, on which is placed the motor unit; a pulpit sometimes exists for also remote command, to which some conductors could be connected.
In this case, since the problem list of the emissions is very tied up to factors of plant, the recommendations that follow they are dictated by good technique standards and by experiences on the field and they must essentially have concerned as reference lines and not as certain solutions.

**The three-phase transformer MV/LV** of the feeder line to which some converters of electric drives are connected must have an apparent power suitable to the loads, keeping in mind the power factor and the distortion factor. For the converters DCD3DCD2 please to see at paragraph “Apparent power and current consumption“ at page 14.

**The copper cross section area of the feeder line** connected to the terminal block of the converter (see Drawing 1 at page 17 and

Drawing 2 at page 18), must be suitable to the rated current of every converter. The design must be made in such way to avoid voltage drops that can bring the supply voltage values out of the contractual tolerance.
The Table 2 at page 19 shows the maximum section of the conductors that they are usable on every type of converter.
Moreover it is necessary to carefully study the runs to minimize the length.

All the metallic raceways, the metallic sheaths and, all the shielding, if not otherwise specified, must generally to be connected to the PE both on the electrical cabinet both on the motor; these connections must to be very short and have a wide cross section area..

## Specific indications for the converters model DCD3

The drives type DCD3 don't require, generally, particular modality for placing and installation over the normal professionalism and knowledge of the rules of the art of the electric and electronic planting sector.
In every case, it is necessary to follow how much prescribed or recommended on this instruction book.
Following some specific indications are brought for the installation of the converters DCD3, as it regards the EMC and Low Voltage directive.

The connection schemes on Drawing 1 at page 17 and Drawing 2 at page 18 contains some important practical instructions about wiring to respect the EMC standards, and about the shields connections to the drives type DCD3.

When the drives type DCD3 are utilized in **first environment**, with reference to how much brought on the paragraph “Recall of some definitions“ at page 9, it is necessary to install a **filter** on the three-phase supply of the converter; also the connections of such filters are suitable on the figure above pointed.

On the Table 1at page 13 are brought the types of the three-phase filters to utilize when is used the scheme at Drawing 1 at page 17.
Making the connections brought on the pointed scheme must be observed the following rules:

WARNING ! It is necessary to keep in mind that the run of the cables, their length, their shielding and the shield connection to the right ground point of the converter are **essential to the EMC compliance**.

The **location of the filter** is very important: it must be placed, inside the electrical cabinet, the nearest possible to the component connected to her output. On the Drawing 1 at page 17 such component is named “**FILTER**”.

**The length of the connections** between the filter output and the input of the component connected to its output **should not overcome 0,3 m** and must be made by conductors, having a suitable cross section area, shielded as far as possible. It is evident that, in certain cases, is not be possible to shield components as fuses and contactors; for this reason it is necessary that the runs of the connections are the shortest possible.

**WARNING! The input and the output of the filter cannot be exchanged!**

The ground connections of the converter have been increased for making the most functional wiring; different ground points in the converter exist, marked by the symbol “ ⏚ ”. Please to see the Drawing 10 a pagina 38 e nel Drawing 11 at page 39the connections “E1” and “E2”.

ATTENZIONE !

**E1** (Drawing 10 or Drawing 11), made by one or two M5 screws (dependent from the size). It is the main ground and must to be connected to the PE and therefore to the earth of the plant, by a conductor having a cross section area not less then that of the three-phase supply conductors. **This connection is essential to the protection compliance** and not only to the EMC compliance.
**E2** (Drawing 10 or Drawing 11)it is the connecting point of the shields of the signal cables, that they are brought on paregraph X11“ from page 23.

The ground terminal of the metallic frame of the filter, must to be connected as suitable on Drawing 1 at page 17 and on Drawing 2 at page 18.

You have seen, at page 10, that the three-phase MV/LV transformer must have a suitable apparent power (kVA).
In this session it is important to note however that in addition to the transformer, also the filter must have a power suitable to that of the converter (or of the converters); it is also necessary that the voltage drop of the transformer, to full load, it must be less them 3%.

To comply with how much prescribed on the Low Voltage directive and on the standards that can make reference to it, we recall, as follow, some connected general safety dispositions with specific references to the drives type DCD3.


WARNING !

For any reason, are had to enter inside the converter when it is fed. To enter **must surely be disconnected: the three-phase supply (terminals L1, L2, L3), the service supply (terminals 230V)** and every other supply having a voltage value more them 50Va.c. and 75Vd.c., eventually existing on the connectors. Inside the converter, when it is fed, **there are some voltages potentially dangerous for the safety of the operator!**

The startup of the converter, can directly be performed by the frontal panel, without the need to open the equipment; therefore **you are not allowed to open** (even provisionally) the metallic container to effect this operation.


WARNING !

To observance the instructions contained on this instruction book, **from the point of view of the safety, it is important to follow the prescriptions regarding the value and the type of protections (fuses) prescribed** (see Table 1 at page 13).

In relationship to the current of every type of the converters DCD3, it is necessary that the **cross section area of the conductors** for the connection to the feeder line and to the motor **must guarantee a current density according to the general prescriptions of the plant.**. Make reference to the Table 2 at pag 19..


WARNING !

All the connections to the common ground of the electrical cabinet has to be short and have a suitable cross section area; the PE of the electrical cabinet must to be connected to a **good ground**. Also the ground of the motor must be connected to a good heart, as suggested on Drawing 1 at page 17 and Drawing 2 at page 18.

# Chapter 4 - Technical characteristics

## Generality

These converters are designed to feed and to control the running of d.c. motors.

The IGBT bridge is placed within the converter.

The energy recovery resistor clamp is mounted internally (or externally).

All the regulation and control circuits are analog and completely isolated from the power.

The inputs and outputs are static and opto-isolated.

With an external command You can insert a ramp acceleration and deceleration on the speed reference.

The acceleration and deceleration times are adjustable.

The current limit can be set internally so fixed and adjustable from the outside with an analog reference.

The I / O Connectors, Test Point, Led, Trimmer, are completely accessible to facilitate connections, measurements, adjustments, adaptations, and the diagnosis of the operation.

These converters are suitable for the control of the motors used in machine tools, graphic, motion tape, etc.. and in all those applications where it requires a great flexibility of operation.

The Table 1 shows the rated values of some quantities for each size of the converters.

## Technical data

| CONVERTER | | | | | | INSIDE CLAMP RESISTOR | FILTER | INDUCTANCE | FUSES L1-L2-L3 or [4] DC+ DC- | |
|---|---|---|---|---|---|---|---|---|---|---|
| INPUT CURRENT L1-L2-L3 Rated / Peak | INPUT CURRENT DC+ DC- Rated / Peak | OUTPUT CURRENT Rated/Peak | SIZE | MAXIMUM POWER LOSS | INSIDE CLAMP RESISTOR POWER | | | | I rated | Max. $I^2t$ at 10ms |
| **[1]** [Arms] | **[5]** [Adc] | **[1]** [A] | **[2]** | [W] | [W] | TYPE | **[3]** TYPE | TIYPE | [A] | [$A^2s$] |
| 3,5 / 7 | 4 / 8 | 6 / 12 | 1 | 50 | 150 | RES33R1KW5 | 23/020 | 17/001 | 10 | 684 |
| 6 / 12 | 6 / 12 | 10 / 20 | 1 | 90 | 150 | RES33R1KW5 | 23/020 | 17/001 | 20 | 684 |
| 9 / 18 | 9 / 18 | 15 / 30 | 1 | 150 | 150 | RES33R1KW5 | 23/020 | 17/001 | 25 | 2400 |
| 14 / 14 | 15 / 15 | 24 / 24 | 1 | 250 | 150 | RES33R1KW5 | 23/020 | 17/001 | 20 | 2400 |
| 19 / 19 | 20 / 20 | 32 / 32 | 2 | 320 | 300 | RES16R2KW5 | 23/020 | 17/001 | 32 | 8000 |
| 28 / 28 | 30 / 30 | 48 / 48 | 2 | 530 | 300 | RES16R2KW5 | 23/003 | 17/002 | 50 | 8000 |
| 35 / 35 | 37 / 37 | 60 / 60 | 2 | 640 | 300 | RES8R4KW5 | 23/003 | 17/002 | 50 | 8000 |
| 42 / 42 | 44 / 44 | 72 / 72 | 2 | 800 | 300 | RES8R4KW5 | 23/003 | 17/003 | 63 | 18000 |
| 52 / 52 | 54 / 54 | 88 / 88 | 2 | 1000 | 300 | RES8R4KW5 | 23/004 | 17/003 | 100 | 18000 |
| 64 / 64 | 68 / 68 | 110 / 110 | 2 | 1200 | 300 | RES8R4KW5 | 23/004 | 17/003 | 100 | 18000 |
| 76 / 76 | 80 / 80 | 130 / 130 | 2 | 1300 | 300 | RES8R4KW5 | 23/004 | 17/004 | 160 | 51000 |

Table 1

**NOTES:**

[1] With temperature inside the electrical cabinet in which is mounted the drive from 0 to 40 ° C. Reduction of the rated current of 4% per ° C above 40 ° C. The peak current is delivered for a maximum time of 1 second.

[2] Outline dimensions and weights on the page 38 and 39.

[3] The filter is necessary when the drives model DCD3 are utilized in first environment, to satisfy the requisite regarding the EMC compatibility (please see the paragraph "Specific indications for the converters model DCD3" at page 11).

[4] On three-phase or DC BUS input **is necessary to use only ultra-fast fuses** (Semiconductor Protection). Another fuses type do not give a sufficient protection degree and therefore, in case of failure, the converter can be severely damaged.

## Apparent power and current consumption

To size the transformer / auto-transformer, the inductance and the EMC filter is necessary to calculate the apparent power required by the converters connected to the supply line by following these steps:

1. To calculate the power from the motor to the load:

$$P_m = C \cdot \omega$$

$P_m$ = *Motor power [W]*
$C$ = *Delivered orque [Nm]*
$\omega$ = *Maximum use speed [rad/sec]*

If you do not know the usage data, you consider the data on the motore plate.

With other units you should use the following conversion formulas:

$$C[Nm] = C[Kgm] \cdot 9{,}81 \qquad \omega[rad/sec] = \frac{n[giri/min]}{9{,}55}$$

2. To calculate the power required by each converter:

$$P_c = P_m \cdot 1{,}5$$

$P_m$ = *Motor Power [W]*
$P_c$ = *Power consumption of the converter [VA]*

and calculate the total power as the sum of the power absorbed by each converter:

$$P_t = P_{c1} + P_{c2} + P_{c3} + ....$$

$P_c$ = *Power consumption of the converter [VA]*
$P_t$ = *Total power consumption of all the converters [VA]*

3. The apparent power and the total current needed is calculated using the following formulas:

$$P_a = \frac{P_t \cdot 1{,}73}{\sqrt{d+2}}$$

$$I_u = \frac{P_a}{1{,}73 \cdot V_a}$$

$P_a$ = *Apparent power supplied by the transformer / auto-transform [VA].*
$P_t$ = *Total power of the converters [VA].*
$d$ = *Total number of converters connected to the same power supply.*
$I_u$ = *Current value to be used to size the line reactor and the EMC filter [A].*
$V_a$ = *Voltage used to supply the drivers [V].*

The value of the apparent power and current calculated are valid only if the motors are always working in conditions considered in the calculations. During operation normally you have variations of torque and speed which lead to considerable reductions of the average values of the apparent power and current. To get the most accurate one you must know the actual conditions of use of all motors.

Contact the ALTER technical department to examine special cases.

## Current consumption with DC-BUS power supply

To size the power supply that supplies the DC-BUS is necessary to calculate the total current required by the converters connected to the power supply with the following formula:

$$I_t = \frac{P_t}{V_{dc}}$$

$P_t$ = *Total power of the converters [VA]*
$V_{dc}$ = *Voltage value on the DC-BUS [V]*
$I_t$ = *Current consumption of all the converters [A]*

The Total Power of the converters can be calculated with the formulas of the preceding paragraph "Apparent power and power consumption." The supply voltage on the DC-BUS depends by the power supply utilized, but if you use the model PSR3 this value is 650Vdc.

## General technical characteristics

- Vertical placing on the panel board. Degree of protection IP20.
- Operating temperature: from 0°C to +40°C.
- Storage temperature from: -10°C to +70°C
- Non-inflammable atmosphere, not corrosive and without condense.
- Maximum altitude: 1000 m. a.s.l.

- Service supply: single-phase: 230Va.c. ±10% - 500mA max (Protect by slow fuses 250V - 1A).
- Three-phase / D.C. Bus supply: from 60V to the maximum indicated on the plate of the drive. (protected by external fuses according to Table 1 on page 13).
- Supplies frequency: from 45 to 65Hz.
- Output current: according to Table 1 on page.13.
- Thermal time constant: 15'
- Continuous power dissipation of the internal clamp resistor: according to Table 1 at page.13.
- Clamp resistor: internal or external (available separately).
- Connection terminals to D.C. BUS.
- Galvanic insulation between power and control electronics.
- Surge Protection on:
- Inputs and signal outputs.
- Surge Protection on:
  - Inputs and signal outputs.
  - Feeds service and power.
- Switching frequency: 16KHz.
- Minimum value of the motor electric time constant: 1 mSec. To calculate this value, see the formula in paragraph "Motor wiring" at page 19.
- Connections:
  - Power on connectors (Size 1) or terminal (Size 2).
  - Service and signals on connectors.
- Use with D.C. motors with tachogenerator.
- Adjustable speed signal ramp (enabled by logic control)
- Adjustable time ramp from 0,15 to 15 sec on 2 ranges.
- Opto-isolated logic inputs (voltage control: from 15 to 30Vdc - 10mA max):
  - Converter enable.
  - Speed signal ramp enable.
  - Alarm reset.
- Opto-isolated logic outputs (24Vd.c. - 100mA max) protected against overload and short circuit:
  - Drive ready.
  - No alarm in the drive.
- Analog inputs (Max. differential and common voltage: 10V. - Input resistance: 10KΩ):
  - Differential input for the speed reference.
  - External current limit: +10V max.
- Output supplies:
  - +24V ±20% - 100mA max.
  - +10V ±5% - 5mA max.
  - -10V ±5% - 5mA max.
- LED display of operating status and alarms.
- Converter fault detections:
  - Internal power supplies are missing or inadequate.
  - Power supply (three-phase or DC-Bus) under-voltage or over-voltage.
  - Motor not connected or connected incorrectly.
  - Converter over-temperature.
  - DC-BUS capacitor over-temperature.
  - Converter overload.
  - Converter over-current.
  - Feedback fault.
  - Clamp fault / overload.
  - Converter fault.
  - Logic outputs fault / overload.

## Supplies

> ***Note:*** *Any differential switches placed at the protection of converters must have tripping characteristic of type B. (According to the second amendment of IEC 755).*

### SERVICES

Single-phase supply: 230Va.c. ±10% - 500mA max. (terminals: 230V)

Minimum cross-section of connecting cable: 1.5 $mm^2$

Protect by 2 slow acting fuses (rated current 1A).

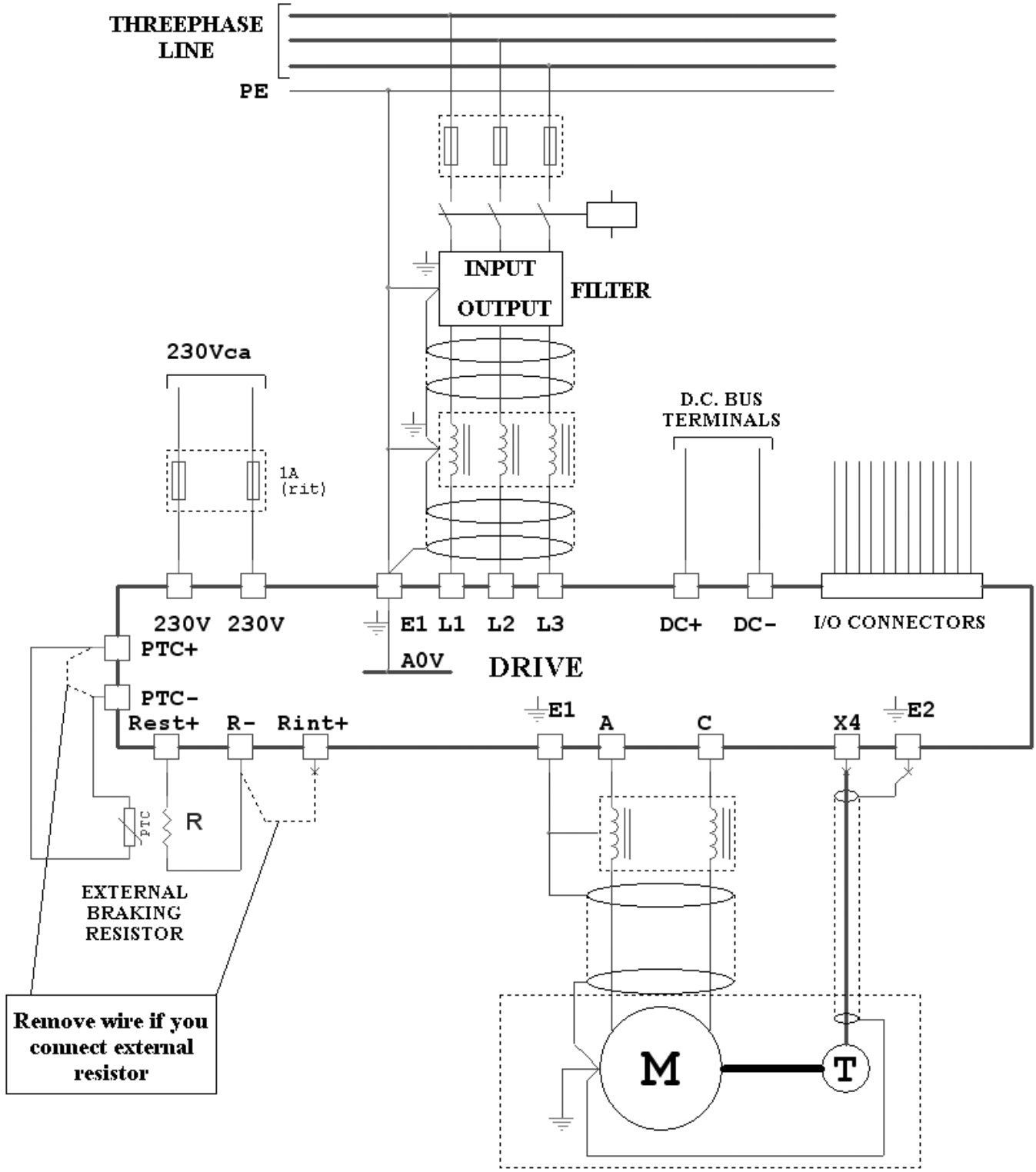
### POWER

The power supply of the converter can be provided in the following ways:

- From a three-phase mains with neutral ground with line voltage within the limits indicated on the plate of the converter (see “Power wiring“ at page.19). Place between the three-phase mains and the converter a three-phase inductor of at least 100 µH sized for the rated current absorbed by the converter and having a saturation current of at least twice the rated current.(see Drawing 1 at page.17).
- From a transformer with △/⅄ connections and central tap connected to ground or auto-transformer (⅄/⅄) to adapt the mains voltage.
- From D.C. supply (see Drawing 2 at page.18).

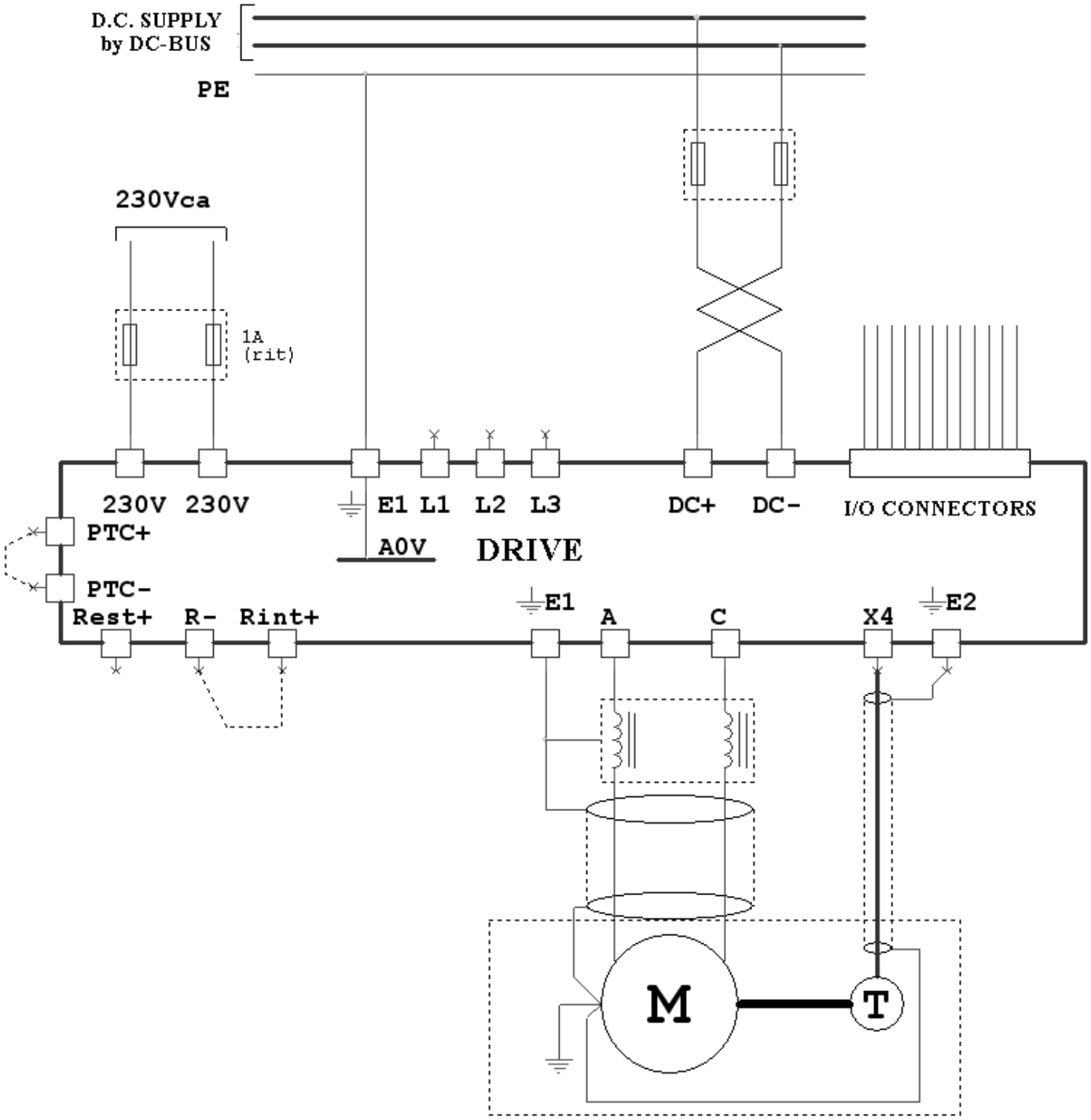
Always protect the power supply with ultra-rapid fuses as shown in Table 1 at page 13.

# Chapter 5 - Installation




*Drawing 1*

***NOTE: It may be necessary to mount an inductance in series to the motor armature. Refer to "****Motor wiring" at page 19* ***to calculate the electric time constant of the motor.***




*Drawing 2*

***NOTE: It may be necessary to mount an inductance in series to the motor armature. Refer to "****Motor wiring" at page 19* ***to calculate the electric time constant of the motor.***

# Preliminary operations

- Check that the drive has not been damaged during transport.
- Mount the converter vertically away from heat sources and so that there is sufficient free space above and below for a good circulation of cooling air.
- Use fixing plates in sheet unpainted and grounded.
- Connect to earth the ground terminal on the right side of the terminal block of the converter.

- Carefully follow the wiring diagrams in the instruction book.
- Use shielded cables for signal connections and power.
- Connect to ground the two ends of the shield.
- Do not use terminal but only shielded connectors for signal and power cables.
- Fit interference suppressors (snubber for ac / diode for d.c.) in parallel to the coils of all contactors, relays, solenoids, motors, single-phase, three-phase motors, etc..

# Motor wiring

Use only shielded cable with 2 conductors + ground to connect the motor and shielded twisted pair cable for tachogenerator.

The wire size of the power cables is shown in Table 2 at page 19.

Connect the shields of the power and signal cables to the housing of the converter and of the motor.

The connection of the shield to the housing must be as short as possible (maximum length 100 mm). The bare (not shielded) of the cable must not exceed 50 mm.

It is recommended to use shielded cables seamless. If this is impossible should use:

- For signals: shielded connectors that do not interrupt the shield.
- For power connections: shielded connectors or terminal blocks.

If you use a terminal must be reduced to minimum the bare cable (unshielded) and must be connected to a ground terminal the shields of the two cable segments.

Using the following formula, calculate the value of the "electrical time constant" of the motor; if the result is less than 1msec, you must mount an inductor between the motor and the converter. In case of doubt or to get more information about it, contact the ALTER technical department.

$$T_e = \frac{L_{mot}}{R_{mot}}$$

*$T_e$= Electrical time constant [msec].*
*$L_{mot}$ = Motor inductance (see motor technical data) [mH].*
*$R_{mot}$ = Motor resistance (see motor technical data) [Ω].*

For the sizing of components listed in the Drawing 1 at page 17 and in the Drawing 2 at page 18, consult the Table 1 at page 13.

# Cable cross-section

| CONVERTER | WIRE SIZE | | | |
|---|---|---|---|---|
| OUTPUT CURRENT Rated/Peak | L1-L2-L3 | A-C | Rext+ R- | X3-X4-X9-X10-X11 |
| [A] | [$mm^2$] | [$mm^2$] | [$mm^2$] | [$mm^2$] |
| 6 / 12 | 1,5 | 1,5 | 2,5 | 1,5 |
| 10 / 20 | 2,5 | 2,5 | 2,5 | 1,5 |
| 15 / 30 | 4 | 4 | 2,5 | 1,5 |
| 24 / 24 | 6 | 6 | 4 | 1,5 |
| 32 / 32 | 10 | 10 | 4 | 1,5 |
| 48 / 48 | 16 | 16 | 6 | 1,5 |
| 60 / 60 | 16 | 16 | 6 | 1,5 |
| 72 / 72 | 25 | 25 | 6 | 1,5 |
| 88 / 88 | 25 | 25 | 10 | 1,5 |
| 110/110 | 50 | 50 | 10 | 1,5 |
| 130/130 | 50 | 50 | 10 | 1,5 |

Table 2

# Power wiring

To identify the location of the connectors on the convert, see the Drawing 10 at page 38 and the Drawing 11 at page 39.

## Three-phase mains

The three-phase mains power supply must be connected to terminals **L1, L2, L3**, available on connector **X1** for size 1converters or screw terminal block for size 2 converters.

## Motor

The motor must be connected to terminals **A** and **C**, available on connector **X2** for size 1converters or screw terminal block for size 2 converters.

## Clamp resistor

The power rating of this resistor (or battery of resistors) must be equal to the average power dissipated during the stopping of the motor and is calculated by the following formula:

$$P = 0{,}2 \cdot J \cdot \omega^2 \cdot F$$

*P = Power dissipated by the resistor [W]*
*J = Total moment of inertia on the motor shaft [Kg·m²] (rotor + load)*
*ω = Max angular speed of the motor [rad/sec]*
*F = Repetition frequency of the working cycle [cycles /sec]*

If the speed is expressed in "RPM" must be used the following conversion formula:

$$\omega[rad/sec] = \frac{n[giri/min]}{9{,}55}$$

If you use the internal clamp resistor, you have to leave the jumper connected across terminals **R-**and **Rint +**.

If the power of the internal resistor is not enough and you are using an external clamp resistor, you must remove the jumper between terminals **R-**and **Rint +** and connect the external resistor between the terminals **Rext+** and **R-**. In this case, the protection from over-temperature resistor is inhibited.

For converters size 1 this connection is in the connector X2, but instead for converters size 2 you must use the appropriate screw terminals.

## DC-Bus

The terminals + DC and-DC can be used for different purposes:

1. 1. Energy balance of clamp: having more than one drive installed in the same cabinet, connect in parallel all the terminals DC + and DC- of all converters, yet maintains the three-phase supply for each of them. In this case, the energy recovered from the converter functioning as a brake is used partially or totally from the other converters operating as a motor. This leads to a partial or total reduction of energy transformed into heat by the clamp resistor of the converters. With this connection, the total recoverable energy is equal to the sum of the energies recoverable by each converter and makes, at times, not necessary to use external clamp resistors. With this connection, the three-phase supply (L1, L2, L3) must be the same for all converters and must be provided and removed at the same time using one or more contactors controlled simultaneously.
2. Additional battery of capacitors on the dc-bus: In order to store more energy recovered, thus reducing the energy transformed into heat in the resistor clamp, you can also use an additional battery of capacitors properly sized and connected to the DC BUS.
3. Discharge of the DC-BUS: within each converter are mounted resistors to discharge in about 3 min. the capacitors on the DC BUS when you do not have the three-phase power feed. If for safety reasons you must quickly discharge these capacitors is necessary to insert, a discharge resistor of low value and adequate power, using the contacts of a relay or contactor between terminals DC + and DC-. The contacts of the relay or contactor may be closed (resistor inserted) only when the contactor on the three-phase power feed (L1,L2,L3) is open.
4. Power supply DC: In this case it is necessary to use an external power supply able to supply the necessary current to the running of all the converters connected to it. This unit should:
    1. To supply the DC bus with a voltage that rises slowly from zero to the final value (to avoid inrush current during capacitor charging mounted on the DC BUS).
    2. To provide a signal of "end of charge" which allows you to enable the converter.
    3. To be able to recover to mains or dissipate by resistor all the energy recovered from the drives connected to it. If the

power supply is designed to dissipate the energy by resistor you can use an additional battery of capacitor properly sized and connected to the DC BUS to reduce the energy disposed in heat by the resistor.

It is advisable to protect the connections of the DC-BUS by two fuses (see Table 1 at page 13) and to use twisted and shielded cables.

For the sizing of the elements described in this section, you should contact the ALTER technical service

For size 1 converters this connection is in the connector X2, but instead for size 2 converters you must use the appropriate screw terminals.

# Signal wiring

To identify the location of the connectors on the converter, see the Drawing 10 at page 38 and the Drawing 11 at page 39.

## X3

Connection to the temperature sensor mounted in the external clamp resistor.

NOTE: If you use the internal clamp resistor or the external resistor is not equipped with thermal sensor you must perform a jumper between the two terminals of the connector X3.

## X4

Connection of a tachogenerator d.c. having a maximum voltage of 317 Vd.c.

If the voltage is higher, it is necessary to switch the SW1 in position F and insert an external resistor (R) in series between the wire and the terminal TGI of the tachogenerator having the following characteristics:

$$R = \frac{V_{dt} - 317}{317} \cdot 333.000 [\Omega]$$

$$P = \frac{(V_{dt} - 317)^2}{R} [W]$$

$$V = V_{dt} - 317 [V]$$

Vdt = Tachogenerator voltage output at max speed of the motor.
V = Max voltage at the terminals of the external resistor.
R = Ohmic value of the external resistor.
P = Maximum power dissipated by the external resistor.

The ohmic value of the resistor used should be equal to or slightly higher than the calculated value.

Check that:

1. The calculated voltage does not exceed the maximum applicable to the resistor.
2. The power dissipated calculated does not exceed half of the maximum dissipated by the resistor.

If it is not possible to satisfy the points 1 and 2 using a single resistor, you can use more equal resistors connected in series. In this case the single resistor has: value, power and voltage equal to those calculated with the above formulas divided by the number of resistors used. The ohmic value of the single resistor used must be equal to or slightly higher than the calculated value.

Pin assignment of the connector:

| | | |
|---|---|---|
| 1 | **A0V** | Connection of the cold pole of the tacho D.C. |
| 2 | **2** | Jumper for input filter capacitor. |
| 3 | **3** | Jumper for input filter capacitor. |
| 4 | **TGI** | Connection of the hot pole of the tacho D.C. |

If noise is present on the transducer cable, you can insert a filter capacitor integrated in the drive. When using such a capacitor, the maximum voltage on terminal 4 must not exceed 250V (measured with respect to terminal 1), to avoid damaging of the component. To insert this capacitor you must make a jumper between terminal No. 2 and No. 3.

## X9

Connection of the analog I/O voltage references.

Always use good quality shielded cable and connect the two ends of the shield to ground. On the housing of the drive, near the connectors are available anchors for the shields (see Mechanical features at page38).

PIN signals assignment:

1 **SIH** Analog input “Speed Input High”. Speed reference hot input. Voltage between: SIH and A0V, SIL and A0V, SIH and SIL = 10V max. Input Resistance 10KΩ.

Connection Examples see Disegno 3, Disegno 4 and Drawing 5 from page 22.

2 **SIL** Analog input “Speed Input Low”. Speed reference cold input.

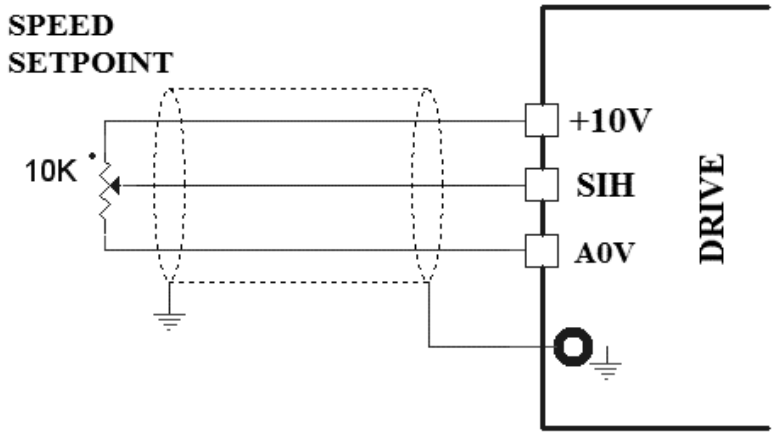
3 **A0V** Analog 0V. Connected to housing of the converter.

4 **CLI** Analog input “Current Limit Input” to externally set the maximum current limit (range 0 ÷ 10V). +10V correspond to the peak current of the converter.

Connection examples see Drawing 6 and Drawing 7 from page 23.

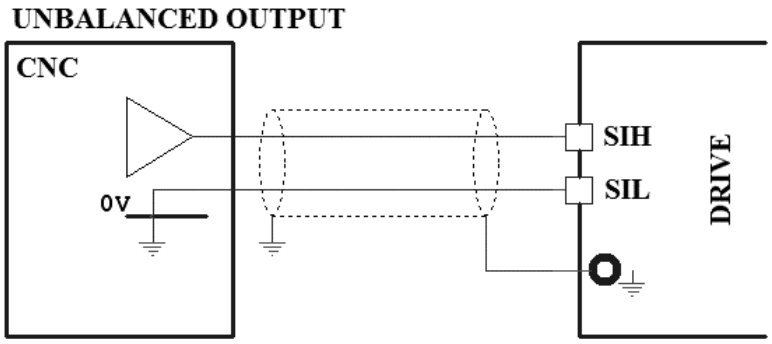
To connect the analog inputs to other electronic equipment (CNC, PLC, etc.), you must use shielded cables of good quality and connect the ends of the shield to ground to reduce noise.

Here are some sample drawings for a correct use of the various signals present on X9:



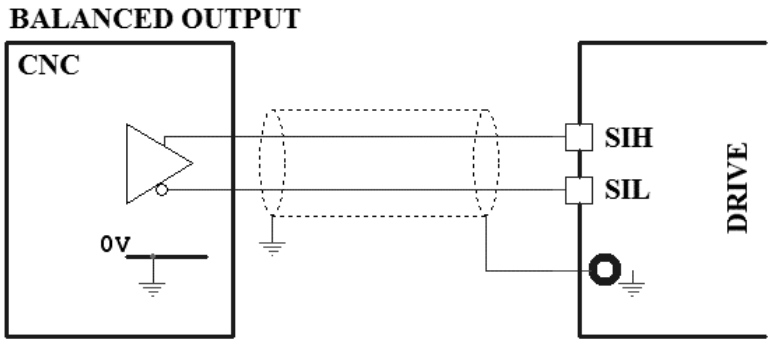

Connecting a **potentiometer** to provide the speed reference.

*Disegno 3*



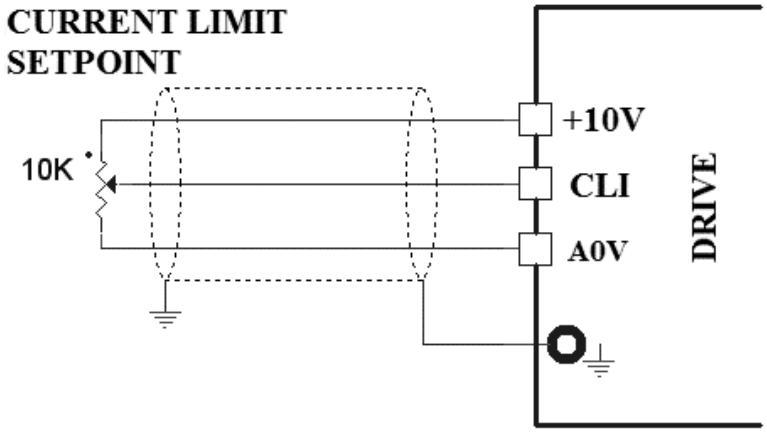

Connection of a numerical control (or a PLC) with **unbalanced output** for providing the speed reference..

*Disegno 4*



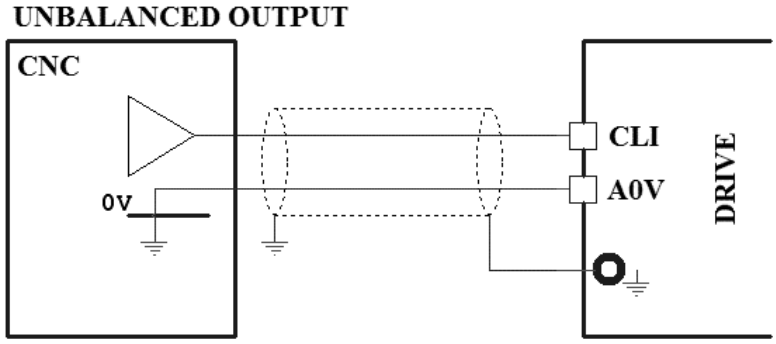

Connection of a numerical control (or a PLC) with **balanced output** for providing the speed reference.

*Drawing 5*




*Drawing 6*

Connection of a **potentiometer** to provide the reference current limit.




*Drawing 7*

Connection of a numerical control (or a PLC) with **unbalanced output** to provide the reference current limit.

## X10

Auxiliary power connection 230Vac 500mA (Max). Install fuses of 1 Ampere delayed. The power supply of services MUST be present before feeding power and must not be removed before that power.

## X11

Connection of the digital I/O voltage references.

**Connection of Voltage reference**

Always use good quality shielded cable and connect the two ends of the shield to ground. On the housing of the drive, near the connectors are available anchors for the shields (see Mechanical features at page38).

**Connection of the Digital inputs.**

Supply voltage from 18Vdc to 30Vdc (24Vdc nominal) also unfiltered. Current consumption 10mA. The status of each digital input is displayed by the corresponding LED which indicates that the command is valid (see paragraph "Yellow LEDs – Controls" from page 30).

In the presence of strong noise, we recommend using good quality shielded cable and connect the two ends of the shield to ground.

**Connection of the Digital outputs.**

Supply voltage from l8Vdc a 30Vdc (24Vd.c. nominal)

Output status:

OFF = Floating

ON = Connected to +24V supply (D24) (displayed by the corresponding LED)

Maximum current for each output 100 mA, internal voltage drop at maximum current 2V.

With no supply, all outputs are OFF.

In case of overload or short circuit on one or more outputs all the outputs are forced in the OFF state permanently.

For connections refer to Drawing 8 and Drawing 9 from page 24.

PIN signals assignment:

1 **+10V** Output +10Vcc ±5% - 5mA max.

2 **-10V** Output -10Vcc ±5% - 5mA max.

3 **+24V** Output +24Vcc ±20% - 100mA max.

4 **DEN** Converter enable input. Without this command, the motor shaft is idle.

5 **REN** "Ramp Enable" input. Enable the speed ramp.
**NOTE:** If the drive is controlled by a CNC, should only be used the CNC ramp speed and not that of the converter.

6 **RST** "Reset" input. Exits from the state of alarm and restore the operation of the converter after removing the cause that generated it.
- The alarm reset is only possible if the drive is disabled (led DEN off ).
- The alarm reset is only possible after 5 sec. that the alarm has occurred.

7 **D0V** Digital inputs 0V

8 **A0V** Analog 0V

9 **+24V** Output +24Vd.c. ±20% - 100mA max.

10 **D24** Common to be connected to +24Vd.c. For digital outputs.

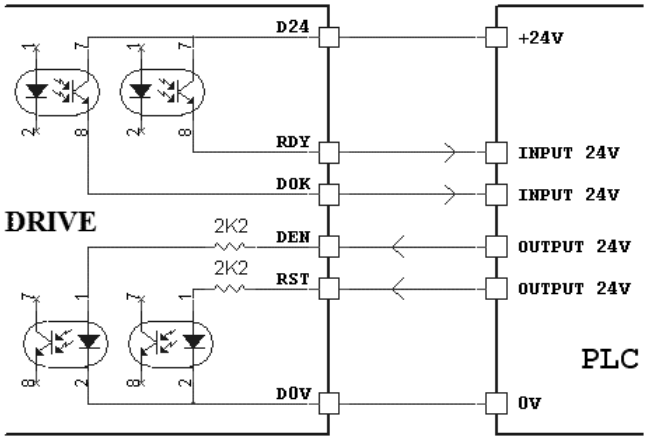
11 **DOK** "Drive OK" digital output. Indicates that no alarms are present which prevent the operation of the converter. Some alarms (red LED on) may be present when the drive is disabled (led DEN off) but if these alarms are present when the converter is enabled (led DEN on), the drive is automatically disabled and no longer controls the motor (idle ). More information can be found in paragraph "Red LEDs - Alarms" at page 30.

12 **RDY** "Ready" digital output. Indicates that the drive is ready to to operate and thus is able to execute commands. More information can be found in paragraph "RDY (Ready)" at page 30.

To connect the analog I / O to other electronic equipment (CNC, PLC, etc.), you must use shielded cables of good quality and connect the ends of the shield to ground to reduce noise.

***Note: If a digital output must drive a capacitive load, you must insert a 100 ohm, ½ watt in series with the output***

Here are some sample drawings for a correct use of the various signals present on X11.

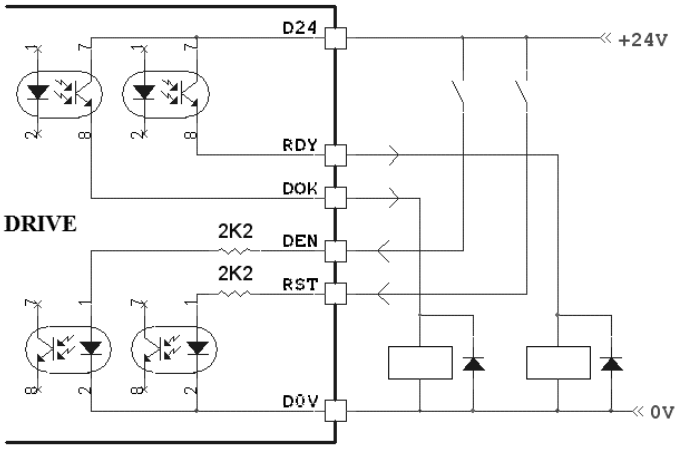



*Drawing 8*

Connection of a **PLC** to send and receive commands from the converter.

Digital inputs and outputs of the PLC must receive and/or provide a voltage of 24Vd.c.

You must connect the +24 V supply of the PLC with the D24 of the converter and the 0V of the PLC with the D0V of the converter.




*Drawing 9*

Connection of relay and contacts to send and receive commands from the converter.

You must connect the D24 to supply +24 VDC and D0V to 0V.

The 24Vd.c. supply can be supplied by the drive (if the total current consumption of the loads connected to the outputs does not exceed 100mA): Connect D24 to terminal +24 V (X11) and the D0V with terminal A0V.

If you can not use the internal power supply, you must use an external power supply.

# Chapter 6 - Start-up

## Settings

To adapt the converter to the characteristics of the tachogenerator mounted on the motor and to the speed reference, is necessary to calculate the value of X:

$$X = \frac{K_{DT1} \cdot n_{max} \cdot 8}{V_{REF}}$$

$$X = \frac{K_{DT2} \cdot n_{max} \cdot 8}{1000 \cdot V_{REF}}$$

$$X = \frac{K_{DT3} \cdot n_{max} \cdot 8}{9{,}55 \cdot V_{REF}}$$

*$K_{DT1}$ = Voltage constant of the tachogenerator (read on his plate)[V/rpm]*
*$K_{DT2}$ = Voltage constant of the tachogenerator (read on his plate)[V/Krpm]*
*$K_{DT3}$ = Voltage constant of the tachogenerator (read on his plate)[V*Sec/rad]*
*$n_{max}$ = Maximum speed motor usage [RPM].*
*$V_{REF}$ = Value of the speed reference corresponding to the speed "ω" of the motor.*

Use the formula corresponding to the speed measurement unit utilized on the plate of the tacho.

***NOTE: If the calculated value of X is greater than 317, you must set the SW1 in position F and place an external resistor connected to terminal TGI (X4-4). To calculate the value of the resistance see the paragraph*** *X4 at page 21.*

Set the switch **SW1** position corresponding to the calculated value.

| Rot N° | Note | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SW1 | X | 0÷5 | 6÷25 | 26÷46 | 47÷68 | 69÷88 | 89÷ 110 | 111÷ 131 | 132÷ 155 | 156÷ 171 | 172÷ 195 | 196÷ 215 | 216÷ 236 | 237÷ 255 | 256÷ 276 | 277÷ 296 | 297÷ 317 |

| Dip N° | .1 | .2 | .3 | .4 | NOTE |
|---|---|---|---|---|---|
| SW2 | OFF | ON | | OFF | SW2.3 = OFF if three-phase supply (L1, L2, L3).<br>SW2.3 = ON if DC BUS supply ( DC+, DC-). |

## Starting sequence

Refer to the connectors X11 at page 23.

1. Apply the power service 230Vac on the connector X10.
2. Make sure that all the LEDs light up for a second and then remains turned on the green LED INI. If it does not, the drive is not fed properly or is broken.
3. Verify that no red LED is lit. Otherwise, refer to the paragraph “Red LEDs - Alarms“ at page 30
4. When the output DOK switches to ON, you can give the three-phase power to terminals L1, L2, L2 or DC power to the DC-BUS. After charging the capacitors on the DC-BUS, the output RDY switches to ON and the green RDY LED lights. From this step the drive is *ready* to be enabled for operation.
5. When the output RDY switches to ON, you can enable the drive by the command DEN.
6. When the converter is enabled and working properly, the led green RUN and outputs DOK and RDY are still in the ON state and you can give the speed reference with consequent rotation of the motor.
7. If the functioning is regular all the red LEDs are off. Otherwise, refer to the paragraph “Red LEDs - Alarms“ at page 30

## Shutdown sequence

Refer to the connectors X11 at page 23.

1. Bring to 0V the speed reference and wait until the motor is stopped.
2. Remove the drive enable (command DEN = OFF). The green led RUN goes off.
3. Remove the three-phase supply (L1, L2, L3) or the DC-BUS supply. The RDY output goes OFF and the green led RDY turns off.

4. Discharge the DC-BUS with an external circuit if required (see paragraph “DC-Bus“ at page 20 the point 3.).
5. Remove the service supply 230Vac.

**NOTE:** During normal operation, start-stop of the motor it is advisable to act only on the speed reference and the enable command (DEN) to avoid unnecessary waiting times due to the charging of the capacitors on the DC-BUS. Remove the power supply and discharge DC-BUS only when you want to stop the motor under safety conditions.

# Command sequence in case of alarm

When the converter goes in alarm state (output DOK = OFF) acts as if suddenly missing the enable command (DEN = OFF), then the motor shaft becomes idle and is driven by the load. It is therefore advisable to provide for a mechanical braking system if such a situation can cause failure.

If you have an alarm, output DOK goes into OFF and turns on the red led that indicates the type of failure. When the control system (PLC or CNC) detects this state of alarm, you must perform the following sequence:

1. Immediately remove the power supply (L1, L2, L3 or + DC, DC-) and the enable command to the inverter (DEN = OFF).
2. Detect and if it is possible remove the cause of the alarm.
3. Reset the alarm with the digital input (RST = ON).
4. Repeat the starting sequence (page 26).

# SETTINGS AND ADJUSTMENTS

Knowing that:

- The OV internal supply is connected to housing.
- The negative probe of the voltmeter and the oscilloscope ground must be connected to the test point marked "AOV" or to the housing
- You must use fully insulated screwdriver for trimmer adjusting.

Operations to be performed:

1. Apply power service 230Vac to the connector X10.
2. Make sure that all the LEDs light up for a second and then remains turned on the green led INI. If it does not, the converter is not fed properly or is broken.
3. Verify that no red LED is lit. Otherwise, refer to the paragraph “Red LEDs - Alarms“ at page 30.

Then make adjustments indicated in the following paragraphs.

## Current limit setting

### Generality

The current limit of the drive can be fixed or variable. If the current limit is variable on the input CLI should apply a voltage proportional to the current limit desired. In both cases it is necessary to determine the maximum current in the motor. If this information is not supplied by the manufacturer of the machine, you can use the nominal current indicated on the motor plate.

### Procedure

Calculate the voltage value on the Test Point CLM with the following formula:

$$V_{CLM} = 10 \cdot \frac{I_{MOT}}{I_{CONV}}$$

*$V_{CLM}$ = Voltage value to set on the Test Point CLM [V].*
*$I_{MOT}$ = Maximum current on the motor [A].*
*$I_{CONV}$ = Peak current indicated on the plate of the converter [A].*

Give only the service supply to the converter and to perform the calibration of the current limit as follows:

- **Fixed current limit:**
  - Set the switch SW2.2 in position ON.
  - Set by the trimmer “CLM” in the Test Point “CLM” the voltage value calculated by the above formula.
- **Variable current limit:**
  - Set the switch SW2.2 in position OFF.
  - Provide maximum signal (+10 V) on "CLI"input (see connector X11 at page 23).
  - Set by the trimmer “CLM” in Test Point “CLM” the voltage value calculated by the above formula. Changing the voltage at the CLI input you change the current limit of the converter. Adjustment range of the current limit from 10% to 100% of the set value.

# Motor speed adjustment

### Speed reference from CNC

Execute on the CNC the following settings:

1. Kv set to minimum (“0” if possible).
2. Threshold of position error and tracking to the maximum possible
3. Display the tracking error of the axes.

Execute on the converter the following settings:

4. Turn the trimmer SSF all the way counterclockwise.
5. Turn the trimmer SLG all the way counterclockwise.

Steps to follow:

1. Execute the sequence of commands for starting. Enable the drive and set on the CNC feed rate to 10% of maximum speed.
2. If the axle is contrary to that set, it should stop the axis and disable the converter. Then reverse the direction of movement of the axis in one of the two following ways:
   - On the CNC reversing the sign of the speed reference.
   - Reversing the connections of the motor armature and Tachogenerator.

   Repeat the procedure from step 1.
3. Turn clockwise the trimmer SSF until you reduce to minimum the tracking error. If you reach the fully clockwise of the trimmer without being able to reduce to zero the tracking error, do this: stop the motor, turn off the converter and increase of one unit in a clockwise direction the position of SW1. For each increment, rotate the trimmer SSF to fully counter-clockwise and repeat the procedure from step 1.
4. On the CNC set a feed rate higher, up to the maximum expected, and reduce to zero the tracking error by the trimmer SSF.
5. While the motor is running at maximum speed expected, measure the voltage at the test point SPR and SPM and check that $V_{SPM} > V_{SPR} \cdot 0{,}6$. If this is not occurred, stop the motor, turn off the converter and decrease of one unit in the counter-clockwise direction the position of SW1. Repeat the procedure from step 1
6. Turn the trimmer SLG in a clockwise direction until the point where they do not feel acoustic or mechanical vibrations of the motor.
7. Set on the CNC Kv value increases up to the maximum allowed and reduce to zero the tracking error at maximum speed by the trimmer SSF.
8. Move the axis to some position and adjust the trimmer SOF to have zero position error displayed on the CNC.

### Manual speed reference

Execute the following steps:

1. Turn the trimmer SSF all the way counterclockwise.
2. Turn the trimmer SLG all the way counterclockwise.
3. Provide to the converter a speed reference equal to 10% of that corresponding to maximum speed.
4. Execute the sequence of commands for starting. Enable the converter and measure with a tachometer the shaft speed of the motor
5. If the rotation of the motor shaft is contrary to that set, it should stop the motor, turn off the converter, reverse the connections of the armature and tachogenerator.

   Repeat the procedure from step 1.
6. Turn clockwise the trimmer SSF to reach the expected speed. If you reach the fully clockwise of the trimmer without being able to reach the expected speed, do this: stop the motor, turn off the converter and increase of one unit in a clockwise direction the position of SW1. For each increment, rotate the trimmer SSF to fully counter-clockwise and repeat the procedure from step 1.
7. Set a higher speed, up to the maximum expected and verify each time the speed reached.
9. While the motor is running at maximum speed expected, measure the voltage at the test point SPR and SPM and check that $V_{SPM} > V_{SPR} \cdot 0,6$. If this is not occurred, stop the motor, turn off the converter and decrease of one unit in the counter-clockwise direction the position of SW1. Repeat the procedure from step 1.
8. Turn the trimmer SLG in a clockwise direction until the point where they do not feel acoustic or mechanical vibrations of the motor..
9. Set the speed reference zero and utilize the trimmer SOF to stop the rotation of the motor.

**NOTE:** Without a position control is not possible that the motor remains stopped for a long time if the converter is enabled.

## Speed ramp

The function is only active if the REN command is active (command REN = ON and yellow led REN lit). The adjustment of the acceleration and deceleration time of the motor is made using the trimmer SRT.

By the switch SW2-1, you can select the time range according to the following table:

SW2.1 = OFF ramp time range 0,15 ÷ 1,5 sec.

SW2.1 = ON ramp time range 1,5 ÷15 sec.

These times are obtained with the maximum variation of the reference speed (10V)

Lower variation of the speed reference corresponds to time ranges that are proportionally lower.

# Chapter 7 - Troubleshooting

## Yellow LEDs – Controls

The message refers to a command supplied from the outside. The command runs only if the corresponding LED is lit. If the command is not valid it is not executed (see paragraph “X11“ at page 23).

### DEN (Drive Enable)

Display the external command DEN that enables the converter.

For more information see paragraph “X11“ at page 23.

### REN (Ramp Enable)

Display the external command REN that enables the speed ramp. For more information see paragraph “X11“ at page 23.

### RST (Reset Alarms)

Display the external command RST that restores the normal operation of the converter after removing the cause of the alarm.

**Note:** The recovery is only possible if there is no control DEN and occurs on the rising edge of RST command.

More information are available at the paragraph “X11“ at page 23.

## Green LEDs – Internal states

### INI (Initialization)

Indicates the loading end of the program into the CPU.

### RDY (Ready)

This led is lit if:

1. the led INI is lit.
2. The charge of the DC-Bus proceeded normally.

The drive is ready for operation and thus is able to execute commands.

### RUN (RUN)

Indicates that the converter is functioning properly, execute commands and feeds the motor.

## Red LEDs - Alarms

- The cause of the alarm is signaled by the corresponding LED lit.
- All of the alarms are stored.
- Restore is done by the RST command (see the paragraph “X11“ at page 23.).
- In case of alarm the converter is automatically disabled and no longer controls the motor (motor idle).

### ASF (Auxiliary Supply Fault)

Auxiliary supply voltages less than allowed.

The causes of this alarm are:

1. Drops of the supply voltage of the services 230Vac.
2. Overloads or short circuits at 24Vdc.

What to do:

- Check the supply voltage of the services.
- Check the load connected to the output 24Vd.c.

## BOT (Bridge Over Temperature)

- Temperature of the converter bridge greater than the allowable limit.

The causes of the alarm are:

1. Temperature inside the cabinet is too high.
2. Inadequate ventilation inside the converter.
3. Material deposited on the radiator, which prevents the cooling.

What to do:

- Check the operation of fans or air conditioning cooling cabinet.

## COL (Clamp Overload)

Overload of the clamp resistor.

The causes of the alarm are:

1. Large number of repeated stops the motor.
2. Time to stop too short.
3. Inertia of the load is too high.
4. Large number of consecutive acceleration and deceleration of the motor.
5. Defect or improper installation of the tachogenerator mounted on the motor.
6. Temperature sensor of the resistor faulty, not connected, missing jumper between the two terminals of the connector X3

What to do:

- Reduce the performance of the machine.
- Check the size of the converter.
- Use a larger size converter.
- Use an external resistor.
- Check the connection and operation of the thermal sensor mounted in the external resistor.

  (If the temperature sensor is not available or is not used the external resistor perform a jumper between the two terminals of the connector X3)

**Note:** More information are available in the section “Clamp resistor“ at page 20. If necessary, contact the ALTER technical service to size the external resistor.

## COT (Capacitor Over Temperature)

Temperature of the capacitors on the D.C. Bus more than permitted.

The causes of the alarm are:

1. 1. Temperature inside the cabinet is too high.
2. 2. Inadequate ventilation inside the converter.

What to do:

- Check the operation of fans or air conditioning cooling cabinet.

## DFT (Drive Fault)

This alarm may indicate two different types of failure:

Led ON FIXED:

Failure of the converter. In this case, contact the ALTER service ALTER.

Led FLASHING:

Failure on the energy recovery circuit. In this case, after removing all power (power and services), check the following:

- Check if there are interruptions on the connections of the external resistor.
- Check if the external resistor is broken.
- Verify that the value of the external resistor used is equal to that of the internal resistor indicated at Table 1 at page 13.
- If you use the internal resistance, check that the jumper is installed between Rint + and R- on X1 connector or terminal block.
- If these checks do not allow to eliminate the cause of the failure, contact ALTER service.

## DOC (Drive Over Current)

Output current of the converter exceeds the maximum value allowed.

The causes of the alarm are:

1. Short circuit in the connecting cables or in the motor windings.
2. Short circuit or ground fault of the connection cables or of the motor windings.
3. Bad contacts on the terminals (terminals oxidized or loose)
4. Sporadic interruptions of the connection cables of the motor.

What to do:

- Check the continuity and insulation of the connection between the motor and the converter.
- Check the condition of the terminals and tighten them
- Check the motor windings.

**Note:**

The faults on cables are more frequent in the case of mobile installation.

The motor failures are more likely if the same reach high operating temperatures.

## DOL (Drive Over Load)

The converter has delivered more than the rated current for a time longer than 1 second.

The causes of the alarm are:

1. Mechanical load greater than expected.
2. Acceleration time is too short.
3. Inertia of the load is too high.
4. Large number of consecutive acceleration and deceleration of the motor.

What to do

- Reduce the performance of the machine.
- Check for the lubrication of the machine.

- Check the size of the drive.
- Use a larger size converter.

## MCF (Motor Connection Fault)

Failure in the connections between the converter and the motor.

The causes of the alarm are:

1. Break in the connection of the motor armature (if the motor has not moved before ignition of the led).

   What to do:

   - Check the continuity of the connection cables between the converter and the motor armature.
   - Check the motor brushes (all brushes should rest on the collector).
   - Check the continuity of the winding of the motor armature.

2. Absence or inversion of polarity of the signal provided by the Tachogenerator (if the motor has moved before ignition of this led).

   What to do:

   - Check the polarity of the Tachogenerator connections.
   - Check if there are breaks or short circuits in the connecting cables of the Tachogenerator.
   - Check the wear of the Tachogenerator brushes (all brushes should rest on the collector).
   - Check the condition and tightness of the connection joint between the motor shaft and the Tachogenerator.

## OUF (Output Fault)

Overload or short circuit on one or more digital outputs.

The causes of the alarm are:

1. Overload or short circuit on one or more outputs.
2. Capacitive load on one or more outputs.

What to do:

- Check the insulation of the connection cables between the converter outputs and the relays or PLC input
- Check the power supply voltage and the absorption of the coils of the relays or PLC
- Insert a 100 Ohm resistor 1/2W in series to each output if driving a capacitive load.

## PSF (Power Supply Fault)

Failure of the power supplies.

The causes of the alarm when the drive is enabled (led DEN lit), are:

1. Three-phase supply voltage is too low.
2. Lack of one or more phases of the three-phase.
3. Voltage on the DC-BUS too low.
4. Converter supplied by DC + and DC- and SW2.3 = OFF (see paragraph “Settings“ at page 26).

The causes of the alarm when the drive is disabled (led DEN off), are:

1. Three-phase supply voltage is too high.
2. Voltage on the DC-BUS is too high.
3. Converter supplied by L1, L2, L3 and SW2.3 = ON (see paragraph “Settings“ at page 26).

What to do:

- If SW2.3 = OFF: Check the three-phase supply.
- If SW2.3 = ON: Check the D.C. BUS supply.

# Test Points

The negative probe of the voltmeter and the oscilloscope ground must be connected to the test point marked "AOV" or to the housing of the converter.

## AØV

Common of supply and measuring points (connected to the housing of the converter).

## ARM (Armature Monitor)

Voltage proportional to the voltage between terminals A and C of the converter (DC motor armature).

1V on the TP correspond to 100V between the terminals A and C.

## BMO (Bus Monitor)

Voltage proportional to the voltage on the DC bus.

1V on TP correspond to 100V on the DC bus.

## CLM (Current Limit)

Reference voltage corresponding to the set current limit. The value setting is made by the trimmer CLM

(see paragraph “Current limit setting“ at page 27).

10V on TP correspond to the peak current of the converter.

## CMO (Current Monitor)

Signal proportional to the motor current.

+/-10V correspond to the peak current of the converter. 1KΩ output resistance.

## SER (Speed Error)

Speed loop output. If the voltage reaches the maximum value of + / - 10V the converter no longer controls the motor speed because the current demand exceeds the maximum set on the converter with the trimmer CLM (see paragraph “Current limit setting“ at page 27).

By measuring the voltage on this TP you can check:

1. If the continuous and inertial loads applied to the motor is within the specified limits.
2. If the acceleration and stop times of the motor are compatible with the setting of the maximum current supplied by the converter.
3. If the sizing of the converter is correct.

## SPM (Speed Monitor)

The signal is proportional to the motor speed. Voltage + /-10V max. - Output Resistance 1KΩ.

The relationship between the measured voltage on the test point and the motor speed is a function of the voltage supplied by tachogenerator used. Use one of the following formulas to calculate the speed of the motor.

$$n = \frac{V_{SPM} \cdot X}{K_{DTI} \cdot 8}$$

$K_{DT1}$ = *Voltage constant of the tachogenerator (read on his plate)[V/rpm]*
$K_{DT2}$ = *Voltage constant of the tachogenerator (read on his plate))[V/Krpm]*

$$n = \frac{V_{SPM} \cdot X \cdot 1000}{K_{DT2} \cdot 8}$$

$$n = \frac{V_{SPM} \cdot X \cdot 9{,}55}{K_{DT3} \cdot 8}$$

*$K_{DT3}$ = Voltage constant of the tachogenerator (read on his plate))[V*sec/rad]*
*n = Speed of the motor [RPM].*
*$V_{SPM}$ = Voltage value measured on the Test Point SPM [V].*
*X = Value depending on the position of SW4 shown in the following tables.*

| **Position SW1** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **A** | **B** | **C** | **D** | **E** | **F** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| X | 5 | 25 | 46 | 68 | 88 | 110 | 131 | 155 | 171 | 195 | 215 | 235 | 255 | 276 | 296 | 317 |

Table 3: Tachogenerator D.C.

If you do not know the data of the tachogenerator, you have to simultaneously measure the speed of the motor, by a tachometer, and the voltage at Test Point SPM. With the formula (1) you can calculate a conversion factor K to be used in the formula (2) to determine the speed of the motor by measuring the voltage on the test point SPM:

(1) $$K_{SPM} = \frac{n_0}{V_{SPM0}}$$

*$K_{SPM}$ = Conversion factor for the Test Point SPM.*
*$n_0$ = Motor speed measured by a tachometer [RPM].*
*$V_{SPM0}$ = Voltage value on the Test Point SPM at speed $\omega_0$ [V].*

(2) $$n = K_{SPM} \cdot V_{SPM}$$

*n = Motor speed [RPM].*
*$V_{SPM}$ = Voltage value on the Test Point SPM at speed $\omega$ [V].*

## SPR (Speed Reference)

Speed reference to the converter.

- Maximum value +/- 10V
- The signal on this test point is equal to that between the inputs SIH and SIL if it is not programmed the speed ramp.
- The signal on this test point is generated by the speed ramp if it is programmed.
- The signal value at the end of the ramp is equal to that between the inputs SIH and SIL.

# Chapter 8 - Attachments

## LEDs Overview table

*In the following table the leds are listed as arranged on the front of the converter, starting from the top.*

| NAME | | DESCRIPTION | Reference Page |
|---|---|---|---|
| DEN | Drive Enable | Converter enable command | 30 |
| REN | Ramp Enable | Ramp enable command | 30 |
| RST | Reset | Alarm reset command | 30 |
| | | | |
| INI | Initialization | Program loaded | 30 |
| RDY | Ready | Converter ready | 30 |
| RUN | Run | Converter running | 30 |
| | | | |
| DOL | Drive Over Load | Exceeding the rated current for more than a second | 32 |
| PSF | Power Supply Fault | Power Supply Fault | 33 |
| ASF | Auxiliary Supply Fault | Auxiliary Supply Fault | 30 |
| OUF | Output Fault | Digital output overload o short circuit | 33 |
| BOT | Bridge Over Temperature | Bridge Over Temperature | 31 |
| COT | Capacitor Over Temp. | Capacitor Over Temperature | 31 |
| DOC | Drive Over Current | Converter over-current | 32 |
| DFT | Drive Fault | Converter fault | 32 |
| COL | Clamp Over Load | Clamp Over Load | 31 |
| MCF | Motor Connection Fault | Motor or tachogenerator connection Fault | 33 |

## Trimmers Overview table

*In the following table the trimmers are listed as arranged on the front of the converter, starting from the top.*

| NAME | | DESCRIPTION | Reference Page |
|---|---|---|---|
| CLM | Current Limit | Setting of Current Limit | 27 |
| SSF | Speed Scale Factor | Setting of the speed scale factor | 28 |
| SOF | Speed Offset | Zeroing of the speed offset | 28 |
| SLG | Speed Loop Gain | Setting of the speed loop gain | 28 |
| SRT | Speed Ramp Time | Setting of the speed ramp | 29 |

# TEST POINTS Overview table

*In the following table the test points are listed as arranged on the front of the converter, starting from the top.*

| NAME | | DESCRIPTION | Reference Page |
|---|---|---|---|
| CLM | Current Limit | Current limit set voltage value | 34 |
| SPR | Speed Reference | Speed Reference voltage value | 35 |
| SER | Speed Error | Speed error voltage value | 34 |
| SPM | Speed Monitor | Speed monitor voltage value | 34 |
| CMO | Current Monitor | Current monitor voltage value | 34 |
| ARM | Armature Monitor | Signal proportional to the voltage between terminals A and C of the converter (Armature of the DC motor) | 34 |
| BMO | Bus Monitor | Signal proportional to D.C. Bus voltage | 34 |
| | | | |
| AØV | Analog 0V | Analog 0V (common for measurement) | 34 |

# ROTARY SWITCH Overview table

| NAME | DESCRIPTION | Reference Page |
|---|---|---|
| SW1 | Selection of the maximum voltage supplied by the tachogenerator. | 26 |

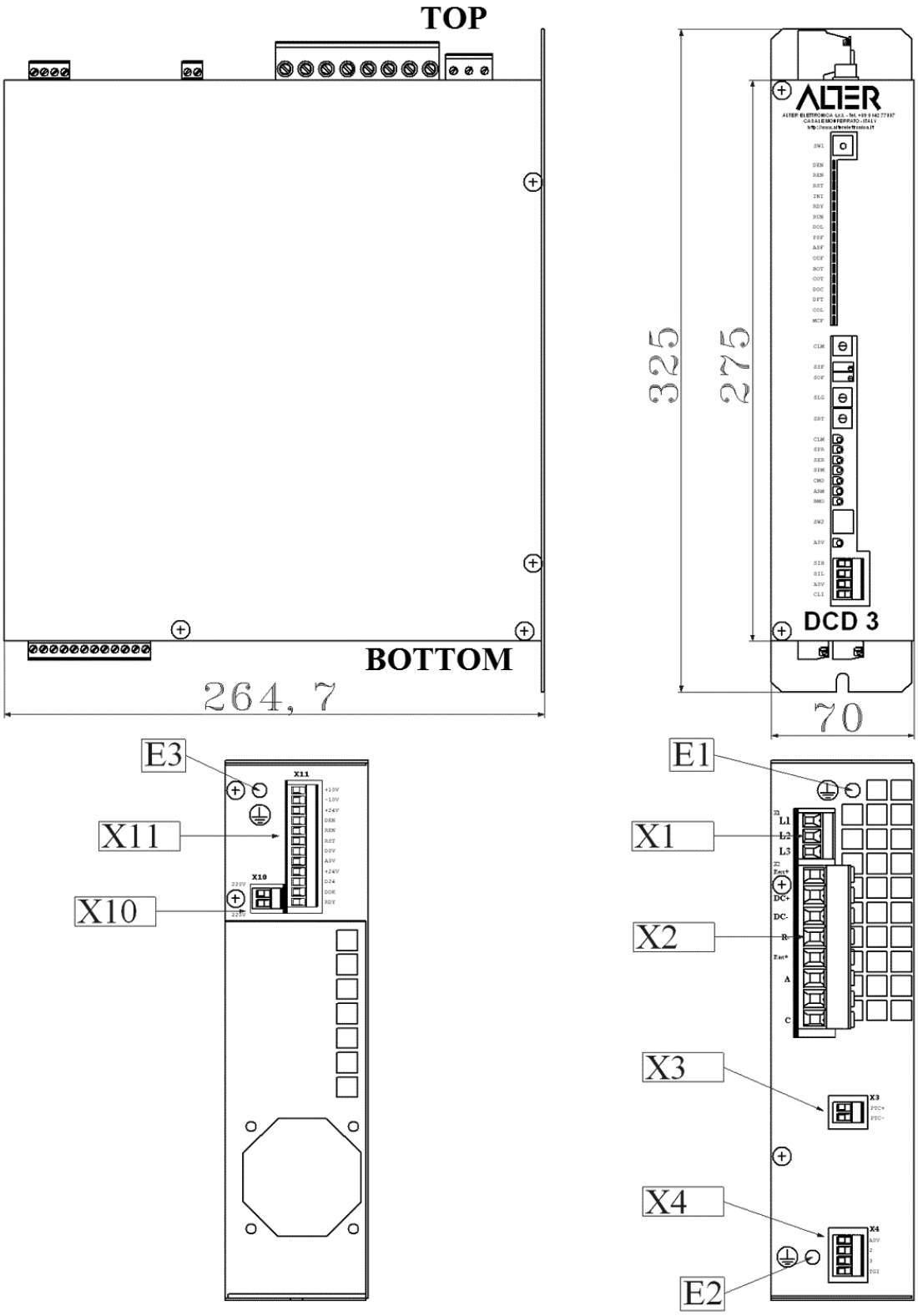
# DIP-SWITCH Overview table

*The numbering of the 4 switch is made from the first at the top.*

| NAME | DESCRIPTION | Reference Page |
|---|---|---|
| SW2.1 | Selection of the time range of the speed reference ramp | 29 |
| SW2.2 | Selection of the Current Limit Internal or External | 27 |
| SW2.3 | Selection of the power supply between Three-phase or D.C.BUS | 26 |
| SW2.4 | NOT USED | - |

# Chapter 9 - Mechanical features

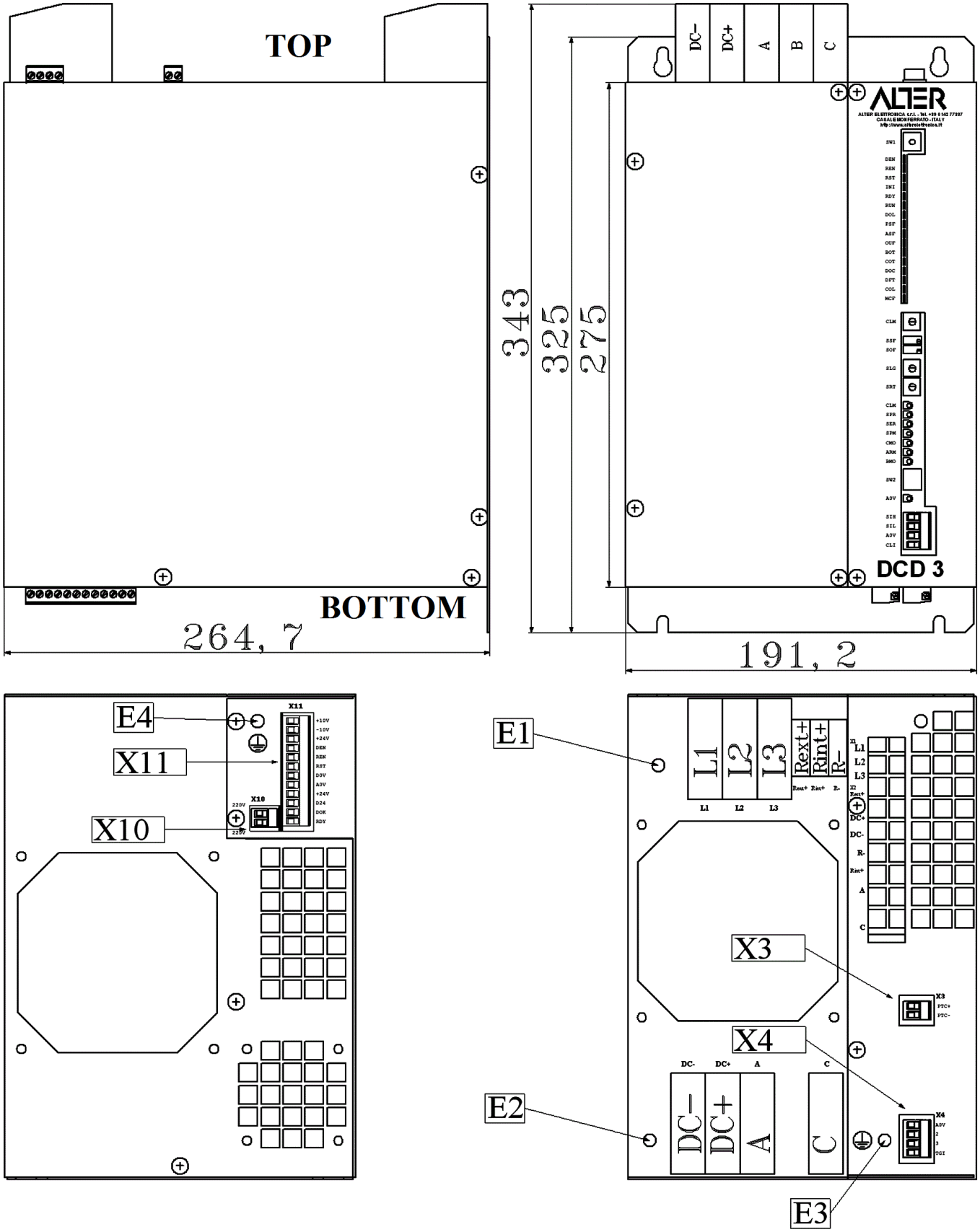
## Size 1




*Drawing 10*

Mass: 4,6 Kg

# Size 2




*Drawing 11*

Mass: 12 Kg

# Chapter 10 - Coding table

| Converter Model | Options | | | Maximum output voltage | Rated output current |
|---|---|---|---|---|---|
| **DCD3-** | **x** | **x** | **x** | **-xxx** | **-xxx** |
| | | | | | 006 = 6A<br>010 = 10A<br>015 = 15A<br>024 = 24A<br>032 = 32A<br>048 = 48A<br>060 = 60A<br>072 = 72A<br>088 = 88A<br>110 = 110A<br>130 = 130A |
| | | | | 400 = 400V | |
| | 000 = Standard<br>001 = Terminals for mounting of the external capacitors on the 24Vd.c. auxiliary services | | | | |
| DCD3 = Converter PWM for D.C. Motor with tachogenerator, 3rd series. | | | | | |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