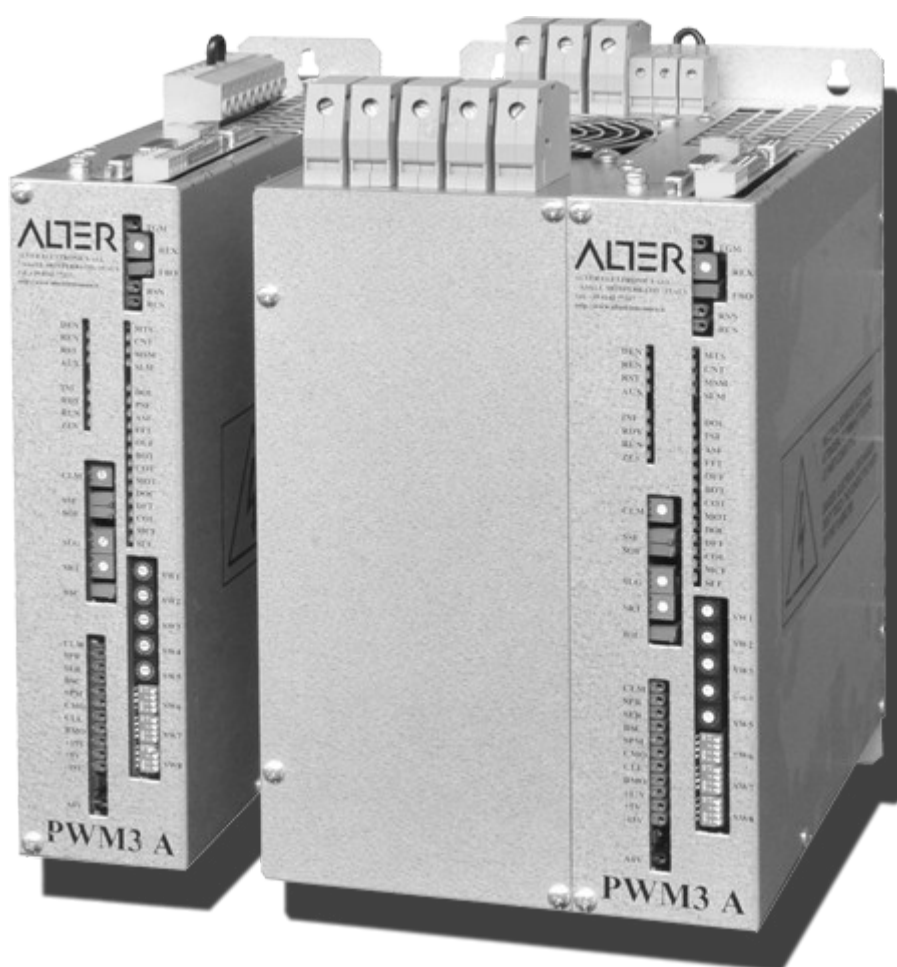


ALTER

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PWM3 A

4 Quadrants Brushless and D.C. Motors Drive Series PWM

Instruction book: 91/102 - Revision 0.1 - Date: 06/13/2013
Compatible with Firmware from V0.0 to V0.6

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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 7 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 7).
2. That for the safety it is necessary that the integrator of the driver (PDS: see paragraph “Recall of some definitions” at page 10), 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 7).

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.



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



Generic danger: it 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 10.

Operation of installation, start-up and maintenance



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 PW-M3A” at page 12.

Power-supply sectioning device



ATTENZIONE !

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



ATTENZIONE !

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



ATTENZIONE !

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



ATTENZIONE !

The motor connected to a drive type DCD3 can be started and stopped utilizing the commands performed by the operator (see paragraph X12 at page 26). **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 (break-down 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 19th 1973, 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 electro-magnetic 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 10) 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 at page 14 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 7, 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 10); 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 10). 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 the Table 1 at page 14.
- 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 10).**
- 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 14, 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 7.

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 7. 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.

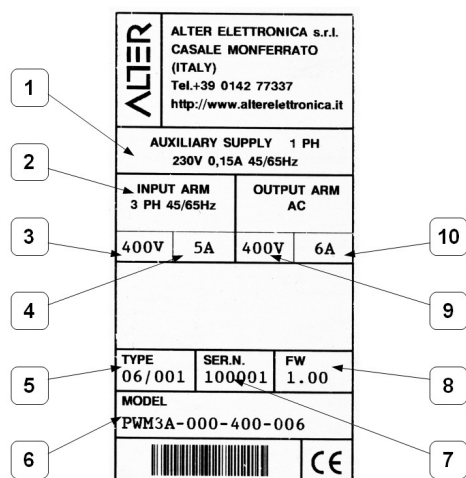
Bring here him following the declaration of the manufacturer (known also as "Declaration of Incorporation").

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 71).
- 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:

ALTER ELETTRONICA S.r.l.	
POSTA:	Via EZIO TARANTELLI, 7 (Zona Ind.le) 15033 CASALE MONFERRATO (AL) ITALY
TELEFONO:	+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 PWM3A 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 PWM3A 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.

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 PWM3A** are placed inside a metallic cabinet (so-called electrical cabinet), that contains 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 PWM3A, have **IP20** degree of protection (see at paragraph "General technical characteristics" at page 15). 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 performed 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 24) 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.



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 PWM3A please to see at paragraph "Apparent power and current consumption" at page 15.

The **copper cross section area of the feeder line** connected to the terminal block of the converter (see Drawing 1 at page 18 and Drawing 2 at page 19), 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 20 at page 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 be very short and have a wide cross section area.

Specific indications for the converters model PWM3A

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 PWM3A, as it regards the EMC and Low Voltage directive.

The connection schemes on Drawing 1 at page 18 and Drawing 2 at page 19 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 PWM3A are utilized in first environment, with reference to how much brought on the paragraph "Recall of some definitions" at page 10, 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 1 at page 14 are brought the types of the three-phase filters to utilize when is used the scheme at Drawing 1 at page 18.

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 18 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 16 at page 68 and Drawing 17 at page 69 the connections "E1" and "E2".



WARNING !

E1 (Drawing 16 or Drawing 17), 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 16 or Drawing 17) it is the connecting point of the shields of the signal cables, that they are brought on paragraph X11" from page 24.

The ground terminal of the metallic frame of the filter, must to be connected as suitable on Drawing 1 at page 18 and on Drawing 2 at page 19.

You have seen, at page 11, 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 PWM3A.



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 14).

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 page 20.



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 18 and on Drawing 2 at page 19.

Chapter 4 - Technical characteristics

Generality

These converters are designed to feed and to control the running of brush-less and 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 ² t at 10ms
[1] [Arms]	[5] [Ade]	[1] [A]	[2]	[W]	[W]	TYPE	[3] TYPE	TIYPE	[A]	[A ² s]
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
100 / 100	105 / 105	170 / 170	3	1800	--	3xRES16R2KW5	23/006	17/005	160	125000

Table 1

NOTE:

- [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 68 and 69.
- [3] The filter is necessary when the drives model PWM3A are utilized in first environment, to satisfy the requisite regarding the EMC compatibility (please see the paragraph "Specific indications for the converters model PWM3A" at page 12).
- [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:

$$P_m = C \cdot \omega \quad \left| \begin{array}{l} P_m = \text{Motor power [W]} \\ C = \text{Delivered torque [Nm]} \\ \omega = \text{Maximum use speed [rad/sec]} \end{array} \right.$$

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

With other units you should use the following conversion formulas:

$$C [\text{Nm}] = C [\text{Kgm}] \cdot 9,81 \quad \omega [\text{rad/sec}] = \frac{n [\text{RPM}]}{9,55}$$

2. To calculate the power required by each converter:

$$P_c = P_m \cdot 1,5 \quad \left| \begin{array}{l} P_m = \text{Motor power [W]} \\ P_c = \text{Power consumption of the converter [VA]} \end{array} \right.$$

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

$$P_t = P_{c1} + P_{c2} + P_{c3} + \dots \quad \left| \begin{array}{l} P_c = \text{Power consumption of the converter [VA]} \\ P_t = \text{Total power consumption of all the converters [VA]} \end{array} \right.$$

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

$$P_a = \frac{P_t \cdot 1,73}{\sqrt{d+2}} \quad \left| \begin{array}{l} P_a = \text{Apparent power supplied by the transformer / auto-transform [VA].} \\ P_t = \text{Total power of the converters [VA].} \\ d = \text{Total number of converters connected to the same power supply.} \end{array} \right.$$

$$I_u = \frac{P_a}{1,73 \cdot V_a} \quad \left| \begin{array}{l} I_u = \text{Current value to be used to size the line reactor and the EMC filter [A].} \\ V_a = \text{Voltage used to supply the drivers [V].} \end{array} \right.$$

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:

$$I_t = \frac{P_t}{V_{dc}} \quad \left| \begin{array}{l} P_t = \text{Total power of the converters [VA]} \\ V_{dc} = \text{Voltage value on the DC-BUS [V]} \\ I_t = \text{Current consumption of all the converters [A]} \end{array} \right.$$

The Total Power of the converters can be calculated with the formulas of the preceding paragraph "Apparent power and current 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. $\pm 10\%$ - 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 at page 14).
- Supplies frequency: from 45 to 65Hz.
- Output current: according to Table 1 at page 14).
- Thermal time constant: 15'
- Continuous power dissipation of the internal clamp resistor: according to Table 1 at page 14).
- 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 20.
- Connections:
 - Power on connectors (Size 1) or terminal (Size 2).
 - Service and signals on connectors.
- Use with brushless motors with the following devices:
 - Brushless tachogenerator and Hall sensors
 - Special encoder for brushless motor (5V line driver)
 - Resolver
 - Sinusoidal encoder (Sin-Cos 5V line driver)
 - Tachogenerator d.c. 10V out and Hall sensors at 120°
 - FANUC motor with encoder TTL (5V line driver)
- Use with D.C. motors with: tachogenerator.
 - Tachogenerator
 - Encoder (5V line driver)
- Simulated encoder output (only for: Resolver, Encoder, Sin-Cos)
- Speed signal ramp (enabled by logic control), adjustable time ramp from 0,15 to 1,5 sec.
- Opto-isolated logic inputs (voltage control: from 15 to 30Vdc - 10mA max):
 - Converter enable.
 - Speed signal ramp enable.
 - Alarm reset.
 - AUX input
- Opto-isolated logic outputs (24Vd.c. - 100mA max) protected against overload and short circuit:
 - Drive ready.
 - Motor over-temperature
 - No alarm in the drive.
 - Unlocking of the brake on the motor
 - motor standstill
- Analog inputs (Max. differential and common voltage: 10V. - Input resistance: 10K Ω):
 - Differential input for the speed reference.
 - External current limit: +10V max.
- Analog outputs ($\pm 10V$ max. - output resistance 1K Ω):
 - Speed monitor.
 - Current monitor.
- Output supplies:
 - +24V $\pm 20\%$ - 100mA max.
 - +10V $\pm 5\%$ - 5mA max.
 - -10V $\pm 5\%$ - 5mA max.
- Input for thermal switch (PTC) inserted in the motor.
- 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.
- Setting error.

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. $\pm 10\%$ - 500mA max. (terminals: 230V)

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

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

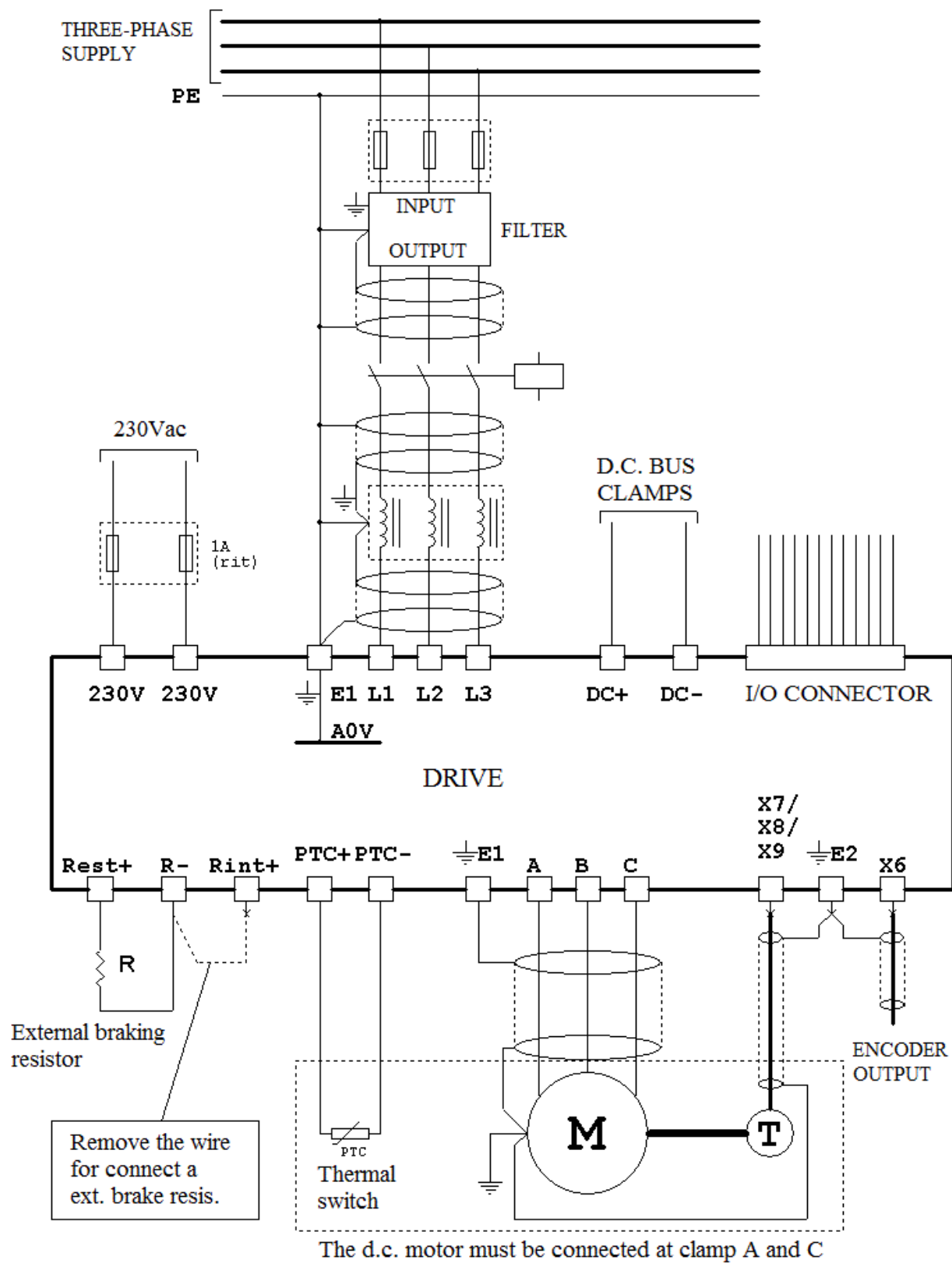
POWER

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.21). Place between the three-phase mains and the converter a three-phase inductor of at least $100 \mu\text{H}$ sized for the rated current absorbed by the converter and having a saturation current of at least twice the rated current. (see Drawing 2 at page.19).
- From a transformer with Δ/Δ connections and central tap connected to ground or auto-transformer (Δ/Δ) to adapt the mains voltage.
- From D.C. supply (see at page.).

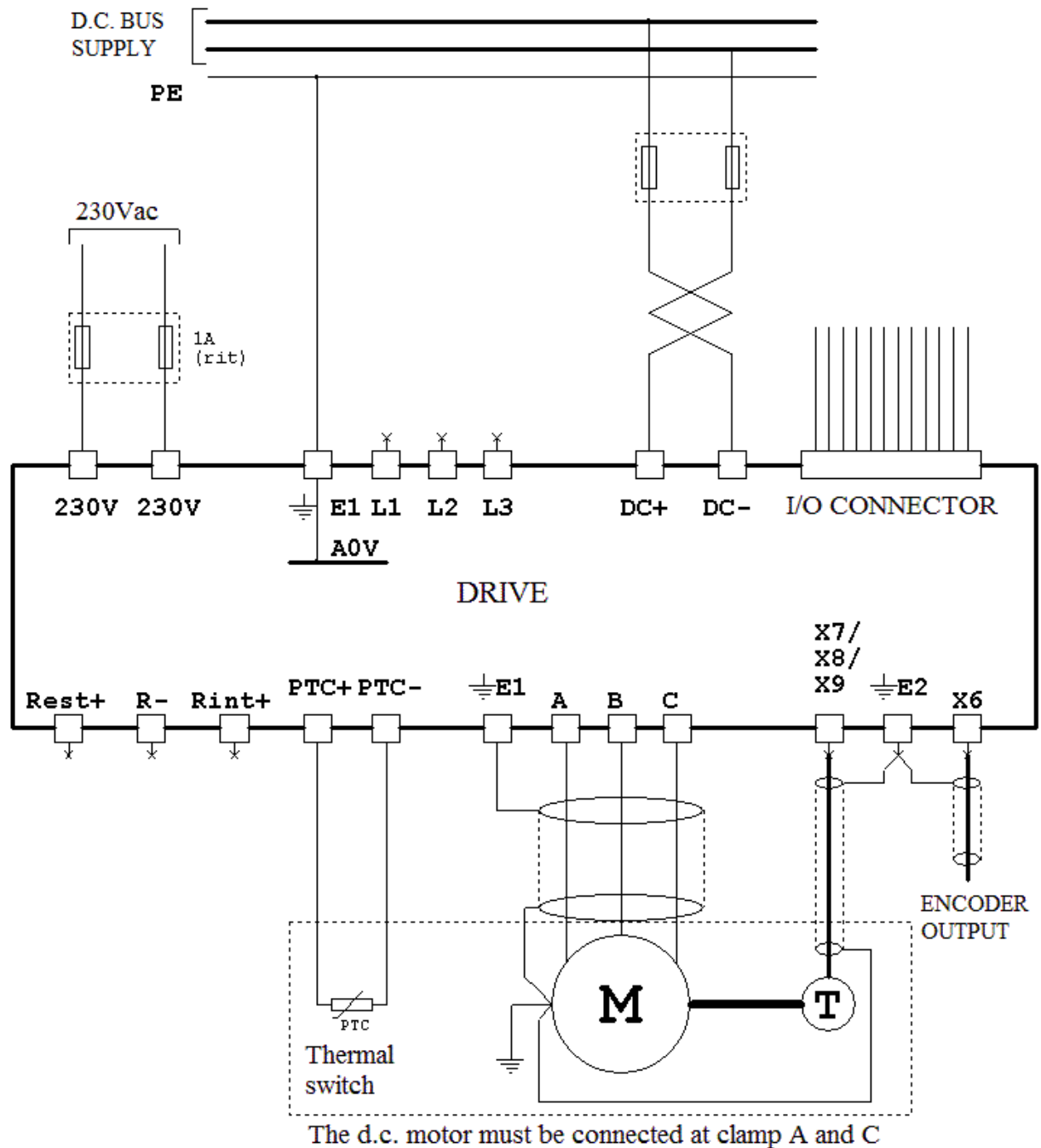
Always protect the power supply with ultra-rapid fuses as shown in Table 1 at page 14.

Chapter 5 - Installation



Drawing 1

NOTE: It may be necessary to mount an inductance between the motor and the terminals A-B-C of the converter. Refer to "Motor wiring" at page 20 to calculate the electric time constant of the motor.



Drawing 2

NOTE: It may be necessary to mount an inductance between the motor and the terminals A-B-C of the converter. Refer to "Motor wiring" at page 20 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 a.c. / 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 3 conductors + ground to connect the brushless motor, or 2 conductors + ground to connect the d.c. Motor. Shielded twisted pair cable for feedback (ALTER model CAV16PSCH-SP1).

The wire size of the power cables is shown in Table 2 at page 20.

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 you 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.

$$T_e = \frac{L_{mot}}{R_{mot}} \quad \left| \begin{array}{l} T_e = \text{Electrical time constant [msec]}. \\ L_{mot} = \text{Motor inductance (see motor technical data) [mH]}. \\ R_{mot} = \text{Motor resistance (see motor technical data) [\Omega]}. \end{array} \right.$$

To size the components listed in the Drawing 1 at page 18 and in the Drawing 2 at page 19, consult the Table 1 at page 14.

Connect the thermal switch as shown in the Drawing 1 at page 18 or in the Drawing 2 at page 19 only if the wires of the thermal switch are not available in the feedback connector.

Cable cross-section

CONVERTER	CABLE CROSS-SECTION					
OUTPUT CURRENT Rated/Peak	L1-L2-L3	A-B-C	Rest+ R-	230V	X11-X12	X3÷X9
[A]	[mm ²]	[mm ²]	[mm ²]	[mm ²]	[mm ²]	[mm ²]
6 / 12	1,5	1,5	2,5	1,5	1,5	0,5
10 / 20	2,5	2,5	2,5	1,5	1,5	0,5
15 / 30	4	4	2,5	1,5	1,5	0,5
24 / 24	6	6	4	1,5	1,5	0,5
32 / 32	10	10	4	1,5	1,5	0,5
48 / 48	16	16	6	1,5	1,5	0,5
60 / 60	16	16	6	1,5	1,5	0,5
72 / 72	25	25	6	1,5	1,5	0,5
88 / 88	25	25	10	1,5	1,5	0,5
110 / 110	50	50	10	1,5	1,5	0,5
130 / 130	50	50	10	1,5	1,5	0,5
170 / 170	50	50	10	1,5	1,5	0,5

Table 2

Power wiring

To identify the location of the connectors on the convert, see the Drawing 16 at page 68 and Drawing 17 at page 69.

Three-phase mains

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

Motor

The brushless motor must be connected to terminals **A,B,C**. The d.c. Motor must be connected to terminals **A** and **C**

The connections are available on connector **X2** for size 1 converters 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· m ²] (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:

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

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. 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 ca-

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 14) 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 16 at page 68 and the Drawing 17 at page 69.

X3

Connection of an optional external module equipped with special cable already wired.

Connector "D" type 9-pin male.

X4

Connection of the thermal switch fitted in the motor (maximum resistance at ambient temperature = $1K\Omega$).

If the thermal switch connection is fitted in the feedback cable, you can utilize the arranged PIN in the connectors **X7** and **X8**.

- 1 **PTC+** plug one wire of the thermistor.
- 2 **PTC-** Plug the other wire of the thermistor.

X5

Connection between 2 converters to implement the anti-backlash function.

La connection must be made by a special cable. See at paragraph “Electric anti-backlash.” at page 54.

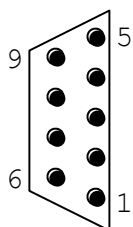
Connector “D” type 15-pin-female

X6

On this connector are available the channels A, \bar{A} , B, \bar{B} , Z, \bar{Z} of the simulated encoder only if are utilized the following feedback: resolver, encoder TTL, encoder Sin-Cos.

Always use good quality shielded cable and connect the two ends of the shield to ground.

PIN signals assignment:



PIN N° SIGNAL NAME

- | | |
|---|-----------------------|
| 1 | Channel “A” |
| 2 | Channel “ \bar{A} ” |
| 3 | Channel “B” |
| 4 | Channel “ \bar{B} ” |
| 5 | Channel “Z” |
| 6 | Channel “ \bar{Z} ” |
| 9 | 0V |

Connector view from solder side.

Connector tipo “D” 9 pin-female

The number of Pulses Per revolution (PPR) and the number of Zero mark per revolution are specified in the following table:

- | | | |
|----------------|------------------------------|-----------------------------|
| • Resolver: | PPR = 1024 x Pairs of poles. | Zero mark = Pairs of poles. |
| • Encoder TTL: | PPR = PPR encoder TTL. | Zero mark = 1. |

- | | | |
|-----------------------------|-------------|----------------|
| • Encoder Sin-Cos: | PPR = 4096. | Zero mark = 1. |
| • Encoder TTL (Fanuc only): | PPR = 2500. | Zero mark = 1. |

[NOTE: *If you need to have a PPR different from that specified in the table, please contact the ALTER technical service.*

X7

Connection of the following feedback:

- “Brushless Tachogenerator” (see at page 30)
- “10V D.C. Tachogenerator” (see at page 33).

Connector type “D” 15 pin-male.

X8

Connection of the following feedback:

- “Encoder TTL” with brushless motor (see at page 31) or d.c. motor (see at page 34).
- “Encoder Sin-Cos” (see at page 33).
- “Resolver” (see at page 32).

Connector type “D” 25 pin-male.

X9

Connection of a tachogenerator d.c. having a maximum voltage of 311 Vd.c.

If the voltage is higher, it is necessary to switch the SW4 in position B and insert an external resistor (R) in series between the wire and the terminal TGI having the following characteristics:

$$R = \frac{V_{dt} - 311}{311} \cdot 100.000 [\Omega]$$

V_{dt} = 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.

$$V = V_{dt} - 311 [V]$$

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.

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 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 page 68).

PIN assignment for the connector:

- | | | |
|---|-------------|---|
| 1 | +24V | Output +24Vcc $\pm 20\%$ - 100mA max. |
| 2 | +10V | Output +10Vcc $\pm 5\%$ - 5mA max. |
| 3 | -10V | Output -10Vcc $\pm 5\%$ - 5mA max. |
| 4 | 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 10K Ω . |

Connection Examples: see Drawing 3, Drawing 4 and Drawing 5 from page 24.

- | | | |
|---|------------|--|
| 5 | SIL | Analog input "Speed Input Low". Speed reference cold input. |
| 6 | A0V | Analog 0V. Connected to housing of the converter. |
| 7 | CLI | Analog input "Current Limit Input" to externally set the maximum current limit (range 0 \div 10V). +10V correspond to the peak current of the converter. |

Connection examples see Drawing 6 and Drawing 7 from page 25.

- | | | |
|---|------------|---|
| 8 | SPM | Analog output "Speed Monitor". The signal is proportional to the motor speed. Voltage $\pm 10V$ max. - Output resistance 1K Ω . Further information are available in the paragraph "SPM (Speed Monitor)" at page 63. |
|---|------------|---|

Connection examples in the Drawing 8 and Drawing 9 from page 26.

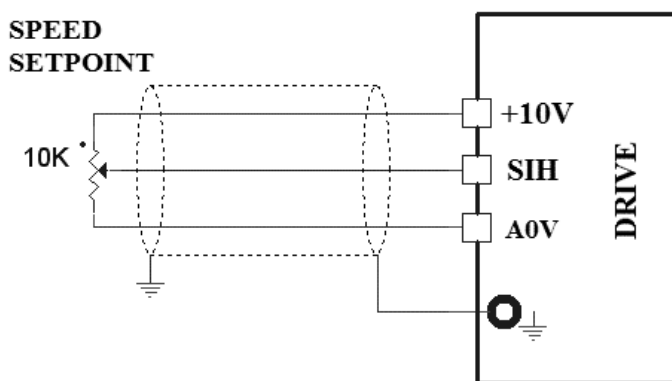
- | | | |
|---|------------|---|
| 9 | CMO | Analog output "Current Monitor". The signal is proportional to the current in the motor. $\pm 10V$ correspond to the peak current of the converter. - Output resistance 1K Ω . |
|---|------------|---|

Connection examples see Drawing 10 and Drawing 11 from page 26.

- | | | |
|----|------------|------------|
| 10 | A0V | Analog 0V. |
|----|------------|------------|

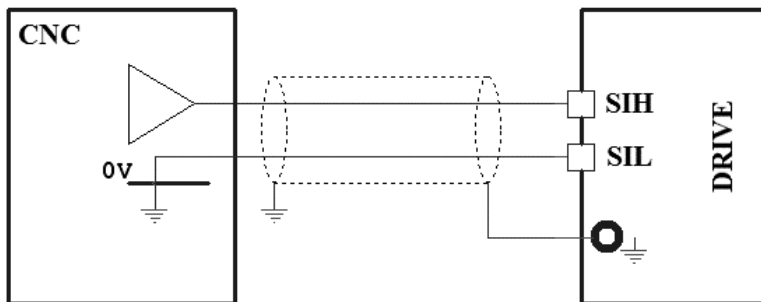
To connect the analog I / O to other electronic equipment (CNC, PLC, etc.), you must use shielded cables of good quality and connect the ends of the shield to ground to reduce noise.

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

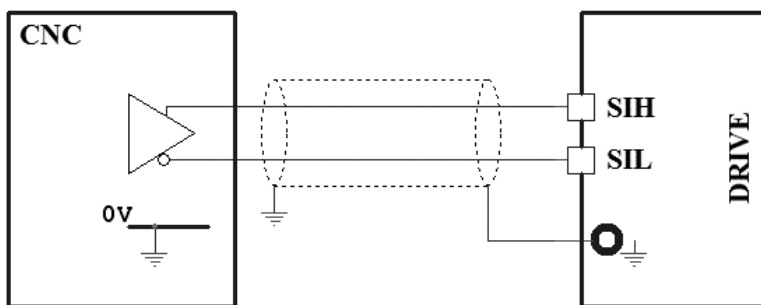


Drawing 3

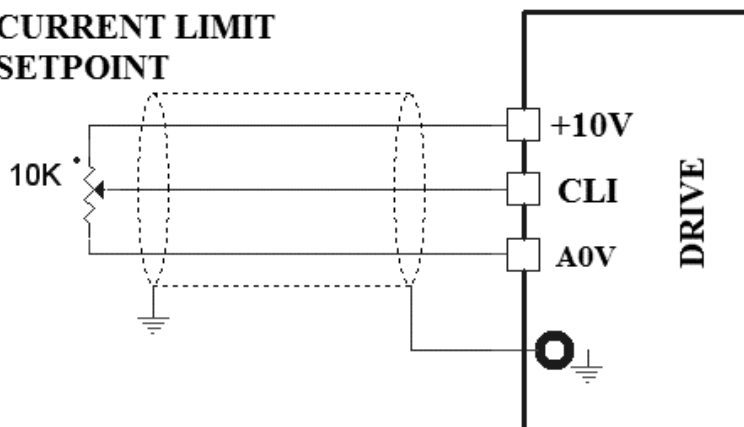
Connection to a **potentiometer** to provide the speed reference.

UNBALANCED OUTPUT*Drawing 4*

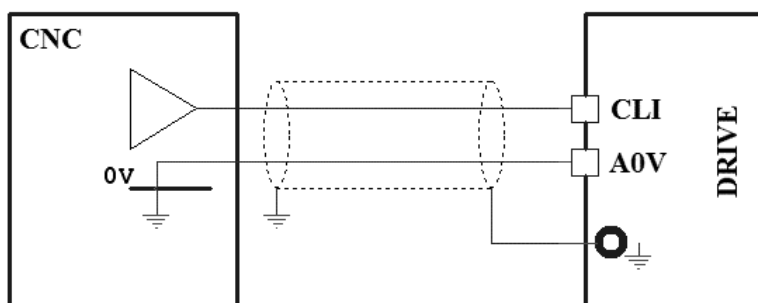
Connection to a C.N.C (or a PLC) with **unbalanced output** for providing the speed reference.

BALANCED OUTPUT*Drawing 5*

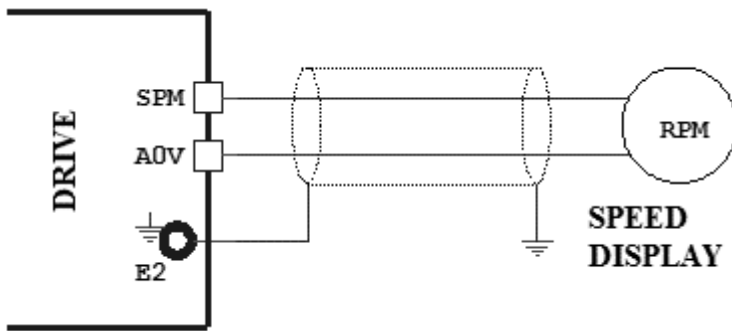
Connection to a C.N.C (or a PLC) with **balanced output** for providing the speed reference.

CURRENT LIMIT SETPOINT*Drawing 6*

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

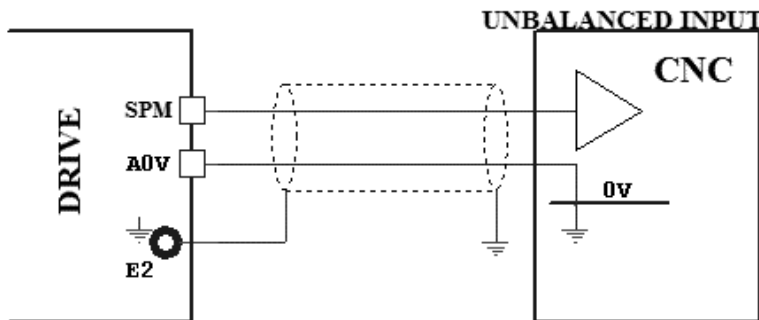
UNBALANCED OUTPUT*Drawing 7*

Connection to a C.N.C. (or a PLC) with **unbalanced output** to provide the reference current limit.



Drawing 8

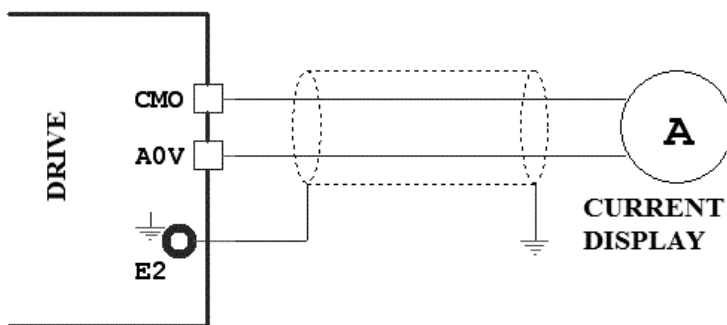
Connection to a speed display with input voltage (+/- 10Vd.c.).



Drawing 9

Connection to a C.N.C (or a PLC) analog input to acquire the **motor speed**.

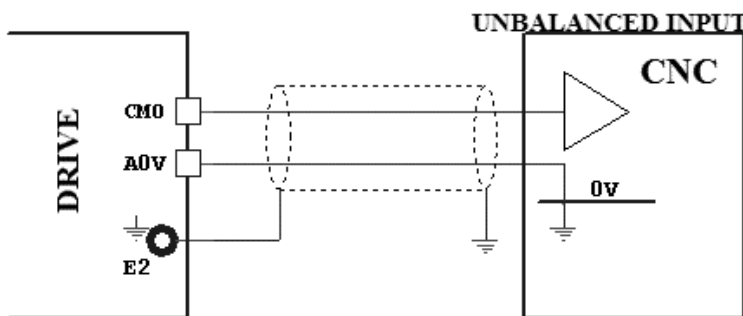
Maximum signal amplitude +/-10V



Drawing 10

Connection to a **motor current display**.

Maximum signal amplitude +/-10V



Drawing 11

Connection to a C.N.C (or a PLC) analog input to acquire the **motor current**.

Maximum signal amplitude +/-10V.

X12

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 57).

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

In the housing of the converter are available the shields connection point. (see Mechanical features at page 68).

Connection of the Digital outputs.

Supply voltage from 18Vdc 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.

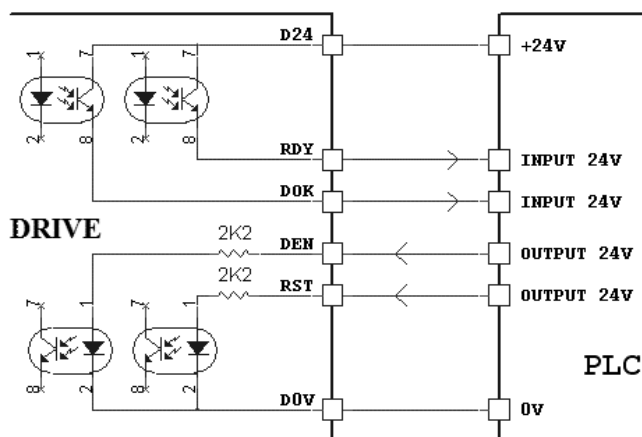
In case of overload or short circuit on one or more outputs all the outputs are forced in the OFF state permanently.

For connections refer to Drawing 12 and Drawing 13 from page 27.

PIN assignment for the connector:

- | | |
|---------------|---|
| 1 DEN | Drive enable input. Without this command, the motor shaft is idle. |
| 2 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. |
| 3 RST | “Reset” input. Exits from the state of alarm and restore the operation of the converter after removing the cause that generated it. <ul style="list-style-type: none"> • 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. |
| 4 AUX | “Auxiliary” input Enable of special functions required by the customer. This command is normally not active. |
| 5 D0V | 0V digital inputs. |
| 6 A0V | 0V analog. |
| 7 D24 | Common to connect to +24Vdc of the digital outputs. |
| 8 DOK | “Drive OK” 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 58. |
| RDY | “Ready” 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 57. |
| 10 ZES | “Zero Speed” output. Indicates that the motor is stopped. |
| 11 BRK | “Brake” output. Actuates the release of the motor brake. The brake is released when the drive is operating (RUN LED is lit). The brake is locked when the motor is stopped and the drive is not running (led ZES is lit and led RUN LED is off) |
| 12 MOT | “Motor Temperature” output. Indicates that the temperature of the motor is greater than that allowed. More information at the paragraph MOT (Motor Over Temperature) at page 60. |

[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 X12.

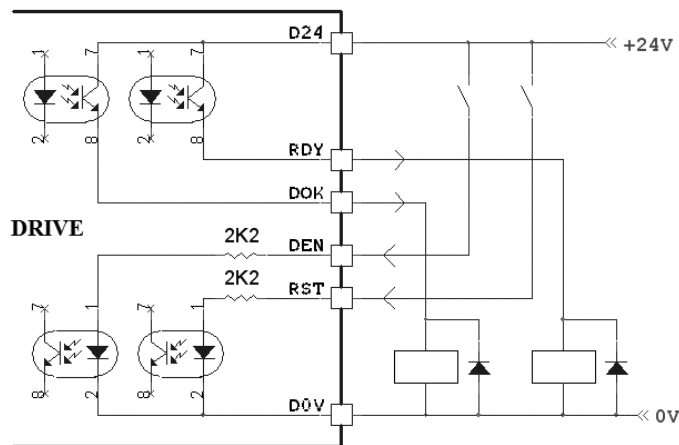


Drawing 12

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 13

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.

Starting sequence

Refer to the connectors X11 at page 24 and X12 at page 26.

1. Apply the power service 230Vac on the connector X10.
2. When the output DOK switches to ON, you can give the three-phase power to terminals L1, L2, L3 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.
3. When the output RDY switches to ON, you can enable the drive by the command DEN.
4. 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.

Shutdown sequence

Refer to the connectors X11 at page 24 and X12 at page 26.

1. Bring to 0V the speed reference and wait until the motor is stopped. When the motor is stopped the output ZES goes ON and the green led ZES lights.
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 21)
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 sys-

tem (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 28).

Specific setup for different motor types

See the following table; looking for the type of motor and feedback used and follow the reference.

MOTOR TYPE	FEEDBACK TYPE	REFERENCE
Brushless	Brushless Tachogenerator and Hall sectors at 60° / 120°	Page 30
Brushless	Encoder TTL (Facoder) (Output: Line driver 5V)	Page 31
Brushless	Resolver	Page 32
Brushless	Encoder (Sin-Cos) (Output: Line driver 5V)	Page 33
Brushless	D.C. 10V Tachogenerator and Hall sector at 120°	Page 33
Brushless (Fanuc)	Encoder TTL special (2500ppr) (Output: Line driver 5V)	Page 34
D.C.	Encoder TTL (Output: Line driver 5V)	Page 34
D.C.	D.C. Tachogenerator	Page 35

Brushless motor + brushless tachogenerator

If the motor is among those listed in Table 3, scrupulously respect the connections shown. If not, execute the connections shown for *Any Motor*.

MOTOR MODEL		CONNECTIONS MOTOR SIDE														
TYPE	HALL SECT.	MOTOR CABLE			FEEDBACK CABLE											
					BRUSHLESS TACHOGENERATOR										PTC	
A.B.B. (Isoflux) series 64 e 74	120°	C	G	F	G	H	F	I	B	E	D	C	A	D	E	
BAUMULLER series SM	120°	V	W	U	10	11	9	8	2-4-6	7	5	3	1-12			
BAUMULLER series DS56-DS71-DS100	120°	U	V	W	9	10	7	6-8-11	2	5	3	4	1			
DRIVE SYSTEM series BLT	120°	1	2	3	B	K	A	J	D	N	W	Z	M			
LAFERT-SELCA series T (old)	120°	W	V	U	GW	GV	GU	GØ	Vdc	SU	SV	SW	VØ	9	10	
LAFERT-SELCA series T (old)	120°	4	3	2	12	11	7	6	4	1	2	3	5	9	10	
LAFERT-SELCA series T (new)	120°	C	B	A	12	11	7	6	4	1	2	3	5	9	10	
LAFERT-SELCA series T (new)	120°	W	V	U	12	11	7	6	4	1	2	3	5	9	10	
SEIDEL KOLLMORGEN series SM	120°	V	W	U	10	11	9	8	2-4-6	7	5	3	1-12			
SIEMENS series FT1 e FT5	120°	4	3	2	12	11	7	6	4	1	2	3	5	9	10	
SIEMENS series FT1 e FT5	120°	W	V	U	12	11	7	6	4	1	2	3	5	9	10	
Any Motor		U	V	W	TC2	TC1	TC3	ØV	+15V	SE3	SE2	SE1	ØV	PTC	PTC	
		A	B	C	11	10	12	2	3	6	15	14	13	7	1	9
		TERMINALS			CONNECTOR X7 (pin)											
					<div><div>18</div><div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div><div>915</div></div>											
CONNECTIONS CONVERTER SIDE																

NOTE: Connect together the PIN 2 and 3 of the connector.

Table 3

Brushless motor + encoder TTL

If the motor is among those listed in Table 4, scrupulously respect the connections shown. If not, execute the connections shown for *Any Motor*.

MOTOR MODEL	NOTE	CONNECTIONS MOTOR SIDE															
		MOTOR CABLE			FEEDBACK CABLE												
					ENCODER TTL											PTC	
ACM series 155		U	W	V	A+J	F	G	H	P	B	N	M	R	L	C	S	T
ALLEN-BRADLEY series F-4050		A	B	C	K	P	T	N	C	D	A	B	E	F	L		
BRUSATORI series BR		W	V	U	P	C	E	G	L	K	H	J	M	N	A	S	T
BRUSATORI series BR		C	B	A	P	C	E	G	L	K	H	J	M	N	A	S	T
LAFERT-SELCA series T (new)	1	W	V	U	A	H	G	F	P	B	M	N	R	L	C	S	T
MITSUBISHI series MA-SA152		W	V	U	S	M	H	K	A	B	C	D	F	G	R		
R.C.V. series UL5 e UL7		C	B	A	E	D	C	P	J	F	M	K	L	H	A	*	*
R.C.V. series UL5 e UL7		yell	red	blue	E	D	C	P	J	F	M	K	L	H	A	*	*
Any Motor		U	V	W	+5V	SE3	SE1	SE2	A	\overline{A}	B	\overline{B}	Z	\overline{Z}	ØV	PTC	PTC
		A	B	C	1	11	9	10	3	4	6	7	17	18	2	25	13
		TERMINALS			CONNECTOR X8 (pin)												
					<div><div><div>1</div><div>13</div></div><div><div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div><div><div>14</div><div>25</div></div></div></div>												
					VIEW SOLDER SIDE												
		CONNECTIONS CONVERTER SIDE															

Table 4

* = In this motor the (PTC) is not connected in the feedback connector; to connect the (PTC) on the connector X4 (see at page 22).

NOTE 1: For this motor model to set SW3 = 6.

Brushless motor + resolver

If the motor is among those listed in Table 5, scrupulously respect the connections shown. If not, execute the connections shown for *Any Motor*.

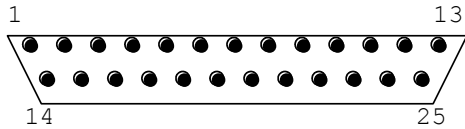
MOTOR MODEL				NOTE	CONNECTIONS MOTOR SIDE									
TYPE	MOT POLES	RES POLES	MOTOR CABLE		FEEDBACK CABLE								PTC	
					RESOLVER									
A.B.B. series 8	6	2		V	W	U	7	5	1	10	11	2		
ACM series BRL 152	6	2		U	V	W	F	D	B	A	C	E	H	G
BAUMULLER series DS100M	6	2		V	W	U	10	12	6	5	8	1		
BAUMULLER series DS400M	6	2	1	V	W	U	10	12	6	5	8	1		
BRUSATORI series BR	8	2	1	B	C	A	V	U	F	E	D	C	S	T
BRUSATORI series BR (from date: Oct 2000)	8	2	1	C	A	B	V	U	F	E	D	C	S	T
Control Techniques series DUTY MAX	6	2	1	B	A	C	A	B	D	C	E	F		
Control Techniques series MSB	6	2		B	A	C	B	A	F	E	D	C		
Control Techniques series MSB	6	2		W	V	U	2	1	6	5	4	3	7	8
E.C.S. (made by SBC)	8	2		B	A	C	A	B	F	E	D	C	J	K
HDT LOVATO B10, B14, B20	6	2	1	yell	red	blue	D	F	C	E	A	B	H	G
ISOFLUX series 6 e 7	4	2		G	C	F	7	5	1	10	11	2		
LAFERT-SELCA series S	6	2		V	W	U	7	11	6	1	3	2	9	10
LAFERT-SELCA series S	4	2		V	W	U	11	7	6	1	3	2	9	10
LAFERT-SELCA series T (old)	6	2		3	4	2	11	7	3	2	6	1	9	10
LAFERT-SELCA series T (new)	6	2		B	C	A	11	7	3	2	6	1	9	10
LAFERT-SELCA series T (new)	6	2		V	W	U	11	7	3	2	6	1	9	10
LAFERT-SELCA series T (new)	4	2		V	U	W	11	7	2	3	6	1	9	10
MAGNETIC	6	2		U	V	W	E	A	G	B	C	H	I	J
NUM series BMG,BMH,BMS	6	6		B	A	C	B	A	D	C	E	F	H	K
NUM series BPG	6	6		1	6	2	7	10	2	1	11	12	8	9
R.C.V. series UL5 e UL7	8	2		B	C	A	F	D	C	E	A	B	G	H
R.C.V. series UL5 e UL7	8	2		red	yell	blue	F	D	C	E	A	B	G	H
SBC series MB	8	2	1	B	A	C	A	B	E	F	C	D	J	K
SELCA type R	6	6		U	V	W	7	11	6	1	2	3	9	10
STOEBER	6	2		2	3	1	8	7	3	4	1	2		
VICKERS series FAS-T	6	2		C	A	B	B	D	H	G	C	E		
VICKERS series FAS-T	6	2		W	U	V	B	D	H	G	C	E		
VICKERS series FAS	8	8	1	W	U	V	D	B	H	G	C	E		
VICKERS series FAS	8	8	1	C	A	B	D	B	H	G	C	E		
Any Motor	?	?	1	U	V	W	REF+	REF-	SIN+	SIN-	COS+	COS-	PTC	PTC
				A	B	C	23	24	19	20	21	22	25	13
				TERMINALS			CONNECTOR X8 (pin)							
														
							VIEW SOLDER SIDE							
							CONNECTIONS CONVERTER SIDE							

Table 5

NOTE 1: For this type of motor, it is necessary execute the motor phasing.

Brushless motor + encoder sin-cos

If the motor is among those listed in Table 6, scrupulously respect the connections shown. If not, execute the connections shown for *Any Motor*. With this feedback is very important to use a shielded cable composed of twisted pairs individually shielded. If you have a cable compatible with the standard SERCOS is best to use this cable. If not, you can utilize the cable ALTER type CAV16PSCH-SP1.

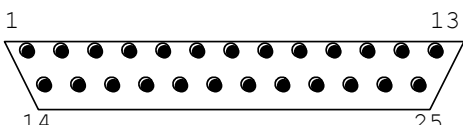
MOTOR MODEL		NOTE	CONNECTIONS MOTOR SIDE																	
TYPE	POLES		MOTOR CABLE			FEEDBACK CABLE														
						ENCODER SIN-COS												PTC		
						SERCOS compliant connector (direct connection).														
Siemens 1F T6/S6/K7	8			U	V	W	SERCOS compliant connector (direct connection).													
Brusatori series BR	8		1	W	U	V	P	A	L	K	H	J	M	N	E	F	C	D	T	S
RCV UL5 e UL7	8			blue	red	yell	SERCOS compliant connector (direct connection).													
RCV UL5 e UL7	8		A	B	C	SERCOS compliant connector (direct connection).														
Any Motor	?		U	V	W	+5V	ØV	A+	A-	B+	B-	R+	R-	C+	C-	D+	D-	PTC	PTC	
			A	B	C	1	2	3	4	6	7	17	18	19	20	21	22	25	13	
			TERMINALS			CONNECTOR X8 (pin)														
																				
						VIEW SOLDER SIDE														
			CONNECTIONS CONVERTER SIDE																	

Table 6

NOTE 1: For this type of motor, it is necessary to execute the motor phasing.

Brushless motor + d.c. tachogenerator

If the motor is among those listed in Table 7, scrupulously respect the connections shown. If not, execute the connections shown for *Any Motor*.

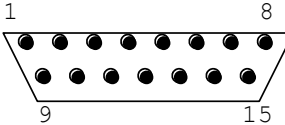
MOTOR MODEL		CONNECTIONS MOTOR SIDE												
TYPE	HALL SECT.	MOTOR CABLE			FEEDBACK CABLE									
					D.C. TACHOGENERATOR								PTC	
					10	4	5	9	11	3	2	1		
Bosch SD-ISE	60°	1	3	2	11- 2		4	10	12	7	8	9		
Indramat MAC	120°	V1	W1	U1	11- 2		4	10	12	7	8	9		
Indramat MAC	120°	B	C	A	11- 2		4	10	12	7	8	9		
<i>Any Motor</i>		U	V	W	ØV	DC-	DC+	+15V	-15V	SE1	SE2	SE3	PTC	PTC
		A	B	C	7	4	5	6	8	13	14	15	1	9
		TERMINALS			CONNECTOR X7 (pin) 									
		VIEW SOLDER SIDE												
		CONNECTIONS CONVERTER SIDE												

Table 7

Brushless motor (Fanuc) + encoder TTL

If the motor is among those listed in Table 8 , scrupulously respect the connections shown. If not, execute the connections shown for *Any Motor*.

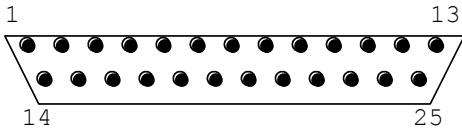
MOTOR MODEL	CONNECTIONS MOTOR SIDE																
	MOTOR CABLE			FEEDBACK CABLE													
				ENCODER TTL													
				J,K	C	P	L	M	A	D	B	E	F	G	N,T	JUMPER	
5-0, 4-0, 3-0	Black	Red	White	J,K	C	P	L	M	A	D	B	E	F	G	N,T	JUMPER	
2-0, 1-0	W	U	V	J,K	C	P	L	M	A	D	B	E	F	G	N,T	JUMPER	
0, 5, 10, 20M, 20, 30	C	A	B	J,K	C	P	L	M	A	D	B	E	F	G	N,T	JUMPER	
30R	E,F	A,B	C,D	J,K	C	P	L	M	A	D	B	E	F	G	N,T	JUMPER	
Any Motor	W	U	V	+5V	C1	C2	C4	C8	A	\overline{A}	B	\overline{B}	Z	\overline{Z}	\emptyset V	JUMPER	
	A	B	C	1	9	10	11	12	3	4	6	7	17	18	2	15	16
	TERMINALS			CONNECTOR X8 (pin)													
																	
				VIEW SOLDER SIDE													
	CONNECTIONS CONVERTER SIDE																

Table 8

D.C. Motor + encoder TTL

In this case, perform the connections for *Any Motor*.

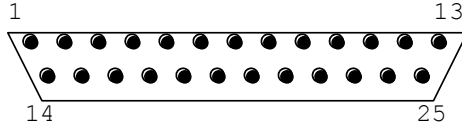
MOTOR MODEL	CONNECTIONS MOTOR SIDE													
	MOTOR CABLE			FEEDBACK CABLE										
				ENCODER TTL									PTC	
				A+	---	A-	+5V	A	\overline{A}	B	\overline{B}	Z	\overline{Z}	\emptyset V
<i>Any Motor</i>	A	B	C	1	3	4	6	7	17	18	2	25	13	
	TERMINALS			CONNECTOR X8 (pin)										
														
				VIEW SOLDER SIDE										
	CONNECTIONS CONVERTER SIDE													

Table 9

If the PTC is not connected to the feedback connector, to connect the PTC on the connector X4 (see at page 22).

D.C. Motor + d.c. tachogenerator

In this case, perform the connections for *Any Motor*. Follow the instructions given in the paragraph “X9” at page 23.

MODELLO MOTORE	CONNECTIONS MOTOR SIDE						
	MOTOR CABLE			CAVO TRASDUTTORE			
				TACHOGENERATOR			
	<i>Any Motor</i>	A+	---	A-	TACHO-	Filter Jumper	TACHO+
	A	B	C	1	2	3	4
	TERMINALS			CONNECTOR X9 (pin)			
	CONNECTIONS CONVERTER SIDE						

Table 10

If necessary, to connect the PTC on the connector X4 (see at page 22).

Chapter 6 - Start-up

Specific settings for different motor types

Refer to table below; looking for the type of motor and feedback used and follow the reference.



MOTOR TYPE	FEEDBACK TYPE	REFERENCE
Brushless	Brushless tachogenerator and Hall sectors at 60°/120°	Page 36
Brushless	Encoder TTL (Facoder) (Output: Line driver 5V)	Page 37
Brushless	Resolver	Page 39
Brushless	Encoder (Sin-Cos) (Output: Line driver 5V)	Page 42
Brushless	D.C. 10V Tachogenerator and Hall sectors at 120°	Page 45
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D.C.	D.C. Tachogenerator	Page 49

Brushless motor + brushless tachogenerator

Set the switches in the positions shown.

Switch	Note	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
SW1			Hall 120°	—	—	—	—	Hall 60°	—	—						—	—
SW2		•															
SW3		•															
SW4	X	0÷3	4÷12	13÷20	21÷29	30÷37	38÷52	53÷60	61÷77	78÷92							
SW5																	

Switch	.1	.2	.3	.4	NOTE
SW6	OFF	OFF	OFF	OFF	
SW7	OFF			OFF	
SW8					SW8.1 = OFF if supply by L1, L2, L3. SW8.1 = ON if supply by DC+, DC-

NOTE: A cell color  indicates a position "not valid" of the switch that causes the switch-on of the the red led SEF (Setting Fault). A cell color  indicates a position that does not affect the settings. The symbol "•" indicates the starting position of the switch that during the phasing could also take other positions between those that are valid. The symbol "—" indicates a position that does not cause the switch-on of the red led SEF, but that is not valid for this type of feedback.

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. [V].

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

Use the calculated value of X, to set the switch SW4..

Motor connection test and possible phasing

NOTE: This test must be always done whatever the motor used to check the wiring and to have no problems during the next steps of the start-up.

The motor shaft must be idle (not connected to the machine) and the brake must be released.

What to do:

1. Apply the power service 230Vac on the connector X10.
2. Make sure that all the leds are lit for a second and then remains lit 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 58.
4. Set SW 7.4 = ON (yellow led CNT lit).
5. Apply the power supply to the converter.
6. Verify that the green led RDY is lit. If it does not, verify the presence of the power supply (L1,L2,L3 or DC-BUS).
7. Verify that no red led is lit. Otherwise, refer to the paragraph “Red LEDs - Alarms“ at page. 58.
8. Enable the converter by the command DEN to start the the procedure.
9. When the procedure is running the green led RUN flashes and the motor shaft rotates in steps.
10. Verify that no red led is lit. Otherwise, refer to the paragraph “Red LEDs - Alarms“ at page. 58.

Observe the rotation of the motor shaft (viewed from the flange) and the state of the red led FFT when the motor rotation ends (when the green led RUN goes off). You can have the following cases:

- The motor shaft has rotated clockwise and at the end of the cycle the red led FFT is off. In this case the connection and the phasing of the motor are correct. Remove the enable (DEN = OFF) and hold SW2 and SW3 in their respective positions. Set SW7.4 = OFF. Go to “Setting and adjustments“ at page 51.
- The motor shaft has rotated counterclockwise. In this case, remove the enable (DEN = OFF) and the power supply to the drive. After at least 3 minutes invert 2 phases (between them)of the motor supply. Then repeat the procedure from step 5.
- The motor shaft has rotated clockwise and at the end of the cycle the red led FFT lit . In this case disable the converter; set SW3 in sequence: 1, 2, 3, 4, 5 and repeat the procedure from step 8 for each setting.
- The motor shaft has rotated clockwise and the red led FFT flashes. In this case, disable the drive, set SW2 in sequence: 1, 2, 3, 4, 5 and repeat the procedure from step 8 for each setting.



If it is not possible to complete the procedure successfully is necessary to verify the settings, connections and signals provided by the feedback.

Brushless motor + encoder TTL

Set the switches in the positions shown.

Switch	Note	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
SW1		—	—	•	—	—	—	—	—	—	—	—	—	—	—	—	—
SW2		•	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
SW3		•	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
SW4	PPR Encoder	—	1024	1025 ÷ 2048	2049 ÷ 3072	3073 ÷ 4096	—	—	—	—	—	—	—	—	—	—	—
SW5		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Switch	.1	.2	.3	.4	NOTE
SW6	OFF	OFF	OFF	OFF	
SW7		OFF	OFF	OFF	SW7.1 = OFF if the maximum motor speed is 3000 RPM. SW7.1 = ON if the maximum motor speed is 6000 RPM.
SW8					SW8.1 = OFF if three-phase supply (L1, L2, L3). SW8.1 = ON if DC BUS supply (DC+, DC-).

NOTE: A cell color  indicates a position "not valid" of the switch that causes the switch-on of the the red led SEF (Setting Fault). A cell color  indicates a position that does not affect the settings. The symbol "●" indicates the starting position of the switch that during the phasing could also take other positions between those that are valid. The symbol "—" indicates a position that does not cause the switch-on of the red led SEF, but that is not valid for this type of feedback.

To correctly set the switch SW4 is necessary to know the number of pulses / revolution (PPR) of the encoder used.

NOTE:

- The use of encoder with less than 1024 PPR significantly reduces the performance of the converter.
- Verify that the maximum frequency of the signals of channels A and B (corresponding to the maximum speed of the motor) is less than the maximum specified by the manufacturer of the encoder. The maximum frequency is calculated as follows:

$$F_{MAX} = \frac{PPR \cdot n_{MAX}}{60}$$

F_{MAX} = Maximum frequency of the encoder [Hz].
 n_{max} = Maximum speed of the motor [RPM].
 PPR = Pulse per revolution of the encoder.

Motor connection test and possible phasing

NOTE: This test must be always done whatever the motor used to check the wiring and to have no problems during the next steps of the start-up.

The motor shaft must be idle (not connected to the machine) and the brake must be released.

What to do:

- Apply the power service 230Vac on the connector X10.
- Make sure that all the leds are lit for a second and then remains lit the green led INI. If it does not, the drive is not fed properly or is broken.
- Verify that no red led is lit. Otherwise, refer to the paragraph "Red LEDs - Alarms" at page 58.
- Set SW 7.4 = ON (yellow led CNT lit).
- Apply the power supply to the converter.
- Verify that the green led RDY is lit. If it does not, verify the presence of the power supply (L1,L2,L3 or DC-BUS).
- Verify that no red led is lit. Otherwise, refer to the paragraph "Red LEDs - Alarms" at page 58.
- Enable the converter by the command DEN to start the the procedure.
- When the procedure is running the green led RUN flashes and the motor shaft rotates in steps.
- Verify that no red led is lit. Otherwise, refer to the paragraph "Red LEDs - Alarms" at page 58

Observe the rotation of the motor shaft (viewed from the flange) and the state of the red led FFT when the motor rotation ends (when the green led RUN goes off). You can have the following cases:

- The motor shaft has rotated clockwise and at the end of the cycle the red led FFT is off. In this case the connection and the phasing of the motor are correct. Remove the enable (DEN = OFF) and hold SW2 and SW3 in their respective positions. Set SW7.4 = OFF. Go to "Setting and adjustments" at page 51.
- The motor shaft has rotated counterclockwise. In this case, remove the enable (DEN = OFF) and the power supply to the drive. After at least 3 minutes invert 2 phases (between them) of the motor supply. Then repeat the procedure from step 5.
- The motor shaft has rotated clockwise and at the end of the cycle the red led FFT lit. In this case disable the converter; set SW3 in sequence: 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B and repeat the procedure from step 8 for each setting.
- The motor shaft has rotated clockwise and the red led FFT flashes. In this case, disable the drive, set SW2 = 1 and repeat

the procedure from step 8.

If it is not possible to complete the procedure successfully is necessary to verify the settings, connections and signals provided by the feedback.

Brushless motor + resolver

Set the switches in the positions shown.

Switch	Note	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
SW1		■	—	—	●	—	—	—	—	—	■	■	■	■	■	—	—
SW2		●															
SW3		●															
SW4	Resolver poles	■	2	4	6	8	■	■	■	■	■	■	■	■	■	■	■
SW5	Motor poles	■	■	4	6	8	■	■	■	■	■	■	■	■	■	■	■

Switch	.1	.2	.3	.4	NOTE
SW6	OFF	OFF	OFF	OFF	
SW7		OFF	OFF	OFF	SW7.1 = OFF if the maximum motor speed is 3000 RPM. SW7.1 = ON if the maximum motor speed is 6000 RPM.
SW8		■	■	■	SW8.1 = OFF if three-phase supply (L1, L2, L3). SW8.1 = ON if DC BUS supply (DC+, DC-).

NOTE: A cell color ■ indicates a position "not valid" of the switch that causes the switch-on of the the red led SEF (Setting Fault). A cell color ■ indicates a position that does not affect the settings. The symbol "●" indicates the starting position of the switch that during the phasing could also take other positions between those that are valid. The symbol "—" indicates a position that does not cause the switch-on of the red led SEF, but that is not valid for this type of feedback.

If the resolver has 2 pole the motor can have 4, 6, 8 poles. If the resolver has 4, 6, 8 poles, the motor must have the same number of poles. Otherwise the converter can not drive the motor and you should contact the ALTER technical service. Refer to Table 5 at page 32 to find, depending on the type of motor used, the information for the startup. If the motor is not in the table must be set temporarily SW4 = 1 and SW5 = 2 (The correct setting will be executed after).

Adjustment of the excitation voltage of the resolver

NOTE: This adjustment must ALWAYS be done whatever the motor used.

What to do:

1. Apply the power service 230Vac on the connector X10.
2. Make sure that all the leds are lit for a second and then remains lit the green led INI. If it does not, the drive is not fed properly or is broken.
3. set SW7.2 = OFF and SW7.3 = OFF.
4. Turn the trimmer REX in the clockwise or counterclockwise direction until you get the red led FFT = OFF.
5. If this is not possible, you must set in steps SW7.2 = OFF and SW7.3 = ON, SW7.2 = ON and SW7.3 = OFF, SW7.2 = ON, and SW7.3 = ON and repeat every time the adjustment specified in paragraph 4 until you turn off the red LED FFT.
6. The correct position of the trimmer REX is in the middle of the zone in which the led FFT stays off.

Then perform a more accurate adjustment as follows:

7. Manually rotate very slowly the motor shaft until the voltage at test point RSN is reduced to zero as possible.
8. Adjust the trimmer REX to get on the test point RCS a voltage of 2.2 Vd.c.
9. Manually rotate very slowly the motor shaft until the voltage at test point RCS is reduced to zero as possible.

10. Check that the voltage on the test point RSN is 2.2 Vdc.

If it is not possible to complete the procedure successfully is necessary to verify the settings, connections and signals provided by the feedback.

After performing this adjustment can occur three cases:

- The motor is shown in the Table 5 at page 32 and does not need phasing: perform as described in the paragraph “Motor connection test at page 40.
- The motor is shown in the Table 5 at page 32 and needs phasing: perform as described in the paragraph “Motor phasing at page 41.
- The motor is not shown in the Table 5 at page 32: perform as described in the paragraphs “Determining the number of resolver poles at page 40, “Determining the number of motor poles“ at page 41 and “Motor phasing“ at page 41.

Motor connection test

NOTE: This TEST must be done ALWAYS because it allows you to verify the correctness of the settings and connections. To perform this TEST is imperative the successful calibration of the resolver excitation and the settings of the poles of the resolver and of the motor. The other settings to be made are: SW2 = 0 and SW3 = 0.

The motor shaft must be idle (not connected to the machine) and the brake must be released.

What to do:

1. Apply the power service 230Vac on the connector X10.
2. Make sure that all the leds are lit for a second and then remains lit 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 58.
4. Set SW 7.4 = ON (yellow led CNT lit).
5. Apply the power supply to the converter.
6. Verify that the green led RDY is lit. If it does not, verify the presence of the power supply (L1,L2,L3 or DC-BUS).
7. Verify that no red led is lit. Otherwise, refer to the paragraph “Red LEDs - Alarms“ at page 58.
8. Enable the converter by the command DEN to start the the procedure.
9. When the procedure is running the green led RUN flashes and the motor shaft rotates in steps.

The test is positive if the motor shaft has rotated clockwise and at the end of the cycle (when the green led RUN turns off) the red led FFT is turned off. In this case the connection and the phasing of the motor are correct. Remove the command DEN, set SW7.4 = OFF and go to paragraph “Setting and adjustments“ at page 51.

If the test is negative (red LED lit FFT) proceed as follows:

1. Remove the command DEN and the power and service feeds
2. Verify the accuracy of the settings, the connections of the motor and resolver, repeat the test.

Determining the number of resolver poles

NOTE: Operation to be done only after the “Adjustment of the excitation voltage of the resolver at page 39.

The motor shaft must be idle (not connected to the machine) and the brake must be released.

1. Set SW7.4 = ON (yellow led CNT lit).
2. Slowly rotate by hand the motor shaft for a full revolution and count the number of flashes of the green led ZES.
3. The number of resolver poles is two times the number of flashes of the green led ZES.

Example: 3 flashes of the led ZES = 6 poles of the resolver.

Set by SW4 the number of the resolver poles

Determining the number of motor poles

NOTE: This procedure assumes that the motor is powered and rotating.

The motor shaft must be idle (not connected to the machine) and the brake must be released.

1. Apply the power service 230Vac on the connector X10.
2. Make sure that all the leds are lit for a second and then remains lit 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. 58.
4. Set SW 7.4 = ON (yellow led CNT lit) and set SW5 = 0.
5. Apply the power supply to the converter.
6. Verify that the green led RDY is lit. If it does not, verify the presence of the power supply (L1,L2,L3 or DC-BUS).
7. Verify that no red led is lit. Otherwise, refer to the paragraph "Red LEDs - Alarms" at page 58.
8. Enable the converter by the command DEN to start the the procedure.
9. When the procedure is running the green led RUN flashes and the motor shaft rotates in 6 steps.
10. When the procedure is finished, the green led RUN goes off; remove the command DEN and take note of the position of the motor shaft "*Start position*".
11. Re-enable the drive by the DEN command to restart the procedure.
12. When the procedure is finished, the green led RUN goes off; remove the command DEN and the power supply and take note of the position of the motor shaft "*Final position*".
13. Measure the angle between the "*Start position*" and the "*Final position*" of the motor shaft.

The number of motor poles is calculated by the following formula:

$$Poles = \frac{720}{\alpha} \quad | \quad \alpha = \text{Angle of rotation of the motor shaft.}$$

Examples: $\alpha = 180^\circ$: Poles = 4

$\alpha = 120^\circ$: Poles = 6

$\alpha = 90^\circ$: Poles = 8

Set by SW5 the number of motor poles.

NOTE: If the motor shaft has rotated counterclockwise (viewed from the coupling flange) is necessary to reverse 2 phases of the motor supply.

Motor phasing

NOTA: To perform this procedure it is imperative at first to successful perform the "Adjustment of the excitation voltage of the resolver at page 39 and to set correctly the number of poles of the motor and of the resolver. These data are contained in Table 5 at page 32 or determined experimentally, by proceeding as described above

Settings to be made: SW2 = 0, SW3 = 0 e SW7.4 = OFF.

The motor shaft must be idle (not connected to the machine) and the brake must be released.

This procedure assumes that the motor is powered and rotating.

What to do:

1. Apply the power service 230Vac on the connector X10.
2. Make sure that all the leds are lit for a second and then remains lit 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 58 .
4. Manually rotate the motor shaft clockwise (viewed from the flange) and measure the voltage at test point SPM. If the voltage is negative the resolver connections are correct otherwise it is necessary to reverse the signals SIN+ and SIN- or COS+ and COS-.
5. Set SW 7.4 = ON (yellow led CNT lit).
6. Apply the power supply to the converter.

7. Verify that the green led RDY is lit. If it does not, verify the presence of the power supply (L1,L2,L3 or DC-BUS).
8. Verify that no red led is lit. Otherwise, refer to the paragraph “Red LEDs - Alarms“ at page 58
9. Enable the converter by the command DEN to start the procedure and to see the state of the red led FFT when, at the end of the cycle, the green led RUN goes OFF.

NOTE: When the procedure is running, the green led RUN flashes and the motor shaft rotates in steps. At the end of the procedure (when the green LED RUN goes off) the red led FFT OFF indicates a phasing within the limits allowed; ON a phasing beyond the permitted limits.

10. Remove the command DEN.
11. Set on SW2 in progression values from 0 to F and repeat as indicated in step 9 for each setting.
12. Take note of what are the 5 values set on SW2 that allow you to have the red led FFT off at end of cycle.
13. Set on SW2 the central value among those who indicated a phasing within limits.
Example: Values within the limits = F, 0,1,2,3. Central value = 1
14. Remove the command DEN. Set SW 7.4 = OFF.
15. Set the trimmers SLG and CLM halfway; the trimmer in SSF stroke end counterclockwise
16. Give the command DEN and provide a positive reference speed very low (approximately 1V measured on test point SPR) to have a rotation of the motor shaft at low speed.
17. Change the position of **SW3** in successive steps to obtain a uniform rotation (without shots). If it is not possible to obtain a satisfying result, increase or decrease by one unit the position of **SW2** and vary the position of **SW3** again. The irregularity of rotation is detectable visually, if of great magnitude, or braking the motor shaft with your hand, if of small entity. Braking with moderation the motor shaft and take precautions to avoid accidents.
18. Remove the command DEN and set SW6.3 = ON (to reverse the rotation direction)
19. Give the command DEN and repeat what specified at item 17 to obtain a uniform rotation in both directions.
20. Remove the command DEN; set SW6.3 = OFF and go to paragraph “Setting and adjustments“ at page 51.

Brushless motor + encoder sin-cos

Set the switches in the positions shown.

Switch	Note	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
SW1		■	—	—	—	●	—	—	—	—	■	■	■	■	■	—	—
SW2		●															
SW3		●															
SW4		■	■	●	■	■	■	■	■	■	■	■	■	■	■	■	■
SW5	Motor poles	■	■	4	6	8	■	■	■	■	■	■	■	■	■	■	■

Switch	.1	.2	.3	.4	NOTE
SW6	OFF	OFF	OFF	OFF	
SW7		OFF	OFF	OFF	SW7.1 = OFF if the maximum motor speed is 3000 RPM. SW7.1 = ON if the maximum motor speed is 6000 RPM.
SW8		■	■	■	SW8.1 = OFF if three-phase supply (L1, L2, L3). SW8.1 = ON if DC BUS supply (DC+, DC-).

NOTE: A cell color ■ indicates a position "not valid" of the switch that causes the switch-on of the the red led SEF (Setting Fault). A cell color ■ indicates a position that does not affect the settings. The symbol "●" indicates the starting position of the switch that during the phasing could also take other positions between those that are valid. The symbol "—" indicates a position that does not cause the switch-on of the red led SEF, but that is not valid for this type of feedback.

To adapt the converter to the characteristics of the motor you must know the number of poles of the motor. Refer to Table 6 at page 33 to find, depending on the type of motor used, the information for the start-up. If the motor is not in the table must be set temporarily SW5 = 4 (The correct setting will be executed after).

You can have three cases:

- The motor is shown in the Table 6 at page 33 and does not require phasing: perform what is described in paragraph “Motor connection test” at page 43.
- The motor is shown in the Table 6 at page 33 and require phasing: perform what is described in paragraph “Motor phasing” at page 44.
- The motor is not shown in the Table 6 at page 33: perform what is described in the paragraphs “Determining the number of motor poles” at page 43 and “Motor phasing” at page 44.

Motor connection test

NOTE: This TEST must be done ALWAYS because it allows you to verify the correctness of the settings and connections.

The settings to be made are: SW2 = 0 e SW3 = 0.

The motor shaft must be idle (not connected to the machine) and the brake must be released.

What to do:

1. Apply the power service 230Vac on the connector X10.
2. Make sure that all the leds are lit for a second and then remains lit 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 58. .
4. Set SW 7.4 = ON (yellow led CNT lit).
5. Apply the power supply to the converter.
6. Verify that the green led RDY is lit. If it does not, verify the presence of the power supply (L1,L2,L3 or DC-BUS).
7. Verify that no red led is lit. Otherwise, refer to the paragraph “Red LEDs - Alarms” at page 58.
8. Enable the converter by the command DEN to start the the procedure.
9. When the procedure is running the green led RUN flashes and the motor shaft rotates in steps.

The test is positive if the motor shaft has rotated clockwise and at the end of the cycle (when the green led RUN turns off) the red led FFT is turned off. In this case the connection and the phasing of the motor are correct. Remove the command DEN, set SW7.4 = OFF and go to paragraph “Setting and adjustments” at page 51.

If the test is negative (red LED lit FFT) proceed as follows:

1. Remove the command DEN and the power and service feeds
2. Verify the accuracy of the settings, the connections of the motor and encoder, repeat the test.

Determining the number of motor poles

NOTE: This procedure assumes that the motor is powered and rotating.

The motor shaft must be idle (not connected to the machine) and the brake must be released.

1. Apply the power service 230Vac on the connector X10.
2. Make sure that all the leds are lit for a second and then remains lit 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 58.
4. Set SW 7.4 = ON (yellow led CNT lit) and set SW5 = 0.
5. Apply the power supply to the converter.
6. Verify that the green led RDY is lit. If it does not, verify the presence of the power supply (L1,L2,L3 or DC-BUS).
7. Verify that no red led is lit. Otherwise, refer to the paragraph “Red LEDs - Alarms” at page 58.

8. Enable the converter by the command DEN to start the procedure.
9. When the procedure is running the green led RUN flashes and the motor shaft rotates in 6 steps.
10. When the procedure is finished, the green led RUN goes off; remove the command DEN and take note of the position of the motor shaft "Start position".
11. Re-enable the drive by the DEN command to restart the procedure.
12. When the procedure is finished, the green led RUN goes off; remove the command DEN and the power supply and take note of the position of the motor shaft "Final position".
13. Measure the angle between the "Start position" and the "Final position" of the motor shaft.

The number of motor poles is calculated by the following formula:

$$Poles = \frac{720}{\alpha} \quad | \quad \alpha = \text{Angle of rotation of the motor shaft.}$$

Examples: $\alpha = 180^\circ$: Poles = 4

$\alpha = 120^\circ$: Poles = 6

$\alpha = 90^\circ$: Poles = 8

Set by SW5 the number of motor poles.

NOTE: If the motor shaft has rotated counterclockwise (viewed from the coupling flange) is necessary to reverse 2 phases of the motor supply.

Motor phasing

NOTE: To perform this procedure it is imperative to set correctly the number of poles of the motor.

These data are contained in Table 6 at page 33 or determined experimentally, by proceeding as described above.

Settings to be made: SW2 = 0, SW3 = 0

The motor shaft must be idle (not connected to the machine) and the brake must be released.

This procedure assumes that the motor is powered and rotating.

What to do:

1. Apply the power service 230Vac on the connector X10.
2. Make sure that all the leds are lit for a second and then remains lit 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 58.
4. Manually rotate the motor shaft clockwise (viewed from the flange) and measure the voltage at test point SPM. If the voltage is negative the encoder connections are correct otherwise it is necessary to check the signals A+, A-, B+, B-, R+, R-.
5. Set SW 7.4 = ON (yellow led CNT lit).
6. Apply the power supply to the converter.
7. Verify that the green led RDY is lit. If it does not, verify the presence of the power supply (L1,L2,L3 or DC-BUS).
8. Verify that no red led is lit. Otherwise, refer to the paragraph "Red LEDs - Alarms" at page 58.
9. Enable the converter by the command DEN to start the procedure and to see the state of the red led FFT when, at the end of the cycle, the green led RUN goes OFF.

NOTE: When the procedure is running, the green led RUN flashes and the motor shaft rotates in steps. At the end of the procedure (when the green LED RUN goes off) the red led FFT OFF indicates a phasing within the limits allowed; ON a phasing beyond the permitted limits.

10. Remove the command DEN.
11. Set on SW2 in progression values from 0 to F and repeat as indicated in step 9 for each setting.
12. Take note of what are the 5 values set on SW2 that allow you to have the red led FFT off at end of cycle.

NOTE: If the values are not 5 must be checked signal connections C +, C-, D +, D-(after removing: DEN command, the

service and power supply) and repeat the phasing of the motor

13. Set on SW2 the central value among those who indicated a phasing within limits.

Example: Values within the limits = F, 0,1,2,3. Central value = 1



14. Remove the command DEN. Set SW 7.4 = OFF.
15. Set the trimmers SLG and CLM halfway; the trimmer in SSF stroke end counterclockwise
16. Give the command DEN and provide a positive reference speed very low (approximately 1V measured on test point SPR) to have a rotation of the motor shaft at low speed.
17. Change the position of SW3 in successive steps to obtain a uniform rotation (without shots). If it is not possible to obtain a satisfying result, increase or decrease by one unit the position of SW2 and vary the position of SW3 again. The irregularity of rotation is detectable visually, if of great magnitude, or braking the motor shaft with your hand, if of small entity. Braking with moderation the motor shaft and take precautions to avoid accidents.
18. Remove the command DEN and set SW6.3 = ON (to reverse the rotation direction)
19. Give the command DEN and repeat what specified at item 17 to obtain a uniform rotation in both directions.
20. Remove the command DEN; set SW6.3 = OFF and go to paragraph "Setting and adjustments" at page 51

Brushless motor + d.c. tachogenerator

Set the switches in the positions shown.

Switch	Note	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
SW1			—	—	—	—	Hall 120°	—	—	Hall 60°						—	—
SW2		•															
SW3		•															
SW4			•														
SW5																	

Switch	.1	.2	.3	.4	NOTE
SW6	OFF	OFF	OFF	OFF	
SW7	OFF			OFF	
SW8					SW8.1 = OFF if three-phase supply (L1, L2, L3). SW8.1 = ON if DC BUS supply (DC+, DC-).

NOTE: A cell color  indicates a position "not valid" of the switch that causes the switch-on of the the red led SEF (Setting Fault). A cell color  indicates a position that does not affect the settings. The symbol "•" indicates the starting position of the switch that during the phasing could also take other positions between those that are valid. The symbol "—" indicates a position that does not cause the switch-on of the red led SEF, but that is not valid for this type of feedback.

Motor connection test and possible phasing

NOTE: This TEST must be ALWAYS done whatever the motor used to check the wiring and to have no problems during the next steps of the start-up.

The motor shaft must be idle (not connected to the machine) and the brake must be released.

What to do:

1. Apply the power service 230Vac on the connector X10.
2. Make sure that all the leds are lit for a second and then remains lit 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 58.

4. Set SW 7.4 = ON (yellow led CNT lit).
5. Apply the power supply to the converter.
6. Verify that the green led RDY is lit. If it does not, verify the presence of the power supply (L1,L2,L3 or DC-BUS).
7. Verify that no red led is lit. Otherwise, refer to the paragraph "Red LEDs - Alarms" at page 58.
8. Enable the converter by the command DEN to start the procedure.
9. When the procedure is running the green led RUN flashes and the motor shaft rotates in steps.
10. Verify that no red led is lit. Otherwise, refer to the paragraph "Red LEDs - Alarms" at page 58.

Observe the rotation of the motor shaft (viewed from the flange) and the state of the red led FFT when the motor rotation ends (when the green led RUN goes off). You can have the following cases:

- The motor shaft has rotated clockwise and at the end of the cycle the red led FFT is off. In this case the connection and the phasing of the motor are correct. Remove the enable (DEN = OFF) and hold SW2 and SW3 in their respective positions. Set SW7.4 = OFF. Go to "Setting and adjustments" at page 51.
- The motor shaft has rotated counterclockwise. In this case, remove the enable (DEN = OFF) and the power supply to the drive. After at least 3 minutes invert 2 phases (between them) of the motor supply. Then repeat the procedure from step 5.
- The motor shaft has rotated clockwise and at the end of the cycle the red led FFT lit. In this case disable the converter; set SW3 in sequence: 1, 2, 3, 4, 5, and repeat the procedure from step 8 for each setting.
- The motor shaft has rotated clockwise and the red led FFT flashes. In this case, disable the drive, set SW2 = 1 and repeat the procedure from step 8.

If it is not possible to complete the procedure successfully is necessary to verify the settings, connections and signals provided by the feedback.

Brushless motor Fanuc + encoder TTL

Set the switches in the positions shown.

Switch	Note	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
SW1		■	—	—	—	—	—	—	●	—	■	■	■	■	■	—	—
SW2		●	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
SW3		●	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
SW4		■	■	■	●	■	■	■	■	■	■	■	■	■	■	■	■
SW5		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

Switch	.1	.2	.3	.4	NOTE
SW6	OFF	OFF	OFF	OFF	
SW7		OFF	OFF	OFF	SW7.1 = OFF if the maximum motor speed is 3000 RPM. SW7.1 = ON if the maximum motor speed is 6000 RPM.
SW8		■	■	■	SW8.1 = OFF if three-phase supply (L1, L2, L3). SW8.1 = ON if DC BUS supply (DC+, DC-).

NOTE: A cell color ■ indicates a position "not valid" of the switch that causes the switch-on of the the red led SEF (Setting Fault). A cell color ■ indicates a position that does not affect the settings. The symbol "●" indicates the starting position of the switch that during the phasing could also take other positions between those that are valid. The symbol "—" indicates a position that does not cause the switch-on of the red led SEF, but that is not valid for this type of feedback.

Motor connection test

NOTE: This TEST must be ALWAYS done whatever the motor used to check the wiring and to have no problems during the next steps of the start-up.

The motor shaft must be idle (not connected to the machine) and the brake must be released.

What to do:

1. Apply the power service 230Vac on the connector X10.
2. Make sure that all the leds are lit for a second and then remains lit 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 58.
4. Set SW 7.4 = ON (yellow led CNT lit).
5. Apply the power supply to the converter.
6. Verify that the green led RDY is lit. If it does not, verify the presence of the power supply (L1,L2,L3 or DC-BUS).
7. Verify that no red led is lit. Otherwise, refer to the paragraph "Red LEDs - Alarms" at page 58.
8. Enable the converter by the command DEN to start the the procedure.
9. When the procedure is running the green led RUN flashes and the motor shaft rotates in steps.
10. Verify that no red led is lit. Otherwise, refer to the paragraph "Red LEDs - Alarms" at page 58.

Observe the rotation of the motor shaft (viewed from the flange) and the state of the red led FFT when the motor rotation ends (when the green led RUN goes off). You can have the following cases:

- The motor shaft has rotated clockwise and at the end of the cycle the red led FFT is off. In this case the connection and the phasing of the motor are correct. Remove the enable (DEN = OFF) and set SW7.4 = OFF. Go to "Setting and adjustments" at page 51.
- The motor shaft has rotated counterclockwise. In this case, remove the enable (DEN = OFF) and the power supply to the drive. (After at least 3 minutes) to check and properly connect the 3-phase motor power. Then repeat the procedure from step 5.
- The motor shaft has rotated clockwise and at the end of the cycle the red led FFT is off. In this case disable the converter and check the connections of the signals C1, C2, C4, C8. Repeat the procedure from step 8.
- The motor shaft has rotated clockwise and at the end of the cycle the red led FFT is off. In this case disable the converter and check the connections of the signals A, An, B, Bn. Repeat the procedure from step 8.

D.C. motor + encoder TTL

Set the switches in the positions shown.

Switch	Note	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
SW1		■	—	—	—	—	—	—	—	—	■	■	■	■	■	●	—
SW2		●	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
SW3		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
SW4	Encoder PPR	■	1024	1025 ÷ 2048	2049 ÷ 3072	3073 ÷ 4096	■	■	■	■	■	■	■	■	■	■	■
SW5		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

Dip N°	.1	.2	.3	.4	NOTE
SW6	OFF	OFF	OFF	OFF	
SW7		OFF	OFF	OFF	SW7.1 = OFF if the maximum motor speed is 3000 RPM. SW7.1 = ON if the maximum motor speed is 6000 RPM.
SW8		■	■	■	SW8.1 = OFF if three-phase supply (L1, L2, L3). SW8.1 = ON if DC BUS supply (DC+, DC-).

NOTE: A cell color ■ indicates a position "not valid" of the switch that causes the switch-on of the the red led SEF (Setting Fault). A cell color ■ indicates a position that does not affect the settings. The symbol "●" indicates the starting position of the switch that during the phasing could also take other positions between those that are valid. The symbol "—" indicates a

Position that does not cause the switch-on of the red led SEF, but that is not valid for this type of feedback.
To set correctly the switch SW4 is necessary to know the (PPR) of the encoder.

NOTE:

- The use of encoder with less than 1024 PPR significantly reduces the performance of the converter.
- Verify that the maximum frequency of the signals of channels A and B (corresponding to the maximum speed of the motor) is less than the maximum frequency specified by the manufacturer of the encoder. The maximum frequency is calculated in the following way:

$$F_{MAX} = \frac{PPR \cdot n_{MAX}}{60} \quad \left| \begin{array}{l} F_{MAX} = \text{Maximum output Frequency of the encoder [Hz].} \\ n_{MAX} = \text{Maximum speed at which the motor is used [RPM].} \\ PPR = \text{Pulses Per Revolution of the encoder.} \end{array} \right.$$

Motor connection test and possible phasing

NOTE: This TEST must be ALWAYS done whatever the motor used to check the wiring and to have no problems during the next steps of the start-up.

The motor shaft must be idle (not connected to the machine) and the brake must be released.

What to do:

1. Apply the power service 230Vac on the connector X10.
2. Make sure that all the leds are lit for a second and then remains lit 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 58.
4. Set SW 7.4 = ON (yellow led CNT lit).
5. Apply the power supply to the converter.
6. Verify that the green led RDY is lit. If it does not, verify the presence of the power supply (L1,L2,L3 or DC-BUS).
7. Verify that no red led is lit. Otherwise, refer to the paragraph “Red LEDs - Alarms“ at page 58.
8. Enable the converter by the command DEN to start the the procedure.
9. When the procedure is running the green led RUN flashes and the motor shaft rotates for a short time.
10. Verify that no red led is lit. Otherwise, refer to the paragraph “Red LEDs - Alarms“ at page 58.

Observe the rotation of the motor shaft (viewed from the flange) and the state of the red led FFT when the motor rotation ends (when the green led RUN goes off). You can have the following cases:

- The motor shaft has rotated clockwise and at the end of the cycle the red led FFT is off. In this case the connection and the phasing of the motor are correct. Remove the enable (DEN = OFF) and set SW7.4 = OFF. Go to “Setting and adjustments“ at page 51.
- The motor shaft has rotated counterclockwise. In this case, remove the enable (DEN = OFF) and the power supply to the drive. After at least 3 minutes invert the connections (between them) of the motor armature. Then repeat the procedure from step 5.
- The motor shaft has rotated clockwise and the red led FFT lit. In this case, disable the drive, set SW2 = 1 and repeat the procedure from step 8.

If it is not possible to complete the procedure successfully is necessary to verify the settings, connections and signals provided by the feedback.

D.C. Motor + d.c. tachogenerator

Set the switches in the positions shown.

Switch	Note	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
SW1		■	—	—	—	—	—	—	—	—	■	■	■	■	■	—	●
SW2		●	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
SW3		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
SW4	X	0÷5	6÷20	21÷44	45÷71	72÷95	96÷140	141÷164	165÷191	192÷215	216÷259	260÷284	285÷311	■	■	■	■
SW5		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

Switch	.1	.2	.3	.4	NOTE
SW6	OFF	OFF	OFF	OFF	
SW7	OFF	■	■	OFF	
SW8		■	■	■	SW8.1 = OFF if three-phase supply (L1, L2, L3). SW8.1 = ON if DC BUS supply (DC+, DC-).

NOTE: A cell color ■ indicates a position "not valid" of the switch that causes the switch-on of the the red led SEF (Setting Fault). A cell color ■ indicates a position that does not affect the settings. The symbol "●" indicates the starting position of the switch that during the phasing could also take other positions between those that are valid. The symbol "—" indicates a position that does not cause the switch-on of the red led SEF, but that is not valid for this type of feedback.

To adapt the converter to the characteristics of the tachogenerator mounted on the motor and to the speed reference should be calculated:

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

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

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

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

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 311, it is necessary to set the SW4 = B and insert an external resistor connected to terminal TGI (X9-4). To calculate the resistance value see the paragraph X9 at page 23.

Motor connection test and possible phasing

NOTE: This TEST must be ALWAYS done whatever the motor used to check the wiring and to have no problems during the next steps of the start-up.

The motor shaft must be idle (not connected to the machine) and the brake must be released.

What to do:

1. Apply the power service 230Vac on the connector X10.
2. Make sure that all the leds are lit for a second and then remains lit 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 58.
4. Set SW 7.4 = ON (yellow led CNT lit).
5. Apply the power supply to the converter.
6. Verify that the green led RDY is lit. If it does not, verify the presence of the power supply (L1,L2,L3 or DC-BUS).
7. Verify that no red led is lit. Otherwise, refer to the paragraph "Red LEDs - Alarms" at page 58.
8. Enable the converter by the command DEN to start the the procedure.
9. When the procedure is running the green led RUN flashes and the motor shaft rotates for a short time.

10. Verify that no red led is lit. Otherwise, refer to the paragraph “Red LEDs - Alarms“ at page 58.

Observe the rotation of the motor shaft (viewed from the flange) and the state of the red led FFT when the motor rotation ends (when the green led RUN goes off). You can have the following cases:

- The motor shaft has rotated clockwise and at the end of the cycle the red led FFT is off. In this case the connection and the phasing of the motor are correct. Remove the enable (DEN = OFF) and set SW7.4 = OFF. Go to “Setting and adjustments“ at page 51.
- The motor shaft has rotated counterclockwise. In this case, remove the enable (DEN = OFF) and the power supply to the drive. After at least 3 minutes invert the connections (between them)of the motor armature. Then repeat the procedure from step 5.
- The motor shaft has rotated clockwise and the red led FFT lit. In this case, disable the drive, set SW2 = 1 and repeat the procedure from step 8.

If it is not possible to complete the procedure successfully is necessary to verify the settings, connections and signals provided by the feedback.

Setting 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 58.

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:

$$V_{CLM} = 10 \cdot \frac{I_{MOT}}{I_{CONV}} \quad \left| \begin{array}{l} V_{CLM} = \text{Voltage value to set on the Test Point CLM [V]}. \\ I_{MOT} = \text{Maximum current on the motor [A]}. \\ I_{CONV} = \text{Peak current indicated on the plate of the converter [A]}. \end{array} \right.$$

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 SW6.1 in position OFF.
 - Set by the trimmer "CLM" in the Test Point "CLM" the voltage value calculated by the above formula.
- **Variable current limit:**
 - Set the switch SW6.1 in position ON.
 - Provide maximum signal (+10 V) on "CLI"input (see connector X11 at page 24).
 - 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.

Zeroing of the feedback offset

Zeroing of the output SPM offset.

What to do:

1. Do not enable the converter (Led DEN = OFF).
2. Set to zero the voltage on the test point SPM by the trimmer FBO.

Motor speed adjustment

Speed reference from CNC

Execute on the CNC the following settings:

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

Execute on the converter the following settings:

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

Steps to follow:

1. Enable the drive and set on the CNC feed rate to 10% of maximum speed.
2. If the axis motion is opposite 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 direction of rotation by means of SW 6.3

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 SW4. 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 SW4. 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

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. Enable the converter and measure with a tachometer the motor shaft speed.
5. If the axis motion is opposite to that set, it should stop the motor, turn off the converter and to reverse the direction of rotation by means of SW 6.3.

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.

8. 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 SW4. Repeat the procedure from step 1.
9. Turn the trimmer SLG in a clockwise direction until the point where they do not feel acoustic or mechanical vibrations of the motor..
10. 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:

Ramp time range 0,15 ÷ 2 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.

Special functions

Unbalanced axis compensation

Generality

Normally the vertical axes of the machine tool are mechanically balanced by balance weight or by hydraulic piston and therefore the torque (motor current) required for motion in both directions is equal. In this case the tracking error upward and downward is equal. If the axis is not balanced the torque required for the upward normally exceeds that for the downward, and then the tracking error in the two directions is sometimes considerably different. To bring the tracking error almost equal in both motion directions is necessary to electrically compensate the mechanical unbalance.

Adjustment

This adjustment should only be performed after performing the start-up and finished all the settings and adjustments.

What to do:

1. Turn the trimmer BSC all the way counterclockwise.
2. Check that the voltage on the Test Point BSC is 0.
3. Set SW6.2 = ON.
4. Enable the operation of the converter by CNC. Move the axis in any position and wait until the position is reached.
5. Measure the voltage at Test Point SER and proceed as follows:
 - If the voltage is positive set SW6.4 = OFF and turn the trimmer BSC in a clockwise direction until you obtain 0V on the Test Point SER.
 - If the voltage is negative set SW6.4 = ON and turn the trimmer BSC in a clockwise direction until you obtain 0V on the Test Point SER.
6. Move the axis in both directions and verify that the tracking error is the same.
7. Adjust, if necessary, the following trimmers:
 - BSC to make equal the tracking error in both directions.
 - SSF to minimize the tracking error.
 - SOF to have zero position error.

Electric anti-backlash.

Generality

The function of the electric anti-backlash is to take up slack in the kinematic chain when it is used reduction gear and pinion-rack.

The electric anti-backlash utilizes two identical units, each consisting of a converter and an electric D.C. Or brushless motor.

The two converters control that the torque generated at standstill by the two motors is equal but of opposite sign.

In this way the gear teeth are in contact and the backlash of the kinematic chain are canceled.

When the system is in motion the torque delivered by a motor increases while that of the other decreases always nullifying the backlash of the kinematic chain.

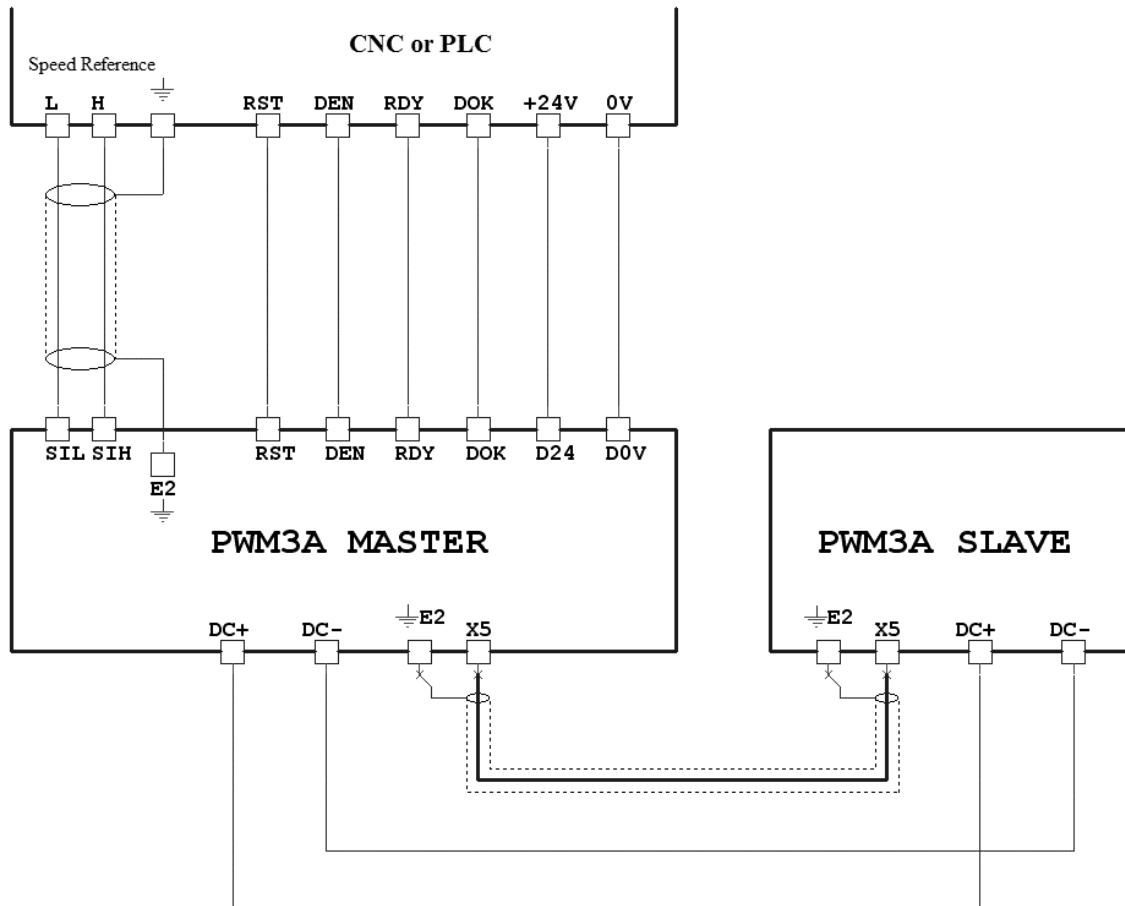
The electric anti-backlash uses two identical converters (same rated current). A converter is called *Master* and the other *Slave*.

The converter *Master* receives all commands and controls the system while the *Slave* is driven by the *Master*.

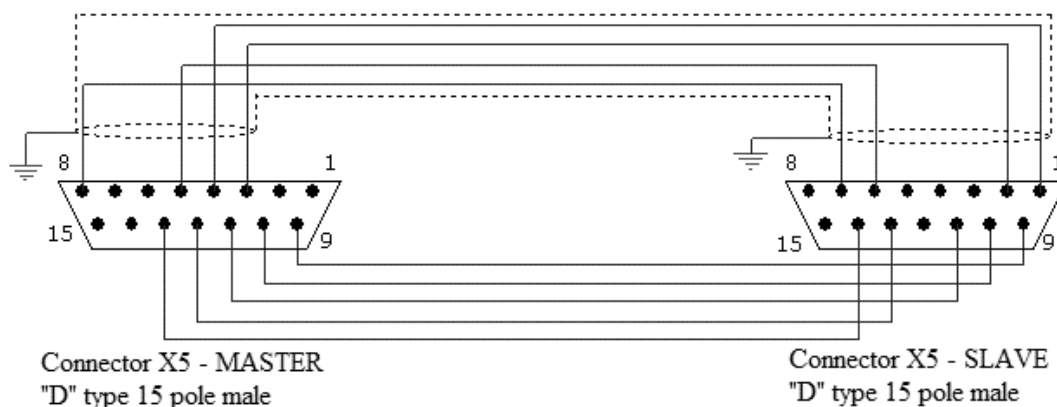
Connection diagram

1. Connect the MASTER converter as shown in Drawing 1 at page 18 (Three-phase supply) or as shown in Drawing 2 at page 19 (D.C. Bus supply)..

2. Connect the SLAVE converter as the MASTER except for the input and output signals. All the input and output signals are handled by the MASTER converter, as shown on Drawing 14 at page 55.
3. Connect DC+ e DC- of the MASTER converter to DC+ e DC- of the SLAVE converter, as shown on Drawing 14 at page 55.
4. Connect the MASTER and SLAVE converters by a special cable inserted on the X5 connector of the two converters, as shown on Drawing 14 at page 55. . This cable can be supplied, on request, by ALTER or made by the user according to the connections shown on the Drawing 15 at page 55.



Drawing 14



Drawing 15

Adjustment

1. Do not plug the cable into the connectors X5.

2. Perform the start-up only of the MASTER converter, following the steps of the paragraph concerning the motor used. (see “Start-up“ from page 36) and “Setting and adjustments“ at page 51.
3. When the MASTER motor is working properly and were performed ALL settings, perform the “Shutdown sequence at page 28 and move the connectors X11 and X12 from MASTER converter to SLAVE converter.
4. Perform the start-up only of the SLAVE converter, following the steps of the paragraph concerning the motor used. (see “Start-up“ from page 36) and “Setting and adjustments“ at page 51.

NOTE: If is necessary to reverse the direction of rotation of the SLAVE motor, change the position of the switch SW6.3.

5. When the SLAVE motor is working properly and were performed ALL settings, perform the “Shutdown sequence at page 28 and move the connectors X11 and X12 from SLAVE converter to MASTER converter.
6. Plug the connection cable (see Drawing 15 at page 55) into the connector X5 of the MASTER and SLAVE converters.
WARNING: Plug correctly the connector MASTER to the MASTER converter and the connector SLAVE to the SLAVE converter. (both connectors are 15-pin male).
7. Apply power service 230Vac to the connector X10 and verify that the leds MSM (on the MASTER converter) and SLM (on the SLAVE converter) are lit. 7. If you do not have this condition check the correct insertion of the connectors X5 and the wiring between the two connectors.
8. In the MASTER converter, turn the trimmer BSC all the way counterclockwise and check that the voltage in the Test Point BSC is zero.
9. Enable the drivers (command DEN= ON) ed adjust the trimmer BSC of the MASTER converter to have a smooth motion of the axis at all speeds and in both directions.

In the Test Point BSC you can measure a voltage proportional to the setting of the opposition current.

10V in the Test Point BSC corresponds:

- To the peak current if indicated on the plate.
- To the rating current in the in the other cases.

The maximum value is about 5V.

Too low current causes a not fluid motion of the axis. Too high current causes excessive heating of the motors.

10. Adjust, if necessary, the following trimmers:
 - SLG to have the maximum quickness.
 - SSF to minimize the tracking error.
 - SOF to have zero position error.

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 at paragraph “X12“ at page 26).
- An operation mode of the converter which is enabled by the command DEN.

AUX (Auxiliary Input)

Display the external command AUX that enables specific functions required by the customer.

Note: This command is normally not active.

CNT (Connection Test)

Displays the enabling of checking or determining the correct connections between the motor and the converter (SW7.4 = ON).

More information at Chapter 6 from page 36.

DEN (Drive Enable)

Display the external command DEN that enables the converter. More information at paragraph “ X12“ at page 26.

MSM (Master Mode)

Displays the setting of the converter to operate as MASTER. More information at paragraph “Electric anti-backlash.“ at page 54.

MTS (Motor Temperature Sense)

Displays the enabling to control the motor temperature (SW8.2 = ON).

More information at paragraph “MOT (Motor Over Temperature)“ at page 60.

REN (Ramp Enable)

Display the external command REN that enables the speed ramp. More information at paragraph X12 at page 26.

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. More information at paragraph X12 at page 26.

SLM (Slave Mode)

Displays the setting of the converter to operate as SLAVE. More information at paragraph “Electric anti-backlash.“ at page 54.

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.

RUN (RUN)

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

ZES (Zero Speed)

Displays the status “Motor Stop”. This led is lit when the output “ZES” is ON.

Note: If SW7.4 = ON this LED blinks at the transition to the zero position of the resolver.

More information at paragraph “Determining the number of resolver poles“ at page 40.

Red LEDs - Alarms

- The cause of the alarm is signaled by the corresponding LED lit.
- All the alarms are stored if the converter is enabled (DEN = ON).
- If the converter is disabled, the alarms will end when there is no longer the cause that generated them
- Restore is done by the RST command (see the paragraph “X12 at page 26).
- In case of alarm, with the exception of the alarm MOT, 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:

3. Check the supply voltage of the services.
4. 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 the cabinet.

COL (Clamp Over Load)

Overload of the clamp resistor placed inside the converter. On the Test Point CLL you can measure a voltage proportional to the energy recovered and dissipated by the clamp resistor. If the voltage on test point reaches +10 V, the converter generates this alarm.

The causes of the alarm are:

1. Large number of repeated stops the motor.

2. Time to stop is 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 feedback mounted in the motor.

What to do:

- Reduce the performance of the machine.
- Check the size of the converter.
- Use a larger size converter.
- Use an external resistor.

Note: More information at paragraph “Clamp resistor“ at page 21. 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. Temperature inside the cabinet is too high.
2. Inadequate ventilation inside the converter.

What to do:

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

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 14.
- If you use the internal resistance, check that the jumper is installed between Rint + and R- on X1 connector or terminal block.

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 Overload)

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 converter.
- Use a larger size converter.

FFT (Feedback Fault)

Failure or mistake of the signals provided by the feedback mounted in the motor.

The causes of the alarm are:

1. Failure of the feedback mounted in the motor
2. Wrong setting of the type / data of the feedback
3. Mistake in the connections between the feedback and the converter
4. Interruption or short circuit in the cable between the feedback and the motor
5. Bad contact or non-insertion of the connectors mounted on the motor and on the converter.
6. Noise on the connection cable between the feedback and the motor

What to do:

- Perform the Connection Test to verify the signals provided by the feedback
- Check the continuity and insulation of the conductors inside the shielded cable that connects the feedback
- Check the welds and the continuity of the shield on the following connectors: motor, intermediate and converter.
- Check that the cable shield is grounded both on the motor and the converter

MCF (Motor Connection Fault)

Interruption of the power connections between the converter and motor.

The causes of the alarm are:

1. Full or partial interruption of the power connection between the converter and motor.

What to do:

- Check the power connections between the converter and motor

MOT (Motor Over Temperature)

The motor temperature exceeds the maximum value allowed.

Note: To have the alarm signaling and the MOT digital output enabling, you must:

1. To connect the temperature sensor of the motor to the converter terminals (see Drawing 1 at page 18).
2. To set SW8.2 = ON.

Even if this alarm is present the converter will continue, if enabled, to supply the motor. It is recommended to stop the machine as soon as possible to prevent damage to the motor.

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.
5. Insufficient ventilation.

What to do:

- Reduce the performance of the machine.
- Check for the lubrication of the machine.
- Check the size of the motor.
- Check the motor ventilation.

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.

SEF (Setting Fault)

Wrong setting of the converter.

The causes of the alarm are:

1. Invalid settings, if the converter is disabled (DEN = OFF). In this case, the alarm stops when all the settings are valid.
2. Changes to settings, if the drive is enabled (DEN = ON). In this case the alarm is stored.

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.

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.

What to do:

- If SW8.1 = OFF: Check the three-phase supply.
- If SW8.1 = ON: Check the D.C. BUS supply.

Test Point

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.

+15V

+15Vdc internal supply. This test point is only used to check the correct operation of the supply circuits inside the converter.

+5V

+5Vdc internal supply. This test point is only used to check the correct operation of the supply circuits inside the converter.

-15V

-15Vdc internal supply. This test point is only used to check the correct operation of the supply circuits inside the converter.

AØV

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

BMO (Bus Monitor)

Voltage proportional to the voltage on the DC bus.

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

BSC (Bias Current)

Voltage proportional to the current set, required to compensate the axis imbalance (see at page 54 Unbalanced axis compensation) or to set to zero the backlash (see at page 54 Electric anti-backlash).

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

Setting by trimmer BSC.

CLL (Clamp Load Level)

Voltage proportional to the energy recovered by the clamp resistor.

If the voltage on TP reaches +10 V **Clamp Overload** alarm is generated. More information at paragraph "COL (Clamp Over Load)" at page 58.

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 51).

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. 1K Ω output resistance.

RCS (Resolver Cosine)

Voltage proportional to the peak voltage on the resolver cosine winding. When the voltage on the T.P. RSN is 0V, the voltage on this T.P. must be 2.2 VDC. More information at paragraph "Adjustment of the excitation voltage of the resolver" at page 39.

RSN (Resolver Sine)

Voltage proportional to the peak voltage on the resolver sine winding. When the voltage on the T.P. RCS is 0V, the voltage on this T.P. must be 2.2 VDC. More information at paragraph "Adjustment of the excitation voltage of the resolver" at page 39.

SER (Speed Error)

Output voltage of the speed loop. 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 by the trimmer CLM (see paragraph "Current limit setting" at page 51).

By measuring the voltage on this TP is possible to verify:

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

SPM (Speed Monitor)

Voltage proportional to the motor speed. Maximum voltage +/-10V. - Output resistance 1KΩ.

The relationship between the measured voltage on the T.P. and the motor speed is a function of the feedback used.

- Feedback type: Resolver, encoder, sin-cos.

Scale factor: 8V are equivalent to: 3000RPM (if SW7.1 = OFF) or 6000RPM (if SW7.1 = ON).

- Feedback type: Brushless and D.C. Tachogenerator.

Use the formula corresponding to the measurement unit utilized on the plate.

(regarding the speed constant of the tachogenerator).

$$n = \frac{V_{SPM} \cdot X}{K_{DT1} \cdot 8}$$

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

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

K_{DT1} = Voltage constant of the tachogenerator. (read on the plate)[V/rpm]

K_{DT2} = Voltage constant of the tachogenerator. (read on the plate)[V/Krpm]

K_{DT3} = Voltage constant of the tachogenerator. (read on the plate)[V*sec/rad]

n = Motor speed[RPM].

V_{SPM} = Voltage on the Test Point SPM [V].

X = value that depends on the setting made by SW4 (see the following tables).

SW4 Position	0	1	2	3	4	5	6	7	8
X	3	12	20	29	37	52	60	77	92

Table 11: Brushless Tachogenerator

SW5 Position	0	1	2	3	4	5	6	7	8	9	A	B
X	5	20	44	71	95	140	164	191	215	259	284	311

Table 12: D.C. Tachogenerator

If they are not known the data of the tachogenerator, you must simultaneously measure the speed of the motor, by a tachometer, and the voltage on the 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:

<p>(1) $K_{SPM} = \frac{n_0}{V_{SPM0}}$</p>	$\left \begin{array}{l} K_{SPM} = \text{Conversion factor for the Test Point SPM.} \\ n_0 = \text{Motor speed (measured by a tachometer) [RPM].} \\ V_{SPM0} = \text{Voltage on the Test Point SPM at speed } \omega_0 [V]. \end{array} \right.$
<p>(2) $n = K_{SPM} \cdot V_{SPM}$</p>	$\left \begin{array}{l} n = \text{Motor speed [RPM].} \\ V_{SPM} = \text{Voltage on the Test Point SPM at speed } \omega [V]. \end{array} \right.$

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.

TGM (Tachogenerator Monitor)

Signal provided by the D.C. Tachogenerator (where present).

WARNING: This signal is equal to that found on terminal TGI (X9-4), therefore, could reach a maximum voltage of 311V.

(see at paragraph X9 at page 23).

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	57
REN	Ramp Enable	Ramp enable command	57
RST	Reset	Alarm reset command	57
AUX	Auxiliary Input	Auxiliary Input command	57
INI	Initialization	Program loaded	57
RDY	Ready	Converter ready	57
RUN	Run	Converter running	58
ZES	Zero Speed	Motor stopped	58
MTS	Motor Temp. Sense	Motor temperature control enable	57
CNT	Connection test	Motor connection test function activation	57
MSM	Master Mode	Operation of the converter in MASTER mode	57
SLM	Slave Mode	Operation of the converter in SLAVE mode	57
DOL	Drive Over-Load	Exceeding the rated current for more than a second	60
PSF	Power Supply Fault	Power Supply Fault	61
ASF	Auxiliary Supply Fault	Auxiliary Supply Fault	58
FFT	Feedback Fault	Feedback unit fault	60
OUF	Output Fault	Digital output overload o short circuit	61
BOT	Bridge Over Temperature	Bridge Over Temperature	58
COT	Capacitor Over Temp.	Capacitor Over Temperature	59
MOT	Motor Over Temperature	Motor Over Temperature	60
DOC	Drive Over Current	Converter over-current	59
DFT	Drive Fault	Converter fault	59
COL	Clamp Over Load	Clamp Over Load	58
MCF	Motor Connection Fault	Motor Connection Fault	60
SEF	Setting Fault	Setting Fault	61

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 the Current Limit	51
SSF	Speed Scale Factor	Setting of the speed scale factor	52
SOF	Speed Offset	Zeroing of the speed offset	52
SLG	Speed Loop Gain	Setting of the speed loop gain	52
SRT	Speed Ramp Time	Setting of the speed ramp	53
BSC	Bias Current	Setting of the Compensation Current for Unbalanced axis compensation or Opposition Current for Electric anti-backlash..	54 o 54
REX	Resolver Excitation	Adjustment of the excitation voltage of the resolver	39
FBO	FeedBack Offset	Zeroing of the feedback offset	51

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	62
SPR	Speed Reference	Speed Reference voltage value	64
SER	Speed Error	Speed error voltage value	63
BSC	Bias Current	Compensation Current for Unbalanced axis compensation or Opposition Current for Electric anti-backlash. voltage value.	54 o 54
SPM	Speed Monitor	Speed monitor voltage value	63
CMO	Current Monitor	Current monitor voltage value	62
CLL	Clamp Load Level	Voltage proportional to the energy recovered by the clamp resistor.	62
BMO	Bus Monitor	Voltage proportional to D.C. Bus voltage	62
+15V	+ 15V	Auxiliary Supply +15Vdc	62
+5V	+ 5V	Auxiliary Supply +5Vdc	62
-15V	-15V	Auxiliary Supply -15Vdc	62
A0V	Analog 0V	Analog 0V (common for measurement)	62
TGM	Tacho Generator Monitor	D.C. Tachogenerator output voltage	
RSN	Resolver Sine	Resolver SIN winding output voltage	39
RCS	Resolver Cosine	Resolver COS winding output voltage	39

ROTARY SWITCHES Overview table

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

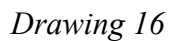
NAME	DESCRIPTION	Reference Page
SW1	Selection of the motor type and of the feedback type	36, 37, 39, 42, 45, 46, 47, 49
SW2	Motor phasing.	37, 38, 41, 44, 45, 46, 48, 49
SW3	Motor phasing.	37, 38, 41, 44, 45, 46, 48, 49
SW4	Specific setting of the feedback type	36, 37, 39, 42, 45, 46, 47, 49
SW5	Setting of pairs poles of the motor. (only for some motor types).	36, 37, 39, 42, 45, 46, 47, 49

DIP-SWITCHES Overview table

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

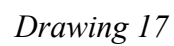
NAME	DESCRIPTION	Reference Page
SW6.1	Selection of the Current Limit Internal / External.	51
SW6.2	Enable of Compensation Current for Unbalanced axis compensation / Opposition Current for Electric anti-backlash.	54
SW6.3	Reversing the direction of rotation of the motor.	52
SW6.4	Sign of Compensation Current for Unbalanced axis compensation / Opposition Current for Electric anti-backlash.	54
SW7.1	Maximum Speed 3000 RPM / 6000 RPM	36, 37, 39, 42, 45, 46, 47, 49
SW7.2	Amplification factor of the resolver outputs	39
SW7.3	Amplification factor of the resolver outputs	39
SW7.4	Motor connection test function activation.	37, 38, 40, 43, 45, 46, 48, 49
SW8.1	Selection of the power supply: Three-phase / D.C.BUS.	36, 37, 39, 42, 45, 46, 47, 49
SW8.2	Enables the control of the motor temperature (MTS)	57
SW8.3	NOT USED	-
SW8.4	NOT USED	-

Size 1



Mass: 4,6 Kg

Mass: 12 Kg



The technical drawings show the top and bottom views of the Altera board. The top view includes dimensions: 477 (width), 325 (height), 275 (height), 264, 7 (width), and 191, 2 (width). The bottom view shows a large circular cutout and various component labels including E1, E2, E3, E4, X10, X11, X12, X3, X4, X5, X6, L1, L2, L3, DC-, DC+, A, B, C, and PWM3 A. The board is labeled 'ALTERA' and 'ALTER ELECTRONICS S.p.A.'.

Drawing 18

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Chapter 10 - Coding table

Converter Model	Options			Maximum output voltage	Rated output current
PWM3A-	x	x	x	-xxx	-xxx
					006 = 6A 010 = 10A 015 = 15A 024 = 24A 032 = 32A 048 = 48A 060 = 60A 072 = 72A 088 = 88A 110 = 110A 130 = 130A 170 = 170A
				400 = 400V	
000 = Standard 001 = Terminals for mounting of the external capacitors on the 24Vd.c. auxiliary services					
PWM3A = PWM Converter (for Brushless and D.C. motors type), 3 Series, Analog control					

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