



ALTER ELETTRONICA S.R.L.  
CASALE MONFERRATO (Italy)

## GUIDE OF INSTALLATION

INTEGRATIVE TO INSTRUCTION BOOKS

91/087

91/088

in conformity to Directive EMC and BT

4 QUADRANT PWM  
DRIVER FOR  
DC and BRUSLESS MOTORS

**SERIES PWM**

MODELS

**DCD - BTD**

**GUIDE OF INSTALLATION  
INTEGRATIVE TO THE INSTRUCTIONS BOOKS  
91/087 or 91/088  
in conformity to the Directive EMCs and LV**

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# 1 - Preliminary instructions

## 1.1 Purpose and destination

### 1.1.1

The present guide is destined to the user of the converters **Series PWM** for d.c and brushless motors., as detailed to the paragraph 2.2, produced by ALTER. Insofar it must always be used in union to the "Instructions books 91/087 issue 1/'98 or 91/088", issue 1/'98, being an integration and not a substitution of such manual.

### 1.1.2

Particularly, the present guide is furnished in observance to how much prescribed in the paragraph 4.3 of the norm about the EMC (Electromagnetic Compatibility: you see point 2.1.1) of the adjustable speed electrical power drive systems [7]<sup>1</sup>.

### 1.1.3

Purpose of the present guide is that to update the "Manual Instructions 91/087 or 91/088" to the light of the in force Directive EEC in subject of Electromagnetic Compatibility and safety for the so-called Low Voltage materials; particularly, to furnish prescriptions and indications about the EMC to the operators (see the paragraph 5) that they use the converters of the Series PWM to realize installations with varying speed d.c. or brushless motors; to such intention it is recalled the attention on the fact that is necessary, for the performer of the driving<sup>2</sup>, to coordinate the content of the present guide with the guide EMC of the builder of the motor, that is joined to the converters of the Series PWM

# 2 - Reference to the equipments

## 2.1 Call to some definitions

In the norm [7] and in the dictionary [11] the relative terms to the electric power drives have been defined; since these definitions have a non negligible value from the technical-contractual point of view, we think useful to bring later the most important.

### 2.1.1

**ELECTROMAGNETIC COMPATIBILITY (EMC):** the fitness of a device, of an apparatus or of a system to work in the proper electromagnetic environment in satisfactory way, without introducing unacceptable electromagnetic disturbances for other devices that are placed in such environment; in practice this expression includes the requisite is of **emission** (disturbance produced by the apparatus) and of **immunity** of the same apparatus to the environmental disturbances.

### 2.1.2

**EQUIPMENTS:** all the electric and electronic devices, as well as the apparatus, the systems and installations containing the electric or electronic component.

### 2.1.3

**ELECTROMAGNETIC DISTURBANCE:** the electromagnetic phenomenons that can alter the operation of a device of an equipment or of a system.

### 2.1.4

**IMMUNITY:** the fitness of a device, of an equipment or of a system to work in presence of electromagnetic disturbances without prejudice for its performances.

<sup>1</sup> The relative bibliographical references to the directives, to the norms and to other remarkable documents, listed in the paragraph 3, they are brought in the text between square bracket.

<sup>2</sup> For the relative definitions to the drivings see at the paragraph 2.2.

### 2.1.5

**POWER DRIVE SYSTEM PDS** (reference to the Fig. 1): an electric power drive is a system that convert electric energy in mechanical energy, with the use of electronic power equipments, in accord with a function of command (and according to an established program).

A Power Drive System is essentially constituted by:

- a **COMPLET DRIVE MODUL, CDM** that comprise the whole driver with exception of the motor and the sensors builted in the motor; particularly it comprise Basic Drive Modul **BDM** and its possible extensions like the section of feeding or some auxiliary ones (f.e. ventilation). The BDM includes the functions of conversion, control and self protection. In the practice the CDM is often called, for brevity, **Converter**.
- a Group Motor.

### 2.1.6

**APPARATUS**: end product with an intrinsic function for the final consumer, destined to be putted on the market like single commercial unity.

### 2.1.7

**SYSTEM**: Assembly of more apparatuses combined in such way to realize a specific objective and destined to be putted on the market like a single commercial unity.

### 2.1.8

**INSTALLATION, INSTALLED SYSTEM**: Assembly constituted by more apparatuses and/or systems combined in such way to realize a specific objective but destined not to be putted on the market like single commercial unity.

### 2.1.9

**UNRESTRICTED DISTRIBUTION**: Mode of sales distribution in which the supply of equipment is not dependent on the EMC competence of the customer or the user for the application of drives. This implements restrictive emission limit in accordance with essential EMC protection requirements.

### 2.1.10

**RESTRICTED DISTRIBUTION**: Mode of sales distribution in which the manufacturer restricts the supply of equipment to suppliers, customers or users who separately or jointly have technical competence in the EMC requirements of the application of drives. For economical reasons, the partners should ensure the essential EMC protection requirements, for the specific installation, by choice of suitable emission class, by measurement in situ with actual conditions and by exchange of technical specifications.

### 2.1.11

**FIRST ENVIRONMENT**: environment that includes domestic premises. It also includes establishments directly connected, without intermediary transformers, to a low-voltage power supply network which supplies buildings used for domestic purposes.

### 2.1.12

**SECOND ENVIRONMENT**: environment that includes establishments other than those directly connected to a low-voltage power supply network which supplies buildings used for domestic purposes.

## 2.2 Equipments to which the guide is applicable.

The equipments to which the present guide is applicable are the CDMs (converters: you see point 2.1.5) of the **Series PWM**:

- **DCD** for driving d.c. motor;
- **BTD** for driving brushless motor.

### NOTE

The complete characteristics of the converters above mention they are brought in the "**Instruction books 91/087 or 91/088.**"

## 3 - Reference to the directives and the norms

They come here following recalled the principal normative documents, to which reference is done the text of the manual present. The calls in the text are brought between square brackets.

- [1] Community directive 89/336/EEC dated May 3 rd 1989 relative to the Electromagnetic Compatibility and subsequents modifications 92/31/EEC and 93/68 /EEC.
- [2] Decree legislative December 4 th 1992, n° 476 "Realization of the directive 89/336/EEC of the Council dated May 3 rd 1989, in subject of approximation of the legislations of States members about the electromagnetic compatibility, modified from the directive 92/31/EEC of the Council dated April 28 th 1992."
- [3] Decree legislative dated November 12 th 1996, n° 615 "Realization of the directive 89/336/EEC of the Council dated May 3 rd 1989, in subject of approximation of the legislations of States members about the electromagnetic compatibility, modified and integrated by the directive 92/31/EEC of the Council dated July 22 nd 1993, and by the directive 93/97/EEC of the Council dated October 19 th 1993". (Abrogative, except paragraph 2 of the art. 14, of the legislative decree of which at the [2]).
- [4] Directive 73/23/EEC dated February 19 th 1973, relating the approximation of the legislations of the States members about the electric material destined to be used within some limits of voltage, integrated from the Directive 93/68/EEC dated June 29 th 1993.
- [5] Law October 18 th 1977, n° 791 "Realization of the directive of the Council of the Communities European (n. 73/23/EEC) about the safety guarantees that the electric material destined to be used within some limits of voltage must possess.
- [6] Decree legislative November 25 th 1996, n° 626 "Realization of the directive 93/68/EEC in subject of marking CE of the electric material destined to be used within some limits of voltage.
- [7] Norm CEI CENELEC EN 61800-3 dated 1996-09: "Adjustable speed electrical power drive systems - Part 3:EMC product standard including specific test methods", classification CEI 22-10, issue 2861.
- [8] Norm CEI CENELEC EN 60204-1, class. CEI 44-5, "Safety of the machinery. Electric equipment of the machinery. Part 1: General rules".
- [9] Norm CEI CENELEC EN 60146-1, Class. CEI 22-7 - F.2520 and "Semiconductor converters - General requirements and line commutated converters. Part 1-1: Specifications of basic requirements".
- [10] Norm CEI EN 60146-1-3 Class. 22-8-F.2521 and "Semiconductors converters - General requirements and line commutated converters Part 1-3: Transformers and reactors".

[11] CEI CT 22 Dictionary "Electric power drives" (in progress of press).

## 4-Conformities to the directive EEC and marking CE

### 4.1 Warning

The converters defined at the paragraph 2.2 are CDM and therefore they are used in union with a motor - in the particular case a d.c.motor - to constitute a driver (PDS); The PDS is, in turn, integrated in an electric apparatus (see 5.1.2). The phenomenons EMCs are particularly sensitive to the conditions of the plant, what length of the connections, shielding of the same, connections to the PE of the plant and connection to earth. The conformity of the converters of the **Series PWM**, listed in the paragraph 2.2 and the relative marking CE, affixed on these converters, as regardj the **directive EMC**, of which to the documents [1], [2], and [3] mentioned in the paragraph 3, it does reference the norms [7], with the following precise statements.

#### 4.1.1

The converters of the Series PWM, as CDM [7],they are commercialized in regime of **restricted distribution** (see point 2.1.10); therefore the builder of the driving, and/or of the control box and/or the installer and/or the builder of the machinery and/or the final user they are competent persons about the EMC.

#### 4.1.2

The converters of the Series PWM can be utilized is in "**First Environment**" or in "**Second Environment**" (see points 2.1.11 and 2.1.12). In the case of application in First Environment it is necessary to connect a filter at the power input of the converter, as specified to the point 5.4.2.

#### 4.1.3

The converters of the Series PWM, like as component of a PDS they are sold to be included like as part in an equipment or system or installed system; therefore the operational conditions of the CDM, like as part of the PDS, and therefore of an equipment, system or installed system, **they must follow in subject of EMC how much prescribed and/or recommended in the present manual, particularly in the paragraph 5.**

#### 4.1.4

As far as required by the directives "Low Voltage", according to the documents [4], [5] and [6], the converters of the Series PWM, make reference to the norms [8], [9] and [10], however applicable.

### 4.2 Declaration of conformity

*The ALTER S.r.l. declare that, under condition specified in the present document, particulary at the paragraph 4.1, the converters (CDM) of the Series PWM, specified at the paragraph 2.2, they result in conformity with the directives community EMC [1], included the last changes, with the relative Italian legislation [5] and [6]; the applicable normative references are brought in the paragraph 3.*

*Insofar the marking CE, affixed on the converters (CDM) of the Series PWM it attest the conformity with the directive EMC and with the directive Low Voltage.*

### 4.3 Application of other directives EEC

The converters are not subject to other directives EEC, moreover those mentioned at the paragraph. They exist yet, for application requirements, calls in other directives; particulary to comply to how much in demand in the article 4 of the **Machines Directive 89/392 EEC and following changes 91/368/CEE, 93/44 EEC, 93/68 EEC, Italian legislation of actuation D.P.R. n°459 of 24/07/1996**, bring here following the declaration of the manufacturer (known also as Declaration of Incorporation).

## 4.4 Declaration of the manufacturer

*The ALTER S.r.l., according with that in demand in the Machines Directive (DM) 89/392 and following changes, with the relative Italian legislation of applicatio D.P.R. 459 dated Jule 24 th 1996, declare that the converters of the **Series PWM** must be installed according to the contained instructions in the relative manuals and they must not to start up to that the machines in which will be incorporated has not been declared conforming to the directive DM here mentioned.*

## 5 - EXECUTION OF THE INSTALLATION

### 5.1 General indication

#### 5.1.1

We refer in these paragraphs essentially to the dispositions of installation details according with the electromagnetic compatibility, it as phenomenons of emission, that can disturb other equipments, and as immunity to the disturbances. Very often the measures to adopt, that are recommended in this manual, serve in the two cases.

#### 5.1.2

Except very particular cases, the **converters Series PWM** are mounted into a metallic box (the so-called electric box), that contains also electric apparatuses of varied type (other electronic power converters, contactors, transformers, impedances, etc..)

**The motor** or, better, the group motor (because there could be present also other accessories like a tachogenerator, a resolver, an encoder, an electric fan, a brake, etc.) it is located to edge machine, to a certain distance from the electric box.

They exist therefore, really, two separate types of plant: what is refered to the manufacture of the electric box and the real definitive plant, that it is realized from the installer near the final customer.

### 5.2 Installation of the converter in the electric box

#### 5.2.1

The converters of the Series PWM, as brought in the Manual Instructions 91/087 or 91/088, they have degree of protection IP20. They will be put of rule into an electric box; to satisfy EMC compliance **the electric box must be metallic**, in iron plate having thickness more than 1 mm.

Besides it is important that within the electric box all the panels are united among them with mechanical connections that introduces **low electric impedance at the high frequencies**. This can be made, for example, adding clamping screws, using panels with galvanized surface or cadmium plate rather than painted or removing the paint from the points of interconnection, using special metallic gaskets.

#### 5.2.2

The **disposition of the component** interior shot the electric box, as in terms of positioning as in terms of distances, it must be performed with the criterion to minimize the mutual influences of the apparatuses

mounted to reduce the electromagnetic disturbances. Generally the transformers, the impedances, the contactors, cause of coils, can produce some field enough elevated at short distance.

### 5.2.3

**The wiring of the power circuits must** be physically separated by the wiring of the control and signal circuits; the power circuits must be carefully shielded from the signal circuits; this is possible or employing in the electric box metallic raceways, metallic sheaths or shielded cables, also for power.

### 5.2.4

Particular care in the **wiring of the signal circuits** must be set for motives of electromagnetic immunity. Needs therefore that **the connections of the signal circuits**, either in input that in output by the converter, is **realized using duplex cables braided and carefully screened**, that screen must be connected to mass from the side of the converter, as illustrated in the Fig. 2 of the present manual and -where needs - also to the mass of the peripheral party.

### 5.2.5

All the apparatuses, for which **additional devices** are prescribed for making them conforming EMC, must be provided to the norms of such devices, assembled on according to the prescriptions of the manufacturer; particularly the good norm is referred to assembly the **interferenc suppressor** 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 H.F. conducteds disturbances to assembly on the power input of some converters, when is prescribed.

### 5.2.6

The **shieldings of the cables** must finish the nearest possible to the terminal board; if is prescribed the connection of the shield to ground or, in some case to earth, it must be effected possibly by the special fairlead with 360° socket of ground and, in lack of this, by connections as short as possible and by suitable section of conductor.

## 5.3 Complete electric plant

### 5.3.1

Like we have said previously, we refer to the plant in situ, in the final installation of the machine. The electric box is physically connected to the machine for some types of machines and therefore, in practice, the electric plant in situ is been reduced to the connection of the machine to mains.

Usually, yet, the electric box he finds to a certain distance from the machine, on which is assembled the motor group; a pulpit sometimes exists also for remote control, to which some conductors could be connected.

In this case, since the emission problems are very tied up to factors of plant, the recommendations that follow are dictated from norms of good technique and from experiences on the field and they must be take essentially as lines guide and not as solutions.

### 5.3.2

**The three phase MV/LV transformer** of the line to which the converters of the Series PWM are connected must be of suitable apparent power of the supplied load keeping track of the power factors and the distorsion factors.

NOTE

For the particular application to the converters Series PWM you see the paragraph 5.4.

### 5.3.3

**The copper section of the connection from mains** to the terminal board of the converter (to see the schemes "External connections of converters" to the Pag. 10 of the Instruction book 91/087 for DCD and to the Pag.10-11-12-13 of the Instruction book 91/088 for BTD) it must be proportioned to the rating current of every converter. The calculus must be made in such way to avoid a voltage drop that can bring the feeding

voltage values out of contractual tolerance.

Besides it is opportune to study the runs of the cables of the plant carefully minimizing the length.

#### 5.3.4

All the metallic raceways, the metallic scabbards and, generally, all the shieldings, except that is not specified otherwise, they must be connected to the PE as at the electric box side as the motor side; these connections must be of section largely dimensioned and very short.

### 5.4 Specific indications for the Series PWM

#### 5.4.1

The converters of the Series PWM don't require, in general, particular formalities of assembly and installation over normal professionalism and knowledge of the rules of the art of the sector system, electrotechnical and electronic.

In every case it is necessary to follow how much prescribed or recommended in the "Instruction book 91/087 issue 1/'98 or 91/088", issue 1/'98, and in the present one "Integrative Guide."

In the present paragraph they are brought some specific indications for the installation of the series in object, as far as it concern the directive EMC and Low Voltage.

#### 5.4.2

The schemes of connection brought in the "Instruction book 91/087", issue 1/'98, at Pag. 10 for the model DCD and in the "Instructions book 91/088" issue 1/'98, at Pag.10-11-12-13 for the model BTD must be **integrated with the schemes of connection brought in the manual present at the Fig. 2**. The scheme brought in such figure contains important practical instructions as about the type of necessary wiring to respect the norms EMC, as about the formalities of connection of the shields to the converters of the series PWM.

When the converters of the Series PWM are employed in **First Environment**, in reference to how much brought in the point 4.1.2, it is necessary to install a **filter of net** toward the mains; also the connections of the filter are suitable at the Fig.2.

In the Table 1 is brought the code of the three phase filters to employ when is used the scheme of Fig. 2.

TABLE 1

N.	CURRENT (duty S1) OF CONVERTERS DCD and BTD	CODE OF THE THREE PHASE FILTER
1	6A	23/001
2	10A	23/001
3	15A	23/001
4	20A	23/001
5	30A	23/002
6	40A	23/002
7	50A	23/003

In the wiring of the connections brought in the Fig. 2 must be observed the following rules.

#### Attention!

- It is necessary to keep in mind that the run of the cables, their length, their shielding and the connection of the shield to an opportune ground of the converter they are **essential to the EMC**.
- The **location of the filter** is very important: it must be put, interior shot the electric box, the nearest possible to the component connected to its output. In the Fig.2 such component it is the three phase transformer **TR1**.

- The **length of the connections** between the output of the filter and the input of the component connected to the output **should not overcome 0,3 m.** and it must be made with conductors, with suitable section and shielded however possible. It is evident that, in certain cases, it won't be possible to shield component like fuses and contactors; to great reason it is necessary that the runs of the connections are shortest as possible.
- **Attention! The input and the output of the filter can not be exchanged!**
- The connections of ground of the converter have been multiplexed to make more functional the wiring; four point of ground of the converter exist, marked from the signature E1, and E2. To see the scheme of Fig. 2.
- E2 it is the anchorage of the shields of the signal cables, that they are not brought in the figures of the present guide, but they appear in the scheme at Pag.10 of the "Instructions book 91/087", issue 1/'98, for DCD at Pag.10-11-12-13 of the "Instructions book 91/088", issue 1/'98, for BTB.
- **Attention!**
- **E1** it is the principal ground that it must be connected to the PE and therefore to the earth of the plant, with cable having section not less than the cable used for three phase power supply connection. **This connection is essential for the purposes of protection and not only for the purposes EMCs!**
- The **terminal of ground of the metallic container of the filter**, must be connected like suitable in Fig.2.
- All the connections to the common ground of the electric box must be short and of opportune section; the PE of the electric box must be connected to a **good earth clamp**.

#### 5.4.3

It is seen you, in the paragraph 5.3.2, that the three phase MV/LV transformer of establishment must have an apparent suitable power (kVA); remembers that in the Series PWM it is **required the use of a three phase transformer** for the principal feeding R, S, T.

It is made notice that to the secondary one of this transformer can be connected also other converters PWM. It is however important to notice that also this transformer, and therefore the filter, must have suitable power to that of the converters supplied; it is necessary to take account that the voltage drop of the transformer, from no load to full load it must be less than 3%.

#### 5.4.4

To comply to how much prescribed in the directive Low Voltage and in the norms that to these can make reference, we bring here following some **dispositions about safety** of use of the converters of the Series PWM.

##### 5.4.4.1

#### **Attention!**

For any reason must enter at the interior shot of the converter when it is feeded. To enter must be **surely disconnected the principal feeding** (terminals R, S, T) three phase, the service feeding (terminals 220V), every other feeding having voltage value up 50 V a.c. and 75 V d.c. and to **attend at least 15 minutes**. Interior shot of the converter they are **present dangerous voltages when it is feeded!**

##### 5.4.4.2

Since the converters of the Series PWM are suitable (see point 5.1.2) to be assembled in the electric apparatus of the machine, containing eventually also other apparatuses, the **device of dissection of the feeding having manual control**, required from EN60204-1 § 5.3.1 4, it must be **provided and climbed on by the builder of the machine**.

##### 5.4.4.3

**The functions of stop**, as prescribed from EN 60204-1, § 9.2.2, **particularly the stop of category 0, must be made by the builder of the machine**, in how much specific of the machine control, also using eventually the logical signals in input and output of the converters, as brought in the Instruction book 91/087 or 91/088.

5.4.4.4

**Attention!**

**The emergency stop**, according with EN60204-1, § 9.2.5.4, **must** be provided according with the specific characteristics of the machine and therefore **it must be made by the builder of the machine within** the electric apparatus of the machine.

5.4.4.5

Observing the instruction contained in the “Instructions book 91/087 or 91/088”, **from the point of view of safety it is important to follow the relative prescriptions about the value and the type of protections (fuses) prescribed.**

5.4.4.6

In relationship to the 7 sizes of current for every model of the converters of the Series PWM, with current from 6A to 50A, it is necessary to **adopt some conductors section** for the power connection of the converter to the line and the motor **such to get density of current according to the general prescriptions of plant.**

In the case of the converters of the Series PWM it is necessary besides to keep in mind that **an ability of overload of 100 %**, obviously limited in the duration, but of which is necessary to hold account in the sizing of the cables section, not so much for thermal motives, how much because doesn't verify them, during the overload, inadmissible voltage drops.

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INSTALLATION or part of installation  
*INSTALLAZIONE o parte di installazione*

**Power Drive System (PDS)**  
*Azionamento Elettrico*

**CDM (Complete Drive Module)**  
*Gruppo di alimentazione, conversione e controllo*

System control and sequencing

**BDM (Basic Drive Module)**  
*Modulo di conversione e controllo*

Control  
Converter  
and Protection

Feeding section  
Field supply  
Auxiliaries  
Others

**Motor and sensors**  
*Motore e sensori*

**Driven equipment**  
*Apparecchiatura azionata*

Fig.1

