DRIVE SYSTEMS with 8C SERIES Brushless Servomotors and 500 Series BIVECTOR Converters

In compliance with EEC Directives and CE marking

Installation, Commissioning and Use Manual

First Part: Installation

Ref. MANIU10.9906 GB
Update 01
Issue September 1999

ABB Servomotors S.r.l.

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ABB Servomotors S.r.l.
Registered office: piazzale Lodi, 3 I 20137 Milano
Headquarter, Offices and Plant:
Frazione Stazione Portacomaro 97/C
I 14100 ASTI

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CHAPTER 1 – INTRODUCTION

1.1 Preliminary note

This manual describes the drive systems[1] made by the **500 Series BIVECTOR** digital converters and the **8C Series** brushless servomotors. It was prepared by ABB Servomotors S.r.l. and it must only be used by its customers, who use it under their own responsibility. No further warranty, except what established by contract, will therefore be offered by ABB Servomotors, especially for any defect and/or lackness of the text, and all responsibilities are expressly excluded for direct or indirect damage, however caused by the use of the present document.

For a correct installation and commissioning of the drive systems, made of the 500 Series BIVECTOR converters and the 8C Series servomotors, it is necessary to thoroughly follow what is described in the present manual.

Since this manual covers different issues concerning Electromagnetic Compatibility (EMC), note that the related terminology is extracted from the standard quoted in item [8], Section 1.2.[2]. Fig. 1-1 (extracted from the same publication) briefly describes the drive system and its parts, as well as its physical limits related to its use in an installation or in a system.

Fig. 1-1: Block diagram of the installation and the power drive systems (PDS)

It is anyway better to report below definitions of some terms concerning the EMC field, particularly important as far as contract is concerned.

UNRESTRICTED DISTRIBUTION [8]: Mode of sales distribution in which the supply of equipment is not dependent on the EMC competence of the customer or user for the application of drives. This implements restrictive emission limits in accordance with essential EMC protection requirements.

RESTRICTED DISTRIBUTION [8]: 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 boundary conditions and by exchange of technical specifications.

[1] For definitions related to power drive systems, used in this manual, see the CEI 301-1 (1997-10) document, Issue 3977 “Azionamenti elettrici – Dizionario” (Power drive systems – Dictionary); this document also reports the corresponding English term for each item.

[2] All the bibliographic references are called with a number in brackets.

FIRST ENVIRONMENT [8]: Environment that includes domestic premises. It also includes establishments directly connected without intermediate transformers to a low voltage power supply network which supplies buildings used for domestic purposes.
SECOND ENVIRONMENT [8]: Environment that includes all establishments other than those directly connected to a low voltage power supply network which supplies buildings used for domestic purposes.

1.2 Reference and standard documents

The main documents (European directives, related Italian legislation of implementation, normative documents) to which the text of this manual refers are indicated below. The references in the text are reported between brackets.

1.2.1 Electromagnetic Compatibility (EMC) Directive

[1] Directive 89/336/EEC, “On the approximation of the laws of the Member States relating to electromagnetic compatibility” and the subsequent amendments 92/31/EEC and 93/68/EEC.

[2] Italian Legislative Decree, 4 December 1992, No. 476 “Attuazione della direttiva 89/336/CEE del Consiglio del 3 maggio 1989, in materia di ravvicinamento delle legislazioni degli Stati membri relative alla compatibilità elettromagnetica, modificata dalla direttiva 92/31/CEE del Consiglio del 28 aprile 1992” (Directive 89/336/EEC, “On the approximation of the laws of the Member States relating to electromagnetic compatibility” and the subsequent amendments 92/31/EEC and 93/68/EEC).

[3] Italian Legislative Decree, 12 November 1996, No. 615 “ Attuazione della direttiva 89/336/CEE del Consiglio del 3 maggio 1989, in materia di ravvicinamento delle legislazioni degli Stati membri relative alla compatibilità elettromagnetica, modificata ed integrata dalla direttiva 92/31/CEE del Consiglio del 22 luglio 1993 e dalla direttiva 93/97/CEE del Consiglio del 29 ottobre 1993” (Implementation of the directive 89/336/EEC, 3 May 1989, “On the approximation of the laws of the Member States relating to electromagnetic compatibility” changed and integrated by the Directive of the Council 92/31/EEC, 22 July 1993 and by the Directive of the Council 93/97/EEC, 29 October 1993).
IMPORTANT NOTE: This Legislative Decree repeals the Legislative Decree [2], excepting article 14, sub-section 2.

1.2.2 Low Voltage Directive

[4] Directive 73/23/EEC, 19 February 1973, “Harmonization of the laws of Member States relating to electrical equipment designed for use within certain voltage limits”, integrated by the Directive 93/68/EEC, 29 June 1993.

[5] Italian Law 18 October 1977, No. 791 “Attuazione della direttiva del Consiglio delle Comunità europee (n. 73/23/CEE) relativa alle garanzie di sicurezza che deve possedere il materiale elettrico destinato ad essere utilizzato entro taluni limiti di tensione” (Directive 73/23/EEC, 19 February 1973, “Harmonisation of the laws of Member States relating to electrical equipment designed for use within certain voltage limits”, integrated by the Directive 93/68/EEC, 29 June 1993).

[6] Italian Legislative Decree, 25 November 1996, No. 626 “Attuazione della direttiva 93/68/CEE in materia di marcatura CE del materiale elettrico destinato ad essere utilizzato entro taluni limiti di tensione” (Implementation of the Directive 93/68/EEC concerning the CE marking of electric material designed for use within certain voltage limits).

1.2.3 Normative references

[7] CEI EN 60204-1, issue 98/04, Fascicolo 4445 “Sicurezza del macchinario. Equipaggiamento elettrico delle macchine. Parte 1: Regole generali”. (Safety of machinery - Electrical equipment of machines - Part 1: General requirements.)

[7 bis] IEC 61800-2, First edition 1998-03, "Adjustable speed electrical power drive systems - Part 2: General Requirements - Rating Specifications for low voltage adjustable frequency a.c. power drive systems".

[8] CENELEC EN 61800-3, Adjustable speed electrical power drive systems - Part 3: EMC product standard including specific test methods.

Documents [7], [7bis] and [8] include very detailed lists concerning the regulatory references.

[9] CENELEC EN 60034-1, Rotating electrical machines - Part 1: Rating and performance.

[10] CENELEC EN 60034-5, Rotating electrical machines - Part 5: Classification of degrees of protection provided by enclosures of rotating electrical machines (IP code).

[11] CENELEC EN 60034-7, Rotating electrical machines - Part 7: Classification of types of constructions and mounting arrangements (IM code).

[12] CENELEC EN 60034-9, Rotating electrical machines – Part 9: Noise limits.

[13] CENELEC EN 60034-18, Rotating electrical machines - Part 18: Functional evaluation of insulation systems - Section 1: General guidelines.

1.3 Compliance with EEC Directives and CE marking

*1.3.1 Conditions for compliance with EMC Directives of the drive systems composed by the **500 Series BIVECTOR** converters and **8C Series** servomotors.*

The compliance of the drive systems, defined in the title of this section, with the directives and/or legislative provisions [1], [2] and [3], related to the Electromagnetic Compatibility, are only valid under the following conditions.

1.3.1.1

The drive systems defined in the title of this section are only delivered as PDS (Complex component), **“Restricted distribution”** Class, and only sold to professional assemblers to be included as part of a system or of an installation. The actual EMC behaviour is under the responsibility of the equipment manufacturer of the system or of the installation, to which the specific standards apply.
Therefore the CE marking, placed on the converter and the servomotor, only certifies the compliance of the said components with the directives and the laws specified in section 1.2.2. “Low Voltage Directive”.

1.3.1.2

The drive systems specified in the title of this section must be **installed according to the instructions contained in Chapter 3 of this manual**; provisions indicated in section 1.5 **“Application guide to Electromagnetic Compatibility”** must also be strictly followed.

1.3.1.3

The drives defined in the title of this section are intended for use in the **“Second Environment”** and in the **“First Environment**”, remembering the following caution.

CAUTION

- The drives with 500 Series BIVECTOR converters size S, type 3, 5 and 9 (see Table 2/1 in Chapter 2) can be used in both environments without input filters for conducted emissions, because they comply inherently with the EMC Directive.

- If the drives with 500 Series BIVECTOR converters size M1, type 13 and 18 and size M2 type 25 (see Table 2/1 in Chapter 2) have to be used in the "First Environment", the professional assembler must follow the precautions described in section 3.4.2.3, Chapter 3, and he must install filters on the power supply line.

1.3.2 Compliance of the drive systems with the Directives

Declaration of Conformity
ABB Servomotors declares that, under the conditions specified in this document, in particular in section 1.3.1, the drive systems composed of the **500 Series BIVECTOR converters** and **8C Series servomotors** comply with EMC European Directives [1], including the most recent changes, with the related endorsement Italian legislation [2] and [3], and with the Low Voltage European Directives [4], [5] and [6]; the applicable regulatory references are indicated in section 1.2.3.

1.3.3 Note for the application of other EEC Directives

Since drive systems are complex electrical components, they are not subject to other EEC directives, apart from those specified in section 1.2. As far as the **89/392 EEC Machine Directive and subsequent changes 91/368/EEC, 93/44 EEC, 93/68 EEC, Italian legislation for implementation of the Presidential Decree No. 459, 24 July 1996**, the Certificate of Incorporation (also known as "Manufacturer's declaration") is sometimes required, although various experts believe it is not relevant.

Certificate of Incorporation
ABB Servomotors, according to what required in the Machine Directive (MD) 89/392 EEC and subsequent changes, declares that the drive systems, composed of the **500 Series BIVECTOR converters** and **8C Series servomotors**, must be installed in accordance with our installation instructions and must not be put into service until the machinery into which it is to be incorporated has been declared in conformity with the Machinery Directive.

1.4 References to safety regulations

1.4.1 Safety symbols

In this document the following symbols are used:

1.4.1.1

WARNING! This symbol signals a situation that could cause serious harm to human life or serious machine or system damage. This is the most important alarm level. It is **absolutely necessary** to follow the instructions indicated by symbols 1.4.1.2 and 1.4.1.3!

1.4.1.2

WARNING! Dangerous voltage: it signals dangerous situations, according to subsection 1.4.1, caused by electrical voltages.

1.4.1.3

WARNING! Generic danger: it signals dangerous situations, according to subsection 1.4.1, not caused by electrical voltage.

1.4.1.4

CAUTION This symbol is used to signal a lower danger level than the one indicated by “WARNING!”. Situations signaled by this symbol could result in minor injuries to human body or things.

1.4.1.5

NOTE Sections indicated in this way contain specific warnings, that have always to be taken into consideration in the commissioning and operation of the drive systems.

1.4.2 Reference to safety regulations

1.4.2.1 Installation operations

WARNING! Troubleshooting and, in general, maintenance work on the drive system should be carried only by qualified personnel.

Personnel must refer to the specific documentation supplied by ABB Servomotors, and in particular to this manual.
For no reason should an unskilled operator work on the terminal block of the converter or open the servomotor connection box.

1.4.2.2 Residual voltages

WARNING! The BIVECTOR converter contains high capacity capacitors which, for functional reasons, can not always be discharged in less than 5 seconds following a power outage.

For no reason should any person access the internal part of the converter, before at least two minutes from the power outage.
Potentially lethal voltages are present on a DC intermediate circuit and on the associated circuits!
On the 500 Series BIVECTOR converter, an appropriate warning placed in a visible place warns of this danger, according to EN 60204-1 § 6.2.4.

1.4.2.3 Disconnecting device on the power supply

WARNING! Since the converter must be integrated in an electrical control cabinet, which may contain other equipment, the **manual control power supply disconnecting device**, required by EN 60204-2 § 5.3.1, can be shared by all the electrical control cabinet and must be, in any case, installed **by the machine manufacturer**.

1.4.2.4 Stop function

WARNING! According to EN 60204-1 § 9.2.2, the **stop functions**, in particular **the 0 category stop, must be prepared by the machine manufacturer**, following the instructions contained in this manual, because they are inherent to the machine logic, which is obviously different according to the drive machine type.

1.4.2.5 Emergency stop

WARNING! According to EN 60204-1 § 9.2.5.4, even the **emergency stop** must be a function of the specific characteristics of the operated machine and therefore it **must always be made by the machine manufacturer**.

1.4.2.6 Protection degree of drive system components

For the protection degree of the 8C Series servomotors see subsection 3.3.1 Chapter 3 (according to EN 60034-5).
The 500 Series BIVECTOR converters have an **IP20 protection degree**; to comply with section 4.4.6 “Contaminates” of the EN 60204-1 standard, the machine manufacturer must install the converters in an appropriate housing (electrical control cabinet), according to the protection degree required.

1.5 Guidelines on the application of electromagnetic compatibility

1.5.1

This section applies to prescriptions specified in subsection 1.3.3 concerning the standard about electromagnetic compatibility for drive systems [8].

1.5.2

The need to follow precise rules as far as EMC is concerned, is due to the increasing use of electronic power units, which, for the used techniques, represent a noise source in a wide frequency range (**emission**). These devices are at the same time sensitive to noise produced by other devices; for this reason they must be provided with an adequate **immunity** level.

1.5.3

Noise is conventionally classified as **low frequency** (0 = < f < 9 kHz) and **high frequency** (f > 9 kHz) noise.
In the range of the low frequency noise, the **harmonic frequency** phenomena of the power supply line frequency are particularly important.
There are also **large spectrum** events, such as electrostatic discharges in the air or by contact.

1.5.4

Noise can be transmitted both through conductors (**<conducted noise>**; conducted emission: 0,15 MHz ÷ 30 MHz) and through irradiation (**<irradiated noise>**; irradiated emission: 30 MHz ÷ 1000 MHz).

1.5.5

Industrial experience showed that the main causes of compatibility lack are caused by conducted noise.

1.5.6

The drive system installation must be carried out by closely following the instructions contained in Chapter 3.

1.5.7

For electromagnetic compatibility, the installation must be carried out following some appropriate instructions; the most important follows.
Apart from some very specific cases, the **500 Series BIVECTOR converter** is enclosed into a metal cabinet (the so-called electrical control cabinet), also containing different kinds of electrical equipment (other power electronic converters, contactors, transformers, chokes, etc.).
The motor assembly, including the **8C Series** servomotor and the **resolver** angle position transducer, as well as the motor thermal switch and - where necessary - the brake, is usually mounted on the machine at a certain distance from the electrical control cabinet.
There are actually two different types of installations: the one referring to the electrical control cabinet manufacture and the actual on-site installation, which is carried out by the installer at the premises of the final user.

1.5.8 Electrical control cabinet

According to the EMC, it is important to keep in mind some important prescriptions for the electrical control cabinet, which are listed in the following subsections.

1.5.8.1

The arrangement of the components within the electrical control cabinet, both in terms of positioning and distances, must be carried out to minimize the mutual influences of the equipment mounted for the electromagnetic noises.
As an example, note that some types of transformers, power chokes or also contactor coils can generate rather strong fields at short distance.

1.5.8.2

The power circuit wirings must be physically separated from the driving and control circuit wirings (signal circuits); the power circuits must be carefully shielded against signal circuits; this can be achieved by using metal wire channels and metal sheaths or shielded cables, even power cables, arranged within plastic channels.
As an example, the power circuits (cables provided with U, V, W, R1, R2, R3, R, S, T, 230 V~ end terminals, as shown in Fig. 3-2, Chapter 3) must be physically separated, in the above mentioned way, from the cables provided with end terminals or connectors with signal cables, such as DIGITAL I/O, RESOLVER, etc.

1.5.8.3

All the equipment, for which supplementary units are prescribed in order to comply with EMC standards, must be provided with these units, mounted according to the manufacturers prescriptions.
Example: anti-noise units to be mounted in line with AC contactor coils, diodes to be installed in parallel with relays or DC coil contactors, filters against high frequency conducted noise to be mounted at the line input of some converters.

1.5.8.4

Cable shields must end as close as possible to the terminal block; if the shield has to be connected to ground or sometimes to earth, the connections must be as short as possible and the conductors must have an adequate section.

1.5.8.5

Within the electrical control cabinet, it is important that all the panels are connected one to the other with mechanical connections and that they have low electrical impedance at high frequencies.
As an example, to achieve this connection, it could be necessary to add locking screws, remove the paint in the interconnecting points and use special EMC metal gaskets.

1.5.9 Electrical equipment

As stated in section 1.5.7, we refer to the on-site installation, in the final installation of the machine. For some types of machines (such as small machine tools), the electrical control cabinet is physically connected to the machine and therefore the on-site electrical equipment is reduced to the connection of the machine to the power mains. Nevertheless, the electrical control cabinet is usually placed at a certain distance from the machine, on which the motor assembly is mounted; sometimes there is also a remote control desk, to which conductors could be connected.
In this case, since the emission problem is strictly linked to installation factors, the following recommendations come from good technique standards and from experience in field and must be basically considered as guidelines and not as sure solutions.

1.5.9.1

For use in a "Second Environment", i.e. industrial environments where the low voltage network does not feed residential buildings, it is necessary to follow the instructions as per section 1.5; If the drive system is used in a "First Environment" and for the sizes listed in subsection 1.3.1.3, Chapter 1, the solutions prescribed in subsection 3.4.2.3, Chapter 3, have to be adopted.

1.5.9.2

(This point is cancelled).

1.5.9.3

The connections in the electrical control cabinet from the MAINS (R,S,T) terminal block of the 500 Series BIVECTOR converter and the mains circuit breaker (see subsection 1.4.2.3) **as well as the connection lines from this device and the secondary of the medium voltage transformer of the plant must avoid voltage drops which can get the power supply voltage values at converter terminals out of contractual tolerance.**

1.5.9.4

Sometimes, the low tension power factor compensation systems of the power supply line can cause problems, with possible resonances.

1.5.9.5

Carefully study the installation cable routes, minimizing length.

1.5.9.6

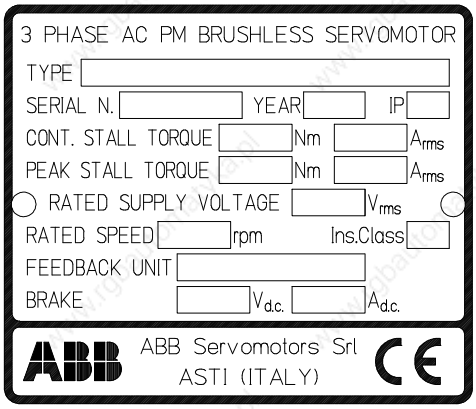
All the metal channels and sheaths and, in general, all the shields, if not otherwise specified, must be earthed both on the electrical control cabinet side and on the motor side; the earthing connections must have a largely dimensioned section and their route must be as short as possible.
This is an EMC specific need, which can seem in contrast with what is often prescribed, that is to say the need to earth shields at only one side; this prescription requires very efficient earths.

1.6 References for technical assistance

1.6.1 Preliminary warning

NOTE This "Installation and Use Manual" is intended for use by the manufacturer of the electrical control cabinet, the installer and the final user. In the text, it is sometime recommended to contact the Customer Service, as described in section 1.6.4. Refer to the Customer Service for any problem that arises or in case of troubles; remember that you always have to provide the serial number (S.N.) of basic components (see section 2.1, Chapter 2). This is to accelerate troubleshooting as much as possible in order to remove faults.
Except for special cases, any repair work must be carried out by qualified personnel.

1.6.2 Servomotor nameplate



1.6.3 Converter nameplate

ABB Servomotors S.r.l. ASTI -ITALY CE			BIVECTOR *AC / AC CONVERTOR*	
PART NUMBER			S. N.	
FOR MOTOR TYPE			YEAR	
RATED IN. VOLTAGE	V 3ph. 50/60 Hz		RATED IN. CURRENT	A (rms)
AUX. IN. VOLTAGE	V 1ph. 50/60 Hz			
RATED OUT. VOLTAGE	V (rms) 3ph.		RATED OUT. CURRENT	A (rms)
RATED OUT POWER	kVA			
FACTORY LEVEL	HW	SW	D.	S.
LEVEL UPGRADE	HW	HW	D.	S.
	SW	SW	D.	S.

Note For lack of space, some data related to the converter are not contained in the nameplate. Refer to section 2.4 “500 Series BIVECTOR (CDM) converter specifications”, Chapter 2.

1.6.4 Customer Service

For any doubt, service or spare part inquiry, contact:
ABB Servomotors S.r.l.
Customer Service
Frazione Stazione Portacomaro, 97/C
I – 14100 ASTI (ITALY)
Tel. +39 (0141) 276.111
Fax +39 (0141) 276.294

CHAPTER 2 – THE DRIVE SYSTEM AND ITS COMPONENTS

2.1 Basic components

According to CEI/CENELEC definitions, the power drive system includes:

a) BDM/CDM electronic converter; in our case: 500 BIVECTOR;
b) motor assembly, including the motor and the built-in transducer; in our case: 8C Series servomotor.

2.2 Additional components

As shown in the diagram in Fig. 3-2, Chapter 3, the system or the installation are provided with the following additional components:

c) line automatic circuit breaker or breaker + line fuse;
d) power and signal connecting cables;
e) external braking resistor (see section 3.4.2.4, Chapter 3);
f) hand-held Key-B type keyboard and/or PC (if necessary, both the components must be used only in the installation and commissioning phase, or for troubleshooting).

Note: The c) to f) components are not part of the drive system scope of supply. They can be required as separate material. Please contact the Customer Service (see subsection 1.6.4, Chapter 1).

2.3 Optional components

As well as the above mentioned components, some other components can be supplied on request.

2.3.1 Mains filters

Only for the application in a “First Environment” and for some sizes of 500 Series BIVECTOR converters (see items 3.4.2.4, Chapter 3) it is necessary to use filters for high frequency conducted emissions which must be installed on the three-phase power supply of the mains. See item 3.4.2.3, Chapter 3.

2.3.2 Servomotor’s Brake

For particular applications, the motor assembly may be provided with an electrically-driven brake, which mechanically acts on the servomotor shaft and whose construction is integrated in the motor assembly structure. See item 3.4.2.6, Chapter 3.
Do not confuse this mechanical-action brake with the electronic unit for the control of the converter intermediate DC voltage circuit, allowing for the dissipation of electric power generated by the servomotor during electric braking on the resistor; this part of the electronic circuit is often simply called “braking”.
The servomotor’s brake can be considered as a “parking and emergency brake” because its main functions are to lock the motor shaft when there is no electric power supply to the converter and to brake in emergency cases. In case of axial loads on the motor shaft, please contact the Customer Service.

2.3.3 Different options

Options for fieldbus communication are available.
For any specific need, please contact the Customer Service.

2.4 500 Series BIVECTOR (CDM) converter specifications

500 Series BIVECTOR is a last-generation converter, being part of the so-called category of "smart converters". Actually many functions that were previously obtained by using external controllers are now directly implemented in the converter.

Table 2/1

500 Series BIVECTOR Size		**S**			**M1**		**M2**
Type		**3**	**5**	**9**	**13**	**18**	**25**
Power supply: phase to phase rated voltage U_{VN}	[V_{RMS}]	Three-phase 400 V -15% ÷ 440 V +10% 50/60 Hz					
Auxiliary power supply U_{AUXNN}	[V_{RMS}]	Single-phase, 230 V ±10%, 50/60 Hz					
Rated input current I_{VN}	[A_{RMS}]	3,8	5,7	9,4	13,8	19	26,5
Rated output voltage U_{aN1}	[V_{RMS}]	Three-phase, 400 V					
Output continuous current I_{aN}	[A_{RMS}]	3,5	5,3	8,8	13	18	25
Output continuous power @ U_{VN} = 400 V	[kVA]	2,4	3,6	5,5	9	12,4	17,3
Output continuous power @ U_{VN} = 440 V	[kVA]	2,6	4	6	9,9	13,7	19
Overload time @ $I_{aM} = 2 \times I_{aN}$	[s]	1,8					
Power dissipation @ I_{aN} (excluding possible brake internal resistor)	[W]	100	130	180	270	360	485
Ambient temperature	[°C]	+5 ÷ +40					
Maximum ambient temperature	[°C]	55					
Derating in the 40÷55 °C range	[%/ °C]	2,5					
Humidity	[%]	max 85 (condensation is not allowed)					
Altitude	[m a.s.l.]	1000					
Maximum altitude	[m a.s.l.]	2000					
Derating in the 1000 ÷ 2000 m a.s.l. range	[%]	1% every 100 m					
Weight	[kg]	4,6			8,6		10,5
Dimensions		See Fig. 3-1b					

Table 2/2

01	Processor	HITACHI H8/3003
02	IGBT	IPM module
03	Switching frequency	10 kHz
04	Encoder emulator	Configurable: pulses/rev., width and position of the North Marker
05	Multiturn positioner	Absolute, time optimal based
06	Synchronization (high dynamic)	Phase control, variable gear ratio
07	Special functions	"On-fly" tables change, homing, jog, limit switch protection (hardware and software)
08	Autotuning functions	currently being prepared
09	Digital and analog inputs	10 digital inputs (2 dedicated and 8 configurable), 2 differential analog inputs
10	Digital and analog outputs	7 digital outputs (1 relay and 6 configurable), 2 analog outputs
11	Serial interface	RS232 / RS485

Table 2/1 indicates the size and some features of power section, while Table 2/2 specifies some technical performance of the series. As far as U_{VN} power supply voltage is concerned, note that power supply source should have a maximum value of the internal impedance such as to allow the power supply voltage at converter terminals, under overloading conditions, not to be less than 360 V. For the meaning and the use of functions, listed in Table 2/2, see the Second Part of this manual.

2.5 8C Series brushless servomotors specifications

2.5.1 General features

The 8C Series servomotors are high performance 6-pole brushless servomotors with rare earth permanent magnets (neodymium, iron, boron). Each motor assembly, used in the drive systems described in this manual, is not only made of the **8C Series servomotor**, but also of a **brushless/frameless resolver** (integrated mounting on the servomotor), of a **temperature sensor** and, only as an option, of a **brake**.
Other features are described in the notes to Table 2/5.

2.5.2 Some usage notes

During the use of all servomotors, pay special attention to mechanical aspects; to better use 8C Series servomotors, Table 2/3 indicates axial and radial loads for each servomotor, which must not be exceeded in order to guarantee a regular lifetime of 20,000 hours in continuous duty of the bearings with permanent lubrication. In general, the locked bearing is mounted on the motor front-side. The configuration related to the load application is shown in Fig. 2-1.

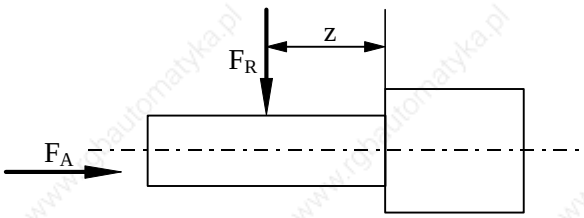


Fig. 2-1: Axial and radial loads on motor shaft

Table 2/3

Servomotor type	Speed [rpm]		Sealed bearing type		Radial load F_R [N]		Axial load F_A [N]		Distance z
8 SERIES	n_1	n_N	Front side (shaft end)	Back-side	@ n_1	@ n_N	@ n_1	@ n_N	[mm]
8C1	3000	6000	6004-C3	6002-C3	475	375	290	240	20
8C4	1500	3000	6205-C3	6204-C3	950	750	575	475	20
8C5	1500	3000	6207-C3	6205-C3	1750	1400	1000	850	27,5

Notes:

(1) Values for simultaneous axial stresses are available on request.

(2) Values for versions with integrated brake (special versions) are available on request.

(3) The permissible axial load values refer to the F_A force direction towards the motor; for reverse direction a reduction is necessary (values are available on request).

WARNING For motors provided with brake, if axial loads are present, please contact the Customer Service.

WARNING Taking into consideration the foreseen duration, F_R radial loads must not exceed the values indicated, even for a transient period (accelerations, decelerations). In particular, shocks caused, for example, by the assembling of mechanical parts (couplings, keys, nuts, etc.) on the shaft end are not allowed.

2.5.3 Overall dimensions

The overall dimensions drawings of 8C Series servomotors are shown in Fig. 2-2; Fig. 2-2a is referred to the version with the power connector as well as the signal connector; the Fig. 2-2b is referred to the version with the signal connector and connection box for power connections (available only for 8C4 and 8C5); the mm dimensions related to the a.m. drawings are shown in Table 2/4.

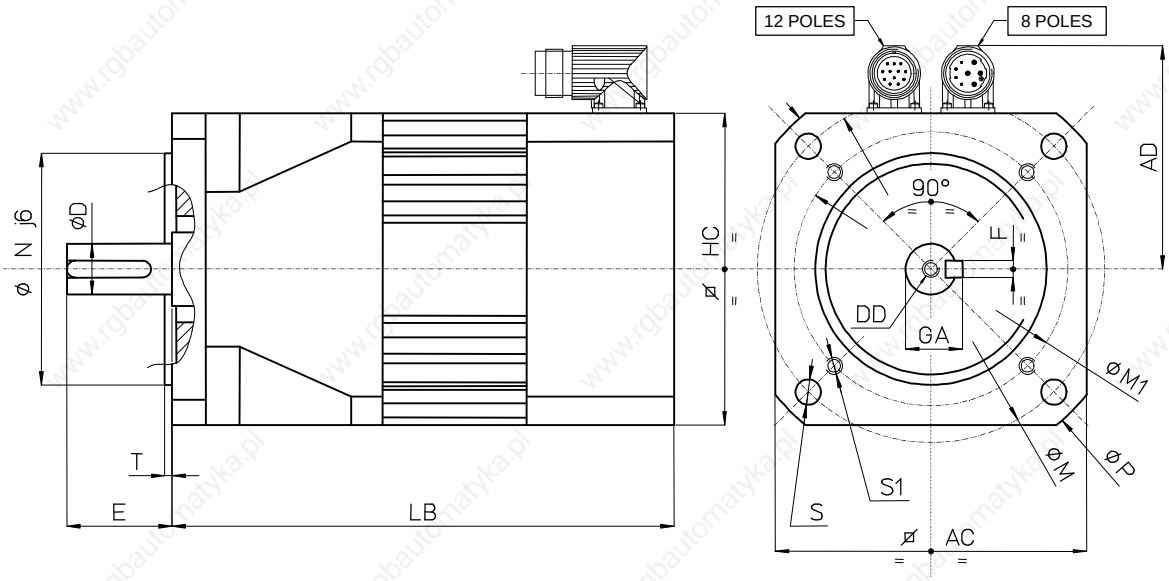


Fig. 2-2a: Overall dimension drawings of 8C Series servomotors with connectors

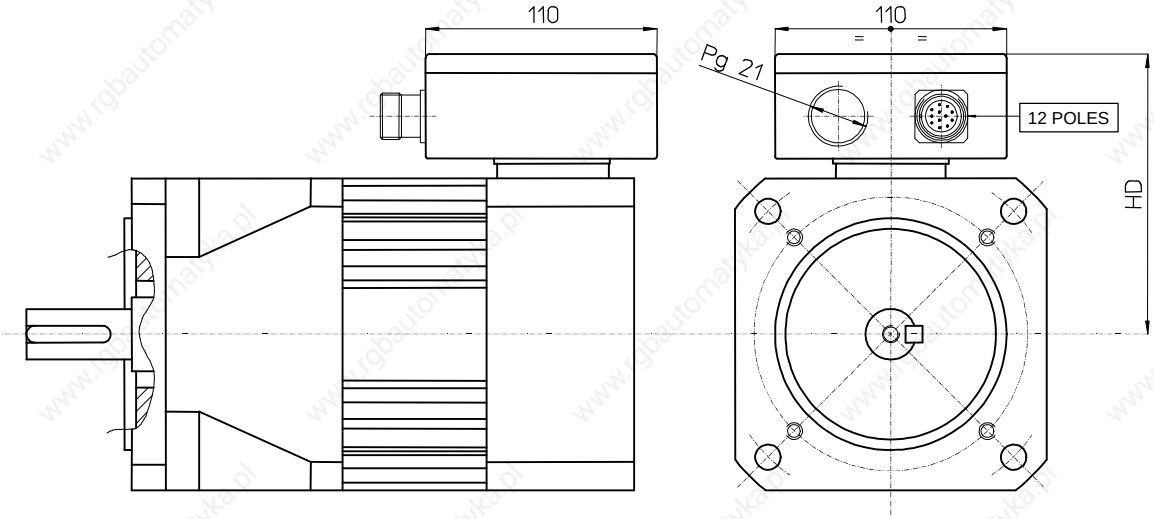


Fig. 2-2b: Overall dimension drawings of 8C Series servomotors with connection box (only for 8C4 and 8C5)

Table 2/4

TYPE		LB	AC	N	T	M	S	M1	S1	P	D	E	DD	F	GA	AD	HC	HD
8C1.1		185																
8C1.2	xx0xxxxxSE3M	212	80	60	2,5	75	M5x10	/	/	100	16 j6	40	M5x12,5	5	18	83	80	-
8C1.3		239																
8C1.4		266																
8C1.1		185																
8C1.2	xx1xxxxxSG3M	212	100	95	3	115	Ø10	/	/	140	19 k6	40	M6x16	6	21,5	83	80	-
8C1.3		239																
8C1.4		266																
8C1.1		185																
8C1.2	xx2xxxxxSC3M	212	90	80	3	100	Ø7	/	/	120	14 k6	30	M5x12,5	5	16	83	80	-
8C1.3		239																
8C1.4		266																
8C4.0		220																
8C4.1		251																
8C4.2	xx0xxxxxSG3M	276	118	110	3,5	130	Ø10	/	/	150	19 j6	40	M6x16	6	21,5	91	118	116
8C4.3		299																
8C4.4		332																
8C4.0		220																
8C4.1		251																
8C4.2	xx1xxAxxSG3M	276	118	95	3	115	Ø10	/	/	150	19 k6	40	M6x16	6	21,5	91	118	116
8C4.3		299																
8C4.4		332																
8C4.0		220																
8C4.1		251																
8C4.2	xx9xxxxxSL3M	276	140	130	3,5	165	Ø12	/	/	190	24 j6	50	M8x19	8	27	91	118	116
8C4.3		299																
8C4.4		332																
8C5.0		266																
8C5.1	xx0xxAxxSL3M	296									24 j6	50	M8x19	8	27			
8C5.2		326																
8C5.3		356	148	130	3,5	165	Ø12	/	/	190						106	148	133
8C5.4	xx0xxxxxSN3M	387									32 k6	58	M12x28	10	35			
8C5.5		418																
8C5.6		447																
8C5.0		266																
8C5.1	xx4xxxxxSL3M	296							M		24 j6	50	M8x19	8	27			
8C5.2		326							8									
8C5.3		356	148	110	4	165	Ø12	130	x	190						106	148	133
8C5.4	xx4xxxxxSN3M	387							1		32 k6	58	M12x28	10	35			
8C5.5		418							2									
8C5.6		447																

Note

The motor code (or better, the motor assembly code) is made of a combination of letters and/or digits. In the "TYPE" column of Table 2/4, the first two positions (**8C**) indicate the series, the third position indicates the axis height (**1, 4,** etc.), the forth indicates the motor size (**1, 2**, etc.) related to axial length, the sixteenth indicated the servomotor/converter matching (letter **E:** 300 Series BIVECTOR, letter **M:** 500 Series BIVECTOR).

The other letters/digits indicate further specifications of the servomotor.

2.5.4 8C Series servomotor technical specifications

The most important performance data of 8C Series servomotors are shown in Table 2/5, while data mainly related to the electrical features of the series are illustrated in Table 2/6.

Note that all of these data are provided for information, but only a part of them is currently used by users.

Table 2/5

TYPE (4)	Continuous torque at zero speed M_0 [Nm] (3)	Current at continuous torque I_0 [A] (1) (2) (3)	Rated torque M_N [Nm] (3)	Rated current I_N [A] (1) (2) (3)	Rated speed n_N [revi/min]	Mechanical rated power P_N [kW] (3)	Peak torque M_{max} [Nm]	Current at peak torque I_{max} [A] (1)	Motor current limit I_{limit} [A]
8C1.1.30... ..M	1,3	1,4	1,2	1,3	3000	0,38	4,6	5,5	9,3
8C1.1.60... ..M	1,3	2,1	1,05	1,8	6000	0,66	4,6	8,1	13,8
8C1.2.30... ..M	2,5	2,5	2,2	2,3	3000	0,69	8,8	9,7	16,4
8C1.2.60... ..M	2,5	3,1	1,8	2,4	6000	1,13	8,8	12,2	20,7
8C1.3.30... ..M	3,6	2,4	3,1	2,2	3000	0,97	12,6	9,3	15,8
8C1.3.60... ..M	3,6	4,3	2,3	2,9	6000	1,45	12,6	16,7	28,3
8C1.4.30... ..M	4,5	2,8	3,8	2,5	3000	1,19	15,8	10,8	18,4
8C1.4.60... ..M	4,5	4,9	2,5	3,0	6000	1,57	15,8	19,2	32,5
8C4.0.15... ..M	4	1,5	3,9	1,5	1500	0,61	14	5,8	9,9
8C4.0.30... ..M	4	2,8	3,6	2,6	3000	1,13	14	10,8	18,3
8C4.1.15... ..M	7,5	2,6	7,2	2,6	1500	1,13	26,3	10,3	17,5
8C4.1.30... ..M	7,5	4,7	6,5	4,3	3000	2,04	26,3	18,3	31,1
8C4.2.15... ..M	10	3,4	9,4	3,4	1500	1,48	35	13,4	22,7
8C4.2.30... ..M	10	6,1	8,4	5,4	3000	2,64	35	23,8	40,4
8C4.3.15... ..M	12,2	4,1	11,5	4,0	1500	1,81	42,7	15,9	26,9
8C4.3.30... ..M	12,2	7,6	10	6,6	3000	3,14	42,7	29,5	50,0
8C4.4.15... ..M	15,1	4,9	14	4,8	1500	2,2	52,9	19,2	32,5
8C4.4.30... ..M	15,1	8,5	12,2	7,3	3000	3,83	52,9	33,0	56,1
8C5.0.15... ..M	12,2	4,2	11,6	4,1	1500	1,82	42,7	16,3	27,7
8C5.0.30... ..M	12,2	8,0	10	6,8	3000	3,14	42,7	31,0	52,6
8C5.1.15... ..M	16,9	5,3	16	5,1	1500	2,51	59,2	20,5	34,7
8C5.1.30... ..M	16,9	11,0	13	8,8	3000	4,08	59,2	43,0	72,9
8C5.2.15... ..M	21,5	7,5	20	7,1	1500	3,14	75,3	29,3	49,7
8C5.2.30... ..M	21,5	14,1	16	10,9	3000	5,03	75,3	54,6	92,7
8C5.3.15... ..M	25,8	8,4	23,5	7,8	1500	3,69	90,3	32,8	55,6
8C5.3.30... ..M	25,8	15,6	18,5	11,6	3000	5,81	90,3	60,5	102,7
8C5.4.15... ..M	30	9,8	27	9,0	1500	4,24	105	38,1	64,7
8C5.4.30... ..M	30	17,8	21	13,0	3000	6,6	105	69,3	117,6
8C5.5.15... ..M	34,1	11,9	30,5	10,9	1500	4,79	119	46,4	78,8
8C5.5.30... ..M	34,1	21,2	22,7	14,8	3000	7,13	119	82,5	140,1
8C5.6.15... ..M	38,2	12,5	33	11,0	1500	5,18	134	48,5	82,4
8C5.6.30... ..M	38,2	23,4	24	15,5	3000	7,54	134	91,0	154,5

Notes

(1) Current values shown in table are RMS values.
(2) Tolerance ± 5%.
(3) Duty type S1, ambient temperature mounted on 40°C, steel flange (dim. 300x300x20 mm), altitude ≤ 1000 m above sea level.
(4) See Note to Table 2/4 about the servomotor code.

Other features of the series

- operating ambient temperature: 0 ÷ 40°C;
- max ambient temperature: 50°C with 1% / °C derating in the 40 to 50°C range;
- storage temperature: -30°C ÷ 85°C;
- cooling: IC0041 (completely enclosed machine, surface cooled - no fan);
- thermal class F;
- IP65 protection degree (for the motor frame, for the connector version) or IP54 (for the connection box version); see also sub-section 3.3.1.
- optional integrated brake (the presence of the brake does not change the motor length); its features are listed in Table 2/7.
- integrated 2-pole brushless “hollow shaft” resolver;
- sinewave b.e.m.f.

Table 2/6

TYPE (5)	Torque constant **K_{t0}** [Nm/A] (1) (2) (3)	B.e.m.f. between phases at rated speed **V** [V] (1) (2) (3)	Resistance at terminals **R_{UV}** [Ω] (1) (3)	Inductance at terminals **L_{UV}** [mH] (4)	Moment of inertia of rotor **J_m** [kgcm^2] (3) (6)	Weight **m** [kg]
8C1.1.30... ..M	1,05	190	20,8	47	0,9	3,1
8C1.1.60... ..M	0,71	257	9,07	21	0,9	3,1
8C1.2.30... ..M	1,14	208	6,85	23	1,65	4,1
8C1.2.60... ..M	0,90	328	4,26	14	1,65	4,1
8C1.3.30... ..M	1,71	310	8,33	31	2,35	4,9
8C1.3.60... ..M	0,95	346	2,60	9,6	2,35	4,9
8C1.4.30... ..M	1,84	333	6,27	25	3	5,8
8C1.4.60... ..M	1,04	376	2,02	8	3	5,8
8C4.0.15... ..M	3,04	276	29,3	113	5	6,9
8C4.0.30... ..M	1,63	296	8,51	33	5	6,9
8C4.1.15... ..M	3,22	292	10,7	52	9,4	9,2
8C4.1.30... ..M	1,81	328	3,22	16	9,4	9,2
8C4.2.15... ..M	3,30	299	6,76	38	12,8	10,8
8C4.2.30... ..M	1,85	336	2,12	12	12,8	10,8
8C4.3.15... ..M	3,40	308	5,13	30	16	12,4
8C4.3.30... ..M	1,83	332	1,46	8,7	16	12,4
8C4.4.15... ..M	3,48	316	3,76	24	20,5	14,8
8C4.4.30... ..M	2,02	366	1,30	8	20,5	14,8
8C5.0.15... ..M	3,30	300	5,71	44	21	15
8C5.0.30... ..M	1,74	315	1,58	12	21	15
8C5.1.15... ..M	3,65	331	3,65	32	30,2	18,3
8C5.1.30... ..M	1,74	315	0,82	7,3	30,2	18,3
8C5.2.15... ..M	3,25	294	1,91	19	40	21,9
8C5.2.30... ..M	1,74	315	0,55	5,3	40	21,9
8C5.3.15... ..M	3,48	315	1,59	17	49,2	25,3
8C5.3.30... ..M	1,88	342	0,46	4,9	49,2	25,3
8C5.4.15... ..M	3,48	315	1,23	13	59	28,6
8C5.4.30... ..M	1,91	347	0,38	4,1	59	28,6
8C5.5.15... ..M	3,25	294	0,89	9,8	68,4	32
8C5.5.30... ..M	1,83	331	0,28	3,1	68,4	32
8C5.6.15... ..M	3,48	315	0,86	9,7	78	35,4
8C5.6.30... ..M	1,85	336	0,24	2,8	78	35,4

Notes

(1) All parts of motor at 20°C.
(2) Voltage and current values are RMS values.
(3) Tolerances ±5 %.
(4) Tolerances ±10 %.
(5) See Note to Table 2/4 about the servomotor code.
(6) Rotor inertia can be increased on request.

Table 2/7

TYPE	Technical data related to the permanent magnet brakes Power supply voltage: 24 VDC; Tolerance: ±10%			
	Holding torque (20°C) M_{br} [Nm]	Moment of inertia J_{br} [kgcm²]	Weight M [kg]	Excitation current I_{br} [A]
8C1.1.30	2	0,4	0,4	0,5
8C1.1.60	2	0,4	0,4	0,5
8C1.2.30	2	0,4	0,4	0,5
8C1.2.60	2	0,4	0,4	0,5
8C1.3.30	2	0,4	0,4	0,5
8C1.3.60	2	0,4	0,4	0,5
8C1.4.30	2	0,4	0,4	0,5
8C1.4.60	2	0,4	0,4	0,5
8C4.0.15	10	4	1,2	0,75
8C4.0.30	10	4	1,2	0,75
8C4.1.15	10	4	1,2	0,75
8C4.1.30	10	4	1,2	0,75
8C4.2.15	10	4	1,2	0,75
8C4.2.30	10	4	1,2	0,75
8C4.3.15	10	4	1,2	0,75
8C4.3.30	10	4	1,2	0,75
8C4.4.15	10	4	1,2	0,75
8C4.4.30	10	4	1,2	0,75
8C5.0.15	18	11	2	0,9
8C5.0.30	18	11	2	0,9
8C5.1.15	18	11	2	0,9
8C5.1.30	18	11	2	0,9
8C5.2.15	18	11	2	0,9
8C5.2.30	18	11	2	0,9
8C5.3.15	18	11	2	0,9
8C5.3.30	18	11	2	0,9
8C5.4.15	18	11	2	0,9
8C5.4.30	18	11	2	0,9
8C5.5.15	18	11	2	0,9
8C5.5.30	18	11	2	0,9
8C5.6.15	18	11	2	0,9
8C5.6.30	18	11	2	0,9

Notes

Brakes with higher torques are available on request with following features:
motor type 8C1: 4 Nm
motor type 8C4: 20 Nm
motor type 8C5: 36 Nm
The addition of the above mentioned brakes does not increase servomotor length.

2.6 Drive system specifications and servomotor/converter matchings

Servomotor/converter matchings were chosen for general use and for the optimization of the overall performances of the drive system; for specific applications, please contact the Customer Service (see sub-section 1.6.4, Chapter 1).

Table 2/8

Servomotor Type	Converter Type	PDS performance				
		Continuous torque at zero speed	Peak torque at zero speed	Peak torque at rated speed	Rated speed	Operating curve No.
		$\mathbf{M}_{0\ (PDS)}$	$\mathbf{M}_{max\ (PDS)}$ (1)	$\mathbf{M}_{mn\ (PDS)}$ (2)	$\mathbf{n}_N$	
(4) **8C Series**	**BIVECTOR**	[Nm]	[Nm]	[Nm]	[rpm]	(3)
8C1.1.30... ..M	500-3	1,3	4,6	4,6	3000	500745
8C1.1.60... ..M	500-3	1,3	3,9	3,9	6000	500745
8C1.2.30... ..M	500-3	2,5	6,3	6,3	3000	500746
8C1.2.60... ..M	500-3	2,5	5,6	5,6	6000	500746
8C1.3.30... ..M	500-3	3,6	9,5	9,5	3000	500747
8C1.3.60... ..M	500-5	3,6	8,9	8,9	6000	500747
8C1.4.30... ..M	500-3	4,5	10,2	10,2	3000	500748
8C1.4.60... ..M	500-5	4,5	9,7	9,7	6000	500748
8C4.0.15... ..M	500-3	4	14,0	8,9	1500	500749
8C4.0.30... ..M	500-3	4	9,1	9,1	3000	500749
8C4.1.15... ..M	500-3	7,5	17,8	17,8	1500	500750
8C4.1.30... ..M	500-5	7,5	16,9	16,9	3000	500750
8C4.2.15... ..M	500-3	10	20,3	20,3	1500	500751
8C4.2.30... ..M	500-9	10	25,9	25,9	3000	500751
8C4.3.15... ..M	500-5	12,2	28,5	28,5	1500	500752
8C4.3.30... ..M	500-9	12,2	28,3	28,3	3000	500752
8C4.4.15... ..M	500-5	15,1	32,5	32,5	1500	500753
8C4.4.30... ..M	500-9	15,1	31,3	31,3	3000	500753
8C5.0.15... ..M	500-5	12,2	27,7	27,7	1500	500754
8C5.0.30... ..M	500-9	12,2	26,9	26,9	3000	500754
8C5.1.15... ..M	500-5	16,9	34,1	34,1	1500	500755
8C5.1.30... ..M	500-13	16,9	39,8	39,8	3000	500755
8C5.2.15... ..M	500-9	21,5	50,3	50,3	1500	500756
8C5.2.30... ..M	500-18	21,5	49,6	49,6	3000	500756
8C5.3.15... ..M	500-9	25,8	53,9	53,9	1500	500757
8C5.3.30... ..M	500-18	25,8	59,7	59,7	3000	500757
8C5.4.15... ..M	500-13	30	71,6	71,6	1500	500758
8C5.4.30... ..M	500-18	30	60,6	60,6	3000	500758
8C5.5.15... ..M	500-13	34,1	74,3	74,3	1500	500759
8C5.5.30... ..M	500-25	34,1	80,3	80,3	3000	500759
8C5.6.15... ..M	500-13	38,2	79,6	79,6	1500	500760
8C5.6.30... ..M	500-25	38,2	81,6	81,6	3000	500760

Notes

(1) The peak torque provided by the PDS is limited by the converter maximum current value. On request, it is possible to create servomotor/converter matchings or windings to allow the PDS to supply higher peak torques (see Table 2/5)

(2) $\mathbf{M}_{mn}$: it si the maximum peak torque (except for rotational losses) the PDS can supply, at rated speed, with a rated value of the power supply voltage.

(3) The operational curves representing the continuous and intermittent operating torque at various speeds are available on request.

(4) See Note to Table 2/4 about the servomotor code.

CHAPTER 3 – DRIVE SYSTEM INSTALLATION

3.1 General

As described in Chapter 2, the power drive system (PDS) is generally made up of different physically separated components, basically connected by electric wires. Therefore, the installation of the whole drive system begins with the mechanical installation of its individual components, followed by the laying of cables and the related connection to the various terminal blocks and/or connectors.

The following sections provide first of all a detailed description of the basic components[1] mechanical installation and, subsequently, of the drive system electrical installation.

The installation must be executed according to the state of the art and in compliance with applicable directives and technical standards; in this respect, see section 1.2, Chapter 1.
The instructions and/or recommendations provided in section 1.5 "Guideline on the application of electromagnetic compatibility" must be observed and thoroughly complied with.

3.2 Mechanical installation of the 500 Series BIVECTOR converter

500 Series BIVECTOR converters are manufactured with degree of protection **IP20**; therefore, except for exceptional cases, in a regular industrial environment they shall be installed inside a metal cabinet. The front of the converter is shown in Fig. 3-1a; the dimensions of different sizes are shown in Fig. 3-1b (small variations might be possible).
The converter should always be vertically installed; above and below the BIVECTOR converter, a distance of at least 150 mm should be allowed for; this clearance is required for air flow circulation; similarly, a distance of at least 30 mm should be allowed for at both side (see Fig. 3-1b).

The converter is usually vertically fixed on a metallic panel, that is typically 2,5 mm thick and zinc-plated; the converter zinc-plated sheet-steel backwall leans against this panel, that is also an auxiliary heat sink, which in the thermal calculation was counted for.
The converter operation would be regular, even in case the converter is mounted on guides and therefore the backpart of it faces directly the air. Anyway, it must be kept in mind that the backwall, because of the placing of the internal braking resistor, could reach absolute temperature up to 85°C (in a 40°C environment), therefore involving **burning danger**, if in the same time the following extreme conditions should be present:

- rated current in continuous duty;
- maximum ambient temperature;
- rated braking power in continuous duty with internal braking resistor.

A special plate highlights the burning danger.

[1] See section 2.1, Chapter 2.

Based on what explained above, not only is it necessary to avoid placing the converter too close to foreign objects, in order to provide for cooling air flow circulation, and to keep it far from heat sources, but it is also necessary to calculate the power dissipated inside the metal cabinet and **take appropriate cooling measures** to keep the temperature inside the cabinet within the prescribed limit.

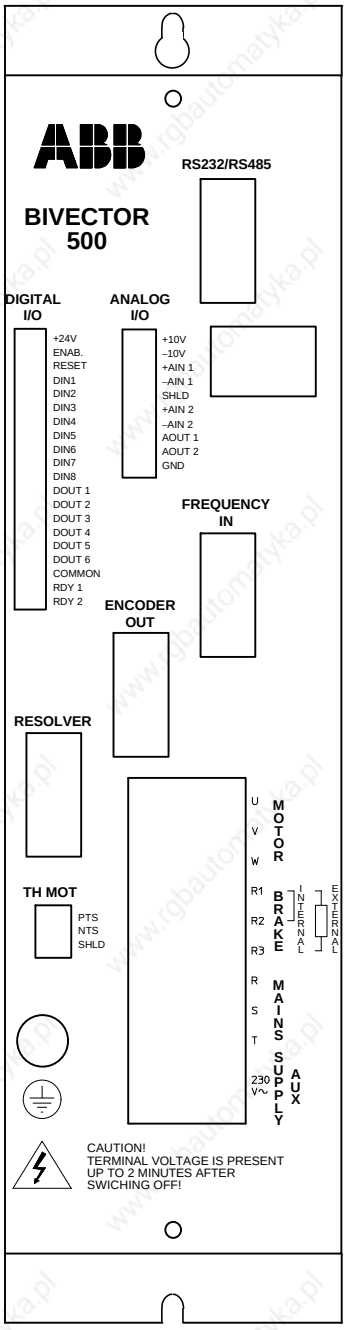


Fig.3-1a: 500 Series BIVECTOR converter front panel

The power dissipating capacity of 500 Series BIVECTOR converters is indicated, for each size, in Table 2/1 of Chapter 2.
The converter is mechanically mounted using the upper and the lower slots, both having 6,0 mm diameter, located on the background wall of the converter.
From a mechanical point of view, the cables, in particular the multiple power cables, should be fixed so as not to exert any force on the terminal blocks.

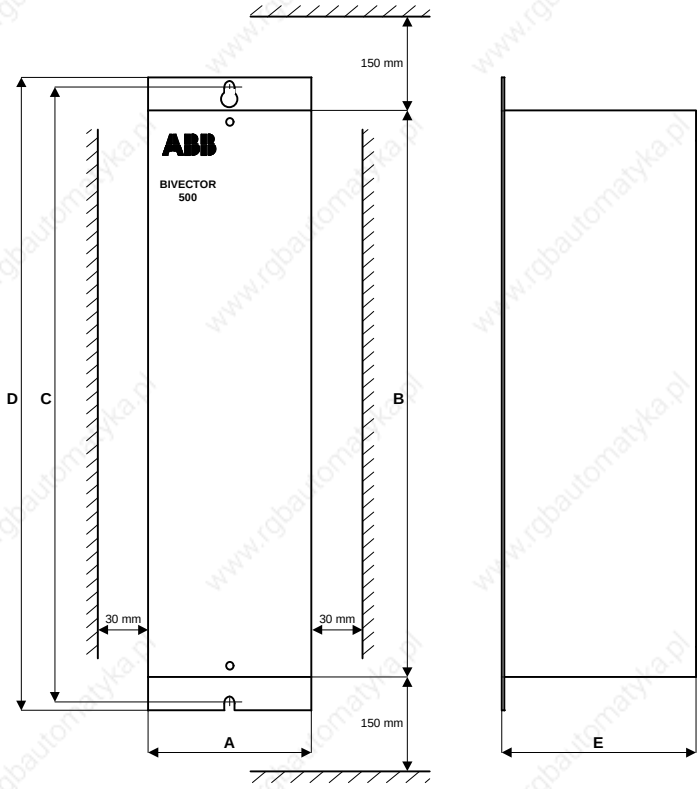


Fig.3-1b: 500 Series BIVECTOR converter dimensions

BIVECTOR 500			
Dimensions [mm]	Size **S** (3 – 5 – 9)	Size **M1** (13 – 18)	Size **M2** (25)
A	91	96	124
B	300	321	325
C	324	347	352
D	336	359	366
E	248	333	309

3.3 Mechanical installation of 8C Series brushless servomotors

The mechanical installation of 8C Series servomotors does not require any particular specification; it is obviously necessary to follow the common mechanical practice rules. However, the following indications can provide additional guidance. During installation, bear in mind the installation features of the standard execution of this series, including the following.

3.3.1 Degree of protection (in compliance with EN 60034-5)

For 8C Series servomotors with power and signal connectors:
- for motor frame: degree of protection IP65;
- for shaft end (Front-side) with oil sealer ("corteco") installed: IP64;
- for shaft end (Front-side) without oil sealer: IP54.

For the servomotors with signal connector and connection box (only for 8C4 and 8C5): IP54.

3.3.2 Types of construction and mounting arrangements

The servomotors of this series can only provide for flange installation. The different possibilities for the different sizes as listed in Table 3/1.

Table 3/1

SERVOMOTOR TYPE	Construction type and Mounting arrangement					
	IMB5	IMV1	IMV3	IMB14	IMV18	IMV19
8C1.x.xx.0.x.x.x.x.x.S.x.3.M	No	No	No	Yes	Yes	Yes
8C1.x.xx.1.x.x.x.x.x.S.x.3.M	Yes	Yes	Yes	No	No	No
8C1.x.xx.2.x.x.x.x.x.S.x.3.M	Yes	Yes	Yes	No	No	No
8C4.x.xx.0.x.x.x.x.x.S.x.3.M	Yes	Yes	Yes	No	No	No
8C4.x.xx.1.x.x.x.x.x.S.x.3.M	Yes	Yes	Yes	No	No	No
8C4.x.xx.9.x.x.x.x.x.S.x.3.M	Yes	Yes	Yes	No	No	No
8C5.x.xx.0.x.x.x.x.x.S.x.3.M	Yes	Yes	Yes	No	No	No
8C5.x.xx.4.x.x.x.x.x.S.x.3.M	Yes	Yes	Yes	Yes	Yes	Yes

Legend

The strict definitions of the IM code numbers are laid down in CEI EN 60034-7 (1993), number 2179 E; the practical meaning is provided below.

IMB5: flange mounted with passing holes on the flange, horizontal.
IMV1: flange mounted with passing holes on the flange, vertical, shaft down.
IMV3: flange mounted with passing holes on the flange, vertical, shaft up.
IMB14: flange mounted with tapped blind holes on the flange, horizontal.
IMV18: flange mounted with tapped blind holes on the flange, vertical, shaft down.
IMV19: flange mounted with tapped blind holes on the flange, vertical axis, shaft up.

Note

Upon request, 8C1.x.xx.0..x.x.x.x.x.S.x.3.M servomotors are also available with IMB5, IMV1 and IMV3 design.

3.3.3 Pulleys and couplings

Couplings, sheaves and pinions must be assembled using adequate tools, **absolutely avoiding the use of a hammer**, which could cause serious damage to the motor. Once the assembly has been completed, the shaft should be greased in order to avoid oxidation.

3.3.4 Oil sealer

All servomotors of this series are mechanically designed to accommodate an oil sealer on the shaft (the so-called front or “corteco” oil sealer); in the standard execution, this sealer is not included and is supplied or installed on request.

WARNING! This oil sealer shall be installed (by the user or by ABB Servomotors on request) **only** if the motor shaft and the oil sealer itself are actually wet by oil. If lubricating fluids other than common mineral and synthetic oils are used and in case of over-pressure of these fluids, ABB Servomotors should be contacted.

3.4 Drive system electrical installation

3.4.1 Introduction

After completing the mechanical installation of the 500 Series BIVECTOR converter and of the 8C Series servomotor, as well as of the additional components described under 2.2 of Chapter 2, the cables for the various equipment are to be connected.

The notes provided under 1.5.7 of Chapter 1, concerning the distinction between electrical wiring inside the electrical cabinet and external system, apply here as well; the external system can in turn be divided into two parts: system on the machine and on-site electrical system which is installed by the construction electrician at the machine final installation location.
This manual does not obviously indicate the specific procedures for the installation of the various electrical system parts, except for the particular instructions relating to the use of power drive systems, as was the case under 1.5.7 of Chapter 1 with regard to EMC issues.
With respect to the installation aspects, please note:

- the connection diagrams, included in this manual (for example Fig. 3-2), are basic diagrams; it is necessary to provide for standardized diagrams, with all the required references[2];
- the maximum allowable length of the connection cables, when indicated, refers to the overall length of the various cable stretches;
- in some particular cases it may be necessary to avoid interrupting the cable with intermediate terminals.

It is advisable to examine the power cable connections and signal connections separately; please note that by the latter term we indiscriminately refer to conductors of various kind, able to carry analog, logical and digital signals.

3.4.2 Power cable installation

As showed in Fig. 3-2, the power cables are:

- converter input power supply cables (three-phase power supply and single-phase auxiliary power supply);
- converter output cables for the motor assembly (see item 3.4.2.5);
- converter output cables for the external braking resistor (only if the resistor is actually installed).

[2] In this respect, see for example the reference to regulations [7] and standard CEI 44-6 “Equipaggiamenti elettrici di macchine industriali Parte 2: Designazione dei componenti ed esempi di disegni, schemi, tabelle, istruzioni” (Electrical equipment of industrial machines Part 2: Components designation and examples of drawings, diagrams, tables, instructions); this standard conforms to Modification 1 of standard CENELEC EN 60204-1.

3.4.2.1 Power supply

BIVECTOR side connections **MAINS** terminal block terminals **R – S – T**	*connect to:*	External connection Factory electrical net: three-phase, 400 V -15% …. 440 V +10%, 50,/60 Hz Required power: see Table 2/1 and Notes, point 2.
Earth terminal ⏚.	*connect to:*	installation **PE**.

Notes

1 - WARNING! The power supply three-phase line has to be protected by an automatic circuit breaker (**QF1**) or, alternatively, by a disconnecting switch plus three fuses. (**QS1** and **F1**), see Fig. 3-2.

2 - In case of systems with power components (such as the protection devices mentioned under item 2, filters, etc.) common to more drive systems, **it is necessary to size them in relation to the installed apparent power rating (kVA),** according to data in Table 2/1 for each converter, and to the minimum overload voltage (see section 2.4), considering the following factors: rated and peak power required by each drive system, simultaneous operation function, usage of each drive system.

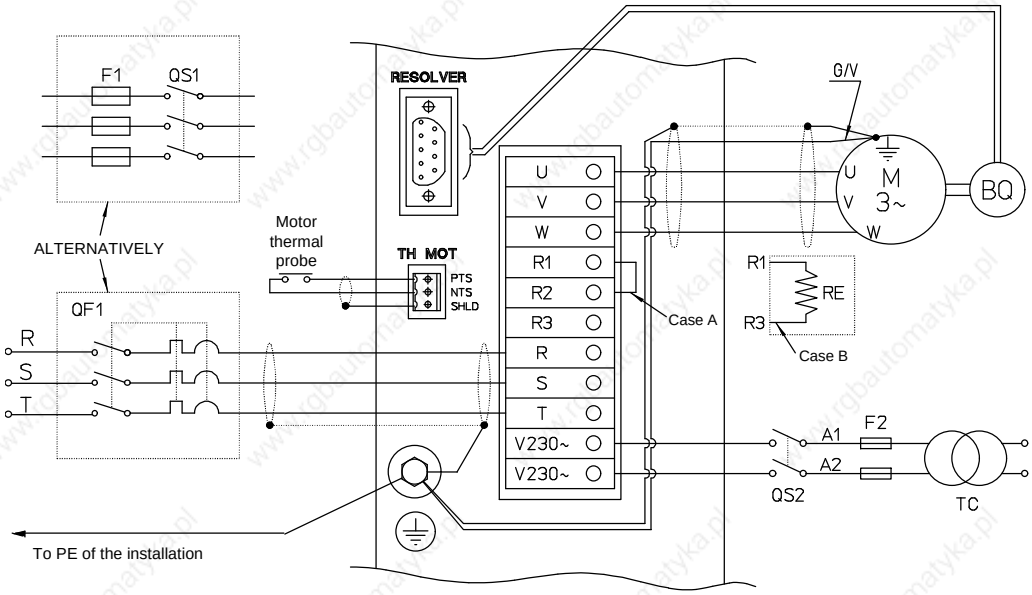


Fig. 3-2: Power supply and related drive system connection diagram

3.4.2.2 Auxiliary power supply

BIVECTOR side connections **SUPPLY AUX** terminal block no. 2 terminals at **230 V~**	*connect to:*	External connection single-phase transformer secondary (***TC***), 230 V ±10%, 50/60 Hz, 40 VA power

Notes

1 - WARNING! The auxiliary power supply single-phase line must be protected by an automatic circuit breaker or, as shown in Fig. 3-2, by two fuses (***F2***); the use of a disconnecting switch (QS2) can also be useful. These devices need to be sized based on the TC transformer power rating.

2 - WARNING! It is not allowed to use an autotransformer instead of the TC transformer, because the **auxiliary circuit must have a galvanic insulation from any other circuit and earth.**

3.4.2.3 Connection of the mains filter (only for BIVECTOR size M1 and M2, used in First Environment)

With reference to Chapter 1, item 1.3.1.3, if the drive system with BIVECTOR size M1 or M2, (see Table 2/1) is to be installed in a "First Environment", the mains connection needs to be provided with an appropriate line filter, installed on the connection to factory electrical net. No filter is required when a drive system with 500 Series BIVECTOR size S (type 3A – 5A – 9A) is to be installed.
When many converters BIVECTOR size M1 and/or M2 are in one installation, it is useful and advisable to use only one filter for all converters; therefore the filter input must be connected to three phase power line and all converters must be connected in parallel to the filter output. In this case it is necessary to size the filter according to: a) the sum of the apparent powers (rated power as well as peak power) of all converters; b) the simultaneous operation function; c) the duty type of each drive system.

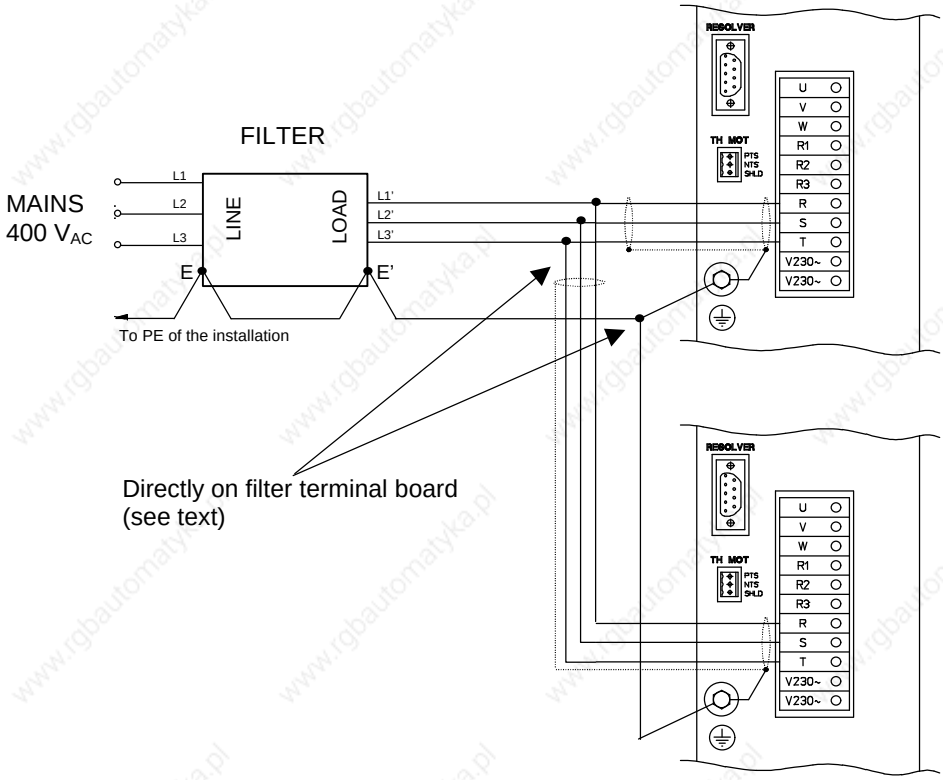


Fig. 3-3: Line filter connection diagram

Fig. 3-3 shows, for instance, the filter connection diagram for two converters. The filter needs to be installed as close as possible to the converters, so that the connections between R, S and T of two converters and connections L1', L2', L3' on the "LOAD" side of the filter are as short as possible. It is useful to connect the cables coming from the converters directly on the filter terminal block; it is allowed to use an intermediate terminal block, on condition that the cables between the filter and the converters are as short as possible and the cable size is suitable.
Of paramount importance is the connection between the BIVECTOR converter earth (marked by the earth symbol in Fig. 3-2 and in Fig. 3-3), the earth E and E' of the filter and **the installation PE**. These earth connections have to be performed as shown in Fig. 3-3, with cable section not smaller than the transformer power cable and with short routes.

Note
Please contact the Customer Service for the available filter codes for BIVECTOR size M1 and M2.

3.4.2.4 Braking resistor

3.4.2.4.1

Warning: There are two possibilities, whether it is necessary to use the external resistor or the internal one is sufficient. For the choice between these two alternatives and the resistor sizing, see item 3.4.2.4.2.

Case A: no external resistor

BIVECTOR side connections **BRAKE** terminal block		External connection
Terminal **R1**	*connect to:*	terminal **R2** of the same **BRAKE** terminal block (jumper connection).
Terminal **R2**	*connect to:*	terminal **R1** of the same **BRAKE** terminal block (as above).
Terminal **R3**	*not connected*	

Case B: external resistor

BIVECTOR side connections **BRAKE** terminal block		External connection
Terminal **R1**	*connect to:*	first terminal of external resistor.
Terminal **R2**	*not connected*	
Terminal **R3**	*connect to:*	second terminal of external resistor.

WARNING! The braking resistor terminals feature dangerous DC electric potentials (up to 800 V). When the braking resistor is external, it must be mounted in an electrical control cabinet, provided with adequate measures to ensure insulation and cooling.

BIVECTOR is fully protected against any short circuit between the terminals R1, R2 and R3 and also between R1, R2 and the earth; on the contrary **the short-circuit between R3 and the earth may seriously damage the converter.** Therefore it is necessary to take action on the electric installation to avoid damages.

The type of resistors compliant with standards can be purchased from ABB Servomotors; see codes and features in Table 3/2.
For the connection between the converter and the resistor, use cables with section at least equal to the section of power supply cables; the cables must be twisted and as short as possible; the maximum length must be 2 m. The route of these cables must be such as to prevent any interaction with other signal or power cables.

3.4.2.4.2

In order to choose the features (resistance and power) of the braking resistor, both internal and external, it is necessary to know quite in detail the driven load conditions. A possible way to obtain the required values is suggested below. First of all some fundamental data need to be remembered.

a) The drive system consisting of 8C Series servomotors and 500 Series BIVECTOR converters is characterized by four quadrant operation, with dissipating braking (or dynamic)[3]; this means that, during the cycle phases where there is a deceleration, the kinetic

[3] See items 1.2.3 and 1.2.4 of CEI 301-1 1997-10 “Power drive systems – Dictionary”.

energy of the motor and of the connected mechanical load is converted into electric energy which is dissipated on a resistor.

b) The BIVECTOR converter power circuit can be represented as in the diagram of Fig. 3-4; DI is a three-phase diode bridge, which rectifies the input AC current and powers the DC intermediate circuit IC, where the capacitor C and the braking circuit CF are located; CO is the power converter in the strict sense of the word, whose variable frequency AC output supplies the servomotor.

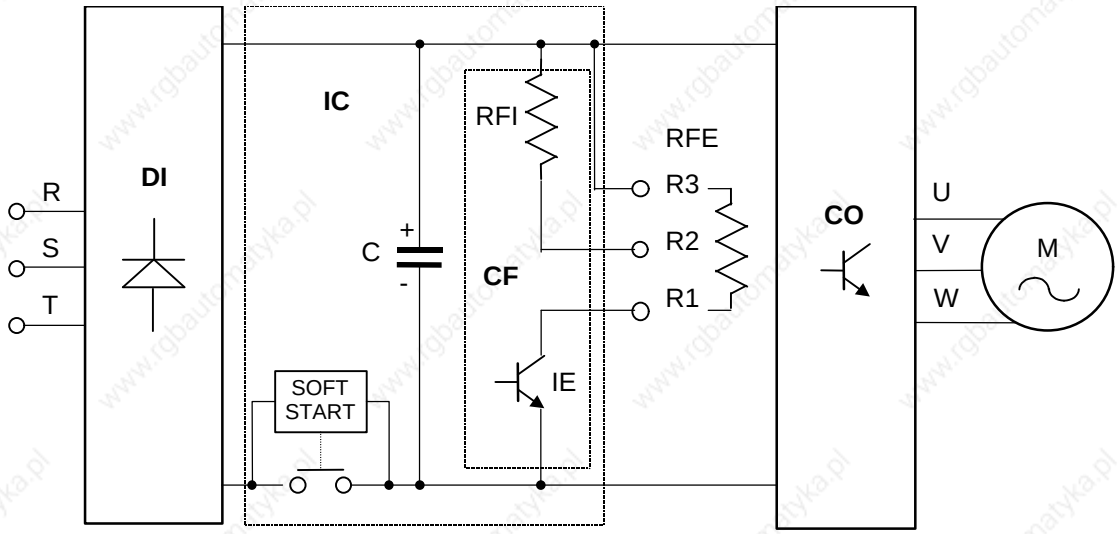


Fig. 3-4: Power stage basic diagram

Inside the braking circuit CF, IE is an electronic switch (for example an IGBT) used to adjust the braking current, RFI is a braking internal resistor, RFE is the optional external braking resistor, while R1, R2 and R3 are the terminals mentioned under 3.4.2.4.1; as clearly illustrated in Fig. 3-4 and as deduced from the connections prescribed in the above mentioned section, one or the other resistor can be used.

The adjusting circuit controlling I.E. depends on the V_{BUS} voltage to the C capacitor ends (rated value: 565 V_{DC} @ input voltage U_{VN} = 400 V_{AC}); the CF circuit trip threshold is 775 V_{DC}. If the power generated by the braking motor exceeds the power that can be dissipated by resistor RFI or by resistor RFE and the V_{BUS} voltage rises beyond 775 V_{DC}, an alarm circuit, not represented in Fig. 3-4, stops the operation of the entire converter[4].

c) The braking power can be established based, for example, on the mechanical performance required by the load[5]. It can be constant over time or slowly change as in the drive mechanisms of continuous cycle machines (e.g. paper machines, printing machines) or - as is more frequently the case for operating machines - there can be repetitive cycles with periods of acceleration, constant speed, deceleration. A simple example of braking cycle is provided in Fig. 3-5.

[4] See second Part of the manual, alarm O.1 “Overvoltage DC Bus_HW”.

[5] The mechanical power, expressed in [W], results from $P_M = T\ \omega$, where torque T is expressed in [Nm] and the motor angular speed ω in [rad/s].

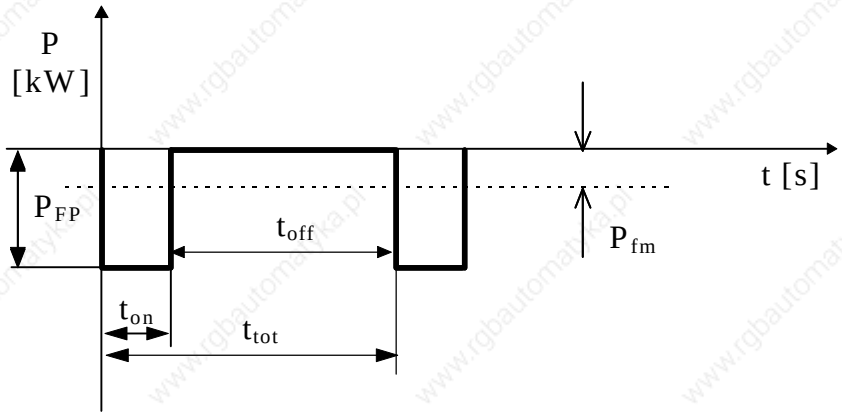


Fig. 3-5: Braking cycle example

The braking power is in the negative half plane, because in this case the motor acts as generator. In Fig. 3-5, t_{tot} is the overall cycle duration, t_{on} the actual braking duration and t_{off} the time when there is no braking (but there could be, for example, acceleration or constant speed). During t_{on} the braking power value P_{FP} remains constant and is defined as "peak power"; the braking power cycle average value is indicated with P_{fm}.
In more complex cycles, the power average value needs to be adequately calculated, considering the different peak values and related duration:

$$P_{fm} = \Sigma (P_{FPi} \cdot t_{oni}) / t_{tot} .$$

For the sake of simplicity, it is suggested to divide complex cycles into sub-cycles as illustrated in Fig. 3-5.

d) To correctly use the braking circuit, it is necessary to abide by <u>all</u> the three following conditions:

d1) P_{FP} can never exceed the P_{PEAK} value of Table 3/2

d2) t_{on} must always be lower or equal to $T_{P(PEAK)}$ of Table 3/2

d3) the cycle average value P_{fm} must be lower or equal to the P_{CONT} value of Table 3/2.

Table 3/2

		BIVECTOR 500				
		Size **S**		Size **M1**		Size **M2**
		3 - 5 - 9 A		**13 - 18 A**		**25 A**
Quantities		Internal resistor	External resistor	Internal resistor	External resistor	External resistor
Resistance	[Ω]	75	75	54	54	38
$P_{CONT.}$	[W]	120	max. 1000	200	max. 1500	max. 2000
P_{PEAK}	[W]	7000	7000	10000	10000	16500
$T_{p(PEAK)}$	[s]	0,6	0,8	0,6	0,8	0,8
$T_{p(0)}$	[s]	35	(see Note 2)	30	(see Note 2)	(see Note 2)

<u>Notes</u>:
1) time $t_{P(0)}$ corresponds to time t_{off} of Fig. 3-8, when $P_{FP} = P_{PEAK}$.
2) $t_{p(0)} = (P_{PEAK} / P_{CONT} - 1) * t_{p(PEAK)}$
3) please contact the Customer Service (see section 1.6.4) when the external brake resistor is used.

3.4.2.5 Connection to the motor assembly[6]

All power and signal connections to the motor assembly are indicated in this item.
The motor assemblies with 8C Series servomotors use for connections:
either

a) power and signal connectors, right-angled fixed on the frame of the motor; Fig. 2-2a in Chapter 2 shows the overall dimension drawings; Fig. 3-7a and Fig. 3-7b show the pin numbers;

or

b) connection box for connections to the servomotor and the possible brake and one connector for connections to the resolver; Fig. 2-2b in Chapter 2 shows the overall dimension drawings; Fig. 3-8a and Fig. 3-8b show the pin numbers; this version is available only for 8C4 and 8C5.

Fig. 3-6 shows the electric diagram of motor assembly components, with terminal identification either in the case a) (digit in the square) or in the case b) (letter in the circle).
The specific connections are showed in next items.

☐ - Connector pin digit

○ - Letter in the connection box

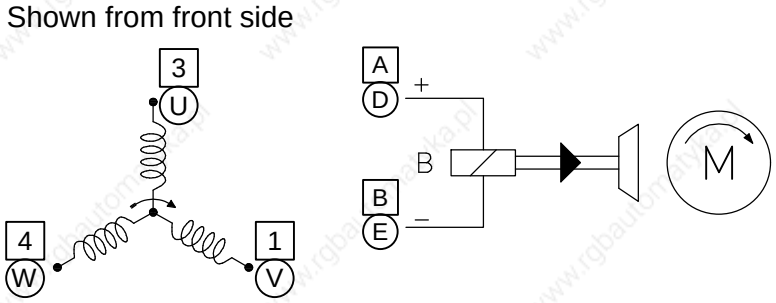


Fig. 3-6: Electric diagram of motor assembly components

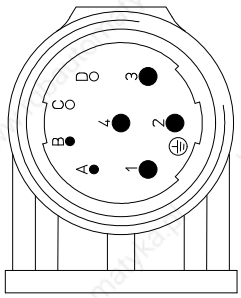


Fig. 3-7a: Front view of the power connector when right-angled fixed on the motor frame

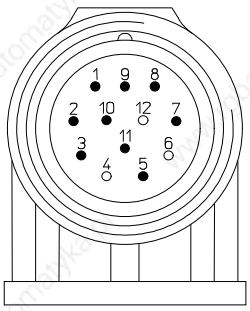


Fig. 3-7b: Front view of the signal connector when right-angled fixed on the motor frame

[6] See section 2.4 in Chapter 2.

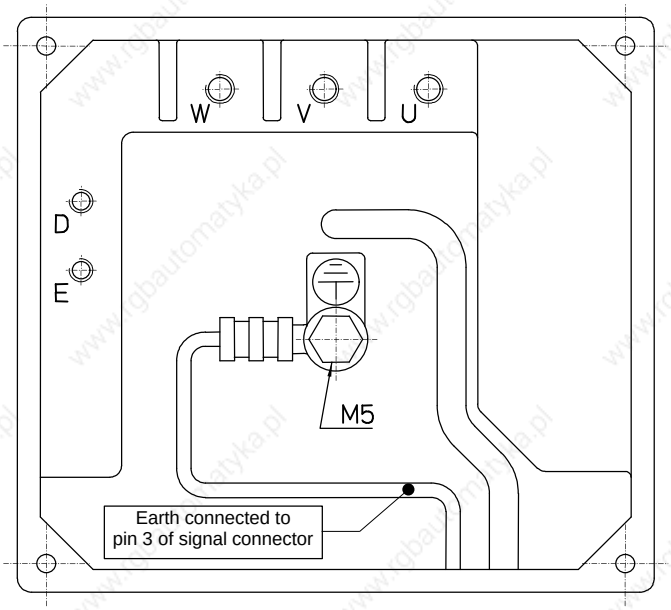


Fig. 3-8a: Connection box (only for 8C4 e 8C5)

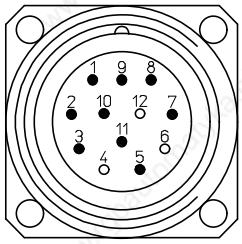


Fig. 3-8b: Fixed on the connection box signal connector (only for 8C4 e 8C5)

3.4.2.5.1 Connection to servomotor

Case **a)** (power connector on the motor)

BIVECTOR side connections **MOTOR** terminal block		Motor assembly side connection **Power connector** (Fig. 3-7a)
Terminal **U**	*connect to:*	pin **3**
Terminal **V**	*connect to:*	pin **1**
Terminal **W**	*connect to:*	pin **4**
Earth terminal ⏚	*connect to:*	pin **2**

The connection cables must be connected, motor assembly side, to a suitable female plug connector (code on request), which is to be inserted on the power connector when right-angled fixed on the motor frame.

Case **b)** (Connection box on the motor)

BIVECTOR side connections **MOTOR** terminal block		Motor assembly side connection Servomotor **connection box** (see Fig. 3-8a)
Terminal **U**	*connect to:*	terminal **U**
Terminal **V**	*connect to:*	terminal **V**
Terminal **W**	*connect to:*	terminal **W**
Earth terminal ⏚	*connect to:*	motor **earth** terminal ⏚

1 – For cable connections, the connection box contains a kit of loose nuts and washers.
2 – The cable must be introduced into the box through the PG21 hole (see Fig.2-2b) using an adequate cable gland.

Notes for both cases a) and b)

1 - At least for the route between the electrical control cabinet and the motor, it is suggested to use a shielded four-pole cable (three-phases + yellow-green), with appropriate section for the 500 series BIVECTOR converter output rated current. For each size, see values

indicated in Table 2/1 of Chapter 2. For these connections it is also possible to use metal sheath cables. **In any case, the external shield must be connected to the motor earth.**
2 - It is important to keep in mind that it is necessary to strictly observe what described in section 1.5 of Chapter 1 “Application guide to electromagnetic compatibility ”.

WARNING! **The correct correspondence of the connections between motor and converter must be strictly observed**. The exchange of phases prevents the drive system from operating.

3.4.2.5.2 Connection to the resolver

BIVECTOR side connections **RESOLVER** connector		Motor assembly side connection **Signal connector**
Male, 9-pin, SUB-D type drawer connector	*Through cable (see code in Table 3/3)* *Connect to:*	Signal connector right-angled fixed on the motor frame (see Fig. 3-7b) Or Signal connector fixed on the connection box (see Fig. 3-8b)

Note
For the resolver connection between motor assembly and converter, **standardized cables** for fixed installation are available complete with connector both on the motor assembly side and on the converter side. These cables can be purchased together with the drive system, specifying the related code, as in Table 3/3 depending on the desired length.

Table 3/3

Cable code	Length [m]
BVC1C**Y**SGN0L5**Z**XX	0,5
BVC1C**Y**SGN1L0**Z**XX	1
BVC1C**Y**SGN2L0**Z**XX	2
BVC1C**Y**SGN2L5**Z**XX	2,5
BVC1C**Y**SGN5L0**Z**XX	5
BVC1C**Y**SGNL10**Z**XX	10
BVC1C**Y**SGNL15**Z**XX	15
BVC1C**Y**SGNL20**Z**XX	20
BVC1C**Y**SGNL25**Z**XX	25
BVC1C**Y**SGNL30**Z**XX	30

Table 3/4: Connections to signal connector (motor side)

PIN	1	2	3	4	5	6	7	8	9	10	11	12
Connections to resolver	S2	S1	⏚	N.C.	R1	N.C.	R2			S4	S3	N.C.
Connections to thermal sensor				N.C.		N.C.		PTC	PTC			N.C.

Note: N.C. = not connected.

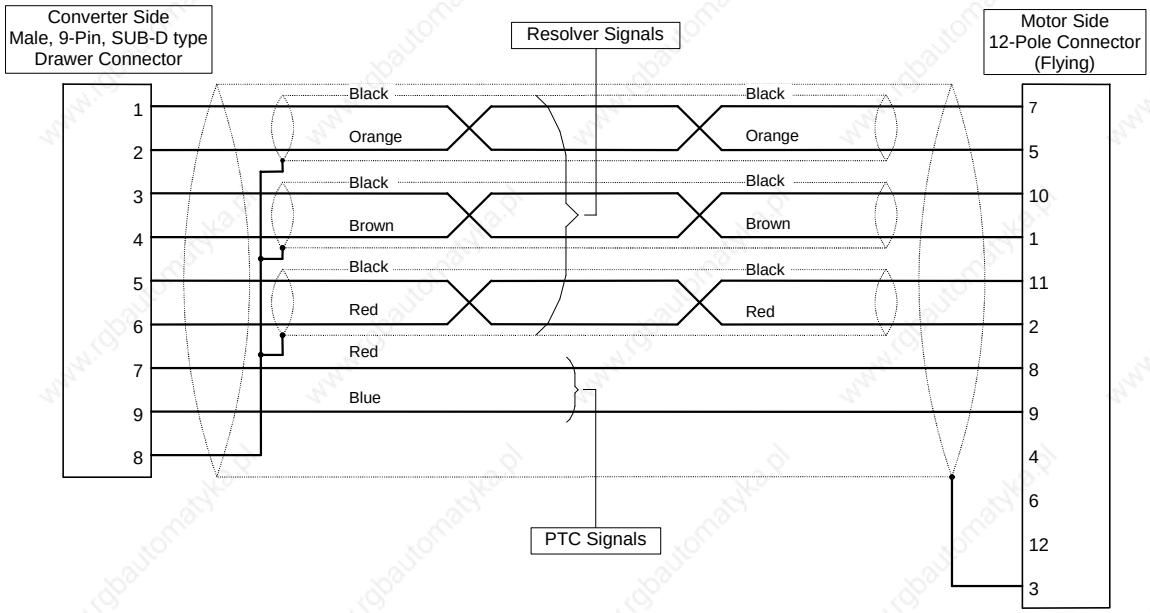


Fig. 3-9: Resolver cable connection diagram

WARNING! **Resolver connections are extremely important!** A malfunctioning of this part of the circuit may seriously compromise the operation of the whole drive system.

If users prefer to prepare the complete cable by themselves, cabling the flying connectors, the following rules should be observed:

a) the assembly must be performed by skilled personnel;
b) only ABB Servomotors S.r.l. approved cable type can be used, code 16080125; connections must be those described in Fig. 3-9;
c) only flying connectors can be used, which are supplied on request;
d) the prescriptions contained under section 1.5 “Guidelines on the application of electromagnetic compatibility” of Chapter 1 must be complied with;
e) **for no reason should the cable be interrupted between the motor assembly connector and the converter connector**: no intermediate terminal blocks and/or connectors are allowed;
f) the maximum cable length must not exceed 30 m;
g) if, for special reasons, a non-approved type of cable needs to be used, the Customer Service should be contacted (see section 1.6).

3.4.2.5.3 Connection to the thermal sensor

Inside the motor a PTC thermal sensor is provided; this device informs the BIVECTOR control circuit about a possible overtemperature of the motor. The connection of the PTC sensor to the converter is made through the resolver cable see Table 3/4.
The incorrect connection of the thermal sensor prevents the drive system from operating.

Note

In the standard version of Series 8C servomotors only the PTC sensor is provided; it is possible to supply a special version of the servomotor, in which a thermal switch – instead the PTC thermal sensor - is included. This special version is identified by the fifteenth digit in the motor code. For the special version, the shielded bipolar cable, connecting the thermal switch to the converter, must be connected to terminal block **TH MOT** (see Fig.3-1a) and absolutely it cannot be connected to the signal connector. For this special application please contact Customer Service.

3.4.2.6 Brake connections at the motors axis (only if the brake option is available)

When the brake option is available, the connection must be performed observing the following.

WARNING! The brake management is fully under the care and responsibility of the electrical control cabinet manufacturer. The installed brake is a safety brake and so it is **operating (i.e. it brakes) when it is not powered**. It is therefore absolutely necessary for the motor to be free (without brake) before being powered, so the logic of the electrical control cabinet must provide for a timely and adequate power supply to the brake, also checking that during the servomotor operation the brake is always powered.

All the electrical and mechanical data relating to the brakes are reported in Table 2/7, for the various servomotor sizes. In this respect, it must be remembered:

a) the brake is powered by **DC current**, coming from a power supply (not included in the drive system supply) having adequate power and the specified voltage tolerance;
b) the power supplied to the brake must come from a mains separated circuit;
c) the connections of the power supply circuit must be compliant with what indicated under section 3.3;
d) **the power supply polarity must absolutely be respected** (positive pole on terminal **D** and negative pole on terminal **E**): exchanging the poles means failure of supply and therefore a braking action on the motor.

3.4.3 Signal cable installation

3.4.3.1 Warning

As shown in Fig. 3-1a, the 500 Series BIVECTOR converter front features 4 terminal blocks, 4 drawer connectors and an earth terminal. The previous sections have specified connections that depend on the power terminal block (MOTOR, BRAKE, MAINS, AUX SUPPLY), on the TH MOT terminal block and on the RESOLVER connector.
In this section, the connections depending on the other terminal blocks and connectors will be presented– essentially from an installation point of view. Please note that the information provided on the type of signals and their management, with regard to the various connections, is exclusively meant as useful guidance for electrical installation purposes; for the complete description of the control and monitoring functions and related software, refer to the Second Part of Manual “Commissioning and use”.

WARNING! The installation must be performed according to the state of the art and in compliance with applicable directives and technical regulations; in this respect, see also section 1.2 of Chapter 1.
The prescriptions and/or recommendations contained under section 1.5 “Guidelines on the application of electromagnetic compatibility” must be observed and strictly complied with.

*3.4.3.2 **RS232 / RS485** connector*

Front panel: female, SUB-D type, 9-pin drawer connector.
This connector is provided for the connection of multiple cables for serial communication to external devices, by means of two different protocols: RS-232 and RS-485. The two protocols have different features; the most significant ones are described in Table 3/5.

WARNING! This connector is physically similar to the RESOLVER and FREQUENCY IN connectors (they are all female); it is therefore necessary to be careful not to exchange the cables during installation and/or converter replacement.

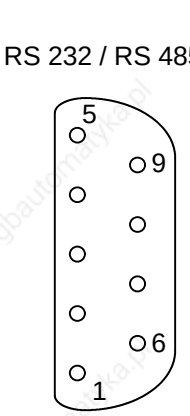
Table 3/5

Type	Maximum distance	Some features	
RS-232-C	20 m	Single-point	Full-duplex single-pole
RS-485	1000 m	Multi-point	Half-duplex differential

Fig. 3-10 shows the flying connector (500 Series BIVECTOR side) of the connection cable for external devices, as well as the pin numbering, for the connection in the two different cases; as can be seen, the references GND (ground) and SHIELD (shield) are controlled by the same pins, whereas the active conductors are controlled by pairs of pins, different for each type of protocol.
This connection is designed to connect, alternatively, the following equipment:

A) KEY-B type control keyboard;
B) Personal computer (PC);
C) Any other equipment with serial input.

A – Connection with KEY-B type keyboard
Protocol RS232-C is used. In this case no wiring is necessary, because the KEY-B keyboard (see section 2.3 in Chapter 2) is equipped with connection cable, code BVC1CBTSN1LOXXX.
This 1-m long cable features on one end a SUB-D type, 9- pin male flying connector for connection to the BIVECTOR, and on the other end a MINIDIN type, 8-pin male round connector for connection to the keyboard.
Connection of the KEY-B keyboard to the 500 Series BIVECTOR with cables other than the standardized ones is not allowed.
For the use of the keyboard, refer to the Second Part of this manual.



Terminal to use for RS232 communication

Terminal	Description
2	Tx (RS 232)
3	Rx (RS 232)
5	GND
1	SHIELD

Terminal to use for RS485 connections

Terminal	Description
8	RX/ Tx - (RS 485 B)
9	RX/ Tx + (RS 485 A)
5	GND
1	SHIELD

Fig. 3-10: Serial connection terminal

B – Connection with PC
The PC must be equipped with a RS232-C serial port and be DOS compatible; connection requires a cable prepared by the installer in accordance with Fig. 3-11 diagram which must not be longer than 20 m. On the converter side, the flying connector is male, while on the PC it is normally female and must be connected to a serial port.
This connection is particularly important because, as described in the Second Part, one of the most convenient way to install, control and monitor the drive system is a special program, called BIVCOM, installed on a PC, connected to the BIVECTOR through the hereby described connection.

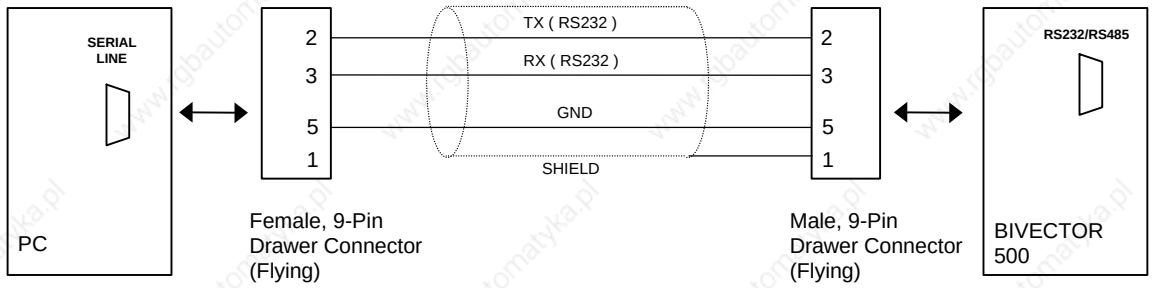


Fig. 3-11: PC – BIVECTOR connection diagram

C – Connection with other equipment provided with serial port

The connection can be of type RS232 or type RS485.

Since this is a particular type of connections, it is important to agree with the Customer Service (see section 1.6.4) on the usage modalities both for the hardware part (connection cable, connection procedures) and the software part.

Fig. 3-12 shows a connection diagram using protocol RS485, between an external device (PC, PLC, etc.) as master and a certain number of 500 Series BIVECTOR converters as slave; up to 32 slaves can be connected. The master can never be a BIVECTOR converter. No branch connections, for example star topology, are possible. The connection between the equipment must be physically carried out as shown in the figure; in particular, the connection cables must be multiplied only at the BIVECTOR terminal blocks. The terminal resistors (R_T = 120 Ω, 1/4 W) need to be directly mounted at the connectors of the two devices at the line ends, the cables must be twisted and shielded and the shields are to be connected on both sides, as indicated in the figure.

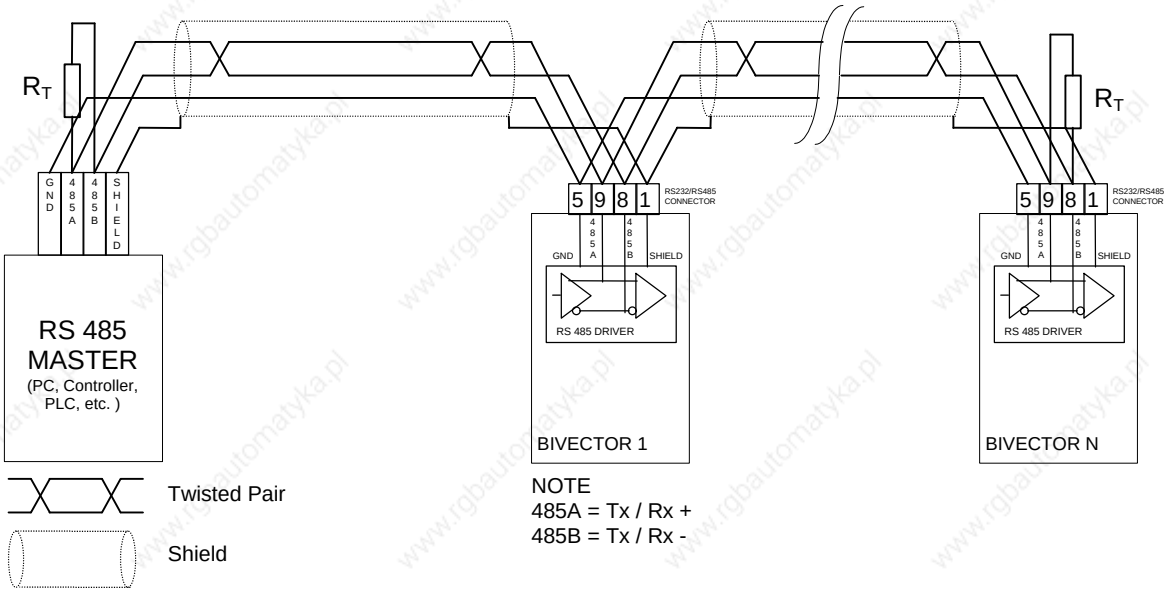


Fig. 3-12: RS485 multipoint connection diagram

*3.4.3.3 **ENCODER OUT** connector*

Front panel: SUB-D type, 9-pin male drawer connector.
The electrical circuit, inside the BIVECTOR, depending on this connector is shown in Fig. 3-13.

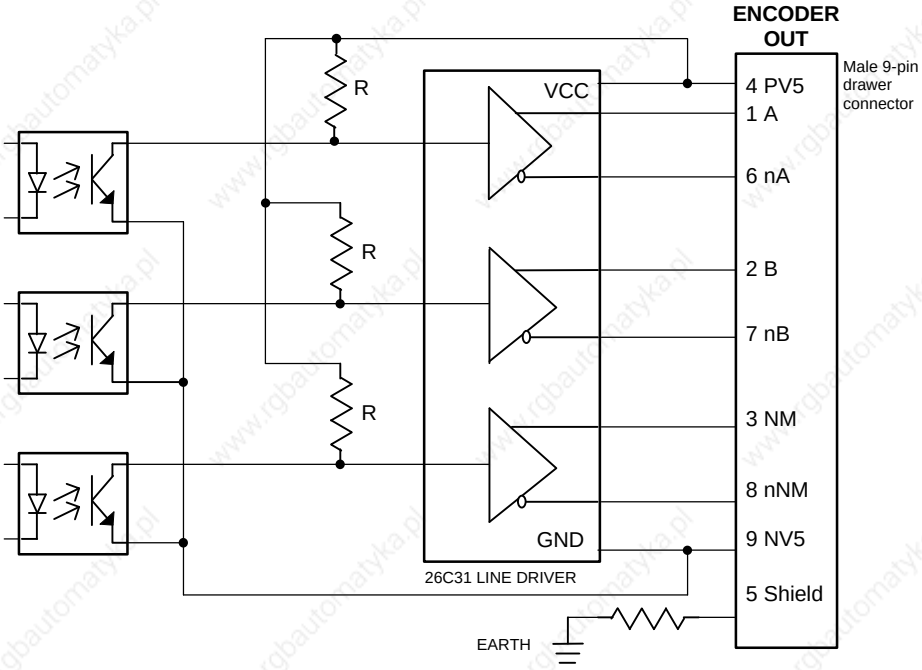


Fig. 3-13: ENCODER OUT internal circuit diagram

Through digital signals, this output provides the rotor angular position against the servomotor stator. Therefore it can be considered equivalent to that provided by an incremental binary encoder. The signal provided by this output is shown in Fig. 3-14; while this part provides some hardware-related data, for the meaning and use of the signals refer to the Second Part of this manual.
The nine pins (see Fig. 3-13) should be connected as follows:

- six are used for the outputs in the strict sense of the word (as explained further on);
- one pin, marked **SHIELD,** is intended for the cable shield connection;
- two pins are to receive the DC power, to be externally supplied; more precisely, between pin **PV5** (positive pole) and pin **NV5** (negative pole) a DC voltage source must be connected (12 V ± 3 V, maximum current required: 60 mA).

This power supply is not necessary in case of type A application (see below).
The output signals are three (**A**, **B** and **NM**) and can be used differentially; in this case the outputs are, respectively, pairs A-nA, B-nB and NM-nNM corresponding to the connector pins indicated in Fig. 3-13. As shown in Fig. 3-14, signal **A** has a 90° phase lag angle in respect to signal **B**. Signal NM (North Marker) is a synchronism signal, provided every mechanical 360° angle, whose position can be configured by the user at any angle of the round angle. The main features of the signals are:

- output voltage: typically 10 V_{pp}, without load;
- output voltage: 5 V_{pp}, with output current of 20 mA;
- bandwidth: 500 kHz;
- user device impedance: R_{min} = 500 Ω, R_{max} = 10 kΩ; 200 pF in parallel; (note: a resistance greater than 10 kΩ can generate reflection; it is therefore suggested to terminate the connection with a 1 kΩ resistor, again connected in differential);
- cable maximum length: 10 m.

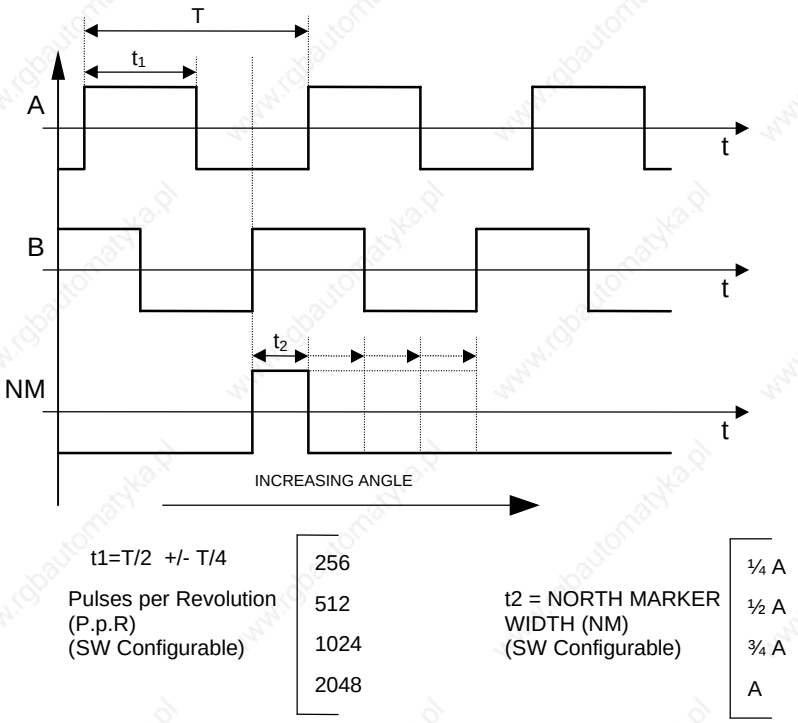


Fig. 3-14: ENCODER OUT signal waveform

Note: The three signals mentioned above can also be taken with reference to pin NV5; in this case the output signals are taken from the pin pairs A-NV5, B-NV5, NM-NV5 and the available voltage is typically 5 V in no load condition and 2,5 V with load.
Two typical applications for the output signals from this connector can be mentioned.
A – Connection with another converter of BIVECTOR 500 Series, as a position slave (synchronization, electrical axis).
This is the typical application for which this output has been implemented; in this case the connection must be carried out between the converter ENCODER OUT connector acting as *master* and the converter FREQUENCY IN connector acting as *slave*; the complete connection is shown in Fig. 3-15. The master converter can only have one slave.
The cable terminates with a SUB-D type 9-pin female drawer flying connector for the master converter side connection and with a SUB-D type 9-pin male flying drawer connector for the slave converter side connection. The maximum length of this cable is 10 m.

B – Connection to other equipment for rotor position data transmission. This application implies knowledge of the device to be connected and must be regarded as a particular application; for the ENCODER OUT connector output signals, refer to Fig. 3-14 and to the signal features described above.

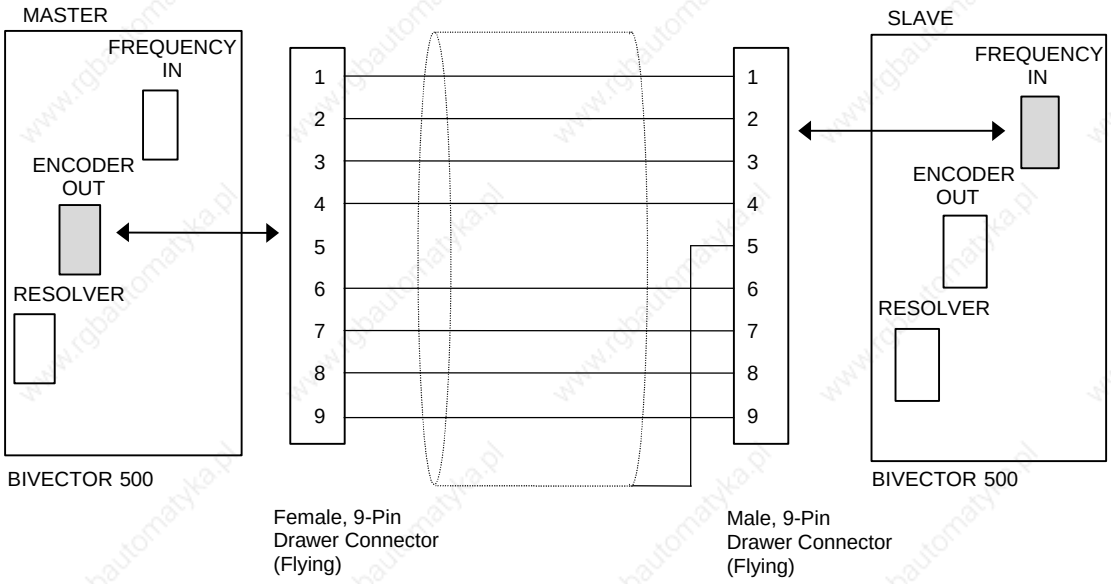


Fig. 3-15: Master-slave connection

*3.4.3.4 **FREQUENCY IN** connector*

Front: SUB-D type, female, 9-pin drawer connector.
The electrical circuit, inside the BIVECTOR, is shown in Fig. 3-16.

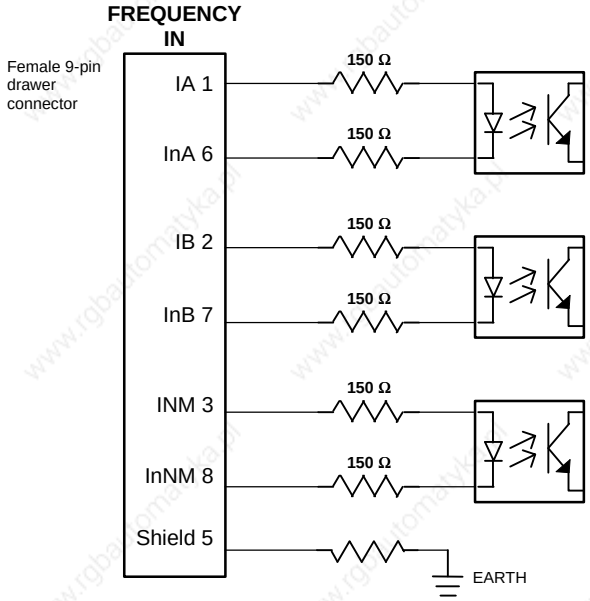


Fig. 3-16: FREQUENCY IN internal circuit diagram

Again, two applications are possible.
A – Connection to a 500 Series BIVECTOR converter, as slave, for use as a position slave (synchronization, electrical axis).
In this case, the converter using the FREQUENCY IN connector acts as slave (see 3.4.3.3 A).
B – Connection with other equipment for data reception. This application implies knowledge of the device to be connected and must be regarded as particular application; for the type of connection, take into account the receiving internal circuit, as shown in Fig. 3-16.

*3.4.3.5 **DIGITAL I/O** terminal block*

3.4.3.5.1

This box with 20 terminals is basically, but not exclusively, designed for input and output digital signals (or simply logical signals). This section reports some data concerning the installation aspects, while for the description of signals and their use see the Second Part of this manual.

Note: The flying part of this terminal block is supplied with the converter.

3.4.3.5.2

Fig. 3-17 shows the input/output electronic circuits leading to this terminal block. Please note that for the sake of clarity, the input signal electronic circuit and the output signal electronic circuit have been illustrated just once, meaning that they repeat for all other inputs and, respectively, outputs.

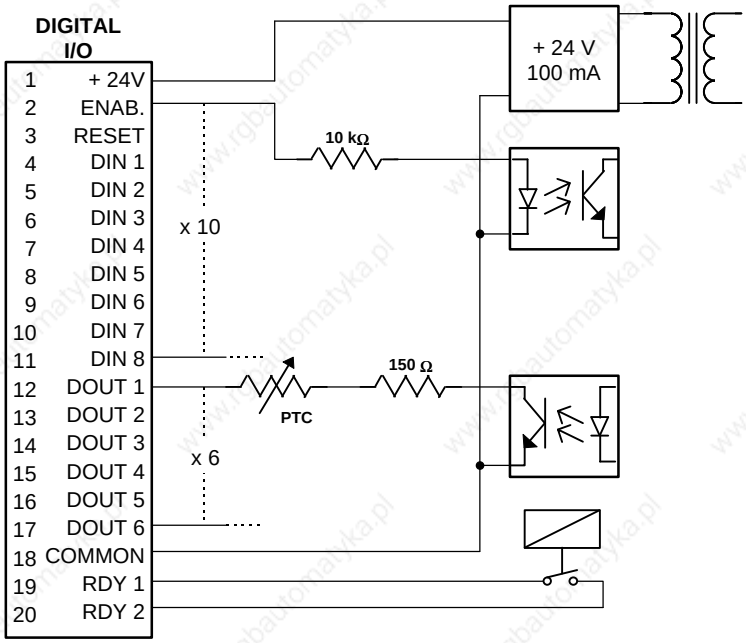


Fig. 3-17: Digital input and output internal circuit diagram

The terminal block provides for the following connections:

A – **Outputs**:

- N. 1 power output: auxiliary voltage for 24 V DC supply: between **+24 V** terminal and **COMMON** terminal;

Note stabilized voltage within ±10%;
maximum output current: 100 mA;
output galvanically insulated from the mains;
output protected against short-circuit.

- N. 1 output for non powered contact of internal relay, terminals **RDY1** and **RDY2**;

Note maximum voltage 48 V (AC or DC);
maximum current 0,5 A.

- N. 6 digital outputs **DOUT1 ÷ DOUT6**, referred to the **COMMON** terminal;

Note optoinsulated and protected outputs;
maximum output voltage: 30 V_{DC} (open collector);
maximum current sink 20 mA, for each output;
configurable via SW.

Note Because these outputs are open collector, an external pull-up resistor is needed (for

each output). For example, if an output current of 1 mA is required and voltage +24 V available on terminal 1 is used, a 24 kΩ resistor between +24 V and the used output is necessary.

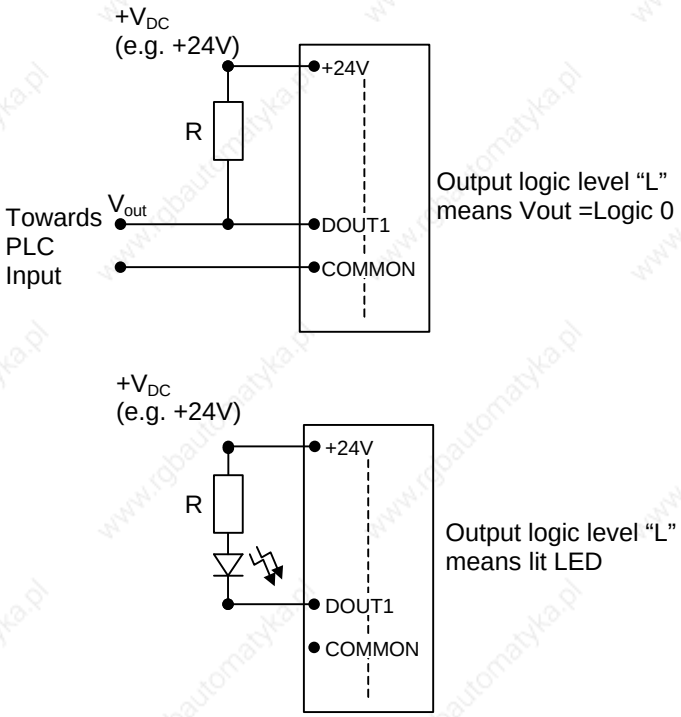


Fig. 3-18: Some examples of connection and interpretation of the digital outputs

B – **Inputs**:

- N. 2 **ENAB** and **RESET** status logical inputs, referred to the **COMMON** terminal;
- N. 8 digital inputs **DIN3 ÷ DIN10**, referred to the **COMMON** terminal;

Note optoinsulated and protected inputs;
maximum input voltage: 30 V_{DC};
typical input resistance: 10 kΩ;
SW configurable;
maximum input voltage for logical level 0: V_{IL} = 4 V (differential)
minimum input voltage for logical level 1: V_{IH} = 7,5 V (differential)

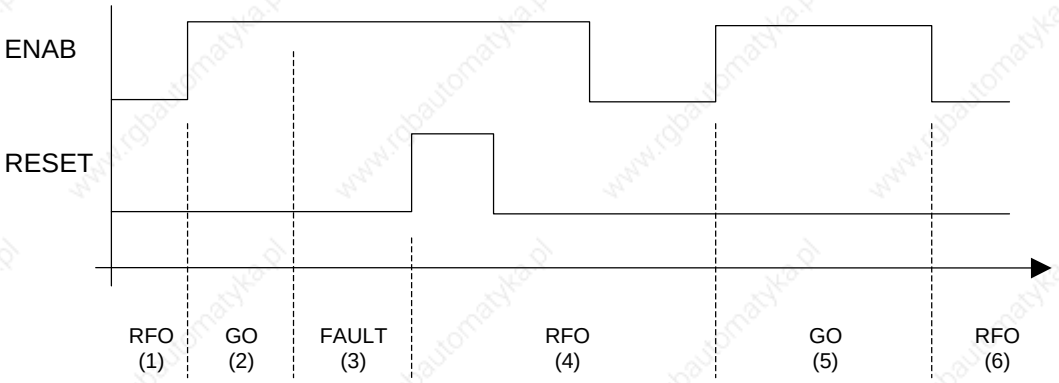


Fig. 3-19: Example: status of the drive system versus ENABLE and RESET inputs

Notes

(1) At first the converter is in RFO status.
(2) **LOW-HIGH** transition on ENAB moves the drive in GO status.
(3) If an external failure occurs (for instance the resolver cable is disconnected), then the drive moves in Fault status (Converter display Failure message: F1).

(4) When the problem is solved, the **LOW-HIGH** transition on the reset INPUT moves the drive in RFO status.
(5) A next **LOW-HIGH** transition on ENAB input moves the drive in GO status.
(6) The **HIGH-LOW** transition moves the drive in RFO status.

3.4.3.5.3

Note on the wiring. It is almost needless to say that the cables to this terminal block must be connected observing the general principles for signal connections. It is recommended to separate the inputs from the outputs, (separate shielded cables), to keep away from the power cables, to prepare cables as short as possible (max. 10 m) with section not smaller than 0,5 mm², essentially for mechanical reasons.

*3.4.3.6 **ANALOG I/O** terminal block*

3.4.3.6.1

This box with 10 terminals is essentially, but not exclusively, meant for input and output analog signals. While this section provides some data concerning the installation part, for the description of signals and their use refer to the Second Part of this manual.
Note: The mobile part of this terminal block is included in the converter scope of supply.

3.4.3.6.2

Fig. 3-20 shows the electronic circuits leading to this terminal block.

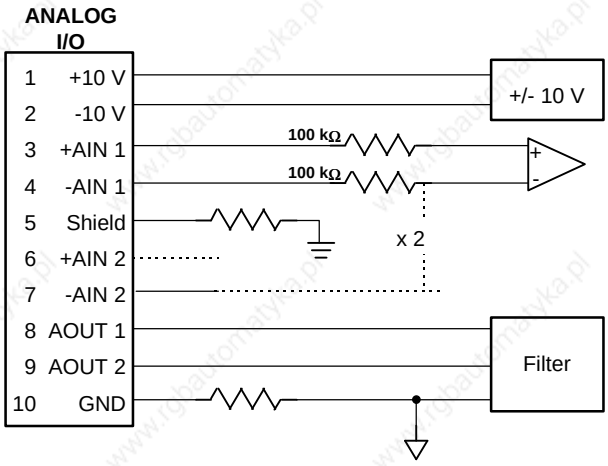


Fig. 3-20: Wiring diagram of the analog inputs and outputs

This terminal block provides for the following connections.

A – **Outputs**
N. 1 power output: DC reference voltage
20 V_{DC} between terminal **+10V** and terminal **–10V**.
Note Stabilized voltage within ±2%.
maximum current: 10 mA.
N. 2 analogue outputs **AOUT1** and **AOUT2**, ±5 V_{MAX} or ±10 V_{MAX} programmable, referred to the **GND** terminal.

B – **Inputs**
N. 2 analogue inputs; between **+AIN1** and **–AIN1**: ±10 V, 12 bit resolution, f_{MAX} = 300 Hz;
between **+AIN2** and **–AIN2**: ±10 V, 10 bit resolution, f_{MAX} = 1 kHz.

3.4.3.6.3

Notes on cable connections. The recommendation provided under 3.4.3.5.3, namely the need to connect the cables leading to this terminal block observing the general principles for signal connections, is here once again so repeated. It is in particular recommended to shield the analog inputs and to observe the maximum cable length of 10 m.

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Headquarters, Offices and Factory
Frazione Stazione Portacomaro, 97/C
14100 - ASTI - I
Telephone +39(0141)276111
Telefax +39(0141)276294

Sales Dept.
Viale Edison 50
20090 Sesto San Giovanni (MI) - I
Telephone +39(02)26232565
Telefax +39(02)26232979