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

Second Part: Commissioning and Use

Ref. MANIU10.9906 GB
Update 01
Issue September 1999

ABB Servomotors S.r.l.

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CHAPTER 1 – INTRODUCTION

1.1 Preliminary note

1.1.1

The content of this manual is compatible with the **software (SW) version 1.04** of the 300 Series and 500 Series BIVECTOR converters.

1.1.2

There are two application versions of the installed SW.

The first one – called VEL – is provided when the drive is used in "Torque Mode" or in "Speed Mode"; in this case the operating modes "Positioning Mode" and "Synchronizing Mode" are excluded, therefore the relative functions and parameters are excluded too. See Chapter 4.

In the second version – called POS – all functions described in this manual are implemented.

1.2 Editorial note

This manual is the Second Part of the "Installation, commissioning and use manual" for drive systems with 8C Series brushless servomotors and 500 Series BIVECTOR converters.

Since in both parts of the manual the chapter numbering starts with number 1, to avoid confusion references to the First Part (Installation) of the manual are followed by the indication (1st Part), while when this indication is not provided, we refer to this Second Part, "Commissioning and use".

In both parts, figures are numbered with two digits, the first of which refers to the chapter; the same applies to tables.

1.3 Notes for the reading of the Second Part

1.3.1

Some preliminary notes are necessary concerning the subjects contained in the Second Part of the manual, with special regard to Chapter 2, "Preliminary test of the drive system installation".

The First Part of the manual, "Installation", provides data, instructions and recommendations addressed both at the designers of the system or installation using power drive systems and at the installers, who are physically responsible for the installation. Once has been completed the installation, it is obviously necessary to test and commission it.

1.3.2

It is, of course, advisable for the tester (who can sometimes be the installer himself, provided that he has the skills and qualification for both jobs), to read and preliminarily study the Second Part of the manual.

1.3.3

It can sometimes be useful and necessary to provide for a **preliminary test**, in quite a short term, basically to check that the system has been correctly installed, postponing any optimization of the drive system to a later stage. The preliminary test, described in Chapter 2, allows – by using an especially dedicated command – to dramatically reduce the time generally required to study the Second Part of the manual.

1.4 Content of the Second Part

In the Second Part, Chapter 1 provides some editorial preliminary information; Chapter 2 describes a quick test procedure for the drive system installation and operation; Chapter 3 describes the control system, the table system and contains the complete list of parameters with related instructions for use. Chapter 4 and Chapter 5 illustrate the drive system

operation modes (torque, speed, positioning or synchronizing mode with another drive system) and the special functions, which are implemented in the software of the BIVECTOR converter. Chapter 6 addresses the operation faults and failures, with procedures using the self-diagnosis software and the BIVECTOR alarms. Finally, Chapter 7 and 8 contain detailed instructions for use of the removable keyboard and of the BIVCOM communication program for PC connection.

CHAPTER 2 – PRELIMINARY TEST OF THE DRIVE SYSTEM INSTALLATION

2.1 Important note

The activities described in this chapter refer to preliminary tests of the drive system, after it has been installed into a machine system. The tests described imply:
- the energizing of the whole equipment and of the drive system, in particular of the BIVECTOR converter;
- the commissioning of the drive system and therefore the motion of the mechanical units connected to the motor axis.

As a result, only skilled and expressly authorized personnel are allowed to carry out the activity described in this chapter. The operator must have the competence of a tester.
In particular, all the standards and recommendations provided under section 1.4.2 "**Reference to safety standards**" of Chapter 1 in the First Part of the manual MANIU10.9906 GB must be complied with.

WARNING! Dangerous voltages. Many operations described in this chapter involve the electrical measuring of parts of the live circuit. (Low voltage: Voltage comprised between AC 50 V and 1000 V and between DC 75 V and 1500 V). The measurement procedures and the instruments used must be compliant with safety standards and regulations.
WARNING! Residual voltages. See item 1.4.2.2 in Chapter 1 of the manual First Part.

WARNING! Danger due to moving mechanical parts. Some of the activities described in this chapter cause motor rotation. Consequently, make sure that the driven mechanisms (driven load) can move freely and that their motion does not cause material damage or physical injuries. Otherwise, the motor axis must be **mechanically disconnected** from the motion drive train.

2.2 Purpose of the activity

The purpose of the activity described in this chapter is to allow a quick test of the drive system and an initial test of the overall system operation. For the sake of convenience, this test procedure has been simply defined as TEST.
This type of preliminary test is subject to some limitations (see section 2.3 of this chapter) and is not meant to replace other more detailed types of test provided for by the machine system designers. In addition, it is obviously always necessary to subsequently perform all the setting, tuning and checking steps described in this manual for the final commissioning.
TEST uses a special program, especially developed to help the user during the first installation and to facilitate the practical approach to the drive system use. This program can be used through a PC and the BIVCOM communication program or through the hand-held Key-B keyboard, as described in Table 2/1.
When started in accordance with the procedures contained in Table 2/1, TEST automatically activates a speed-controlled motion cycle, as shown in Fig. 2-1.

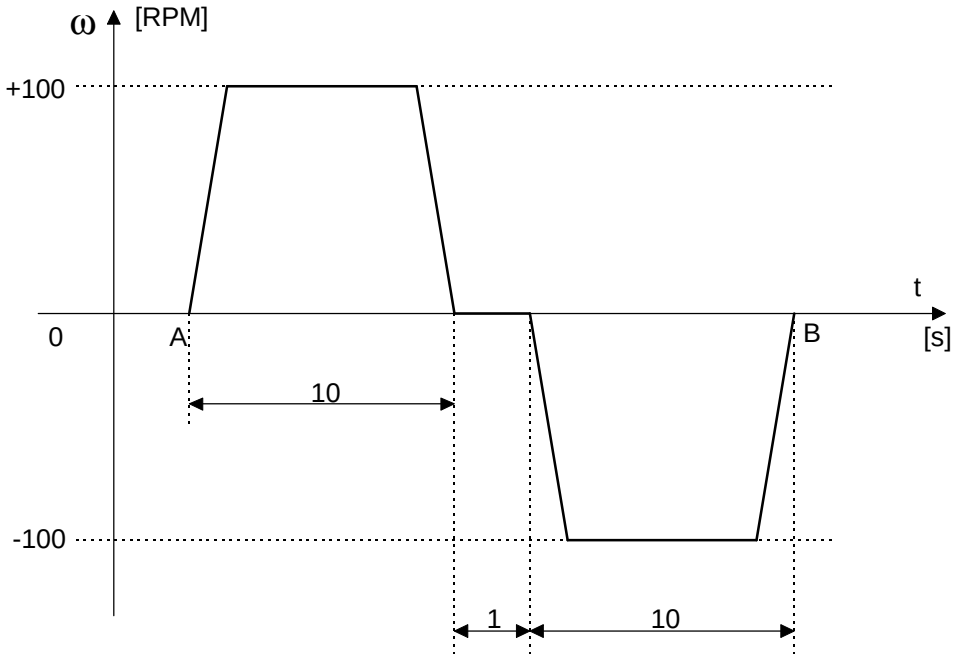

Fig. 2-1: TEST program motion cycle

Fig. 2-1 shows the diagram of the motor rotation speed as a function of time. The motor rotates in positive direction (clockwise seen from the shaft end side) with a speed of 100 rpm, for 10 seconds; subsequently – again without any intervention of the operator – the motion direction is reversed and the motor rotates in negative direction (counterclockwise seen from the shaft end side) with a speed of 100 rpm, for 10 seconds; after cycle completion, the motor stops.

2.3 Conditions for the use of TEST

The use of TEST is subject to the following conditions.

A -
The complete power drive system (PDS), including both the 500 Series BIVECTOR converter and the motor assembly, must be purchased from ABB Servomotors. This is the regular purchase modality, which allows to receive the two drive system basic components already programmed for matched operation.
Yet, under particular conditions, the BIVECTOR converters and the 8C Series servomotors may be stored by the customer, who thus has the possibility of choosing from Table 2/8 (1st Part) the desired combination of converter and servomotor. In this case, **the TEST procedure should not be used** and the Customer Service should be contacted.
B -
It is necessary to use, alternatively:
a) the BIVCOM program, which requires a Personal Computer, at least during this test stage;
b) the Key-B type hand-held keyboard.
C -
During the test, the motor rotation should be allowed. In this respect, refer to section 2.1, paragraph “Warning! Danger due to moving mechanical parts”.
D -
The possibility should be provided of a sight check of the motor axis motion or of a mechanism driven by it.

2.4 References to the other manual chapters

The TEST procedure asks the operator to have learned only some basic parts of this Second Part, without the need for a thorough study, which can take place subsequently.

Important notes:

A -

Because TEST can be used both through a PC and the hand-held keyboard, either Chapter 7 or 8 should be read, according to the actually used equipment.

The items of the manual Second Part that need to be known in order to perform TEST are the following:

Chapter 1 - Overview: the whole chapter.

Chapter 2 – Preliminary test of the drive system installation: the whole chapter.

Chapter 6 – Non compliant operation and failures: a preliminary study is not required; it can provide guidance, when necessary. Read the parts referred to in Table 2/1.

Chapter 7 – Use of the BIVCOM program: (in particular section 7.4.3)

Alternatively

Chapter 8 – Use of the hand-held Key-B keyboard: (in particular section 8.4)

2.5 Drive system preliminary test

A -

Before performing the activity described in this chapter, the drive system components need to be identified. To this purpose, the commercial documentation (order, order acknowledgment, material delivery note, etc.) needs to be compared with the special nameplates on the 500 BIVECTOR converter and on the 8C Series servomotor.

Inform the Customer Service about any discrepancy.

B -

Before starting the drive system preliminary test, it is necessary for the machine system – **with drive system not connected** – to have been tested according to the required standards, in particular according to standard CEI EN 60204-1.

This means that, with reference to Fig. 2-2, disconnecting switch QS1 (or automatic break QF1) must be open, as well as disconnecting switch QS2.

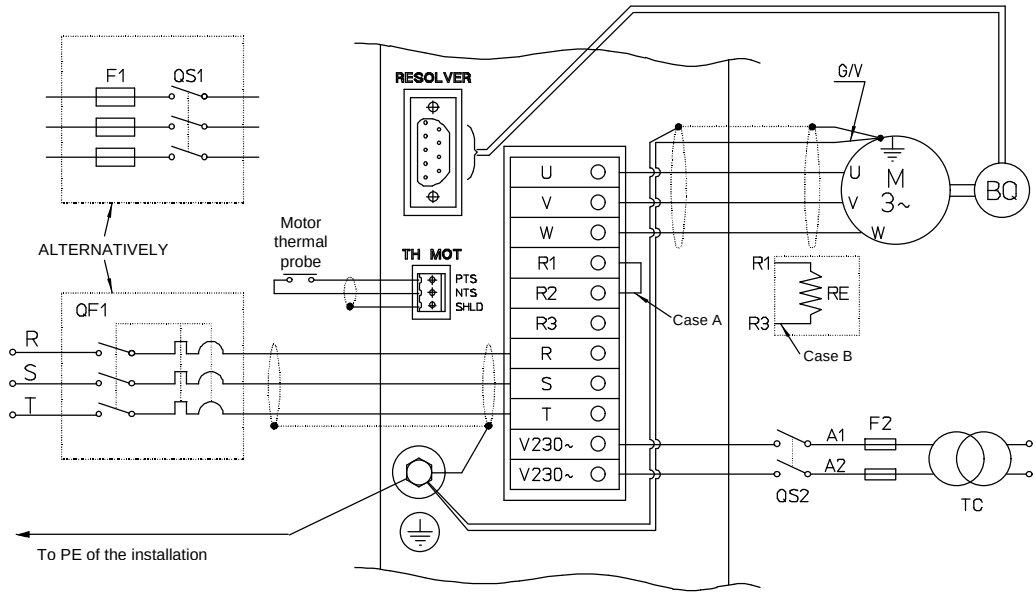

Fig. 2-2: Power supply and related drive system connection diagram

C – *Test procedure and measurements*

Table 2/1 describes the sequence of procedures and measurements that must be performed in order to carry out TEST.

Note: Because TEST can be performed both using the BIVCOM program and the Key-B hand-held keyboard, in the table – when the procedure is different – the step for the Key-B features the same number as BIVCOM, followed by letter a). Obviously, either one or the other step is to be performed.

Table 2/1

Step No.	Test title	Operating procedures	Result To achieve	Achieved result	Notes
2.5.C.1	**U_{VN}** measurement – power supply voltage	[Fig. 2-2] QF1 (or QS1) open; measurement at the disconnecting switch input terminals (three measurements): S-R, S-T, R-T.	rated: 400 V minimum: 360 V maximum: 440 V	A: compliant B: non compliant	A: go to 2.5.C.2 B: see Chap. 6
2.5.C.2	Measurement of auxiliary voltage [3.4.2.2.(1st Part)] Note: only in case of auxiliary power supply use	[Fig. 2-2] QS2 open; measurement at disconnecting switch input terminals: A1, A2	rated: 230 V minimum: 207 V maximum: 253 V	A: compliant B: non compliant	A: go to 2.5.C.3 B: see Chap. 6
2.5.C.3	Check of power and signal cables	[Fig. 2-2], [Fig. 3-6(1st Part)], [Fig. 3-7(1st Part)], [Fig. 3-8(1st Part)], [§ 3.4, (1st Part)] and machine system diagrams. Use of testers and circuitry testers.	Connections matching with diagrams	A: compliant B: non compliant	A: go to 2.5.C.4 or to 2.5.C.4.a B: correct according to diagrams.
2.5.C.4	Connection of PC to BIVECTOR and BIVCOM program installation on PC	See Chapter 7	See Chapter 7	See Chapter 7	See Chapter 7
2.5.C.4.a	Connection of Key-B to BIVECTOR	See Chapter 8	See Chapter 8	See Chapter 8	See Chapter 8
2.5.C.5	Empty	//	//	//	//
2.5.C.6	Three-phase power supply: Measurement of **U_{VN} –** at BIVECTOR converter terminals [Table 2/1 (1st Part)]	Close QF1 (or QS1). QF1 (or QS1) closed. Measurement at BIVECTOR terminals: R-S, S-T, R-T.	rated: 400 V minimum : 360 V maximum: 440 V	A: compliant B: non compliant	A: go to 2.5.C.6 B: Repeat measurements 2.5.C.1 and see Chap. 6
2.5.C.7	Measurement of the auxiliary voltage at the BIVECTOR terminal block Note: only in case of auxiliary power supply use.	[Fig. 2-2] Close QS2. QS2 closed. Measurement at terminal pair marked V230 ~.	rated: 230 V minimum: 207 V maximum: 253 V	A: compliant B: non compliant	A: go to 2.5.C.8 B: Repeat measurement 2.5.C.2 and see Chap. 6
2.5.C.8	Drive system status	QF1 (or QS1) closed.	A few seconds after step 2.5.C.6 the BIVECTOR DISPLAY must show letters **OH (**Drive **OK).**	A: compliant B: non compliant	A: go to 2.5.C.9 or to 2.5.C.9.a B: see Chap. 6

2.5.C.9	System operation preliminary test: START OF TEST with use of PC	 Make sure that the motor rotates freely! Following the procedures described in Chap. 7, start TEST: press **F5** on the keyboard.	1) The BIVECTOR DISPLAY shows: **GO** **2) The MOTOR rotates clockwise (seen from the shaft side) and counterclockwise according to the cycle described in § 2.2.**	A: compliant B: non compliant	A: go to 2.5.C.10 B: see Chap. 6
2.5.C.9.a	System operation preliminary test: START OF TEST with use of Key-B	 Make sure that the motor rotates freely! Following the procedures described in Chap.8 § 8.4, start TEST: press **F3.**	1) The BIVECTOR DISPLAY shows: **GO** **2) The MOTOR rotates clockwise (seen from the shaft side) and counterclockwise according to the cycle described in § 2.2.**	A: compliant B: non compliant	A: go to 2.5.C.10 B: see Chap. 6
2.3.C.10	System operation preliminary test: TEST PROCEDURE AUTOMATIC STOP	Wait for an adequate lapse of time (at least 21 sec). In case of emergency, give **STOP** command via serial link (BIVCOM or Key-B) or digital input.	After the automatic execution of the operation cycle as in Fig. 2-1: 1) The BIVECTOR DISPLAY shows: **OH**; **2) The MOTOR stops, with free shaft.**	A: compliant B: non compliant	A: go to 2.5.C.11 B: see Chap. 6
2.5.C.11	END OF TEST PROCEDURE	The preliminary test is completed and the drive system is now in RFO (Ready for Operation) status; now it is possible to proceed according to the user's requirements.			

NOTE:
According to Table 2/1 in the First Part of this manual MANIU10.9906 GB, the absolute limits of power voltage supply of the 500 Series BIVECTOR converter are: 340 V minimum and 484 V maximum; the values indicated in 2.5.C.1 and 2.5.C.6 are referred to standard three-phase power supply voltage of 400 V ± 10 %.

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CHAPTER 3 – DESCRIPTION OF THE CONTROL SYSTEM

3.1 General

In every converter for drive systems the most qualifying part is that concerning the drive and control circuits; this is especially true for the 500 Series BIVECTOR converters, belonging to the latest generation of the so-called “intelligent converters”. Indeed, the BIVECTOR converter incorporates many functions that, in less advanced systems, are still exclusive domain of controllers (numerical controls, PLC, programmers, positioners, etc.). Thanks to these features, it is possible to use the drive systems combined with BIVECTOR for a wide range of applications, often without the aid of other controllers, thus simplifying the system and reducing costs.

3.2 Control system architecture

3.2.1

The electronic converter is conceptually (but also structurally) composed of two main parts: the power stage, which converts the electrical energy absorbed by the mains to electrical energy with features suitable for supply to the variable speed motor, and a second so-called “signal” part, or “drive and control stage”.

3.2.2

The power stage block diagram is shown in Fig. 3-8, Chapter 3 of the First Part of the manual. The drive stage simplified block diagram is shown in Fig. 3-1 of this chapter.
The blocks indicated in Fig. 3-1 basically refer to the hardware composition of the BIVECTOR drive and control circuits; related functions and processing are performed by the various components as a whole and are outlined in the operation diagram (see section 3.2.3).
In Fig. 3-1, the block indicated with **μC** is the H8/3003 microcontroller. The system is completed by the following main blocks:
- **PGA** programmable logic;
- **RAM** memory;
- **EEPROM** memory;
- **EPROM FLASH** memory;
- **RTC** real time clock.

The **DISPLAY** is located on the BIVECTOR front and provides the user with operation status information; see Chapter 6 for its functions.
The block marked **FOC** (Field Oriented Control) consists of different components that contribute to the motor control strategy. **FOC** sends the control signals to the **POWER STAGE** and, in turn, receives signals from **PGA**, feedback from **POWER STAGE** and from the $\mathbf{B_Q}$ position transducer. **POWER STAGE** feeds **M,** which, in this case, is the 8C Series motor.

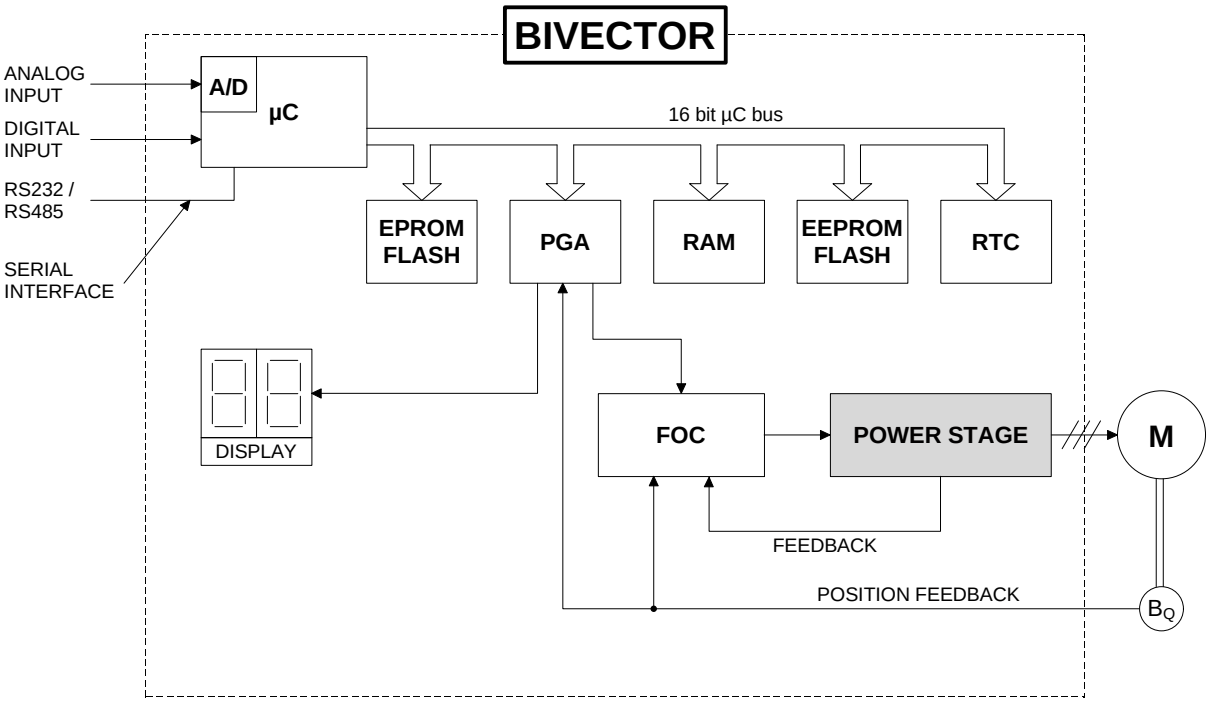


Fig. 3-1: Control stage block diagram

3.2.3

Fig. 3-1 shows the converter's memories; because it is important for the operator to precisely know their location and function, in order to avoid losing information and/or processing operations during data storage, Table 3/1 summarizes some data relating to the memories installed in the BIVECTOR.

Table 3/1

Memory	Type	Use	Accessible to user
Permanent	EPROM FLASH	Micro-controller program	no
Rewritable	EEPROM FLASH	Contains the drive system parameters	yes
Volatile	RAM	Duty memory	yes

Please note that, when completion components are used, the memories contained in the components themselves are used too, such as, for example, the PC hard disk, when the BIVCOM program is used, or the EEPROM memory of the Key-B hand-held keyboard.

3.2.4

The part outlined in the previous sections makes up the HW structure of the drive and control system. It is useful to also know the basics of the operating structure, whose block diagram is shown in Fig. 3-2.
The use of the FOC control strategy allows to achieve excellent results for torque control:

- optimum positioning of the working point (flux-current) for maximum torque constant;
- strong control in the flux weakening area;
- damping features, achieved by minimizing the total torque ripple.

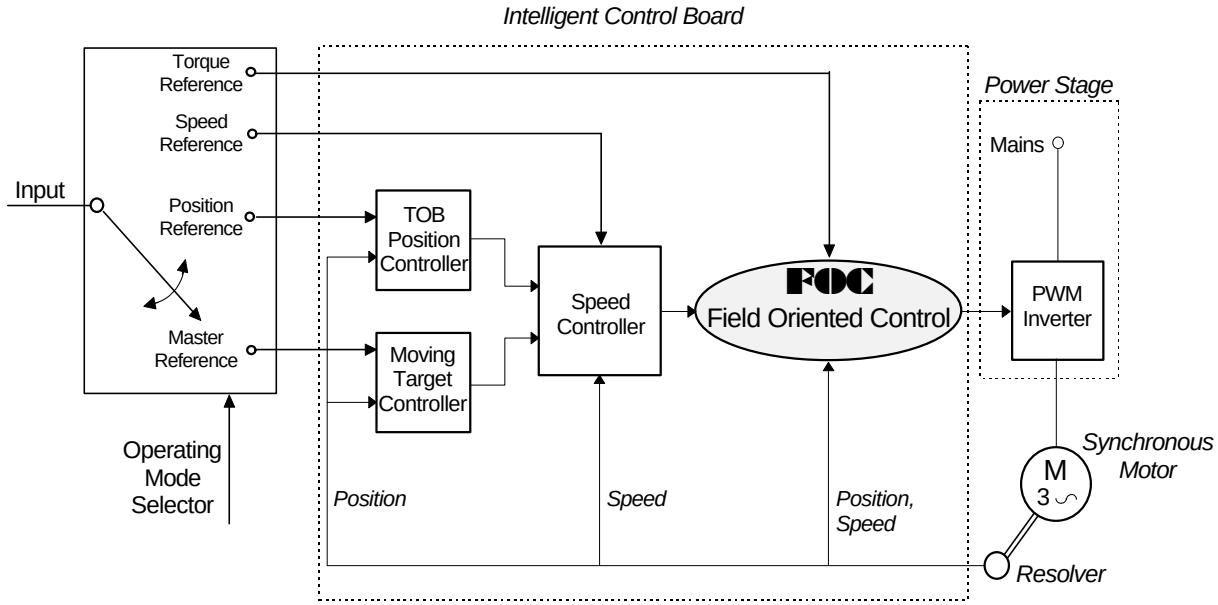


Fig.3-2: Drive system functional diagram

3.3 List of operating modes

3.3.1 Introduction

The Power Drive System (PDS) that uses the BIVECTOR converter provides for many operating modes and is extremely flexible to use.
The drive system with BIVECTOR converter is a single-motor and single-variable drive system.

3.3.1.1
The definition of single-motor drive system applies to a drive system that:
a) accepts only one motor as converter load (terminals **U**, **V** and **W** of the BIVECTOR are meant for the connection of one single motor and it is not possible to feed more motors in parallel);
b) does not share power parts (such as the DC intermediate circuit) with other converters.

3.3.1.2
By principle, the single-variable drive system drives and controls – in compliance with the specified tolerances (e.g. accuracy, response time, etc.) – only one variable at a time, among those physically possible. In general, the slaving is achieved by using a closed loop.

3.3.2 Operating modes

The BIVECTOR provides for four programmable operating modes:
- Torque mode (torque drive and control);
- Speed mode (speed drive and control);
- Positioning;
- Synchronizing.

For each operating mode, Fig. 3-2 indicates the connection locations in the control circuit and related closed loops.
For the operating details, see Chapter 4, “Implementation of the operating modes”.

3.4 Drive system status and related commands

3.4.1 Preliminary note

In this manual, some of the words commonly used in relation to servodrives have the meaning provided in the following Table 3/a:

Table 3/a

Word	Notes
Warning	Procedure that does not change the converter status but, in some circumstances, limits its performance.
Failure	(also: failed operation, fault) Procedure which disables the converter and determines its FAIL status, described in the following section.
Alarms	It comprises *Warnings* and *Failures*.
Edit, Editing	Function that allows to read/write and save the converter parameters.

3.4.2 Drive system status

The drive system can be under different conditions, which mainly depend on the commands received and on its activity history; each of these conditions is defined as **status**.
The drive system with BIVECTOR converter can provide for three possible conditions, listed in Table 3/b; each status corresponds to one or more indications on the display located on the BIVECTOR front.

Table 3/b

Status	Meaning	Indication on the BIVECTOR display
RFO	Ready For Operation	**OH** (drive OK)
GO	Operating	**GO**
FAIL	Failure	Different according to the type of Failure: e.g. **d.1, U.1, H.5**, etc. (see Chapter 6).

For each status, the features and the commands with related action shall now be described, also indicating any transition to another status.

*3.4.3 **RFO** status (Ready For Operation)*

3.4.3.1 Status features

- there are no Failures, but there may be Warnings.
- converter disabled, yet ready for operation.

3.4.3.2 Possible actions and commands

- **Start** commands (see section 3.7); the converter moves to status GO.
- start of the **TEST** procedure for the drive system preliminary test (see Chap. 2, “Preliminary test of the drive system installation”); in a regular operation, the converter moves to the GO status for about 21 sec and then returns automatically to the RFO status.
- start of **PLC** functions (Homing, Tune, Jog), described in Chapter 7, “Special Functions”; the converter moves to status GO.
- start of autotuning functions (currently under development).
- enabling/disabling of the digital monitor of some values (**Display Parameters** function).
- display of the Warnings in process.

- **Editing** function: editor open/close, editing of parameters of any table, parameter saving in EEPROM (see section 3.5); the RFO status is the most suitable to configure the drive system according to the operating needs, using the Editing function;

Notes: the RFO status is the only one that allows to:
1 – save parameters in EEPROM
2 – edit the table of the motor-converter data.
3 – use function “Copy user table GenP #... in place of user table GenP #...”).

- **Copy Parameters** function to transfer all parameters from one converter to another that is to be configured in the same way (also called “drives clonation” function).

*3.4.4 **GO** status*

3.4.4.1 Status features

- there are no Failures, but there may be Warnings.
- converter enabled, operating in one of the four possible operating modes.

3.4.4.2 Possible actions and commands

- **Stop** (see section 3.7) and **User Stop** (see section 3.7.4) commands; the converter moves to RFO status.
- **On-the-fly change** of tables, commanded by the user (see section 5.2) or self-controlled according to a logic chosen by the user (see section 5.3); the converter remains in GO status.
- enabling/disabling of the digital monitor of some values (**Display Parameters** function).
- display of the Warnings in process.
- **Editing** function: editor open, editing of parameters of system, control and user tables (see section 3.5); in this status, the Editing function allows to tune different dynamic performances.

*3.4.5 **FAIL** status (Failure)*

3.4.5.1 Status features

- determined by the occurrence of at least one Failure; there may be Warnings as well.
- converter disabled.

3.4.5.2 Possible actions and commands

- **Alarm reset** command; if the alarm persists, the converter remains in FAIL status; if all Failures have been eliminated, the converter moves to RFO status.
- display of the Warnings in process.
- display of the first occurred Failure (in time order) and of all the Failures currently occurring.
- **Editing** function: editor open/close (without saving), editing of parameters of system, control and user tables; in this way, the user is allowed to repair a Failure due to a wrong parameter setting (see section 3.5).

3.5 Parameters editor and tables management

3.5.1 Description of tables

The BIVECTOR parameters are grouped into tables, according to operation and management requirements. The main contents of each table are reported below. In section 3.6, all the parameters contained in the tables are listed in detail, with the related meaning and data input procedure, when this is allowed to the user and necessary.

3.5.1.1 System table #0, system table #1

These two tables concern the drive system, namely the motor assembly plus the BIVECTOR converter, with the related interface; the tables are two for management convenience. By means of the parameters of these tables, the user can configure:

- presence/absence of the auxiliary supply voltage;
- motor assembly: - motor: rated current, thermal time constant, thermal probe;
  - pole pairs, phase reference;
- logical inputs: function, active levels;
- logical outputs: function, active levels;
- analog inputs: configuration, offset;
- scale of the speed analog reference inputs;
- scale of torque analog reference inputs;
- analog outputs: configuration, function, signal levels;
- serial interface configuration (baud-rate, drive identification, serial priority);
- simulated encoder output: resolution, North Marker;
- frequency input: resolution;
- phase current offset levels;
- SW limit switch: enabling/disabling, position;
- reference position set in the Homing procedure;
- overspeed threshold (motor overspeed).

3.5.1.2 Control table

It allows to tune the BIVECTOR control system. The user has access to only one parameter for

- tuning of the speed signal second harmonic.

3.5.1.3 Motor-converter data table

This table includes parameters not accessible to the user.

3.5.1.4 User table

The parameters and/or instructions contained in this table define the motion task desired by the user; the main parameters or instructions are the following:

- operating mode (see section 3.3);
- reference values;
- tuning of speed and position loops;
- limitations (speed ramps, output phase current, drive system torque and power);
- electrical axis configuration;
- tables selfcommutation logic.

User tables are divided into two categories:

a) **special** – dedicated to a specific converter function.

- apart from RFO and Security tables, all the other tables can be fully configured by the user (with some warning notes, pointed out for each special function in Chapter 5);
- they can be comprised within the user tables selfcommutation logic through the Target special function;
- the on-the-fly change cannot be activated by an external command (via serial link or digital inputs);
- list of the special user tables:

Name	Accessible to user	Associated function
RFO (Ready For Operation)	no	RFO status
Security	no	Stop command
Limit Switch Hardware - Right	yes	Trip of limit switch HW - right
Limit Switch Hardware - Left	yes	Trip of limit switch HW - left
Limit Switch Software #1 - Right	yes	Trip of limit switch software #1 - right
Limit Switch Software #1 - Left	yes	Trip of limit switch software #1- left
Limit Switch Software #2 - Right	yes	Trip of limit switch software #2 - right
Limit Switch Software #2 - Left	yes	Trip of limit switch software #2 left
User Stop	yes	Stop command customized by the user
Homing	yes	Homing procedure
Free for further developments	--	--
Jog +	yes	Jog+ procedure and TEST
Jog -	yes	Jog- procedure and TEST
Tune	yes	Tuning the speed signal second harmonic

b) **general** (GenP = General Purpose) – used to configure the desired motion tasks during normal operation.

- 32 tables.
- fully configurable by the user.
- can be changed on-the-fly (during normal operation):
  - external command (via serial link or logical controls);
  - selfcommutation (when the Target special function is used).

3.5.2 Converter parameterization procedure

For a correct and consistent parameterization of the converter, the recommended procedure is the following:

1. For refining the speed signal tuning: perform the TUNE procedure described in section 5.8.
2. With the converter disabled, the system (converter, motor assembly and interfaces) is configured according to the application requirements. The customization possibilities are described in section 3.5.1.1; the concerned parameters are in system tables #0 and #1.

Note: it is recommended to perform these settings with the converter disabled because a wrong setting may cause undesired operations.

3. a) With the converter still disabled, motion tasks are set according to the desired operating cycle:
   - define the user tables to be used in the operating cycle and the way they are started:
     - with Start command – the starting point is always user table GenP #0 (available both via serial link and via ENABLE dedicated logical input) – see section 3.7.
     - with command “Start with table #...” – the starting point is any general user table (available via serial link only) – see section 3.7.
     - using the on-the-fly change of the user tables set via serial link or via logical inputs (the logical inputs in system table #0 must be appropriately set) – see section 5.2.
     - using the self-controlled on-the-fly change of the user tables through the Target procedure, adequately configured in the user tables concerned – see section 5.3.
   - define the operation modes (see Chap. 4) and set the desired references and limitations by adequately setting the relevant user tables.

Note: the converter can now be enabled by a Start command; it is suggested (when possible) to always begin with low gains for the adjusting loops and with conservative limitations and references, in order to avoid failures due to a bad drive system tuning.
b) With the converter enabled, the speed, positioning and synchronization loops are set through the appropriate parameters of the relevant user tables.

*3.5.3 **Edit** function*

3.5.3.1 Definition

Edit can be defined as the function including:
F1 – category of commands for reading, editing and saving table parameters.
F2 - (Parameters Copy) – category of commands for copying all the 68 tables from one BIVECTOR converter to another BIVECTOR converter (the so-called "drives clonation" procedure)

3.5.3.2 Editor status

a - Editor OFF (closed) – the active tables (i.e. those that are currently used in the control algorithms) are in the BIVECTOR's EEPROM memory.
b - Editor ON (open) – the active tables are in the BIVECTOR's RAM memory.

3.5.3.3 Editor commands

It is possible to edit one table at a time; even for reading / editing / saving one single parameter of a table, it is necessary to work on the entire table.
The main commands of the Edit function are the following:

Cat.	Editor Command	Action	Editor status	Notes
F1	**Open Editor**	Copies all the 68 tables from BIVECTOR's EEPROM to BIVECTOR's RAM.	ON	The next command must be of type "Load table".
F1	**Close Editor Without Saving**	Tables existing before the opening remain in EEPROM. Any performed editing is not stored.	OFF	Use this command carefully because all the settings and tunings performed may be lost.
F1	**Close Editor with Saving**	All the tables with any editing performed in RAM is copied into EEPROM.	OFF	Command available in RFO status only (e.g. after a Stop command).
F1	**Save without Exit**	As above, but Editor remains open.	ON	Command available in RFO status only.
F1	**Load Table**	The table to be edited is chosen.	ON	
F1	**Load User Table GenP #xx As GenP #yy**	Copies the user table GenP #xx in place of the user table GenP #yy.	ON	Important! The user table GenP #yy is the one that will be edited. Command available in RFO status only.
F2-A	**Read Parameters**	Reads the 68 tables from the source converter's EEPROM and stores them in: - EEPROM of Key-B - RAM of PC (see Note below)	-	
F2-B	**Write Parameters**	Writes the 68 tables in the EEPROM memory of the destination converter (see Note below)	-	

Note: Using the PC and the BIVCOM program, the function **Copy Parameters** is available through data files saved on hard disk or floppy disk. To create the files, perform step F2-A ("Read Parameters from EEPROM") followed by step "Write Parameters to Disk", in the desired file. To load the parameters from a file to a converter, perform "Read Parameters from Disk" (data is loaded into the PC RAM selecting the desired file) followed by step F2-B ("Write Parameters to EEPROM").

3.6 Parameters

3.6.1 General

Parameters are information of logical or numerical type that are provided from the outside to the control stage of the BIVECTOR. Parameters can be communicated to the control stage by:
- the converter's manufacturer, upon initialization and/or test;
- the manufacturer's service (in certain special cases by the user's service);
- the user.

Not all parameters can be modified by the user; those that are accessible to the user are marked in bold characters.

3.6.2 Parameters of system table # 0

01: Auxiliary Supply

- It indicates the presence ("Yes") / absence ("No") of the single-phase 230 V, 50/60Hz auxiliary supply, which acts as backup for the control board; when the presence of this supply is indicated, the Warning "Auxiliary 230V Undelivered" (A.1) is enabled, indicating any lack of it; the main use of this function is to keep the position feedback active even after the power supply has been switched off.

02: Motor Thermal Probe

- It indicates the type of thermal probe fitted on the motor: Klixon normally closed ("Klixon ON"), Klixon normally open ("Klixon OFF"), a PTC mounted on a motor phase ("PTC-1") or three PTCs in series installed on the three motor phases ("PTC-3"); the activation of the alarm "Motor Thermal Probe Protection" (H.2) depends on the chosen configuration; for example, choosing "Klixon ON", alarm H.2 is triggered when the motor thermal probe is disconnected or when the motor is overheated (Klixon opened).

- **03: User Tables Selected**
- It indicates the number of general user tables selected via digital inputs; based on this parameter, the digital inputs via which the on-the-fly change of the tables is performed are automatically assigned (see the following table), regardless of their previous meaning. The automatic assignment of the digital inputs has the following features: the occupied digital inputs are contiguous starting from input DIN 1 and the least significant bit of the digital word is given by DIN1. The on-the-fly change of the user tables via the digital inputs is enabled when the priority of the commands sent via serial link RS232 or RS485 is removed (Par. 26, *Serial Priority*, in this system table #0, set at "No").

Note: remember that the on-the-fly tables change function (via digital inputs or serial link) has less priority than the function of the Target to be reached; in other words, if at a certain time the Target table is active, the on-the-fly change of tables is disabled.

Selection	Selected tables	Digital inputs used
00 User Tables	None	None
02 User Tables	GenP 0 ÷ GenP 1	DIN 1
04 User Tables	GenP 0 ÷ GenP 3	DIN 1 ÷ DIN 2
08 User Tables	GenP 0 ÷ GenP 7	DIN 1 ÷ DIN 3
16 User Tables	GenP 0 ÷ GenP 15	DIN 1 ÷ DIN 4
32 User Tables	GenP 0 ÷ GenP 31	DIN 1 ÷ DIN 5

Example: Par. 03 = “08 User Tables” implies a number of user table configured via DIN1, DIN 2 and DIN 3. To select user table GenP 4, the digital inputs need to be set as follows: DIN 3 = 1 (the most significant bit), DIN 2 = 0 and DIN 1 = 0.

04: Digital Input 1 Configuration

- It configures digital input No. 1, assigning a certain function enabled by the status of the input signal. The available functions are:
  - user table selection (“User Tables Selector”) (see section 5.2)
  - right/left limit switch (“Rx/Lx Hardware Limit Switch”) (see section 5.7)
  - STOP command configurable by the user (“User Stop”) (see section 3.7.4)
  - rotation direction reversal (“Speed Reversing”)
  - proximity/homing sensor (“Home Input”) (see section 5.4)
  - manual motion function (“Jog”) (see section 5.5)

The enabling modes of these functions are:
- “High” : the function is enabled when the input signal level is high.
- “Low” : the function is enabled when the input signal level is low.

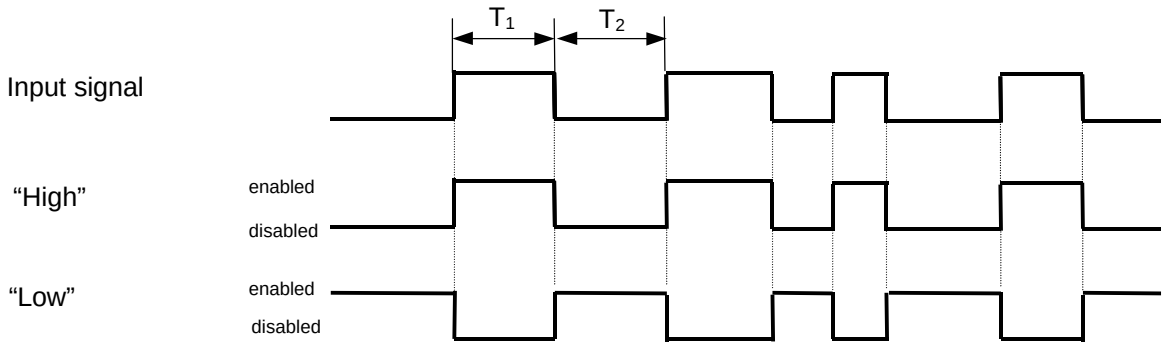


Fig. 3-3: Enabling of the functions according to the digital input signal status

To summarize, the possible configurations are the following:
- User Tables Selector
- Right HW Limit Switch High
- Right HW Limit Switch Low
- Left HW Limit Switch High
- Left HW Limit Switch Low
- User Stop High
- User Stop Low
- Speed Reverse High
- Speed Reverse Low
- Home Input High
- Home Input Low
- Jog+ High
- Jog+ Low
- Jog- High

- Jog- Low
- Start Homing High
- Start Homing Low
- Not Used

Note:
1 – for the “User Tables Selector” function, only mode “High” is available.
2 – the input signal specifications are : $T_1 > 2$ ms, $T_2 > 2$ ms .
3 – digital inputs rate: 1 ms.

05: Digital Input 2 Configuration
- it configures digital input No. 2
- specifications: as Par.04

06: Digital Input 3 Configuration
- it configures digital input No. 3
- specifications: as Par.04

07: Digital Input 4 Configuration
- it configures digital input No. 4
- specifications: as Par.04

08: Digital Input 5 Configuration
- it configures digital input No. 5
- specifications: as Par.04

09: Digital Input 6 Configuration
- it configures digital input No. 6
- specifications: as Par. 04, except for the “User Tables Selector” function, which is not available on this digital input.

10: Digital Input 7 Configuration
- it configures digital input No. 7
- specifications: as Par. 09

11: Digital Input 8 Configuration
- it configures digital input No. 8
- specifications: as Par. 09

12: Digital Output 1 Configuration
- it configures digital output No. 1; the following table lists the status of the digital outputs based on the chosen configuration; this description applies when Par. 18, *Digital Output Reversing*, of the same table, is set as “No Reverse”. Reversed levels can be obtained by setting Par. 18 as “Reverse”. As for levels “L” and “H” of the output signals, refer to Chapter 3 (1st Part), item 3.4.3.5.1.

Configuration	Meaning
Fail Status	"L" ⇒ Fail status
Drive Enable	"L" ⇒ Drive enabled
Zero Speed Reached	"L" ⇒ Zero speed reached (*)
Speed Sign	"H" ⇒ Positive rotation direction
Reached Speed	"L" ⇒ Reference speed reached (*)
Reached Position	"L" ⇒ Reference position reached (*)
Reached Time Target	Toggle ⇒ Time Target reached (**)
Converter I2xt	"L" ⇒ Alarm "Converter Thermal Estimate" (H.3)
Motor I2xt	"L" ⇒ Alarm "Motor Thermal Estimate" (H.4)
HW Limit Switch	"L" ⇒ Overtravel of one of the HW limit switches
SW1 Limit Switch	"L" ⇒ Overtravel of one of the SW limit switches, level 1
SW2 Limit Switch	"L" ⇒ Overtravel of one of the SW limit switches, level 2
Not Used	

Rate of digital outputs: 2 ms.
Note:
(*) reaching a certain speed or position means obtaining an absolute value for the error (between the reference and actual value) less than the one specified in Par.32, *Target Error*, in the currently active user table;
(**) when the time target (specified by Par. 31, *Target Value*, in the currently active user table) is reached, the digital output is reversed.

13: Digital Output 2 Configuration
- it configures digital output No. 2
- specifications: as Par.12

14: Digital Output 3 Configuration
- it configures digital output No. 3
- specifications: as Par.12

15: Digital Output 4 Configuration
- it configures digital output No. 4
- specifications: as Par.12

16: Digital Output 5 Configuration
- it configures digital output No. 5
- specifications: as Par.12

17: Digital Output 6 Configuration
- it configures digital output No. 6
- specifications: as Par.12

18: Digital Output Reversing
- it allows to reverse ("Reverse") or not ("No Reverse") the meanings of the 6 digital outputs, vis-à-vis the meanings provided at Par.12, *Digital Output 1 Configuration*.

19: Analog Output 1 Configuration
- it configures analog output No. 1; the signal value which corresponds to the full scale of each value is set at 5 or 10 V, via Par.21, *Analog Output 1 Scale*. The values that can be displayed are:

Configuration	Full scale
Actual Speed	W_FS = 7324,2 rpm
Reference Speed	W_FS = 7324,2 rpm
Actual Speed Module	W_FS = 7324,2 rpm
Current Module	I_FS (*) x 1,24
Flux Current	I_FS (*)
Torque Current	I_FS (*)
Converter I2xt Level	I_FS x I_FS (*)
Motor I2xt Level	I_FS x I_FS (*)
Brake Ixt Level	Duty-cycle = 100%
DC Bus Voltage	Vdc_FS = 450 V
Mechanical Angle	π
Not Used	

The output data is updated every 1 ms.
Note:
(*) I_FS (current full scale) = 1,414 x Par.02, *Converter Peak Current*, (motor-converter data table). Example: for a 18/36 converter, I_FS = 1,414*36 = 50,91 A^.

20: Analog Output 2 Configuration
- it configures analog output No. 2; the signal value which corresponds to the full scale of each value is set at 5 or 10 V, via Par.22, *Analog Output 2 Scale*. The values that can be displayed are the same as those listed for Par.19.

21: Analog Output 1 Scale
- for analog output No. 1, it sets the signal value corresponding to the full scale of each value. Possible options are: “5 V” and “10 V”.
- default value: “10 V”

22: Analog Output 2 Scale
- for analog output No. 2, it sets the signal value corresponding to the full scale of each value. Possible options are: “5 V” and “10 V”.
- default value: “10 V”

23: Serial Identification
- it represents the drive identifier, used in RS232 and RS485 serial communication (for details, see MANSER09.9810 I).
- the value is enabled after it has been saved in EEPROM
- value range: 1÷ 254
- default value: 1

24: Baud Rate Serial RS232
- it represents the baud rate on the serial line RS232; the available rates are the following: 2400, 4800 and 9600 b/s
- default value: 9600 b/s
- this value is enabled after it has been saved in EEPROM.

25: Baud Rate Serial RS485
- it represents the baud rate on the serial line RS485; the following rates are available: 2400, 4800, 9600, 19200, 31250 and 38400 b/s
- default value: 9600 b/s
- this value is enabled after it has been saved in EEPROM

26: Serial Priority

- For the on-the-fly commands of the User Table it manages the priority between the commands transmitted via serial link RS232/485 and the commands transmitted via digital inputs.

- When Par.26 = “Yes”, the on-the-fly table change is exclusively controlled via serial link; when Par.26 = “No”, this function is exclusively controlled via configurable digital inputs (see Par.03 in this table).

- default value: “Yes”

27: Resolver Pole Pairs

- it indicates the number of resolver pole pairs; preset value: “1 pole pair”
- parameter not accessible to the user

28: Resolver Phase Adjustment

- this parameter concerns the resolver phase adjustment; when the resolver phase has been adjusted by the manufacturer of the motor assembly – in the normal case – the parameter value is 0 and therefore the resolver angle does not need any correction; when the resolver phase has not been adjusted (for example, after disassembling the motor), to provide angle correct information, this parameter needs to be appropriately set.
- this parameter is automatically set through procedure “Resolver Autophasing”, currently under development.

29: Switching Frequency

- it indicates the switching frequency of the power switches; preset value: 10 kHz
- parameter not accessible to the user

30: Output Encoder Resolution

- it indicates the resolution, in pulses per revolution (ppr), of the simulated encoder output
- possible values: “256 ppr”, “512 ppr”, “1024 ppr” (default) and “2048 ppr”

31: Output North Marker Width

- it indicates the width (in fractions of the pulse A or B width) of the North Marker pulse of the simulated encoder output
- possible values: “1/4 A” (default), “1/2 A”, “3/4 A”, “1/1 A”

32: Output North Marker Position

- it indicates the position (in degrees, with respect to the mechanical zero angle) of the North Marker pulse of the simulated encoder output.
- value range: - 179,9° ÷ + 179,9°; default value: 0°

33: Input Encoder Resolution

- it indicates the resolution, in pulses per revolution (ppr), of the frequency input; when the drive is configured as slave in the electrical axis operation, the frequency input represents an encoder signal (emulated) coming from the drive master.
- possible values: “256 ppr”, “512 ppr”, “1024 ppr” (default), “2048 ppr”.

34: Speed Reference Full Scale

- it indicates the speed value [rpm] which corresponds to 10V of analogue reference
- value range: 0 rpm ÷ 29000 rpm
- default value: 6000 rpm

35: Torque Reference Full Scale

- it indicates the torque value [Nm] which corresponds to 10V of analogue reference

36: Analog Input 1 Offset
- parameter used for the compensation of any analogue input AIN1offset.
- it is automatically set by means of the procedure “AIN1 Offset Autotuning”, currently under development.

37: Analog Input 2 Offset
- parameter used for the compensation of any analogue input AIN2 offset.
- it is automatically set by means of the procedure “AIN2 Offset Autotuning”, currently under development.

38: Offset Current Phase 1
- parameter used for the compensation of any offset on the measure of phase 1 current.
- this parameter is automatically set by means of the procedure “Current Offsets Autotuning”, currently under development.

39: Offset Current Phase 2
- parameter used for the compensation of any offset on the measure of phase 2 current.
- this parameter is automatically set by means of the procedure “Current Offsets Autotuning”, currently under development.

40: Offset Current Phase 3
- parameter used for the compensation of any offset on the measure of phase 3 current.
- this parameter is automatically set by means of the procedure “Current Offsets Autotuning”, currently under development.

3.6.3 Parameters of system table # 1

01: Enable Software Limit Switch #1
- it enables/disables (“Enable”/”Disable”) the right and left software limit switch tests, level #1; the 2 limit positions are set via Par. 03 and Par. 04 of this table.
  WARNING! before enabling this alarm, make sure about the absolute position value (a Homing procedure must have been performed).
- default value: “Disable”

02: Enable Software Limit Switch #2
- it enables/disables (“Enable”/”Disable”) the right and left software limit switch tests, level #2; the 2 limit positions are set via Par. 05 and Par. 06 of this table.
  WARNING! before enabling this alarm, make sure about the absolute position value (a Homing procedure must have been performed).
- default value: “Disable”

03: Right Software Limit Switch #1
- it represents the value (in revolutions) of the outermost right position (direction: increasing positions), level 1, the overtravel of which is tested via SW; the test is enabled via Par. 01 above. When moving right of this position, the alarm “SW Limit Switch #1” is triggered (P.2) which controls operation with the special user table “Right SW Limit Switch #1”, dedicated to this function (see section 5.7); by definition, the direction of increasing positions corresponds to a clockwise rotation seen from the shaft end side
- value range: - 32767,9999 rev. ÷ + 32767,9999 rev., with a resolution of 0,0001 rev.
- default value: + 32767,9999 rev.

04: Left Software Limit Switch #1
- it represents the value (in revolutions) of the outermost left position (direction: decreasing positions), level 1, the exceeding of which is tested via SW; the test is enabled via Par. 01 above. When moving left of this position, the alarm “SW Limit Switch #1” is triggered (P.2), which controls operation with the special user table “Left

SW Limit Switch #1", dedicated to this function (see section 5.7); by definition, the direction of decreasing positions corresponds to a counterclockwise rotation seen from the shaft end side

- value range: - 32767,9999 rev. ÷ + 32767,9999 rev., with a resolution of 0,0001 rev.
- default value: - 32767,9999 rev.

05: Right Software Limit Switch #2

- it represents the value (in revolutions) of the outermost right position (direction: increasing positions), level 2, the exceeding of which is tested via SW; the test is enabled via Par. 02 above. When moving right of this position, the alarm "SW Limit Switch #2" is triggered (P.3), which controls operation with the special user table "Right SW Limit Switch #2", dedicated to this function (see section 5.7); by definition, the direction of increasing positions corresponds to a clockwise rotation seen from the shaft end side
- value range: - 32767,9999 rev. ÷ + 32767,9999 rev., with a resolution of 0,0001 rev.
- default value: + 32767,9999 rev.

06: Left Software Limit Switch #2

- it represents the value (in revolutions) of the outermost left position (direction: decreasing positions), level 2, the exceeding of which is tested via SW; the test is enabled via Par. 02 above. When moving left of this position, the alarm "SW Limit Switch #2" is triggered (P.3), which controls operation with the special user table "Left SW Limit Switch #2", dedicated to this function (see section 5.7); by definition, the direction of decreasing positions corresponds to a counterclockwise rotation seen from the shaft end side
- value range: - 32767,9999 rev. ÷ + 32767,9999 rev., with a resolution of 0,0001 rev.
- default value: - 32767,9999 rev.

07: Home Position

- it represents the value (in revolutions) of the reference position set to the drive at the end of the Homing procedure (described under section 5.4), when the "Home Input" digital input is enabled (see Par. 04, *Digital Input 1 Configuration*)
- value range: - 32767,9999 rev. ÷ + 32767,9999 rev., with a resolution of 0,0001 rev.
- default value: 0,0000 rev.

08: Motor Rated Current

- it represents the rated current value (in A_{rms}) of the motor coupled with the converter; it is used in the algorithm of the motor thermal image ($I^2 \cdot t$) (alarm H.4); when this alarm is triggered, the current supplied to the motor is limited to the motor rated value here indicated.
- value range: 0,0 ÷ IPEAK A_{rms} with resolution 0,1 A_{rms} (I PEAK = Converter Peak Current; it is the Par.02 of the motor-converter data table described under section 3.6.5)
- default value: the rated current of the motor coupled with the converter; when the motor is not known, the default value is equal to the converter's rated current; the correct parameter setting is therefore for the user to perform.

09: Motor Thermal Constant

- it represents the value (in seconds) of the thermal time constant (main) of the motor coupled with the drive system; it is used in the algorithm of the motor thermal image ($I^2 \cdot t$) (alarm H.4)
- value range: 0,2 s ÷ 6553 s
- default value: 1092 s

10: Brake Thermal Constant
- it represents the value (in seconds) of the thermal time constant of the braking circuit; it is used in the algorithm of brake thermal image (alarm H.5) and is preset by the manufacturer, based on the braking resistance chosen (internal or external)
- parameter not accessible to the user.

11: Brake Resistance
- it represents the value [ohm] of the braking resistor resistance; it is used in the algorithm of the brake thermal image (alarm H.5) and is preset by the manufacturer, based on the braking resistance chosen (internal or external)
- parameter not accessible to the user

12: Brake Rated Power
- it represents the value (in W) of the braking resistance rated power; it is used in the algorithm of the brake thermal image (alarm H.5) and is preset by the manufacturer, based on the braking resistance chosen (internal or external)
- parameter not accessible to the user

13: Converter Rated Current
- it represents the value (in A_{rms}) of the converter continuous current and is preset by the manufacturer; it is used in the algorithm of the converter thermal image (alarm H.3); when this alarm is triggered, the current supplied to the motor is limited to the rated value of the converter here indicated
- parameter not accessible to the user

14: Converter Thermal Constant
- it represents the value (in milliseconds) of the thermal time constant (main) of the converter and is preset by the manufacturer; it is used in the algorithm of the converter thermal image (alarm H.3)
- parameter not accessible to the user

15: Overspeed Limit
- it represents the value (in rpm) of the overspeed protection threshold; when the actual speed exceeds this limit, the drive system triggers protection “Overspeed”, S.1
- default value: 6500 rpm

16: Undervoltage SW Level
- it represents the value (in V) of the operating threshold of the alarm “Undervoltage DC Bus (U.1)”
- parameter not accessible to the user

17: Overvoltage SW Level
- it represents the value (in V) of the operating threshold of the alarm “Overvoltage DC Bus (O.1)”
- parameter not accessible to the user

3.6.4 Control table parameters

Note: The parameters contained in this table (except for Par.07, *2-nd Harmonic Tuning*) can be only read and not modified by the user. The parameters not accessible to the user are listed exclusively for the sake of complete information.

01: Peak Current
- it concerns the protection against current peaks of the converter and motor (demagnetization)
- parameter not accessible to the user

02: Modulation Index Gain
- it concerns the flux weakening control tuning
- parameter not accessible to the user

03: Voltage Margin
- it concerns the flux weakening control tuning
- parameter not accessible to the user

04: Modulation Index Reference
- it concerns the flux weakening control tuning
- parameter not accessible to the user

05: Current Module Regulator Gain
- it concerns the tuning of the output phase current limitation
- parameter not accessible to the user

06: Current Loop Regulator Gain
- it concerns the current loop tuning
- parameter not accessible to the user

07: 2-nd Harmonic Tuning
- meaning: parameter for the tuning of the feedback speed signal second harmonic; tuning concerns the motor-converter combination
- value range: - 127 ÷ + 127; default value: 0

08: 4-th Harmonic Tuning
- meaning: parameter for the tuning of the feedback speed signal fourth harmonic; this tuning only concerns the converter and is performed by the manufacturer
- parameter not accessible to the user

09: Leading Factor
- it concerns the control tuning both in the constant torque and flux weakening range
- parameter not accessible to the user

10: Minimum Flux Level
- it concerns the flux weakening control tuning
- parameter not accessible to the user

11: Flux Feedforward Gain
- it concerns the current loop tuning
- parameter not accessible to the user

12: Saturation Gain
- it concerns the tuning of the output phase current limitation
- parameter not accessible to the user

3.6.5 Parameters of the motor-converter data table

01: Main Supply
- it indicates the voltage between lines of the three-phase power supply
- parameter not accessible to the user

02: Converter Peak Current
- it indicates the converter peak current; for the indicated temperature range, the current peak value is defined as 200% I_{nom}, where I_{nom} is the converter rated current;
- parameter not accessible to the user

03: Motor Rated Speed
- it indicates the rated speed of the motor coupled with the converter
- parameter currently not used

04: Motor Phase-Phase Bemf
- it indicates the bemf at the terminals (at rated speed) of the motor matched with the converter
- parameter currently not used

05: Motor Pole Pairs
- it indicates the number of pole pairs of the motor matched with the converter
- parameter not accessible to the user

06: Motor Phase-Phase Inductance
- it indicates the inductance at the terminals of the motor matched with the converter
- parameter currently not used

07: Motor KT Saturation
- it indicates the current saturation coefficient of the torque constant of the motor matched with the converter
- parameter currently not used

08: Motor Phase-Phase Resistance
- it indicates the resistance (at 20°C) at the terminals of the motor matched with the converter
- parameter currently not used

09: Motor Inertia
- it indicates the moment of inertia of the motor matched with the converter
- parameter currently not used

10: Load Inertia
- it indicates the moment of inertia of the load
- parameter currently not used

11: Motor Type
- it indicates the type of motor matched with the converter
- parameter currently not used

12: Flux Full Scale
- it indicates the flux full scale value
- parameter not accessible to the user

13: Brake Voltage Threshold
- it indicates the voltage threshold for the braking circuit intervention
- parameter not accessible to the user

3.6.6 User table parameters

Note: “Default value” means, for the parameter under consideration, the value set by ABB Servomotors before delivery to the customer; this value must be customized by the user according to the application specific demands.

01: Operating Mode
- it defines the drive system operating mode, the reference type and any torque analog limitation. The possible configurations are:

Operating mode	Reference type	Analog torque limitation
Torque Mode - 0	Digital (Par. 11)	No
Torque Mode - 1	Digital (Par. 11)	Reference: AIN1
Torque Mode - 2	Digital (Par. 11)	Reference: AIN2
Torque Mode - 3	Analog - AIN1	No
Torque Mode - 4	Analog - AIN1	Reference: AIN2
Torque Mode - 5	Analog - AIN2	No
Torque Mode - 6	Analog - AIN2	Reference: AIN1
Speed Mode - 0	Digital (Par. 12)	No
Speed Mode - 1	Digital (Par. 12)	Reference: AIN1
Speed Mode - 2	Digital (Par. 12)	Reference: AIN2
Speed Mode - 3	Analog - AIN1	No
Speed Mode - 4	Analog - AIN1	Reference: AIN2
Positioning - 0	Digital (Par. 13)	No
Positioning - 1	Digital (Par. 13)	Reference: AIN1
Positioning - 2	Digital (Par. 13)	Reference: AIN2
Synchronizing - 0	Digital	No
Synchronizing - 1	Digital	Reference: AIN1
Synchronizing - 2	Digital	Reference: AIN2

- default value for general purpose user tables: “Speed Mode - 0”
- for the active user table, the parameter modification is immediately effective

WARNING! The real time change of the operating mode may have undesired consequences for the drive system; it is suggested to avoid changing the operating mode of an already operating table, taking care to enable it only after setting the parameter.

02: Power Switches

- it enables (“ON”) /disables (“OFF”) the commands to the IPM drivers
- default value for general purpose user tables: “ON”
- for the active user table, the parameter modification is immediately effective; through command Power Switches “OFF”, the supply to the motor is switched off, with resulting free rotation; through command Power Switches “ON”, the motor power control is recovered.

WARNING! The setting *Power Switches* =“OFF” of the drive system in RFO status may be dangerous for loads of particular type (e.g.: gravitational); the Stop command may therefore has undesired consequences. For the normal stopping of the motor, it is possible to use both the “User Stop” function and the switching to an appropriately configured general table.

03: Analog Torque Limitation

- describes the application mode of the analog limits on the reference torque. This function is active both in Torque Mode, when the torque reference is explicit, and in the other operating modes, when the torque reference comes from an external speed loop. Via Par.01, the input for the analog torque limitation signal is chosen. The signal scale [Nm/V] is established by Par.14, Torque Reference, of the converter-motor data table (the same scale of the torque analogue reference); the analog signal module constitutes a limit for the reference torque. Via Par.03 it is possible to choose the following configurations:
  - Superior & Inferior Limitation
  - Superior Limitation

- Inferior Limitation
- No Limitation

- default value for the general purpose user tables: “No Limitation”

04: Enable Ramps

- it enables (“Enable”) /disables (“Disable”) the limitation of the acceleration/deceleration ramps of the speed reference; the ramp values are set via parameters 21, 22, 23 and 24 of the same user table.
- default value for the general purpose user tables: “Disable”

05: Target Table

- it configures the user table as Target table (“Yes”) or not (“Not”); other necessary parameters to configure a Target table are: the type of target (Par.06, *Target Type*), the time target value (Par.31, *Target Value*), the error with which the target is reached (Par.32, *Target Error*) and the table called up when the target has been reached (Par.33, *Next Table*) - see section 5.3; for a Target table, the on-the-fly table change system controlled from the outside is automatically disabled (if the target has not been reached yet, it is possible to exit a Target table through a STOP command only or when an alarm occurs).
- default value for the general purpose user tables: “Not”

06: Target Type

- it defines the type of target to reach and is valid only for a table defined as Target table (Par.05 = “Yes”)

Target type	Target value
Enable	Not available for user
Time	Par.31, *Target Value*
Speed	Par.12, *Digital Speed Reference*
Position	Par.13, *Position Reference*
No Target	-

- default value for the general purpose user tables: “No Target”

07: Ratio Numerator

08: Ratio Denominator

- they define the gear ratio between the slave and the master speed in the electrical axis operation (see section 4.5, Synchronizing Mode); the gear ratio can be changed from 1:255 to 255:1, with resolution 1 both for the numerator and the denominator; for the active user table, the parameter modification is immediately effective (it is therefore possible to change the gear ratio in real time, via serial interface).
- default values for the general purpose user tables: Par.07 = 1 and Par.08 = 1

09: Synchro Direction

- it defines the slave motion direction with respect to the master in the electrical axis operation (see section 4.5, Synchronizing Mode); when “No Reverse” is selected, the master and slave speeds have the same sign; when “Reverse” is selected, the two speeds have opposite sign; in both cases, the ratio of the speed modules is set through the gear ratio (Par.07 and 08).
- default value for the general purpose user tables: “No Reverse”

10: Synchro Phase Shift

- it defines the phase shift between master and slave in the electrical axis operation (see section 4.5, Synchronizing Mode); with positive master speed and Par.09 = “No Reverse”, a positive phase shift implies that the slave is in advance vis-à-vis the master; obviously, this parameter applies when the reduction ratio is 1:1; for the active user

table, the parameter modification is immediately effective (it is therefore possible to modify the phase shift in real time, via serial interface).

WARNING! The real time change of the phase shift is performed by the slave with all its available dynamics; if necessary, check the transient through adequate limitations (e.g.: torque, speed, power, ramps, current).

- value range: -179,9 deg ÷ + 179,9 deg; default value for the general purpose user tables: 0,0 deg.

11: Digital Torque Reference

- it represents the digital torque reference, in Nm, valid when the drive system is in the operating mode "Torque Mode" – 0,1 or 2 (set via Par.01 of the same user table); in the other operating modes, this value is ignored.
- a torque is defined positive when it has clockwise direction seen from the shaft output side.

12: Digital Speed Reference

- it represents the digital speed reference, in rpm, valid when the drive system is in the operating mode "Speed Mode" – 0,1 or 2 (set via Par.01 of the same user table); in the other operating modes, this value is ignored.
- a rotation is defined positive when it has clockwise direction seen from the shaft output side.
- if the user table is a Target table (Par.05, *Target Table* = "Yes") and the target is the reached speed (Par.06, Target Type = "Speed"), the digital speed reference also represents the speed value to be reached.

13: Position Reference

- it represents the absolute position reference (multiturn), valid when the drive system is in the operating mode "Positioning" – 0,1 or 2 (set via Par.01 of the same user table); in the other operating modes, this value is ignored.
- the position reference, being absolute, has a correct meaning only after a Homing procedure has been performed (see section 5.4).
- if the user table is a Target table (Par.05, *Target Table* = "Yes") and the target is to reach a certain position (Par.06, *Target Type* = "Position"), the position reference also represents the absolute position value to be reached.
- value range: -32767,9999 rev. ÷ + 32767,9999 rev.

14: Positive Torque Limit

- it represents the digital upper limit, in Nm, of the torque reference (see Fig. 3-4). This function is enabled both in Torque Mode, when the torque reference is explicit, and in the other operating modes as well, when the torque reference comes from an external speed loop. When the analog torque limitation is also active, the upper limit is calculated as the lowest value between the digital and the analog limit;
- the convention regarding the torque sign defined at Par.11, *Digital Torque Reference,* applies here as well.

15: Negative Torque Limit

- it represents the digital lower limit, in Nm, of the torque reference (see Fig. 3-4). This function is active both in Torque Mode, when the torque reference is explicit, and in the other operating modes as well, when the torque reference comes from an external speed loop. When the analog torque limitation is also active, the lower limit is calculated as the highest value between the digital and the analog limit.
- the convention regarding the torque sign defined for Par.11, *Digital Torque Reference,* applies here as well.

16: Maximum Phase Current

- it represents the maximum current, in A_{rms}, supplied to the motor; the phase current limitation can be considered as a degree of freedom which the user can use to limit the dynamics of the speed transients, to prevent any demagnetization of the brushless motors and to reduce the thermal stress of the motor or of the braking resistor.
- value range: 0,0 ÷ IPEAK [A_{rms}], resolution 0,1 A_{rms} (IPEAK = *Converter Peak Current*, Par.02 in motor-converter data table, see item 3.6.5); for example, for a Bivector converter with rated 18 A_{rms} (with an overload default of 200% I_{nom}), the value range is 0,0 ÷ 36,0 A_{rms}

17: Maximum Positive Speed

- it represents the maximum positive value, in rpm, of the speed reference. This function is enabled both in Speed Mode, when the speed reference is explicit, and in Positioning Mode or Synchronizing Mode, when the speed reference comes from an external loop.
- the convention regarding the speed sign defined at Par.12, *Digital Speed Reference,* applies here as well.
- maximum setting value: 7324,2 [rpm]

18: Maximum Negative Speed

- it represents the maximum negative value, in rpm, of the speed reference. This function is enabled both in Speed Mode, when the speed reference is explicit, and in Positioning Mode or Synchronizing Mode, when the speed reference comes from an external loop.
- the convention regarding the speed sign defined at Par.12, *Digital Speed Reference,* applies here as well.
- maximum setting value: -7324,2 [rpm]

19: Motor Power Limit

- it represents the limit of supplied power, in W, in motoring operation (see Fig. 3-4) and can be enabled in all operating modes.

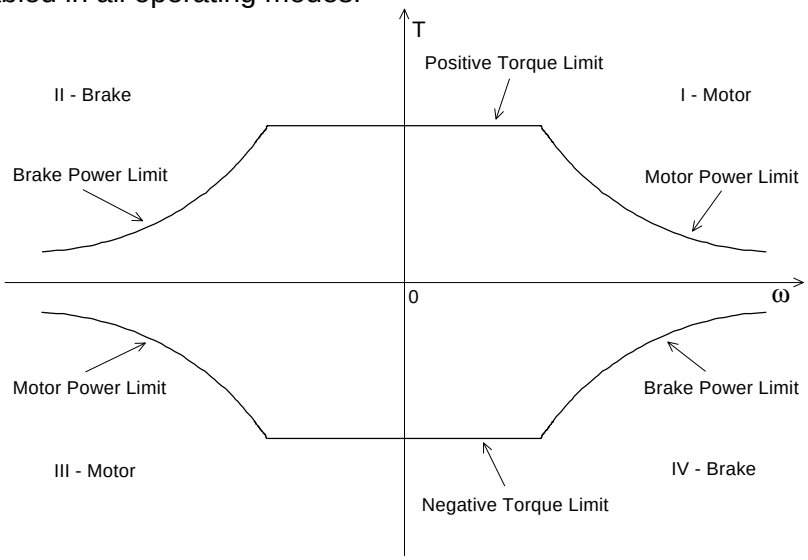
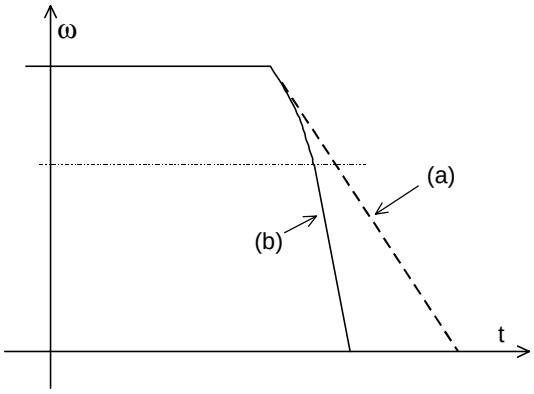


Fig. 3-4: Torque and power limitations

20: Brake Power Limit

- it represents the maximum power dissipation during braking (see Fig. 3-4), in W, and is a function enabled in all operating modes. This parameter allows to directly limit the braking power peak, preventing the intervention of the Overvoltage DC Bus protection. Fig. 3-5 shows how the maximum brake power is limited through the power limitation and the modality conventionally used, through the braking ramps limitation. With the

same maximum power during braking, the power limitation requires a definitely shorter time to stop the motor.



(a) braking with deceleration ramp limitation

(b) braking with power limitation

Fig. 3-5: Use of the "Brake Power Limit" to optimize braking

21: CW Acceleration Ramp

- it represents the maximum acceleration set for rotation in positive direction (clockwise seen from the shaft end side), see Fig. 3-6. The limitation is applied to the reference speed and is enabled both in Speed Mode, when the speed reference is explicit, and in Positioning Mode or Synchronizing Mode, when the speed reference comes from an external loop.
- the ramp is defined in milliseconds required to vary a 1000 rpm speed
- value range: 5 ms ÷ 5000 ms

22: CCW Acceleration Ramp

- it represents the maximum acceleration set for rotation in negative direction (counterclockwise seen from the shaft end side), see Fig. 3-6. The limitation is applied to the reference speed and is enabled both in Speed Mode, when the speed reference is explicit, and in Positioning Mode or Synchronizing Mode, when the speed reference comes from an external loop.
- the ramp is defined in milliseconds required to vary a 1000 rpm speed
- value range: 5 ms ÷ 5000 ms

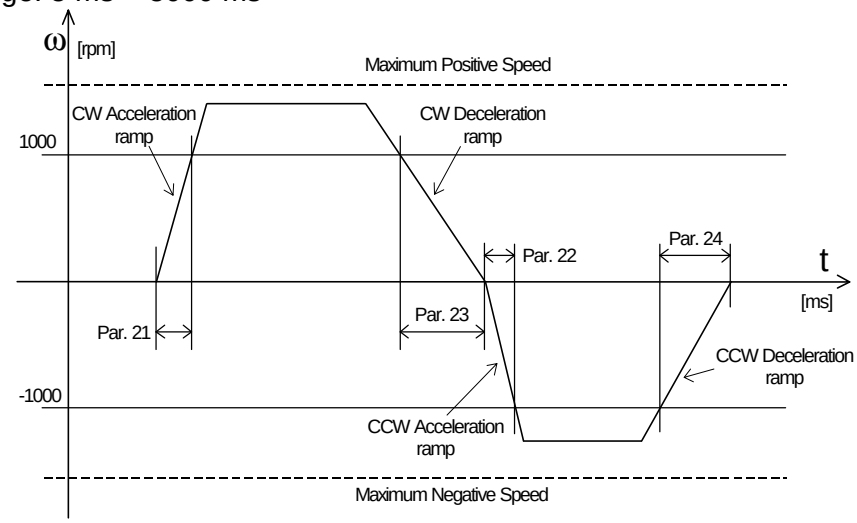


Fig: 3-6: Acceleration/deceleration ramps applied to the reference speed

23: CW Deceleration Ramp

- it represents the maximum deceleration set for rotation in positive direction (clockwise seen from the shaft end side), see Fig. 3-6. The limitation is applied to the reference speed and is enabled both in Speed Mode, when the speed reference is explicit, and in

Positioning Mode or Synchronizing Mode, when the speed reference comes from an external loop.
- the ramp is defined in milliseconds required to vary a 1000 rpm speed
- value range: 5 ms ÷ 5000 ms

24: CCW Deceleration Ramp
- it represents the maximum deceleration set for rotation in negative direction (counterclockwise seen from the shaft end side), see Fig. 3-6. The limitation is applied to the reference speed and is enabled both in Speed Mode, when the speed reference is explicit, and in Positioning Mode or Synchronizing Mode, when the speed reference comes from an external loop.
- the ramp is defined in milliseconds required to vary a 1000 rpm speed
- value range: 5 ms ÷ 5000 ms

25: Torque Reference Filter
- it characterizes the digital filter applied to the torque reference. The filter can be enabled both in Torque Mode, when the torque reference is explicit, and in the other operating modes, when the torque reference comes from an external speed loop.
- value range: 0 ÷ 7 with resolution 1; this value represents the time constant of the filter according to the following formula: time constant = 2^n x 0,25 [ms] (n = 0 ÷ 7);
- default value for the general purpose user tables: 2

26: Speed Proportional Gain
- it represents the proportional gain of the speed regulator. The parameter modification is immediately effective, allowing to adequately tune the speed loop.
- value range: 0 ÷ 16383 with resolution 1; default value for general purpose tables: 600.

27: Speed Integral Gain
- it represents the gain of the integral part only of the speed regulator. The parameter modification is immediately effective, allowing to adequately tune the speed loop.
- value range: 0 ÷ 16383 with resolution 1; default value for general purpose tables: 200.

28: Speed FeedForward
- it represents a gain that allows to tune the torque feedforward used in the speed regulator. This parameter is effective only if the ramps have been enabled (Par.04, *Enable Ramps* = “Enable”). The parameter modification is immediately effective, allowing to adequately tune the speed loop.
- value range: 0 ÷ 16383 with resolution 1; default value for general purpose tables: 0.

29: Position Proportional Gain
- it represents the proportional gain of the position regulator. The parameter modification is immediately effective, allowing to adequately tune the position loop both in Positioning and in Synchronizing Mode.
- value range: 0 ÷ 16383 with resolution 1

30: Position Integral Gain
- parameter currently not used

31: Target Value
- this parameter is applicable in case of a Target table (Par.05, *Target Table* = “Yes”), with time target (Par.06, *Target Type* = “Time”) and represents the time for which the steps defined in the user table are executed. When the time is out (time target reached) the table specified by Par.33, *Next Table*, is called up.
- value range: 0,000 ÷ 99999,999 [s] with resolution 0,001 [s]

32: Target Error

- this parameter is applicable in case of a Target table (Par.05, *Target Table* = "Yes"), with speed/position target reached (Par.06, *Target Type* = "Speed"/"Position") and represents the error absolute value within which the target is considered as reached. When the target has been reached, the table specified by Par. 33, *Next Table,* is called up or an adequately configured digital output is switched.
- value range: 0 ÷ 32767 with resolution 1; when the target is to reach a certain speed, this range corresponds to 0,0 ÷ 7324,2 [rpm] (for example: value 5 corresponds to an error of approx. 1 [rpm]); when the target is to reach a certain position, this range corresponds to 0,00 ÷ 179,99°. For example, see the following table.

Target Error Value	Target Type = "Position" value in [°]	Target Type = "Speed" Value in [rpm]
0	0	0
5	0,028	1,1
10	0,055	2,2
20	0,110	4,5
50	0,257	11,2
100	0,550	22,4
200	1,100	44,7
500	2,750	111,8
….	….	….

33: Next Table

- this parameter is applicable in case of a Target table (Par.05, *Target Table* = "Yes") and represents the user table called up when the target has been reached. The following tables can be selected:
  - special user tables – see section 3.5.1.4
  - 32 general user tables: from general table No. 0 to general table No. 31

3.7 Start and Stop Commands

3.7.1 Start Command (RUN)

The Start command (RUN) can be transmitted:

- via ENABLE dedicated logical input, when a Lo-Hi transition of the applied signal is performed
- via serial interface, with PC (with the BIVCOM program) or Key-B, using the command RUN associated to dedicated keys.

Features of the Start command (RUN):

- it is accepted only if the drive system is in RFO status
- action performed: the converter is enabled and starts operation with the general user table #0, performing the function described in this table.

3.7.2 Start Command (RUN) with general user table # ...

If, by transmitting the Start command (RUN), you want the converter to operate with a general user table other than #0, this type of start is possible through command "Start (RUN) with general user table # ...", whereby the desired starting table is specified. In this case too, the command is accepted only if the drive system is in RFO status.
This command can only be transmitted via serial interface, through PC (with BIVCOM program) or Key-B, using the command "RUN with Table #...".

3.7.3 Stop Command

The Stop command can be transmitted:

- via ENABLE dedicated logical input, when a Lo-Hi transition of the applied signal is performed
- via serial interface, through PC (with the BIVCOM program) or Key-B, using the command STOP associated to dedicated keys.

WARNING!

The machine electrical system designer should, according to his risk analysis, install all the stop devices provided for by standards, following the appropriate procedures; in any case, he should directly install the machine system observing all the safety standards provided for by the law.

Features of the stop command:

- it is accepted only if the drive system is in GO status
- action performed: the motor is brought to 0 rpm, then the converter is disabled, moving to RFO status; if, for any reason, it has not been possible to stop the motor, after about 2 sec from the STOP command, the converter is automatically disabled and the motor stops due to friction.

3.7.4 User Stop Command (End of cycle set by user)

To associate the Stop command with a different action from the default one, described in the previous section, the "User Stop" command can be used (End of cycle set by user). This command can be transmitted:

- via logical input DIN1 ÷ DIN8, configured as "User Stop High/Low"
- via serial interface, through PC (with the BIVCOM program), using the User Stop command associated with keys (**Ctrl + U**) and described in section 7.4.9.

The step performed is set through the special user table "User Stop", dedicated to this function. As default, this table is configured as the above described Stop command:

- Par.02, *Operating Mode*: "Speed Mode - 0" (digital reference)
- Par.05, *Target Table*: "Yes"
- Par.06, *Target Type*: "Speed"
- Par.12, *Digital Speed Reference*: 0.0 rpm
- Par.32, *Target Error:* 16
- Par.33, *Next Table*: "RFO"

This setting means that **the motor is stopped,** the drive system disabled and brought to **RFO** status; so, at the end of the procedure, the motor is free to rotate. This condition should be assessed when there are gravitational loads and no "parking" mechanical and emergency brake is used in the motor assembly; in this respect, refer to item 2.3.2 of Chapter 2(1st Part).

The user is free to modify the settings according to his requirements, bearing in mind the warning above.

3.8 Signal inputs and outputs

3.8.1 Note

This paragraph only refers to the signal inputs and outputs of the BIVECTOR 500 converter, connected to terminal blocks DIGITAL I/O and ANALOG I/O, and to connectors FREQUENCY IN and ENCODER OUT; in this respect, see Fig. 3-1 in Chapter 3 (1st Part).

3.8.2 Digital inputs

3.8.2.1 HW references

- Fig. 3-17 of Chapter 3 (1st Part) shows the terminal block DIGITAL I/O, with the wiring diagram of the digital inputs
- the electrical features of the 10 digital input circuits are described under 3.4.3.5.2 B of the same chapter

3.8.2.2 Configurability

- two inputs have a pre-defined function: they are **ENAB** (Enable), used for commands Start and Stop, and **RESET**, used for command Alarms Reset;
- the other 8 digital inputs **DINn** (**D**igital **IN**put, followed by a number **n** which may be comprised between 1 ÷ 8) are configurable, namely the user can assign a different and programmable function to each of them. The parameters to use are in system table #0 (see item 3.6.2) and are Par.04 ÷ Par.11, *Digital Input n Configuration*. Through these parameters it is possible to configure, for each digital input DIN1 ÷ 8 :
  - the function (the possibilities are listed at Par.04)
  - the input signal level for which the function is enabled: “High” (the function is enabled when the input signal level is high) or “Low” (the function is enabled when the input signal level is low)

3.8.3 Digital outputs

3.8.3.1 HW references

- Fig. 3-17 of Chapter 3 (1st Part) shows the terminal block DIGITAL I/O, with the wiring diagram of the digital outputs
- the electrical features of the 6 digital output circuits are described under 3.4.3.5.2 A of the same chapter

3.8.3.2 Configurability

All the 6 digital (logical) outputs **DOUTn** (**D**igital **OUT**put, followed by a number **n**, which can be comprised between 1 ÷ 6) are configurable, which means that the user can assign a different and programmable function to each of them. The parameters to use are in system table #0 (see item 3.6.2) and are Par.12 ÷ Par.17, *Digital Output n Configuration*. The digital outputs can feature two levels: “High” and “Low”; in Par. 12, for each possible configuration, the meaning of the two levels obviously applies to all the digital outputs.
Note: the meaning of the output status, described at Par.12, applies when Par.19, *Digital Output Reversing*, is set to “No Reverse” and is reversed when “Reverse” is set.

3.8.4 Analog inputs

3.8.4.1 HW references

- Fig. 3-18 of Chapter 3 (1st Part) shows the terminal block ANALOG I/O, with the wiring diagram of the analog inputs
- the electrical features of the 2 analog input circuits are described under 3.4.3.5.3 B of the same chapter.

3.8.4.2 Configurability

Via the 2 analog inputs **AINn** (**A**nalog **IN**put, followed by a number **n**, which can be 1 or 2) it is possible to provide the BIVECTOR with:

- speed reference for operation in Speed Mode, with analog reference:
  - only applicable to the input AIN1 – by setting, in the active user table, Par.01, *Operating Mode* = “Speed-Mode - 3 or 4”
  - the user can set the scale of the input signal, in rpm/V, via Par.34, *Speed Reference Full Scale*, in the system #0 table

- torque reference for operation in Torque Mode, with analog reference:
  - applied to the input AIN1 – by setting, in the active user table, Par.01, *Operating Mode* = "Torque-Mode - 3 or 4"
  - applied to the input AIN2 – by setting, in the active user table, Par.01, *Operating Mode* = "Torque-Mode - 5 or 6"
  - the user can set the scale of the input signal, in Nm/V, via Par.35, *Torque Reference Full Scale*, in the system #0 table
- reference for the torque analog limitation, active in all operating modes:
  - applied to the input AIN1 – by setting in the active user table Par.01, *Operating Mode,* as follows:
    - "Torque Mode -1 or 6" for operation in torque mode
    - "Speed Mode -1" for operation in speed mode
    - "Positioning -1" for operation in positioning mode
    - "Synchronizing -1" for operation in synchronizing mode
  - applied to the input AIN2 – by setting in the active user table Par.01, *Operating Mode*, as follows:
    - "Torque Mode -2 o 4" for operation in torque mode
    - "Speed Mode -2 o 4" for operation in speed mode
    - "Positioning -2" for operation in positioning mode
    - "Synchronizing -2" for operation in synchronizing mode
  - the user can set the input signal scale, in Nm/V, via Par.35, *Torque Reference Full Scale*, in the system #0 table
  - the user can set how to apply the torque analog limitation via Par.03, *Analog Torque Limitation*, in the active user table; possible options:
    - "Superior & Inferior Limitation" – limitation of the positive and negative torque values
    - "Superior Limitation" – limitation of positive torque values only
    - "Inferior Limitation" - limitation of negative torque values only

Note:
1) the level of the signals that can be applied to each of the two analog inputs is ±10 V; the voltage polarity can be any, with respect to the two terminals +AIN1/2 and -AIN1/2, because the input acts differentially; of course, with the polarity of the input signal equal to the polarity of the terminals, the established match references for the drive system are respected (for example, if operation in speed mode with analog input is chosen, applying a positive voltage between +AIN1 and -AIN1, a clockwise rotation is achieved, seen from the shaft end side); in the opposite case, the opposite polarity for reference is achieved (in the case of the previous example, the motor rotates counterclockwise);
2) the resolution and the passband are different for the two analog inputs; the user can choose the most favourable combination for the specific application;
3) any offset in the signals applied in AIN1 and AIN2 can be respectively compensated via Par. 36, *Analog Input 1 Offset* and Par.37, *Analog Input 2 Offset* in system table #0; an offset automatic tuning procedure is currently under development.

3.8.5 Analog outputs

3.8.5.1 HW references

- Fig. 3-18 of Chapter 3 (1st Part) shows the terminal block ANALOG I/O, with the wiring diagram of the analogue outputs.
- the electrical features of the 2 analog input circuits are described under 3.4.3.6.3 A of the same chapter

3.8.5.2 Configurability

The analog outputs, **AOUTn** (**A**nalog **OUT**put, followed by a number **n**, which can be 1 or 2) can be used as analog monitors of some values (speed, current, etc.), providing information on the drive system operation.

- for the assignment of the configuration of each analog output, see system table #0 (item 3.6.2), respectively Par.19, *Analog Output 1 Configuration* and *Par.20, Analog Output 2 Configuration*.
- in the same table, via Par.21, *Analog Output 1 Scale* and Par.22, *Analog Output 2 Scale*, it is possible to set 5 V or 10 V as full scale of the output signal.
- the analog monitor updating rate is 2 ms.

3.8.6 Simulated encoder output

3.8.6.1 HW references

The electrical connections and the features of the output signals from the ENCODER OUT connector are described in Chapter 3 (1st Part) under 3.4.3.3.

3.8.6.2 Configurability

For the output of the simulated encoder it is possible to configure:

- resolution, in pulses/revolution (ppr – pulses per revolution), via Par.30, *Output Encoder Resolution*, in system table #0; possible values: 256, 512, 1024 and 2048 ppr;
- width (in A⊙B pulse fractions) of the North Marker pulse), via Par.31, *Output North Marker Width*, in system table #0; possible values: 1/4A, 1/2A, 3/4A and 1/1A;
- position (in degrees, with respect to the mechanical zero angle) of the North Marker pulse via Par.32, *Output North Marker Position*, in system table #0.

3.8.7 Frequency input

3.8.7.1 HW references

The electrical connections and the circuit features of the frequency input (FREQUENCY IN connector) are described in Chapter 3 (1st Part) under 3.4.3.4.

3.8.7.2 Configurability

This input is essentially meant for the master-slave connection of two drive systems with BIVECTOR converters, see Fig. 3-15 (1st Part), namely for the operation in synchronizing mode described in section 4.5.

For the frequency input it is possible to configure the resolution, in pulses/revolution (ppr - pulses per revolution), via Par.33, *Input Encoder Resolution*, in system table #0; possible values: 256, 512, 1024 and 2048 ppr.

CHAPTER 4 – IMPLEMENTATION OF THE OPERATING MODES

4.1 Notes

The operating modes are listed in section 3.3, “List of operating modes”. This chapter provides detailed instructions for each operating mode, with appropriate references to other parts of the manual, when necessary.

4.2 Torque Mode

4.2.1 Reference and output torque

This operating mode establishes that the input reference sets the mechanical torque, measured in [Nm], to be achieved at the drive system output, on the servomotor axis.
This torque is delivered at any allowable speed listed in Table 2/8, in section 2.6, “Drive System specifications and servomotor/converter combinations” of Chapter 2 (1st Part). However, it is not possible to achieve a higher torque than the peak torque at zero speed $\mathbf{M_{max(PDS)}}$. Any higher value, set by the user, is automatically rejected.

WARNING! The range of torque values, as explained above, is protected and there is no risk of setting damaging torque values for the drive system. Nevertheless, to prevent physical injuries and material damages, the user should assess whether:
a) the set torque value is correct for the application;
b) a load of the machine is actually applied to the motor axis; remember that, in no load conditions, the servomotor reaches the maximum safety speed established by Par.15, *Overspeed Limit*, in system table #1, followed by the protection tripping and the disabling of the converter. Nevertheless, **it may be dangerous** for people and for the machine, if the motor reaches certain speed values, even for a very short time.

4.2.2 Setting and tuning

4.2.2.1 Torque reference

- To configure the torque operating mode, with digital reference, the parameters of the active user table need to be set as follows:
  - for the type of reference: Par.01, *Operating Mode* = “Torque Mode – 0,1 or 2”
  - for the reference value: Par.11, *Digital Torque Reference* = desired value, in Nm.
- to configure the torque operating mode, with analog reference, the parameters need to be set as follows :
  - for the type of reference, in the active user table:
  - Par.01, *Operating Mode* = “Torque Mode - 3 or 4”, when the torque analog reference is given via analog input AIN1 (resolution 12 bit; f_{MAX} = 300 Hz)
  - Par.01, *Operating Mode* = “Torque Mode - 5 or 6”, when the torque analog reference is given via analog input AIN2 (resolution 10 bit; f_{MAX} = 1000 Hz)
  - for the reference value: Par.35, *Torque Reference Full Scale,* in the system #0 table, which allows to set the Nm/V scale of the analog signal.

4.2.2.2 Limitations

In the active user table, parameters are available which limit the torque values in the following way:

- torque digital limitation:
  - to limit torque positive values: Par.14, *Positive Torque Limit* = desired value, in Nm
  - to limit torque negative values: Par.15, *Negative Torque Limit* =desired value, in Nm
- torque analog limitation:
  - applied to input AIN1 – by setting Par.01, *Operating Mode* = "Torque Mode -1 or 6" in the active user table
  - applied to input AIN2 - by setting Par.01, *Operating Mode* = "Torque Mode -2 or 4" in the active user table
  - the modality of application of the analog torque limitation through Par.03, *Analog Torque Limitation*; possible options:
    - "Superior & Inferior Limitation" – limitation of the torque positive and negative values
    - "Superior Limitation" - – limitation of the torque positive values only
    - "Inferior Limitation" - – limitation of the torque negative values only
  - the user can set the scale of the input signal, in Nm/V, through Par.35, *Torque Reference Full Scale*, in the system #0 table.
- power digital limitation:
  - to limit the power supplied during motoring operation: Par.19, *Motor Power Limit* = desired value, in W
  - to limit the power dissipated during braking operation: Par.20, *Brake Power Limit* = desired value, in W
- limitation of maximum phase current:

- through Par.16, *Maximum Phase Current* = desired value, in A_{rms}

Note: the values set for the limitations must be consistent with the set reference torque, otherwise the latter can not be implemented. Let us consider as an example a motor with torque constant k_T = 1 Nm/A_{rms} and a converter configured to operate in torque mode, with digital reference Par.11, *Digital Torque Reference* = 10 Nm and a maximum phase current limitation Par.16, *Maximum Phase Current* = 8 A_{rms}. This current limitation allows to supply a maximum torque of 8 A_{rms} x 1 Nm/ A_{rms} = 8 Nm which is, therefore, lower than the 10 Nm value, set as reference.

4.2.2.3 Tuning

The reference torque can be filtered depending on the application requirements. The filter tuning is achieved through Par.25, *Torque Reference Filter*, in the active user table. Obviously, this filter only concerns the cases where the torque reference is analog or coming from a speed or position external loop (in the other operating modes).

4.3 Speed Mode

4.3.1 Reference and output speed

This operating mode establishes that the input reference sets the desired angular speed at the drive system output, namely that of the servomotor axis. Instead of being [rad/s] as prescribed in the SI system, the measuring unit of this speed in this manual is [rpm = revolutions per minute]; this is because the SI measuring unit has not yet become of common use.

4.3.2 Setting and tuning

4.3.2.1 Speed reference

- To configure the speed operating mode, with digital reference, the parameters of the active user table need to be set as follows:
  - for the type of reference: Par.01, *Operating Mode* = “Speed Mode - 0,1 or 2”
  - for the reference value: Par.12, *Digital Speed Reference* = desired value, in rpm
- to configure the speed operating mode, with analog reference, the parameters need to be set as follows:
  - for the type of reference, in the active user table:

- Par.01, *Operating Mode* = “Speed Mode - 3 or 4”; the speed analog reference is given via analog input AIN1
  - for the reference value: Par.34 *Speed Reference Full Scale,* in the system #0 table, which allows to set the rpm/V scale of the analog signal.

4.3.2.2 Limitations

The active user table provides parameters that allow for limitations in the speed operating mode:

- limitation of the torque that can be supplied by the drive system – through the settings described under 4.2.2.2 concerning limitations in the torque mode;
- digital limitation of the reference speed:

- to limit speed positive values: Par.17, *Maximum Positive Speed* = desired value, in rpm
- to limit speed negative values: Par.18, *Maximum Negative Speed* = desired value, in rpm

- limitation of the acceleration/deceleration ramps of the speed reference (the desired values are set in msec per 1000 rpm of reference speed variation):

- to enable the ramps: Par.04, *Enable Ramps* = “Enable”
- for clockwise acceleration ramp: Par.21, *CW Acceleration Ramp*
- for counterclockwise acceleration ramp: Par.22, *CCW Acceleration Ramp*
- for clockwise deceleration ramp: Par.23, *CW Deceleration Ramp*
- for counterclockwise deceleration ramp: Par.24, *CCW Deceleration Ramp.*

Note: if the deceleration ramps have been introduced to limit the peak brake power (preventing the protection “Overvoltage DC Bus” from tripping), a better step-measure, in terms of system response time, consists in using Par.20, *Brake Power Limit*, in the active user table (see Fig. 3-5, section 3.6.6).

4.3.2.3 Tuning

For a correct tuning of the speed loop, the procedure sequence is the following:

- the drive system should operate under the reference load and speed conditions of the real system or, if not possible, simulating them
- set the speed reference and the limitations concerning the torque loop (see section 4.2.2.2), and the speed loop (see section 4.3.2.2)
- tune the speed regulator through the following parameters of the active user table:
  - proportional gain: Par.26, *Speed Proportional Gain*
  - integral gain: Par.27, *Speed Integral Gain*
    - feed-forward (enabled only when the ramps have been enabled): Par.28, *Speed FeedForward*
- if, for stability or noise reasons, the filter on the reference torque is changed (Par.25, *Torque Reference Filter*), it is necessary to adjust the above mentioned speed regulator parameters. Indicatively, the filter default value (“2”) is suitable for most applications.

4.4 Positioning Mode

4.4.1 Positioning Mode features

The drive system with BIVECTOR converter acts, in "Positioning" mode, as point-to-point absolute positioner of a mechanical load, usually provided with linear motion. In addition, the positioning motion is time optimal based (it minimizes the positioning cycle time).
Because it is absolute positioning, the arbitrary zero needs to be set univocally; this is possible through a special procedure, called Homing (machine reference position). See section 5.4 of Chapter 5 "Special functions".

WARNING! To avoid losing the information regarding the machine reference position and the current position, in case of three-phase power supply interruption – see item 3.4.2.1 in Chapter 3 (1st Part) – it is necessary to connect the single-phase auxiliary supply, according to item 3.4.2.2 in Chapter 3 (1st Part).
In case of interruption risk of the auxiliary supply too, this needs to be equipped with UPS (power requirement 40 VA @ 230 V, 50/60 Hz).

The maximum positioning "length" features a range from – 32767,9999 rev. to + 32767,9999 rev.; therefore, the whole range is virtually of 65536 revolutions. The position information resolution is 16bit at the round angle, while the positioning precision is 12 bit, that is approx. ± 0,05°.
If the driven load is connected to the motor with a *t* mechanical relationship, this needs to be taken into account.
In many cases, the load has a linear motion and there is a mechanical device to transform the rotation motion of the motor into a linear motion. This is typically achieved through a screw/leadscrew device, where the screw is connected to the motor axis (with a mechanical gear ratio, if required) and the leadscrew is connected to the driven load, often called "axis". For this reason, in the line above, the word "length" has been intentionally used, which is an improper way to refer to the motor revolutions, but which becomes relevant when referring to the driven load stroke.
For example, if the screw has a 40[mm/rev.] pitch and the gear ratio is t =1, the whole stroke is 2621,440 m long, the resolution is 0,0006 mm, while precision is approx. ± 0,005 mm.

4.4.2 Setting and tuning

4.4.2.1 Position reference

- To configure the positioning mode, the parameters of the active user table need to be set as follows:

- for the operating mode: Par.01, *Operating Mode* = "Positioning - 0,1 or 2"
- for the reference value (which can only be digital): Par.13, *Position Reference* = desired value, in rev.

4.4.2.2 Limitations

In a typical speed profile, during a positioning step (see Fig. 4-1), the following needs to be defined:
a) acceleration ramp R_A;
b) servomotor speed ω_P, considering the mechanical ratios, during the constant speed range ("plateau");
c) deceleration ramp R_D .

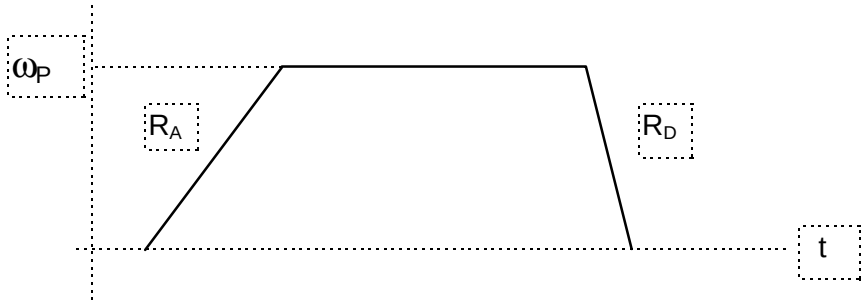


Fig. 4-1: Speed profile in a positioning cycle

The active user table provides for the parameters that affect the positioning cycle configuration:

- it is first of all necessary to define the limitations of the torque suppliable by the drive system and make them consistent with the desired speed profile (in the following way: knowing the load and the desired acceleration/deceleration ramps, the necessary torque is determined, which must be lower than suppliable torque); this is possible through the settings described under 4.2.2.2 relating to the limitations in the torque operating mode;
- setting of the "plateau" speed (digital):

- for speed positive values: Par.17, *Maximum Positive Speed* = desired value, in rpm
- for speed negative values: Par.18, *Maximum Negative Speed* = desired value, in rpm

- setting of the acceleration/deceleration ramps (the desired values are set in ms per 1000 rpm of reference speed variation):

- to enable ramps: Par.04, *Enable Ramps* = "Enable"
- for clockwise acceleration ramp: Par.21, *CW Acceleration Ramp*
- for counterclockwise acceleration ramp: Par.22, *CCW Acceleration Ramp*
- for clockwise deceleration ramp: Par.23, *CW Deceleration Ramp*
- for counterclockwise deceleration ramp: Par.24, *CCW Deceleration Ramp.*

Note: if the deceleration ramps have been introduced to limit the peak brake power (preventing the protection "Overvoltage DC Bus" from tripping), a better step-measure, in terms of system response time, consists in using Par.20, *Brake Power Limit*, in the active user table (see Fig. 3-5, section 3.6.6).

Important:
1 – to achieve a motion that optimizes (minimizes) the duration of the positioning cycle, proceed as follows:

- set the limitations concerning the suppliable torque
- set the "plateau" speed
- do not enable the ramps

In this way, the motion will be achieved using all the torque that the drive system can supply, therefore the time required to reach the desired value will be minimum.
2 – generally, in the long travels, when the stretch at constant speed ("plateau") becomes significant, a considerable cycle time reduction is achieved by increasing the "plateau" speed; the FOC control strategy used by the BIVECTOR allows to work with the brushless motors even during flux weakening and, consequently, to keep strong control up to speeds that are 33% higher than the motor rated speed.

4.4.2.3 Tuning

For a correct tuning of the position loop, the procedure sequence is the following:

- the drive system should operate under the load and motion conditions of the real system or, if not possible, simulate them
- set the limitations relating to the suppliable torque (see section 4.2.2.2)
- tune the speed regulator (see section 4.3.2.3) by setting a speed operation mode with speed values possibly similar to those of the positioning cycle
- set the desired motion cycle (see section 4.4.2.2)

- tune the position loop through Par.29, *Position Proportional Gain*; this tuning concerns the loop bandwidth and mainly influences how the reference value is reached. Starting from the minimum gain values up to the maximum values, the system response changes from "overdamped" to "underdamped" and the user has the possibility of choosing the value corresponding to the desired arrival to the reference position.

4.5 Synchronizing Mode

4.5.1 Synchronizing Mode features

4.5.1.1

Synchronization can only occur between two drive systems, both using BIVECTOR converters, even of different size. One of the two drive systems is the independent drive system, called **Master**. The Master can be used in any operating mode. The dependent drive system, called **Slave**, operates in Synchronizing Mode and follows the Master speed profile, as explained above.

The connection diagram between Master and Slave is shown in Fig. 3-15 of Chapter 3 (1st Part). As can be seen, the connection is performed between the simulated encoder output of the Master (ENCODER OUT) and the frequency input of the Slave (FREQUENCY IN).

4.5.1.2

The synchronization – in the strict sense of the word - between the two motors means that the two axes rotate at the same angular speed with zero speed error and with zero phase (angular) error when at steady state and limited within pre-established values during the transients. In the extended sense of the word, the definition of synchronized axes often refers to axes that rotate with different angular speeds, but whose ρ_ω ratio is constant. The BIVECTOR synchronizing system also allows to establish the ratio between the angular speed of the Slave ω_S and that of the Master ω_M :

$$\rho_\omega = \omega_S / \omega_M$$

This ratio can be established by setting four parameters: the numerator R_N (Par.07, *Ratio Numerator*, in the user table enabled for the Slave) and the denominator R_D (Par.08, *Ratio Denominator*, in the user table enabled for the Slave) of the set speed ratio

$$\rho_{\omega i} = R_N / R_D$$

as well as the ratio ρ_R between the resolution of the simulated encoder output R_M (Par.30, *Output Encoder Resolution*, in system table #0 of the Master) and the frequency input resolution R_S (Par.33, *Input Encoder Resolution*, in system table #0 of the Slave)

$$\rho_R = R_S / R_M$$

Result:

$$\rho_\omega = \rho_{\omega i} \bullet \rho_R$$

When $\rho_\omega = 1$, the two drive systems are synchronized in the strict sense of the word. When the ratio $\rho_\omega \neq 1$, the ρ_ω value determines the angular speed value of the Slave vis-à-vis the Master.

For example, if $\rho_\omega = 0{,}5$ and the Master speed is $\omega_M = 1000$ [rpm], the speed of the Slave is $\omega_S = \rho_\omega \bullet 1000 = 500$ [rpm].

4.5.1.3

If more drive systems are desired as slave to one single Master, only a cascade connection is possible; it is not possible to multiple the ENCODER OUT output of the Master on more FREQUENCY IN connectors of different slaves.

A cascade connection between more drive systems is achieved in the following way: the connection between the Master and the first Slave is performed as in the above mentioned figure. Subsequently, using the ENCODER OUT output of the first Slave as **Master signal** for the second Slave drive system, the ENCODER OUT of the first Slave is connected to FREQUENCY IN of the second Slave, and so forth for all the desired Slaves of the Master. Apart from the Master, all the slaves are to be configured in Synchronizing Mode. Please note that static and dynamic errors add up for each chain component.

4.5.2 Setting and tuning

4.5.2.1 Synchronization reference

- The synchronizing mode is to be set for the Slave only (the Master can operate in any mode):

- for the synchronizing mode, set Par.01, *Operating Mode* = “Synchronizing - 0,1 or 2”, in the Slave active user table
- for the reference supplied to the Slave, it is necessary to set the desired reduction ratio following the procedure described under 4.5.1.2; to provide an example, the best way to set a so-called Angle Synchronization (“phase closed electrical axis ”), characterized by a reduction ratio of 1:1, is here described:
  - Par.30, *Output Encoder Resolution* = “2048 ppr”, in system table #0 of the Master (maximum resolution for simulated encoder output)
  - Par.33, *Input Encoder Resolution* = “2048 ppr”, in system table #0 of the Slave (maximum resolution for frequency input)
  - Par.07, *Ratio Numerator* = 1, in the Slave active user table
  - Par.08, *Ratio Denominator* = 1, in the Slave active user table
- for the relative motion direction between Master and Slave:
  - Par.09, *Synchro Direction*, in the Slave active user table (“No Reverse” implies the same speed direction for both)
- for the phase shift between Master and Slave (it only applies to the Angle Synchronization configuration):
  - Par.10, *Synchro Phase Shift*, in the active user table of the Slave.

4.5.2.2 Limitations

For a correct tuning in synchronizing mode, it is fundamental to make sure that the Slave has sufficient dynamics to follow the Master. Therefore, during the setting of the Slave limitations, the following is to be taken into account:

- the limitations of the torque suppliable by the Slave drive system (through the settings described under 4.2.2.2) must be consistent with the speed profile to be followed, making sure that there is a sufficient torque margin required to minimize the phase error under transient condition;
- it is suggested not to enable the speed ramps in the Slave configuration.

4.5.2.3 Tuning

Reference is made here to Slave tuning only, because the Master is tuned according to the operation mode for which it has been configured. As a result:

- the speed regulator tuning (see section 4.3.2.3) for the Slave should be performed beforehand, setting a speed operation mode, with speed values possibly similar to those of the electrical axis operating cycle
- the phase loop is tuned through Par.29, *Position Proportional Gain,* in the Slave active user table; this tuning concerns the loop bandwidth and its optimum point is set between high gain values, which may cause instability in the Slave control, and low values, which allow a greater phase error during transient condition.

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CHAPTER 5 – SPECIAL FUNCTIONS

5.1 Note

Special functions provide a series of functions that were traditionally obtained only by combining a drive system and a controller, typically a Numeric Control (NC). A certain number of typical operations of "Motion Control" can be easily performed by means of these special functions. In this way, it is sometimes possible to control an operating machine or a different type of machine, without the need of controllers, thus saving money and getting it simpler and more reliable.

5.2 On-the-fly table change

5.2.1 Features

BIVECTOR software allows to change the active general purpose user table and therefore the converter operation, by only one command. This change is practically immediate (as it is usually said, "on-the-fly") and it can be performed when the converter is in GO status.
As shown in section 3.5.1.4, the desired motion (operating mode, reference values, limits, etc.) is established by a user table and it is set by 33 parameters, described under item 3.6.6 "User table parameters". On-the-fly user table change can involve, at the worst, the change of the entire set of 33 parameters. For example, from active general purpose table # 0, which is configured in the speed mode, with an analog reference, it is possible to switch to general purpose table # 23 which is configured in the torque mode, with a digital reference.
Important note:
1 – Freedom degrees (33 parameters max which can be simultaneously changed) offered by on-the-fly change function must be handled by user with utmost care, not to introduce transients harmful for the machine during table switching.
2 – On-the-fly table change function has less priority than Target procedure, described in following section 5.3. Therefore, when a target procedure is in progress, any on-the-fly table change command is ignored ("target reaching can not be stopped").

5.2.2 Setting

The on-the-fly table change setting can be performed as follows:

- prepare the general purpose user tables:
  - define the general purpose user tables involved in the operation cycle to be implemented;
  - configure the desired operating modes within each table (by the 33 parameters); to configure very similar tables, we recommend to use the Edit menu function "Load User Table GenP #xx As GenP #yy", described under item 3.5.3.3, "Editor commands";
  - define table sequence within the operation cycle;
- give the Start (RUN) command or "Start (RUN) with the general purpose user table #... ";
- start on-the-fly table change, when desired, in one of the following ways:
  - via serial interface:
    - set Par.26, *Serial Priority* = "Yes", in system table #0;
    - use "Change User Table" command sent through Key_B (see Chapter 8) or PC, with BIVCOM program (see Chapter 7);
  - via configurable digital inputs – in system table #0:
    - set Par.26, *Serial Priority* = "No";

- choose the number of general purpose user tables involved in the on-the-fly change: Par.03, *User Tables Selected*; the number chosen should be higher or equal to the number of tables actually involved in the on-the-fly change; as a function of this parameter, digital inputs through which the on-the-fly table change is performed are automatically assigned (see the following table), independent of their previous meaning. Digital input automatic assignment has the following features: involved digital inputs are adjacent, starting from DIN 1 input, and the least significant bit on the digital word is provided by DIN1.

Selection	Selected tables	Involved digital inputs
00 User Tables	None	None
02 User Tables	GenP 0 ÷ GenP 1	DIN 1
04 User Tables	GenP 0 ÷ GenP 3	DIN 1 ÷ DIN 2
08 User Tables	GenP 0 ÷ GenP 7	DIN 1 ÷ DIN 3
16 User Tables	GenP 0 ÷ GenP 15	DIN 1 ÷ DIN 4
32 User Tables	GenP 0 ÷ GenP 31	DIN 1 ÷ DIN 5

Example: Par. 03 = “16 User Tables” implies a number of user table configured through DIN 1, DIN 2, DIN 3 and DIN 4. To select general user table #11, it is necessary to set digital inputs as follows: DIN 4 = 1 (the most significant bit), DIN 3 = 0, DIN 2 = 1 and DIN 1 = 1;

- configure digital inputs involved in the control of the on-the-fly change through Par.04...08, *Digital Input 1...5 Configuration* = “User Table Selector”; this operation is not strictly necessary, due to automatic assignment described above;
- the user table active at a certain time is configured through the status of digital inputs;
- status change of at least one digital input implies the change of the configured digital word and, therefore, switching on the new selected general purpose user table (on-the-fly change); digital input scanning is carried out every 1 ms.

Note:
To avoid transient passages through not desired tables, we recommend to switch tables with a sequence requiring the change of only one bit at a time.

5.3 Target procedure

5.3.1 Features

This special feature is basically a selfcommutation from a user table (start table) to another table (end table) when a well determined condition takes place.

- The target to be reached - Target - (it could be, for example, a specified speed) is defined by user in the start table, which is called and designed as Target table; when target is reached, the current (start) user table commutates automatically to the user table identified as next table.
- Each user table can be configured as Target table.
- Since process can be repeated, operating cycles can be carried out with a maximum number of 32 general purpose user tables and, in some particular situations, these cycles can also be carried out with some special user tables. It is in practice a series of on-the-fly commutable tables, that by selfcommutation procedure can be automatically activated in sequence.
- the Target special function is of top priority towards on-the-fly change of user tables commanded from the outside, via serial interface or via digital inputs.

- 3 types of Targets are available ("Time", "Speed" and "Position"), different for Target definition modes and reaching criterion of the target itself (see from section 5.3.2 to section 5.3.4). "Enable" Target cannot be accessed by user.

*5.3.2 "**Time**" Target*

Start user table can be set as follows:
A – define the start table as Target table: Par.05, *Target Table* **=** "Yes";
B – define the Target type to be reached: Par.06, *Target Type* **=** "Time";
Target reaching criterion: when stay time in the start table reaches the value defined by Par.31 (see point C).
C – Define the stay time in the start table: Par.31, *Target Value,* in [sec.];
setting range: 0,000 sec. ÷ 99,999,99 sec.
On time expiring, selfcommutation to end table designated by Par.33 takes place (see point D).
D – Define the end table: Par.33, *Next Table,* by choosing one of the special user tables or one of the 32 general purpose user tables.

*5.3.3 "**Speed**" Target*

The start user table can be set as follows:
A – define the start table as Target table: Par.05, *Target Table* **=** "Yes";
B - define the Target type to be reached: Par.06, *Target Type* **=** "Speed";
Target reaching criterion: when current speed, during operation with start table, reaches the value defined by Par.12 (see point C) within an error specified by Par.32 (see point D);
C – define the speed to reach: Par.12, *Digital Speed Reference*, in [rpm];
D – define the error range within which speed can be considered as reached: Par.32, *Target Error*; setting range: from 0 to 32767, corresponding to a speed range of 0,0 ÷ 7324,5 rpm (for example, value "5" corresponds to an error of about 1 rpm); when speed is reached within the preset error range, selfcommutation to end table designated by Par. 33 (see point E) takes place.
E – define the end table: Par.33, *Next Table,* by choosing one of the special user tables or one of the 32 general purpose user tables.

*5.3.4 "**Position**" Target*

The start user table can be set as follows:
A – define the start table as Target table: Par.05, *Target Table* **=** "Yes";
B - define the Target type to be reached: Par.06, *Target Type* **=** "Position".
Target achieving criterion: when the current multiturn position during operation with the start table reaches the value defined by Par.13 (see point C) within an error range specified by Par.32 (see point D);
C – define the multiturn position to be reached: Par.13, *Position Reference,* in [turns];
D – define the error range within which the position is considered as reached: Par.32, *Target Error*; setting range: from 0 to 32767, corresponding to a position range of 0,00 ÷ 179,99° (for example, value "18" corresponds to an error of about 0,1°); when the position is reached within the preset error range, selfcommutation to end table designated by Par.33 (see point E) takes place.
E – define the end table: Par.33, *Next Table,* by choosing one of the special user tables or one of the 32 general purpose user tables.

5.4 Homing (axis reference position)

5.4.1 Features

5.4.1.1
Note that in this section the driven load has been called “axis”, referring to the fact that very often the load is provided with linear motion.
Section 4.4 “Positioning Mode” describes the chance to operate the drive system with a BIVECTOR converter as a real point-to-point positioner; it is therefore necessary to fix an absolute origin of measures; this procedure is called “Homing”; it determines the traditional origin of distance calculations and of software limit switch positioning.
The following sections describe the features of the special Homing function.

5.4.1.2

WARNING! Not to lose information concerning the reference position of the machine and the current position, in case of three-phase power supply cutoff - see section 3.4.2.1, Chapter 3 (1st Part) –, it is necessary to connect the single-phase auxiliary power supply, according to item 3.4.2.2, Chapter 3 - 1st Part).
If you think that the auxiliary power supply can also be cut off, the auxiliary power supply should be provided with a continuity assembly (power requirements 40 VA @ 230 V, 50/60Hz).

5.4.1.3
Homing function must determine a physical position of the driven axis; therefore, as well as an appropriate parameter setting, this function also requires installation of a sensor (for example a DIP switch, a proximity sensor or a similar device), whose position becomes the axis mechanical reference. From now on this device is referred to as Homing sensor, for the sake of brevity.
Problems related to the Homing sensor, such as activation precision, any mechanical hysteresis, etc. must be estimated by the user.
The position sensor sends its digital signal (more simply: logic signal, because it can only be open/closed) to one of the logic inputs (see section 3.8, “Signal inputs and outputs”), appropriately configured.

5.4.1.5
Homing position can be defined as the distance origin (zero dimension), or it can have any value, with any sign; obviously this will be taken into consideration when target dimensions (positions, SW limit switches, etc.) are determined.

5.4.1.6

WARNING! Homing special function must always be used, following the procedure described under item 5.4.2, before setting operation in the positioning mode (section 4.4) and SW limit switch functions (section 5.7).

5.4.2 Procedure

The procedure to be used is specified in the following points.

A – Connect the two Homing sensor terminals between one of the 8 configurable digital inputs and the “COMMON” input of the DIGITAL I/O terminal block.

B – Configure the chosen input by the appropriate parameter *Digital Input...Configuration* (from Par.04 to Par.11 in system table # 0) as “Home Input High/Low”, also as a function of the signal level chosen as “active” (when passing in front of the sensor).

C – Set the value assigned to the reference position, corresponding to Homing sensor position, by Par.07, *Home Position*, in system table #1, in [turns]; the default position is fixed at 0,0000 turns;

D – be sure the drive system is in RFO status; in this condition, the BIVECTOR display must show **OH.**

E – Give "Start Homing" command:

- via serial interface (available in "PLC Functions" menu):
  - through PC and BIVCOM program (see Chapter 7);
    or
  - through Key-B keyboard (see Chapter 8);
- via digital input, configured as "Starting Homing High" or "Starting Homing Low" via a suitable parameter (Par.04 ÷ Par.11) in the system #0 table.

F – the drive system switches to GO status (the Bivector display shows **GO**), and it operates according to settings of the Homing special user table, currently active;

- the default configuration of Homing special table is as follows:
  - Par.01, *Operating Mode* = "Speed Mode - 0" (speed mode, with digital reference)
  - Par.12, *Digital Speed Reference* = +100 rpm (after "Start Homing" command, motor rotates at the speed +100 rpm)
  - Par.05, *Target Table* = "No";

Note: User can change these parameters and any other parameter of the Homing special user table (for example, speed loop tuning), according to his own needs.

G1 – End of normal procedure: after reaching the Homing sensor active level, the program automatically commands two operations:

- it sets the current position at reference position value (see point **C**);
- it commands the motor stop.

G2 – End of the emergency procedure: user can give, when necessary, the **STOP** command, both via serial interface and by a dedicated logic input; in the latter case, motor stops and Homing procedure is automatically canceled, but it can even be restarted.

5.5 Jog (Manual motion)

5.5.1 Features

Jog is the normal manual motion control, which is used on most operating machines during machine adjustment. It turns the motor, at preset speed, during all the command activation time. User can fix two different angle speeds, one for each rotation direction.

WARNING! The angle speed values set by this special function are also used in the **TEST** special function (see section 2.5, "Drive system preliminary test". User should pay much attention when setting Jog speed parameters.

5.5.2 Procedure

The procedure to be used is described in the following points.

A – Be sure the drive system is in the RFO status; in this condition, the BIVECTOR display shows **OH**.

B – Give the command "**Jog+**" or "**Jog-** ":

- via serial interface (command available in "PLC Functions" menu): through PC and BIVCOM program or through Key-B keyboard;
- via configurable digital inputs: configure the chosen inputs by the appropriate parameters *Digital Input...Configuration* (from Par.04 to Par.11 in system table # 0) respectively as "Jog+ High/Low" and "Jog- High/Low", also as a function

of the signal level chosen as “active”. The activation of input signal level corresponds to the command corresponding to “**Jog+**” or “**Jog-** “ input.

C – The drive passes to GO status (Bivector display shows **GO**), operating according to settings of special user table “Jog+” or “Jog-”, currently active;

- the “Jog+” and “Jog-” special table default configuration is as follows:
  - Par.01, *Operating Mode* = “Speed Mode - 0” (speed mode, with digital reference)
  - Par.12, *Digital Speed Reference* **=**
    a) + 100 rpm for “Jog+” table (after the “Jog+” command, motor rotates at +100 rpm);
    b) - 100 rpm for “Jog-” table (after the “Jog-” command, motor rotates at -100 rpm)
  - Par.05, *Target Table* = “No”

Note: User can change these parameters and any other parameter of these special user tables (for example, speed loop tuning), according to his own needs.

D – To stop the operation, procedures are different according to the control mode:

D1 – if the command was issued via serial interface (BIVCOM or Key-B), give the command **STOP** to stop rotation;

D2 – if the command was given via a configurable digital input, just get the signal in the corresponding input to an “off” level (for example, to stop a motion in the positive direction, commanded via a configured digital input such as “Jog+ High”, stop the motor by getting signal to low level in this input).

WARNING! In any case, regardless of the activation mode, during the operation with Jog + and Jog – special functions, **the STOP command is always active**, both from serial interface and digital input, for any emergency stop.

5.6 Autotuning

Autotuning functions of some variables, listed in the following points, are currently being prepared; tunings can now be performed by user, setting the related parameters in system table # 0.

- Resolver Autophasing concerns:
  - Par.28, *Resolver Phase Adjustment*
- Currents Offset Autotuning concerns:
  - Par.36, *Offset Current Phase 1*
  - Par.37, *Offset Current Phase 2*
  - Par.38, *Offset Current Phase 3*
- AIN1 Offset Autotuning concerns:
  - Par.34, *Analog Input 1 Offset*
- AIN2 Offset Autotuning concerns:
  - Par.35, *Analog Input 2 Offset*

5.7 Limit switches

5.7.1 Introduction

WARNING!

Limit switches of any type described in this section are all handled via SW; therefore, according to his risk estimations, the machine electrical equipment designer must, where necessary, install safety limit switches, acting at power level; he must, in any case, directly make the machine installation, in compliance with all law safety standards. Limit switches here described should essentially be considered as operating limit switches and not as safety limit switches.

5.7.2 Definitions

Definitions specified in section 5.4, “Homing (Axis reference position)” are called. Besides,

- the limit switch term can also be shortened to LimSW.
- The limit switch alarm activates a determined LimSW; the alarm effect can be of different types, according to the limit switch activated;
- when motor shaft turns clockwise, seen from shaft end side, motor angle speed is defined as positive, **ω+**;
- when motor shaft turns conterclockwise, seen from shaft end side, motor angle speed is defined as negative, **ω-**;
- axis motion caused by motor rotating with speed **ω+** (increasing positions) is defined as motion towards right or positive motion;
- axis motion caused by motor rotating with speed **ω-** (decreasing positions) is defined as motion towards left or negative motion;
- right limit switches are the ones placed at axis right end.
- left limit switches are the ones placed at axis left end.

5.7.3 General features

Two types of limit switches are available:
A – two hardware (HW) limit switches, named Right HW LimSW and Left HW LimSW.
B – two-level software (SW) limit switches, named Right SW LimSW #1 and #2 and Left SW LimSW #1 and #2.
It is not allowed to cross LimSWs, that is to say all Right LimSWs must remain to the right of all Left LimSWs. Fig. 5-1 shows schematically the arrangement of LimSWs (Lx = Left and Rx = Right) and the alarms that are activated when going out from the allowed space.
Hardware limit switches are activated by a sensor (for example a DIP switch, a proximity sensor or similar devices); it is necessary for the sensor to give a status signal and not a transition signal; this means that the mechanical contact for a limit switch (or a similar situation for a magnetic sensor) must remain from the moment of activation up to the end of the travel.

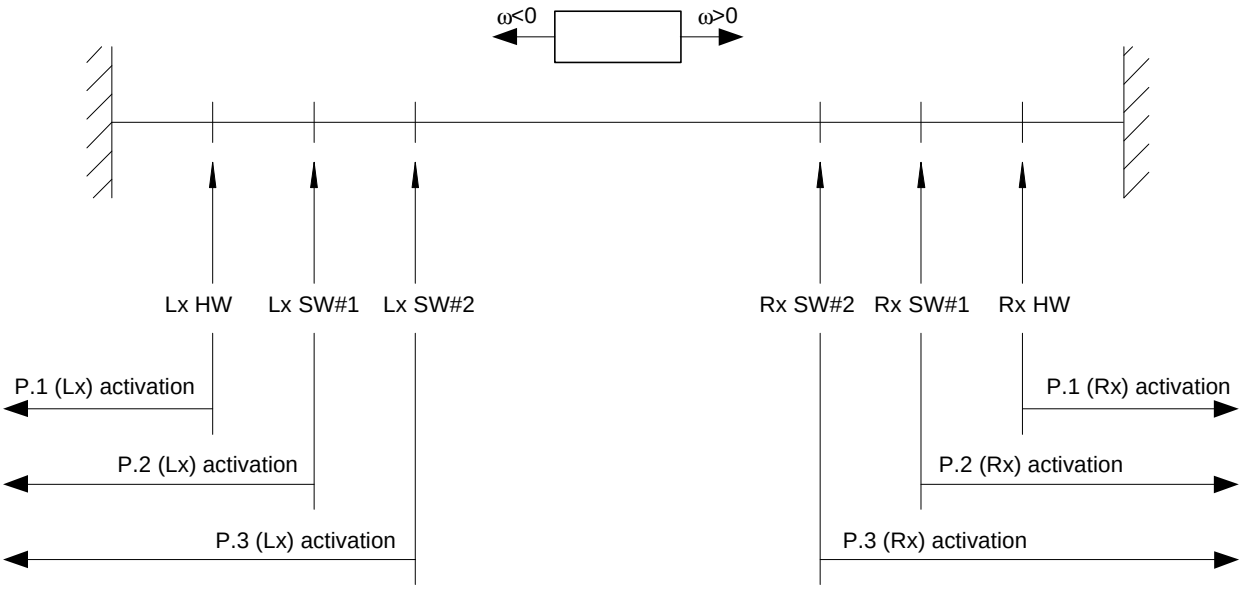

Fig. 5-1: Limit switch arrangement

5.7.4 Procedure

The procedure to be used is described in the following points. Obviously, this procedure must be performed before starting the desired operation cycle.

A1 – HW limit switch installation

- connect the two limit switch sensors to 2 configurable digital inputs;
- appropriately configure these digital inputs by using the appropriate parameters *Digital Input...Configuration* (from Par.04 to Par.11 in system table # 0), respectively as “Right HW LimSw High/Low” and “Left HW LimSw High/Low“, also as a function of the signal level chosen as “active”. Input signal level activation corresponds to P.1 alarm activation, “HW Limit Switch”.

A2 – SW limit switch installation

- you should have previously performed Homing procedure to determine reference axis position (see section 5.4);
- enable Software (SW) limit switches by Par.01 and 02, *Enable Software Limit Switch #1/#2* = “Enable” for #1/#2 level, both in system table #1;
- define Software (SW) limit switch values, right and left, for #1 and #2 levels, by parameters Par.03, 04, 05 and 06, *Right/Left Software Limit Switch #1/#2*, in [turns]; when getting out of the space limited by these values, the alarms P.2 “SW Limit Switch #1” (for level #1) and P.3, “SW Limit Switch #2” (for level #2) are respectively activated (see Fig. 5-1).

5.7.5 Alarm effects

Alarm activation is fixed, for each limit switch, by 6 special user tables, specific for these functions:

- “Limit Switch Hardware - Right/Left” : for right and left HW limit switches;
- “Limit Switch Software #1/#2 - Right/Left” : for right and left SW limit switches, levels #1 and #2.

Table becomes active when the corresponding alarm is activated and it remains active until a **STOP** command is given. If the motor position has not been brought back in the allowed range, the alarm is immediately back and the corresponding table gets active again.

The default contents of the 6 tables is summarized in the following parameters:

- Par.01, *Operating Mode* = “Speed Mode - 0” (speed mode, with digital reference)
- Par.12, *Digital Speed Reference* **=** 0 rpm (motor stop is commanded)

- Par.17, *Maximum Positive Speed* **=** 0 rpm, for tables corresponding to right HW or SW limit switches (it only allows motion towards the right direction to get back in the allowed range)
- Par.18, *Maximum Negative Speed* **=** 0 rpm, for tables corresponding to left HW or SW limit switches (it only allows motion towards the right direction to get back in the allowed range)
- Par.05, *Target Table* = "No" (the GO status is maintained and the table is not selfcommutated).

These tables can be changed by the user, who must be **warned that the two parameters, Par.17, *Maximum Positive Speed,* (for right limit switches) and Par.18, *Maximum Negative Speed,* (for left limit switches)** must not absolutely be changed.

5.7.6 Return procedure after limit switch overtravel

Since motor stops for an alarm caused by a limit switch overtravel, it is necessary to move the axis in order to turn back in the allowed range. To do so, perform the operations listed below.

- properly change (pay attention to the sign!) Par.12**,** *Digital Speed Reference,* in the table of the limit switch which produced the alarm.
- put back the axis position within the allowed range.
- as soon as the position has got back within the allowed limit, press **STOP**.
- zero set par.12 value.
- at this point, the drive system can restart in a normal way.

Another procedure mode requires a limit switch table configuration different from the default configuration. To obtain it, it is necessary to:

- configure the limit switch tables for speed mode operation, with analogue reference given on AIN1 input, by a potentiometer; it is necessary to set Par.01, *Operating Mode* = "Speed Mode - 3 or 4";
- we recommend to keep the analog reference at a nearly zero value (after alarm activation, the motor will be practically still);
- by the potentiometer, adjust the speed reference to put back the axis position within the allowed range;
- as soon as the position is again within the allowed limit, send a **STOP** command.
- at this point, the drive system can restart in a normal way.

5.8 Tune

5.8.1 Features

This function allows the user to perform tuning, or better, to minimize the second harmonic ripple of the speed signal. To meet this goal, you have to be provided with an appropriate oscilloscope, to display the speed analog signal from a BIVECTOR analog output.

5.8.2 Procedure

The procedure to be used is described in the following points.

A – Be sure the drive system is in RFO status; in this status, the BIVECTOR display must show **OH**.

B – check that motor can freely rotate.

WARNING! Moving part danger. The activation of special TUNE function causes motor rotation; therefore tuning could require a few minutes to the operator; it is then necessary to take the appropriate actions as far as load is concerned, and if it is necessary to perform the operation when load is disconnected.

C – Give the **"Tune**" command, via serial interface, by PC with BIVCOM program or by Key_B; the command is available from "PLC Functions" menu;

D – the drive system enters GO status (the Bivector display shows **GO**), operating according to settings of special "Tune" user table, which is active at this moment;

- the default configuration of special "Tune" table is as follows:
  - Par.01, *Operating Mode* = "Speed Mode - 0" (speed mode, with digital reference);
  - Par.12, *Digital Speed Reference* **=** + 1000 rpm (after "Tune" command, motor turns at +1000 rpm);
  - Par.05, *Target Table* = "No" (GO status remains active and table is not automatically commutated);

Note: User can change these parameters and any other parameter of these special user tables (for example, tuning of speed loop), according to his own needs.

E – Set the variables to be monitored during tuning on AOUT1 and AOUT2 analog outputs:

- Par.19, *Analog Output 1 Configuration* = "Actual Speed", in system table # 0; this analog output, observed with the oscilloscope, will present a certain ripple of second harmonic, which will have to be minimized (for a better display of ripple, we recommend to configure the oscilloscope representation to "AC");
- Par.20, *Analog Output 2 Configuration* = "Mechanical Angle", in system table # 0; this analog output, observed with the oscilloscope, represents a reference to identify harmonics of speed signal (in particular, to identify the second harmonic, the one that must be tuned);

F – perform tuning by means of Par.07, *2-nd Harmonic Tuning*, of control table, acting in an experimental way; change this parameter (possible values range from - 127 to + 127) until the minimum second harmonic ripple is obtained.

G – End the test by activating the **STOP** command, via serial link or digital input.

Note: the STOP command is always active, for any emergency stop during the test.

CHAPTER 6 – NON COMPLIANT OPERATIONS AND FAILURES

6.1 General

This chapter contains the procedures to look for, detect and remove not compliant operations and any failures of the drive system (BIVECTOR converter and motor assembly), as well as faults of the power supply installation.
The BIVECTOR converter is provided with an efficient protection system for safeguarding the equipment from damages which could arise from internal or external causes or from incorrect operation conditions; the protection system also provides the operator with information, which is an efficient help for the detection of incorrect operation causes and/or drive system failures.
Most of non compliant operations and failures can be identified by the operator, by means of the instructions contained in this chapter; there are cases where Customer Service help may be needed.

6.2 Protection system

The operation protection system works by means of two procedures, which produce different effects and messages:

- **Warning** does not cause any change in the drive system status; for example, it does not stop motor rotation, but it can reduce some performances; this procedure is activated when the fault, which produced the alarm, does not need an immediate correction;
- **Failure** disables the BIVECTOR and gets the drive system into the FAIL status; disabling can be immediate or it can take place after motor automatic stop, according to failure seriousness.
- Both for **Warning** and **Failure**, for each not compliant operation or failure, the following messages are displayed:
  A – an extended message on Key-B display and on PC screen;
  B – a two-character reference alphanumeric tag on BIVECTOR display.

6.3 Warning and Failure messages

Table 6/1

Converter display	Alarm name	Description	Protection type and action	Remedy
d.1	Failure IPM	IPM valve protection	**Failure** Converter immediate disabling	**a**) Check ground insulation of BIVECTOR and motor. **b**) In case of bad insulation, replace the component. **c**) If insulation is good, contact the Customer Service.
O.1	Opened Relay	Power relay open (not supplied DC Bus)	**Failure** Converter immediate disabling	**a)** Measure $\mathbf{U_{VN}}$, three-phase power supply, voltage to R-S, S-T, R-T terminals: the voltage must be the nominal one (see Table 2/1- 1st Part – and Note): ± 10%. For instance: if $\mathbf{U_{VN}}$ = 400 V; then rated value: 400 V minimum value: 360 V maximum value: 440 V. **b)** If the voltage is out of tolerance, supply with the correct voltage. **c)** Check braking resistor dimensioning and its correct connection. **d)** Possible temporary absence of power supply. **e)** Possible absence of one phase.
O.2	Overvoltage DC Bus SW	Overvoltage on DC Bus	**Failure** Converter immediate disabling	See remedy for O.1
U.1	Undervoltage DC Bus	Undervoltage on DC Bus	**Failure** Motor stop and converter disabling	**a)** follow the measures prescribed in O.1, while the drive system is overloaded; minimum voltage between lines: 340 V. **b)** check Par.16 setting, *Maximum Phase Current*, in the user table.
U.2	Undervoltage Line	Power supply undervoltage	**Failure** Motor stop and converter disabling	**a**) See remedy for O.1. **b**) Possible temporary lack of mains supply. **c**) One phase possible lack.
C.1	Current Tripping	Real current level out of control	**Failure** Converter immediate disabling	**a)** Possible short circuit between two or more converter output phases, terminals **U, V, W**.
C.2	Homopolar Current Limiter	Non-zero level of homopolar current	**Failure** Converter immediate disabling	See remedy for d.1.
H.1	OverHeating Converter Heatsink	Converter thermal probe activation	**Failure** Motor stop and converter disabling	**a)** check temperature in the cabinet where the converter is placed; **b)** check converter ventilation.

H.2	Motor Thermal Probe Protection	Motor thermal probe activation	**Failure** Motor stop and converter disabling	**a)** Check that Par.02, *Motor Thermal Probe*, in system table # 0, is correctly set, according to sensor type. **b)** check the circuit from **I** and **J** terminals of the motor assembly connection box to terminals **PTS** and **NTS** of the converter TH MOT connector; **c)** check temperature of the environment where motor assembly is placed; **d)** check operation cycles according to average torque, peak torque and average power.
H.3	Converter Thermal Estimate	Converter thermal image	**Warning** Current at converter rated value is limited	**a)** Check operation cycles according to average torque, peak torque and average power.
H.4	Motor Thermal Estimate	Motor thermal image	**Warning** Current at motor rated value is limited	**a)** check operation cycles according to average torque, peak torque and average power. The chosen drive system could be underdimensioned for operation needs.
H.5	Braking Resistor Thermal Estimate	Brake thermal image	**Failure** Converter immediate disabling	**a)** check peak power and average braking power during the operation cycle; **b)** limit, where necessary, the power during braking(see Par.20, *Brake Power Limit*) and deceleration ramps (see Par.23, *CW Deceleration Ramp*, and Par.24, *CWW Deceleration Ramp*) of user table.
S.1	Overspeed	Permissible speed threshold has been exceeded	**Failure** Converter immediate disabling	**a)** Check the overspeed value set in Par.15, *Overspeed Limit*, in system table #1; **b)** check set speed value, digital (Par.12 of user table) or analog.
P.1	HW Limit switch	HW limit switches exceeded	**Warning** Is commanded the special user table Limit Switch Hardware – Right or Limit Switch Hardware – Left	**a)** Check the set motions towards points where mechanical references of the right and left hardware limit switches are placed; **b)** check the configurations (function and active level) set for digital inputs in system table # 0 from Par.04 to Par.11; **c)** move the axis until the position is within the permissible range, according to the procedure described under item 5.7.5, Chapter 5.
P.2	SW Limit Switch #1	SW #1 limit switches exceeded	**Warning** Is commanded the special user table Limit Switch Software #1 – Right or Limit Switch Software #1 - Left	**a)** Check parameter settings of system table # 1: Par.01, *Enable Software Limit Switch #1*, Par.03, *Right Software Limit Switch #1*, Par.04, *Left Software Limit Switch #1*; **b**) check motions set according to set software limits; **c)** check that **Homing** procedure has been correctly executed; **d)** move the axis, until its position is within the permissible range, according to procedure described under item 5.7.5, Chapter 5.

P.3	SW Limit Switch #2	SW #2 limit switches exceeded	**Warning** Is commanded the special user table Limit Switch Software #2 – Right or Limit Switch Software #2 - Left	**a)** Check parameter setting of system table # 1: Par.02, *Enable Software Limit Switch #2*, Par.05, *Right Software Limit Switch #2*, Par.06, *Left Software Limit Switch #2*; **b**) check motions set according to set software limits; **c)** check that **Homing** procedure has been correctly executed; **d)** move the axis, until its position is within the permissible range, according to procedure described under item 5.7.5, Chapter 5.
F.1	Fault Resolver	Resolver signal lack	**Failure** Converter immediate disabling	**a)** check the cable is correctly connected on the converter and on the motor assembly; **b)** check the cable is not cut.
A.1	Auxiliary 230 V Undelivered	Buffer 230 V auxiliary power supply lack	**Warning** Signaling	Case A – Auxiliary voltage is to be used: **a)** Measure the single phase auxiliary voltage on the converter terminal box between terminals marked with 230 V ~: rated: 230 V minimum: 207 V maximum: 253 V; **b)** supply with the correct voltage. Case B – Auxiliary voltage is not to be used: a) check that Par.01, *Auxiliary Power Supply*, of system table # 0 is set on "No"**.**
A.2	Weak Boards Supply	8 - 9 V edge lack on ICB	**Warning** Signaling	See remedy for U.1.
E.1	Firmware Error	Error signaled by PGA	**Failure** Converter immediate disabling	Contact the Customer Service.
E.2	ICB Supply Down	Lack of 5 V stabilized on ICB control board	**Failure** Converter immediate disabling	Contact the Customer Service.
E.3	RAM Error	Check sum RAM error	**Warning** Signaling	In case of incorrect operation, please contact the Customer Service.
E.4	EPROM Error		**Warning** Signaling	In case of incorrect operation, please contact the Customer Service.
E.5	EEPROM Error		**Warning** Signaling	In case of incorrect operation, please contact the Customer Service.

6.4 Miscellaneous alarms

When connecting the BIVECTOR converter and the completion devices (PC with BIVCOM program and Key-B removable keyboard) **communication errors** signals can be displayed. Check:

- cable and serial connection connectors between BIVECTOR and completion device;
- Par.24, *Baud Rate Serial RS 232*, of system table # 0;
- serial port selection (COM 1, COM 2, ...) when using the PC with BIVCOM program.

CHAPTER 7 – USE OF BIVCOM PROGRAM

7.1 General features

7.1.1 Warning

The contents of this manual, in particular of this chapter, is compatible with **SW version 1.04** of BIVCOM program.

7.1.2 Preliminary notes

Warning and error messages are displayed on the screen in the language chosen for installation (Italian or English).
Please note some general practical information.

- Commands and movements on the screen can be performed by:
  1 – up/down and right/left arrows on PC keyboard (←↑→↓);
  2 – function keys on PC keyboard **(F2 ÷ F 9)**.
- The display shows three different areas which are called, starting from top: area A (high), area C (center) and area B (low).
- Each area of the display can contain: a) fixed information; b) real time updated information.
- To briefly indicate that you have to press a key on the keyboard, the symbol ☛ will be used. The commanded function is indicated after the name of the key and the symbol ➔.
  For example: ☛ F5 ➔ Test means that, by pressing F5 key on PC keyboard, the "Test" command is given (see § 7.4.3).
- The **ESC** (Exit) command brings back to the previous condition/display.

7.1.3 Program features

BIVCOM program has been specifically made to be used with all the drive systems using BIVECTOR converters, produced by ABB Servomotors S.r.l.
BIVCOM program is an advanced communication program, for the connection between the BIVECTOR converter and a personal computer (PC).
The connection with a PC allows to use the PC itself for many goals; the most important goals are indicated below.

- Carry out all Editing operations to know and change component (servomotor and converter) features of the drive system and of combination between them. In particular:
  - read the contents of tables;
  - modify the parameters;
  - save table contents.
- Send the commands via serial interface using dedicated keys, such as RUN, STOP, RESET, that are displayed on the screen.
- Monitoring of some drive typical dimensions such as reference speed, actual speed, axis position, digital inputs status. Note that all these values can be detected in any converter status, without altering operation or command transmission.
- Execute the "Copy Parameters" function, which transfers the contents of the 68 tables between two converters.
- Print each converter table on paper or on file.

BIVCOM program is a wizard program, which interacts with the operator/user. Therefore, since user should know actions that have to be performed to execute specific operations,

described in Chapters 4 and 5, this chapter will be particularly useful as an example and a guide for a correct usage of the program.

7.2 Hardware connections

The connection between PC and BIVECTOR converter is easily made by a cable for serial connection; it must be made as described under item 3.4.3.2B ”RS232/RS485 Connector – Connection to PC”, Chapter 3 (1st Part).
It is necessary to respect the maximum prescribed cable length.
In order for the PC to effectively control the BIVECTOR converter operation, apart from the above mentioned connection, it is necessary to install BIVCOM program, as described in section 7.3 and correctly supply the BIVECTOR converter.

7.3 Installation and start-up of BIVCOM program

7.3.1 PC hardware and software requirements

Before installing BIVCOM program, be sure that the PC on which the program is installed has the following features:
- IBM PC 486 / Pentium or compatible (program was tested on IBM PSPV, HP Vectra, Compaq Armada, Compaq DeskPro);
- 3,25” and 1,44 MB floppy disk drive;
- 2 MB minimum available on hard disk;
- 1 serial port minimum available;
- available RAM: 640 kB minimum;
- MS-DOS operating system version 3.1 and later, Windows 95 (MS_DOS prompt), but not Windows NT.

7.3.2 Installation procedure of BIVCOM program

We recommend to make a copy of the original disk, before installation, as a precaution in case the original disk is lost or broken.
- Place the installation disk in the appropriate PC floppy drive.
- Type “A: <CR> “ (This tag indicates the keyboard command “”Enter” or “Return”).
- Type “Install <CR>“. The window displayed on PC prompts the user to enter:
  - user company name (“Company Name”);
  - message language, English or Italian (“Language”);
  - place of installation program (“Install from ...”); recommended default place: ”A:\ “;
  - final directory of BIVCOM program (“Install to ...”); recommended default directory: “C:\BIVCOM”.

After confirmation of installation start, user is informed (in area B of the screen) about the progress state of file transfer on the PC.
In case of reinstallation, the PC asks the user to authorize overwriting of old files; to continue, answer :”Yes”.
At the end of installation, user is informed about the end of this procedure and the mode to continue and start the program.

7.3.3 BIVCOM program start-up

- Enter again the drive where BIVCOM program is installed (default directory “C:\”).
  - For PC lower to Pentium 200 MHz level, type “BIV <CR>“.
  - For PC higher or equal to Pentium 200 MHz level, type “BIVH <CR>“.

Step 1: ****Main Menu**** is displayed, see Fig. 7-1. There are five possible options.
A - “Drive Communication” allows to start communication procedure with the drive system; go to Step 2.

E - “Tables Editor”; by selecting this option, “Generic Table Config” menu opens, where you can change:
- serial communication baud rate between PC (with BIVCOM) and BIVECTOR converter; if you modify the 9600 b/sec. default value, be sure that the converter has the same baud-rate configuration (Par.24, *Baud Rate Serial RS232*, in system table # 0). For the first start-up, we recommend not to change this parameter;
- extension of disk saving files of 68 tables parameters of BIVECTOR during “Copy Parameters” procedure;
- display settings (colors, background).

Fig. 7-1: BIVCOM Program Main Menu

R - “Data Base Reindex”: this operation is recommended in the following cases:
- after improper exit from BIVCOM program;
- when program messages expressly require it;
- after accidental PC switching off;
- after accidental power supply cutting off.

S - “Environment Settings“ allows to perform settings of monitor and printers connected to the PC.

V - “Quit”: it closes BIVCOM application.

Step 2: selection of PC serial port (COM1, COM2,...).
With an autodetect internal function, BIVCOM program detects serial ports available on PC; when more than one serial ports are available, the user is prompted to select the port which he used for out the connection with the BIVECTOR drive system; in this case, use the keys (↑ ↓) in the top window, left to area C.
To select the serial port: ☛ <CR>.

Step 3:
If connection and other conditions are correct, the main window of BIVCOM program opens; see Fig. 7-2.

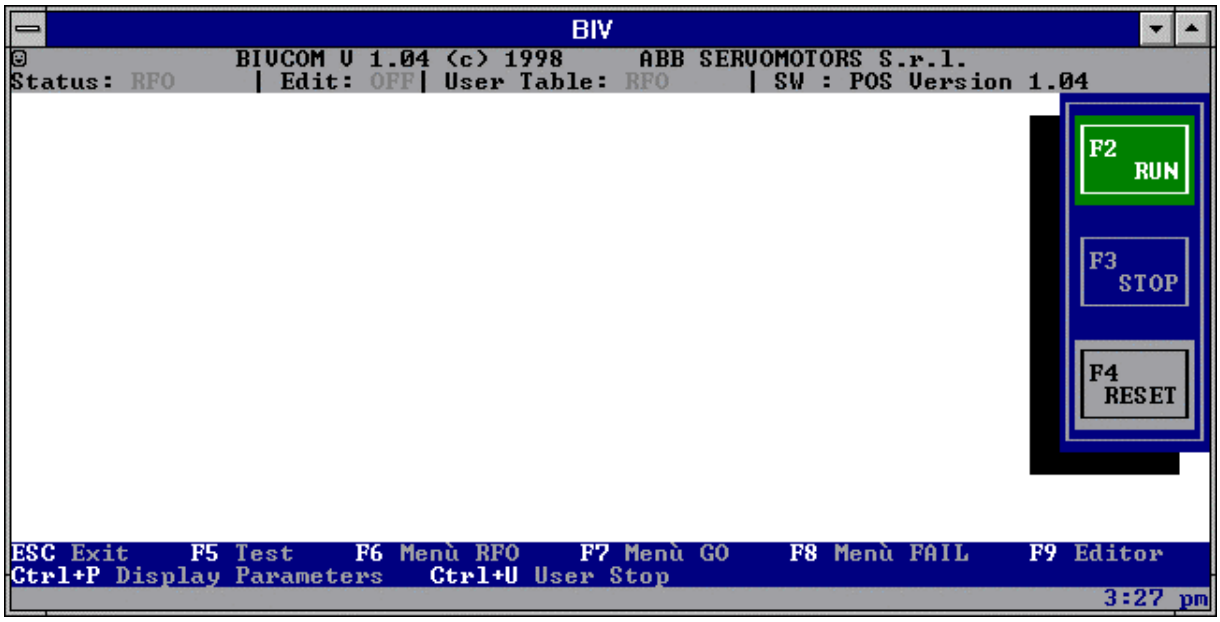

Fig. 7-2: BIVCOM Program Main Window

If connection is not correct, “Status: NO DIAL” message is displayed, together with error messages written in area B of the screen; see Fig. 7-3.

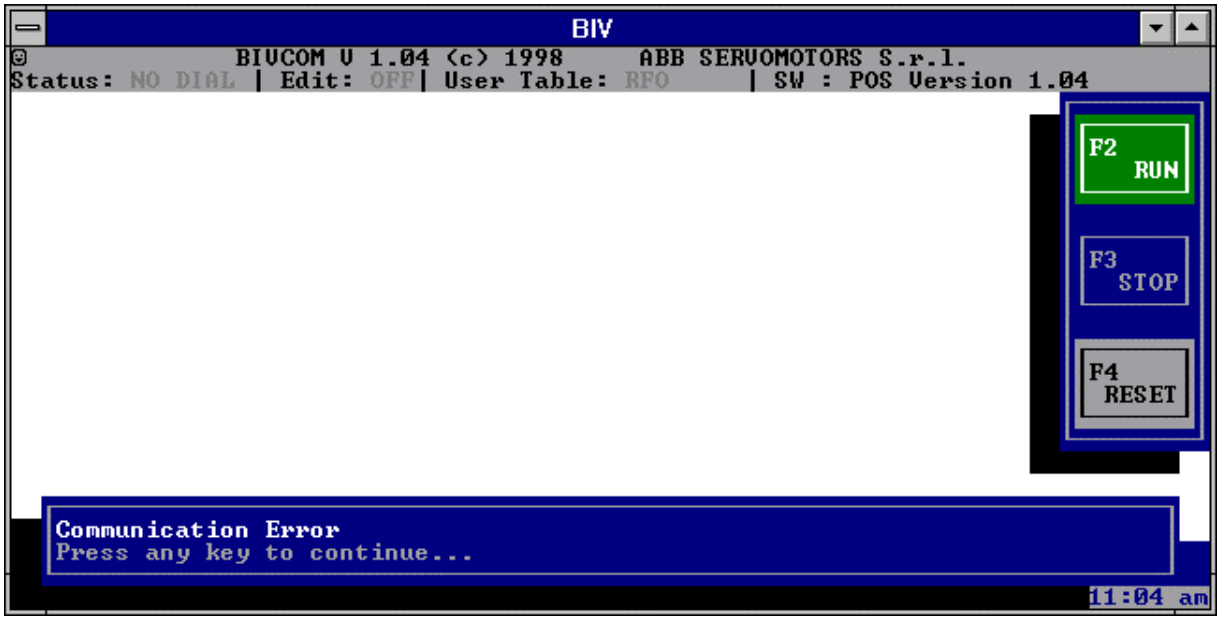

Fig. 7-3: “NO DIAL” Status: PC-BIVECTOR Communication Error

- In this case, check that:
  - the converter is correctly supplied;
  - the connectors of the cable connecting the PC with the BIVECTOR converter are correctly inserted in the prescribed terminal block;
  - the cable corresponds to prescriptions and is not damaged,
  - in step 2, the selection of the actually connected port has been performed;
  - baud-rates of BIVCOM program and converter are equal (program default guarantees compatibility in this sense).

7.4 Guide to program usage

7.4.1 Note

We will now examine a series of typical operation displays, drive system status and program configurations, to highlight communication or operator action particular elements.

7.4.2 BIVCOM Program Main Window

Refer to Fig. 7-2.

Area A displays:
1 - fixed information, repeated for all displays:
- Program version: BIVCOM V 1.04 (c) 1998
- Name of manufacturer: ABB SERVOMOTORS S.r.l.
- Microcontroller SW version: VEL 1.04 (for “Speed Mode”) or POS 1.04 (for Positioning Mode).

2 – status bar, containing real time updated information:
- Status: **RFO** - converter current status
- Edit: **OFF** - Editor status (ON / OFF)
- User Table: **RFO** - active user table

Area C displays:
1 - fixed information, repeated for all displays:
- Right window, with three buttons **F2 ➔ RUN, F3 ➔ STOP, F4 ➔ RESET**; the button which is active at a certain moment is illuminated with a color different from background.

WARNING! Moving part danger. F2 – RUN button is active; this command causes motor rotation. Therefore, be sure that driven mechanisms (driven load) can move freely and that its motion can not cause damage to persons or things.
F3 – STOP button is also active; **in case of emergency, push it immediately.**

Area B displays:
1 – Commands:
ESC Exit **F5** Test **F6** RFO Menu **F7** GO Menu **F8** Fail Menu **F9** Editor
Ctrl + P Display Parameters **Ctrl + U** User Stop
2 – Real time updated information:
- (*current time*) **hour min**

7.4.3 "Test" command

Follow the detailed instructions contained in Chapter 2 "Drive system installation preliminary test".
The procedure to activate the command is extremely simple: from BIVCOM program main window: ☛ **F5 ➔ TEST.**
• Motor starts and performs Test cycle;
- in area A:
  - Status: **GO**
  - User Table: (*in subsequent pattern*) **Jog +** , **RFO, Jog -** , **RFO**
- in area C:
  - **"Drive Testing. . .** " message is displayed;
  - "F2 RUN" switches off;
  - "F3 STOP" switches on;
- after about 21 seconds, motor automatically stops and it returns to RFO status.

7.4.4 RFO Menu

This menu allows to access commands/functions, hierarchically structured; the structure is specified below (see also Fig. 7-4).

- Configuration Set Up *(it activates Configuration Set-Up Menu)*
  - Motor-Converter Data *(motor-converter data table reading*)
    - it shows the motor-converter data table;
  - Motor-Converter Model *(reading of motor-converter matching model)*
    - it shows a string, that fixes the motor-converter matching model actually loaded on EPROM flash.
      NOTE: such information must be communicated to Technical Assistance, in case of non compliant operations.
  - Create Parameters Copy (*it creates a copy of 68 tables written in EEPROM*)
    - Read Parameters
      - From EEPROM *(reading of parameters from EEPROM)*
        - 1) If parameters haven't already been loaded, the message "Reading parameters 0 % ⇒ 100%" is displayed *(during reading, the percentage of read parameters is updated);*
        - 2) If parameters have already been loaded, the following message is displayed: "Parameters Already Loaded ..."
          - Overwrite – it continues as for point 1
          - Exit –operation is not executed
      - From Disk *(parameter reading from a file saved on disk)*
        - 1) If parameters haven't been loaded yet, the following message is displayed: "Reading parameters"
        - 2) If parameters have already been loaded, the following message is displayed: "Parameters Already Loaded ..."
          - Overwrite - it continues as for point 1
          - Exit – operation is aborted
    - Write Parameters
      - To EEPROM *(parameters writing on the EEPROM*)
        - Confirm – during writing, the written parameter percentage is updated
        - Exit – operation is not executed
      - To Disk *(parameters writing on PC hard disk)*
        - Message*:* "Save to C:\BIVCOM As xxxx.DAT". When saving on disk, a C:\BIVCOM directory and a file extension, ***.**DAT, are suggested; user types the name xxxx of the saving file.
- Autotuning Procedures
  - Functions currently in preparation.
- PLC Functions
  - Start Homing *(start of Homing procedure)*
    - Message: "Homing..... " (*motor starts rotating)*
  - Start Jog + *(start of manual motion Jog +)*
    - Message*:* "Running Jog +..... Press F3 to Stop" *(motor rotates clockwise)*
  - Start Jog - *(start of manual motion Jog –*)
    - Message*:* "Running Jog -..... Press F3 to Stop" *(motor rotates counterclockwise)*
  - Start Tune *(start of Tune procedure)*
    - Message*:* "Running Tune ..... Press F3 to Stop"
- INFOS from RTC
  - Function not accessible to the user

- RUN with Table N° ... (*Command "RUN with general purpose user table No..."*)
  - Value range: 00 ....31 *(type the number of the chosen table).* The confirmation of this number, <CR>, activates Start command with the general user table chosen.

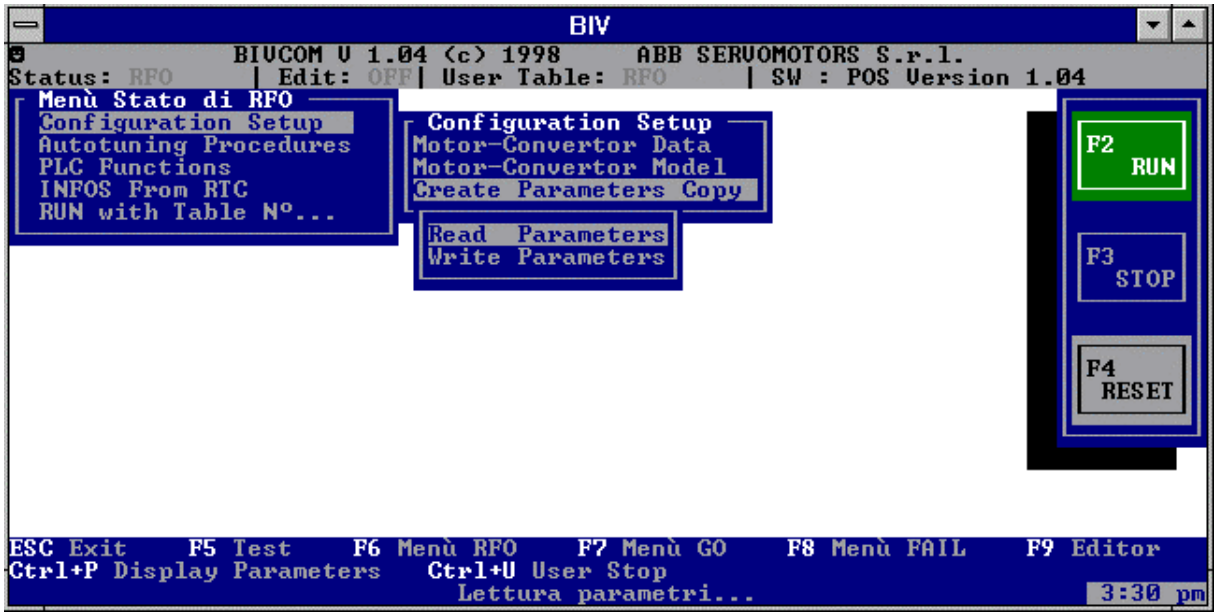

Fig. 7-4: RFO Menu and Configuration Set-Up

GO Menu

To open this menu, the drive system must be in GO status.

☛ **F7** GO Menu:

- area C (see Fig. 7-5) displays: " GO menu" windows with only one possible choice, "Change User Table" (*on-the-fly user table change*) and a further window "00 - 31" which allows to choose between 32 general purpose user tables from # 0 to # 31. Type the number of the chosen table. By confirming this number, <CR>, the on-the-fly user table change command is activated.

To return to RFO status: ☛ **F3 → STOP**

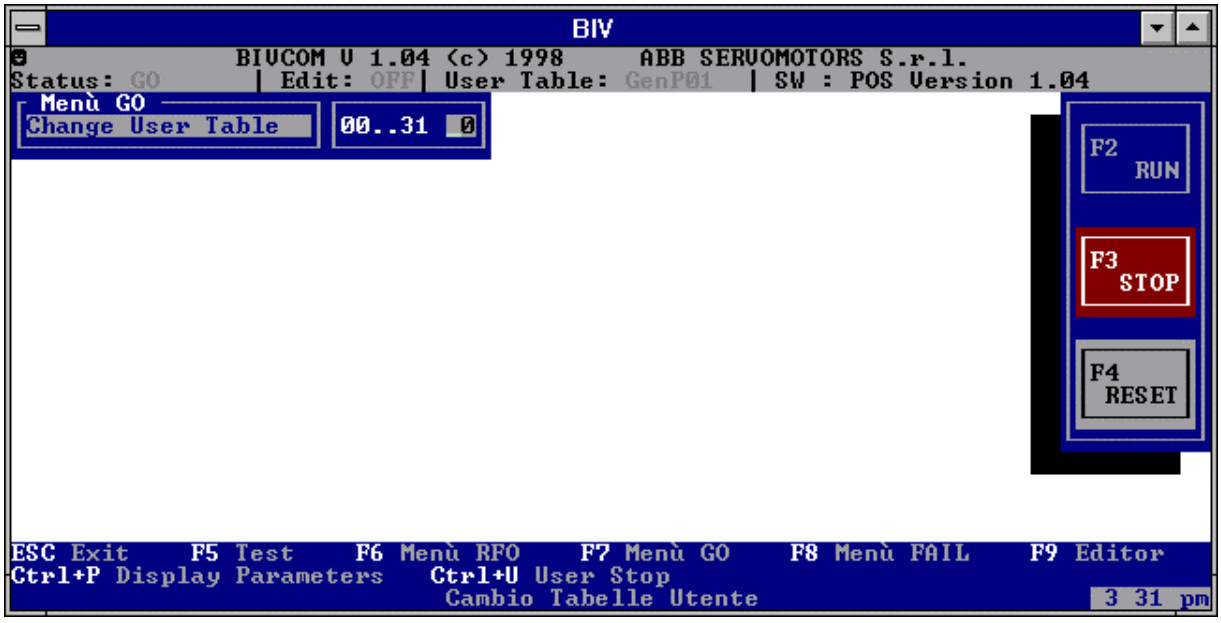

Fig. 7-5: GO Menu and User Table Change Command

FAIL Menu

This menu can be opened in any drive system status.

☛ **F8** FAIL Menu:

- area C (see Fig. 7-6) displays: "Alarms" window; within this window, you can select the following displays:
- **F1** "All Failures" (it displays all failures present at that moment)
- **F2** "First Failure" (first detected failure, which got the converter into FAIL status)
- **F3** "Warnings".

To exit the menu: ☛ Exit.

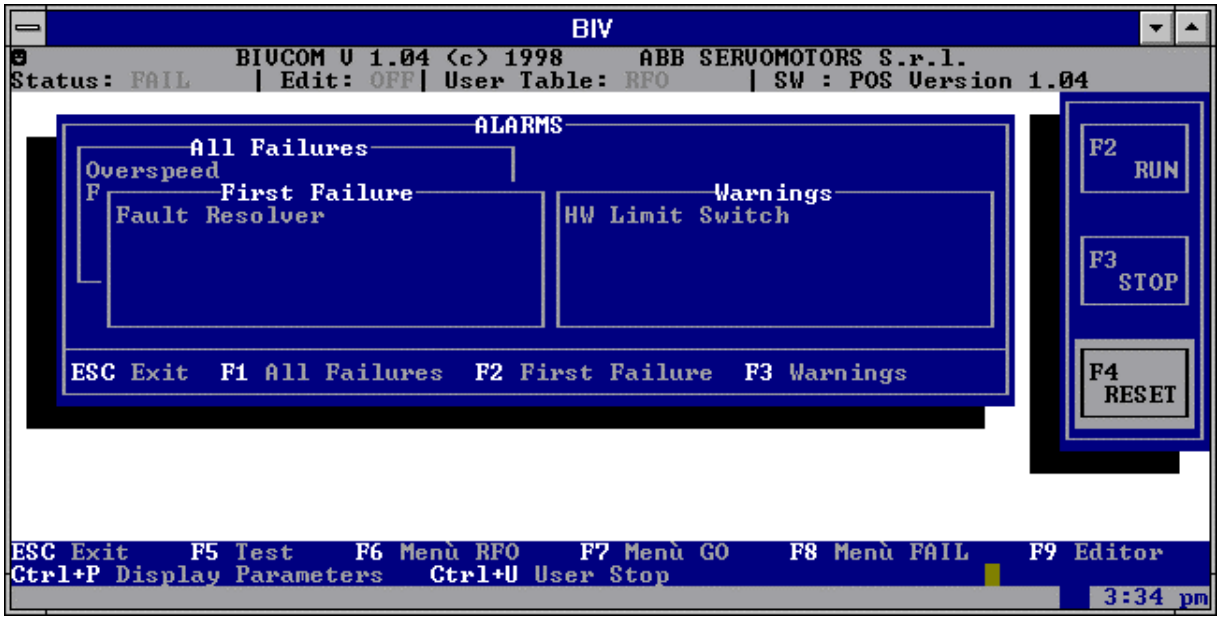

Fig. 7-6: FAIL Menu

Edit Menu

This menu allows to access commands/functions, hierarchically structured; the structure is indicated below. See the following figures: Fig. 7-7, Fig. 7-8, and Fig. 7-9.

This menu can be opened from any drive system status: ☛ **F9** (Edit Menu).

Area C displays the message "Open Edit?"; confirm "Yes" <CR>; if editor is already opened, the message “Editor already Opened” is displayed; see Fig. 7-9, with the following options:

- “Load Table”
- “Save without Exit”
- “Exit”; you can still choose to save or not; in the latter case, changes are lost.

Note From this menu you can give the command “Print parameters”, by pressing **F10.** Parameters can be printed on paper, through the available printer (see “Main Menu”, “Working Environment”) or on File.

Edit Menu structure

- Load Table
  - System Table #0 *(It loads system table #0)*
    - It shows system parameters #0; only the highlighted parameters can be modified by user; see Fig. 7-7.
  - System Table #1 *(It loads system table #1)*
    - It shows system parameters #1; only the highlighted parameters can be modified by user.
  - Control Table *(It loads the control table)*
    - It shows control parameters; only the highlighted parameters can be modified by user.
  - User Table (*Choice between the two types of user table*)
    - General Purpose *(Choice of general user table to load)*
      - Load . . . 00 . .31 [**] *(it loads the general user table No. ** chosen).* In the appropriate box, type the number of the table chosen; (see Fig. 7-8); parameters will be shown afterwards; only the highlighted parameters can be modified by user)
      - Load . . . As . . . 00 . . 31 [**] → 00 . . 31 [°°]*(It loads the general user table No. ** chosen in the general user table No. °°);* in the appropriate boxes, type the number of table chosen and the number of the final table respectively.
    - Special *(Choice of special user table to be loaded)*
      - A scroll list of special user tables is displayed; the desired special user table is loaded (except for RFO and Security), whose parameters will be displayed.

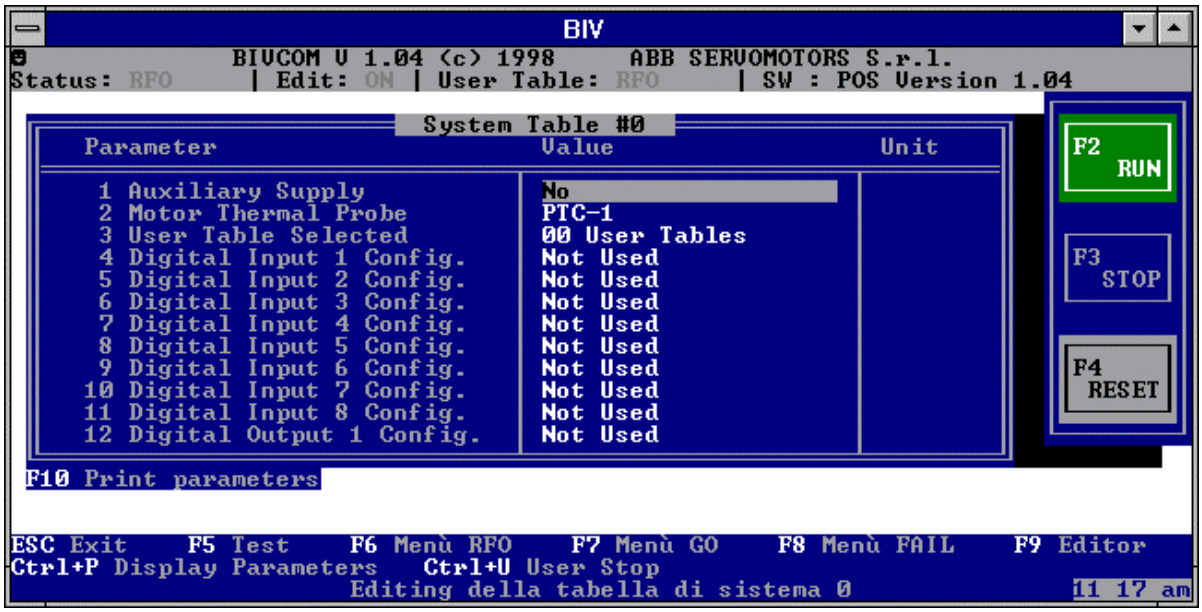

Fig. 7-7: Edit Menu – Table Contents Display
(Example: System Table #0)

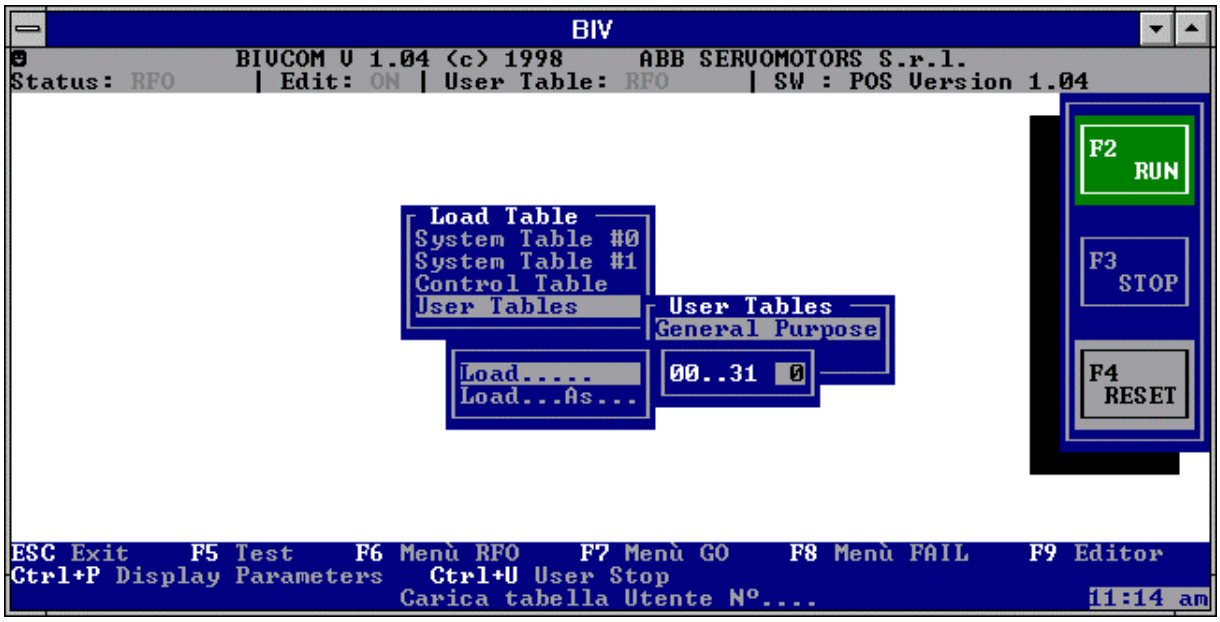

Fig. 7-8: Edit Menu – It loads the general user table No. ...

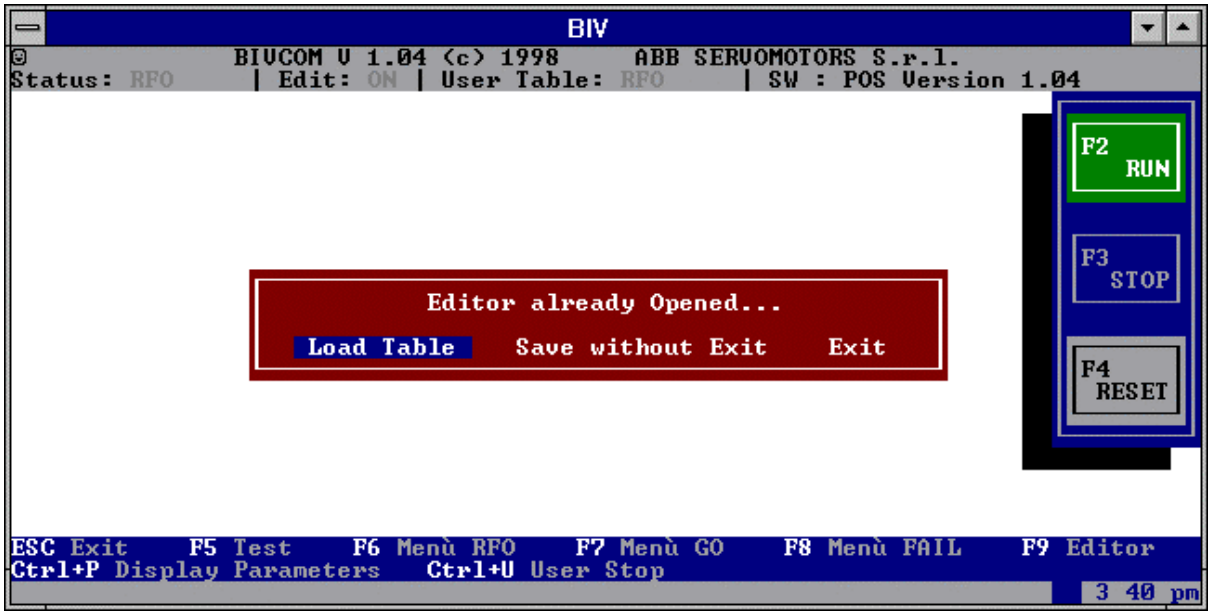

Fig. 7-9: Edit Menu - Editor Message Already Opened

"Display Parameters" command

This command is available from any drive system status.
In area B the command **Ctrl + P** "Display Parameters" is available; in the four rows the following values are displayed (see Fig. 7-10):
- Reference Speed in [rpm];
- Actual Speed in [rpm];
- Actual Position in [turns];
- Digital Inputs *(digital inputs status)*

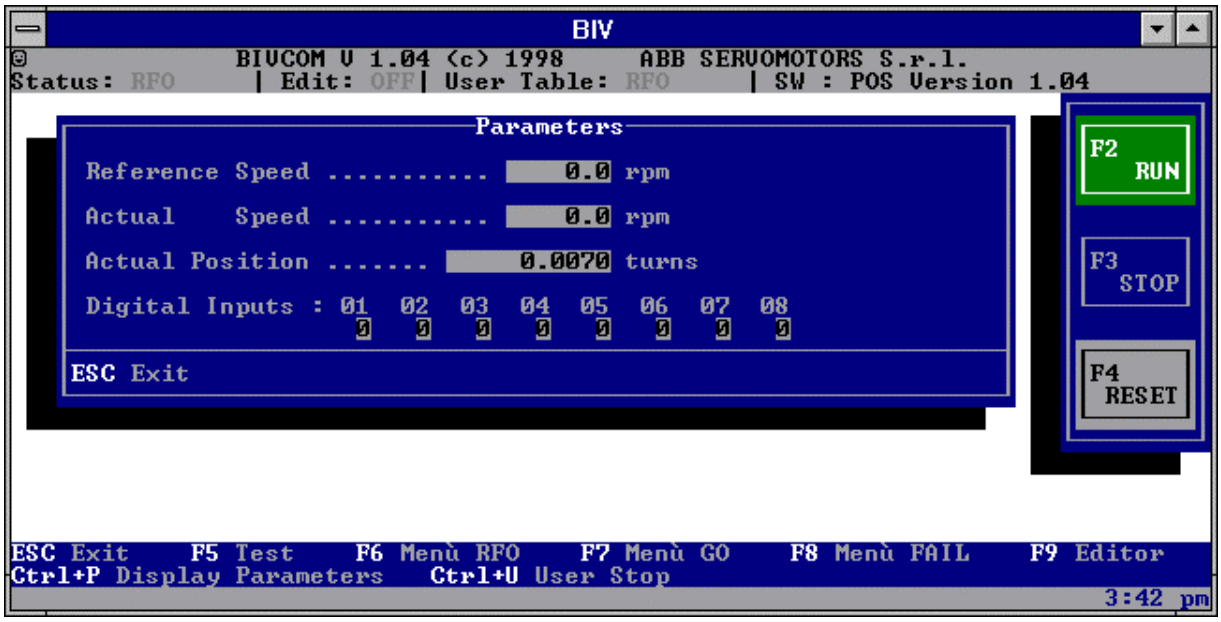

Fig. 7-10: Parameter Display

"User Stop" command

In area B the command **Ctrl + U** "User Stop" is available. The function executed is described in section 5.8 and it is active in GO status.

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CHAPTER 8 – USE OF THE HAND-HELD KEY-B

8.1 Preliminary notes

8.1.1

This chapter provides the instructions for the correct use of hand-held Key-B keyboard; its use is particularly interesting for installation testing, parameters change and diagnostics.
Actually, the Key-B performs almost all functions that can be carried out by a PC and by the BIVCOM program. The text part in Key-B is clearly more concise than in the same part in BIVCOM program.

8.1.2

One of the differences from BIVCOM program is that in Key-B all messages are in English.

8.1.3

As far as hardware installation of Key-B hand-held keyboard is concerned, refer to item **A –** of section 3.4.3.2, Chapter 3 (1st Part).

8.1.4

For maximum user comfort and for safety conditions, the BVC1CBTSN1LOXXX code cable, used for the connection between the BIVECTOR and the Key-B, can be connected both to the keyboard and to the BIVECTOR at any time, i.e. when the BIVECTOR is supplied and operating or switched off.

8.1.5

The connection between the Key-B and the converter can be removed at any time, without altering the BIVECTOR status. This possibility is appropriate because it allows to carry out the permissible operations on the Key-B and then to the disconnect it, (for example leaving the drive system in operation) and to use the keyboard itself on another converter.

8.1.6

For a question of brevity, the symbol ☛ will be used to indicate that you must press a key; after the name of key and of symbol ➔, the commanded function is specified.
For example: ☛ **F4 ➔ More** means that, by pressing F4 key in current display, the “More” action is obtained (in multi-page menus, it advances a page).

8.1.7

In this chapter, the *display* writing indicates messages shown on Key-B display, after the instruction commanded by user by pressing a key has been executed.
For example: if starting from RFO 1/3 display and pressing F4, on the new display, you can read “Load User Table, F1 ➔ EEPR, F3 ➔ Dflt”; this is summarized as follows:

- ☛ **F4 ➔ User** *display*: **Load User Table**
  F1 ➔ EEPR, F3 ➔ Dflt

WARNING! Motion mechanical danger. Some operations described in this chapter cause motor rotation. It is therefore important to be sure that driven mechanisms can move freely and that their motion cannot cause damages to people or things.

8.2 Key-B front and keys

8.2.1

Key-B front is shown in Fig. 8-1; it is provided with a display and 8 keys.

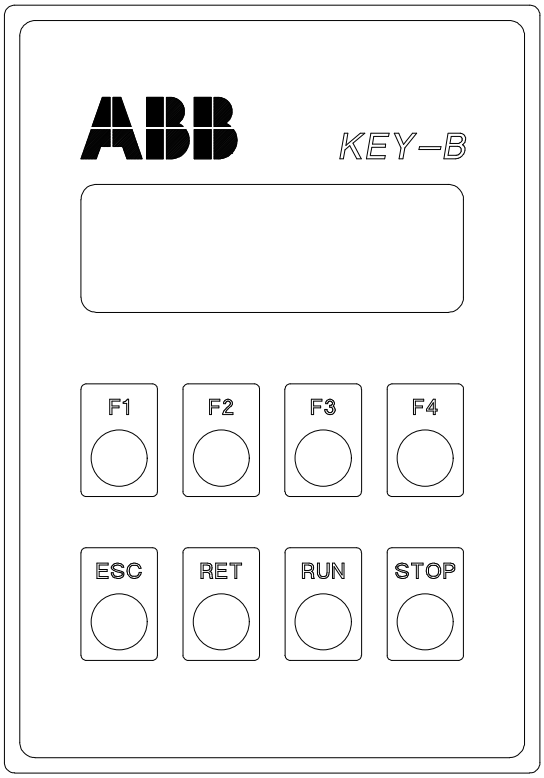

Fig. 8-1: Key-B Front

Messages are shown on the **display** with a maximum of four rows; the last row contains a maximum of four words (normally abbreviations), regarding the related commands.

8.2.2

When the message, i.e. **display title** allows a choice between more than 4 operations, there are various subsequent displays for the same title; they can be distinguished thanks to two digits separated by a bar (for example **1/3**); the first digit indicates the display number, while the second one indicates the total number of displays for that title.

8.2.3

Keys are displaced on two rows: the top row contains 4 **function keys**, named **F1, F2, F3** and **F4.** When pressing a function key, the subsequent action is the one indicated in the corresponding word on the forth display row; since the four words in the fourth row can change according to the display, the action that will be performed when a function key is pressed will change.

8.2.4

Keys in the second row are **dedicated keys** and therefore each of them commands a precise and invariable action. The four dedicated keys have the following functions.

- **ESC** (ESCAPE): it returns the display to the previous screen;
- **RET** (RETURN): it is the typical key for confirmation and execution of an order or setting.
- **RUN** (green color): it commands the start of motor rotation, when conditions allowing the execution of this order are satisfied.
- **STOP** (red color): it commands motor stop, when conditions allowing the execution of this order are satisfied. When this command has been executed, the drive system is disabled.

8.3 Power on and starting screen displays

8.3.1 Power on

When powering the converter on, with the Key-B correctly connected, the screen display shown in Fig. 8-2 is displayed.

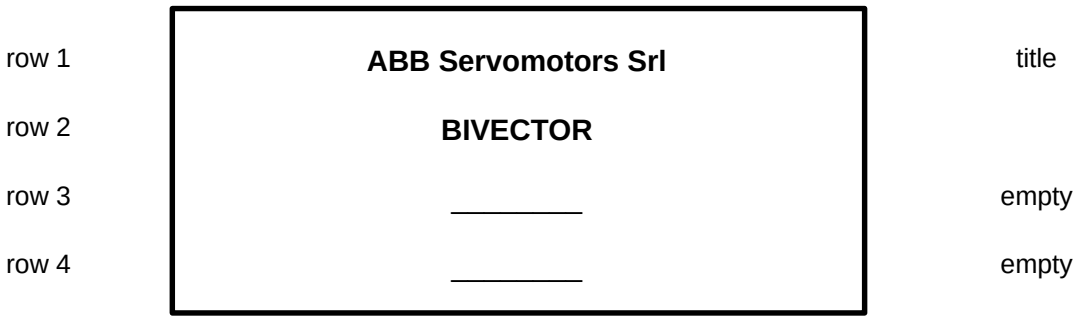

Fig. 8-2

8.3.2 RFO Status Display; example of display changing

After a few seconds, the display automatically switches to the configuration shown in Fig. 8-3, without the need for the operator to press any key:

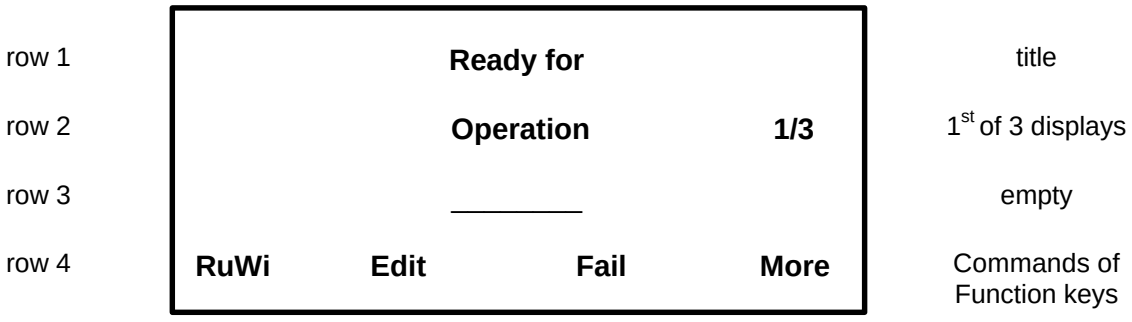

Fig. 8-3

Between the four commands that can be chosen, select: ☛ **F4 ➔ More**
The display screen shown in Fig. 8-4 is displayed.
Notes: 1) What is described in this section assumes that no alarm is present; the BIVECTOR status is then **RFO;** on the BIVECTOR display, the following message is displayed: **OH** (which means OK).

2) If the Key-B is connected to an already operating BIVECTOR (always assuming the connection is correct), the display switches to the screen display corresponding to the converter status (RFO, FAIL or GO).

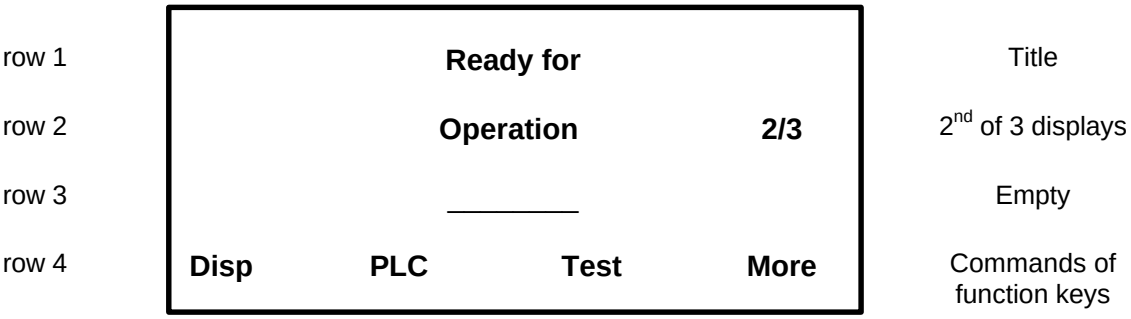

Fig. 8-4

Between the four commands that can be chosen, select: ☛ **F4 ➔ More**
The screen display shown in Fig. 8-5 is displayed.

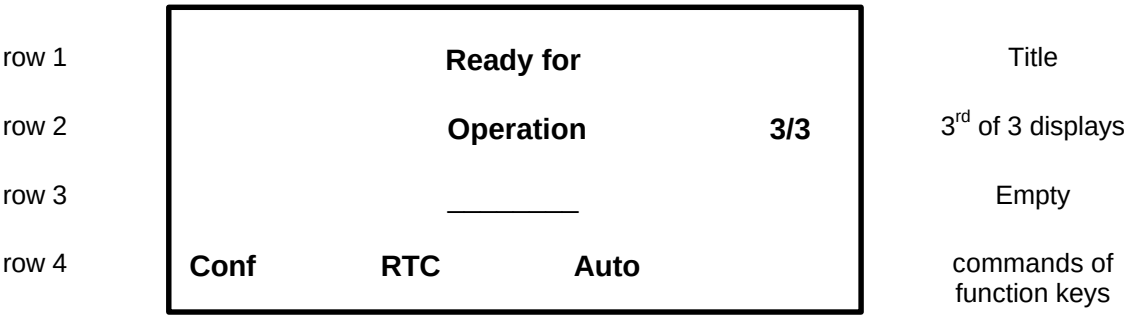

Fig. 8-5

8.4 "Test" Command

Follow the detailed instructions contained in Chapter 2, "Drive system installation preliminary test". The procedure to give the command is as follows:

- If starting from RFO 1/3 screen display in Fig. 8-3:
- ☛ **F4 ➔ More:** *display* **Ready for Operation 2/3**
  F1 ➔ Disp, F2 ➔ PLC, F3 ➔ Test, F4 ➔ More
- ☛ **F3 ➔ Test:** the motor starts and executes the TEST cycle;
  display **Testing Drive...**
- (automatically, after about 21 seconds): the motor stops
  display **Ready for Operation 2/3**
  F1 ➔ Disp, F2 ➔ PLC, F3 ➔ Test, F4 ➔ More

Note: In case of emergency, press the dedicated key **STOP** to stop the TEST procedure and the motor.

8.5 Example of a user table setting

Users can check all parameters contained in tables shown in Chapter 3 and, except for some cases, they can modify their values. As an example of a procedure, a case is reported where the user wants to read the contents of one user table, for example the general purpose user table # 0 and to modify the values of some set parameters.

Procedure

- Start from a screen display with the "Edit" command available, for example RFO 1/3 screen display, in Fig. 8-2:
- ☛ **F2 ➔ Edit** *display* **Editing OFF** *(if editing is closed)*
  F1 ➔ Open, F4 ➔ Exit
- ☛ **F1 ➔ Open** *display* **Load Table to Edit**
  F1 ➔ Sys 0, F2 ➔ Sys 1, F3 ➔ Ctr1, F4 ➔ User
- ☛ **F1 ➔ User** *display*: **Load EEPROM User**
  F1 ➔ GenP, F3 ➔ Spec
- ☛ **F1 ➔ GenP** *display* **Load EEPROM User GenP # 0**
  F1 ➔ Up, F2 ➔ Down, F3 ➔ OK, F4 ➔ As...
- ☛ **F3 ➔ OK** *display* **EEPROM GenP # 0**
  01: Operating Mode
  Speed Mode - 0
  F1 ➔ Next, F2 ➔ Prev

Note: If you accept the operating mode "Speed Mode - 0" (speed mode operation, with digital reference), only press F1 ➔ Next; at the same time, the current value is validated and the reading of other parameters continues, by pressing F1 ➔ Next each time.

- ☛ **F1 ➔ Next** *display* **EEPROM GenP # 0**
  02: Power Switch
  ON
  F1 ➔ Next, F2 ➔ Prev
- ☛ **F1 ➔ Next** *display* **EEPROM GenP # 0**
  03: Analog Torque Lim
  No Limitation
  F1 ➔ Next, F2 ➔ Prev

Note: parameter scrolling continues until parameter 12 is displayed.

- **..... ....**
- ☛ **F1 ➔ Next** *display* **EEPROM GenP # 0**
  12: Digital Speed Ref
  0,0 rpm
  F1 ➔ Next, F2 ➔ Prev

Note: In this case, the user decides not to accept a 0,0 rpm speed setting, but to set a speed of -530 rpm (CCW motor rotation, seen from shaft end side).

- ☛ **RET** *display* **EEPROM GenP # 0**
  12: Digital Speed Ref
  0,0 rpm
  F1 ➔ Up, F2 ➔ Down, F3 ➔ Zero
- ☛ **F2 ➔ Down** *display* **EEPROM GenP # 0**
  12: Digital Speed Ref
  - 530,0 rpm
  F1 ➔ Up, F2 ➔ Down, F3 ➔ Zero

Note: F2 can be pressed continuously and/or jogged, until the desired speed value is reached. The sign " - " (minus) is automatically set because F2 (Down = backward) was pressed. Setting can of course be corrected, also acting on F1 (Up = forward). Up and Down commands have a setting automatic acceleration, if the button is kept pressed, to save time for multiple digit number settings.

- ☛ **RET** *display* **EEPROM GenP # 0**
  12: Digital Speed Ref
  - 529,9 rpm
  F1 ➔ Next, F2 ➔ Prev

Note: a) Speed value displayed represents the value actually used by the drive system; it can be different from the one set at the beginning, for a question of truncation.
b) Acceptation or change of all table parameters can continue, with modes identical to the ones provided up to now or you can switch to motor start rotation command execution. In this case, starting from the previous screen display:

- ☛ **RUN** motor starts rotating at 530,0 rpm speed, in CCW direction
  display **EEPROM GenP # 0**
  12: Digital Speed Ref
  - 529,9 rpm
  F1 ➔ Next, F2 ➔ Prev

Note Motor rotates indefinitely until a stop command is given.

- ☛ **STOP** motor stops
  display **EEPROM GenP # 0**
  12: Digital Speed Ref
  - 529,9 rpm
  F1 ➔ Next, F2 ➔ Prev

Note When motor rotates, if you get back to the initial screen display through subsequent **ESC** commands, you'll finally get to the GO status screen display:

display
Running... GenP # 0

F1 ➔ Chng, F2 ➔ Edit, F3 ➔ Fail, F4 ➔ Disp

- ☛ **STOP** *display* as Fig. 8-3.

8.6 Table saving

Table current parameters (confirmed and/or changed), can be saved in EEPROM.
Procedure
From any arrival condition, it is necessary to open the Editing with the following screen display:

- *display* **Editing ON**
  F1 ➔ Load F3 ➔ Save, F4 ➔ Exit
- ☛ **F3 ➔ Save** *display* **Saving...**
- automatically,
  after a few seconds *display* **Editing ON**
  F1 ➔ Load F3 ➔ Save, F4 ➔ Exit

Note: The contents of all 68 tables have been saved.

If you want to exit Editing:

- ☛ **F4 ➔ Exit** *display* **Save before**
  Exit? (Y/N)
  F1 ➔ Yes, F2 ➔ No

You can choose to save or not; in the latter case, changes made to parameters are lost.

8.7 Commands structure

8.7.1

Commands have a “tree-type” structure; therefore, to get to a desired command, it can be necessary to pass through a certain number of commands, as already seen in the example of section 8.5 “Example of a user table setting”.
In the following sections, you can find the paths to reach all the available commands by using the Key-B. The section title is the title of the start screen display.
Functions and meanings of single commands are indicated in Table 8/1, section 8.8.

8.7.2 Ready For Operation 1/3

		Title 1			Title 2			Notes
F1	**RuWi**	Run With GenP User Table # 0				→		It starts the motor rotation with the general user table #.. chosen.
			F1	**Up**		→		It increments the table number of one unit and, if continuously pressed, it scrolls values.
			F2	**Down**		→		It decrements the table number of one unit and, if continuously pressed, it scrolls values.
			F3	**//**		→		//
			F4	**OK**		→		It confirms the table chosen and sends the Run command with this user table.
F2	**Edit**	Editing ON				→		The Editing has already been opened.
			F1	**Open**	Load Table to Edit			It opens the Editing and switches to the new title.
						F1	Sys0	It loads system table # 0; see § 8.7.5.
						F2	Sys1	It loads system table # 1; see § 8.7.6.
						F3	Ctrl	It loads control table; see § 8.7.7
						F4	User	It loads user table; see § 8.7.8.
			F2	**//**				//
			F3	**Save**	Saving . . .	→		It saves tables in EEPROM, without exiting the Editing.
			F4	**Exit**	Save before Exit? (Y/N)	→		It exits Editing, after saving or not.
						F1	Yes	It saves before exiting.
						F2	No	It exits without saving.
						F3	//	//
						F4	//	//
F3	**Fail**	Fail Status:				→		FAIL status menu (see § 8.7.10).
			F1	**Rset**	Alarms Reset	→		It sends the Alarms Reset command.
			F2	**Edit**		→		See Edit command, described under § 8.7.2.
			F3	**All**		→		It displays all failures present at that moment.
			F4	**Warn**		→		It displays all warnings present at that moment.
F4	**More**	Ready For Operation 2/3	See § 8.7.3 Ready For Operation 2/3.					

8.7.3 Ready For Operation 2/3

	Title 1			Title 2		Notes
F1	**Disp**	wref 0,0 rpm Tref 0,0 Nm w 0,0 rpm			→	It displays three of the following dimensions updated in real time: reference speed, reference torque, actual speed, actual position, actual value of the current.
			F1	**var1**	→	It varies the type of the dimension displayed on the first display row.
			F2	**var2**	→	It varies the type of the dimension displayed on the second display row.
			F3	**var3**	→	It varies the type of the dimension displayed on the third display row.
			F4	**//**		//
F2	**PLC**	PLC Functions			→	PLC functions menu
			F1	Jog +	Press <STOP> to Terminate →	It starts manual motion in CW direction.
			F2	**Jog -**	Press <STOP> to Terminate →	It starts manual motion in CCW direction.
			F3	**Tune**	Press <STOP> to Terminate →	It starts Tune procedure.
			F4	**Home**	Homing . . . →	It starts Homing procedure.
F3	**Test**	Testing Drive . .			→	It starts TEST procedure (Chapter 2).
F4	**More**	Ready For Operation 3/3	See § 8.7.4 Ready For Operation 3/3.			

8.7.4 Ready For Operation 3/3

Title 1			Title 2				Title 3 and Notes
F1	**Conf**	Configuration Set-Up			→		Configuration Set-Up.
			F1	**Data**	Motor-Convertor Data 01: Voltage Supply 230 Vrms	→	It indicates motor-converter data table parameters.
						F1 Next	It increments the table number of one unit and, if continuously pressed, it scrolls parameters.
						F2 Prev	It decrements the table number of one unit and, if continuously pressed, it scrolls parameters.
						F3 Save	It saves current tables in EEPROM.
						F4 Exit	It exits prompting whether saving is needed.
			F2	**Copy**	Create Parameters Copy	→	Reading/writing function of all 68 tables in / from EEPROM.
						F1 Read	Transferring 01 / 68. Counter 01/68
						F2 //	//
						F3 Write	Transferring 01 / 68 Counter 01/68
						F4 //	//
			F3	**//**	//	// //	//
			F4	**//**	//	// //	//
F2	**RTC**						Not accessible to user.
F3	**AUTO**						Function currently in preparation.
F4	**Ver**						It displays the SW version and the motor-converter matching model. Such information must be communicated to Technical Assistance, in case of non compliant operations.

8.7.5 Load System Table # 0

Title 1			Title 2		Notes
EEPROM System #0 01:Auxiliary Supply No				→	it shows parameter 01 of system table # 0 present in EEPROM; to confirm it, press F1; to change it, press **RET.**
F1	**Next**			→	It shows table next parameter and, if continuously pressed, it scrolls parameters.
F2	**Prev**			→	It shows table previous parameter and, if continuously pressed, it scrolls parameters.
F3	**//**				//
F4	**//**				//

Note: The use of **RET** dedicated key, as indicated in the first table note, is described in the following table.

Title 1			Title 2		Notes
RET	EEPROM System #0 01:Auxiliary Supply No				After pressing RET, the commands of the 4 function keys and dedicated keys are available.
	F1	**Up**	EEPROM System #0 01:Auxiliary Supply Yes	→	It increments the scrolling list of one unit (third row of title 1; see, for example, title 2, after pressing F1 ➔ Up).
	F2	**Down**		→	It decrements the scrolling list of one unit.
	F3	**Zero**		→	It resets the scrolling list or it starts from zero value for numeric parameters.
	F4	**>>**		→	Specific setting accelerator; to be used only for parameters concerning the position (for example, Par.13, *Position Reference*, of GenP #0: if F4 is kept pressed before pressing F1 or F2, the position increment is of 1 turn. If you first press F1 or F2 and then F4, setting acceleration takes place very quickly).
	ESC				Parameter change is given up and the previous display value is reset.
	RET				The change is validated, the new value is transmitted to the converter and the previous display is reset.
	RUN				The motor starts running and the operator can check the effect of the change carried out on the parameter.
	STOP				It stops running.

8.7.6 Load System Table # 1

The procedure is identical to the one indicated under § 8.7.5.

8.7.7 Load Control Table

The procedure is identical to the one indicated under § 8.7.5.

8.7.8 Load UserTable

	Title 1	Title 2			Notes
	Load EEPROM User		→		It allows to choose between general and special user tables, that you want to load from EEPROM.
F1	**GenP**	Load EEPROM User GenP # 0			
			F1	**Up**	It increments the number of general user table of one unit and, if continuously pressed, it scrolls tables.
			F2	**Down**	It decrements the number of table of one unit and, if continuously pressed, it scrolls tables.
			F3	**OK**	it confirms the loading of the chosen table and it starts listing parameters; see section 8.7.5.
			F4	**As . .**	It saves the contents of general table chosen in general table #...., that will be chosen in the next screen display.
F2	**//**				
F3	**Spec**	Load EEPROM User Special RFO			
			F1	**Up**	It shows the next special user table and, if continuously pressed, it scrolls special tables.
			F2	**Down**	It shows the previous special user table and, if continuously pressed, it scrolls special tables.
			F3	**//**	//
			F4	**OK**	For tables that can be accessed by user (except for RFO and Security), it loads the table chosen and it starts listing parameters.
F4					

8.7.9 GO status menu

If **RUN** command is given when the drive system is in RFO (Ready for Operation) status and the Key-B shows messages indicated in sections 8.7.2, 8.7.3 and 8.7.4 (Ready for Operation 1/3, 2/3 and 3/3), then the message changes for all the time in which the drive system is in the Go status, as shown in the following table. If the **STOP** button is pressed, the RFO Menu is displayed again.

	Title 1		Title 2		Notes
	RUN **Running. . .GenP # 0**			→	Message indicating the operation of the drive system, specifying the active user table (in the shown example, it is the general user table #0).
	F1	**Chng**	General Purpose User Table # 0	→	It allows to choose a new general user table and to perform the on-the-fly change.
				F1 Up	It shows the next general user table and, if continuously pressed, it scrolls general tables
				F2 Down	It shows the previous general user table and, if continuously pressed, it scrolls general tables.
				F3 //	//
				F4 OK	It gives the on-the-fly command; the drive system will operate with the new table chosen.
	F2	**Edit**	Editing	→	See F2 Edit, § 8.7.2
	F3	**Fail**	Fail Status:	→	See F3 Fail, § 8.7.10
	F4	**Disp**	Display	→	See F1 Disp, § 8.7.3

If the current table is different from GenP # 0, the message is different in the first row.

8.7.10 FAIL Status Menu

This menu can be opened starting from RFO status and from GO status. If no failure is present, message (1) is displayed; if failures are present, message (2) is shown.

	Title 1		Title 2		Notes
(1)	**Fail Status: No FAIL . . .**			→	This message is displayed if there are no Failures.
	F1	**Rset**		→	It sends the Alarms Reset command; the command only acts if failure cause has been removed.
	F2	**Edit**		→	See Edit command, described under § 8.7.2.
	F3	**All**	No Failures Detected!	→	It displays all failures present at that moment. If no failure is present, the message of title 2 is displayed.
	F4	**Warn**	No Warnigs Detected!	→	It displays all warnings present at that moment. If no warning is present, the message of title 2 is displayed.
(2)	Fail Status: **FAIL** H.2 Motor Thermal Probe Protection				Example of a message in case of Failure. FAIL writing is blinking and it is present in any screen display.

8.8 List of commands and functions

Table 8/1 lists the commands and functions, with their meaning and some notes.

Table 8/1

8.7.5F1	Name	Notes	Ref. §
All	All Failures	It displays all failures	8.7.2F3+F3
As...	As....	It copies data from one table to another	8.7.8F1+F2+F4
Auto	Autotuning	Function currently in preparation	-------
Chng	Changing	On-the-fly user table change	8.7.9
Conf	Configuration	It starts the Configuration Set-Up menu	8.7.4F1
Ctrl	Control Table	It loads the control table	8.7.2F2+F1+F3
Data	Data	It loads the motor-converter data table	8.7.4F1+F1
Disp	Display	It displays the digital monitors	8.7.3F1; 8.7.9F4
Down	Down	It decreases a value or a list content	8.7.2F1+F2 (p.e.)
Edit	Editor	It starts the Edit menu	8.7.2F2; 87.9F2; 8.7.10F2
EEPR	EEPROM	It loads the table from EEPROM	Da 8.7.5 a 8.7.8: f1
ESC	**Escape**	**It returns to the previous value / screen display**	**8.2.4**
Exit	Exit	Explicit exit from a function	8.7.2F2+F4; 8.7.4F1+F1+F4
Fail	Failure	It opens the Fail menu	8.7.2F3; 8.7.9F3
GenP	General Purpose	It loads a general purpose user table	8.7.8F1+F1; 8.7.8F3+F1
Home	Home	It starts the Homing procedure	8.7.3F2+F4
Jog	Jog	Manual motion start	8.7.3F2+F1/F2
Load	Load	It loads a table for editing	8.7.2F2+F1
More	More	In multi-page menus, it advances a page	8.7.2F4; 8.7.3F4
Next	Next	Next parameter in a list	8.7.5F1+F1 (p.e.)
OK	OK	Confirmation of a screen display data	8.7.2F1+F4 (p.e.)
Open	Open	It opens the Editor	8.7.2F2+F1
PLC	Programmable Logic Circuit	It starts PLC menu (Functions)	8.7.3F2
Prev	Previous	Previous parameter in a list	8.7.5F1+F2 (p.e.)

8.7.5F1	Name	Notes	Ref. §
RET	**Return**	**Confirmation of the inserted datum**	**8.2.4**
Rset	Reset	Alarms reset command	8.7.10F1
RTC	Real Time Clock	Not accessible to user	----
RUN	**Run**	**Starts motor running**	**8.2.4**
RuWi	Run with. . .	Starts motor running with table ...	8.7.2F1
Save	Save	It saves in EEPROM	8.7.2F2+F3; 8.7.4F1+F1+F3
Spec	Special	It loads special user tables	8.7.8F1+F3; 8.7.8F3+F3
STOP	**Stop**	**It orders motor stop**	**8.2.4**
Sys0	System # 0	It loads system tables #0	8.7.2F2+F1+F1
Sys1	System # 1	It loads system tables #1	8.7.2F2+F1+F2
Test	Test	It starts TEST procedure	8.7.3F3
Tune	Tune	It starts TUNE function	8.7.3F2+F3
Up	Up	It increments a value or the list content	8.7.8F1+F1/F3+F1 (p.e.)
User	User	It loads user tables	8.7.2F2+F1+F4; 8.7.9F1+ F1/F2/F3
var	Variable	It changes the digital monitors displayed	8.7.3F1+F1/F2/F3
Ver	Version	It displays the SW version and the motor-conveter matching model	8.7.4F4
Warn	Warning	It displays the current warnings (if any)	8.7.10F4

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