

**SERVO DRIVE SYSTEM
SOFTWARE MANUAL**

DDS - SOFTWARE



Ref.1109

(SOFT 06.2X)

- ABOUT THIS MANUAL -

Title

Servo drive system. Software manual

Type of documentation

Fagor servo drive system's software description. Setup, parameters involved and error listing. WinDDSSetup application.

Internal code

It belongs to the manual directed to the manufacturer (OEM). The manual code depends on the software version: standard or advanced.

MAN REGUL (IN) STAN

Code 04754000

MAN REGUL (IN) AVANZ

Code 04754021

Manual reference

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Associated software

Servo drive software version: (Soft. 06.2x).

Startup



Verify that the machine on which the servo system is installed complies with European Directive 2006/42/EC on machine safety.

Before setting up the servo drive system, read the instructions in chapter 1 Prior knowledge of the "dds-software" manual.

Warning



The information described in this manual may be subject to changes due to technical modifications.

FAGOR AUTOMATION, S. Coop. reserves the right to change the contents of this manual without prior notice.

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- ABOUT THE PRODUCT -

Software options

Bear in mind that some of the features or applications described in the "dds-hardware" manual depend on the software version installed.

These considerations are indicated in this manual that is supplied together with the "dds-hardware" manual.



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- VERSION HISTORY -

The history of versions shows the list of software applications added in each manual version. To know the hardware elements added to the hardware and the version of the manual that describes them, see the "dds-hardware" manual that is supplied with this one.

Manual reference	Events
9702	Software 01.01. First version
9707	No new software has been implemented
9802	Software 02.xx Halt signal via digital input. Range expansion, (C axis) SERCOS interface (connection and parameters)
9810	Software 03.xx Sincoder feedback (E1). Motor identification at the encoder. Emergency ramps. Current filter. SERCOS interface (servo system adjustment). Expansion of parameters for gear ratios. Communications with the PLC. Overload detection. Spindles at low rpm.
9904	Software 03.03 Full motor identification. Drive off Delay time, GP9
0002 (only in CD Rom)	Software 04.01 (preliminary) Current filter Position loop Feed-forward, homing, backlash compensation. Following error control, module format Direct feedback WinDDSSetup
0103	Software 04.01 (final) Motion parameters in the L group.
0112	Software 04.02 On-line feedback change Axis synchronization Index DNC communications protocol



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0303	<p>Software 04.03</p> <p>New checksum parameters: GV3 and GV6 New variables for communication between the PLC of the 8055 CNC and the PLC of the drive: XV12 and XV13 Nuevo parámetro de selección de la fuente del master en la sincronización: LP59</p> <hr/> <p>Software 04.04</p> <p>New variable to read the rotary switch: HV13 Reversal peak with an exponential shape</p> <hr/> <p>Software 04.05 (with Vecon board) and 05.05 (with Vecon2 board)</p> <p>New parameter QP13 to increase the number of axes accessible via RS422. New variable for torque control (on-line): TV92</p> <hr/> <p>Software 04.06 and 05.06</p> <p>FM7 motors (E01 version) . They recognize the Motor ID of these motors.</p> <hr/> <p>Software 04.07 and 05.07</p> <p>FM7 motors (C axis and maximum speed). New ModBus protocol in RS-422</p> <hr/> <p>Software 04.08 and 05.08</p> <p>FM7 motors (E02 family) Drive-CNC synchronism detection via SERCOS channel (error E412) .</p> <hr/> <p>Software 04.09 and 05.09</p> <p>Error correction</p>
0305	<p>Software 04.10 and 05.10</p> <p>New maximum currents on spindle drives.</p>
0310	<p>Software 06.01</p> <p>New current-loop topology (structure) . Natural units. There is no variable PI. A second current filter has been included: New parameters CP33 and CP34. Flow and EMF parameters. Natural units: FP1, FP2, FP21 and FP22. Control of high speed spindles: Parameters renamed: SP12 is now MP25 SP11 is now MP26 MP25 is now MP21 FP30 ... FP38 is now MP30 ... MP38 MP22 is now TP22 Parameters that disappear: MP8 New parameters: CP16, TP86, MP41 Auto-adjustment of the rotor resistance value: Parameters FP30 and FP31. Command to validate parameters off line: GC4. Command to execute the inertia auto-adjustment: GC5 (in off-line mode). Offsets of feedback signals: RP1 ... RP4 and their equivalent RP51 ...</p>



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Manual reference	Events
<p>0310 (continuation)</p>	<p>New variables SV10 and SV11 New units for TV1 and TV2 Velocity ramps: SP51= 2 PWM adjustable Default emergency ramps: SP70 = 1 ACForward with velocity loop</p>
<p>0403</p>	<p>Software 06.02 Home switch movement: New parameter: PP4 New variable: PV1 New command: GC6. Other new variables: RV9 and RV59. Absolute direct feedback with Stegmann sinusoidal encoder.</p>
<p>0405</p>	<p>Software 06.03 The initial coordinates are checked after a home search. Error E150. New variables: HV1 (modified), HV2 (new), RV10. Square signals RV1 and RV2. Home search with spindle I0 and gear ratio other than 1:1</p>
<p>0407</p>	<p>Software 06.04 Error correction.</p>
<p>0410</p>	<p>Software 06.05 Calculation of the serial inductance for high speed spindles. Modification of the values permitted in variables LV160 and LV193. E922. Wrong Jerk value. New on-line parameters: PP76, PP103, LP143, PP55, PP49 and PP50. Parameter NP116 makes sense when using resolvers.</p>
<p>0501</p>	<p>Software 06.06 Error correction. E205: The motor has no voltage for the demanded work conditions.</p>
<p>0504</p>	<p>Software 06.07 Error correction.</p> <hr/> <p>Software 06.08 Fagor absolute linear encoder. Fagor absolute linear encoder reading protocol. Expanded parameter GP10. New parameters RP60, RP61, RP62 and RP63. E610: Error at the signals of the Fagor absolute linear encoder. E611: Error indicating that the signals of the Fagor absolute linear encoder are unstable. Identification of R and L in asynchronous motors. New variable FV1. New structure of the velocity loop. Parameter involved SP52. << Default >> option with motor ID. WinDDSSetup: Parameter setting assistance for the DDS system. New help tool for configuring an application.</p>



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Manual reference	Events
0506	<p>Software 06.09</p> <p>Modifications in the home search feature when using a spindle reference mark and transmission ratio other than 1:1.</p> <p>PP5=-0,0001, Both feedbacks independent from each other.</p>
0602	<p>Software 06.10</p> <p>Control of new FM7 spindle motors. Series E03 and HS3. Star-triangle configuration change while the motor is stopped.</p> <p>Control of a synchronous spindle. New parameters involved: MP42, MP43 and MP50. Readjustment of the current loop for high rpm on a spindle motor. CP9: CurrentLoopTimeConstant. Detection of the electrical position of a synchronous motor on power-up. GC7: AutophasingOnline. PP160: MonitoringWindowPosEleCalc. Backlash compensation with position control and direct feedback. PP58: Backlash. (More functions for this parameters) PP59: Backlash12 (holgura entre captaciones) Compensated torque. TV5: TorqueFeedforward. Delayed exponential compensation of the backlash due to movement reversal peak. PP13: BacklashPeakDelay. Cancellation of exponential compensation of the backlash due to movement reversal peak. PP14: BacklashPeak2FeedbackDisplacement. Hysteresis in the exponential compensation of the backlash due to a movement reversal peak. PP15: ReversalHysteresis. Improved friction compensation. Zero compensation of the friction during the exponential compensation of the backlash due to movement reversal peak. Hysteresis in the friction torque compensation. TP15: TorqueCompensationSpeedHysteresis.</p> <p>New error messages: E158: Movement greater than the value given in parameter PP160. E216: Internal error. E316: "Soft Start" problem to charge the power bus at a compact drive. E813: Error when initializing the electrical position of a synchronous motor on power-up.</p> <p>It also includes the documentation regarding the control software of the RPS regenerative regulated power supplies.</p> <hr/> <p>Software 01.02 (RPS)</p> <p>Parameters, variables and commands. List of errors. Warnings and solutions.</p>
0606	<p>Software 06.11</p> <p>Error correction.</p>



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<p>0606 (continuation)</p>	<hr/> <p>Software 06.12</p> <p>Feedback combination. New parameter: PP16. New variable: PV153.</p> <p>Velocity estimator. New parameters: SP15, SP16 and SP17. New variable: SV12.</p> <p>Error messages. E205 (modification): Braking with emergency ramp. Errors E610 and E611 become E814 and E815.</p>
<p>0612</p>	<p>Software 06.13</p> <p>Error correction.</p> <hr/> <p>Software 06.14</p> <p>Control of an asynchronous motor without feedback (Sensorless). Parameters: AP2, FP50, FP51, FP60. New parameter: MP44.</p>
<p>0706</p>	<p>Software 06.15</p> <p>U signal as I0 in a feedback device (rotary or linear encoder) with U, V and W signals. Parameter: RP7.</p> <p>Linear temperature sensor that may be set by parameters. Parameters: MP14=5, MP45 and MP46.</p> <p>Automatic simplification of mechanical ratio NP121/NP122. New variables: TV51, PV191, PV192 and PV193.</p> <hr/> <p>Software 01.07 (RPS)</p> <p>New parameters GP7 and GP8. New warning and error codes: A4, E316, E317, E318.</p>
<p>0710</p>	<p>Software 06.16</p> <p>Compensation of the elastic deformation in the coupling of an axis. Parameter: PP20.</p>
<p>0802</p>	<p>Software 06.17</p> <p>Error correction.</p> <hr/> <p>Software 06.18</p> <p>On-line change of the Y-delta (star-triangle) connection of the stator winding on FM7 motors, series E03 and HS3. Parameter MP23.</p> <p>On-line motor change. Modifications in the interpolator. Modifications of the minimum values of variables LV160 and LV193.</p> <p>Treatment of EnDat encoders</p> <p>Feedback parameter setting procedure using bits Parameters involved: GP2 and GP10.</p> <p>Modifications to the execution of the GC7 command. New parameters involved: CP21, CP22, CP23, CP24, CP26 and CP27.</p>



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<p>0802 (continuation)</p>	<p>Home search with direct feedback and inexact ratio for rotary axes.</p> <p>New GC8 command: Update the Rho value when passing through the reference mark (I0).</p> <p>Recognizing the asynchronous motor FM7-E600</p> <p>Recognizing the synchronous motor FKM62.60A</p> <p>Warning A.189. GP10 has been set to 0 when having the direct feedback board installed.</p>
<p>0806</p>	<p>Software 06.19</p> <p>Error E159. Phases swapped in the power cable and/or in the motor feedback.</p> <p>Error E816. The C and D signals of the motor feedback are unstable.</p>
<p>0811</p>	<p>Software 06.20</p> <p>CRC check on FAGOR absolute linear encoders. New parameter: RP64</p> <p>Error E817. CRC checking error</p> <p>Recognizing the feedback with ENDAT digital interface as motor feedback.</p> <p>Monitoring of feedback reference mark signal. New parameters: RP8 and RP9.</p> <p>Error E256. The reference mark signal is not repeated in the same number of pulses per turn of the feedback device</p> <p>Emergency ramp watch while braking. New parameters: SP71 and SP72.</p> <p>Error E160. In an emergency stop, the evolution of the braking operation does not properly follow the reference emergency ramp.</p> <p>Stegmann™ encoder data reading, New commands: RC2 and RC3. New variables: RV11, RV12, RV13, RV14, RV15, RV16, RV17 and RV18</p> <p>More (*.mot) files with non-Fagor spindle motors.</p> <p>Recognizing the new references of FKM motors: FKM22.60A.XX.X0X, FKM42.60A.XX.X0X and FKM66.20A.XX.X0X.</p> <p>Maximum controllable speed of a synchronous spindle.</p>
<p>0905</p>	<p>Software 06.21</p> <p>EnDat™ reading protocol. Related parameters: RP60 ... RP63</p> <p>Motor selection. DEFAULT2 option</p>
<p>0906</p>	<p>Software 06.22</p> <p>Autoadjustment. New variable: HV4.</p> <p>Modified recognizing of the SPD3.200 drive (incompatibility) aimed at controlling 60kW FM7 motors and 71 kW FM9 motors. With previous software versions, it was not possible to govern this drive model and, consequently, neither these spindle motors.</p>



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1003	<p>Software 06.23</p> <p>Recognizing synchronous FKM9 motors, models FKM94.20A, FKM95.20A, FKM96.20A.</p> <p>Recognizing the FM9 asynchronous motor, model FM9-B071-C5C□-E01.</p> <p>Recognizing the SKS36 encoder from Stegmann™ whose parameters are set the same way as those of any other Stegmann™ encoder (ref. E1, A0, A1...)</p> <p>Possibility of continuous latching with Stegmann encoders ref. E1.</p> <p>Correction of the start-up position with CD encoders when going through the first I0.</p> <p>Enabling of parameter MP21 with synchronous motors that will allow changing the order (sequence) of the power phases (motor turning direction).</p> <p>New possible configuration at the drives: Analog card in slot SL1 and 8I/16O card in slot SL2.</p>
1107	<p>Software 06.24</p> <p>Modifications to parameter SP13.</p> <p>Modification to parameters TP10, TP11, TP12, TP13.</p> <p>Maximum valid value of parameter SP16 modified.</p>
1109	<p>Software 06.25</p> <p>Maximum valid value and default value of parameter SP15 modified.</p> <p>Maximum valid value of parameter SP16 modified.</p>



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- SAFETY CONDITIONS -

Read the following safety instructions in order to prevent harming people and damage to this product or to the products connected to it.

The unit can only be repaired by personnel authorized by Fagor Automation.

Fagor Automation shall not be held responsible of any physical or material damage originated from not complying with these basic safety rules.

Precautions against personal harm

❑ Use the right mains cables.

In order to avoid risks, use only the SERCOS and mains cables recommended for this unit.

❑ Avoid electric shocks.

To avoid electric shocks and the risk of fire, do not apply electrical voltage beyond the range indicated in this manual.

❑ Make the ground connection.

In order to avoid electric shocks, connect the ground terminal of this unit to the main ground point. Also, before connecting the inputs and outputs, make sure that the ground connection has been done.

❑ Make sure that the ground connection has been made.

In order to avoid electric shocks, before turning the unit on, make sure that the ground connection has been made.

❑ Make sure not to work in humid environments.

To avoid electric shocks, always work in environments where relative humidity is lower than 90% without condensation at 45°C (113°F).

❑ Make sure not to work in explosive environments.

In order to avoid risks, harm or damages, do not work in explosive environments.

Precautions against damage to the product

❑ Work environment.

This unit is ready to be used in industrial environments and comply with the current directives and regulations of the European Community.

Fagor Automation shall not be held responsible for any damage that could suffer or cause when installed under other conditions (residential or domestic environments).

❑ Install the unit in the right place.

We recommend that, whenever possible, the servo drive system be installed away from coolants, chemicals, blows, etc. that could damage it.

This unit meets the European directives on electromagnetic compatibility. Nevertheless, it is recommended to keep it away from sources of electromagnetic disturbance, such as:

- Powerful loads connected to the same mains as the unit.
- Portable nearby transmitters (radio-telephones, CB radio emitters).
- Nearby radio/TV transmitters.
- Nearby arc welding machines.
- Nearby high voltage lines.
- ...

❑ Enclosures.

It is up to the manufacturer to guarantee that the enclosure where the unit has been installed meets all the relevant directives of the European Union.



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□ **Connecting the power supply to ground.**

The zero Volt point of the external power supply must be connected to the main ground point of the machine.

Precautions during repairs

□ **Do not access the inside of this unit.**

Only personnel authorized by Fagor Automation may access the interior of this unit.

□ **Do not handle the connectors while the unit is connected to mains.**

Before handling the connectors (mains, moving power, feedback, ...) make sure that the unit is not connected to mains.

Safety symbols

□ **Symbols that may appear in this manual.**



Danger or prohibition symbol.

It indicates the actions or operations that could harm people or units.



Warning or caution symbol.

It indicates situations that could be caused by certain operations and the actions to take to prevent them.



Mandatory symbol.

It indicates actions or operations that **MUST** be carried out.



Information symbol.

It indicates notes, warnings and advises.

□ **Symbols that the product may carry.**



Ground protection symbol.

It indicates that that point must be under voltage.

- WARRANTY TERMS -

Initial warranty

All products manufactured or marketed by Fagor Automation carry a 12-month warranty for the end user.

In order to prevent the possibility of having the time period from the time a product leaves our warehouse until the end user actually receives it run against this 12-month warranty, the OEM or distributor must communicate to Fagor Automation the destination, identification and installation date of the machine by filling out the Warranty Form that comes with each product.

The starting date of the warranty for the user will be the one appearing as the installation date of the machine on the Warranty Form.

This system ensures the 12-month warranty period for the user.

Fagor offers a 12-month period for the OEM or distributor for selling and installing the product. This means that the warranty starting date may be up to one year after the product has left our warehouse so long as the warranty control sheet has been sent back to us. This translates into the extension of warranty period to two years since the product left Fagor Automation's warehouse. If this sheet has not been sent to us, the warranty period ends 15 months from when the product left our warehouse.

Fagor is committed to repairing and replacing its products from the time when the first such product was launched up to 8 years after such product has disappeared from the product catalog. It is entirely up to FAGOR AUTOMATION S. Coop. to determine whether a repair is to be considered under warranty.

Exclusive clauses

The repair will be done in our facilities; therefore, all shipping expenses as well as travelling expenses incurred by technical personnel to repair the unit are NOT under this warranty even when the unit is under warranty.

The warranty will be applied so long as the equipment has been installed according to the instructions, it has not been mistreated or damaged by accident or negligence and has been handled by personnel authorized by Fagor Automation.

If once the service call or repair has been completed, the cause of the failure is not to be blamed on those elements, the customer must cover all generated expenses according to current fees.

No other implicit or explicit warranty is covered and FAGOR AUTOMATION shall not be held responsible, under any circumstances, of the damage which could be originated.

Service contracts

Service and Maintenance Contracts are available for the customer within the warranty period as well as outside of it.

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- ADDITIONAL NOTES -

Install the servo drive system away from coolants, chemicals, blows, etc that could damage it.

Before turning the unit on, verify that the ground connections have been made properly. See chapter 8 of the "dds-hardware" manual.

In case of a malfunction or product failure, disconnect it and call the technical service department. Do not access the inside of these units.



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- RECOMMENDED DOCUMENTATION -

Available manuals

 <p>Manual available in electronic format, included in the CD-ROM</p>	 <p>Manual available on paper</p>
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Product selection guides

Document	Description	Format
man_drive_ord_hand.pdf (only in English)	It describes the products that make up the dds system and allows selecting each element according to the user's needs.	
man_fm7/fm9_ord_hand.pdf (only in English)	It describes the FM7/FM9 asynchronous motors and allows selecting each model according to the user's needs.	
man_fxm_fkm_ord_hand.pdf (only in English)	It describes the synchronous motors and allows selecting each model according to the user's needs.	

Quick references

Document	Description	Format
man_dds_mod_quick_ref.pdf (only in English)	It describes each element that make up the system as well as the most important considerations regarding the installation of motors and modular drives, power supplies and accessories such as cables, connectors, etc.	
man_dds_comp_quick_ref.pdf (only in English)	It describes each element that make up the system as well as the most important considerations regarding the installation of motors and compact drives and accessories such as cables, connectors, etc.	

Servo drive system manuals

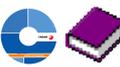
Document	Description	Format
man_dds_hard.pdf (in Spanish and English) For dds without CAN interface	It describes each device and equipment that make up the servo drive system as well as their installation. Note: Does not include CAN equipment.	
man_dds_soft.pdf (in Spanish and English) For dds without CAN interface	It describes the adjustments of the servo drive system. Available parameters, variables and commands. Features. Operation of the WinDDSetup software for PC.	



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<p>man_dds_hard_canopen.pdf (in Spanish and English) For dds with CAN interface</p>	<p>It describes each device and equipment that make up the servo drive system as well as their installation in system with CAN interface.</p>	
<p>man_dds_soft_canopen.pdf (in Spanish and English) For dds with CAN interface</p>	<p>It describes the adjustments of the servo drive system. Available parameters, variables and commands. Features. Operation of the WinDDSSetup software for PC, ... in systems with CAN system.</p>	

Motion Control manuals

Document	Description	Format
<p>man_dds_mc.pdf (in Spanish and English)</p>	<p>It describes PLC programming and the Motion Control programming language and how to use it in the various applications.</p>	

Electric motor manuals

Document	Description	Format
<p>man_fm7_fm9_motors.pdf (in Spanish and English)</p>	<p>They describe the FM7/FM9 series of asynchronous motors of the Fagor catalog and how to install them with the DDS system.</p>	
<p>man_fxm_fkm_motors.pdf (in Spanish and English)</p>	<p>They describe each series of synchronous motors of the Fagor catalog and how to install them with the DDS system.</p>	



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A ERROR CODES & MESSAGES ON RPS POWER SUPPLIES 431

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PREVIOUS KNOWLEDGE



After installing all the elements that make up the DDS system and having followed the instructions given in the "dds-hardware" manual, now this "dds-software" manual describes the whole mechanical configuration of the motor as well as how to set up its parameters and adjust the application that involves the drive, the CNC and the feedback.

This chapter mentions knowledge prior to the configuration, parameter setting and adjustment of the application that the user must handle.

All these stages of the parameter setting and adjusting process will be carried out through Fagor's "WinDDSSetup" application for PC; although there is a specific chapter for this application, many chapters will refer to its menus, tool bars, icons and windows to make it easier for the user

It also mentions the different system configurations involving the drive, the CNC and the feedback.

Later chapters will deal in greater detail with the adjusting procedures for **velocity-drive** and **position-drive** applications.



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1.1 Data storage structure

Both the PC and the drive itself have non-volatile memories. These systems keep the stored data even when power is removed. They are the **hard disk** and the **flash memory** respectively.

Also, the drive has another two memory areas used for its internal operation and communications. **internal memory** and **RAM memory**. **FIGURE S1.1** shows the interconnection between all of them.

1.
PREVIOUS KNOWLEDGE
Data storage structure

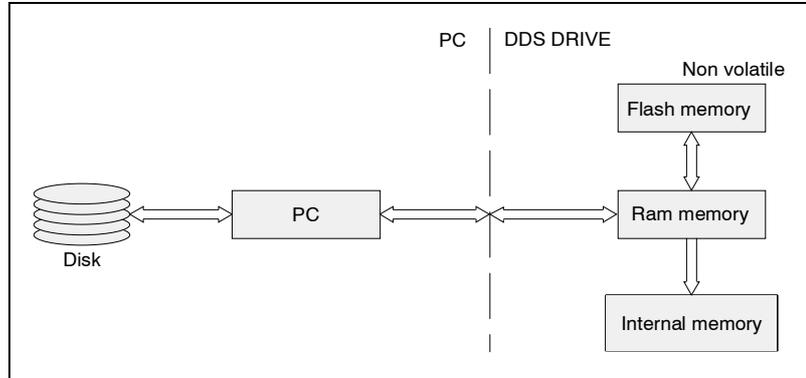


FIGURE S1.1
Data storage structure.



The operation of the drive depends on the data stored in its internal memory.

1.2 Access levels

A parameter table determines the operation of the drive depending on the motor it governs and on the desired behavior.

All these parameters, variables and commands of the drive are organized by access levels:

These levels are:

- USER level.
- OEM level.
- FAGOR level.

To access each parameter, the drive must be set up at the access level required by that parameter.

The access to each level required a password.

The access level change is set via WinDDSetup application by executing the **Access Level...** option. on the **SetUP** menu.

See chapter **16. WINDDSSETUP** of this manual.

- The **USER level** is the basic level. On power up, the drive access this level by default, hence not requiring password.

At USER level, it is possible to access a group of parameters that slightly modify the behavior of the drive depending on the application developed. (free access).

- The **OEM level** is an intermediate access level.

Chapter **13. PARAMETERS, VARIABLES AND COMMANDS** of this manual indicates which variables, parameters and commands may be accessed from this level.

At OEM level, it is possible to access a large group of parameters depending on the motor being connected which set how the electronics of the drive is adapted to that particular motor and to the particular application being developed. (Access restricted to the Fagor servo drive system installer).

- The **FAGOR level** allows full access to all system variables, parameters and commands.

At Fagor level, it is possible to access a group of parameters depending on the electronics of the drive and that are factory sets.

Access restricted to the manufacturing process and technicians from Fagor Automation.



PREVIOUS KNOWLEDGE
Access levels

FAGOR 

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1.3 Parameter editing

Regarding the editing of parameters, the following warning must borne in mind:

Note that the parameters are edited from the <WinDDSSetup> application and affects the data contained in the drive's RAM memory.

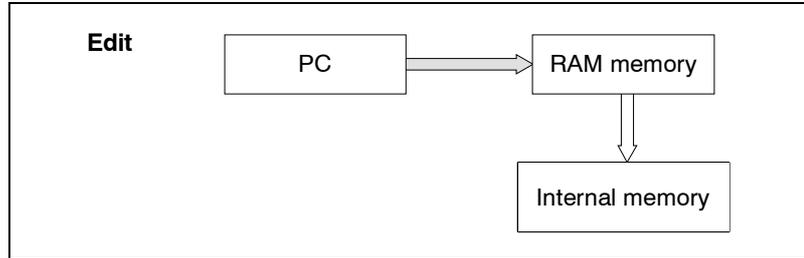


FIGURE S1.2

RAM memory and INTERNAL memory.

Only the modification of certain parameters also affects the data stored in internal memory. These parameters are known as modifiable on-line. Chapter 13 of this manual shows them with an asterisk after the parameter indicator.

Example.

PP58 *Os S00058 Backlash

In order for the changes made in RAM memory to affect the operation of the drive (except for the parameters modified on line which act immediately after being entered and validated with <enter>) they must be <validated> with the relevant icon.

To also save them permanently, they must be <saved into FLASH memory> with the relevant icon.

If the unit is turned off, the values of the parameters (both on-line and off-line) assumed when turning the unit back on will be the last ones saved in the flash memory. This way, the new permanent configuration will be saved.

See the following sections of this chapter that describe what these commands do.

1.
PREVIOUS KNOWLEDGE
Parameter editing



DDS
SOFTWARE

(Soft 06.2x)

Ref.1109

1.4 Save into flash memory



(a)

SAVE INTO FLASH MEMORY: *from the WinDDSSetup application*

In order for the values given to the parameters during setup stay as a permanent drive configuration, they must be transferred into the flash memory. This is so for both on-line and off-line parameters.

Proceed as follows:

- The drive must be connected to power.
- Save the parameters

To do this, execute the command to save into Flash or press the (a) button at the "parameter setting (modifying mode)" window of the WinDDSSetup.

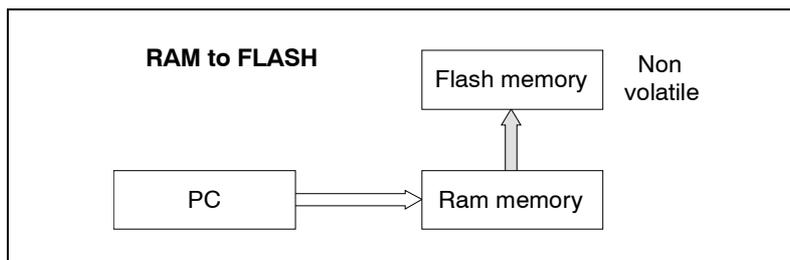


FIGURE S1.3

Save into flash memory.

When it is done saving, the Status Display will display the OK message or the errors (if any).

- The drive needs not to be reset in order for the changes to be effective. This is so from drive software version 06.01 on



PREVIOUS KNOWLEDGE
Save into flash memory



**DDS
SOFTWARE**

(Soft 06.2x)

Ref.1109

1.5 Validating off-line parameters

1.

PREVIOUS KNOWLEDGE
Validating off-line parameters



(b)

VALIDATE: *from the WinDDSSetup application*

Validating **off-line parameters** makes it possible that any change on the value of this type of parameters **be effective** with a single mouse click on the "validate"^(b) icon (its associated command is **GC4**) appearing in the parameter configuration window (modify mode) of the WinDDSetup. This command **does not save** the new value given to the parameter into flash memory, although it won't be necessary to save in Flash in order to **make that change effective**, hence speeding up the setup. To keep the drive configuration change permanent, **it must be saved into flash memory** using the relevant icon ^(a) icon of the previous section).

Hence, off-line parameters will be validated as follows:

□ **Analog axes:** Clicking the ^(b) icon <validate>

This validation must be done without torque, otherwise, the drive will not validate the parameters. If there is any erroneous parameter, it will display error **E502**.

The list of errors may be displayed by clicking the corresponding icon of the icon bar of the WinDDSSetup (SPY window).

See chapter **16. WINDDSSETUP** of this manual.

□ **SERCOS axes:** Clicking the ^(b) icon <validate>, according to the validation of the **SERCOS standard**; in other words, when going from phase 2 to phase 4.



The current versions of the 8070 CNC and 8055 CNC are not ready for such validation and, consequently, the drive parameters must be validated using the method described in the previous section; in other words, saving the parameters in flash memory and then doing a reset at the drive.

This validation tests the following parameters. If there is any erroneous parameter, it will display error **E502**.

The list of errors may be displayed by clicking the corresponding icon of the icon bar of the WinDDSSetup (SPY window).

See chapter **16. WINDDSSETUP** of this manual.

Note that off-line parameters with "SET" can also be validated when doing a SET change or an UNPARK. If there is any erroneous parameter, it will display error **E504**.

Note that both the parameter SET change and the UNPARK change cannot be carried out with common off-line parameters (off-line parameters without "SET") without being validated. These commands will issue an error message in that case.

In all cases, the on-line parameters are validated from the moment they are written in RAM memory.



DDS
SOFTWARE

(Soft 06.2x)

Ref.1109

1.6 Error display

The generated errors may be displayed by clicking the corresponding icon of the icon bar of the WinDDSSetup (SPY window).

See chapter [16. WINDDSSSETUP](#) of this manual.



PREVIOUS KNOWLEDGE
Error display

FAGOR 

**DDS
SOFTWARE**

(Soft 06.2x)

Ref.1109

1.7 Initialization process, reset

Turning the drive causes it to **reset**.

This reset may also be caused by the user:

- By means of the **push - button** located on top of the drive module.
- At the WinDDSetup program using the **GV11 (soft reset)** command. See **FIGURE S1.4**.



FIGURE S1.4

GV11. Soft reset.

This reset has the following effect:

- The Status Display shows the initialization sequence.
- The data stored in the **FLASH** memory (parameters and variables defining its configuration) go into **RAM** memory, and from it into the **internal** memory.
 - The data is cross - checked and verified.
 - Any detected errors are indicated on the display of the face plate.

Error reset.

If the system detects any errors, their cause must be removed and then, an **error reset** must be done.

- **Electrically**, through pin 1 of X2 of the power supplies, pin 1 of X6 on RPS power supplies and pin3 of X2 on the compact drive.
- Executing the command **DC1 (reset errors)** from the WinDDSetup command bar.

There are errors considered as non **resettable** see chapter **14. ERROR CODES AND MESSAGES** of the drive of this manual. These errors can only be eliminated by a reset of the drive.

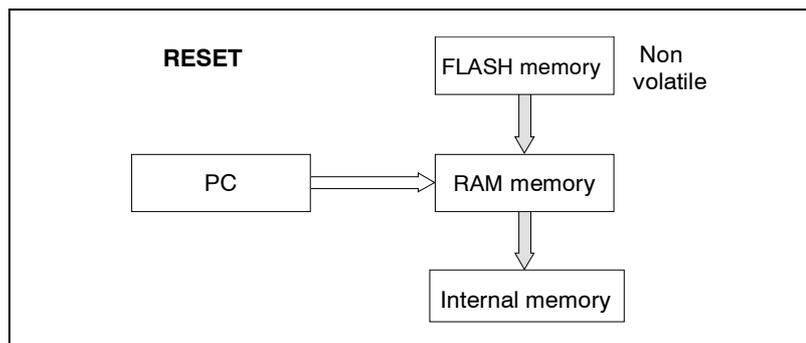


FIGURE S1.5

Error reset.

1.
PREVIOUS KNOWLEDGE
 Initialization process, reset

1.8 Transferring parameter tables



(c)

SAVE: from the WinDDSSetup application

From the Flash memory of the drive to the hard disk of the PC.
This icon of the tool bar of the WinDDSSetup may be used to save (store) the configuration from a drive.



(d)

LOAD: from the WinDDSSetup application

From the hard disk of a PC or a CD-ROM to the flash memory of the drive.
This icon of the tool bar of the WinDDSSetup may be used to load (copy) the configuration into a drive.

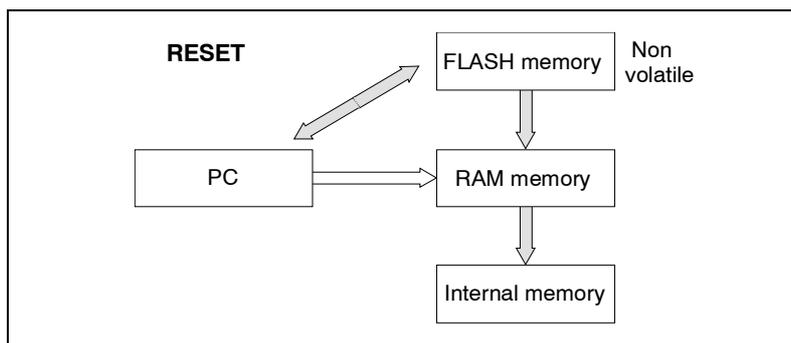


FIGURE S1.6

Transferring parameter tables

Observe that it is different from saving parameters, where:

- From WinDDSSetup, pressing the button ^(a) downloads the contents of the drive's RAM memory into flash memory hence saving the parameters.
- The same operation may also be carried out using the command **GC1** (S00264) BackupWorkingMemoryCommand.

1.

PREVIOUS KNOWLEDGE
Transferring parameter tables

1.9 Transferring (*.mot) motor files

The ^(d) icon of the previous section is also used to transfer a motor file that may be recognized by its extension (*.mot).

Each motor model of the FXM, FKM, SPM, FM7, FM9, FLS or FLM family of the Fagor catalog requires a specific drive software.

This software contains its corresponding file fxm_fkm_xx.mot, fm7_spm_xx.mot, FM9_xx.mot or FLS_FLM_xx.mot with the initialized data of certain parameters for each motor as well as the parameters for the adjustment of the current and flux loops.

Besides, from drive software version 06.20 on, motor files Siemens_xx.mot and Cabezas_Varios_xx.mot have been included for some user motors (i.e. non-Fagor motors).

To assign the proper values the **motor related** parameters, you must "tell" the drive which motor is to be governed.

Important. Before selecting the motor from the corresponding window of the WinDDSSetup, the parameter file of the relevant motor must be transferred to the drive.

Remember that the drive, by default, has a single motor file stored in it that is associated with the drive, but if the user wants to connect it to a different motor, he must load the (*.mot) file of his motor from the **CD-ROM** supplied by Fagor with the software version.

Follow the following procedure.

With the drive powered up and connected to the PC through the **RS232** serial line and the WinDDSSetup application open, click on the icon ^(d) <load> of the tool bar to find folder of the CD-ROM with the version name (see figure) from the box <Find in >. Observe that it will load all the files having the extension (*.mot):

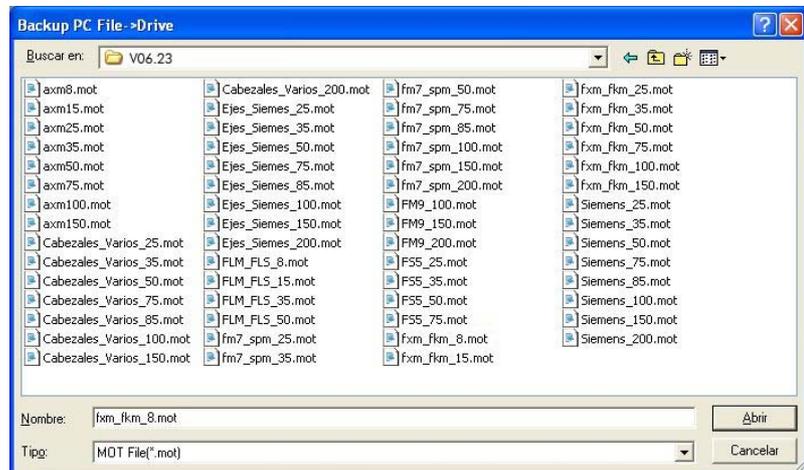


FIGURE S1.7

Window for transferring (*.mot) files from the PC to the drive.

Note that:

"**MOT File**" (*.mot) must be selected in the "**File type**" box that shows all the (*.mot) files existing in the version folder Vxx.xx (this one is V06.10).

FXM and FKM motors on one hand and FM7 and SPM motors on the other have a particular file depending on the drive they are associated with (by default) and it is reflected with the digits after fxm_fkm.

1.
PREVIOUS KNOWLEDGE
Transferring (*.mot) motor files



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These digits represents the drive's peak current. Hence, for example, if an FXM or FKM motor is associated with a 75A AXD axis drive, you must select the file: fxm_fkm_75.mot.

Note. This explanation is also valid for the rest of the files including the user motor files Siemens_xx.mot and Cabezales_Varios_xx.mot.

After selecting the desired file and clicking the "**O**pen" button, it starts transferring the selected file from the PC to the drive.

The process will end after accepting the two notifications appearing on the screen in the transferring process.

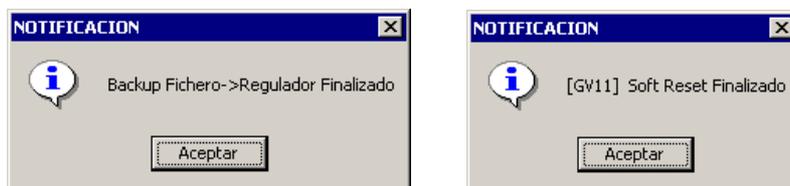


FIGURE S1.8

Notifications while transferring a (*.mot) file from the PC to the drive.

1.

PREVIOUS KNOWLEDGE
Transferring (*.mot) motor files

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1.10 Motor identification

As mentioned in the previous chapter, each motor requires a specific drive software configuration.

This software contains its corresponding file fxm_fkm_xx.mot, fm7_spm_xx.mot, FM9_xx.mot, etc. with the initialized parameter data for each motor as well as the parameters for the adjustment of the current and flux loops. Chapter 13. **PARAMETERS, VARIABLES AND COMMANDS** of this manual shows which are the motor related parameters and which the ones for the current and flux loops.

To assign the proper values to the motor related parameters, you must "tell" the drive which motor is to be governed.

This procedure is to be carried out from the setup program WinDDSSetup as described in chapter 2. **MOTOR IDENTIFICATION** in this manual.

1.10.1 Identification and initialization

The motor selection using this procedure sets the **motor parameters** and also sets **the rest of the parameters of the drive to their default values.**

Within the group of parameters expanded in sets and reductions, this initialization only affects those belonging to set and reduction zero. Set 0 and reduction 0 are left as the only useful ones.

Important. This identification **process + initialization** is the starting point recommended for the first start-up of a servo system .

For further detail, see chapter 2. **MOTOR IDENTIFICATION** of this manual.

1.

PREVIOUS KNOWLEDGE
Motor identification

1.11 System configurations

After identifying the motor other adjustments are necessary.

The drive, with the CNC and the feedback, is ready to work with different configurations. Parameter **AP1** (S00032) configures the drive to work with each of these configurations. See its meaning in chapter 13 of this manual.

A special attention must be paid to the type of communication interface used to transmit the feedback value or the velocity command value in each of the diagrams.



PREVIOUS KNOWLEDGE
System configurations

1.11.1 Velocity drive

See chapter 4 of this manual: Adjustment of the speed drive.

□ Velocity drive with encoder simulator

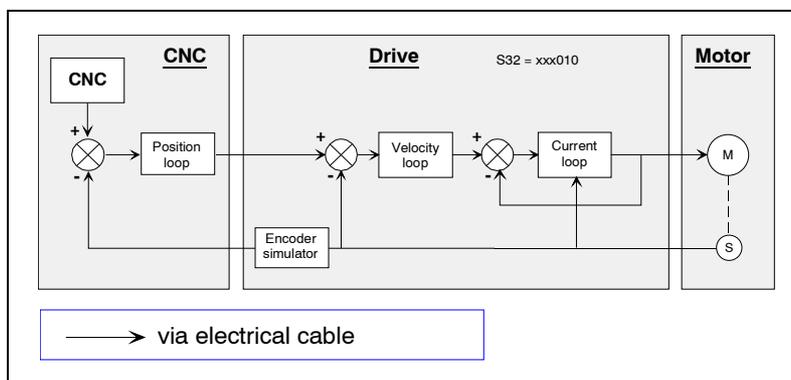


FIGURE S1.9

Velocity drive with encoder simulator.

□ Velocity drive with motor feedback

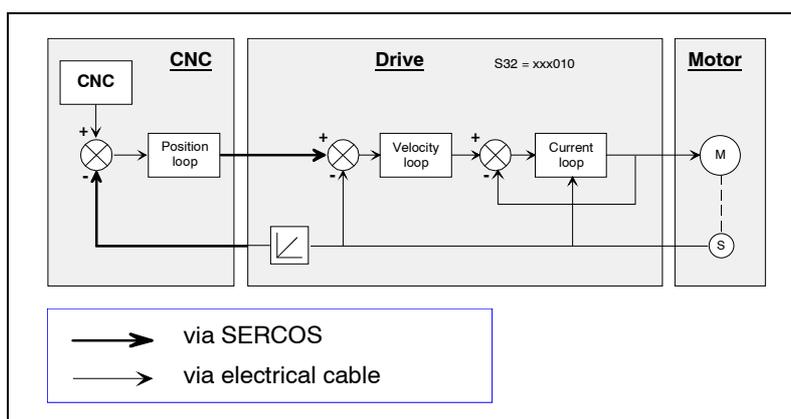


FIGURE S1.10

Velocity drive with motor feedback.



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1.

PREVIOUS KNOWLEDGE
Velocity drive

□ Speed drive with direct feedback (configuration I)

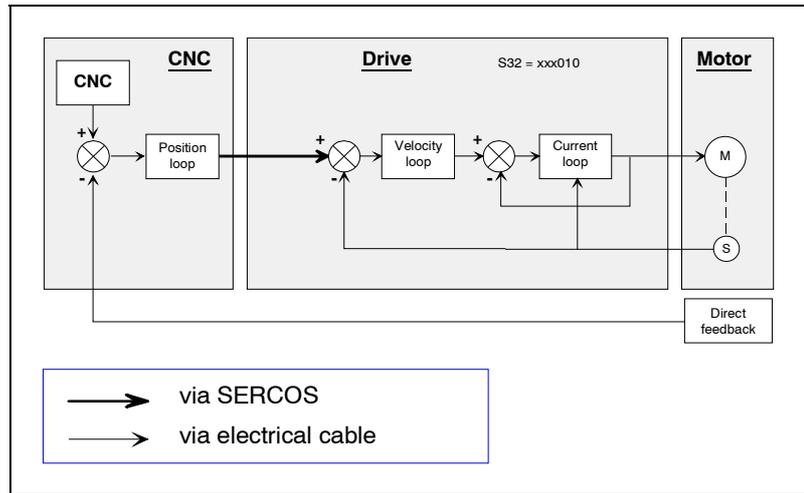


FIGURE S1.11

Velocity drive with direct feedback. Configuration I.

□ Speed drive with direct feedback (configuration II)

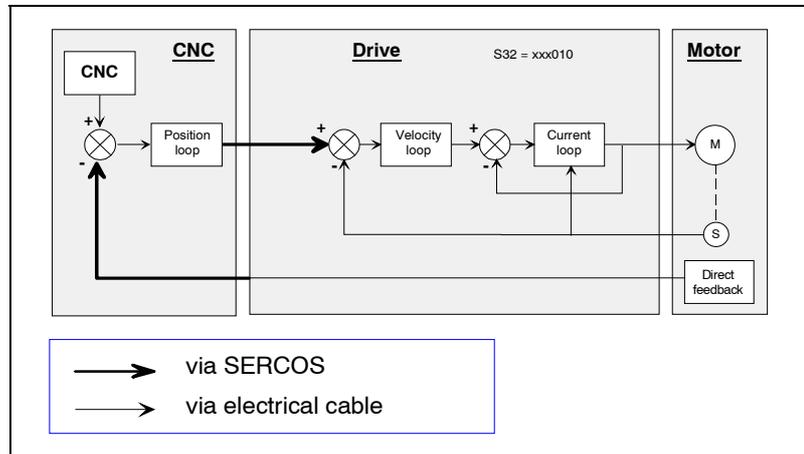


FIGURE S1.12

Velocity drive with direct feedback. Configuration II.



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1.11.2 Position drive

See chapter 5 of this manual: Adjustment of the position drive.

□ Position drive with motor feedback

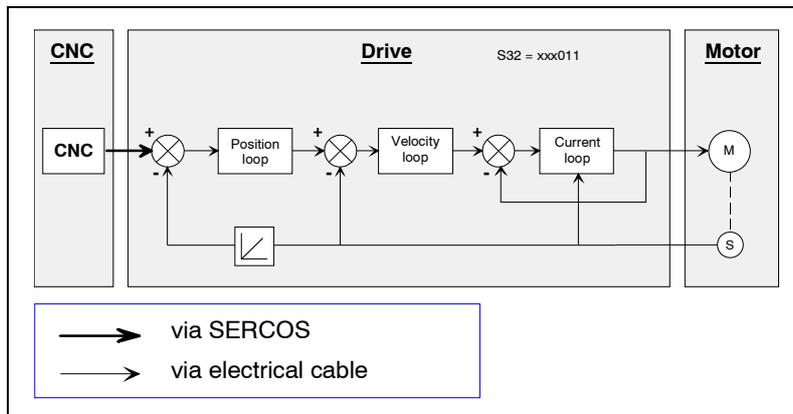


FIGURE S1.13

Position drive with motor feedback.

□ Position drive with direct feedback

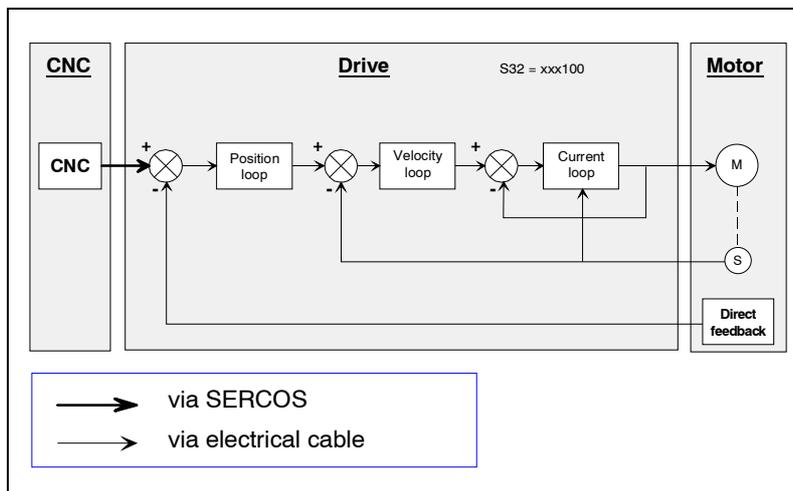


FIGURE S1.14

Position drive with direct feedback.



PREVIOUS KNOWLEDGE
Position drive



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MOTOR IDENTIFICATION

2

Each motor installed in a DDS system requires a specific software version of the drive associated with it.

This software **contains** the relevant motor file that depending on the Fagor motor model will be given by the following table:

TABLE S2.1 Non-Fagor motor models. Associated (*.mot) motor files.

Motor model	Associated motor file
FXM	fxm_fkm_□□.mot
FKM	fxm_fkm_□□.mot
SPM	fm7_spm_□□.mot
FM7	fm7_spm_□□.mot
FM9	FM9_□□.mot
FLS	FLM_FLS_□□.mot

This (*.mot) file contains the initialized data of the parameters for each motor and the parameters for adjusting the current and flux loops.

It also contains the motor files for certain user motor models (non-Fagor motors) They are:

TABLE S2.2 Non-Fagor motor models. Associated (*.mot) motor files.

Motor model	Associated motor file
SIEMENS™	Siemens_□□.mot
Other manufacturers	Cabezales_Varios_□□.mot

For further details on transferring (*.mot) files, see the relevant section in chapter [1. PREVIOUS KNOWLEDGE](#) of this manual.

Chapter 13 of this manual shows which are the motor related parameters and which the ones for the current and flux loops.

2.1 Motor configuration

To assign the proper values the motor related parameters, you must "tell" the drive which motor is to be governed among all of the Fagor catalog.

This motor configuration can only be carried out from the PC application WinDDSetup and, therefore, to do this, the drive associated with the motor and the PC must be connected through the RS232 serial line.

Now, from WinDDSetup program, in the parameter configuration window (modification mode) displayed when activating the corresponding icon of the tool bar, select the M <motor> group.

For further detail, see chapter 16. WINDDSSETUP of this manual.

2.
MOTOR IDENTIFICATION
 Motor configuration



FIGURE S2.1

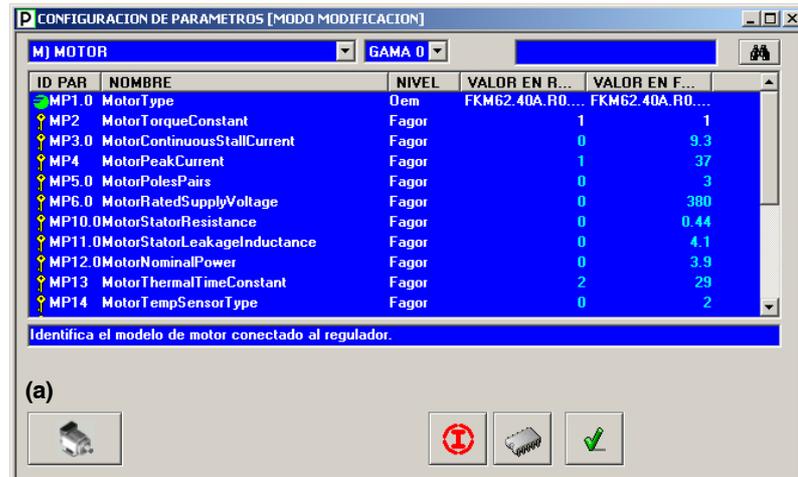
Parameter setting window (modification mode).



(a)

Using an OEM access level or higher, a window such as the **FIGURE S2.1** is displayed showing the motor selection icon ^(a) as long as parameter **MP1.#** MotorType of the M group (Motor) has been previously selected on the list of groups.

Note. When using the BASIC access, the icon ^(a) will not be displayed in the parameter setting window and, consequently, it cannot be selected unless a less restrictive access level is used.



(a)

FIGURE S2.2

Motor selection icon.



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2.2 Motor selection

2.2.1 Fagor synchronous servo motors.



(a)

The motor selection window that is shown when pressing the button ^(a) of the parameter setting window will be similar to the one given in **FIGURE S2.3**.

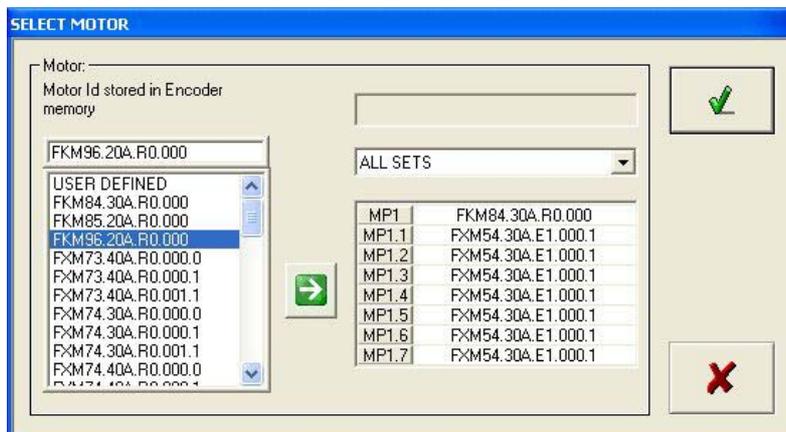


FIGURE S2.3

Window for selecting a synchronous servo motor FXM or FKM.

Note that for the left listing of this window not to be empty, its corresponding `fxm_fkm_xx.mot` file must already be loaded in the drive. Although, by default, a motor file (*.mot) associated with the drive is always stored; if for any reason, this is not so, the motor cannot be selected without first transferring the motor file of the motor to be governed to the drive. See the section "transferring (*.mot) files" described in the previous chapter.

Warning. From drive software version 06.10 on, parameter MP1 may be extended in sets.



Important. Note that all these motor ID's listed on the left side of the window **always appear when using a resolver (R0) feedback**. If your motor has a different feedback device, most likely, identify it by reading the ID on the motor characteristics plate on one of its sides and proceed as shown next.

Proceed this way:

- ❑ Select on the drop list, the option "set by set". The window will show an 8-arrow column (one per set).
- ❑ Select the motor ID from the list according to the one to be governed. See that only ID's with resolver feedback (R0) are considered.

You must select it even if your motor does not have a resolver (Ref. R0).

You will change R0 with the real feedback reference later on !

- ❑ Press the arrow button for the set 0, i.e. MP1. This field will show the ID that has been selected on the left panel. This field **may be edited** and, therefore, if the motor does not have a resolver, you'll have to type the motor's real reference over the R0 reference, the new one may be an encoder E1, E3, A1, A3, etc. To know which one it actually has, see the motor reference on its characteristics plate.

If the first selection were "all the sets", there would only be a single arrow button and pressing that button would have assigned the motor selected on the ID list to the 8 fields of the 8 sets

2.

MOTOR IDENTIFICATION
Motor selection



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With encoder feedback

The Fagor synchronous servo motors equipped with encoder feedback store the motor sales reference in the encoder's memory **permanently**. References E1, A1, E3, A3, etc.

2.
MOTOR IDENTIFICATION
 Fagor synchronous servo motors.

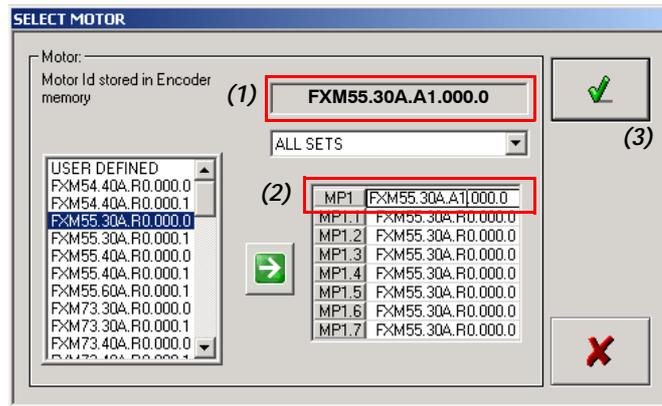


FIGURE S2.4

Window showing the ID of the motor saved in the encoder memory ⁽¹⁾.

The software version is capable of reading this reference and executing an automatic motor identification process. This way, the motor selection window offers the possibility to choose between the motor currently connected and a user motor, default motor, default2 motor and clear motor parameter.

At the window of **FIGURE S2.4**, the motor ID appearing in the ⁽¹⁾ field shows the type of feedback device connected. In this case, it is an A1 encoder. It is then possible to select the same motor that appears in this field on the motor ID list of this window (always with the reference of a resolver R0), it may be assigned to one or all of the MP1 sets using the arrow buttons and type "A1" ⁽²⁾ over "R0" because these fields may be edited. Validate it by pressing the corresponding icon ⁽³⁾

This automatic process does not include the PI adjustment which must be carried out by the operator at the OEM access level.



Important. The selection of the motor using this selection window (as seen in this chapter) modifies parameter MP1.□ (S00141) MotorType (with sets from versions 06.10 on). Assigning a particular reference to parameter MP1.□ means that all the motor parameters, shown in chapter 13. **PARAMETERS, VARIABLES AND COMMANDS** of this manual with an "M" and belonging to the "motor" group, take a fixed value that cannot be changed.

The reference stored in the encoder's memory is also given in the RV7 variable. For further detail on this variable, see chapter 13. **PARAMETERS, VARIABLES AND COMMANDS** of this manual.



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With resolver feedback

Fagor servo motors having resolver feedback (feedback ref. R0) **do not have auto-identification**, hence being necessary to "tell" the drive module which motor is connected to it.

The selection window offers the list of motors included in the fxm_fkm_□□.mot file (for FXM and FKM motors) that has been transferred to the drive. If the connected motor is, for example, an FKM62 of 4000 rpm (see the characteristics plate of the motor), select FKM62.40A.R0.000 from the motor ID list of the window and assign it to one or all the sets of parameter MP1⁽²⁾ with the arrow button. Validate this selection by pressing the corresponding icon⁽³⁾.

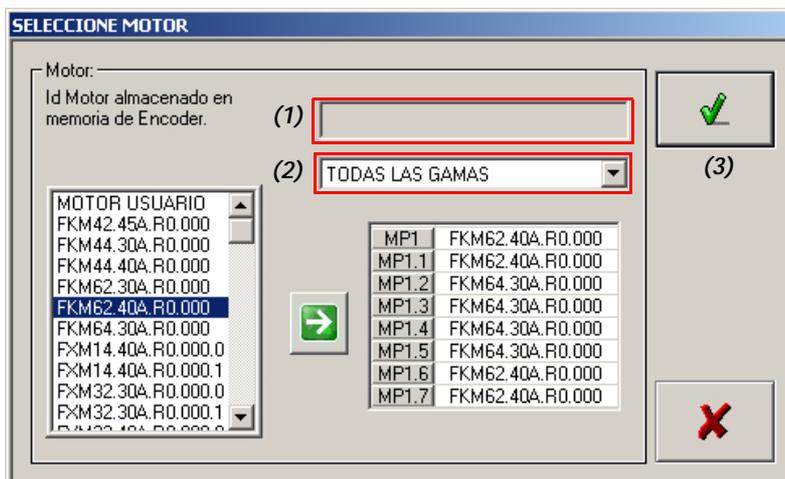


FIGURE S2.5

When using resolver feedback, it does not show the ID of the connected motor⁽¹⁾.



Important. The selection of the motor using this selection window (as seen in this chapter) modifies parameter MP1.□ (S00141) MotorType (with sets from versions 06.10 on). Assigning a particular reference to parameter MP1.□ means that all the motor parameters, shown in chapter 13. **PARAMETERS, VARIABLES AND COMMANDS** of this manual with an "M" take a fixed value that cannot be changed.

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MOTOR IDENTIFICATION
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Selecting the "DEFAULT" option

Warning. The <DEFAULT> option is only operative when the feedback integrated into the motor is an encoder.

From drive software version 06.08 on, the <motor selection> window shows the **DEFAULT** option. Hence, when selecting this option and assigning with the green arrow button for example the motor ID stored in the encoder memory⁽¹⁾ to set 1 of parameter MP1⁽²⁾, it sets MP1.1 with this value and all the parameters of the M group are set to their default values and stored in the RAM memory of the drive.

Remember that the reference or motor ID stored in the encoder's memory may also be displayed in the RV7 variable. For further detail on this variable, see chapter 13. **PARAMETERS, VARIABLES AND COMMANDS** of this manual.

Proceed this way:

Using the OEM or FAGOR access level, activating the icon^(a) from the parameter setting window displays the <motor selection> window.

- Select the "DEFAULT" option after locating it in the area listing all motors.



(a)

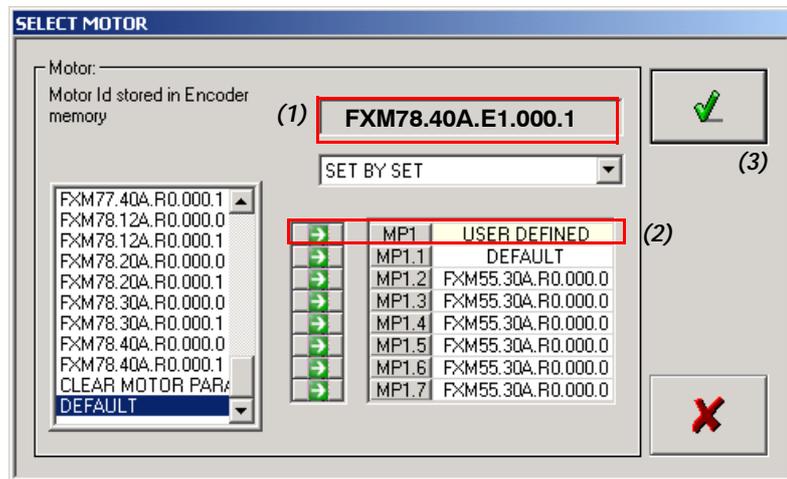


FIGURE S2.6

Motor selection window. <DEFAULT> option.

The drive will automatically recognize the ID stored in the memory of the motor encoder connected to it.

Warning. Note that if the ID stored in the encoder memory does not match one of the motor ID's stored in the file fxm_fkm_xx.mot, the drive's display will show error **E505** indicating this situation.

- Assign DEFAULT with the arrow button to one or all the sets of parameter MP1, e.g. MP1.1 (see 2).
- Validate this assignment by pressing the corresponding icon (see 3).

An automatic parameter setting of the drive has been set for that motor and these values have been stored in its RAM memory.

Note. Do not forget to always execute the GC1 command to store these values permanently in the FLASH memory of the drive.

Important. If the user changes the motor connected to the drive with a different one and selects the "DEFAULT" option, the drive immediately issues error **E502** on its display warning that the values of the motor parameters (M group) of the new motor connected (now stored in the RAM of the drive) and those of the motor have been changed (still stored in the FLASH of the drive) are not the same.

Select the "**DEFAULT2**" option described next to solve this situation if you are going to change motors.

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MOTOR IDENTIFICATION
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Selecting the "DEFAULT2" option

Warning. The <DEFAULT2> option is only operative when the feedback integrated into the motor is an encoder.

From drive software version 06.21 on, the <motor selection> window shows the **DEFAULT2** option.

Its function (as opposed to the "DEFAULT" option) is to make it possible to set the parameters of a drive so when changing the motor that governs with a different one, error **E502** does not come up indicating that the parameters of the new motor (stored in RAM after validating "DEFAULT2") and those of the replaced motor (still stored in the FLASH of the drive) are not the same

Hence, when selecting this option and assigning with the arrow button the motor ID stored in the encoder memory ⁽¹⁾ to set 1 of parameter MP1 ⁽²⁾, it sets MP1.1 with DEFAULT2 value and all the parameters of the M group are set to their default values and stored in the RAM memory of the drive.

Proceed this way:



(a)

Using the OEM or FAGOR access level, activating the icon ^(a) from the parameter setting window displays the <motor selection> window.

- Select the "DEFAULT2" option after locating it in the area listing the motors.

The drive will automatically recognize the ID stored in the memory of the motor encoder connected to it.

Warning. Note that if the ID stored in the encoder memory does not match one of the motor ID's stored in the file fxm_fkm_xx.mot, the drive's display will show error **E505** indicating this situation.

- Assign DEFAULT2 with the arrow button to one or all the sets of **parameter MP1**, e.g. MP1.1.
- Validate this assignment by pressing the corresponding icon.

An automatic parameter setting of the drive has been set for that motor and these values have been stored in its RAM memory.

Note. Do not forget to always execute the GC1 command to store these values permanently in the FLASH memory of the drive.

Important. If the user changes this motor connected to the drive with a different one and selects the "DEFAULT2" option, **the drive will not issue error E502** on its display as it did with the "DEFAULT" option.

Therefore, selecting the "DEFAULT2" option instead of the "DEFAULT" option prevents the activation of **E502** at the drive due to a motor change.

2.

MOTOR IDENTIFICATION

Fagor synchronous servo motors.

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Selecting the "Clear motor parameters" option

Warning. The <clear motor parameters> option must be used when having a non-Fagor servomotor that has never been adjusted.

When installing a **non-Fagor synchronous servomotor that has never been adjusted**, it is necessary to enter all the motor parameters and make sure that they all have been previously set to zero. To do this, the motor must be selected with the "clear motor parameters" option.

The drive does not recognize the motor connected to it; to access and set all the motor parameters, proceed as follows:

- Select the "clear motor parameters" option
- Assign it with the green arrow button to one or all the sets of parameter MP1, e.g. MP1.1.
- Validate this assignment by pressing the corresponding icon.

When selecting the motor with the "clear motor parameters" option, all the parameters of the M motor group are set to 0.

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Fagor synchronous servo motors.



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Selecting the "user defined" option

Warning. The <user defined> option must be used when using a non-Fagor synchronous servomotor (or a Fagor synchronous servomotor with a special non-standard characteristic), whose motor parameters have already been set sometime in the past.

This option is used to change some motor parameter knowing that all of them have already been set sometime in the past.

To do this, proceed as follows:



(a)

Using the OEM or FAGOR access level, activating the icon^(a) from the parameter setting window displays the <motor selection> window. Select the <user defined> option after locating it in the area listing the motor ID's.

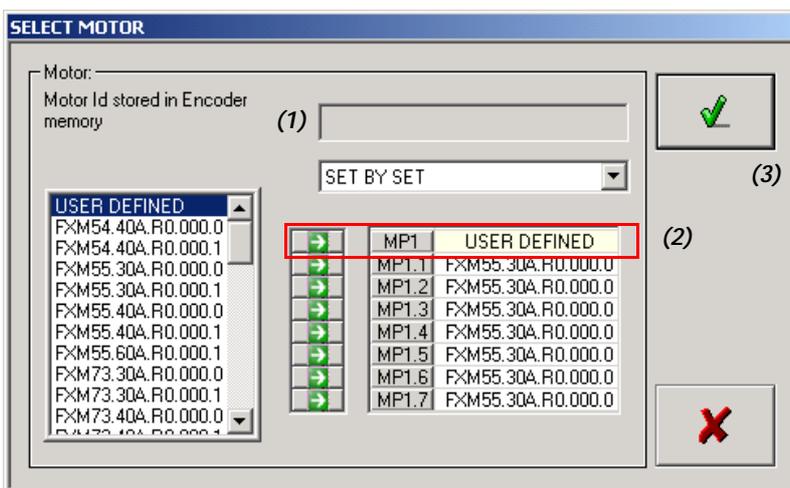


FIGURE S2.7

Motor selection window. <User defined> option.

The drive will not recognize any the ID stored in the encoder of the motor connected to it when it is not a Fagor motor⁽¹⁾.

- Select the "user defined" option.
- Assign it with the arrow button to one of the sets of parameter MP1 (e.g. MP1.0⁽²⁾). It can also be assigned to all the sets if it is useful to the user.

MP1.0 will have been set to 0. Its value may be edited from the keyboard to enter an ID that identifies it by typing always a 0 in front of it, e.g. "0supermotor".
- Validate this assignment by pressing the corresponding icon⁽³⁾.

It is now possible to change the value of the desired motor parameters.



(b)

This new setting will not be permanent until it is saved in flash memory using the^(b) icon.

The drive software versions 06.10 and newer admit both user motors and MP1 sets, i.e. 8 (one per set).

To keep the parameter tables of several user motors with new settings, the various parameter transferring functions must be used.

See "transferring parameter tables" in chapter 1 of this manual.

2.

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Fagor synchronous servo motors.



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2.2.2 Fagor asynchronous motors

Warning. From version 06.10 on, the drive software includes the motor tables of FM7 motors with references E03 and HS3 besides the previous ones with references E01 and E02. It is important to point out that in this version **parameter MP1 has sets**, but not the previous versions. The reason is the possibility the star and in delta connection of the windings of FM7 motors with references E03 and HS3. Motor tables for the FM9 series are included in software version 06.23.

2.

MOTOR IDENTIFICATION
Fagor asynchronous motors



(a)

The motor selection window that is shown when pressing the ^(a) button of the parameter setting window will be similar to the one given in **FIGURE S2.8**.

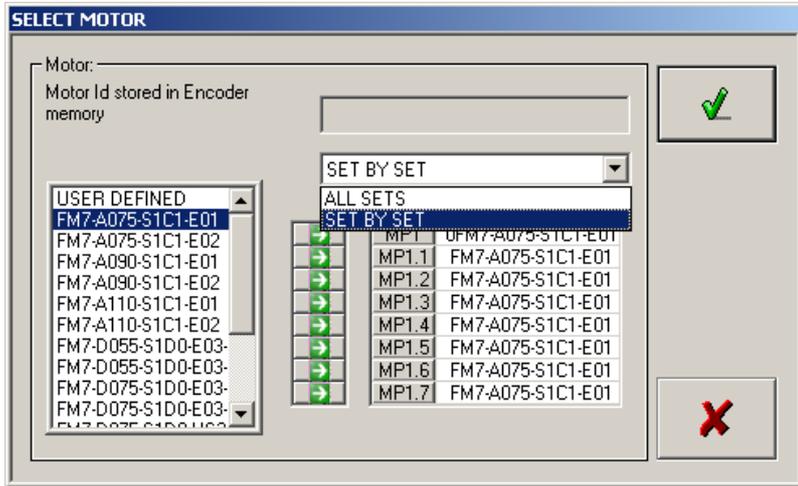


FIGURE S2.8

Window for selecting an FM7, SPM or FM9 asynchronous spindle motor.

Note that for the left listing of this window not to be empty, its corresponding file fm7_spm_xx.mot or FM9_xx.mot must already be loaded in the drive. Although, by default, a motor file (*.mot) conveniently associated with the drive is always stored; if for any reason, this is not so, the motor cannot be selected without first transferring the motor file of the motor to be governed to the drive. See the section "transferring (*.mot) files" described in the previous chapter.

The references E03 and HS3 of the motors on the list correspond to the ID's of the FM7 motors that can only be controlled from version 06.10 on. They have the peculiarity with respect to the motors with references E01 and E02 (that may be governed already with older versions) that they carry an S or a D at the end of their ID.

It is a single motor and its sales reference does not include the last letter (S or D), but their windings may be connected in **Star** or in **delta (Delta)**, the data needed by the drive will be different for each one and the software will treat them like two different motors, although they are actually the same motor. Hence, this window of the WinDDSSetup recognizes them with two different ID's (with S or with D).

How to set the parameters for a star-delta switch

A winding switching maneuver requires:

- Having an E03 series or HS3 series FM7 asynchronous motor.
- Carry out the entire installation as shown in the diagram of chapter 10 of the "dds-hardware" manual. The two contactors shown there will be actuated through the PLC program of the 8070 CNC because the drive does not have any digital output to control it.
- Having version 06.10 or higher at the spindle drive if the switch will be made with the motor stopped or 06.18 or greater if the switch will be made without stopping the motor, on the go.
- Using the motor selection window of the WinDDSSetup, assign the star reference of the motor to a set of parameter MP1 of the drive and the del-



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ta reference to another set of MP1. See **FIGURE S2.9**. Be coherent in the PLC program with the assignments done here.

- Save the parameters permanently (GC1 command).

Also note that the **sales reference** of the motor is FM7-D□□□-S1D0-E03 (without the S or D at the end), but to be able to distinguish the motor so it can work with star/delta winding connection (as needed in each stage of the application), you must select a motor id like FM7-D□□□-S1D0-E03-**S** and assign it to, for example, MP1 (set 0) and select an FM7-D□□□-S1D0-E03-**D** and assign it to, for example, MP1.1 (set 1) in the motor selection window from the WinDDSSetup application.

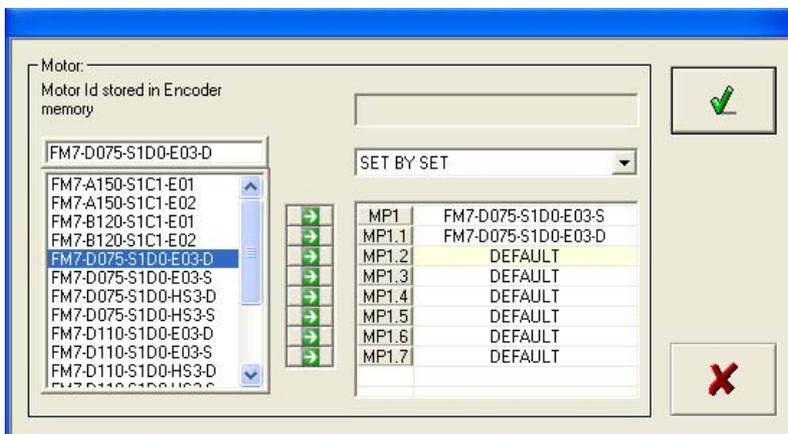


FIGURE S2.9

Window for selecting a asynchronous spindle motor FM7 to carry out the star-delta switch.

Note. There is no need to assign them to sets 0 and 1 of parameter MP1. Any of its available 8 sets may be selected for each ID.

Hollow-shaft motors correspond to FM7-D□□□-S1D0-HS3 type references. The windings of these motors can also be connected in star/delta the same way as the previous E03.

If just one of the winding connection is enough for the application, assign the motor ID directly to any of the 8 sets of MP1 selecting it from the list on the left in the window. Hence, if it is only going to be connected in star (when the motor will be mainly running in the average speed zone) select the ID that carries the S and if it is only going to be connected in delta (when the motor will be mainly running in the high speed zone) the one that carries the D.

Important. If the application only requires one of the winding connections (star or delta), no external contactor will be needed. Set the necessary connection from the 6 terminals of the terminal box.

FM7 motors with references E01 and E02 have a fixed internal winding connection in delta and they cannot be connected in any other way. Therefore, assign the ID selected on the list to any of the 8 sets of the MP1.

Remember that FM7 motors with references E01 and E02 **do not have** the option to connect their windings in star/delta.

How to set the parameters for changing an FM7 motor

The parameters for an online motor change is similar to the star-delta change. In the motor selection window of the WinDDSSetup, select the ID of the first motor, e.g. FM7-A□□□-□□□□-E01 and assign it, for example to MP1 (set 0) and select the ID of the second motor, e.g. FM7-A□□□-□□□□-E02 and assign it, for example, to MP1.1 (set 1).

The identification and initialization process of any motor is described later on in the corresponding section.

Important. The electrical maneuver also needs two external contactors and the electrical connections must be made like those for star-delta winding switching when opening one contactor and closing the other one; it must set one motor running and stop the other one or vice versa.

2.

MOTOR IDENTIFICATION
Fagor asynchronous motors



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Selecting the "DEFAULT" option

2.

MOTOR IDENTIFICATION
Fagor asynchronous motors

Warning. The <DEFAULT> option is only operative when the feedback integrated into the motor is an encoder.

From drive software version 06.08 on, the <motor selection> window shows the **DEFAULT** option. Hence, when selecting this option and assigning with the arrow button the motor ID stored in the encoder memory ⁽¹⁾ to set 1 of parameter MP1 ⁽²⁾, it sets MP1.1 with this value and all the parameters of the M group are set to their default values and stored in the RAM memory of the drive.

Remember that the reference or motor ID stored in the encoder's memory may also be displayed in the RV7 variable. For further detail on this variable, see chapter 13. **PARAMETERS, VARIABLES AND COMMANDS** of this manual.

Proceed this way:



(a)

Using the OEM or FAGOR access level, activating the icon ^(a) from the parameter setting window displays the <motor selection> window.

- Select the "DEFAULT" option after locating it in the area listing all motors.

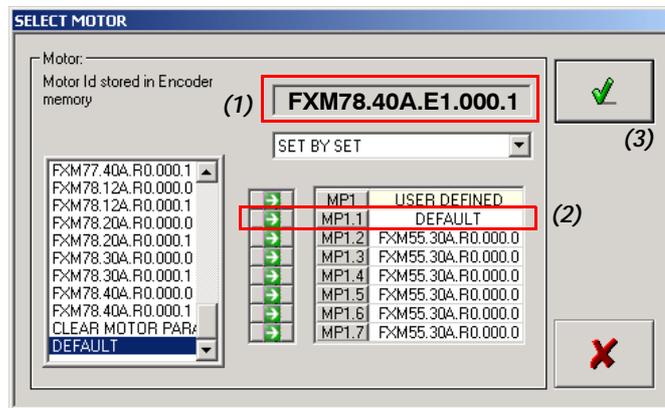


FIGURE S2.10

Motor selection window. <DEFAULT> option.

The drive will automatically recognize the ID stored in the memory of the motor encoder connected to it.

Warning. Note that if the ID stored in the encoder memory does not match one of the motor ID's stored in the file fm7_spm_□□.mot, the drive's display will show error **E505** indicating this situation.

- Assign DEFAULT with the arrow button to one or all the sets of parameter MP1, e.g. MP1.1 (see 2).
- Validate this assignment by pressing the corresponding icon (see 3).

An automatic parameter setting of the drive has been set for that motor and these values have been stored in its RAM memory.

Note. Do not forget to always execute the GC1 command to store these values permanently in the FLASH memory of the drive.

Important. If the user changes the motor connected to the drive with a different one and selects the "DEFAULT" option, the drive immediately issues error **E502** on its display warning that the values of the motor parameters (M group) of the new motor connected (now stored in the RAM of the drive) and those of the motor have been changed (still stored in the FLASH of the drive) are not the same.

Select the "DEFAULT2" option described next to solve this situation if you are going to change motors.



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Selecting the "DEFAULT2" option

Warning. The <DEFAULT2> option is only operative when the feedback integrated into the motor is an encoder.

From drive software version 06.21 on, the <motor selection> window shows the **DEFAULT2** option.

Its function (as opposed to the "DEFAULT" option) is to make it possible to set the parameters of a drive so when changing the motor that governs with a different one, error **E502** does not come up indicating that the parameters of the new motor (stored in RAM after validating "DEFAULT2") and those of the replaced motor (still stored in the FLASH of the drive) are not the same.

Hence, when selecting this option and assigning with the arrow button the motor ID stored in the encoder memory⁽¹⁾ to set 1 of parameter MP1⁽²⁾, it sets MP1.1 with DEFAULT2 value and all the parameters of the M group are set to their default values and stored in the RAM memory of the drive.

Proceed this way:



(a)

Using the OEM or FAGOR access level, activating the icon^(a) from the parameter setting window displays the <motor selection> window.

- Select the "DEFAULT2" option after locating it in the area listing the motors.

The drive will automatically recognize the ID stored in the memory of the motor encoder connected to it.

Warning. Note that if the ID stored in the encoder memory does not match one of the motor ID's stored in the file fm7_spm_□□.mot, the drive's display will show error **E505** indicating this situation.

- Assign DEFAULT2 with the arrow button to one or all the sets of **parameter MP1**, e.g. MP1.1.
- Validate this assignment by pressing the corresponding icon.

An automatic parameter setting of the drive has been set for that motor and these values have been stored in its RAM memory.

Note. Do not forget to always execute the GC1 command to store these values permanently in the FLASH memory of the drive.

Important. If the user changes this motor connected to the drive with a different one and selects the "DEFAULT2" option, **the drive will not issue error E502** on its display as it did with the "DEFAULT" option.

Therefore, selecting the "**DEFAULT2**" option instead of the "**DEFAULT**" option prevents the activation of **E502** at the drive due to a motor change.

2.

MOTOR IDENTIFICATION
Fagor asynchronous motors

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2.3 Motor identification and initialization



(c)

INITIALIZATION

It is possible to identify the motor through the initialization button located in the window itself. Activating this icon ^(c) - see **FIGURE S2.2** to identify it - displays the window **SELECT MOTOR FOR INITIALIZATION**. See the following figures.

2.

MOTOR IDENTIFICATION
Motor identification and initialization

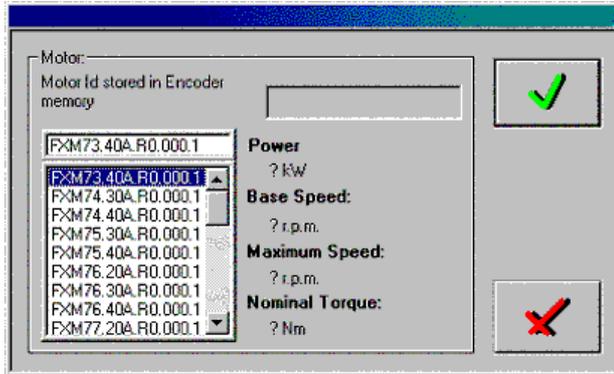


FIGURE S2.11

Window for selecting an FXM motor to be initialized.

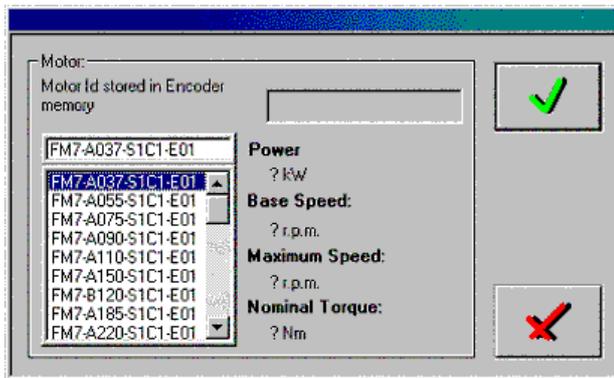


FIGURE S2.12

Window for selecting an FM7 motor to be initialized.

The motor selection using this procedure sets the **motor parameters** and also sets **the rest of the parameters of the drive to their default values**.

Within the group of parameters expanded in sets and reductions, this initialization only affects those belonging to set and reduction zero. Set 0 and reduction 0 are left as the only useful ones.

Warning. From software version 06.13 on, error **E110** (low IGBT heatsink temperature) is disabled every time the default parameters are reset at the drive using the reset button of the WinDDSSetup (see icon c). It is up to the user to enable it using the procedure offered by the WinDDSSetup.

Error **E110** will be disabled when loading parameters of versions older than v.06.13. It is up to the user to enable it using the procedure offered by the WinDDSSetup.

When loading parameters of versions 06.13 and newer **E110** will be disabled or not depending on those parameters. They will not be treated.



The **identification + initialization process** is the starting point recommended for the first start-up of a servo system.



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2.4 Automatic identification process

2.4.1 Fagor motor

Warning. This application is **only** operative when the feedback integrated into the motor is an **encoder**.

When connecting the feedback cable for the first time, the drive reads the reference stored on the encoder, **identifies the motor and initializes** the parameters.

After this automatic setup, modifying parameter MP1 (S00141) MotorType will have no effect on the drive.

Only when assigning a "user motor" value (non-Fagor motor with a name starting with a 0), will it be possible to modify the motor parameters.

The voltage supply loss of the drive or disconnecting the feedback cable will have no effect on the parameter values.

Only when the drive detects a different motor connected to it, will it start a new automatic identification process.

2.4.2 User motor

When installing a non-Fagor motor (user motor), or if it is a Fagor motor to access and modify one of the parameters of the motor group, current group or flux group, it is necessary to load MP1 (S00141) MotorType with a **value starting with 0** (e.g.: 0supermotor).

The drive software only admits one user motor.

To keep the parameter tables of several user motors, the various parameter transferring functions must be used.

See the section "transferring parameter tables" in chapter **1. PREVIOUS KNOWLEDGE** in this manual.

2.

MOTOR IDENTIFICATION
Automatic identification process

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2.5 Final remarks

After any of the identification processes described earlier, the motor reference is stored in RAM memory of the drive and it still has no effect on how it runs. Therefore:

Remember that after the adjustment by any of the previous methods, it is necessary to save the parameter table into Flash memory.

On power - up or after a reset, the system will check that the value given to MP1 (S00141) MotorType (manually or automatically) is correct. In other words, that the motor and the drive are compatible with each other.

The error codes will identify possible incoherence.

This chapter mentions the knowledge needed for the configuration, parameter setting and adjustment of the application that the user must handle.

All these stages of this process will be carried out through Fagor's "WinDDS-Setup" application for PC; although there is a specific chapter for this application, many chapters will refer to its menus, tool bars, icons and windows to make it easier for the user

Later chapters will describe the adjusting procedures for applications with **velocity drive** or **position drive**, once the motor has been identified and initialized.

2.

2.6 Adjustment of the encoder offset

After identifying and initializing the motor, it may make a high-pitch noise due to a certain misadjustment of the feedback signal generation. Although the encoder is factory adjusted, when connected to the drive (CAPMOTOR-X, cable, connector) distorts these signals. To solve this problem, the operator must adjust the offset and the gains used by the drive software to process the signals provided by the feedback device.

2.6.1 Circle adjustment

This procedure may be used to adjust the treatment of the feedback signals so the A and B signals - RV1 (F01506) and RV2 (F01507) - come closer to the $\sin\theta$ and $\cos\theta$ functions. The **gain** and **offset** adjustments compensate the amplitude and offset of the A and B signals with respect to the $\sin\theta$ and $\cos\theta$ functions. The ideal values for the gain and the offset are 1 and 0 respectively.

Adjusting procedure

Follow these steps:

- ❑ Turn the motor at a sinusoidal speed of **6 rev/min** and a period of **6s** (6000 ms) using the internal command generator of the drive. See its meaning in chapter **16. WINDSSSETUP** of this manual.
- ❑ Set the variable RV8 (F01519) to "1". This will start the automatic adjustment.
- ❑ Monitor this variable RV8 (F01519).
- ❑ When RV8 (F01519) recovers its default value (0), the adjustment will be completed.

When the circle adjustment is done, the following values will have changed:

RP1	F01500	Feedback1SineGain
RP2	F01501	Feedback1CosineGain
RP3	F01502	Feedback1SineOffset
RP4	F01503	Feedback1CosineOffset

hence eliminating the noise and improving the control of the motor.

When this process has ended, save into Flash to store these changes permanently.

If the internal command signal generator cannot be used to determine the movement of the axis, it must be done from the CNC at these speeds:

1. For rotary axes

Set an axis movement at a constant speed ($^{\circ}$ / min) given by the formula:

$$V_{\text{feed}} = 3600 * \frac{NP121}{NP122}$$

2. For linear axes

Set a circular movement interpolating this axis with another one at a (mm/min) speed given by the formula:

$$V_{\text{feed}} = 6 \text{ (rpm)} * \frac{NP121}{NP122} * NP123$$

$$\text{Radius} = V_{\text{feed}} * \text{Period}$$

2.

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Adjustment of the encoder offset



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MOTOR IDENTIFICATION
Circle adjustment

Example.

... for NP121 = NP122 = 1
 NP123 = 10 mm/rev.
 ... after replacing values and adjusting units:

$$V_{\text{feed}} = 6 \text{ (rpm)} \cdot \frac{1}{1} \cdot 10 \text{ (mm/rev.)} = 60 \text{ (mm/min)}$$

$$\text{Radius} = 60 \text{ (mm/min)} \cdot 6 \text{ s} \cdot (1\text{min}/60 \text{ s}) = 6 \text{ (mm)}$$

Note. To know the meaning of parameters NP121, NP122 and NP123 see the section "SERCOS Group" in chapter 13 of this manual.

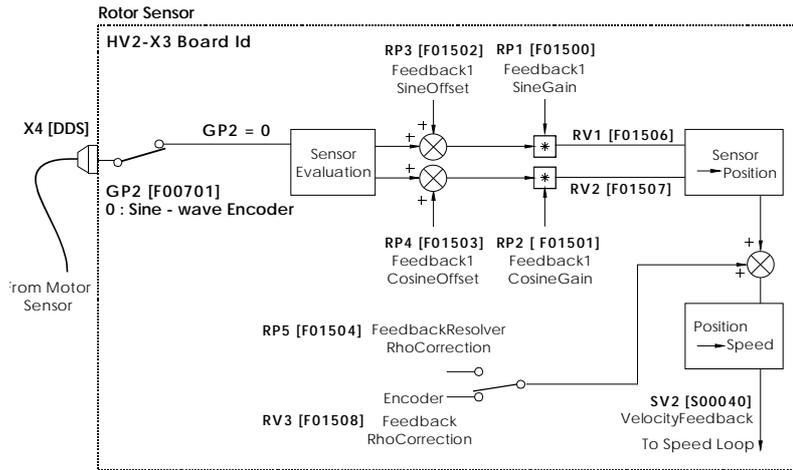


FIGURE S2.13
 Schematics of the variables involved in the encoder offset adjusting procedure.



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A large grid for drawing or writing, with a pencil icon in the top right corner.

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The main function of the current loop is to reach its reference value in the least amount of time and overshooting possible.

For FAGOR motors

The parameters involved in the current loop (CP1,...CP7) **are factory set** for each drive and each FAGOR motor and they all (except CP1 and CP2) need Fagor access to be edited. These parameters take their pertinent values automatically according to the ID set in parameter MP1 (S00141) MotorType.

For user motors

The parameters mentioned earlier may be modified for user ID's. User motor ID's. **User motor** means that it is not supplied by FAGOR and, therefore, the motor ID entered in parameter MP1 must necessarily begin with a "0".

To solve any incompatibility with **user motors**, there is a feature that calculates the current PI according to the motor data and it is good for both synchronous and asynchronous motors.

Calculating the current PI means finding the best values of CP1 (Kp) and CP2 (Ti) depending on the motor model set in MP1.

Activating this feature requires the following conditions:

- ❑ The motor being considered must be a **user motor**, non-FAGOR.
- ❑ **CP8 must be set to 1** and also, parameters MP10 (F01206) MotorStatorResistance and MP11 (F01207) MotorStatorLeakageInductance must necessarily be other than zero

Note that for a synchronous motor, MP11 represents the inductance of the motor stator and not the leak inductance because leak inductance is not applicable to these motors.

Therefore, the procedure is:

1. Set CP8 = 1 to ensure the activation of the PI calculation.
2. Save the parameters using the pertinent icon of the WinDDSSetup or using the GC1 command and do a soft reset using the GV11 command.

The new startup will activate the calculation of the PI and will set CP1 and CP2 with the right values.

3. Save the parameters again, save the obtained CP1 and CP2 values into flash memory and do a soft reset (GV11 command).

The current loop inside the velocity loop makes the system more stable.

Here is a diagram of this loop:

3.

CURRENT CONTROL LOOP

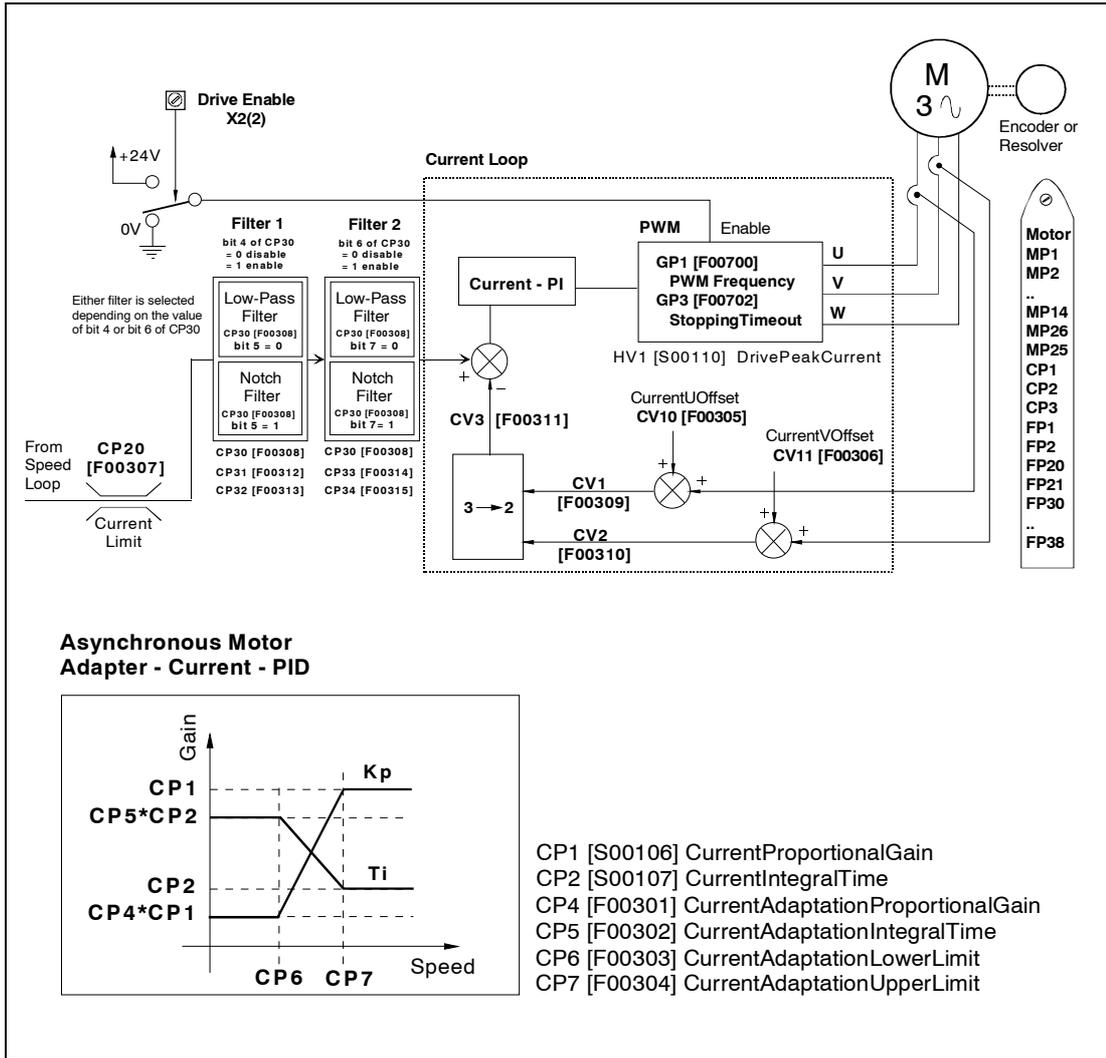


FIGURE S3.1
Current loop diagram.



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3.1 Current limit parameter setting

The current command limit is set by the value of parameter:

CP20.#	O	F00307.#	CurrentLimit
--------	---	----------	--------------

This parameter is default set to an **over-current protection** value both for the motor and for the drive.

For synchronous servomotor systems, the value of CP20 is determined by the lower value of the ones given by the peak current of the drive and the motor.

For asynchronous servomotor systems, the value of CP20 is determined by the maximum current of the drive.

Note: This parameter CP20 can only be modified at an OEM access level or greater.

3.

CURRENT CONTROL LOOP
Current limit parameter setting

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3.2 Current command filters

In order to improve the dynamic behavior of the servo drive system and eliminate noise, two filters have been included in series with the purpose of filtering the current command (torque command) .

These filters may be set as:

- Low - passing filter.
- Bandstop (notch) filter.

The next section describes these filters in detail and the terminology appearing when analyzing the frequency response of the servo drives so the user becomes acquainted with these types of filters. Later on, it will also describe how to set their parameters.

3.2.1 Low-passing filter

The diagram of **FIGURE S3.2** shows the curves representing the frequency response of a 2nd order system in a Bode diagram for different damping factors ξ and a gain $k = 1$ in the passing zone (condition absolutely necessary in machine - tool related servo drive systems).

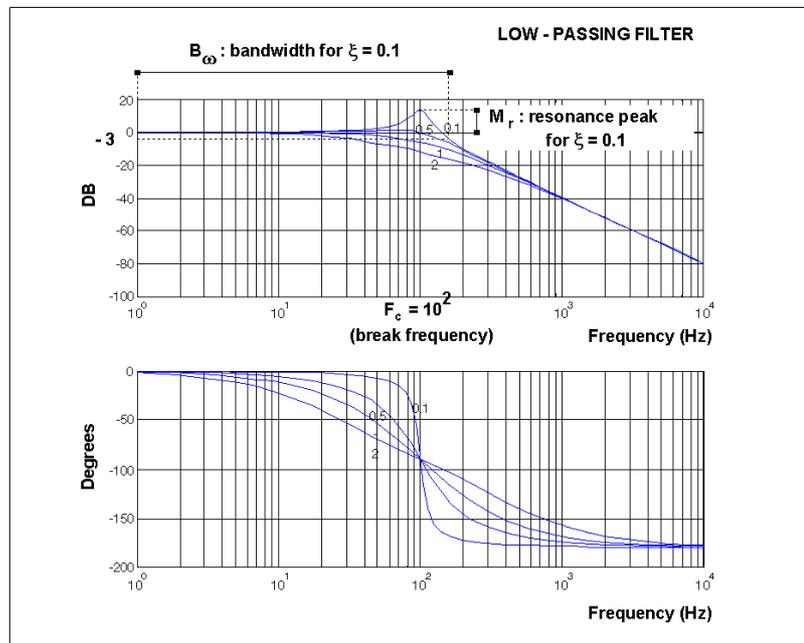


FIGURE S3.2

Low-passing filter. Bode diagram with a cutoff frequency $F_c=100$ Hz and different values of the damping factor ξ .

In this diagram, the dynamic behavior of the servo drives may be measured in terms of the following elements:

- **Resonance peak M_r** , defined as the maximum value of the system's response amplitude. It only depends on the damping factor ξ . The lower ξ is, the higher it is.
- **Bandwidth B_{ω}** , defined as the frequency range where the amplitude of the transfer function drops -3 dB. It depends on the damping factor ξ and it gets smaller as this increases. Once ξ has been set by the resonance peak, the bandwidth depends on the natural frequency ω_n and it increases with it.

In the time response, the bandwidth offers a measurement of the system's response speed so a wide bandwidth makes the system respond quicker. In other words, it increases its capability to follow rapid command signal changes.

On a machine tool, the capability of making changes at high speed on the machining path (comers, circles,...) is directly related with the servo drive's bandwidth.



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- **Break frequency F_c** , defined as the value of the frequency where the value of the response with respect to the input has a damping of -3 dB (the output is 0.717 of the input value). From this frequency value on, the signals are considered to be filtered.

For frequencies below this break frequency F_c the curve may be approximated to an asymptote with a straight ordinate $20 \cdot \log k$ (dB). Since a gain of $k=1$ has been considered, the graph will coincide with the ordinate axis. See **FIGURE S3.2**.

For frequencies above it, the curve may be approximated with a straight line whose slope is -40 dB/decade. Near F_c the shape of the curve depends greatly on the damping factor.

3.

CURRENT CONTROL LOOP
Notch filter

3.2.2 Notch filter

This type of filter eliminates or damps a certain interval of frequencies between two specific limits. This filter is also referred to as band eliminating filter.

The requirements for a notch filter are:

- A break frequency where the gain is minimum of almost zero.
- A frequency width near the break frequency where the gain is lower than -3 dB.

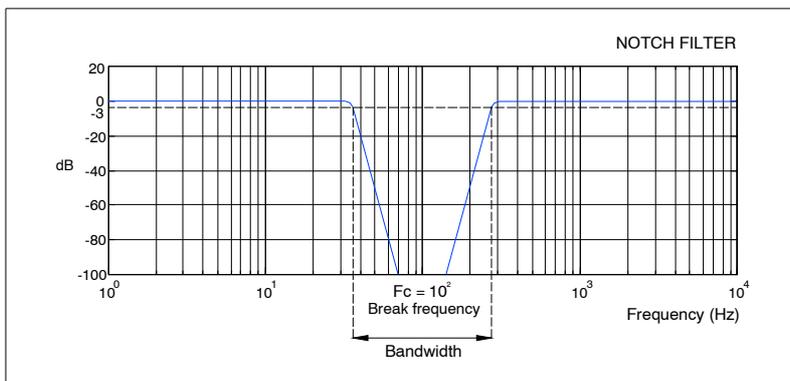


FIGURE S3.3

Notch filter. Bode diagram for a cutoff frequency of 100 Hz.

3.2.3 Filter parameter setting

The parameters to be set for the current command filters are:

CP30	F00308	CurrentCommandFiltersType
CP31	F00312	CurrentCommandFilter1Frequency
CP32	F00313	CurrentCommandFilter1Damping
CP33	F00314	CurrentCommandFilter2Frequency
CP34	F00315	CurrentCommandFilter2Damping

Note: These parameters may be edited at the OEM access level or higher and they have an immediate effect (on-line).



Note. All these filters may be applied on servo drive systems with synchronous machines and with asynchronous machines except when having software versions 06.15 or higher where CP33 and CP34 cannot be applied with asynchronous motors.



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Setting CP30

This parameter may be used to enable / disable current command filters 1 and 2 as well as to select the type of filter (low-passing or notch) for each one of them. Observe that each filter may be set as low passing filter or as notch filter.

TABLE S3.1 Parameter CP30. Selecting the filter selection and the type of filter for the current command.

Parameter.bit	Function
CP30.bit 4	Enable / disable filter 1
	= 0, Filter 1 disabled. CP31 & CP32 not operational.
	= 1, Filter 1 enabled. CP31 & CP32 operational.
CP30.bit 5	Select type for filter 1
	= 0, Filter 1 type: low passing
	= 1, Filter 1 type: notch
CP30.bit 6	Enable / disable filter 2
	= 0, Filter 2 disabled. CP33 & CP34 not operational.
	= 1, Filter 2 enabled. CP33 & CP34 operational.
CP30.bit 7	Select type for filter 2
	= 0, Filter 2 type: low passing
	= 1, Filter 2 type: notch

Remember that the least significant bit is bit 0 (first bit from right to left in the string of bits).

Hence, all the possible values for parameter CP30 are:

TABLE S3.2 Possible parameter combinations for both filters.

CP30	Filter 1	Filter 2
0	Disabled	Disabled
16	Low-passing	Disabled
48	Notch	Disabled
64	Disabled	Low-passing
192	Disabled	Notch
80	Low-passing	Low-passing
112	Notch	Low-passing

Setting CP31

This parameter may be used to set the cutoff frequency of filter 1 of the current command. It will be **operational** only when bit 4 of parameter CP30 is set to "1" and it is **enabled** (i.e. CP31 other than "0")

Setting CP32

This parameter has two functions depending on the filter type selected. It will only be operational when bit 4 of parameter CP30 is set to "1".

- If the selected filter type is **low-passing** (bit 5 of CP30 is 0) it reflects the filter's damping factor ξ .
- If the selected filter type is **notch** (bit 5 of CP30 is 1) it reflects the bandwidth $B\omega$ or width of the filter's cutoff frequency.

Setting CP33

This parameter may be used to set the cutoff frequency of filter 2 of the current command. It will be **operational** only when bit 6 of parameter CP30 is set to "1" and it is **enabled** (i.e. CP33 other than "0")



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Setting CP34

This parameter has two functions depending on the filter type selected. It will only be operational when bit 6 of parameter CP30 is set to "1".

- If the selected filter type is **low-passing** (bit 7 of CP30 is 0) it reflects the filter's damping factor ξ .
- If the selected filter type is **notch** (bit 7 of CP30 is 1) it reflects the bandwidth $B\omega$ or width of the filter's cutoff frequency.

Note. See chapter 13 in this manual for further information on these parameters.

3.

CURRENT CONTROL LOOP
Filter parameter setting

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3.

CURRENT CONTROL LOOP



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THE VELOCITY DRIVE

4

This chapter describes the setup procedure for the DDS drive when working as a velocity drive.

Chapter 5 describes the necessary steps for setting up an application where the drive is configured to work with position control.

4.1 Velocity control loop

The velocity loop of the drive is shown in the following general diagrams that will be described next using their block diagrams as well as its command management.

4.1.1 Block diagram

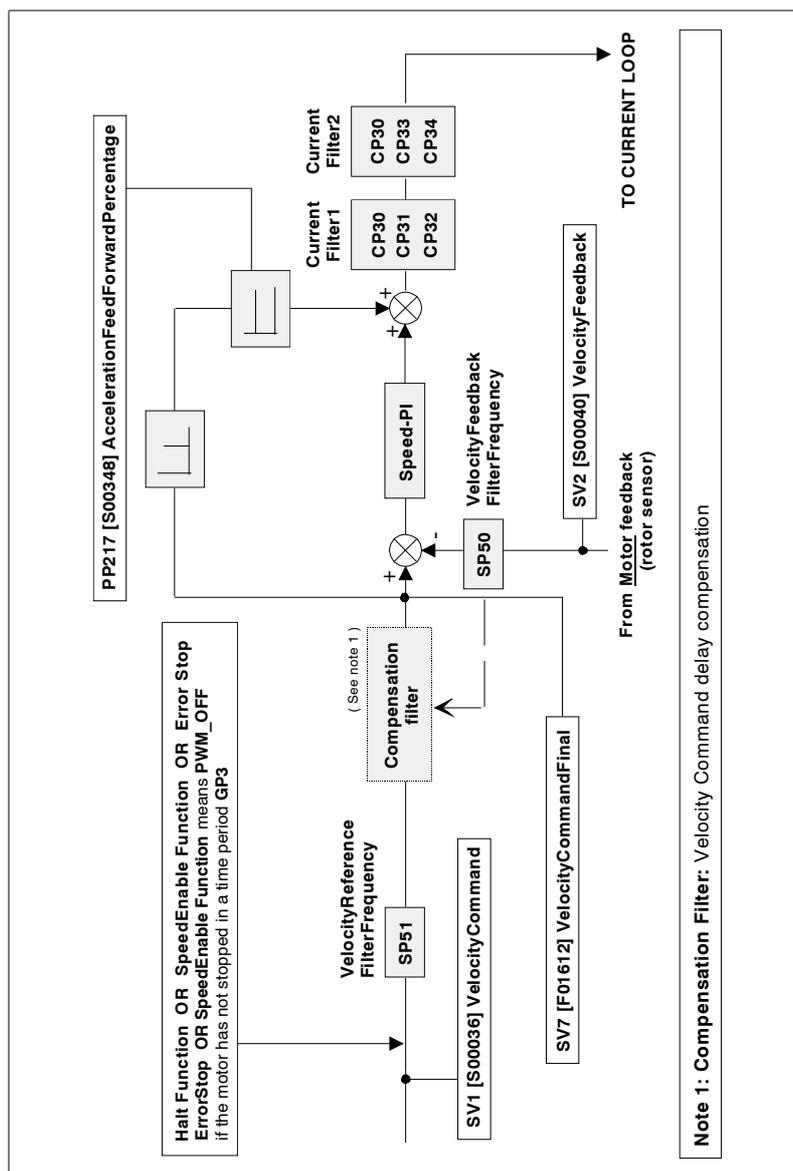


FIGURE S4.1
 Block diagram of the velocity loop.



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4.1.2 Command management diagram

4.

THE VELOCITY DRIVE

Command management diagram

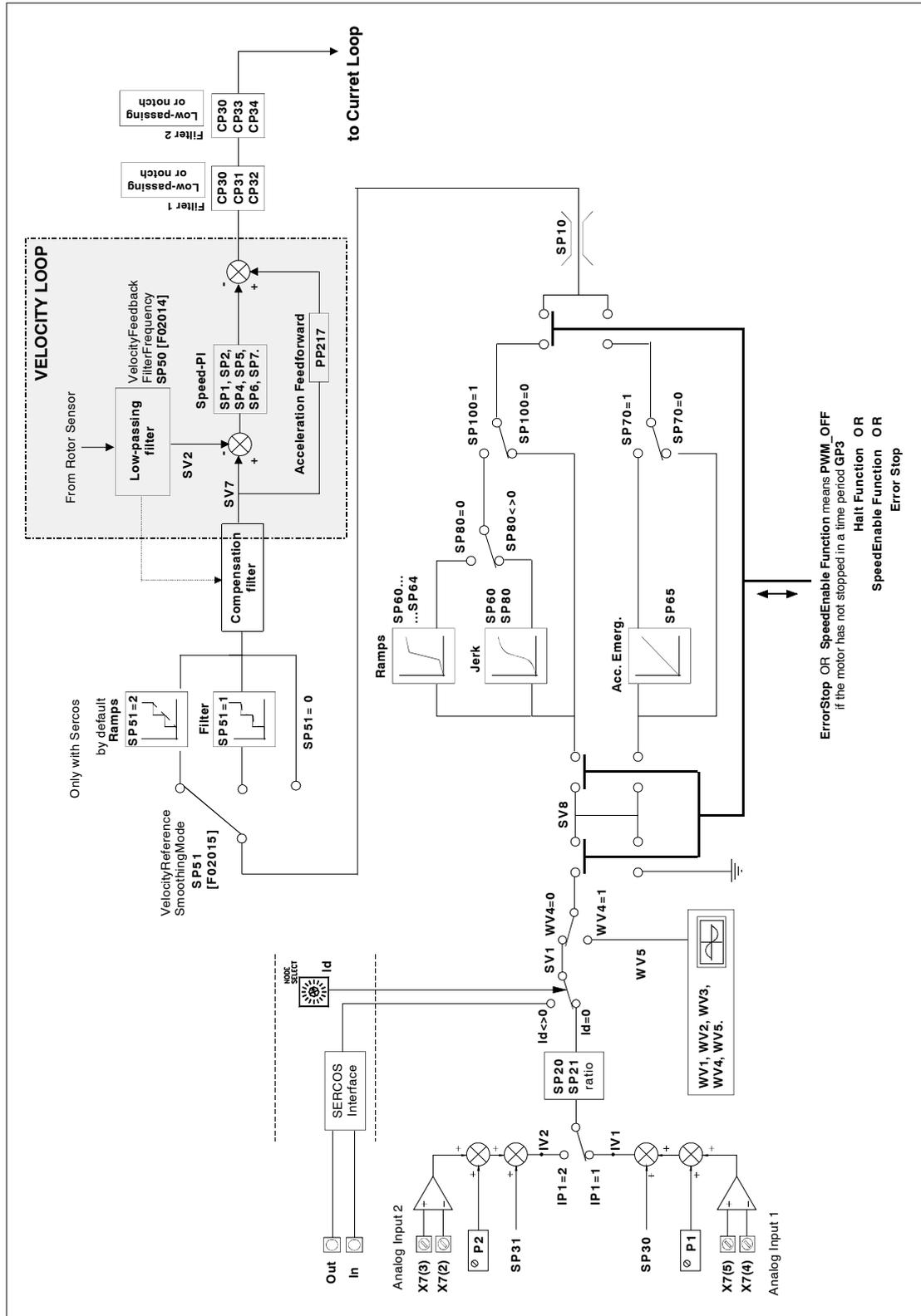


FIGURE S4.2

Diagram for command management diagram in the velocity loop.



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4.2 Parameter setting for velocity control loop

4.2.1 Adjustment of the offset of the analog signal

Power the drive on. After turning the drive on, the next step is to eliminate the possible offset of the analog command.

This section does not apply when using SERCOS interface.

To do this:

- Send 0 volts command to the drive.
- Monitor the velocity of the motor from the CNC or through a <watch> of the "SV2 (S00040)" variable.
- Assign values to the offset parameter "SP30 (F01603)" with the opposite sign to that of "SV2 (S00040)" until the motor stops completely.

Note that this method only eliminates the offset of the drive. The CNC might have another offset that must also be adjusted.

Proceed as follows to adjust the offset for the whole control loop:

- Set the CNC in DRO mode keeping the **Drive Enable** and **Speed Enable** signals active.
- Give values to SP30 (F01603) until the motor stops.

The following is a similar procedure:

- With the CNC, set a position for the axis.
- Adjust SP30 (F01603) until the following error is symmetrical (the same value in both directions).

After determining the correct value for SP30 (F01603), it is necessary to save it permanently into Flash memory.

Apart from this adjustment mechanism, there is a potentiometer P1 - see **FIGURE S4.3** - designed so the user can correct the slight drifts suffered by electrical components in time.

Do the same for analog input 2 with SP31 (F01604) and potentiometer P2 - see **FIGURE S4.3** -

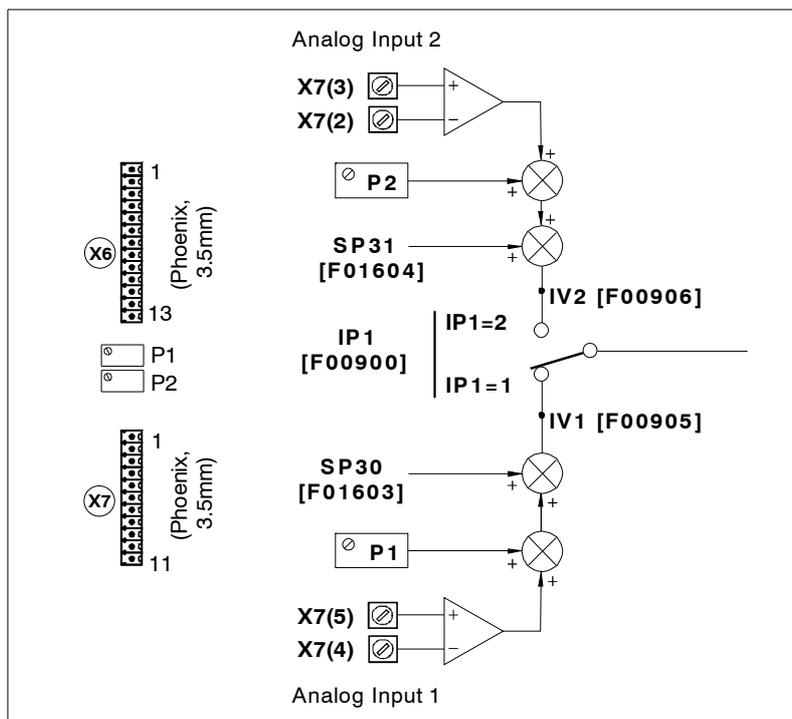


FIGURE S4.3
Adjustment of the offset of the analog signal 1/2.

4.

THE VELOCITY DRIVE

Parameter setting for velocity control loop



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Ref.1109

4.2.2 Command voltage / speed ratio

On equipment having an analog interface and using an 8055/8055i CNC on spindle drives with SERCOS interface, one must indicate the relationship between the analog voltage and the velocity command.

Note that the voltage/speed ratio is not to be set when using an 8070 CNC.

The parameters involved in setting the voltage/velocity ratio are:

SP20	F00031	VoltageRpmVolt
SP21	F00081	RpmRpmVolt
SP10	S00091	VelocityLimit

The first two parameters set the volts/velocity ratio of the command.

SP21 is allocated the maximum speed to be supplied by the motor in our application and SP20 is allocated the analog voltage to be applied for that maximum speed.

Note that the hardware limits SP20 to 10.000 mV (10 V).

Example.

If the application requires a speed of 4000 rev/min when applying an analog voltage of 9.5 V, and the motor has a maximum speed of 4000 rev/min, the values for these parameters could be:

SP20 = 9500 mV
SP21 = 4000 rev/min
SP10 = 4200 rev/min

The values of parameters SP21 and SP10 should not be too close to each other so the external command can momentarily request a higher value than SP21.

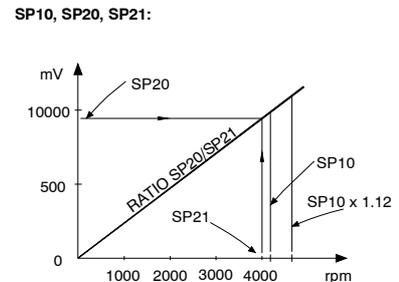


FIGURE S4.4

SP20/SP21 ratio.

Modifying these parameter has no on-line effect.

They are saved in the drive's RAM memory and they must be validated so they can be effective. Then, they must be saved into the Flash memory in order to keep these values permanently.

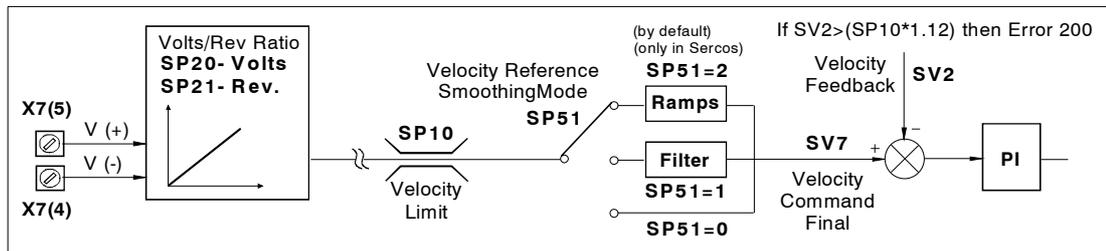


FIGURE S4.5

Parameters SP10, SP20 and SP21.

4.2.3 Parameter setting with encoder simulator

The drive can generate a simulated incremental encoder output with differential TTL signal from the signal of the motor feedback.

They are square signals A and B, their inverted signals /A and /B and the reference marks I0 and /I0.

Remember that the encoder simulator board is optional.

Hence the encoder simulator may be programmed with these parameters:

EP1	F00500	EncoderSimulatorPulsesPerTurn
EP2	F00501	EncoderSimulatorI0Position
EP3	F00502	EncoderSimulatorDirection

Number of pulses

The number of pulses must be programmed before starting up the motor using parameter EP1 (F00500).

Remember that with square wave motor feedback, this parameter must be equal to the resolution of the feedback device (EP1= NP116). Otherwise, it will activate error **E502**.

Reference point (I0)

The I0 point is the feedback reference point. Two methods may be used to set it:

1. Orient the rotor shaft to the desired home (I0) position. Then, execute the command EC1 (F00503).
2. Shift the reference point with parameter EP2 (F00501).

Example.

If EP1=1250 pulses per turn and the current marker point is to be shifted 58°, parameter EP2 must then have a value of $1250 \times (58/360)$, approximately 200.

The range of values of this parameter varies from 1 to that assigned to parameter EP1. It is recommended to initialize it to 1.

Note that marker position is assigned a value greater than the number of pulses per turn set in parameter EP1, it will generate error **E500**.

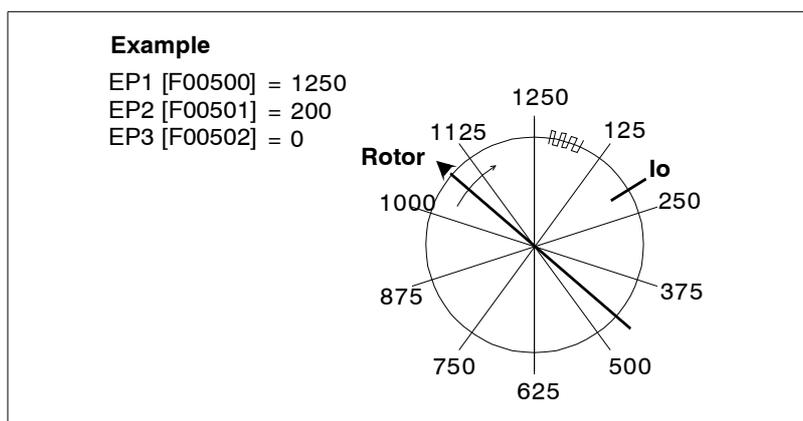


FIGURE S4.6
I0 setting example.

Feedback direction

To set a clockwise turning direction - see **FIGURE S4.7** -, the encoder simulator will generate the A signal 90° ahead of the B signal if parameter EP3=0. If EP3=1, the encoder simulator will generate the B signal ahead of the A signal for this clockwise turning direction of the motor.

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THE VELOCITY DRIVE
Parameter setting with encoder simulator



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4.

THE VELOCITY DRIVE
 Parameter setting with encoder simulator

Note that a counterclockwise direction at the rotor inverts the order of the A and B signals of the encoder simulator.

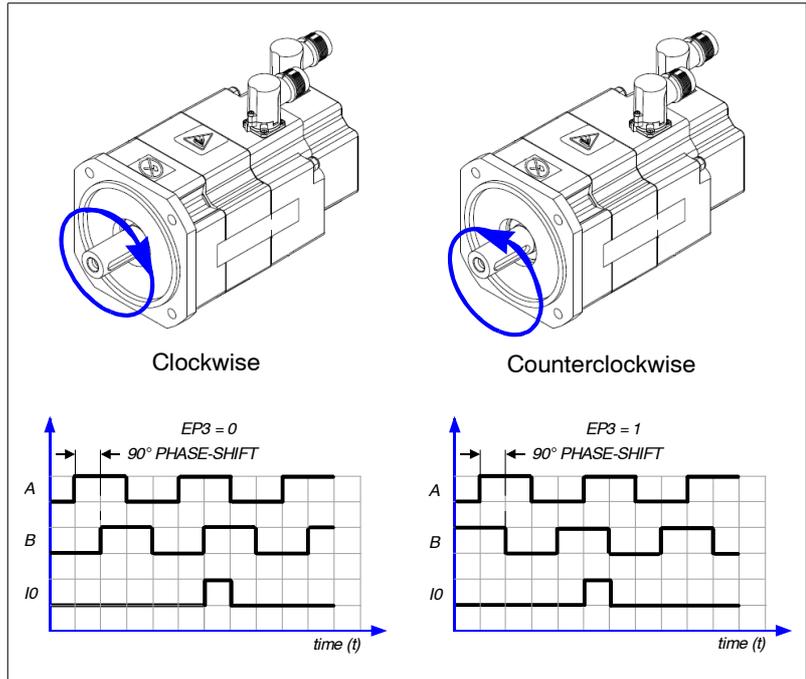


FIGURE S4.7
Feedback direction.

Pinout of the encoder simulator board connector

Drive connector X3 is the one providing the signals generated by the encoder simulator.

See the dds-hardware manual for further detail on this connector.

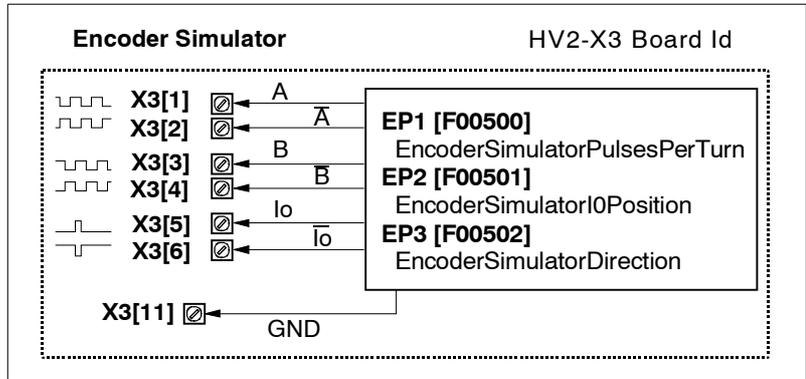


FIGURE S4.8
Pinout of connector X3 of the encoder simulator board.



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4.2.4 Parameter setting for the analog outputs

The DDS module has two analog outputs at connector X7 between pins 10/11 (channel 1) and pins 8/9 (channel 2) which can be programmed for making any internal variable of the drive accessible from the outside.

Anyway, the most common ones are:

SV1	S00036	VelocityCommand
SV2	F00040	VelocityFeedback
SV7	F01612	VelocityCommandFinal
CV3	F00311	CurrentFeedback
TV1	S00080	TorqueCommand
TV2	S00084	TorqueFeedback
TV3	F01701	PowerFeedbackPercentage

The variables **are selected** with the following parameters:

OP1	F01400	DA1IDN
OP2	F01401	DA2IDN

The values of the selected variables that correspond to the 10 V DC in the analog output voltage **are set** with the following parameters:

OP3	F01402	DA1ValuePer10Volt
OP4	F01403	DA2ValuePer10Volt

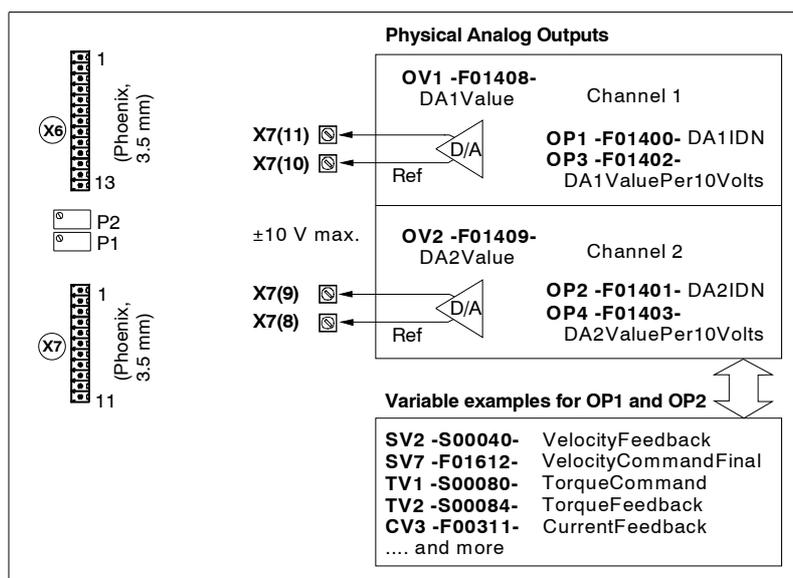


FIGURE S4.9

Analog outputs.

Note that modifying these parameter has an on-line effect.

To permanently keep the values of the parameters just modified, they must be saved into flash memory. Otherwise, when powering up again, they will have the last value saved in flash.

Example.

Proceed as follows to display the instantaneous torque and speed signals:

OP1 = SV2	Actual speed, channel 1, pins 10/11 of connector X7
OP2 = TV2	Actual torque, channel 2, pins 8/9 of connector X7
OP3 = 1000	1000 rpm /10 V - read note -
OP4 = 600	600 dNm / 10 V

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THE VELOCITY DRIVE
Parameter setting for the analog outputs



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4.

THE VELOCITY DRIVE
 Parameter setting for the analog outputs

Important note. With version 06.15 or higher, when programming OP1=SV2 as in the example, OP3 will be set in internal units, i.e. the value that was entered in previous versions (1000) multiplied by $\times 10^4$, therefore 1×10^7 . This is because from version 06.15 on, **SV1 and SV2** are 32-bit variables. The treatment will be the same when considering the SV1 variable.

FIGURE S4.10 shows the oscillograph obtained with a conventional oscilloscope and its interpretation according to the selected gains.

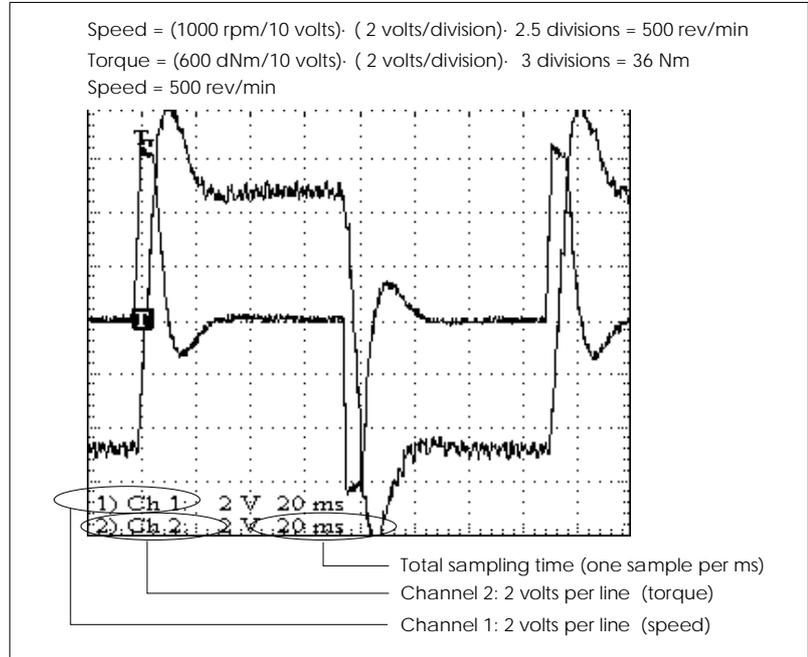


FIGURE S4.10

Oscillograph obtained with a conventional oscilloscope



Warning. Always evaluate parameters OP3 and OP4 with values that the chosen internal variables will never reach so that the output never exceeds the ± 10 V range !

Example.

If the speed is not expected to ever exceed 2500 rpm, the gain may be set to 2500 rpm/10 V or higher.

Note that evaluating parameters OP3 and OP4 with very small values causes the electrical signal to saturate when reaching ± 10 V.

Fagor Automation has a pc application called WinDDSSetup that includes an oscilloscope.

Although this application has its own chapter that describes all its possibilities in full detail, this point refers to it to let the user know that the adjustment described earlier may be carried out much more easily and efficiently using the oscilloscope of the WinDDSSetup.



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Hence, the previous oscillograph obtained with the oscilloscope included in the WinDDSSetup looks like this:

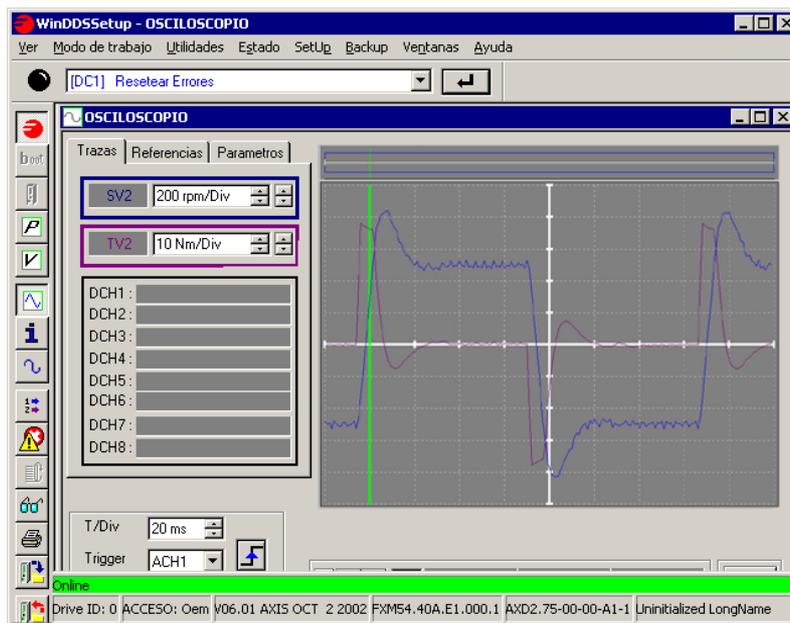


FIGURE S4.11

Oscillograph obtained with the oscilloscope of the WinDDSSetup.

The two channels show the values per division of the instantaneous speed SV2 and the torque TV2.

Calculating the values, we observe that:

$\text{Speed} = (200 \text{ rpm/division}) \cdot 2.5 \text{ divisions} = 500 \text{ rev/min}$ $\text{Torque} = (10 \text{ Nm/division}) \cdot 3.6 \text{ divisions} = 36 \text{ Nm}$

4.2.5 Adjustment of the velocity loop

When adjusting the velocity loop, it will be necessary to:

- Use the internal velocity command generator of the drive itself
- Adjust the PI of the velocity loop
- Filter the velocity command by limiting the acceleration and/or choke and the velocity reference filter with parameter SP51.
- Adjust the speed feedback filter if necessary using parameter SP50.

The following sections describe these steps in further detail.

Velocity command generator

The command generator may be used to generate commands internally. When activated, the drive ignores the velocity command coming from the outside.

It is useful to move the system with known commands and observe its behavior.

The following signal waveforms may be generated and the following parameters may be programmed:

Signal waveforms	Elements that may be
Square	The period
Sinusoidal	The offset
Triangular	The number of waves
Continuous	The duty cycle

The square wave is typically used in order to analyze the system's behavior towards a sudden step (shoulder).

4.

THE VELOCITY DRIVE
Adjustment of the velocity loop



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4.

THE VELOCITY DRIVE
Adjustment of the velocity loop



Example.

For example, we want to display a graph on the oscilloscope of the WinDDS-Setup showing the value of the signal generated by the internal generator as velocity command and the value of the actual (real) velocity. It is crucial to define the velocity command generated by the internal generator as the velocity, hence setting parameter AP1=2. From the WinDDSSetup application:

COMMAND GENERATOR

Being WinDDSSetup open, internal velocity commands may be generated by activating this icon of the icon bar that appears in its window. They can only be activated at OEM or FAGOR access levels, not at the basic level. Activating this button displays on the screen the following window with its corresponding dialog boxes.



FIGURE S4.12

Windows of the velocity command generator.

The range for each field are:

Amplitude	-32768, 32767
The period	1, 32764
The offset	-32768, 32767
The number of waves	0, 65535
The duty cycle	1, 99

Use the button at the bottom of the window to turn the velocity command generator on or off.



Activating the velocity command generator.



Deactivating the velocity command generator.



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Ref.1109

Hence, for a square wave, whose velocity command amplitude is 500 rpm and its period is 152 ms. The following graph is obtained by programming the channels so as to observe variables WV5 and SV2 (oscilloscope):

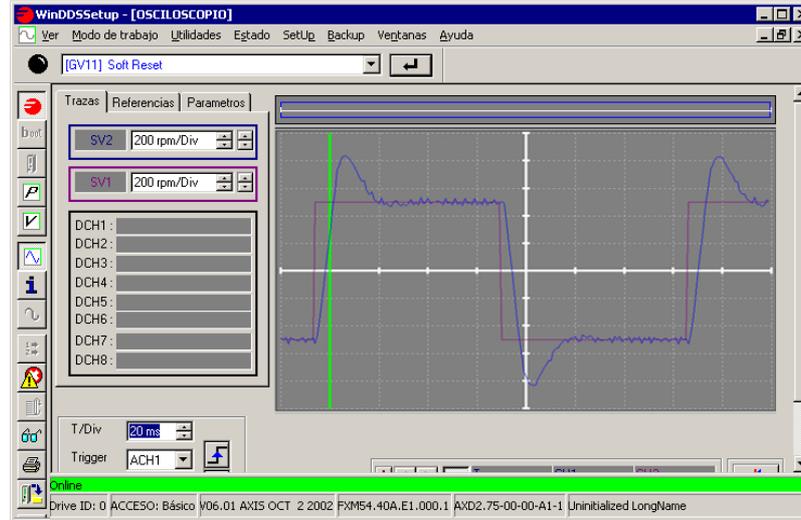


FIGURE S4.13

Oscillograph obtained according to the specified data.

The motor will move trying to follow the command just programmed.

4.
THE VELOCITY DRIVE
Adjustment of the velocity loop

Speed PI adjustment

The velocity loop basically consists of a proportional-integral (PI) controller shown in the **FIGURE S4.14**. Its operation is determined by means of the constants K_p and T_i associated with parameters SP1 and SP2 respectively.

Its diagram is:

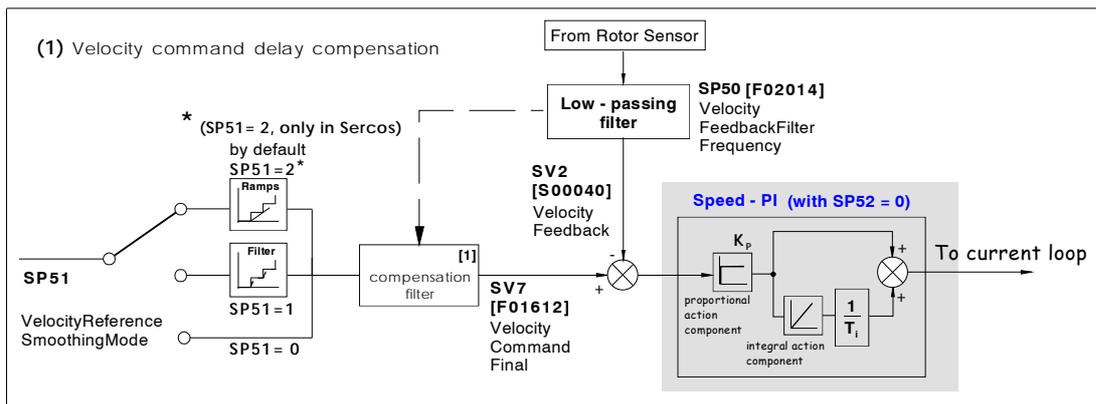


FIGURE S4.14

Structure of the velocity loop with SP52=0.



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4.
THE VELOCITY DRIVE
Adjustment of the velocity loop

For better system performance, Kp and Ti may be assigned different values depending on the speed of the motor.

Usually, a greater proportional and integral factor is preferred when the motor turns slowly; in other words, high Kp and low Ti as shown in **FIGURE S4.15**.

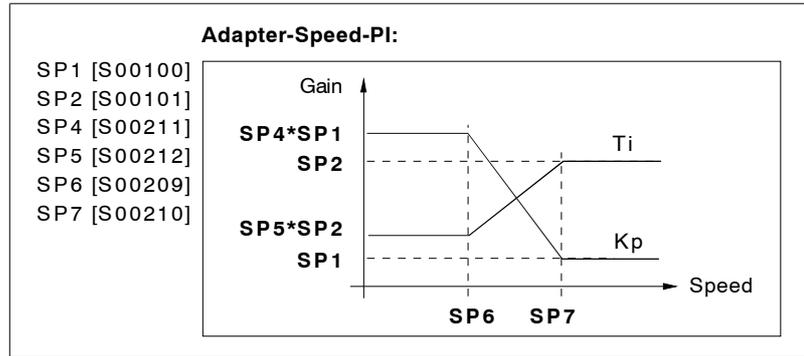


FIGURE S4.15

Kp and Ti values depending on speed.

The velocity loop may be adjusted by using an internal command - see the previous section - or by using directly the command of the external controlling device.

It is common to generate a square signal which serves as an internal velocity command and observe the actual speed and the command itself through the analog outputs.

To make the system adjust its performance to a particular external command, it must be applied between pins 4/5 of connector X7 or between 2/3 of X7 through the auxiliary input.

There are the following parameters for this adjustments:

SP1	S00100	Value of the proportional action (Kp) of the velocity PI.
SP2	S00101	Value of the integral action (Ti) of the velocity PI. A lower Ti value increases the integral effect of the PI.
SP4	S00211	Adapting the value of the proportional action at low speed.
SP5	S00212	Adapting the value of the integral action at low speed.
SP6	S00209	Adaptation limit of the velocity loop at low speed.
SP7	S00210	Adaptation limit of the velocity loop at high speed. Upper velocity at which the PI toggles from being constant to being variable and vice versa.

Example.

If:

SP4=1500	150 %
SP1 = 30	0.030 Arms/rpm.

The value of the proportional gain Kp at low speed will be 150 % of SP1, i.e. 0.045 Arms/rpm.

To properly adjust it, the effect of the velocity command filters prior to the PI must be taken into account. These filters are described in the next section.

Depending on the system's response and the type of application, the user must change the PI parameters.

The modifications to parameters SP1, SP2, SP4 and SP5 are immediately effective.

Once the desired performance is obtained, the values assigned to the parameters must be saved into the drive's flash memory so they are stored permanently.

The operation of the PI is now determined with three constants, Kp given by parameter SP1 (S00100) VelocityProportionalGain, Ti given by parameter SP2 (S00101) VelocityIntegralTime and the time constant T1 of the P-T1 el-



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ement given by parameter SP52 (F02017) VelocityLoopTimeConstant. For further detail, see chapter **FIGURE S4.16** and chapter 13. **PARAMETERS, VARIABLES AND COMMANDS** in this manual.

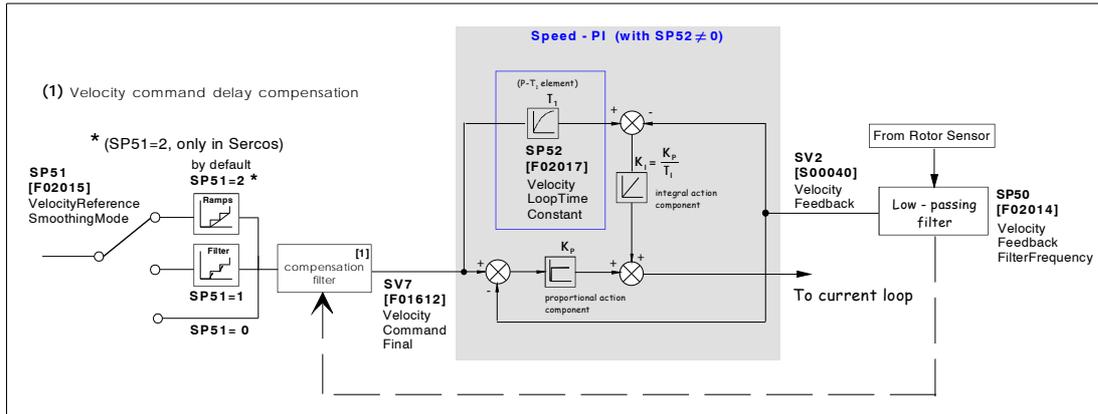


FIGURE S4.16

PI of the velocity loop with delay element P-T1. Structure of the velocity loop with SP52 other than 0.

Warning. With SP52=0, the velocity loop will be the same as that of software versions older than 06.08

4.3 Velocity command filters

The velocity command may be filtered in two different ways in order to improve the dynamic performance of the motor (smoother). Using:

- **Ramp generation:** Converting the command in velocity ramps and limiting the acceleration.
- **Jerk limit:** Limiting the acceleration and the jerk of the velocity command.

Both velocity command filters may be permanently eliminated by setting parameter:

SP100 = 0	F01611	AccelerationLimitOn
------------------	--------	---------------------

In a stop situation, the braking deceleration can be limited to a safe value. This limit, is known as emergency-acceleration limit. See the definition of **stop** in the "Notes" section of chapter 13 of this manual.

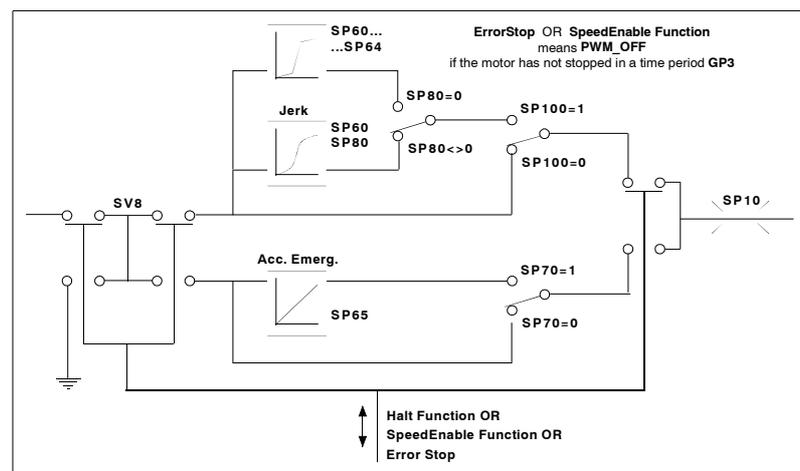


FIGURE S4.17

Velocity command filters.

4.
THE VELOCITY DRIVE
Velocity command filters



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4.3.1 Emergency acceleration limit

To filter the velocity command in an emergency stop, use parameter:

SP70 = 1	F01610	AccelerationOnEmergency
-----------------	--------	-------------------------

4.
THE VELOCITY DRIVE
Emergency acceleration limit

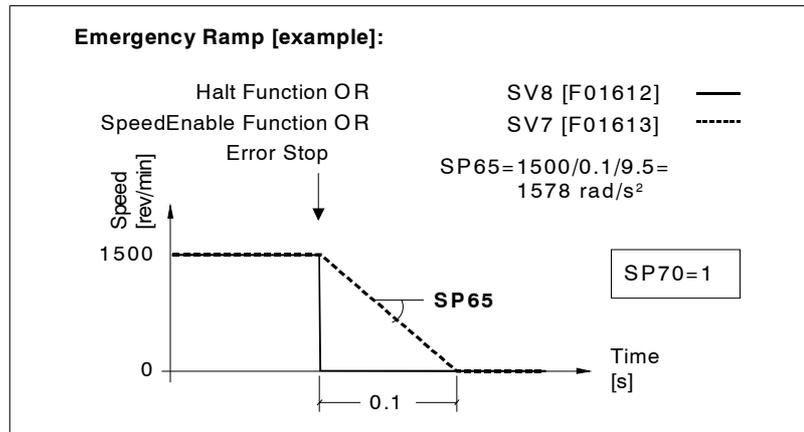


FIGURE S4.18

Emergency acceleration limit.

See the definition of **stop** in the "Notes" section of chapter 13 of this manual.

4.3.2 Monitoring of the ramp during an emergency stop

Available from drive software version 06.20 on.

Control of the system's dynamic behavior (regarding the braking ramp) in an emergency situation using the monitoring of the limits set in parameters:

SP71	F01618	VelFollowMargin
SP72	F01619	VelTimeMargin

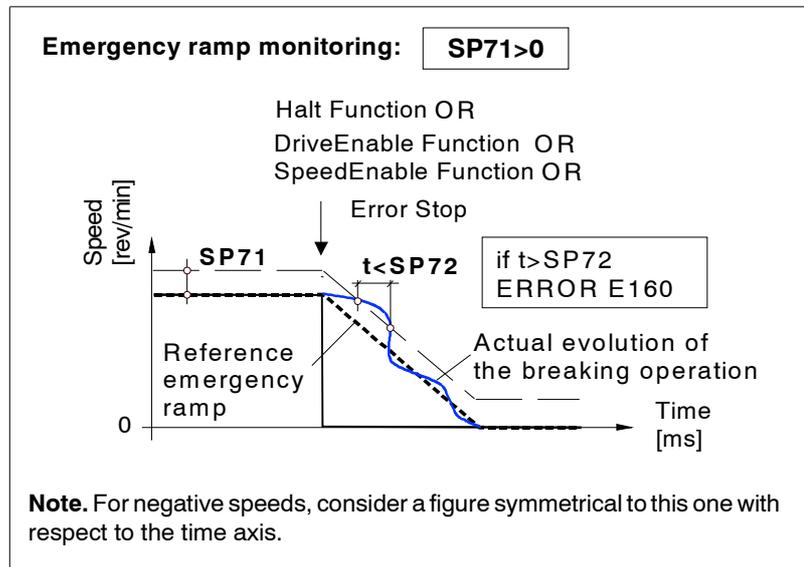


FIGURE S4.19

Monitoring of the actual evolution of the system in an emergency stop.

Observe that SP71=0 disables the ramp monitoring feature in emergency stop and the error code **E160**.

For further detail on parameters **SP71** and **SP72** and error code **E160**, see chapters 13 and 14 respectively in this manual.



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4.3.3 Ramp generation

Use these parameters to activate this velocity command filter mode:

SP80 = 0	F00349	JerkLimit
SP100 = 1	F01611	AccelerationLimitOn

The action of this ramp generating filter is divided into three velocity ranges. In each range, the acceleration may be limited to a different value.

From 0 rpm to SP61, acceleration limited to SP60.
 From SP61 to SP63, acceleration limited to SP62.
 And from SP63, on acceleration limited to SP64..

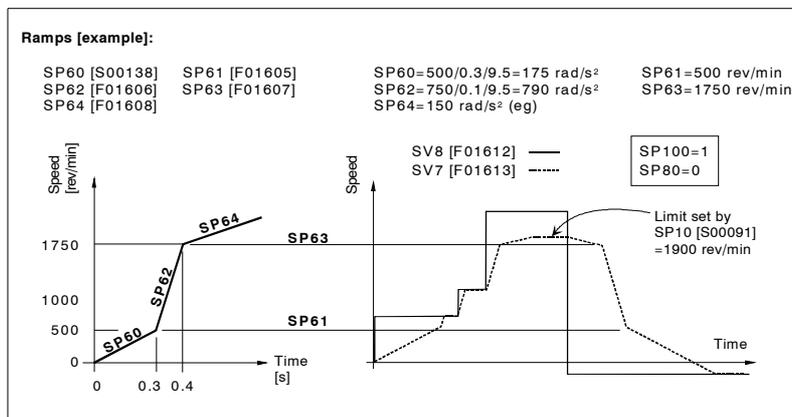


FIGURE S4.20
Ramp generation.

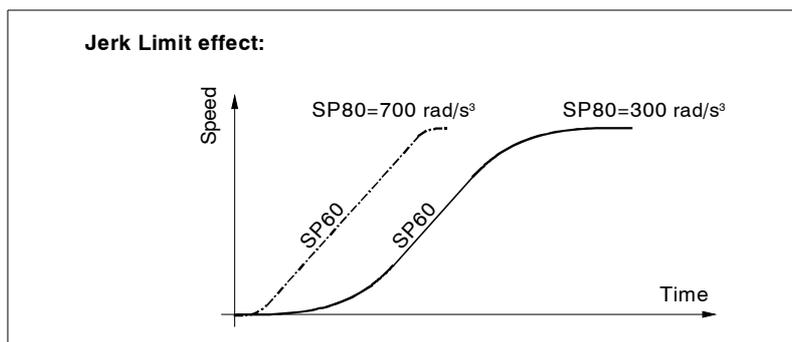
4.3.4 Jerk limit

Use these parameters to activate this velocity command filter mode:

SP80 ≠ 0	F00349	JerkLimit
SP100 = 1	F01611	AccelerationLimitOn

The jerk is a physical magnitude representing the variation of acceleration in time.

SP80	S00349	It sets the jerk limit. The smaller the value of this parameter is, the more smoothly the motor will run.
SP60	S00138	It sets the maximum acceleration in this operating mode.



4.

THE VELOCITY DRIVE
Ramp generation



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THE VELOCITY DRIVE
Velocity reference filter

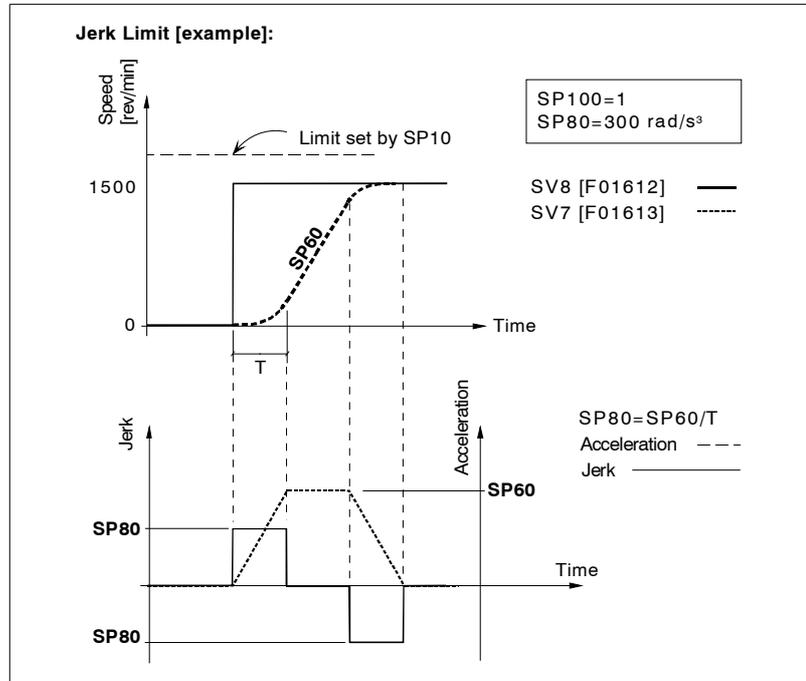


FIGURE S4.21

Jerk limit.

4.3.5 Velocity reference filter

Use these parameters to activate this velocity command filter mode:

SP51	F02015	VelocityReferenceSmoothingMode
-------------	--------	--------------------------------

Using this parameter and with the drive working in velocity mode (e.g. with the 8055 CNC) damps the velocity command generating intermediate commands between the ones sent out by the CNC.

This velocity command damping may be carried out by:

- a first order filter in the velocity command (SP51=1).
- velocity ramps (SP51=2).

It is an on-line parameter and it is on by default (SP51=2).

SP51 can only be set to "2" when using SERCOS communication interface, not analog.

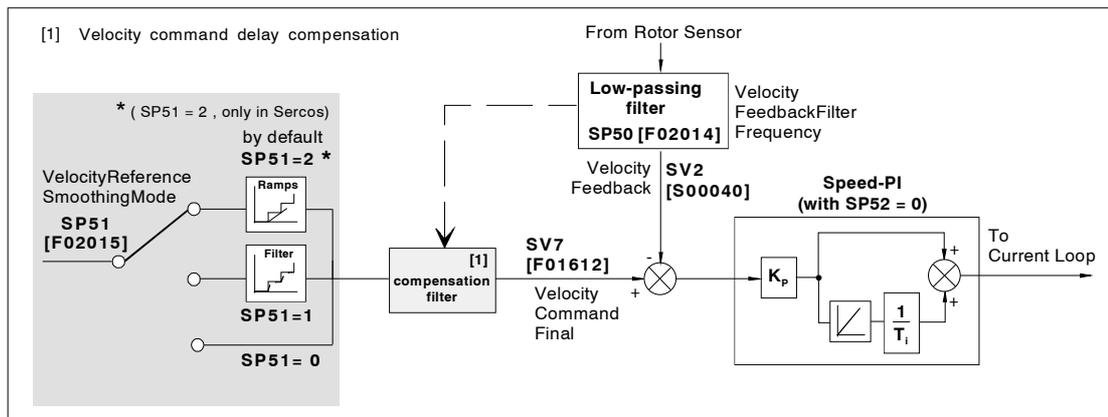


FIGURE S4.22

Location of the velocity reference filter and ramps. Parameter SP51.

Important. If parameter SP80=0 and SP100=1, then set SP51=2 will have no effect.



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4.4 Velocity feedback filter

It is possible to reduce the current noise at the motor and sometimes eliminate resonance hence improving its dynamic performance by filtering (flattening) the actual velocity coming from the velocity feedback.

It is a first order low-passing filter that may be set with parameter:

SP50	F02014	VelocityFeedbackFilterFrequency
-------------	--------	---------------------------------

The value of the velocity feedback, already filtered, may be displayed in the variable SV2 (S00040) VelocityFeedback.

It is an on-line parameter and it is off by default (SP50=0).

It admits values between 1 and 4000 Hz.

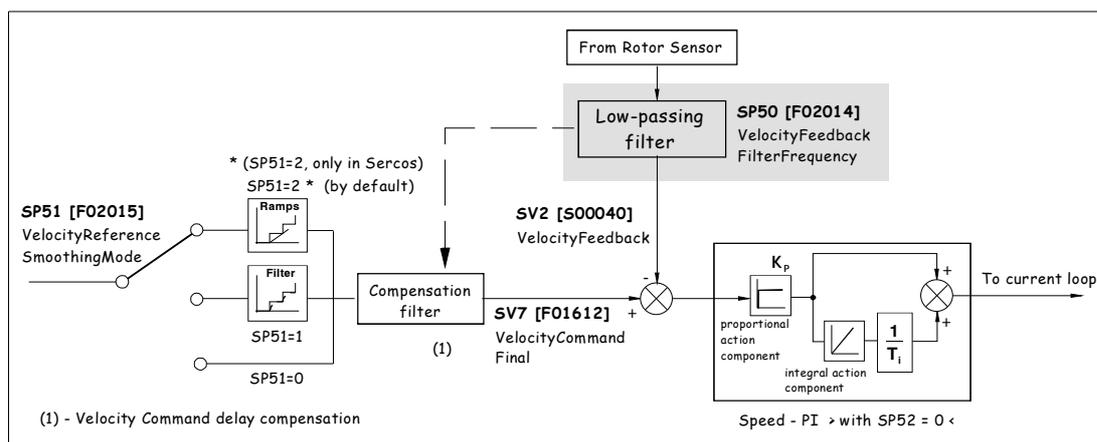


FIGURE S4.23

Location of the velocity feedback filter. Parameter SP50.

Remember that when entering low breaking frequencies, the velocity loop becomes easily unstable. In this situation, increase the value of SP50 and decrease the value of SP1 or increase the value of SP2.



Observe that it is not possible to filter a lot the velocity feedback and maintain the velocity PI adjusted tightly.



Warning. The velocity PI must necessarily be adjusted before setting parameter SP50.

4.4.1 Procedure for adjusting this filter

- Enter its maximum value (SP50=4000), because its default value is null (not activated).
- Display SV2 to observe its effect on the velocity noise.
- Decrease its value, if necessary, until obtaining the desired effect and make sure that the loop does not become unstable.

An increase of the SP50 value increases the amount of following error both with the 8070 CNC and with the 8055/55i CNC.

4.

THE VELOCITY DRIVE
Velocity feedback filter



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4.5 Acceleration feedforward

The acceleration feed-forward is additional to the proportional control and to the velocity loop. Its function at the drive is the same as that of parameter ACFGAIN (P46) of the Fagor CNC.

It has a feed-forward effect on the command reducing the amount of following error without increasing the gain and improving the stability of the system.

Warning. Once the velocity loop has been adjusted the best way possible by setting the parameters and filters mentioned in earlier sections of this chapter as well as parameter ACFGAIN of the 8055/55i CNC, it is sometimes possible to improve the dynamic performance of the velocity loop thanks to the effect of the acceleration feed-forward. This effect may be used to widen the bandwidth of the velocity loop reducing the following error. However, remember that the system may become unstable. The noises generated by the system's instability are due to the derivative of the motor speed.

Acceleration feed-forward gain setting

The effect of the acceleration feed-forward is given at the drive by means of parameter:

PP217	S00348	AccelerationFeedForwardPercentage
-------	--------	-----------------------------------

that sets the percentage of final acceleration command forwarded (anticipated) to the movement. The rest of the final acceleration command is given by the velocity PI with the value of the proportional action given by SP1 and that of the integral action given by SP2.



Warning. It is absolutely necessary to adjust the PI of the velocity loop and the filters already mentioned, before trying to improve the adjustment using PP217.

Warning. If setting PP217 with a certain value in order to improve the dynamic behavior of the system makes it vibrate, decrease this value until it stops vibrating.

See the general block diagram of the velocity loop of **FIGURE S4.1**.

Example.

PP217=80	80% of the acceleration command is due to the acceleration feed-forward. Not setting a value of 100% generates a following error in velocity. Therefore, the rest of the acceleration command will be obtained through the proportional action SP1 and integral action SP2 of the velocity PI.
----------	------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

4.6 Velocity estimator

The velocity estimator may be used to eliminate the high frequency component of the actual (real) speed and stable the velocity loop when a mechanical system goes into resonance above 100 Hz. Its purpose is to interrupt the high frequency component of the actual velocity when estimating the velocity and hence eliminate the high frequency vibration on the machine.

The following figure shows the configuration of the velocity loop including the estimator:

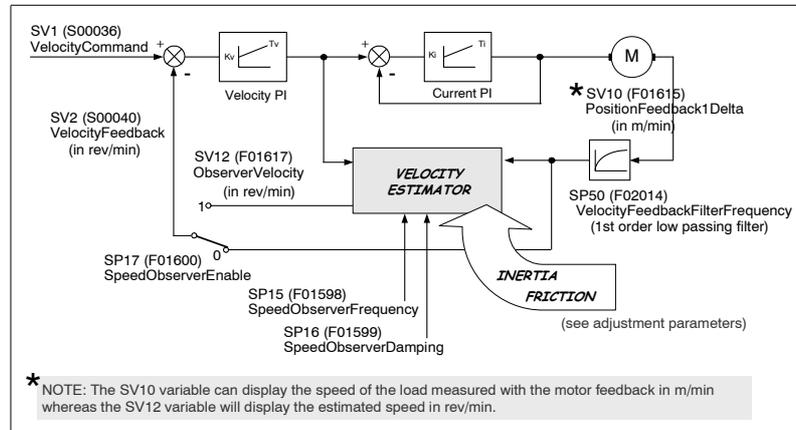


FIGURE S4.24

Block diagram of the velocity loop including the estimator.

The main advantage of using the velocity estimator versus the low-passing filter (that may be set with SP50) is that the estimator filters the signal of the actual speed without inserting delays in the velocity loop, hence achieving a wider bandwidth of the loop and making the system more stable. See **FIGURE S4.24** and observe where the two elements are located in the velocity loop.

The estimator is a mathematical model of the system that needs to know the inertia of the machine and may be evaluated according to:

$$J_{\text{machine}} = J_{\text{load}} \text{ (kg/cm}^2\text{)} + J_{\text{motor}} \text{ (kg/cm}^2\text{)}$$

$$NP1 = \frac{J_{\text{load}} \text{ (kg/cm}^2\text{)}}{J_{\text{motor}} \text{ (kg/cm}^2\text{)}} \quad ; \quad NP1 \text{ (in \%)} = NP1 \times 100$$

$$J_{\text{machine}} = NP1 \text{ (in \%)} \cdot J_{\text{motor}} \text{ (kg/cm}^2\text{)} + J_{\text{motor}} \text{ (kg/cm}^2\text{)}$$

$$J_{\text{machine}} = NP1 \text{ (in \%)} \cdot MP24 \text{ (kg/cm}^2\text{)} + MP24 \text{ (kg/cm}^2\text{)}$$

and friction must be compensated for.

Therefore, the adjustment parameters will be:

INERTIA	
NP1	ReducedActuatedMomentumOfInertiaPercentage
MP24	MotorMomentumOfInertia

FRICTION	
TP10	ConstantPositiveTorqueCompensation
TP11	ConstantNegativeTorqueCompensation
TP12	DynamicPositiveTorqueCompensation
TP13	DynamicNegativeTorqueCompensation
TP14	TorqueCompensationTimeConstant



Note. The inertia and friction parameters may be obtained by executing the inertia auto-adjusting command GC5 (in off-line mode). It won't be necessary to obtain exact values, approximate values will be enough.

4.
THE VELOCITY DRIVE
 Adjustment procedure



Note. There is no need to enable the acceleration feed-forward, but the time constant for torque compensation (that may be set with TP14 and is set to 0 by default) must necessary be set.

Important. Deactivate the first order low passing filter, that may be set with SP50, giving it a zero value to avoid inserting delays in the velocity loop when using this feature; in other words, when the user activates the velocity estimator setting parameter SP17=1.

The velocity estimator is set with the following parameters:

SP15	F01598	SpeedObserverFrequency
SP16	F01599	SpeedObserverDamping
SP17	F01600	SpeedObserverEnable

The first two set the break frequency and the damping factor of the estimator respectively used to correct the estimated velocity. The last parameter of this table may be used to activate (1) or deactivate (0) the estimator within the velocity loop.

It is also possible to display the estimated speed in rpm through the variable:

SV12	F01617	ObserverVelocity
-------------	--------	------------------

Refer to chapter 13 of this manual for further detail on these parameters and this variable.

4.6.1 Adjustment procedure

Being the estimator off (SP17=0) and the first order low passing filter on (SP50≠0):

- Set the parameters for machine inertia and friction by executing the command GC5 - Auto-adjustment of the inertia (off-line) -. Refer to the relevant section of this manual for the procedure to execute this command.
- Use the WinDDSetup application to display the variables SV2 and SV12 while making various movements of the machine (e.g. the one proposed for the auto-adjustment of the inertia in the relevant section of chapter 5 in this manual) and verify that both variables are practically identical.
- Increase or decrease (depending on the resulting effect) the value of parameter SP15 (in 10 Hz steps) when noticing **considerable differences** until getting them to be practically identical.

Note. If the velocity is not filtered well enough, cancel the low passing filter (SP50=0) to avoid inserting delays in the velocity loop and modify the value of parameter SP15 (in 10 Hz steps) until the desired value is obtained.

- Enable now the velocity estimator by setting SP17=1.
- Verify that the desired effects have been obtained.

If not, keep readjusting the value of SP15 in one direction or the other as it causes the desired effect until a satisfactory result is obtained.



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THE POSITION DRIVE

5

This chapter describes the setup procedure for the DDS drive when working as a position drive.

Chapter 4 already described the necessary steps for setting up an application where the drive is configured to work with velocity control.



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5.1 Position control loop

From software version 04.01 on, the drive is capable of closing the position loop and, therefore, attend to positioning commands. The position loop consists of a proportional control and a feed-forward derivative control. See **FIGURE S5.1**. The position feedback value may be obtained from a feedback device mounted on the motor that will be referred to as motor feedback or from a load feedback or external feedback that will be referred to as direct feedback. The following general diagram shows the position loop and its connection with the rest of the control loops:

5.
THE POSITION DRIVE
Position control loop

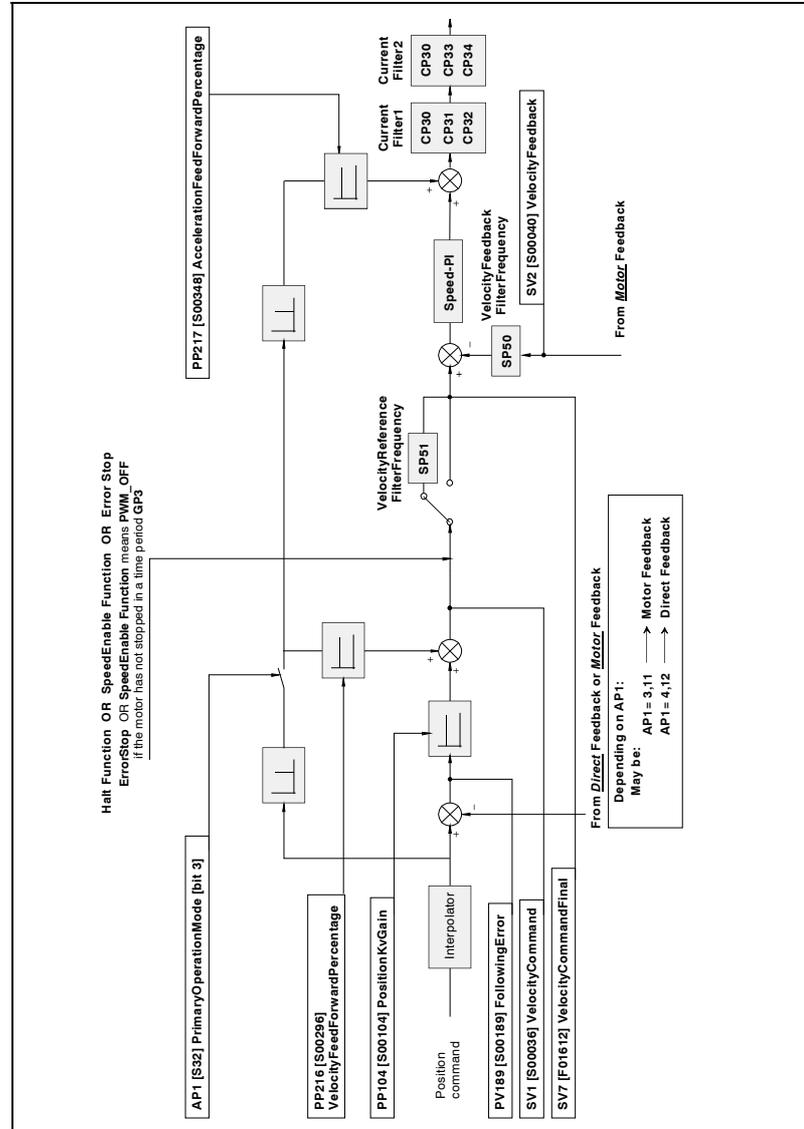


FIGURE S5.1
General diagram. Position loop.

The "in position" operating mode is set with this parameter:

AP1	S00032	PrimaryOperationMode
-----	--------	----------------------

This parameter determines whether:

- The position feedback is on the motor or on the load.
- Feed-forwards are active or not.

Feedback	Feedforwards (OFF)	Feedforwards (ON)
Motor	AP1=3	AP1=11
Load	AP1=4	AP1=12
Motor and load	AP1=5	AP1=13



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5.1.1 Feedback on the motor. Parameter setting

Motor feedback parameter setting using the classic system

- Transmit the signal from the feedback device (integrated into the motor) through a motor feedback cable to connector X4 of the CAPMOTOR-1 board of the drive.
- Deactivate bit 2 of parameter AP1.
- Indicate to the drive the type of signal coming from the feedback; i.e. the type of feedback device and its resolution with parameters:

GP2.#	F00701.#	Feedback1Type
NP116	S00116	ResolutionOfFeedback1

Observe that with any FAGOR catalog, when setting GP2 with its corresponding value to indicate the type of feedback of the motor, NP116 is automatically set with the proper value and, therefore, the user does not need to set this parameter manually.

If your feedback device appears in the following table, set GP2 with the value indicated in the "parameters" column. Use, whenever possible, this classic parameter setting method; in other words, whenever your feedback device is one of those shown in the table.

TABLE S5.1 Setting parameter GP2 using the classic method.

Feedback device	Incremental signals	Absolute position on power-up	Homed	Parameters
E0	512 - 1Vpp	RS485, 1 turn	Cam	GP2=0, NP116=512
E1	1024 - 1Vpp	C/D, 1 turn (A/B)	I0 (RS) & cam	GP2=0, NP116=1024
E2	1024 - 1Vpp	RS485, 1 turn	Cam	GP2=0, NP116=1024
C axis (FM7)	1024 - 1Vpp	RS485, 1 turn	Cam	GP2=0, NP116=1024
E3	1024 - 1Vpp	RS485, 1 turn	Cam	GP2=0, NP116=1024
A0	512 - 1Vpp	RS485 ± 2048 turns	No	GP2=0, NP116=512
A1	1024 - 1Vpp	RS485 ± 2048 turns	No	GP2=0, NP116=1024
A3	1024 - 1Vpp	RS485 ± 2048 turns	No	GP2=0, NP116=1024
R0	1 Modulated	1 turn	Cam	GP2=1, NP116=1
I0	1250 - TTL	U,V,W	I0	GP2=2, NP116=1250
TTL (FM7)	1024 - TTL	No	I0	GP2=2, NP116=1024
Heidenhain	2048 - 1Vpp	C/D, 1 turn	I0	GP2=5, NP116=2048
Spindle 1Vpp	NP116 - 1Vpp	No	I0	GP2=5, NP116=2048

If your feedback device is not among the previous ones and you have a software version 06.18 or later, follow the steps indicated initially in the previous procedure and set GP2 for the bits method that is described next.

Note. Using the bits method to set the motor feedback parameters is fully compatible with the classic method.

Careful, don't be mistaken.

Bear in mind that this does not mean that the decimal value to be entered via WinDDSetup in parameter GP2 using either method will be the same for the same feedback. In fact, it will be different.

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THE POSITION DRIVE

Feedback on the motor. Parameter setting



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Motor feedback parameter setting using the bits system

This motor feedback parameter setting procedure requires a drive software version 06.18 or later.

The parameter involved is:

GP2.#	F00701.#	Feedback1Type
--------------	----------	---------------

and their 16 bits will be interpreted in this order:

B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
-----	-----	-----	-----	-----	-----	----	----	----	----	----	----	----	----	----	----

TABLE S5.2 Meaning of the 16 bits of GP2.

Bit Nr.	Value	Meaning
B15	Parameter setting method	
	0	Old parameter setting method (compatibility)
	1	Parameter setting method by bits
B14	0	GC8 is not executed on power-up.
	1	GC8 is executed on power-up and the rho value is updated automatically when passing through the reference mark (I0).
B13...B7	Indifferent	Reserved
B6...B3	Starting position value	
	0000	GC7 is not executed on power-up.
	0001	Resolver type position reading
	0010	Starting position reading with Stegmann communication
	0011	Hall effect type (U,V,W) starting position reading
	0100	Starting position reading using 1Vpp C and D signals
	0101	Starting position reading via SSI
	0110	Starting position reading via EnDat™. See note.
	0111	Automatic initial rho calculation (the GC7 command is executed automatically on power-up)
B2	Reference (home) signal	
	0	It does not have a reference signal (I0)
	1	It has a reference signal (I0)
B1- B0	Incremental signals	
	00	Reserved
	01	Incremental differential 1Vpp signal
	10	Incremental differential TTL signal
	11	Simulated signal

Note. Connecting a feedback device with an EnDat™ digital interface as motor feedback requires software version 06.21 or later and to have a CAPMOTOR-2 motor feedback board installed at the drive.



Warning. When using a feedback device with EnDat™ digital interface, make sure to always execute the command GC7 - AutophasigOnline on machine power-up so the motor does not run away.

Use WinDDSSetup to assign to GP2 the decimal value equivalent to the 16-bit string being considered. Hence, e.g. for the string "110000000111010", GP2= 49210 (obtained from $2^{15}+2^{14}+2^5+2^4+2^3+2^1$).

The range of valid values for GP2 is from 0 to 65535.

Aviso. The display of the drive will show error **E502** if a wrong combination is detected during the parameter validation check on power-up. The SPY window of the WinDDSSetup provides information on the conflicting parameters.

5.
THE POSITION DRIVE
Feedback on the motor. Parameter setting



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Example on how to set motor feedback parameters

The purpose of this example is to use the bits method to set the motor feedback parameters that have usually been set by the old (classic) method. As mentioned earlier, the parameters of these feedbacks still have to be set as they have until version 06.18, i.e. with the classic method; however, this exercise will be useful to better understand how to use the bits method to set other new feedbacks that are now being considered.

Therefore, the classic method used to set the parameters of a motor feedback was used for feedback devices shown in **TABLE S5.1**; using the bits setting method, GP2 would be set as shown in **TABLE S5.3**. Observe that to enable this parameter setting system, bit 15 of GP2 must be set to 1.

TABLE S5.3 GP2 using the bits method (with classic feedback devices).

Feedback device	Abs.initial	Increm.	NP116	B15	B6-	B2	B1B0	Value
E0, SinCos	RS485	1Vpp	512	1	0010	0	01	32785
E1, SinCoder	C/D	1Vpp	1024	1	0010	1	01	32789
E2 (E3),SinCos2	RS485	1Vpp	1024	1	0010	0	01	32785
A0, SincCosAbs	RS485	1Vpp	512	1	0010	0	01	32785
A1 (A3), SinCoderAbs	RS485	1Vpp	1024	1	0010	0	01	32785
R0, Resolver	Resolver	Resolver	1	1	0001	0	00	32776
I0, 1250TTL	U,V,W	TTL	1250	1	0011	1	10	32798
Yaskawa, 1024TTL	----	TTL	1024	1	0000	1	10	32774
Siemens™, Heidenhain™ - Read the warning note below -	C/D	1Vpp	2048	1	0100	1	01	32805
LenordBauer, +1Vpp	----	1Vpp	xxxx	1	0000	1	01	32773
SSI, +1Vpp	SSI	1Vpp	xxxx	1	0101	0	01	32809
ENDAT, +1Vpp	EnDat	1Vpp	xxxx	1	0110	0	01	32817

Note that NP116=xxxx means that this parameter must be set by the user whereas the one that already assumes a value (e.g. E0, NP116=512) will be set by the encoder itself, not by the user.

Note that using SSI motor feedback, it may be necessary to change some of the communication parameters. RP60, RP61, RP62, RP63.



Warning. Set the parameters using the bits system for a motor feedback that uses a C/D signal, always use the GC3 command (autophasing) and the GC1 command (save changes permanently in Flash) before moving the motor, under the risk of runaway due to the uncertainty of rho shift.

Observe also that from version 06.23 on, the encoder position is updated with C/D signals when going through the first I0.

5.

THE POSITION DRIVE
Feedback on the motor. Parameter setting



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THE POSITION DRIVE
Feedback on the motor. Parameter setting

Other parameters

Also, if the motor shaft and the leadscrew are not coupled directly (e.g. toothed belt), in order for the drive to know the mechanical transmission ratio between the rotation of the motor shaft and the linear movement of the table, set the following parameters:

NP121	S00121	InputRevolutions
NP122	S00122	OutputRevolutions
NP123	S00123	FeedConstant

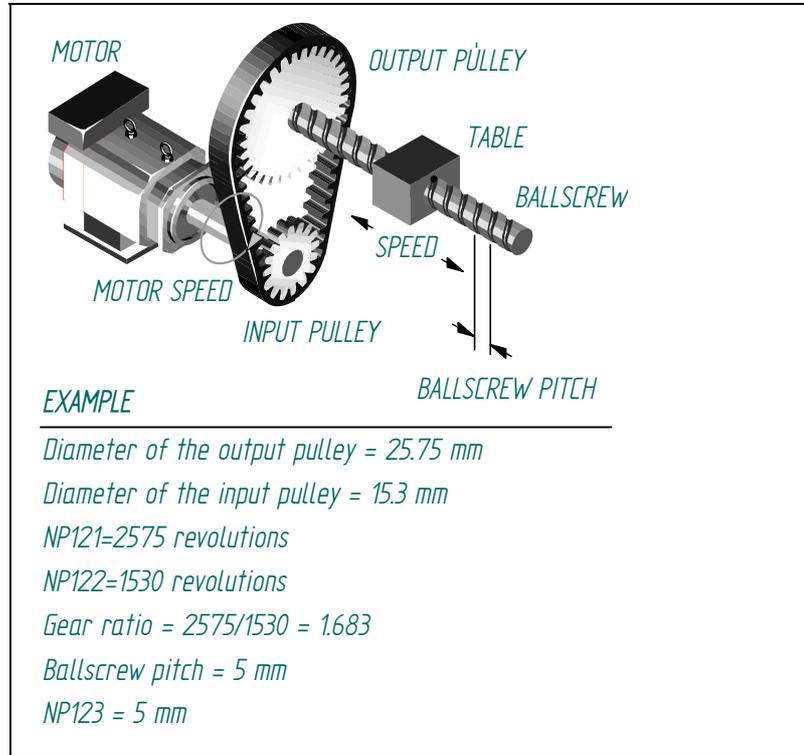


FIGURE S5.2

Gear ratio between the motor shaft and the ballscrew of the machine.

5.1.2 Direct feedback. Parameter setting

Direct feedback parameter setting using the classic system

- Transmit the signal from the load feedback device through a direct feedback cable to connector X3 of the direct feedback board of the drive.
- Activate bit 2 of parameter AP1.
- Indicate to the drive the type of signal coming from the external feedback; i.e. the type of feedback device and its resolution with parameters:

GP10	F00719	Feedback2Type
NP117	S00117	ResolutionOfFeedback2
NP118	S00118	ResolutionOfLinearFeedback
PP115	S00115	PositionFeedback2Type

Observe that if the direct feedback device is rotary, parameter NP118 will have no effect regardless of the value it has been set to.

If the external feedback is absolute (e.g. FAGOR linear encoders SA, SVA, GA or GVA), also set:

RP60	F02360	SSIClockFrequency
RP61	F02361	SSIDataLength
RP62	F02362	SSIDataFormat
RP63	F02363	SSIFeedbackResolution

when using SSI or EnDat™ interface.

The parameters of a Fagor absolute linear encoder are set to their default parameters, they are:

RP60=200 kHz, RP61=32 bits, RP62=0 and RP63=1 μ m

Remember that with SSI (unidirectional) interface, GP10 must be set to 4 (square wave SSI) or 5 (sinusoidal 1 Vpp SSI) when using the classical method. With EnDat™ interface, the parameters must **always** be set using the bits method and as described in the next section.

5.

THE POSITION DRIVE
Direct feedback. Parameter setting

Direct feedback parameter setting using the bits system

This direct feedback parameter setting procedure requires a drive software version 06.18 or later.

The parameter involved is:

GP10.#	F00719.#	Feedback2Type
---------------	----------	---------------

and their 16 bits will be interpreted in this order:

B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
-----	-----	-----	-----	-----	-----	----	----	----	----	----	----	----	----	----	----

TABLE S5.4 Meaning of the 16 bits of GP10.

Bit Nr.	Value	Meaning
B15	Parameter setting method	
	0	Old parameter setting method (compatibility)
	1	Parameter setting method by bits
B14	Indifferent	Irrelevant
B13...B7	Indifferent	Reserved
B6...B3	Starting position value	
	0000	Irrelevant
	0001	Resolver type position reading
	0010	Starting position reading with Stegmann
	0011	Hall effect type (U,V,W) starting position reading
	0100	Starting position reading using 1Vpp C & D signals
	0101	Starting position reading via SSI
	0110	Starting position reading via EnDat™
	0111	Irrelevant
B2	Reference (home) signal	
	0	It does not have a reference signal (I0)
	1	It has a reference signal (I0)
B1- B0	Incremental signals	
	00	Reserved
	01	Incremental differential 1Vpp signal
	10	Incremental differential TTL signal
	11	Simulated signal



Warning. When using a feedback device with EnDat™ digital interface, make sure to always execute the command GC7 - AutophasigOnline on machine power-up so the motor does not run away.

Use WinDDSSetup to assign to GP10 the decimal value equivalent to the 16-bit string being considered. Hence, e.g. for the string "110000000111010", GP10= 49210 (obtained from $2^{15}+2^{14}+2^5+2^4+2^3+2^1$).

The range of valid values for GP10 is from 0 to 65535.

Note. The display of the drive will show error **E502** if a wrong combination is detected during the parameter validation check on power-up. The SPY window of the WinDDSSetup provides information on the conflicting parameters.

5.
THE POSITION DRIVE
Direct feedback. Parameter setting



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Example on how to set direct feedback parameters

The purpose is similar to that of the example given for motor feedback, but now for direct feedback. Hence, the classic method used to set parameter GP10 with direct feedback has been:

TABLE S5.5 GP10 using the classic method.

Feedback device	Incremental signals	Absolute position	Homed	Parameters
TTL	NP117/ NP118 TTL	No	I0	GP10=1, PP115.0 NP117, NP118
1VPP	NP117 / NP118 1Vpp	No	I0	GP10=2, PP115.0 NP117, NP118
STEGMANN™	NP117	See GP20=0	Only A0, A1 and A3	GP10=3, PP115.0=0 NP117
SSI	NP117/ NP118 1Vpp	According to manufacturer	Not required	GP10=4, PP115.0=1 NP117, NP118

from which, using the bits method, GP10 results:

TABLE S5.6 GP10 using the bits method (with classic feedback devices).

Feedback device	Initial Abs.	Incr.	NP117	NP118	B15	B6...B3	B2	B1 B0	Value
Standard TTL, square	----	TTL	xxxx	xxxx	1	0000	1	10	32774
Standard 1 Vpp, sinusoidal	----	1Vpp	xxxx	xxxx	1	0000	1	01	32773
STEGMANN™, Hyperface	----	1Vpp	xxxx	----	1	0010	0	01	32785
FAGOR, SSI	----	1Vpp	xxxx	xxxx	1	0101	0	01	32809
HEIDENHAIN™, EnDat	----	1Vpp	xxxx	xxxx	1	0110	0	01	32817

Note that NP117=xxxx and NP118=xxxx mean that both parameters must be set by the user.

Note. Using the bits method to set the direct feedback parameters is fully compatible with the classic method.

Careful, don't be mistaken.

Bear in mind that this does not mean that the decimal value to be entered via WinDDSetup in parameter GP10 using either method will be the same for the same feedback. In fact, it will be different.

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Direct feedback. Parameter setting

Other parameters

Also, in order for the drive to know the existing mechanical ratio between the load movement and the direct position feedback, set the following parameters:

NP131	F00130	InputRevolutions2
NP132	F00131	OutputRevolutions2
NP133	F00132	FeedConstant2

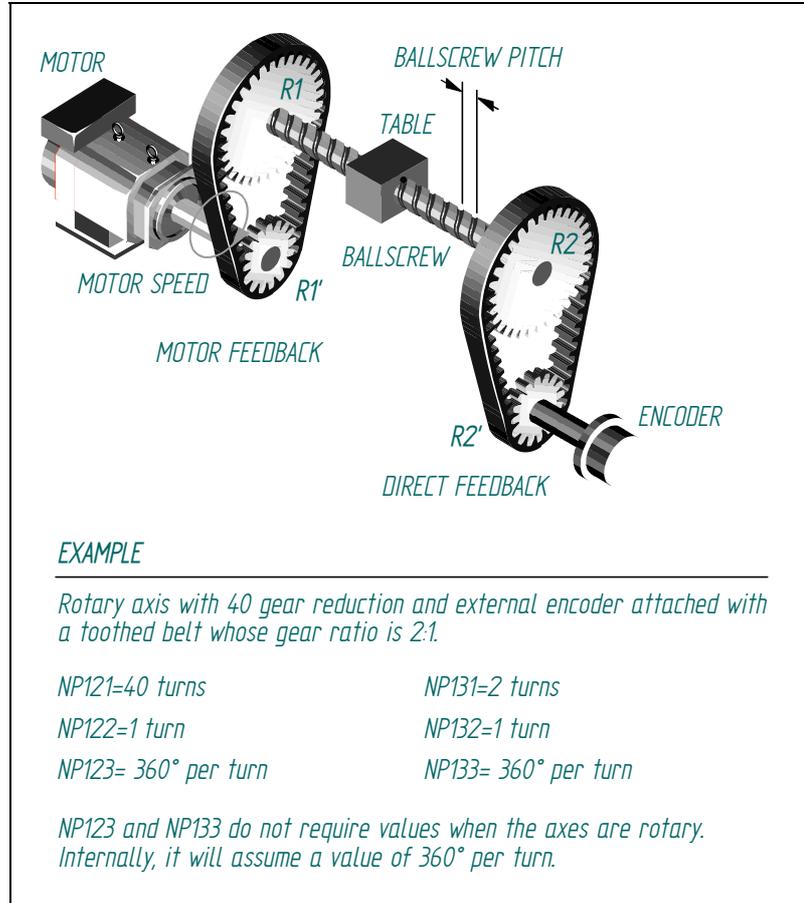


FIGURE S5.3
Linear movement of the axis per revolution of the direct feedback encoder.

Setting of NP133 and NP117. Whole ratio

In a parameter setting process, when using direct feedback (GP10 ≠ 0) and it is rotary (bit 0 of PP115 = 0 → encoder), make sure that the ratio:

$$\text{NP133} \times 10000 \times 2^{10} / \text{NP117} < 1 >$$

is an integer. If this condition is not met, error **E502** will be activated on the drive's display indicating that NP117 has not been set correctly.

Important note. If the position command scaling method has been set as rotary, i.e. PP76(1,0) = 1 0, then it must **always** be set NP133 = 360.0000. Make sure that this is so. If NP133 does not have this value, set it to 360,0000.

If the <1> ratio indicated earlier is not a whole number (integer), it is always possible to set an equivalent setting that will make this ratio an integer. Use the following example to see how to proceed:

Example.

Suppose that parameters NP133 and NP117 have been initially set as follows:

NP133 = 360.0000 degrees (rotary scale)
NP117 = 2600 pulses per turn
NP131 = NP132 = 1 (there is no gear ratio, direct coupling)

Replacing these values in the previous ratio <1>, we obtain:

$$\text{NP133} \times 10000 \times 2^{10} / \text{NP117} = 360 \times 10000 \times 2^{10} / 2600 = 3686400000 / 2600$$

$$3686400000 / 2600 = 1843200000 / 1300 = 18432000 / 13 = 1417846, 154$$

This result is not an integer. Therefore, this setting activates error code **E502** on the drive's display.

Making the result of this ratio an integer and preventing it from issuing the error will require obtaining a parameter setting that is equivalent to the initial one and meets this requirement. For that, proceed following this mathematical trick as shown here:

- Replace the initial parameter values in expression <1> and obtain **the most simplified fraction**.
 For the given values, the result was: 18432000/13 (non-integer number).
- Break up the value of NP117 in a product of two values where one of them is the denominator of the fraction that cannot be reduced (in this case 13). Then NP117=2600=13x200.
- Replace the 13 factor with a close value multiple of the numerator (18432000), e.g. 12. Now, the new value of NP117 will be 12x200=2400. With this change, each encoder revolution would count as 13/12 of a revolution.
- Compensate the deviation by setting, for this example, a 12/13 gear ratio, setting NP131=12 and NP132=13.

$$[\text{NP117} \times \text{NP132} / \text{NP131}]_{\text{INITIAL}} = [\text{NP117} \times \text{NP132} / \text{NP131}]_{\text{EQUIVALENT}}$$

Therefore:

Initial parameter setting	Equivalent parameter setting
NP117 = 2600	NP117 = 2400
NP133 = 360 degrees	NP133 = 360 degrees
NP132 = 1	NP132 = 13
NP131 = 1	NP131 = 12

- Evaluate ratio >1> again with the equivalent parameter setting:

$$\text{NP133} \times 10000 \times 2^{10} / \text{NP117} = 360 \times 10000 \times 2^{10} / 2400 = 1536000$$

This parameter setting is equivalent to the initial one and will establish an integer for the ratio <1>, hence preventing error code **E502** from activating.

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THE POSITION DRIVE
Direct feedback. Parameter setting



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5.1.3 The interpolator

The CNC generates position commands at a frequency set by parameter:

QP1	S00001	ControlUnitCycleTime
------------	--------	----------------------

Depending on these commands sent by the CNC, the interpolator generates internal commands with a period of 250 μs (cubic interpolation).

This treatment of the position commands make the system behavior more linear.

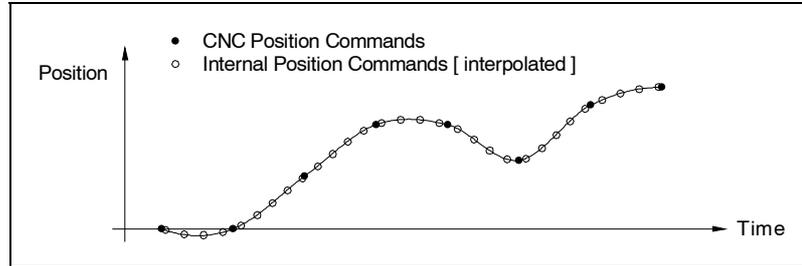


FIGURE S5.4

Interpolator.

5.1.4 Proportional control

The proportional control is the basic element of the position loop. Its function at the drive is the same as that of Fagor CNC parameter **PROGAIN (P23)**.

Proportional gain setting

The gain is given at the drive by parameter:

PP104	S00104	PositionKvGain
--------------	--------	----------------

where:

- for linear axes, it is given in m/min of programmed velocity command per mm of following error.
- for rotary axes, it is given in degrees/min of programmed velocity command per thousandth of a degree of following error.

Examples.

PP104 = 1 It means that a following error of 1 mm is obtained with a programmed feedrate of 1000 mm/min (F1000 at the CNC).

PP104 = 2 It means that a following error of 0.5 mm is obtained with a programmed feedrate of 1000 mm/min (F1000 at the CNC).

For a following error of 5 μm for F2000, the value of Kv is calculated as follows:

$$2 / 0.005 = 400, \text{ luego, PP104} = 400$$

Set this parameter depending on the following error desired for a given feedrate.

5.1.5 Velocity < feedforward >

The velocity feed-forward is additional to the proportional control. Its function at the drive is the same as that of parameter **FFGAIN (P25)** of the FAGOR CNC.

The purpose of the velocity < feed-forward > is to provide the desired velocity (a time derivative of the position), directly in the velocity loop without the need for the proportional gain to give this value, hence decreasing the amount of following error (axis lag).

Therefore, it has a feed-forward effect on the command reducing the amount of following error without increasing the gain and improving the stability of the system.

Velocity < feed-forward > gain setting

The effect of the velocity feed-forward is given at the drive by means of parameter:

PP216	S00296	VelocityFeedForwardPercentage
--------------	--------	-------------------------------

that sets the percentage of final velocity command forwarded (anticipated) to the movement. It does not depend on the following error (open loop).

The remaining percentage of the final velocity command is due to the proportional gain.

See the general block diagram in **FIGURE S5.1**.

Example.

PP216=80 80% of the velocity command is due to the velocity feed-forward. The rest of the velocity command comes from the proportional gain.

5.1.6 Acceleration < feedforward >

The acceleration feed-forward is additional to the proportional control and to the velocity feed-forward. Its function at the drive is the same as that of parameter **ACFGAIN (P46)** of the FAGOR CNC.

It has a feed-forward effect on the command reducing the amount of following error without increasing the gain and improving the stability of the system.

Acceleration < feed-forward > gain setting

The effect of the acceleration feed-forward is given at the drive by means of parameter:

PP217	S00348	AccelerationFeedforwardPercentage
--------------	--------	-----------------------------------

that sets the percentage of final acceleration command forwarded (anticipated) to the movement. The rest of the final acceleration command is given by the velocity PI with the value of the proportional action given by SP1 and that of the integral action given by SP2.

See the general block diagram in **FIGURE S5.1**.

Example.

PP217=80 80% of the acceleration command is due to the acceleration feed-forward. Not setting a value of 100% generates a following error in position and velocity. Therefore, the rest of the acceleration command will be obtained through the proportional action SP1 and integral action SP2 of the velocity PI.

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THE POSITION DRIVE
Velocity < feedforward >



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5.2 Home search

The position drive is capable of carrying out an automatic home searching process.

This automatic home search process is not necessary when using motors with absolute encoder feedback (ref. A1).

5.2.1 Incremental feedback

This procedure may be activated with the servo system in any initial position. When detecting the **reference point** it ends the procedure and sets the **machine reference zero** as the coordinate origin for the following movements in absolute coordinates.

Automatic home search

Let us consider here that the parameters correspond to a feedback device mounted on the motor. A later note mentions the parameters corresponding to a direct feedback.

The (0) point is the machine power-up random point. The position feedback given in the PV51 (S00051) takes this point as coordinate the origin.

(bH) = before Homing = before executing HOME
(aH) = after Homing = after executing HOME

When executing the HOME instruction, the motor starts turning automatically in search of the reference point with two possible behaviors depending on the position of the starting point: Hence:

1/ With the HomeSwitch released PV200 (S00400)=0. Solid line
2/ With the HomeSwitch pressed PV200 (S00400)=1. Dashed line

The parameters that determine the home searching speeds in each stage of the process are:

PP41	S00041	HomingVelocity
PP1	F01300	HomingVelocitySlow

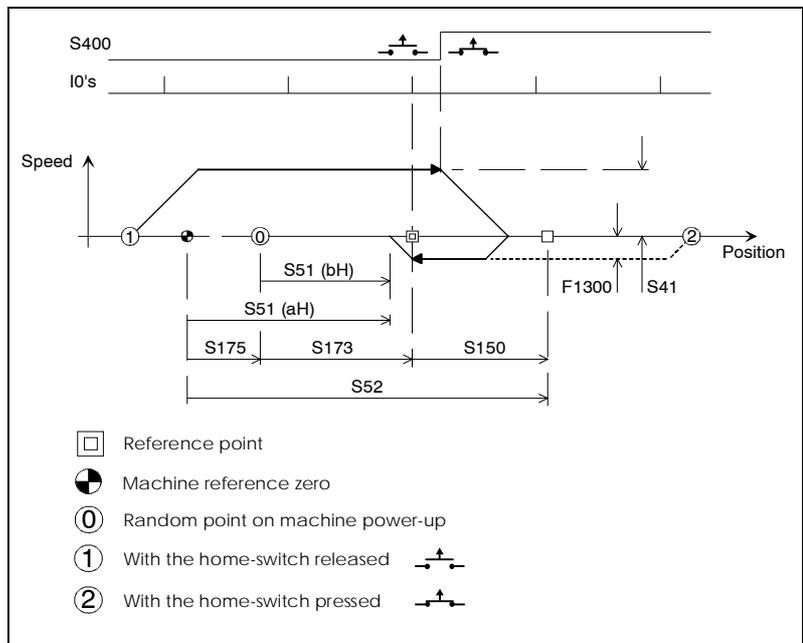


FIGURE S5.5

Incremental feedback. Automatic home searching procedure.

When going through the reference point (point with home signal I0 found) that is always set at low speed PP1, the system registers the position feedback value in the variable:

PV173	S00173	MarkerPositionA
--------------	--------	-----------------

It activates the variable:

PV208	S00408	ReferenceMarkerPulseRegistered
--------------	--------	--------------------------------

and the motor stops.

The new value of PV51 is set with the variable:

PV175	S00175	DisplacementParameter1
--------------	--------	------------------------

with the formula:

$S175 = S52 - S150 - S173$

It activates the variable:

PV203	S00403	PositionFeedbackStatus
--------------	--------	------------------------

and it is assigned to the internal position command given by the variable:

PV47	S00047	PositionCommand
-------------	--------	-----------------

the value of the new position feedback PV51.

Finally, the position drive is ready to execute absolute movements.



After several home searches in a row, the motor may be left in different final positions. This is because the braking is not always the same, but home has been found correctly.

Change of the location of the reference point

Replacing the feedback device or the motor may change the location of the marker pulse.

To keep the same home position, set offset parameter:

PP150	S00150	ReferenceOffset1
--------------	--------	------------------

Determine this offset based on a known position in the previous reference system.

Note.

When the feedback is obtained through a direct feedback sensor for the movement (connector X3 of the drive) some of the parameters mentioned earlier must be replaced by their "twins".

With motor feedback:

PP52	S00052	ReferenceDistance1
PP150	S00150	ReferenceOffset1
PV51	S00051	PositionFeedback1
PV175	S00175	DisplacementParameter1

With direct feedback (same as the previous ones, respectively):

PP54	S00054	ReferenceDistance2
PP151	S00151	ReferenceOffset2
PV53	S00053	PositionFeedback2
PV176	S00176	DisplacementParameter2

Drive parameters ReferenceDistance and ReferenceOffset are equivalent to axis parameters REFVALUE (P53) and REFSHIFT (P47) of the 8055/55i CNC.

Home search configuration

Use the following parameter to set the homing direction and the Boolean logic of the home switch:

PP147	S00147	HomingParameter
--------------	--------	-----------------

that sets with bits 0 and 1 set which home search direction is considered positive and whether the home switch closes or opens its contacts when activated.

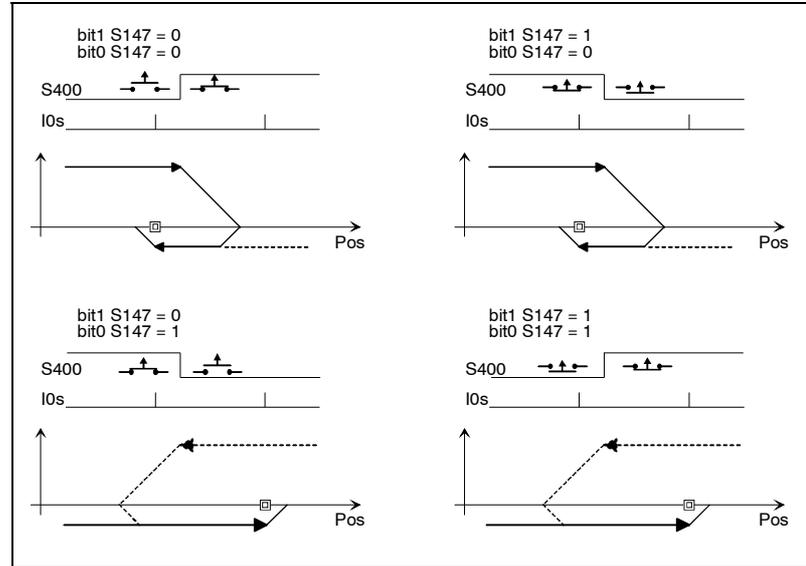


FIGURE S5.6
Home search setting.

Electrical connection of the home switch.

When connecting the electrical contact to one of the digital inputs of the drive:

- If no PLC is used, assign variable PV200 (S00400) to one of parameters IP10 ... , IP13 (in SERCOS nomenclature F00901, ..., F00904). Connect the home switch to the digital input associated with the chosen parameter.
- If a PLC is used, use an instruction to indicate that bit 0 of variable PV200 (S00400) must take the value of one of the digital inputs (for example: I1). The instruction is: I1 = B0S400.

When connecting the electrical contact to one of the digital inputs of the 8070 CNC:

- The CNC communicates the status of the contact via SERCOS; but the drive is still the one controlling the home search process.

Mechanical location of the home switch

In order to avoid possible repeatability problems when homing, it is recommended to take certain precautions regarding the location of the home switch.

- **Feedback without reference marks (I0)**

On the reference of Fagor motors, they appear as E1, E3, R0.

In each encoder turn, the load moves a distance L given by the formula:

$$L = \frac{NP122}{NP121} \cdot NP123$$

At the time when the home search ends, and the motor stops, the position coordinate must be within the $\pm L/4$ margin.

Place the home switch in the load travel point meeting the previous condition.

- **Feedback with reference marks (I0)**

On the reference of Fagor motors, they appear as E1, I0.



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A. Repeatability problem when searching home.

In order to avoid repeatability problems when searching home, it is important to watch for the physical location of the home switch on the machine and for the location of the marker pulse near it.

Hence, placing the home switch very close to the Marker (I0) position may cause a lack of repeatability of the marker pulse when searching home; in other words, it can find two different I0's and consequently a different machine reference zero position.

This potential problem is due to the fluctuation of the on/off flank of the home switch.

See **FIGURE S5.7** (A or B) to verify this.

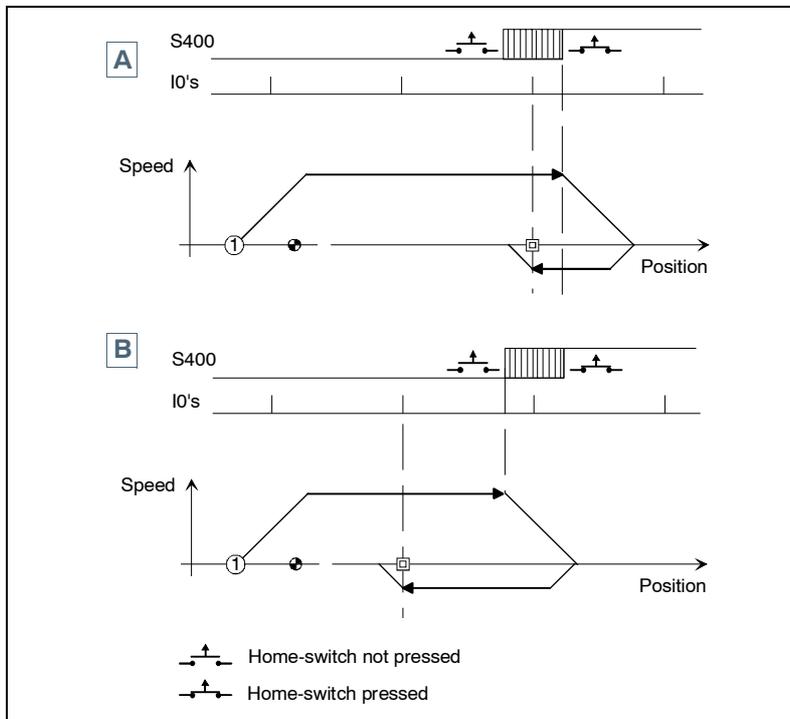


FIGURE S5.7
Repeatability problem when searching home.

B. Solution to the repeatability problem when searching home

When this occurs, there are two ways to solve the problem:

- **By physically moving the home switch:** Place the home switch physically farther away from the marker pulse. The separation distance is given by the variable:

PV1	S00289	HomeSwitchDistance
------------	--------	--------------------

after carrying out a home search.

- **By shifting the home switch via software:** Shift the home switch by executing the command:

GC6	F00615	HomeSwitchAutoCalibration
------------	--------	---------------------------

where the parameters to be considered are:

PP4	S00299	HomeSwitchOffset
PV1	S00298	HomeSwitchDistance

See chapter 13 in this manual for further information on these parameters !

C. Execute the GC6 command

Shifting the home switch using the GC6 command is carried out as follows:

- **Perform a home search** so the drive knows the position of the reference marker (I0) and of the home switch.

The found reference mark will not be the final one because the home switch must be shifted, but the PV1 variable will already have the best value that must be shifted.

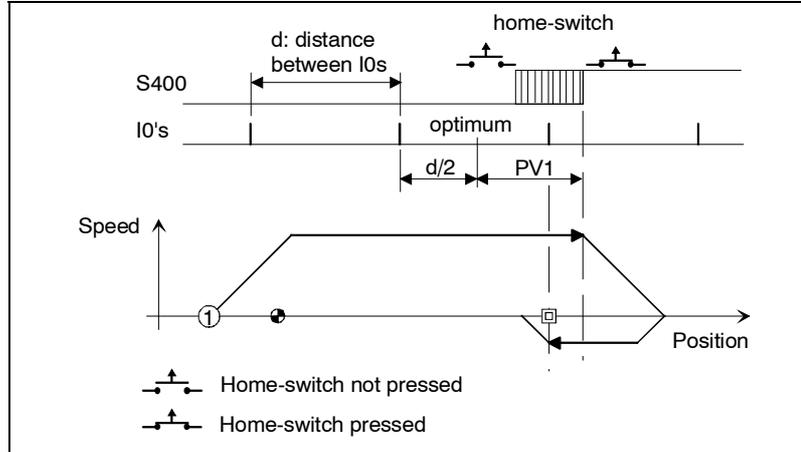


FIGURE S5.8

First home search. Meaning of variable PV1.

- **Execute the GC6 command.**

The value of the best home switch shifting distance is stored in parameter PP4. (PV1 → PP4).

- **Execute the GC1 command.**

The parameters are stored in flash memory so the home switch is stored permanently.

- **Search home again.**

The detected reference mark will be the final one.

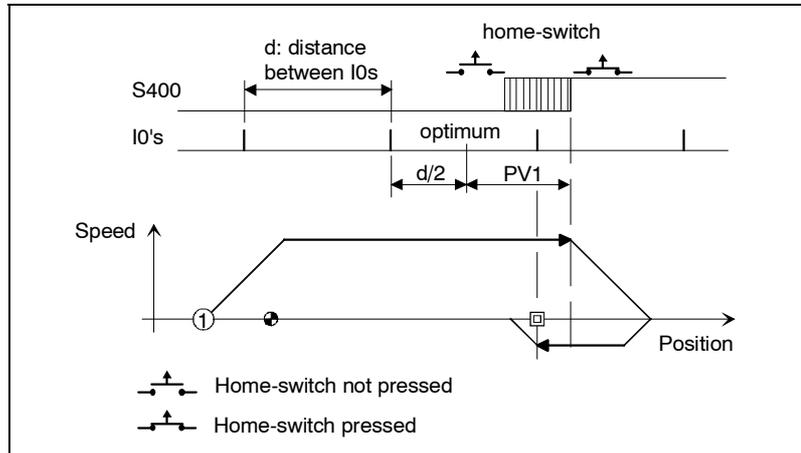


FIGURE S5.9

How to get the valid reference mark (I0).

Warning. From software version 06.03 on, it checks the coordinates obtained after a home search. Hence, if the coordinate obtained (PV51 or PV53 as the case may be) is out of limits and these limits are enabled (PP55.4=1), it will issue error code **E150** (OverTravelLimitsExceeded). This is only checked at the end of the home searched and it is done both in position control and in velocity control.



D. Setting of NP166 (always required)

When using feedback with reference marks, NP166 is usually set by default with a value of 1000 which is valid for most situations. This parameter is used by the drive internally to test the distance between reference marks and generates error code **E253** if the reference mark is not detected in two revolutions.

Remember that parameter NP166 indicates the number of incremental waves between two reference marks. See the following examples to know with which value to set NP166.

Example 1.

Let's suppose a linear encoder that has reference marks. If the distance between reference marks is 20 mm and its resolution is 20 μm. What value should NP166 be set to?

The value of the NP16 will be the quotient between:

$$NP166 = (\text{gap between I0's}) / (\text{resolution})$$

After converting them to the same units:

$$NP166 = 20\,000\ \mu\text{m} / 20\ \mu\text{m} = 1000\ \text{waves between I0's.}$$

therefore: NP166 = 1000.

However, when having a **single reference mark** (something rare), the default value of NP166 and, therefore, this parameter must be set properly.

Example 2.

Let's suppose a linear encoder that has only one reference mark. The distance measured between the home switch and the reference mark is 535 mm and the resolution of the linear encoder is 20 μm. What value should NP166 be set to?

The value of the NP16 will be the quotient between:

$$NP166 = [(\text{gap between the home-switch and the I0})+k] / [\text{resolution}]$$

where the "k" values may be between 20 mm and 30 mm, in general.

Note that this "k" value is entered as a margin to ensure that a home search will find the only reference mark (I0) there is and prevent error code **E253** from coming up.

After converting the data to the same units and considering an arbitrary value of k=25 mm:

$$NP166 = (537\,000\ \mu\text{m} + 25\,000\ \mu\text{m}) / 20\ \mu\text{m} = 28100.$$

therefore: NP166 = 28100.

If the NP166 value calculated in the example 2 generates error code **E253** when searching home, before reaching the I0 area, use a margin value "k" slightly greater than the one used before.



NP166 must necessarily be set whether the feedback has distance-coded reference marks or only regular reference marks.

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Incremental feedback



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5.2.2 With spindle reference mark and gear ratio other than 1:1

From software version 06.03 it is possible to home a spindle that only has motor feedback when the gear ratio NP121/NP122 is not 1/1.

Application restrictions

It will only be applicable to:

- Toothed belt transmission.
- Rotary axes (or spindles).

Note that it does not apply to linear axes.



Note that setting the parameter NP121 with very high values, that sets the number of turns of the driving pulley attached to the motor shaft and having a feedback device with a reference mark may cause repeatability problems when searching home. Therefore:

Do not set NP121 to a value too high !

To avoid possible repeatability problems when searching home, it is very important to make sure that the various reference marks are not too close to each other because the values of NP121 are too high.

The following example gives an idea of the relationship between the value assigned to NP121 and the proximity of 2 different reference marks.

Example.

Supposing a toothed pulley transmission where the driving pulley is attached to the shaft of a motor that has a feedback device that has reference marks. The transmission ratio between the two pulleys is $NP121/NP122 = 5/4$. For each turn of the transmitter motor (a reference mark every 360°) the driven pulley turns 288° according to this transmission ratio. When representing the reference mark positions registered in 5 turns of the motor with respect to the 4 turns of the driven pulley, the resulting 5 reference signals are separated 72° .

If we now set NP121 with a very high value (e.g. 5,000), the transmission ratio will be $NP121/NP122=5000/4$ and by following the previous reasoning, it will result in 5,000 reference signals separated 0.072° for every 4 turns of the driven pulley.

Therefore, it can be observed that these different reference signals would be so close to each other that any fluctuation of the on/off flank of the cam (home switch) in a home search could not repeat the reference mark and consequently could set a different machine zero point.

Remember that when having a software version 06.14 or older, hence, with gear ratios NP121/NP122 that may be simplified mathematically, they must be simplified exactly before setting the parameters. Hence, for a 32/24 ratio, that once simplified results in 4/3, the values to set will be $NP121=4$ and $NP122=3$.



Warning. When searching home using a feedback device that has reference marks and transmission ratio other than 1:1, **it is extremely important** to follow the procedure "solution by shifting the home switch by software" described in the previous section; in other words, execute the GC6 command and follow the consecutive steps indicated in that section. **Note that** for different executions of the GC6 command in this application, the PV1 variable will take different values.

5.

THE POSITION DRIVE
With spindle reference mark and gear ratio other than 1:1



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5.2.3 Feedback with reference marks and distance-coded reference marks

A negligible movement of the motor is enough for the drive to identify the absolute position of the machine.

To carry out this procedure, the feedback device must be identified using the following parameters:

GP10	F00719	Feedback2Type
NP117	S00117	ResolutionOfFeedback2
NP118	S00118	ResolutionOfLinearFeedback
NP165	S00165	DistanceCodedReferenceMarksA
NP166	S00166	DistanceCodedReferenceMarksB
PP115	S00115	PositionFeedback2Type

Note. Setting parameter NP118 only makes sense for linear encoders. It is irrelevant for rotary encoders.

With regular (not distance-coded) reference marks on linear encoders.

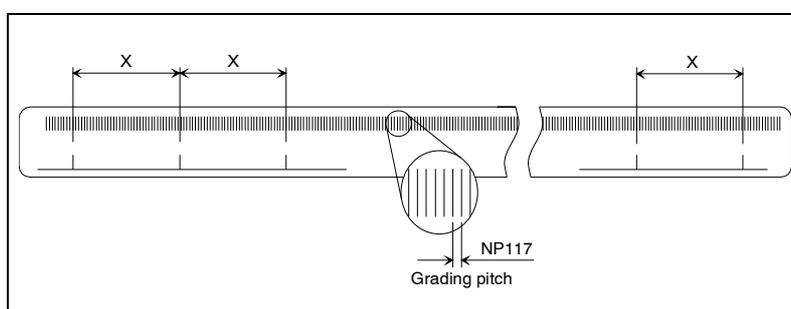


FIGURE S5.10

Illustration of the parameters of a linear encoder with regular (not distance-coded) reference marks.

Example.

A FAGOR SVX model chromed glass linear encoder with a grating pitch of 20 μm and differential TTL output signal with T period of 4 μm has several reference marks with a pitch of 2500 signal cycles (X= 50 mm = 50000 μm). The values to be assigned to the parameters of the drive are:

GP10 = 1. Square TTL signal.
NP117 = Grating pitch = 20 μm (from the catalog)
NP118 = Output signal period T = 4 μm (catalog data)
NP165 = Irrelevant
NP166 = 1000 en todas las reglas FAGOR always !

Besides, bits 6, 5, 3, 1 and 0 of parameter PP115 must be set to set the operation with this type of feedback devices. Proceed as follows:

bit 0=1	Linear
bit 1=0	No distance-coded I0's
bit 3	The pulse counting direction should've been adjusted already
bit 5	Once the home search is done, move the axis in the positive direction and do a home search again. If the coordinate obtained after the second home search is smaller than the first one, change the sign of the value of parameter PP115.
bit 6=0	Incremental feedback device

5.

THE POSITION DRIVE
Feedback with reference marks and distance-coded reference marks

Parameters setting table for FAGOR linear encoders with non-distance-coded reference marks

FAGOR LINEAR ENCODERS										NP166	NP117	NP118	
SX	SVX	GX		MX			MK		CX	1000	20	4	
SY	SVY	GY								1000	20	2	
SW	SVW	GW								1000	20	0,4	
SP	SVP	GP		MT	MK	MT	MKT	MP	CT	CP	1000	20	20
			LX								1000	40	4
			LP								2000	40	40
										FX	2000	100	4
										FT	1000	100	20
										FP	1000	100	100

NP117. Grading pitch of the glass or steel tape of the linear encoder in μm . For FAGOR models, it may be 20, 40 or 100 μm depending on model.

NP118. T period of the output signals of the linear encoder in μm . For FAGOR models, it may be 4, 2, 0.4, 20, 40 or 100 μm depending on model.

NP166. Value obtained from calculating the gap between two consecutive "shifting" distance-coded reference marks divided by the grading pitch.

Note that it is irrelevant to set parameter **NP165** when using linear encoders with no distance-coded reference marks.

Always 1000 on FAGOR models.

With distance-coded reference marks on linear encoders

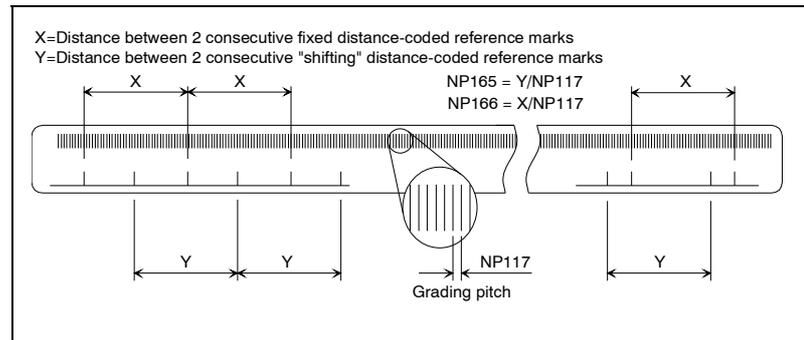


FIGURE S5.11

Illustration of the parameters of a linear encoder with distance-coded reference marks.

Example.

A FAGOR SVOX model chromed glass linear encoder with a grading pitch of 20 μm and differential TTL output signal has several reference marks with a pitch of 100 signal cycles ($X= 20 \text{ mm} = 20,000 \mu\text{m}$). The group of marks alternating with the previous ones are separated 100.1 signal cycles ($Y=20,02 \text{ mm}= 20020 \mu\text{m}$) from each other.

Let us suppose that in this particular linear encoder model an accuracy of 4 μm is obtained (using a multiplying factor of x5) and the output signals are differential TTL, the values to be assigned to the parameters of the drive are:

GP10 = 1. Square TTL signal.
NP117 = Grading pitch = 20 μm (from the catalog)
NP118 = Output signal period T = 4 μm (catalog data)



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NP165 = Y/NP117 = 20.02 mm x (1000 μm/mm) / 20 μm = 1001 Note. Y=20.02 mm for all FAGOR linear encoders except L models.
NP166 = 20 mm x (1000 μm/mm) / 20 μm = 1000 Note. X=20 mm for all FAGOR linear encoders except L models.

Besides, bits 6, 5, 3, 1 and 0 of parameter PP115 must be set to set the operation with this type of feedback devices. Proceed as follows:

bit 0=1	Linear
bit 1=1	With distance-coded I0's
bit 3	The pulse counting direction should've been adjusted already
bit 5	Once the home search is done, move the axis in the positive direction and do a home search again. If the coordinate obtained after the second home search is smaller than the first one, change the sign of the value of parameter PP115.
bit 6=1	Absolute feedback device

The manufacturing of linear scales with distance - coded reference marks causes each feedback device to have a different zero point.

To set the coordinate origin at a particular point of their travel, proceed as follows:

- Search home.
- Move the axis to the point chosen as machine zero.
- Read the PV53 variable.
- Assign to parameter PP178 the value read in PV53 with the opposite sign.

Parameters setting table for FAGOR linear encoders with distance-coded reference marks

FAGOR LINEAR ENCODERS					NP166	NP165	NP117	NP118	MULTIPL FACTOR
SOP	GOP	MOP	COP		1000	1001	20	20	1
SVOP		MOC	COC		1000	1001	20	20	1
		MOT	COT		1000	1001	20	20	1
SOX	GOX	MOX	COX		1000	1001	20	4	5
SVOX					1000	1001	20	4	5
				LOP	2000	2001	40	40	1
				LOX	2000	2001	40	4	10
				FOP	1000	1001	100	100	1
				FOT	1000	1001	100	20	5
				FOX	1000	1001	100	4	25

NP117. Grading pitch of the glass or steel tape of the linear encoder in μm. For FAGOR models, it may be 20, 40 or 100 μm depending on model.

NP118. T period of the output signals of the linear encoder in μm. For FAGOR models, it may be 4, 2, 0.4, 20, 40 or 100 μm depending on model.

NP165. Value obtained from calculating the gap between two consecutive "shifting" distance-coded reference marks divided by the grading pitch. 1001 on FAGOR models except L models (2002).

NP166. Value obtained from calculating the gap between two consecutive "fixed" distance-coded reference marks divided by the grading pitch. 1000 on FAGOR models except L models (2000).

Note that the multiplying factor is the ratio between the grading pitch of the glass or steel tape of the linear encoder and its output signal period T. For FAGOR models, it may be 1, 5, 10 or 25 depending on model and it is not explicitly reflected in any parameter of the drive

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THE POSITION DRIVE
Feedback with reference marks and distance-coded reference marks



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5.

THE POSITION DRIVE
Feedback with reference marks and distance-coded reference marks

With incremental reference mark on rotary encoders

Example.

A FAGOR chromed glass disk whose sales reference is S-P-18000-D90. According to the catalog, its resolution is 18,000 pulses per turn and its output signal is sinusoidal 1 Vpp.

The values to be assigned to these parameters are:

GP10=2	Sinusoidal 1 Vpp signal
NP117=18000	Number of pulses per turn

Note that it is irrelevant to set parameters **NP165, NP166** and **NP118** when using rotary encoders with incremental reference mark.

Bits 6, 5, 3, 1 and 0 of parameter PP115 must be set to set the operation with this type of feedback devices. Proceed as follows:

bit 0=0	Rotary
bit 1=0	No distance-coded I0's
bit 3	The pulse counting direction should've been adjusted already
bit 5	Once the home search is done, move the axis in the positive direction and do a home search again. If the coordinate obtained after the second home search is smaller than the first one, change the sign of the value of parameter PP115.
bit 6=0	Incremental feedback device

Follow these steps to shift the encoder "0":

- Search home.
- Move the axis to the point chosen as machine zero.
- Read the PV53 variable.
- Assign to parameter PP178 the value read in PV53 with the opposite sign.

Parameters setting table for FAGOR rotary encoders with incremental reference mark

FAGOR ROTARY ENCODERS		PULSES PER TURN	NP117
HP	SP	18000	18000
HP	SP	36000	36000
H	S	18000	18000
H	S	36000	36000
H	S	90000	90000
H	S	180000	180000
	S	360000	360000

NP117 = Number of pulses per turn.

Note that it is irrelevant to set parameters **NP165, NP166** and **NP118** when using rotary encoders with incremental reference mark.

For FAGOR models, multiplying factor = Number of pulses per turn /18000.

Note that the multiplying factor is not explicitly reflected in any parameter of the drive.



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With absolute distance-coded reference marks on rotary encoders

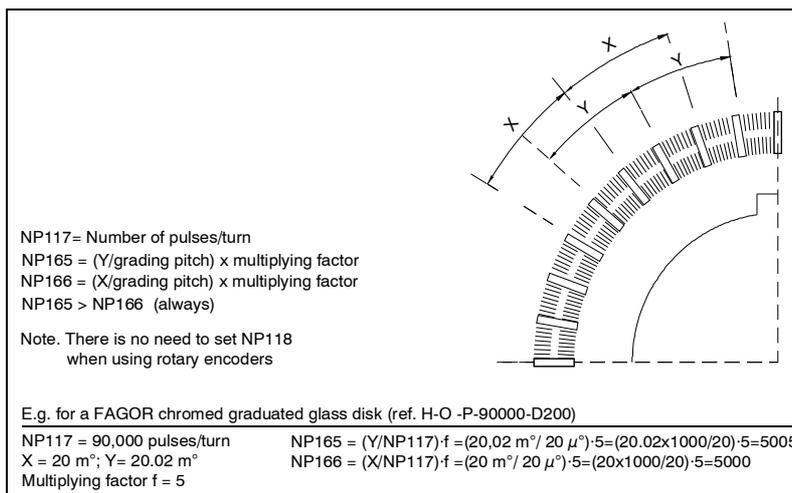


FIGURE S5.12

Illustration of the parameters of a rotary encoder with absolute distance-coded reference marks.

Example.

The chromed disk of a FAGOR encoder S-O-P-36000-D200 has a series of reference marks separated 100 signal cycles from each other. Another group of marks alternating with the previous ones are separated 100.1 signal cycles from each other. The resolution is 36000 pulses per turn (x2 multiplying factor) and the output signal is sinusoidal 1 Vpp.

The values to be assigned to these parameters are:

GP10=2	Sinusoidal 1 Vpp signal
NP117 = 36000	Number of pulses per turn
Multiplying factor = NP117 / 18000 = 36000/ 18000 = 2	
NP165 = 1001 x multiplying factor = 1001 x 2 = 2002	
NP166 = 1000 x multiplying factor = 1000 x 2 = 2000	

Note that it is irrelevant to set parameter **NP118** when using rotary encoders.

Bits 6, 5, 3, 1 and 0 of parameter PP115 must be set to set the operation with this type of feedback devices. Proceed as follows:

bit 0=0	Rotary
bit 1=1	With distance-coded I0's
bit 3	The pulse counting direction should've been adjusted already
bit 5	Once the home search is done, move the axis in the positive direction and do a home search again. If the coordinate obtained after the second home search is smaller than the first one, change the sign of the value of parameter PP115.
bit 6=1	Absolute feedback device

Follow these steps to shift the encoder "0":

- Search home.
- Move the axis to the point chosen as machine zero.
- Read the PV53 variable.
- Assign to parameter PP178 the value read in PV53 with the opposite sign.

5.

THE POSITION DRIVE

Feedback with reference marks and distance-coded reference marks



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Parameters setting table for FAGOR rotary encoders with distance-coded reference marks

ROTARY ENCODERS		PULSES PER TURN	NP166	NP165	NP117	NP118	MULTIPLYNG FACTOR
HOP	SOP	18000	1000	1001	18000	x	1
HO	SO	90000	5000	5005	90000	x	5
HO	SO	180000	10000	10010	180000	x	10

NP117 = Number of pulses per turn.

For FAGOR models, NP117 = 18000 x multiplying factor.

NP118 = Not applicable to rotary encoders, ignore it (x)

NP165 = Multiplying factor x number of waves between two consecutive "shifting" distance-coded reference marks.

For FAGOR models, NP165 = multiplying factor x 1001

NP166 = Multiplying factor x number of waves between two consecutive "fixed" distance-coded reference marks.

For FAGOR models, NP166 = multiplying factor x 1000

Multiplying factor. Ratio between the grading pitch of the rotary encoder and its output signal period T.

For FAGOR models, multiplying factor = number of pulses/18000.

Note that the multiplying factor is not explicitly reflected in any parameter of the drive.

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THE POSITION DRIVE
Feedback with reference marks and distance-coded reference marks



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5.2.4 Absolute feedback

The absolute feedback device on Fagor FXM motors registers the value of its angular position throughout ± 1048 revolutions (2096 revolutions) and does not lose it when turning the machine off. See variable **RV5**. Hence, the drive knows from the very first instant the absolute position of the axis.

To locate the machine reference zero at a particular point of the travel, follow these steps:



Warning. Before carrying out any operation, make sure to set the absolute encoder to zero turns with the motor uncoupled from the mechanical transmission. In other words, move the motor released until variable PV51=0 and set parameter PP177=0.

Now, with the motor already coupled to the mechanical transmission:

- Move the axis to the point chosen as machine zero.
- Read variable PV51 (S00051) PositionFeedback1.
- Assign to parameter PP177 (S00177) AbsoluteDistance1 the value read in PV51.

If the absolute feedback device is a direct feedback, follow the same procedure by taking into account PV53 (S00053) PositionFeedback2 and PP178 (S00178) AbsoluteDistance2.



Very important. Note that - PP147 (S00147) HomingParameter, bit 3 - must always be set even when using absolute feedback to indicate whether motor feedback or direct feedback will be used to home the machine.

5.

THE POSITION DRIVE
Absolute feedback

FAGOR 

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5.3 CRC on FAGOR absolute linear encoder models SA/GA

Task available from drive software version 06.20 on.

The FAGOR absolute linear encoder family SA/GA has CRC (Cyclic Redundancy Check) that detects any data alteration during transmission ensuring its integrity.

This check is particularly effective to detect errors caused by noise entering the transmission channels.

The parameter directly involved in this feature is:

RP64	F02364	SSIFCheck
-------------	--------	-----------

that when set to "1", it forces the drive to check if the initial axis position that it receives, measured by a FAGOR absolute linear encoder model SA/GA, has not been altered (by noise or other disturbances) during transmission, hence ensuring the integrity of the data.

If the value of the initial position, sent to the drive by the feedback device, has been altered during transmission, the CRC will detect it and activate error code **E817** on the display of the drive.

For further detail on parameter **RP64** and errors **E814** and **E817**, see chapters 13 and 14 respectively in this manual.

5.

THE POSITION DRIVE
CRC on FAGOR absolute linear encoder models SA/GA



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(Soft 06.2x)

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5.4 Monitoring the reference mark in each encoder revolution.

Task available from drive software version 06.20 on.



Observe that the reference mark monitoring feature is not compatible with FAGOR programmable linear encoders SUD/SVUD.



Observe that when using a Stegmann™ SinCoder™ encoder on your motor and a CAPMOTOR-1 feedback board on your drive, you will not be able to execute this feature.



When using a Stegmann™ SinCoder™ encoder, install a CAPMOTOR-2 on the drive so this task can be executed.

The purpose of this feature is to check the repeatability of the reference mark signal from the feedback device in each revolution of the motor shaft. To do that, the drive runs a permanent watch that confirms that the same number of pulses per turn are generated from the moment the encoder reference signal is detected until it is detected again in the next revolution and so on in the rest of the revolutions.

The parameters directly involved in this feature are:

RP8	F01518	I0DistanceTest
RP9	F01519	I0Margin

that determine whether the task is to be executed or not (RP8) and the maximum deviation in the number of pulses counted between readings of the reference mark (RP9) that is admitted as margin of error in order to consider marker pulse repeatability OK.



Warning. Make sure that feedback used to check I0 repeatability and to set RP8 matches the feedback used to reference the machine as set in bit 3 of parameter PP147. So, when setting RP8=1, check that PP147.bit3=0 and if RP8=2 check that PP147.bit3=1.

Bear in mind that when setting RP8=0, it does not check the I0 (reference mark) repeatability.

This permanent check per revolution makes it possible to detect a feedback error due to lost feedback pulses or because the position of the reference mark has been changed, and it will be shown on the drive's display with the code **E256**.

For further detail on parameters **RP8** and **RP9** and error code **E256**, see chapters 13 and 14 respectively in this manual.

5.

THE POSITION DRIVE
Monitoring the reference mark in each encoder revolution.



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5.5 Backlash compensation

The type of backlash that may be compensated for and that will be described next are:

- Backlash between the table and the ballscrew.
- Backlash in the mounting support of a linear encoder's reader head.
- Backlash between the motor feedback and the direct feedback.

Any of these backlash compensations may be applied in systems configured to work with position control command. The position feedback will either be by motor feedback or by direct feedback, whichever is being used. AP1 will determine the desired configuration.

See chapter 13 in this manual for further information on parameter **AP1**.

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THE POSITION DRIVE
Backlash compensation



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5.5.1 With motor feedback

Table-leadscREW backlash compensation

When using motor feedback (encoder) as position feedback, it may be necessary to compensate for the backlash between the table and the leadscREW when reversing the axis moving direction.

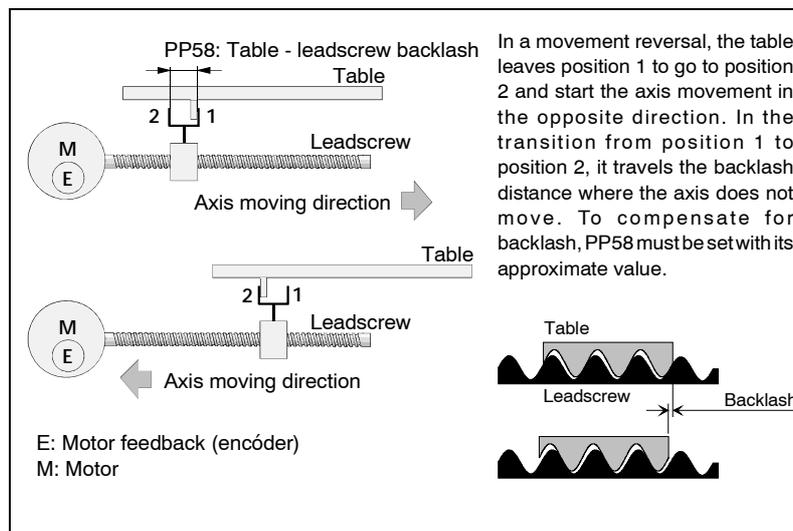


FIGURE S5.13

Table-leadscREW backlash.

The drive **acting internally on the position command** is capable of compensating for the backlash correcting the hysteresis of the movement when the axis reverses its moving direction.

The on-line parameter to adjust the backlash compensation is:

PP58	S00058	Backlash
-------------	--------	----------

And the adjustment will only be applied if:

- the drive is in position control mode.
- and no direct feedback is used.

In other words, the system configuration parameter to set its operation will be AP1= 3 or AP1=11.



Both the drive and the CNC have a parameter to set the value of the table-leadscREW backlash. This value must only be set in one of them; i.e. either at the CNC or at the drive. The other parameter must be set to 0.

Important. The backlash compensation may be adjusted if the software version installed at the drive is older than v.06.10, only with this system configuration, (AP1=3 or AP1=11).



Very important. Setting the backlash compensation mentioned next requires drive software version 06.10 or greater.

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THE POSITION DRIVE
With motor feedback



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5.5.2 With direct feedback

5.
THE POSITION DRIVE
With direct feedback

Table-leadscREW backlash compensation

The drive **acting internally on the velocity command** is capable of compensating for the backlash between the table and the leadscREW, correcting the following error generated when an axis reverses its moving direction. **Table-leadscREW backlash compensation due to movement reversal peak** will be mentioned later on.

The on-line parameters involved in this backlash compensation setting are:

PP2	F01301	BacklashPeakAmplitude
PP3	F01302	BacklashPeakTime

This **reversal peak** backlash compensation is carried out by increasing the motor speed (PP2) for a time period (PP3) so their product **approximately** matches the amount of table-leadscREW backlash.

Reversal peak backlash compensation is given by an exponential function like the one shown in **FIGURE S5.14**:

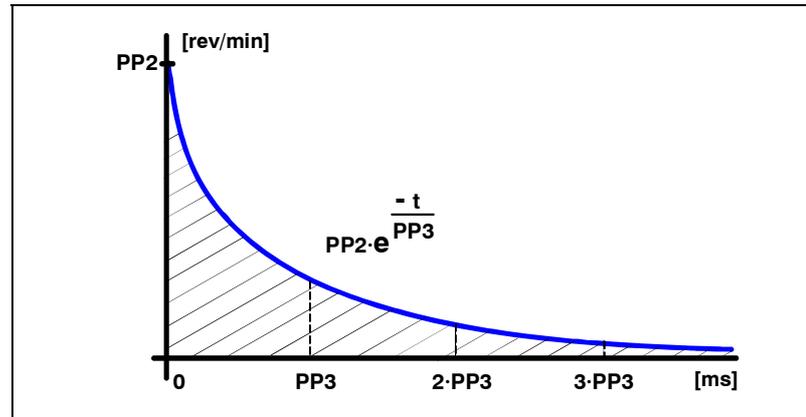


FIGURE S5.14

Exponential compensation of the backlash due to movement reversal peak.

where:

PP2	Initial amplitude in rev/min
PP3	Time constant in ms

The whole area under the curve between (0, infinite) that is equivalent to the integral of the exponential function between those limits represents exactly the table-leadscREW backlash compensation and the area between (0, $\alpha \cdot PP3$) represents an approximate value:

$$\text{Area} \approx PP2 \cdot \alpha \cdot PP3 \approx \text{backlash compensation, with } \alpha = 1, 2, 3$$

Hence, between the values:

0 & 1·PP3	→ it compensates 63% of the backlash
0 & 2·PP3	→ it compensates 87% of the backlash
0 & 3·PP3	→ it compensates 95% of the backlash

Setting of PP2 and PP3

The PP2 value is obtained from the expression:

$$PP2 \text{ (rpm)} \cdot PP3 \text{ (ms)} = \text{Backlash (mm)} \cdot k$$

where:

$$PP3 = 30 \text{ ms (by default)}$$

$$\text{Backlash (mm)} = \text{Backlash measured with a dial indicator.}$$

$$k = \text{unit conversion factor}$$

$$k = \frac{60 \times 1000}{NP122 \times NP123 \text{ (mm)} / NP121}$$

Note. The backlash value measured with the dial indicator is approximate and depending on the dynamic operating conditions may vary slightly.

This ballscrew backlash compensation only takes place if:

- the drive is in position control mode and.
- and direct feedback is used.

In other words, the system configuration parameter to set its operation will be AP1= 4 or AP1=12.

Note. When adjusting it, manipulate both parameters (PP2 & PP3) until minimizing the amount of following error.



Both the drive and the CNC offer parameters setting the value of table-lead-screw backlash. This value must only be set in one of them; i.e. either at the CNC or at the drive. The other parameter must be set to 0.

Compensation of the backlash in the mounting support of a linear encoder's reader head.

Besides the table-leadscrew compensation just described, there may also be a backlash in the reader-head support of a linear encoder when reversing the movement and it can also be compensated for. The drive, acting internally on the position command will be able to compensate for this backlash.

The on-line parameter involved in this backlash compensation setting is:

PP58	S00058	Backlash
-------------	--------	----------

This backlash compensation is only applied if:

- the drive is in position control mode.
- and direct feedback (linear encoder) is used.

i.e. setting AP1=4 or AP1=12.



This backlash compensation has been implemented from drive software version 06.10. This compensation is not possible with older versions.



Important. For compatibility and safety reasons, when updating a 06.10 version or greater from an older one, set with PP58 other than zero (remember that this parameter was in previous versions but only with motor feedback) and position controlled with a linear encoder, it will automatically set this parameter to zero so it behaves like it did before it was updated. After the update, to compensate for a possible backlash on the reader head of the linear encoder, set PP58 with the relevant value.



Both the drive and the CNC offer parameters setting the value of the backlash on the reader head support of the linear encoder. This value must only be set in one of them; i.e. either at the CNC or at the drive. The other parameter must be set to 0.

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THE POSITION DRIVE
With direct feedback



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SOFTWARE**

(Soft 06.2x)

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5.5.3 With both feedbacks

When controlling the position and using both feedbacks (motor feedback and direct feedback), either way the backlash compensation is set in:

PP58	S00058	Backlash
-------------	--------	----------

However, when using motor feedback, this parameter compensates for the table-leadscrew backlash and when using direct feedback, this parameter compensates the backlash on the reader head of the linear encoder.

When using direct feedback, the following parameters must also be set:

PP2	F01301	BacklashPeakAmplitude
PP3	F01302	BacklashPeakTime

to compensate the table-leadscrew backlash due to movement reversal peak because PP58 has been used to compensate the backlash of the reader head.

Therefore, when changing feedbacks on line, since these types of backlash are different, **before** changing feedbacks on line, you must set parameter PP58 accordingly either for motor feedback (table-leadscrew backlash) or for direct feedback (backlash of the reader head of the linear encoder).

Important. These backlash compensations can only be applied when using software version 06.10 or later.

Compensation of the backlash between both feedbacks in movement reversals

Important. This compensation can only be applied when a machine subject to movement reversals does not repeat its behavior in terms of following error.

When using position control and both feedbacks, there could be a relative movement between the two feedbacks before the drive receives a reversal command (e.g. when braking suddenly before reversing the movement). This means that part of the backlash between feedbacks would've been traveled a "d" distance already; therefore, the amount of backlash to compensate for in the reversal (due to reversal peak) would be a certain percentage smaller.

The following on-line parameters are involved when adjusting this backlash:

PP59	F01307	Backlash12
PP2	F01301	BacklashPeakAmplitude
PP3	F01302	BacklashPeakTime

that compensates for the backlash between feedbacks (PP59) with a reversal peak whose value is (PP2·PP3).

PP59	Backlash between feedbacks in mm
PP2	Initial amplitude in rpm
PP3	Time constant in ms

Once the values for these parameters have been entered, the drive, internally calculates the percentage of backlash that it must actually compensate for and recalculates the value of PP2 by multiplying the value it had by a factor of (1-d/PP59).

Setting of PP59

The PP59 backlash value will be set with the value read in PV190 of the oscillograph showing the table movement (use the oscilloscope of the WinDDS-Setup for example). The PV190 variable must be displayed because it provides the value of the difference between feedbacks.

Note. The value of the backlash between feedbacks (PP59) may be obtained using a dial indicator. The result will be the same as the one obtained in the PV190 variable.

Setting of PP2 and PP3

The PP2 value is obtained from the expression:

$$PP2 \text{ (rpm)} \cdot PP3 \text{ (ms)} = \text{Backlash (mm)} \cdot k$$

where:

$$PP3 = 30 \text{ ms (by default)}$$

$$\text{Backlash (mm)} = \text{Value obtained in PV190} - \text{see the oscillograph}$$

k = unit conversion factor:

$$k = \frac{60 \times 1000}{NP122 \times NP123 \text{ (mm)} / NP121}$$

Example.

Let us suppose that the movement of the table is shown on the oscillograph of the figure that shows the following error, the velocity command (SV7) and the difference between feedbacks (PV190). A sudden brake before reversing the table causes a feedback to move a distance "d" with respect to the other one within the backlash.

Let us suppose that PV190 = 20 μM (Backlash between feedbacks) and the movement d = 10 μm (relative movement between feedbacks before reversing the movement). This means that only the percentage of backlash given by e = (1 - d/PP59) must be compensated for, that is = [(1 - 10/20) · PP2] · PP3 = (0.5 · PP2) · PP3. In this example, the drive internally will decrease the set PP2 value to 50% leaving PP3 with the value of 30 ms (by default).

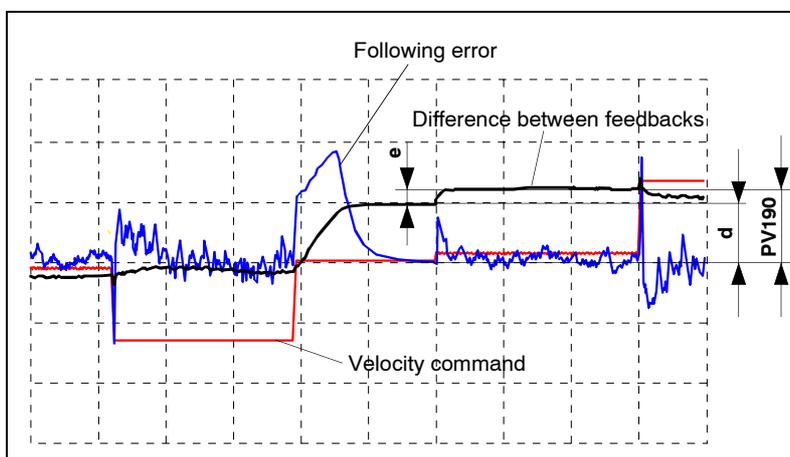


FIGURE S5.15

Oscilloscope showing the behavior of the table in a movement reversal. Obtaining the value of PV190.

Note that the value of PV190 needs not be absolutely exact. Its value obtained on the oscilloscope will be the value to assign to PP59.

There is no need to read the value of "d". The drive does that internally. It is shown here just to inform the user of what it means when we say that a "d" movement has occurred between feedbacks.

There is no need to read the value of "e" either. The drive does that internally too. It is shown here to let the user know of the percentage of backlash that the drive actually compensates for.

5.

THE POSITION DRIVE
With both feedbacks



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THE POSITION DRIVE
Delay of the compensation due to movement reversal peak.

This compensation of the backlash between feedbacks will be applied if:

- the drive is in position control mode.
- it is regulated with both feedback; i.e. the system configuration parameter to set its operation will be AP1= 5 or AP1=13.



The CNC does not have a parameter equivalent to PP59 and, consequently, the compensation of this backlash can only be set at the drive.

Important. This backlash compensation can only be applied when using software version 06.10 or later.

5.5.4 Delay of the compensation due to movement reversal peak.

Important. This backlash compensation delay can only be used with software version 06.10 or later and it is useful when the compensation in a movement reversal takes place too far in advance hence generating small markings on the surface of the machined part.

In order to improve the control on the anticipation of the backlash compensation in a movement reversal with respect to the actual loop position, there is a parameter for delaying the application of this compensation a certain amount time.

The on-line adjustment parameter for this delay is:

PP13	F01304	BacklashPeakDelay
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Hence, a movement reversal in a system configured with position control where the position loop is closed at the drive is carried out as follows:

- The CNC sends out a position increase, with the opposite sign of the previous one; i.e. it sends out the movement reversing command.
- The drive receives this command and orders the backlash compensation in the movement reversal. Internally, it makes this compensation getting ahead of the actual position of the loop.

With this parameter, set to zero by default, it is possible to set a delay in milliseconds for the backlash compensation to be applied. The drive will internally round up the set value to an immediately lower value and multiple of the loop time.



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5.5.5 Improved backlash compensation. Cancellation of the exponential compensation

Important. The backlash compensation due to reversal movement peak when using direct feedback can only be canceled when using software version 06.10 or later. **This feature should always be used** because it is an improvement to the compensation by movement reversal peak. It improves the part finish avoiding markings due to a greater additional velocity command pulse than needed to compensate for the backlash.

An earlier chapter described how the table-lead-screw backlash was compensated for when using direct feedback. Hence, when reversing the movement of the table when applying this exponential compensation due to the reversal movement peak, the product (PP2·PP3) corresponded **in the first approach with the backlash value**.

Now, this approximate backlash value may actually vary depending on the dynamics of the system and then if the backlash is slightly smaller than the one considered, the compensation will have to be canceled (cancellation of the exponential compensation) at the right time. There is now a new on-line parameter to know when the other end of the backlash has been reached and when to cancel the exponential compensation:

PP14	F01305	BacklashPeak2FeedbackDisplacement
-------------	--------	-----------------------------------

This parameter must be assigned the distance the table must move from the instant of the reversal in order to consider that the other end of the backlash has been actually reached and cancel the exponential compensation. The value assigned to this parameter from WinDDSSetup will be in mm when using linear axes or degrees when using rotary axes.

Example.

If PP14 is set to 20 dμm (at the WinDDSSetup, PP14 will be set to 0,0020 mm), when the table has moved this distance after reversing the moving direction, the drive will then consider that the other end of the backlash has been reached and will stop the exponential compensation PP2·PP3 (cancellation of the exponential compensation).

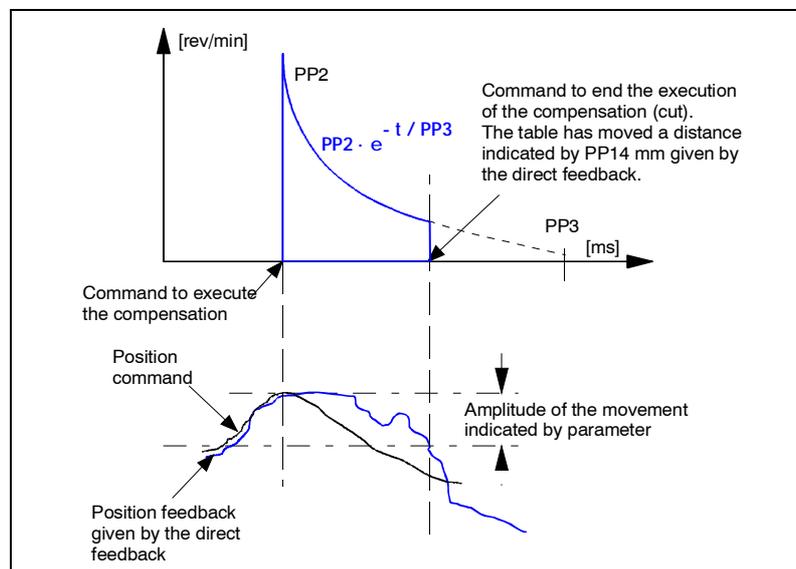


FIGURE S5.16

Cancellation of exponential compensation of the table-lead-screw backlash when using direct feedback. Parameter PP14.



Note that if PP14=0 or PP14= - 0.0001, the exponential compensation of the backlash due to reversal peak will be applied in full; i.e. the cancellation of the exponential compensation will be disabled just like it has been done in earlier versions than 06.10. PP14 is automatically set to - 0.0001 when upgrading to 06.10 or later. For versions 06.10 and later, the default value will be PP14= 0.

Important additional note: If $PP14 \geq 0$ no friction compensation will be applied in the reversal. Until version 06.10, both compensations were applied at the same time.

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THE POSITION DRIVE

Improved backlash compensation. Cancellation of the exponential compensation



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5.5.6 Hysteresis in compensation command

Important. This feature is available from drive software version 06.10 and its application only convenient in situations where very small movement direction reversals occur (for example $\pm 1 \mu\text{m}$). The purpose is to prevent the compensation from launching in the reversal in these situations because it usually leaves markings on the part finish.

Until now, the drive has always given the order to compensate due to reversal peak after detecting a reversal of the table movement following the command given by the CNC. The on-line hysteresis parameter has been added to control when to launch the exponential compensation due to movement reversal peak after detecting a reversal of the movement direction and not to launch it every time a reversal command is received.

PP15	F01306	ReversalHysteresis
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This parameter must be set with the value that the position command given by PV47 must vary after the first movement direction reversal (hysteresis) so the drive considers that it has received the command to compensate, hence avoiding launching compensations every time it receives the command to reverse the moving direction. The value assigned to this parameter from WinDDSSetup will be in mm when using linear axes or degrees when using rotary axes.

Example.

If PP15 has been set to $5 \mu\text{m}$ (from the WinDDSSetup, set PP15 = 0,0005 mm if it is a linear axis), the drive will not activate the reversal compensation in all the reversals after the first one while the position command given by PV47 has not varied at least a value equal to the given in PP15 since the first command to reverse the position command.

In other words, if it receives a reversal command when the position command has changed $2 \mu\text{m}$ from the position where the first reversal command took place, it does not launch the compensation (it has not exceeded the value given in PP15) and it just carries out the movement reversal.

Only when the position command varies $5 \mu\text{m}$, it will launch the compensation and the next command to reverse will be assumed as the new reference used to evaluate the position command variations to determine when the value given in PP15 is reached again and compensate again. See **FIGURE S5.17**.

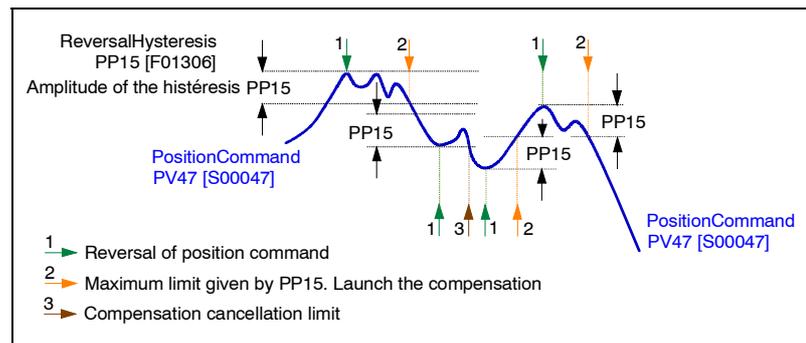


FIGURE S5.17

Compensate or not the backlash (by reversal peak) after detecting a command to reverse the axis moving direction. Parameter PP15.

Note. With **PP15=0**, the exponential compensation of the backlash by reversal peak will be always be applied in every reversal; i.e. without amplitude of hysteresis just like it has been done in drive versions older than 06.10.



5.
THE POSITION DRIVE
Hysteresis in compensation command



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5.5.7 Improved friction compensation

Important. This feature is available from drive software version 06.10 and its application is always useful because it is an improvement.

The friction compensation and backlash compensation (by reversal peak) were applied simultaneously up to drive software version 06.10 which complicated the adjustment. Hence, adjusting the friction compensation and then the backlash compensation optimized the machine's performance. However, if for any reason the friction compensation had to be modified, it was also necessary to readjust the backlash compensation.

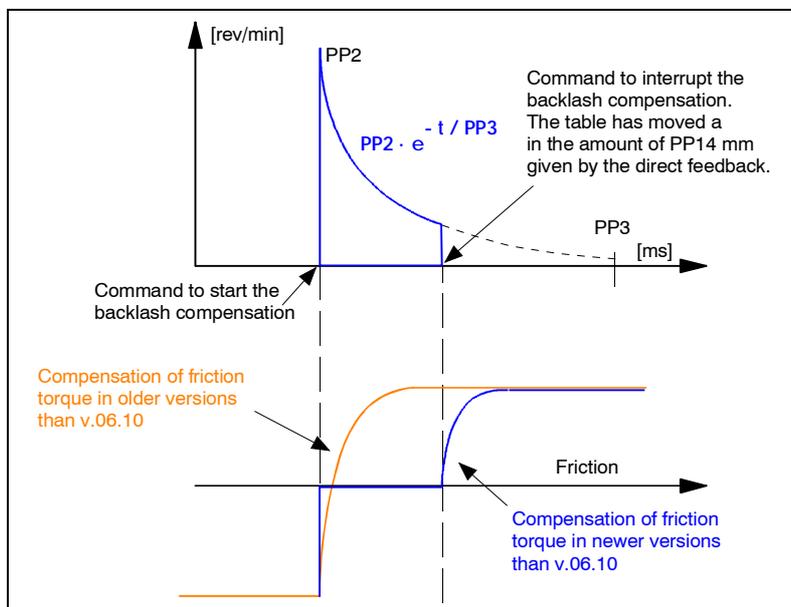


FIGURE S5.18

No compensation of the friction torque in the backlash area.

From drive version 06.10 on, the two compensations are independent and backlash compensation (by reversal peak) cancels the friction compensation. This decision is totally coherent with reality because there is practically no friction in the backlash area. See **FIGURE S5.18**.

On the other hand, this version includes a new on-line parameter to adjust the amplitude of hysteresis in the compensation of friction torque:

TP15	F01909	TorqueCompensationSpeedHysteresis
-------------	--------	-----------------------------------

that allows modifying the amplitude of the hysteresis by parameter to compensate the friction torque. It is set in rpm from the WinDDSSetup.

Note. In versions older than drive software version v.06.10, this friction torque compensation was set to a value of 0.0001 x SP10 (maximum speed of the application).

Now, it is possible to increase this value using parameter TP15 hence solving the problem of certain machines whose Kv value was high and could have noise of that amplitude on the velocity command.

5.

THE POSITION DRIVE
Improved friction compensation



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5.6 Off-line auto-adjustment of the inertia

It is essential to know the actual value of the total inertia J_t (motor inertia + load inertia) of the system in motion to adjust the acceleration feed-forward.

Now a description of how to calculate automatically the inertia parameter NP1 (ratio between the load inertia and the motor rotor) in off-line mode while adjusting the machine.

Note that, according to this calculation of NP1 for PP217 value of 100% with:

- **Motor feedback**, the following error is practically reduced to 0.
- **Direct feedback** and depending on the quality of the machine (backlash between the table and the leadscrew) this factor determines how much the following error will be reduced.

This feature affects the following parameters:

□ **Friction related**

TP10	F01902	ConstantPositiveTorqueCompensation
TP11	F01903	ConstantNegativeTorqueCompensation
TP12	F01904	DynamicPositiveTorqueCompensation
TP13	F01905	DynamicNegativeTorqueCompensation

□ **Inertia related**

NP1	F02200	ReducedActuatedMomentumOfInertiaPercentage
------------	--------	--------------------------------------------

All these parameters are on-line, that is, with immediate effect and, therefore, after executing the feature with the command

GC5	F00615	AutoCalculate
------------	--------	---------------

it recalculates all of them and overwrites them with the new calculated values.

To determine the auto-adjustment of these parameters, the following sequence of movements must be programmed at the CNC :

1. Movement at a constant low speed (e.g.: 50 rpm).
2. Movement at a constant high speed (e.g.: half the motor rated speed).
3. Noticeable acceleration between both movements (e.g.: 2000 mm/s²)
4. Duration of the movements at constant speed (between 1 and 5 s).



Warning. Observe that the real speed and acceleration values must coincide with the values programmed at the CNC. If not, make the necessary adjustments on the machine until obtaining the indicated values (e.g.: set the velocity feed-forward with parameter PP216).



Warning. The maximum total reciprocating (back-and-forth) cycle time will not exceed 25 seconds.

When the machine is in motion, execute the GC5 command and wait for it to be completed.

Check the values of all the parameters mentioned earlier.

If after the calculation, you wish to keep this parameter setting, save them into flash memory using the relevant icon of the WinDDSSetup or the GC1 command.

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THE POSITION DRIVE
Off-line auto-adjustment of the inertia



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The minimum requirements of the programmed movement needed for auto-adjustment of the inertia may be seen in **FIGURE S5.19**:

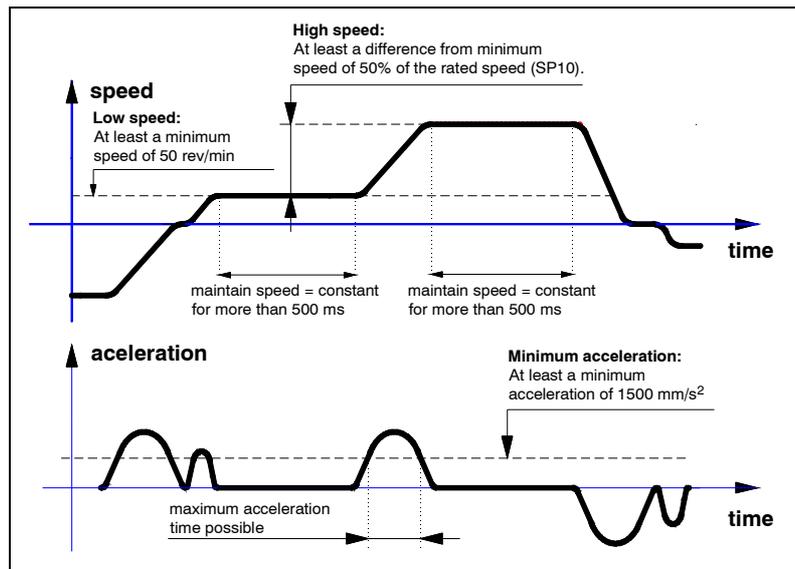


FIGURE S5.19

Movement programmed to auto-adjust the inertia in off-line mode.

5.

THE POSITION DRIVE
Off-line auto-adjustment of the inertia



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5.7 Following error monitoring

The monitoring of following error prevents the axes from running away.

The drive compares these parameters:

PV189	S00189	FollowingError
PP159	S00159	MonitoringWindow

If $\text{FollowingError} > \text{MonitoringWindow}$ means that the servo system follows the command with an excessive delay and it triggers the error message:

E156	DV1 (S00011), bit 11	ExcessiveFollowingError
-------------	----------------------	-------------------------

This monitoring of the following error is only done if:

- The drive is in position control mode.
See parameter **AP1** in chapter 13 of this manual.
- Parameter MonitoringWindow is other than zero. ($\text{PP159} > 0$).
- There is motor torque. ($\text{TV100} = 1$).



Warning. If parameter PP159 (S00159) MonitoringWindow is zero, the following error will not be monitored. It is very important to set it to a value other than zero to prevent the axes from running away out of control.

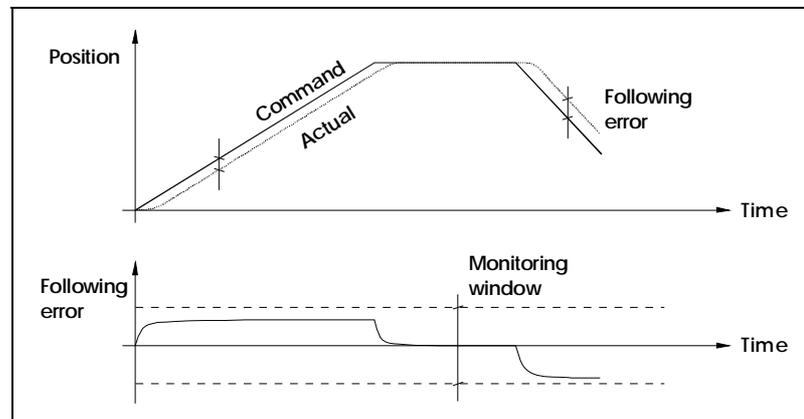


FIGURE S5.20

Following error monitoring.

The CNC also monitors the maximum following error allowed by setting its corresponding parameter in the parameter table of each axis at the CNC.

5.8 Module format

The drive can work in module format. This format is mainly used on rotary axes. This means that it is ready to handle the full mechanical travel of the axis by means of command or feedback data restricted to a range of values; usually between 0 and 360°.

This range of values is set by parameter:

PP103	S00103	ModuleValue
--------------	--------	-------------

The drive configuration in module or absolute format is set by bit 7 of parameter:

PP76	S00076	PositionDataScalingType
-------------	--------	-------------------------

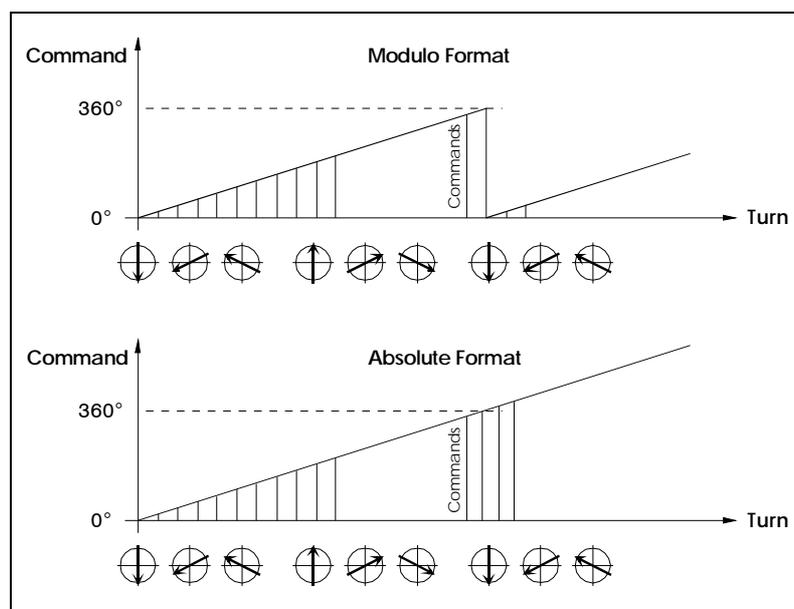


FIGURE S5.21

Module format.

In module format, the drive does not admit velocity commands whose absolute value is higher than PP103.



Warning. Verify that the CNC defines that axis the same way (module or linear format).

5.9 Position limits

The axis travel limits are set by parameters:

PP49	S00049	PositivePositionLimit
PP50	S00050	NegativePositionLimit

This establishes a permitted zone and a forbidden zone for the axis movement.

Any position command given in the variable:

PV47	S00047	PositionCommand
-------------	--------	-----------------

that implies a penetration into the forbidden zone will generate error code **E150**.

For further detail about these parameters, see chapter 13.
Chapter 14 describes the definitions of the error codes.

The position limits may be deactivated by setting bit 4 of parameter PP55 to zero (PP55.4=0) or setting PP49=0 and PP50=0; both conditions need not be met at the same time.

Error code **E150** will not be generated if any of these two conditions is met.

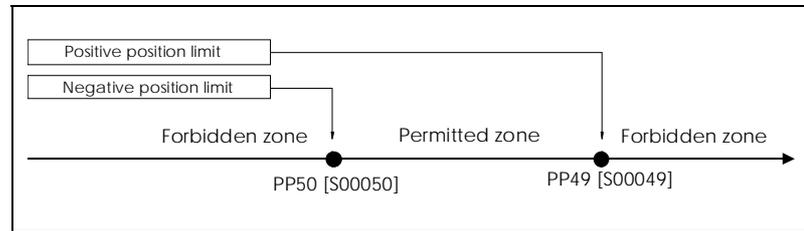


FIGURE S5.22

Position limits.

5.
THE POSITION DRIVE
Position limits

5.10 On-line feedback change

With software version 04.01 of the drive, it could only be regulated with the feedback chosen in the initial parameter setting. Hence, if at a given instant, it were necessary to switch from direct feedback to motor feedback or vice versa, it would have to be turned off and change the relevant parameters.

Many Motion Control applications require changing feedback on line without having to power the unit down, save parameters or reset the drive.

Software version 04.02 already implemented the possibility of changing the feedback on-line.

5.10.1 Mode of operation and parameter setting

Before having this feature, there were two different ways to regulate in position with each one of the possible feedback types.

The operating mode was defined with parameter:

AP1	S00032	PrimaryOperationMode
------------	--------	----------------------

Hence:

AP1=3	Position and motor feedback
AP1=11	Position and motor feedback with feed-forward
AP1=4	Position and direct feedback
AP1=12	Position and direct feedback with feed-forward

This new feature offers two more modes:

AP1=5	Position and both feedbacks
AP1=13	Position and both feedbacks with feed-forward

these two modes are the ones allowing the on-line change of feedback that closes the position loop.

The command that executes the feedback change is:

PC150	F02003	ChangePosFB12
--------------	--------	---------------

that is executed setting PC150=3 (from WinDDSSetup) to change from a motor feedback to a direct feedback.

It returns a value of 7 (ok) when the command is executed correctly, and a value of 15 (error) when executed incorrectly.

When executed correctly, it allows switching to direct feedback. Returning to motor feedback requires setting the command PC150 to 0.

Every time this command is executed, the direct feedback will be equaled to the motor feedback hence preventing a jerk due to an error between feedbacks.



Warning. The motor feedback will be the first one used to close the position loop. Therefore, it will depend on the CNC or on the Motion Control program whether on power-up it executes the command to start regulating with direct feedback or not.

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THE POSITION DRIVE
On-line feedback change

5.10.2 Home search with any feedback

Use the two operating modes defined in AP1 with the values of 5 and 13 to do a home search with any of the two feedbacks regardless of which one has been set.

Bit 3 of parameter PP147 indicates which feedback will be used for home search.

These are all possibilities:

With AP1=5 or AP1=13:

1. Regulation and home search with motor feedback

- The command PC150=0
- Bit 3 of parameter PP147=0

This operating mode is the same as the one given by AP1=3 or AP1=11, forcing the home search to be carried out on the motor feedback.

2. Regulation and home search on direct feedback

- The command PC150=3
- Bit 3 of parameter PP147=1

This operating mode is the same as the one given by AP1=4 or AP1=12, forcing the home search to be carried out on the direct feedback.

3. Regulation with motor feedback and home search on the direct feedback

- The command PC150=0
- Bit 3 of parameter PP147=1

With this setting, the reference mark is that of the direct feedback.

Since both feedbacks must have same coordinate, it calculates PV173 (S00173) MarkerPositionA as PV53 (S00053) PositionFeedback2.

It takes the offset values of the home search on the direct feedback and it calculates the distance to move in the coordinates of PV47, PV51 and PV53 to switch to the new coordinate system.

4. Regulation with direct feedback and home search with motor feedback

- The command PC150=3
- Bit 3 of parameter PP147=0

With this setting, the reference mark is that of the motor feedback.

Warning. The feedback cannot be changed on line while moving. **The motor must be stopped !** Also, before changing the feedback, one must verify that their parameters have been properly set. To do that, either check that the value of PV190 (that indicates the error between both feedbacks) is not too high or use parameter PP5.



5.11 Maximum error allowed between feedbacks.

Parameter:

PP5	F00391	ActualPositionMonitoringWindow
------------	--------	--------------------------------

sets the maximum error allowed between the motor feedback and the direct feedback. This way, when comparing the value of the direct position feedback (this difference may be viewed in PV190), if its deviation exceeds the value set in this parameter PP5 for more than 20 ms, the drive issues error **E157** Excessive ActualPosition Difference - DV11 (S00011), bit 11 -.

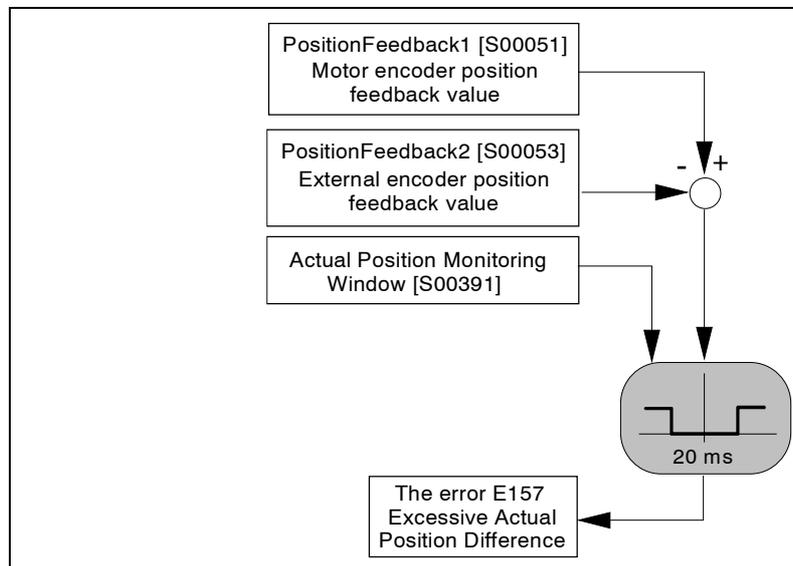


FIGURE S5.23

Maximum error allowed between feedbacks.

Considering that the purpose of this parameter is to offer an additional safety margin in applications that use an external measuring system, it should be set to a value other than zero for external square-wave feedback because there are no other monitoring systems for this case.

Remember that if PP5=0, the difference error between feedbacks will not be monitored.

From software version 06.09 on, it is possible to set PP5= - 0.0001 making the feedbacks fully independent.

Remember that if PP5= - 0.0001, the error difference between feedbacks is not monitored and the feedbacks are not equaled when searching home; therefore, the feedback not used to search home will not be applied the coordinate offset.

This new feature makes it possible to connect to the direct feedback a linear encoder or other feedback device that may be read by a CNC or a PLC and carry out the relevant operations.

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THE POSITION DRIVE
Maximum error allowed between feedbacks.



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5.12 Combined feedback

Usually, machines with large mechanical backlash suffer vibrations that make them unstable and have a negative effect on the position control of systems that use direct feedback (linear encoder). This does not occur when using motor feedback (encoder) to control position since the performance of this type of machines is totally stable.

The purpose of this feature, included in drive software version 06.12, is to obtain a position control with direct feedback on these machines as good as that obtained with motor feedback. This is achieved by combining feedbacks, temporarily, when the machine tends to suffer from vibrations and always controlling position with direct feedback when the vibration causing instability comes up.

The block diagram of the position loop may look like this:

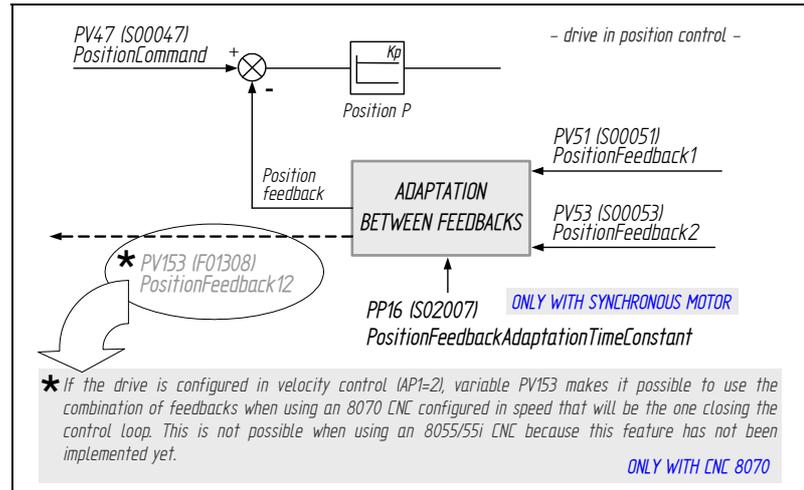


FIGURE S5- 24

Block diagram of the position control with a temporary adaptation change between feedbacks.

To set the time constant for position feedback adaptation, set parameters:

PP16	F02007	PositionFeedbackAdaptationTimeConstant
-------------	--------	----------------------------------------

that sets the delay between the coordinates that are inserted into the position loop of the rotary and linear encoders. See parameter **PP16** and **PV153** variable in chapter 13 of this manual.

5.12.1 Procedure

- Set parameter PP16 (F02007) at first with a value between 10 and 300 ms. For example: 100 ms.
- Increase the value set earlier in 30 ms increments when noticing oscillations in the accelerations or decelerations until the system becomes stable.
- Once the system is stable, decrease the set value in 10 ms decrements until reaching the minimum value of PP16 that makes the system stable.



Observe that, this procedure may be used to control the vibrations during the whole movement as if it were a system whose position control is done with motor feedback but with the positioning accuracy of a direct feedback.

Setting PP16=0 means configuring the position control with direct feedback (linear encoder) whereas setting PP16=3200 (meaning high values) means configuring the position control with motor feedback (rotary encoder).

5.13 Compensation of the elastic deformation in the coupling of an axis



This feature is available from drive version 06.16 on and it should be applied on machines whose dynamics causes significant elastic deformation on the transmission system (coupling) of each axis generating unacceptable deviations on any path followed by the tool tip in machining processes, cutting processes etc. that cannot be compensated by the control loops because they are out of the measuring system.

5.13.1 Prior considerations

Note. Pay special attention to the following considerations

This feature may be applied to any machine that **only** uses motor feedback regardless of the type of path the tool tip will follow.

This chapter analyzes the dynamic behavior of the machine when the tool tip follows a circular path (since it is an easy geometric shape for measuring path deviations) in order to obtain the value of the elastic deformation compensation on each axis of the machine.

That's why most of the mathematical expressions appearing in this chapter are only to be applied to circular paths.

If the user wishes to analyze the elastic deformations on his machine by running some tests with other more complex tool paths, he will not be able to apply some of the expressions shown here.

The numerical data appearing in their examples are merely illustrative. Do not copy this data to run your tests. Remember that each machining operation that the machine carries out requires very specific cutting and working conditions that rarely coincide with the data shown in the examples.

5.13.2 Elastic deformation in the coupling of an axis

Let us suppose a system consisting of a servo motor with its position feedback, an elastic coupling and the tool tip.. See figure.

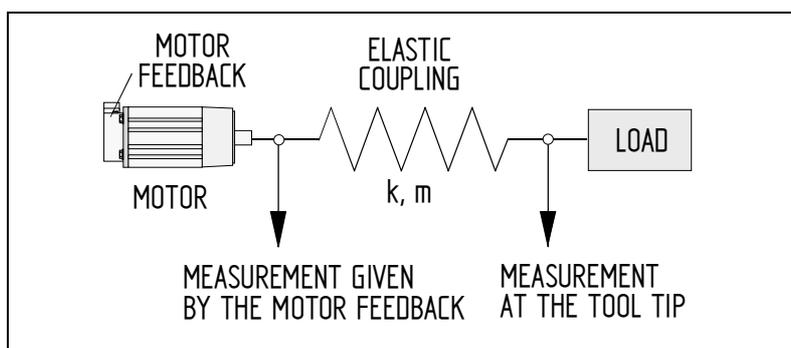


FIGURE S5.25

Diagram.

When the system starts moving, if the coupling would ideally not be deformed, the position of the tool tip would strictly follow the path that the part program of the CNC commanded and it would be the same as the position given by the feedback device integrated into the motor.

However, assuming that the coupling cannot be deformed is not realistic. Therefore, while moving, the coupling suffers an elastic deformation more or less significant depending on its acceleration; i.e. of the relative feedrate between the tool tip and the table that affects, to a greater or lesser degree, the path to follow. Then, the path demanded by the part-program of the CNC is not truthfully followed by the tool tip, there is a deviation due to the elastic deformation of the axis coupling.

5.

THE POSITION DRIVE
Dynamic factors that affect elastic deformation.

This path deviation is not measured by the motor position feedback device because it is located just before the elastic coupling and, consequently, it is not aware of this deformation. This is why there is no deviation for the control loops of the drive to compensate.

In this scenario where this deviation is not measured and, even if it is, it cannot be compensated for by increasing the proportional gain of the system in the control loops, this deviation must be compensated using the on-line parameter:

PP20.#	F02020.#	DynamicDeformationFrequency
--------	----------	-----------------------------

setting it with the value of the resonance frequency (in Hz) associated with the elastic coupling. The procedure to obtain this frequency will be described later on.

5.13.3 Dynamic factors that affect elastic deformation.

The deformation suffered by an elastic mechanical system subject to a force is given by the formula:

$$\text{Force} = k \cdot \Delta x$$

where:

k elastic constant

Δx amount of deformation

Also knowing that:

$$\text{Force} = m \cdot a$$

where:

m mass of all moving elements

a system acceleration

and replacing its value in the previous formula we get the equation:

$$m \cdot a = k \cdot \Delta x$$

Deformation is, therefore, proportional to acceleration:

$$\Delta x = \frac{m}{k} \cdot a = \text{Cte} \cdot a$$

For a circular path, recommended to be used in the machining tests for adjusting the compensation of elastic deformation because it is a comfortable geometrical shape for taking measurements, normal acceleration is given by the formula:

Only applicable to circular paths	$a = \frac{[F/60]^2}{R}$
-----------------------------------	--------------------------

where:

R Radius of the circular path followed by the tool tip. Enter its value in meters (m),

F Feedrate of the tool tip as long as the table is not moving. If the tool and the table are moving, F will be the relative feedrate between them.. Enter its value in meters per minute (m/min),



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Conclusions

The elastic deformation on the axis of a machine is directly proportional to the acceleration and when its dynamics is a circular path, it is also directly proportional to the square of the feedrate.

Therefore, the higher the relative feedrate between the tool tip and the table, the more significant the elastic deformation will be.

Machining a part following a circular path at low feedrate considering the elastic deformation only on one axis or on both implies practically getting the desired circular path because the path deviation suffered on the axes will be very small. It will not be a perfect circle, but, in practice, it will not be necessary to compensate for elastic deformation.

Machining a part following a circular path at high feedrate considering the elastic deformation only on one axis or on both implies getting an elliptic path because the path deviation suffered on the axes will be considerable. The other main radius of the ellipse will be the same as the radius of the circular path when assuming that there was no elastic deformation on the other axis. Considering elastic deformation on both axes will also result in an elliptic path where none of the two main radii coincides with the radius of the programmed circular path.

To compensate these deformations, set parameter PP20 for each axis with the value of the resonance frequency of its elastic coupling. See the procedure to obtain this frequency in the next section.

Remarks

Before compensating the elastic deformation, the CNC will always display a circular path, not elliptical as could be expected because there is elastic deformation. The motor feedback is placed before the elastic coupling and does not register the path deviation due to elastic deformation at all.

After compensating the elastic deformation, the CNC will always display an elliptical path, not circular as could be expected after compensating the elastic deformation..

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THE POSITION DRIVE

Adjusting the compensation. How to set PP20

5.13.4 Adjusting the compensation. How to set PP20

The value of the resonance frequency of the elastic coupling for compensating the elastic deformation may be obtained with two different procedures. One of them based on the Bode diagrams of the machine and the other by running a machining test. Set PP20 with the frequency value obtained.

How to obtain the resonance frequency of the elastic coupling according to its Bode diagram

Let us suppose a block diagram representing the model of a machine like in the figure.

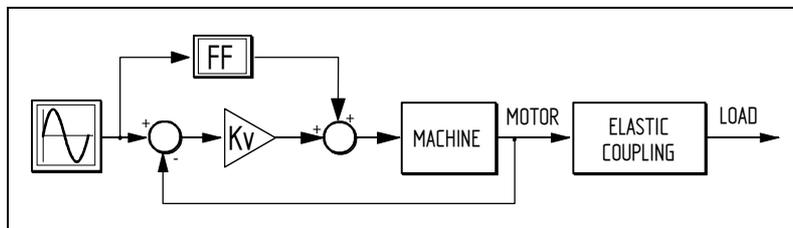


FIGURE S5.26

Block diagram of a machine with motor feedback and elastic deformation of the coupling mounted between the motor feedback and the tool tip.

Observe that the block that represents the elastic deformation is located between the motor feedback and the tool tip.



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Adjusting the compensation. How to set PP20

An indirect way to obtain the frequency is using the Bode diagram obtained from the <speed-current command> of the motor.

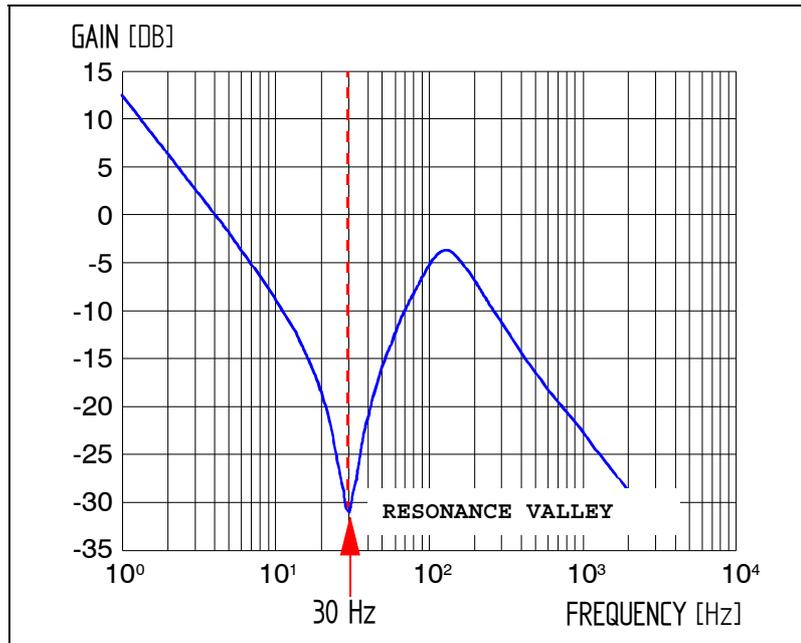


FIGURE S5.27

Ideal theoretical < speed-current command > Bode diagram of the motor.

The frequency value to set PP2 is 30 Hz.

Note. Bear in mind that the Bode diagram shown earlier is an ideal theoretical diagram.

The Bode diagram obtained on real machines corresponds better to the one shown next:

Real Bode Diagram - CURRENT COMMAND / MOTOR SPEED

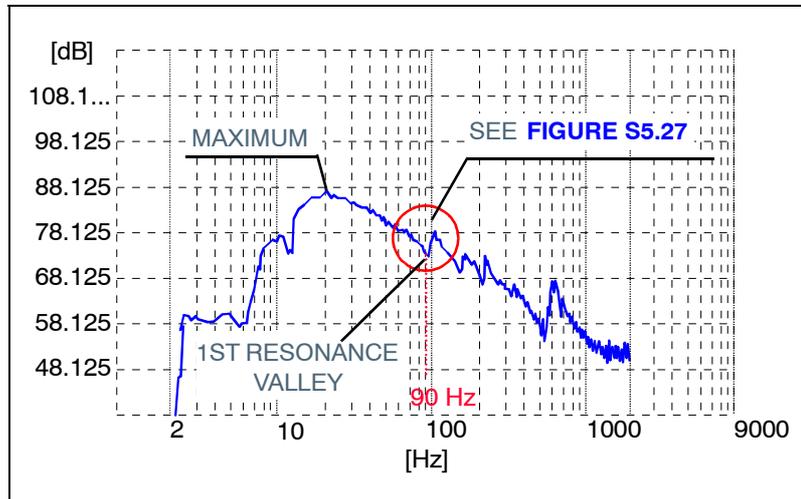


FIGURE S5.28

Real < speed-current command > Bode diagram of the motor.

The resonance valley representing the elastic deformation in this Bode diagram will always be the first one appearing after exceeding the maximum indicated in the figure. The frequency value for setting PP20 must be read in the abscissa axis of the diagram and needs not be exact, just approximate. Set PP20=90 Hz.



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How to obtain the resonance frequency of the elastic coupling by running a machining test

When not having a Bode diagram of the machine or wishing to apply the compensation with a frequency value obtained empirically, proceed as described in this section.

From the formula of the oscillation frequency of a simple harmonic movement (s.h.m.) it is possible to obtain its relationship with acceleration and deformation through this equation:

$$f = \frac{1}{2\pi} \cdot \sqrt{\frac{k}{m}} = \frac{1}{2\pi} \cdot \sqrt{\frac{a}{\Delta x}}$$

For a circular path, the Δx deviation with respect to R may be obtained directly by measuring the part that has been previously machined.

The acceleration of the system is calculated from the formula shown earlier: $a = (F/60)^2 / R$.

With these values, now determined, the formula of the frequency provides the value for setting PP20 to compensate the elastic deformation caused in that axis.

Example.

To adjust the compensation of elastic deformation caused in the X axis of a laser cutting machine. The machine has two servo motors with position feedback that move the tool tip in a plane defined by the X and Y axes. Supposing that only the X axis has an elastic coupling.

Its purpose is to drill circular holes with a radius $R = 5 \text{ mm} = 0.005 \text{ m}$ at high speed on a sheet metal that rests on fixed frame.

To obtain the frequency value for setting PP20 to compensate the elastic compensation on the X axis, proceed as follows.

1. Make a hole keeping the tool tip at high feedrate, for example, $F 8000 \text{ mm/min}$ in order to cause high deviation Δx and generate a clear elliptical path.
2. Once the hole has been made, use a caliper to measure the various diameters of the elliptical hole until obtaining the diameter of the larger axis D_m of the ellipse. Observe that the elliptical shape will not be visually noticeable.

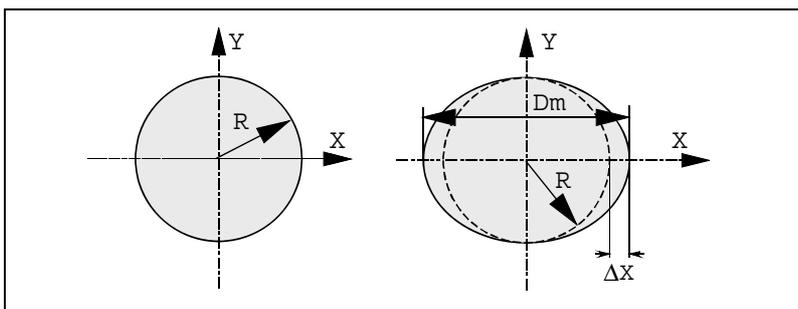


FIGURE S5.29

The real shape is elliptical, not circular, when only the X axis suffers elastic deformation.

3. Obtain the value of the elastic deformation from the formula:

$$\Delta x = \frac{D_m}{2} - R$$

Let us suppose (for the sake of using numbers) that the deformation value is: $\Delta x = 90 \mu\text{m} = 90 \times 10^{-6} \text{ m}$.

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Adjusting the compensation. How to set PP20



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THE POSITION DRIVE

Adjusting the compensation. How to set PP20

4. Obtain the acceleration value for a circular path from the formula:

$$a = \frac{[F/60]^2}{R} = \frac{[8/60]^2}{0.005} = 3.6 \text{ m/s}^2$$

5. Obtain the frequency value from the formula:

$$f = \frac{1}{2\pi} \cdot \sqrt{\frac{a}{\Delta x}} = \frac{1}{2\pi} \cdot \sqrt{\frac{3,6}{90 \times 10^{-6}}} = 31.8 \text{ Hz}$$

6. Set PP20 with the obtained value, i.e. PP20 = 31.8 Hz.
7. Verify that after setting PP20, your particular part is machined properly regardless of the path of its profile.



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6.1 General parameters

General parameters	
AP1	It selects how the drive will operate
3	Position loop with motor feedback without feed-forward
4	Position loop with motor feedback without feed-forward
5	Position loop with motor feedback without feed-forward
11	Position loop with motor feedback and feed-forward
12	Position loop with motor feedback without feed-forward
13	Position loop with motor feedback without feed-forward.
GP10	Direct feedback signal type. Classic method. See section "Direct feedback. Parameter setting" of chapter 5 for further information on the bits method.
0	No direct feedback
1	Square TTL signal
2	1 Vpp sinewave signal
3	Signal from a Stegmann feedback device
4	TTL square signal with SSI communication.
5	1 Vpp sinusoidal signal with SSI communication.
GP2	Motor feedback type. Classic method. See section "motor feedback. Parameter setting" of chapter 5 for further information on the bits method.
0	Sinusoidal encoder
1	Resolver
2	Encoder with square TTL signal
5	Heidenhain encoder (ERN 1387) for Siemens motors, 1FT6 family.
6	Sinusoidal encoder (for spindles only)
7	Without feedback

With motor feedback (AP1=3 or AP1=11).

The following parameters are ignored:

PP54	Refvalue with direct feedback
PP115	Parameter setting for direct feedback
NP117	Pitch/pulses setting for direct feedback

With direct feedback (AP1=4 or AP1=12).

The following parameters are ignored:

PP150	Refshift for motor feedback
PP52	Refvalue with motor feedback

6.

SETUP SUMMARY
General parameters

- If the direct feedback is an absolute linear encoder.

Parameters for using absolute direct feedback. SSI Communications	
GP10	Electrical signal provided by the direct feedback.
4	TTL square signal with SSI interface.
5	1 Vpp signal with SSI interface.
RP60	Frequency supported by the drive's clock.
RP61	SSI data size in bits.
RP62	SSI data format.
	Binary code (bit 0 = 0) or Gray code (bit 0 = 1)
	Normal (bit 1 = 0) or Firtree (bit 1 = 1)
RP63	Resolution value of the absolute linear feedback device with SSI digital communication protocol. It must be set in μm .
	Number of bits per turn of the absolute rotary feedback device with SSI digital communication protocol. It must be set in bits.

The parameters of the Fagor absolute linear encoder with SSI interface are set to the following default values:

RP60 = 200 kHz	Frequency supported by the drive's clock
RP61 = 32 bits	SSI data size in bits
RP62 = 0	The SSI data comes in Binary code
RP63 = 1 μm	Resolution of the absolute linear encoder.

Note that for other absolute feedback devices with SSI communications protocol, the values for parameters RP61 and RP62 must be provided by the manufacturer.



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6.2 Parameters related to the velocity estimator

Parameters of the velocity estimator	
SP15	Cutoff frequency of the low passing filter of the velocity estimator.
SP16	Damping factor of the low passing filter of the velocity estimator.
SP17	Velocity estimator ON (1) or OFF (0).

6.3 Sensorless related parameters

Parameters for Sensorless	
AP2 = 1	"Sensorless" type vector control based on the voltage model.
FP50	Value of the proportional gain of the PI used to estimate the speed of an asynchronous motor with Sensorless type control.
FP51	Value of the integral gain of the PI used to estimate the speed of an asynchronous motor with Sensorless type control.
FP60	Cutoff frequency of the voltage model filter.

6.4 Resolution related parameters

Resolution related parameters.	
PP115	Parameter setting for direct feedback
bit 5	Structure of distance-coded reference marks (I0's) bit 5 = 0 → positive count in the positive direction bit 5 = 1 → negative count in the negative direction
bit 3	Feedback direction bit 3 = 0 → not inverted bit 3 = 1 → inverted
bit 1	Does the feedback have distance-coded reference marks (I0) ? bit 1 = 0 → no distance-coded I0's bit 1 = 1 → with distance-coded I0's. See NP165 and NP166 .
bit 0	Type of direct feedback bit 0 = 0 → rotary (encoder). NP117 will give pulses per turn. bit 0 = 1 → linear encoder (scale). NP118 will give the signal period.
NP117	Resolution of the rotary feedback in direct feedback.
NP118	Resolution of the linear feedback in direct feedback. (linear encoders only) Period of the linear encoder signal. 20 μm for Fagor linear encoders (graduated glass) , S00118 = 20 μm.
NP121	The NP121/NP122 ratio indicates the gear ratio between the motor and the ballscrew. It only admits integers up to 32767.
NP122	
NP123	Ballscrew pitch. If it is a rotary axis, set NP123 = 360000.
NP131	The NP131/NP132 ratio indicates the mechanical (gear) ratio between the direct feedback and the movement of the load. It only admits integers up to 32767.
NP132	
NP133	Linear movement of the axis per revolution of the direct feedback encoder. Rotary axis: NP133 = 0. Linear axis with linear direct feedback: NP133 = 0. Linear axis with rotary direct feedback: NP133 = 0 → The linear movement per number of turns is the same for both encoders. NP133 ≠ 0 → The linear movement per number of turns is different for the two encoders.

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Parameters related to the velocity estimator



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6.5 Parameters to identify a linear feedback with distance coded reference marks

Parameters to identify a linear feedback with distance coded reference marks	
NP165	Distance between reference marks.
NP166	Distance between I0's, within the group of the ones closest

6.6 Home switch parameters

Home switch parameters	
PP147	Setting of the home search
bit 5	Home switch
	bit 5 = 0 → the home switch is evaluated (by default)
	bit 5 = 1 → the home switch is not evaluated
bit 3	Feedback used
	bit 3 = 0 → motor feedback. See PP52 and PP150 .
	bit 3 = 1 → direct feedback. See PP54 and PP151 .
bit 1	Status of the home switch
	bit 1 = 0 → normally open
	bit 1 = 1 → normally closed
bit 0	Motor shaft turning direction in the home search
	bit 0 = 0 → clockwise
	bit 0 = 1 → counterclockwise

For a home search with any of the two feedbacks regardless of which is being used for regulation, bit 3 of parameter PP147 sets which one will be used in the home search. - See the previous table -. When using the 8070 CNC, take the electrical contact "home switch" to one of the digital inputs.

PP1	Slow motor speed during home search when controlled by the drive itself.
PP4	Home switch shift (by software) to avoid reference mark repeatability problems when searching home.
PP41	Fast motor speed when the home search is controlled by the drive itself.
PP42	Acceleration of the movements when searching home.
PP52	Machine reference point position (home) with respect to machine reference zero, (Refvalue motor feedback).
PP54	Machine reference point position (home) with respect to machine reference zero, (Refvalue direct feedback).

Parameters PP52 and PP54 of the drive are equivalent to axis parameters REFVALUE (P53) of the 8055/55i CNC.

PP150	Position of the reference mark with respect to the machine reference point (home), (Refshift motor feedback).
PP151	Position of the reference mark with respect to the machine reference point (home), (Refshift direct feedback).

Parameters PP150 and PP151 of the drive are equivalent to axis parameter REFSHIFT (P47) of the 8055/55i CNC except that the drive does not move to return to the REFVALUE (P53) position. Homing method. The home switch may be connected directly to the PLC or to the drive.

Very important. Note that - PP147 (S00147) HomingParameter, bit 3 - must always be set even when using absolute feedback (without home search) to indicate whether motor feedback or direct feedback will be used to home the machine.



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 Parameters to identify a linear feedback with distance coded reference marks



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6.7 Gain related parameters

Gain related parameters	
PP104	Proportional gain in the position loop. It is similar to parameter PROGAIN (P23) of the axes of the 8055/55i CNC. PP104=1 means a following error of 1 mm at F1000 mm/min.
PP216	Percentage of velocity feed-forward (0 to 100 %). It is similar to parameter FFGAIN (P25) of the axes of the 8055/55i CNC.
PP159	Maximum amount of following error permitted. If this parameter is set to zero, the following error will not be monitored. It is very important to set it to a value other than zero to prevent the axes from running away out of control. The CNC also monitors the maximum following error allowed by setting its corresponding parameter in the parameter table of each axis at the CNC.
PV189	Monitoring of the following error.

6.8 Various parameters for the position loop

Various parameters for the position loop	
PP49	Indicate the maximum position that can be reached by the servo system in both positive and negative directions respectively. These limits are observed only when all the position data is referred to machine reference zero, i.e. bit 0 of PV203=1.
PP50	

If the variable **PV58 (S00058) TargetPosition** exceeds the position limits, the drive will activate bit 13 of DV9.

The CNC also observes the travel limits defined in its axis parameter tables.

PP55	Position data polarity control
bit 4	Position limits. bit 4 = 0 → Deactivates the position limits. bit 4 = 1 → Active (by default). See PP49 and PP50 .
bit 3	Direct feedback counting sign. bit 3 = 0 → positive. bit 3 = 1 → negative (by default).
bit 2	Motor feedback counting sign. bit 2 = 0 → positive. bit 2 = 1 → negative (by default).
bit 0	Position command sign. bit 0 = 0 → positive. bit 0 = 1 → negative (by default).
PP58	Ballscrew error. With motor feedback , the drive compensates for the backlash when changing movement direction. Backlash in the mounting support of a linear encoder's reader head. With direct feedback , the drive compensates for this backlash when changing movement direction.
PP59	Backlash between feedbacks.
PP2	Leadscrew backlash. With direct feedback, the drive compensates for the backlash when changing movement direction. Reversal peak.
PP3	

Both the drive and the CNC offer parameters setting the value of ballscrew backlash. The value must only be registered in one of them. The parameter of the other one must be set to 0.

PP13	Cancellation of exponential compensation of the backlash due to movement reversal peak.
PP14	Hysteresis in the exponential compensation of the backlash due to a movement reversal peak.

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Gain related parameters

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Parameters only to be used in MC applications

PP15	Improved friction compensation. Zero compensation of the friction during the exponential compensation of the backlash due to movement reversal peak.
PP16	Improvements in the position control of machines with large backlash and direct feedback (linear encoder). Adaptation time constant for combining motor feedback and direct feedback.
PP20	Compensation of elastic deformation of the mechanical transmission.
PP76	Command application in module format. Note that the CNC must define the axis the same way (module or absolute format).
bit 7	Module format selection.
	bit 7 = 0 → The module format is not applied to the axis.
	bit 7 = 1 → The module format is applied to the axis.
PP103	Value of the module to be applied on to rotary axes that do not work as linear axes (usually 360°).
QP1	Loop cycle time. Read only parameter that indicates how often the loop is being closed at the drives.
PP5	Maximum error allowed between both feedbacks. Being PP5 = - 0.0001 , independent feedbacks.

6.9 Parameters only to be used in MC applications

Parameters to be used only in Motion Control applications	
PP57	In-position zone. It indicates the difference allowed between the real and final position LV158 (S00258) TargetPosition for considering that the axis is in position.

6.10 Exclusive parameters to control a synchronous spindle

Parameters to be used only to control a synchronous motor in spindle applications	
MP42	Speed at which a synchronous motor working as spindle motor will begin increasing its magnetic field or magnetic flux".
MP43	BEMF (in volts) generated between each pair of phases of the stator winding per every 1000 rpm of the motor.
MP50	It determines whether the motor being governed by the drive is synchronous (0) or asynchronous (1).



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6.11 Configuration of an application

The purpose of this application is to help the user configure a particular application.

Its interface is very intuitive and offers a window to guide the user through the configuration of the application.

From this window and depending on the label that is activated, the user will fill in each of the fields that appear on the screen, that are associated with parameters or variables of the drive.

This chapter does not try to explain once again the meaning of each parameter or variable that appears on the screen, but simply to get the user acquainted with the interface and how to use this tool.

Each parameter or variable displayed by this interface is described in chapter 13 "parameters, variables and command of the drive" in this manual. Should you have any doubts on how any of them works, refer to this chapter.

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Configuration of an application

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6.11.1 Accessing the interface

Before accessing it, establish an RS232 connection between the drive and the PC. The application may be configured once communication has been established between the drive and the WinDDSSetup (on-line mode) using the relevant icon on the tool bar..



FIGURE S6.1

Tool bar of the WinDDSSetup.



APPLICATION CONFIGURATION

Activating this icon lets the user access the interface to configure the application.

Before clicking on this icon, the status bar must show the text <online> over a green background, indicating that the drive is communicating with the WinDDSSetup.

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Accessing the interface

6.11.2 General description of the screen

The data of the screen for <configuring the application> is laid out as follows:

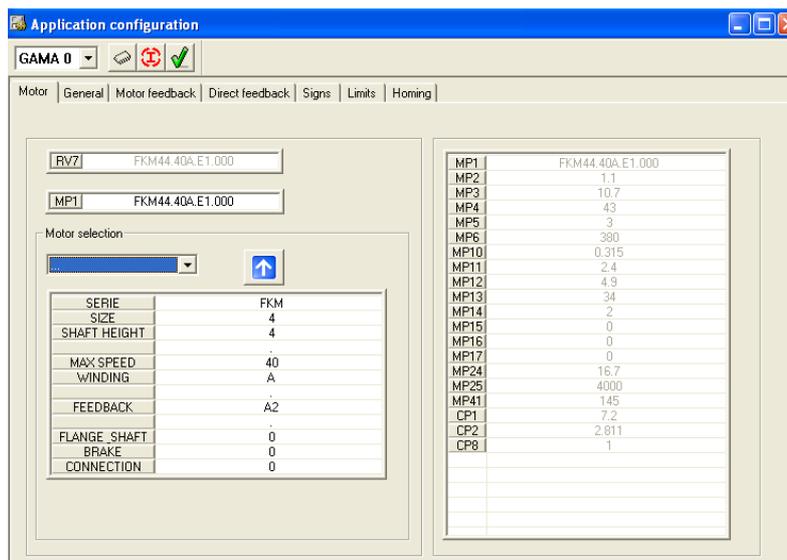


FIGURE S6.2

Configuring the application from the WinDDSSetup.

Execute the following operations from the icon bar located at the top of the window:



FIGURE S6.3

Icon bar.



SET SELECTION

From the drop list, select the gear (bear in mind that it corresponds to a purely mechanical gear ratio)
Possible sets to be selected: gear 0 (no gear ratio or out of range), gear 1 (higher speed gear ratio) ... gear 7 (lower speed gear ratio).



PARAMETERS TO FLASH

It validates the parameter modification and **saves** the change permanently (into flash memory). The commands acting when activating this icon are GC1 and then GC4.



INITIATE PARAMETERS

After entering the ID in MP1, activating this icon **updates** all the parameters that belong to the motor file and the rest of the parameters of the drive to their default values.



VALIDATE

It validates the parameter modification, but does not save the change permanently (into flash memory). The commands that acts when activating this icon is GC4.

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SETUP SUMMARY
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<Configuring the application> with the <motor> label activated:

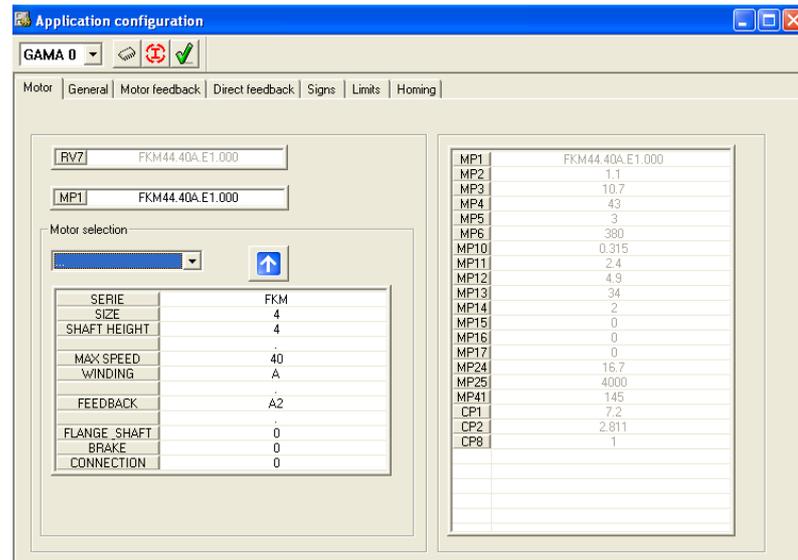


FIGURE S6.4
Configuring the application from the WinDDSSetup with the <motor> label active:

The fields shown in this window are:

- A. Field < Motor selecting options >:** The default value of MP1 appearing in this field may be modified by selecting the option <user motor>, i.e. <USER>. If, after opening this drop list, you do not want to change MP1, select the option < ... > to exit the list. The <DEFAULT> option assigns to MP1 the motor ID stored in the memory of the encoder.



- B. Field < MP1 >:** This field shows the ID of the selected motor.
- C. Field < RV7 >:** This field shows the ID recorded in the encoder that is integrated into the motor. If it does not detect any, the text field will appear empty.
- D. Motor ID fields:** It shows each motor that has the motor file stored at the drive. It is also possible to modify the selection of the motor series and in each field of the motor ID.

SERIE	FKM
SIZE	4
SHAFT HEIGHT	4
MAX SPEED	40
WINDING	A
FEEDBACK	A2
FLANGE_SHAFT	0
BRAKE	0
CONNECTION	0

- E. Parameter table:** This table contains all the parameters related to the motor and some parameters for the current loop. These values may be modified according to the available access level and/or if <user motor> has been selected in the field < motor selection >.

Activating the icons of this window permits:



Entering in MP1 the motor ID selected in the field < Motors at the drive >.

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SETUP SUMMARY
 General description of the screen



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< **Configuring the application** > with the < **General** > label activated:

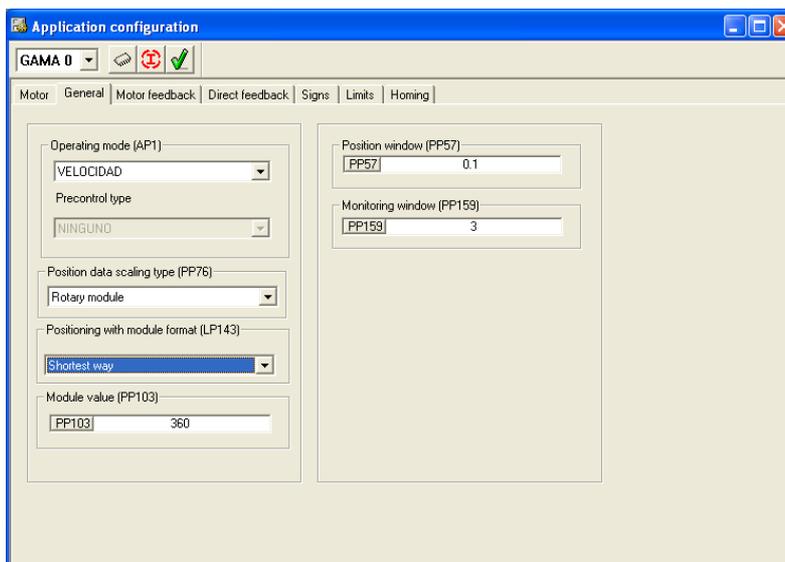


FIGURE S6.5
Configuring the application from the WinDDSSetup with the <General> label active:

The fields shown in this window are:

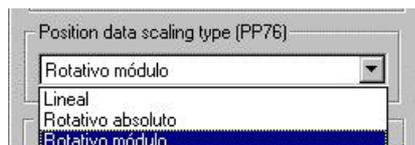
- A. Field < AP1 operating mode >** In this field, it is possible to select the operating mode for the system configuration, define whether it is a velocity command (Velocity), a position command with motor feedback (position FB 1), a position command with direct feedback (position FB 2) or a position command with both feedback (position FB 1 and 2).



- B. Field < Type of precontrol >** This field may be used to decide whether feedforward and accforward will be activated or not, only if the <velocity> option has not been selected in the previous field. If it has been, the < feed + ac forward > option cannot be selected because it is disabled.



- C. Field < Scaling type of the position command >** This field may be used to select either a linear or rotary scaling. If rotary, whether it is absolute or module.



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General description of the screen



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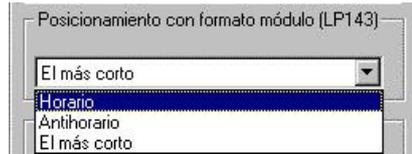
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 General description of the screen

D. Field < Positioning in module format > This field may be used to select either clockwise or counterclockwise rotation or via shortest path, if rotary scaling in module format has been selected in the previous field.



E. Field < Module value > This field shows the value saved in the drive's RAM memory and represents the position data range that is working with. To change this value, type the new value in this field.

F. Field < PositionWindow > This field shows the value saved in the drive's RAM and represents the difference allowed between the real position and the target position. To change this value, type the new value in this field.

G. Field < MonitoringWindow > This field shows the value saved in the drive's RAM memory and represents the permitted range for the following error. To change this value, type the new value in this field.

< **Configuring the application** > with the < **motor feedback** > label active:

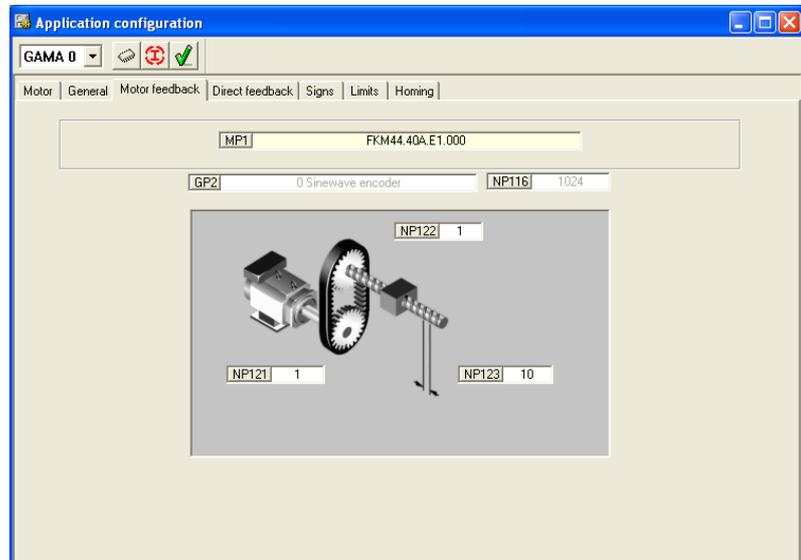


FIGURE S6.6

Configuring the application from the WinDDSSetup with the <motor feedback> label active:

The fields shown in this window are:

- A. Field < MP1 >** This field shows the motor ID.
- B. Field < GP2 >** This field may be used to select the type of motor feedback. Type of feedback integrated into the motor. You may select from the drop list the option:
 - (0) Stegmann™ sinusoidal encoder
 - (1) Resolver
 - (2) Square-wave TTL encoder
 - (5) HEIDENHAIN™ encoder for SIEMENS™ motors, 1FT6 family.
 - (6) Sinusoidal (1 Vpp) encoder
 - (7) Without feedback
 - (10) Motor simulator



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See figure:



- C. **Field < NP121 >** This field may be used to define the number of revolutions of the motor. To change this value, type the new value in this field.
- D. **Field < NP122 >** This field may be used to define the number of revolutions of the leadscrew. To change this value, type the new value in this field.
- E. **Field < NP123 >** This field may be used to define the ratio between the linear movement of the machine and that of the axis moving it, i.e. the leadscrew pitch. To change this value, type the new value in this field.
- F. **Field < NP116 >** This field may be used to define the resolution of the feedback device integrated into the motor. To change this value, type the new value in this field.

The window < **Configuring the application** > with the < **Direct feedback** > label active is:

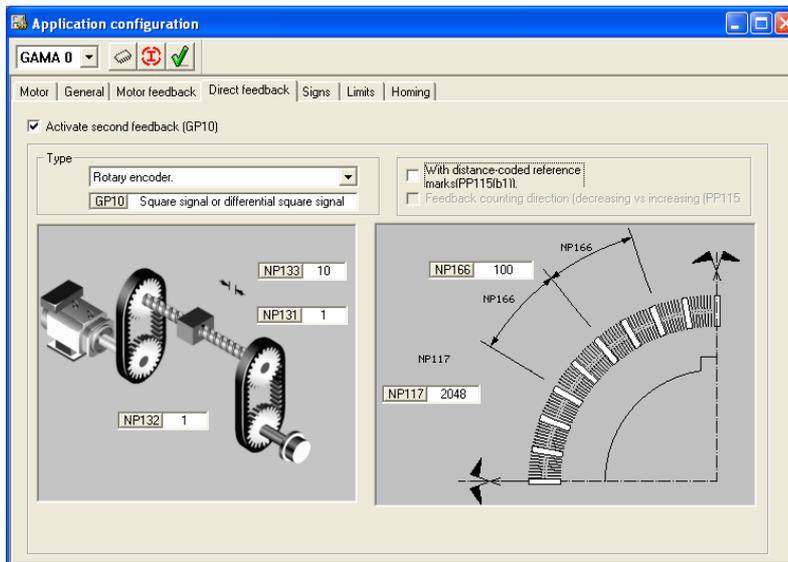


FIGURE S6.7
Configuring the application from the WinDDSSetup with the <Direct feedback> label active.

The fields shown in this window are:

When using direct feedback, activate the option <**Activate second feedback**> and select in:

- A. **Field < Type >** If the direct feedback is linear <linear encoder> or rotary <rotary encoder>. Besides, on the drop list on the right, the type of feedback signal must be selected.
 - Square TTL signal.
 - Sinusoidal signal (1Vpp).
 - Stegmann™ signal (only with rotary encoder)
 - TTL square signal with SSI communication.
 - 1 Vpp signal with SSI communication.

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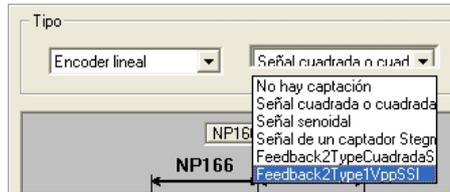


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See figure:



When selecting in this field the < linear encoder > option with the < distance-coded IO's > option off, the window and the fields that will be displayed are:

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General description of the screen

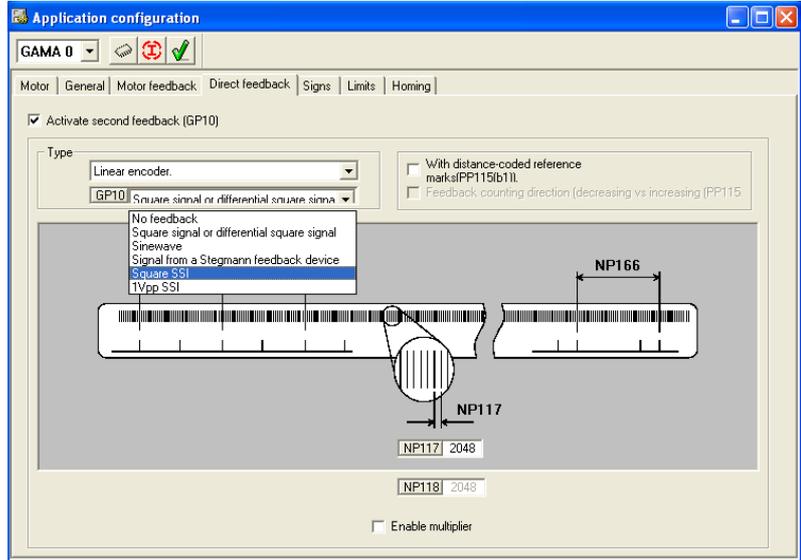


FIGURE S6.8

Configuring the application from the WinDDSSetup with the <Direct feedback> label active. Linear direct feedback without distance-coded IO's.

- B. Field < NP117 > This field is used to define the resolution of the linear feedback. To change this value, type the new value in this field.
- C. Field < NP118 > This field is used to define the resolution of the linear feedback considering the multiplying effect. To change this value, type the new value in this field after activating the bottom box.

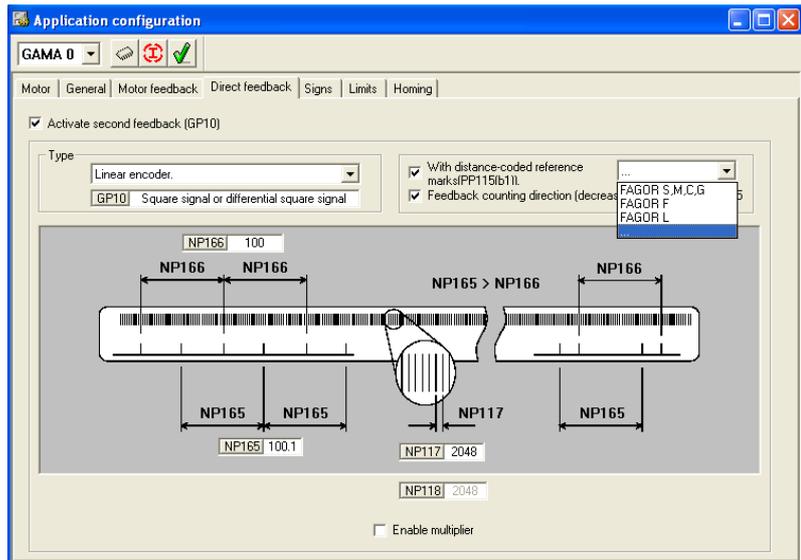


FIGURE S6.9

Configuring the application from the WinDDSSetup with the < Direct feedback > label active. Linear direct feedback with distance-coded IO's.

If the option < With distance-coded IO's > that appears in this window is activated, the following fields are also displayed:



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- D. **Field < NP165 >**. This field is used to define the gap between **two consecutive distance-coded IO's**. The **< With distance-coded IO's > option must be selected previously**. To change this value, type the new value in this field.
- E. **Field < NP166 >**. This field is used to define the gap between **two consecutive IO's**. The **<With distance-coded IO's> option must be selected previously**. To change this value, type the new value in this field.

Being the **< With distance-coded IO's >** option activated, it enables the **<Counting direction (decreasing vs increasing) >** which, when enabled, sets the negative counting direction in the positive direction. See **PP115**.bit 5.

When selecting in this field the **< rotary encoder >** option without activating the **< distance-coded IO's >** option, the window and the fields that will be displayed are:

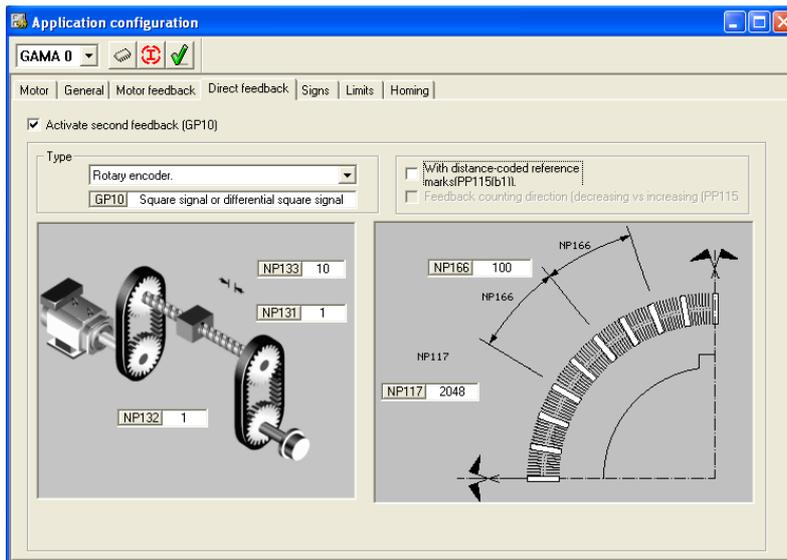


FIGURE S6.10

Configuring the application from the WinDDSSetup with the **<Direct feedback>** label active. Rotary direct feedback without distance-coded IO's.

- F. **Field < NP131 >**. This field is used to define the number of revolutions of the rotary encoder of the direct feedback. To change this value, type the new value in this field.
- G. **Field < NP132 >**. This field may be used to define the number of revolutions of the leadscrew. To change this value, type the new value in this field.
- H. **Field < NP133 >**. This field is used to define the ratio between the linear movement of the machine per revolution of the rotary encoder of the direct feedback. To change this value, type the new value in this field.
- I. **Field < NP117 >**. This field is used to define the resolution of the rotary feedback. To change this value, type the new value in this field.

When activating the < **With distance-coded IO's** > option, the following window and fields are displayed:

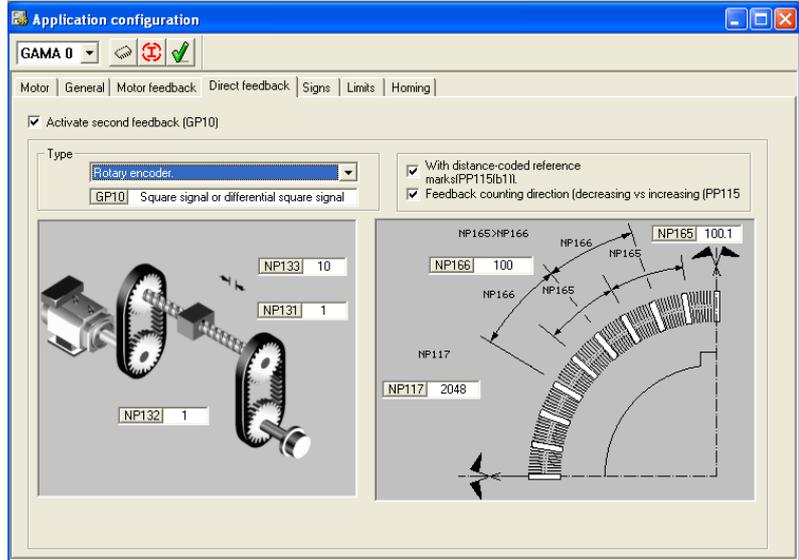


FIGURE S6.11

Configuring the application from the WinDDSSetup with the <Direct feedback> label active. Rotary direct feedback with distance-coded IO's.

- J. Field < NP165 >.** This field is used to define the gap between **two consecutive distance-coded IO's**, when using distance-coded IO's. The <With distance-coded IO's> option must be selected previously. To change this value, type the new value in this field.
- K. Field < NP166 >.** This field is used to define the gap between **two consecutive distance-coded IO's**, when using distance-coded IO's. The <With distance-coded IO's> option must be selected previously. To change this value, type the new value in this field.

Being the < **With distance-coded IO's** > option activated, it enables the <Counting direction (decreasing vs increasing) > option which, when enabled, sets the negative counting direction in the positive direction. See PP115.bit 5.

The window < **Configuring the application** > with the <Signs> label active is:

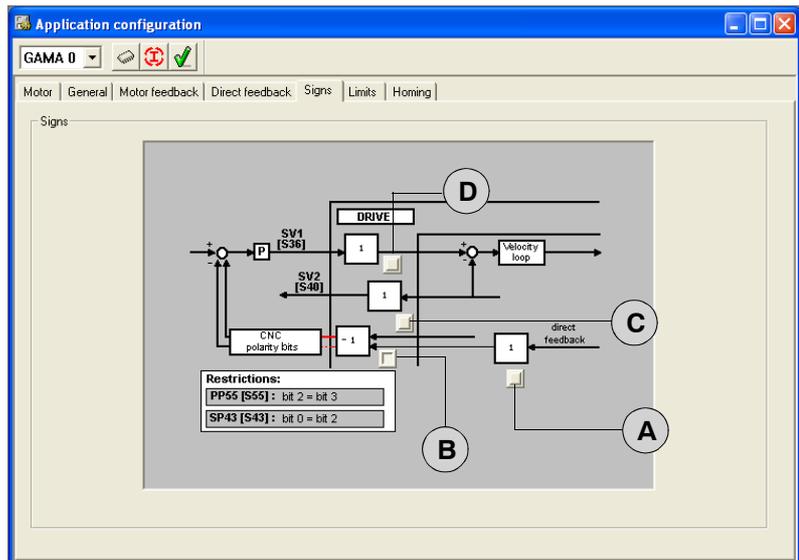


FIGURE S6.12

Configuring the application from the WinDDSSetup with the <Signs> label active: Reverse the sign of the various velocity and position data when the CNC closes the position loop.



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- If in the AP1 operating mode, the <velocity> option was selected, this window will look like the one in the figure, being possible to change the sign of the various data by activating or deactivating the button next to each block with a "1" inside. Therefore, activating each button, the value of (1) displayed in the block associated to it switches to (-1), hence changing the sign of the data it represents.

Hence activating the <activate> button implies:

- Change the counting direction of the direct feedback represented by parameter (PP115.bit 3).
 - Change the sign of the position command value (PP55.bit 0), of the monitored motor position feedback value (PP55.bit 2) and of the monitored position (direct) feedback (PP55.bit 3). They affect the operation of the loop and may be used to solve a positive feedback (axis runaway) problem.
 - Change the sign of the velocity feedback value represented by parameter (SP43.bit 2).
 - Change the sign of the velocity command value represented by parameter (SP43.bit 0).
- If in the AP1 operating mode, any of the <position> options was selected, this window will look like this, being possible to change the sign of the various data by activating or deactivating the button next to each block with a "1" inside. Therefore, activating each button, the value of (1) displayed in the block associated to it switches to (-1), hence changing the sign of the data it represents:

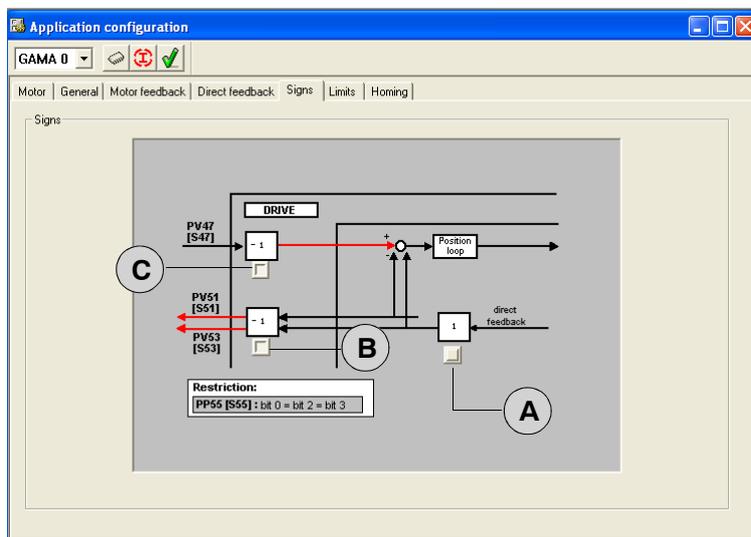


FIGURE S6.13

Configuring the application from the WinDDSSetup with the <Signs> label active: Reverse the sign of the various position data when the drive closes the position loop.

Hence activating the <activate> button implies:

- Change the counting direction of the direct feedback represented by parameter (PP115.bit 3).
- Change the sign of the motor position feedback value (PP55.bit 2) and that of the motor direct position feedback value (PP55.bit 3). They do not affect the operation of the loop and cannot be used to solve a positive feedback (axis runaway) problem.
- Change the sign of the position command value represented by parameter (PP55.bit 0).

6.

SETUP SUMMARY

General description of the screen



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SETUP SUMMARY
 General description of the screen

The window <Configuring the application> with the <Limits> label active is:

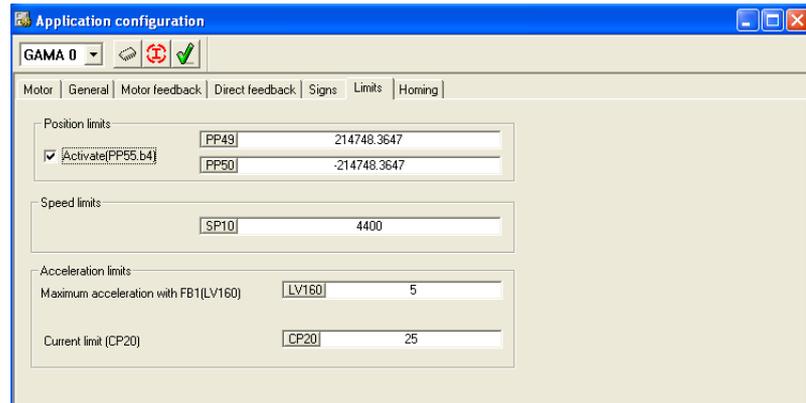


FIGURE S6.14

Configuring the application from the WinDDSSetup with the <Limits> label active:

The fields shown in this window are:

Activating the < **Activate (PP55.bit4)** > option activates the position limits that delimit the area permitted for axis movements.

- A. Field < PP49 >:** This field is used to define the positive position limit. To change this value, type the new value in this field.
- B. Field < PP50 >:** This field is used to define the negative position limit. To change this value, type the new value in this field.

The velocity limit is set in:

- C. Field < SP10.# >:** This field is used to set the maximum value for the final velocity command (**SV7**). To change this value, type the new value in this field.

and the acceleration limit is set in:

- D. Field < CP20.# >:** This field is used to define the maximum value for the current command that reaches the current loop. To change this value, type a new value in this field when having the necessary access level.

Observe that the "acceleration limit" box also shows the field <Maximum acceleration with FB1 (LV160)> if the drive communicating with the WinDDSSetup is an MMC or an CMC (drive modules for MC applications)

- E. Field < LV160 >:** This field is used to set the maximum acceleration applied to all the positioning blocks (in module). See figure.

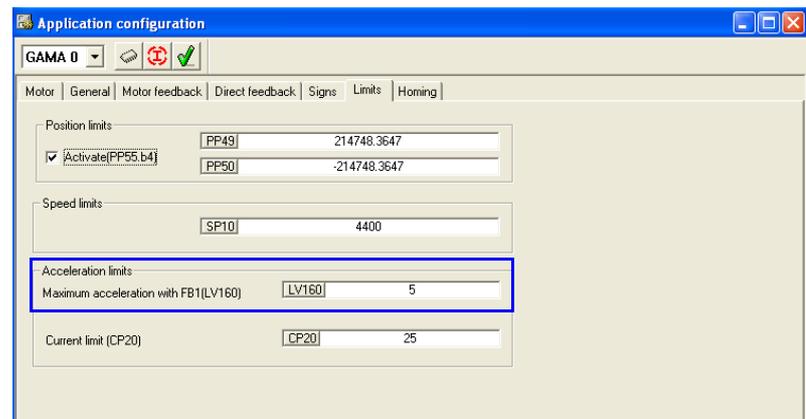


FIGURE S6.15

Configuring the application from the WinDDSSetup with the <Limits> label active: If the connected drive is an MMC or a CMC and the <FB1 position> option has been selected in the <AP1 operating mode>.



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If the <velocity> option has been selected in the field <AP1 operating mode> when the <General> label was activated, the <Configuring the application> window displayed with the <Home search> label is:

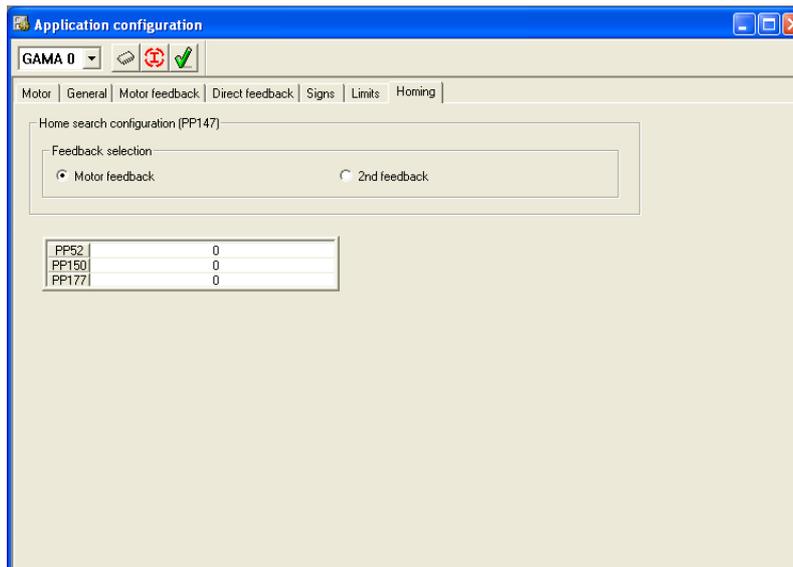


FIGURE S6.16

Configuring the application from the WinDDSSetup with the <Home search> label active:

This window may be used to configure the home search, it lets you select:

□ Motor feedback

The fields shown in this window are:

PP52	0
PP150	0
PP177	0

where:

PP52	Distance from machine reference zero to the machine reference point.
PP150	Position of the machine reference point with respect to the reference mark.
PP177	Distance from the drive's zero position and the theoretical zero position according to the encoder's absolute feedback.

□ Direct feedback

The fields shown in this window are:

PP54	0
PP151	0
PP178	0

where:

PP54	Distance from machine reference zero to the machine reference point.
PP151	Position of the machine reference point with respect to the reference mark.
PP178	Distance from the drive's zero position and the theoretical zero position according to the direct absolute feedback.

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If any option other than <velocity> option has been selected in the field <AP1 operating mode> when the <General> label was activated, the <Configuring the application> window displayed with the active label <Home search> is:

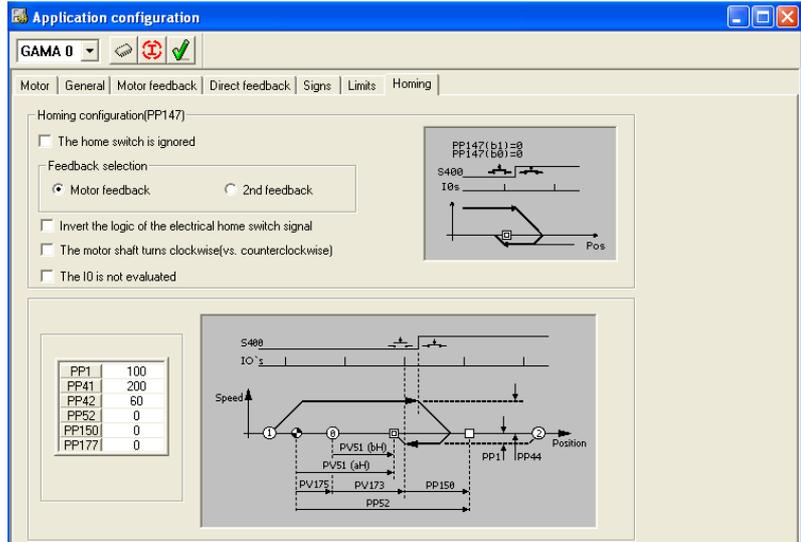


FIGURE S6.17

Configuring the application from the WinDDSSetup with the <Home search> label active:

This window may be used to configure the home search and it is possible to select the following options in the <Home search configuration (PP147)> area.

The Home Switch (HS) is ignored

if this option is active:

Option	
The HS is ignored	PP147.bit 5 = 1

Feedback selection

The feedback used is:

Option	
Motor feedback	PP147.bit 3 = 0
Direct feedback	PP147.bit 3 = 1

Inverted Home Switch signal

Pressing the home switch sets the PLC input:

Option	
(1) Positive logic	PP147.bit 1 = 0
(0) Negative logic	PP147.bit 1 = 1

Home search direction

Motor shaft turning direction:

Option	
Positive. Clockwise	PP147.bit 0 = 0
Negative. Counterclockwise	PP147.bit 0 = 1

Evaluate Home switch

Evaluation of the reference mark (IO):

Option	
Reference mark (IO) evaluated	PP147.bit 6 = 0
Reference mark (IO) not evaluated	PP147.bit 6 = 1



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Observe that depending on the activated options, the representations change in the graphics area.

The fields shown in this window are:
If motor feedback < **was selected** >:

PP1	100
PP41	200
PP42	60
PP52	0
PP150	0
PP177	0

where:

PP1	Slow motor speed during home search when controlled by the drive itself.
PP41	Fast motor speed during home search when controlled by the drive itself.
PP42	Acceleration applied during home search when controlled by the drive itself.
PP52	Distance from machine reference zero to the machine reference point.
PP150	Position of the machine reference point with respect to the reference mark.
PP177	Distance from the drive's zero position and the theoretical zero position according to the encoder's absolute feedback.

If < **Direct feedback** > was selected:

PP1	100
PP41	200
PP42	60
PP54	0
PP151	0
PP178	0

where:

PP1	Slow motor speed during home search when controlled by the drive itself.
PP41	Fast motor speed during home search when controlled by the drive itself.
PP42	Acceleration applied during home search when controlled by the drive itself.
PP54	Distance from machine reference zero to the machine reference point.
PP151	Position of the machine reference point with respect to the reference mark.
PP178	Distance from the drive's zero position and the theoretical zero position according to the encoder's absolute feedback.

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PARAMETER SETTING OF THE CNC-DRIVE SYSTEM



This chapter describes certain peculiarities of the system made up by the Fagor 8055/55i and the drive modules, parameter setting for both depending on their communications interface, description of the PLC 55/55i maneuver and other considerations.

7.1 SERCOS communication with the 8055/55i CNC

SERCOS is an international standard for digital communication, designed especially for the machine-tool industry and simplifies the connection between CNC's and servo drives of different manufacturers.

All the data and commands are transmitted in digital format through fiber optic lines.

These lines form a ring interconnecting all the electronic elements forming a system (CNC and servo drives).

Drives having the SERCOS interface have specific connections for the fiber optic lines located next to the indicator display.

They may be easily recognized by the terms S1 and S0 of their sales reference (e.g.: AXD 1.25.**S1**.0, SPD 2.75.**S0**.0).

The SERCOS interface reduces considerably the needed hardware and simplifies the cabling making the system more robust since it improves its immunity to electrical noise.

For further information, see chapter 7 "System installation" in the "dds-hardware" manual.

Follow this sequence of operations to set it up:

- Connecting the fiber optic lines, identifying the drive and selecting the transmission speed.
- Parameter setting at the 8055/55i CNC.
- Description of the maneuver at the PLC 55/55i.
- Parameter setting for the drive modules.
- Powering the machine up again.
- Error troubleshooting.



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7.1.1 Considerations for the 8055/55i CNC

When using SERCOS interface, it is necessary to identify the drive modules in the ring and establish a mode of operation. Certain 8055/55i CNC and drive parameters must also be set.

Mode of operation and identification

Operating mode

The following CNC parameters must be set for each servo drive.

DRIBUSID Parameter P56 (for axes), P44 (for spindles) and P5 (for auxiliary spindle).

Indicates the SERCOS address associated with the axis or the spindle. It corresponds to the value of the node selector switch at the drives that have SERCOS. It is recommended (not necessary) that the SERCOS addresses of the different axes and spindles be sequential and starting from number 1. E.g.: with 3 SERCOS axes and a SERCOS spindle, the values of this parameter are 1, 2, 3 and 4.

V. valid	Function
0	The drive is transparent in the communications within the ring; but it is not recognized as one of its elements.
1 - 8	The drive is identified in the ring with the DRIBUSID element number, and will have all the features of the SERCOS interface.

Remember that to use the same motor as a C axis and as a spindle, parameter DRIBUSID of both CNC tables must have the same value.

DRIBUSLE Parameter P63 (for axes), P51 (for spindles).

The CNC considers this parameter when the axis (or the spindle) has been assigned a SERCOS address, i.e. a.m.p. DRIBUSID is other than zero.

Determines the feedback source at this servo drive system through its connector at the axes module or through the SERCOS interface.

In any of the two modes, the velocity command is sent to the drives via SERCOS and the position loop is controlled by the CNC.

V. valid	Function
DRIBUSLE=0	The servo system has a rotary or linear encoder outside the motor and the CNC receives the signals through the corresponding connector at its axes module.
DRIBUSLE=1	The CNC receives the feedback position from the drive through the SERCOS ring. This module has generated that signal based on the motor feedback itself.
DRIBUSLE=2	The CNC receives the feedback position from the drive through the SERCOS ring. This module has generated that signal based on the direct feedback.



Warning. The value of the DRIBUSID parameter must match the address selected with the <Node Select> switch at the drive module.

Therefore, it has been seen that parameter DRIBUSLE selects the communication method of the signal and the type of feedback. This creates three work modes that are described next.

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□ **Operating mode (DRIBUSLE=0). External feedback**

In this mode of operation, the CNC receives the position feedback through its connector at the axis module. The velocity command sent out by the CNC to the drive through the optical fiber is given in rpm referred to the motor.

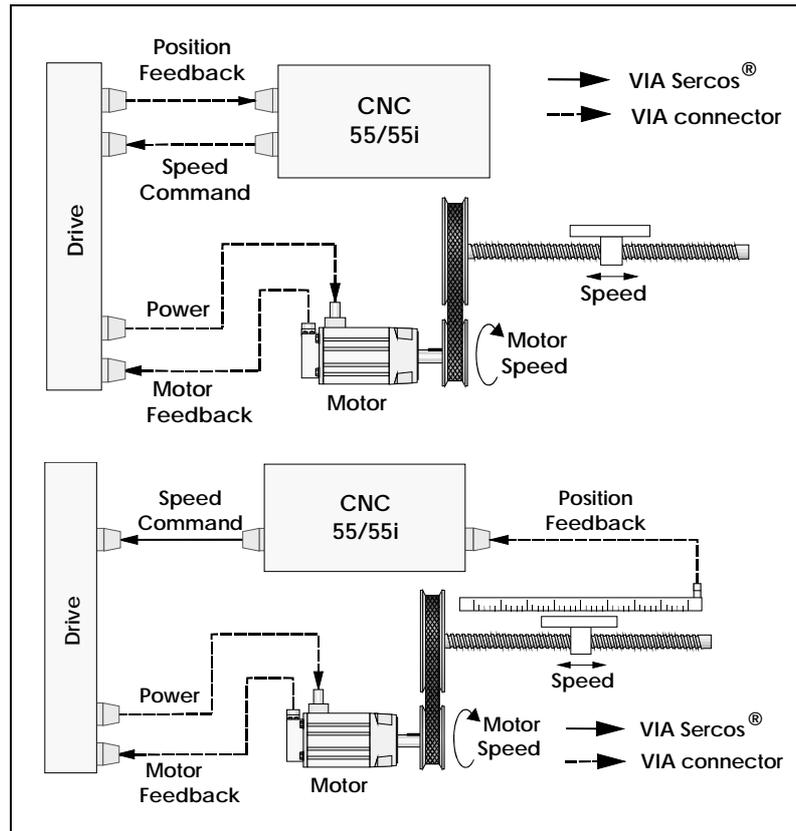


FIGURE S7.1
Operating mode (DRIBUSLE=0).

□ **Operating mode (DRIBUSLE=1). Feedback on the motor**

In this mode of operation, the CNC receives the position feedback through the fiber optic line of the SERCOS ring. This feedback is generated by the drive based on the feedback of the motor itself. The velocity command sent out by the CNC to the drive through the optical fiber is given in rpm referred to the motor.

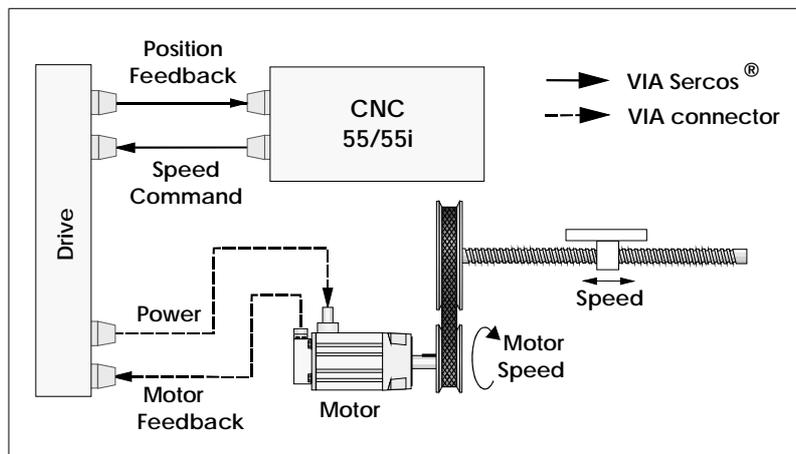


FIGURE S7.2
Operating mode (DRIBUSLE=1).

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Operating mode (DRIBUSLE=2). Direct feedback

In this mode of operation, the CNC receives the position feedback through the fiber optic line of the SERCOS ring. The drive generates this feedback based on direct feedback. The velocity command sent out by the CNC to the drive through the optical fiber is given in rpm referred to the motor.

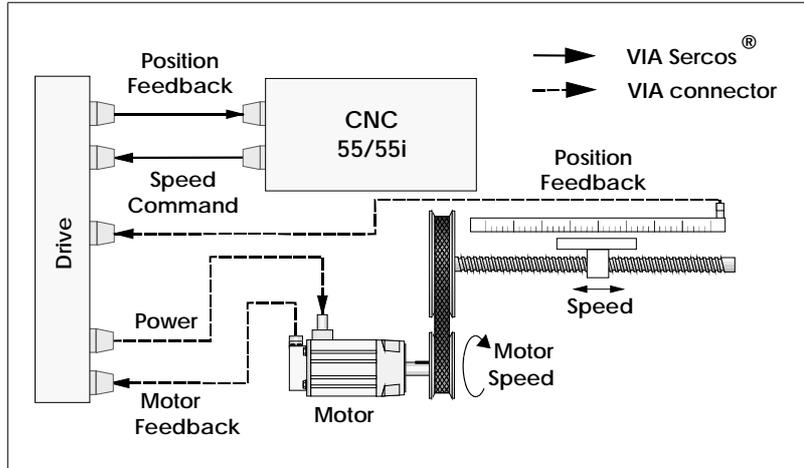


FIGURE S7.3

Operating mode (DRIBUSLE=2).

Particular

It has already been said that it is recommended (not necessary) that the SERCOS addresses of the different axes and spindles be sequential and starting from number 1. E.g.: with 3 SERCOS axes and a SERCOS spindle, the values of parameter DRIBUSLE are 1, 2, 3 and 4 respectively.

The fact that the servo drive identified for example with the number 1 corresponds to the X axis, to the Y axis or to another one, is irrelevant. However, it would be much simpler to make the axes (spindles) of the machine X, Y, Z, U, V, W, A, B and C follow a sequential numbering system. See the following figure:

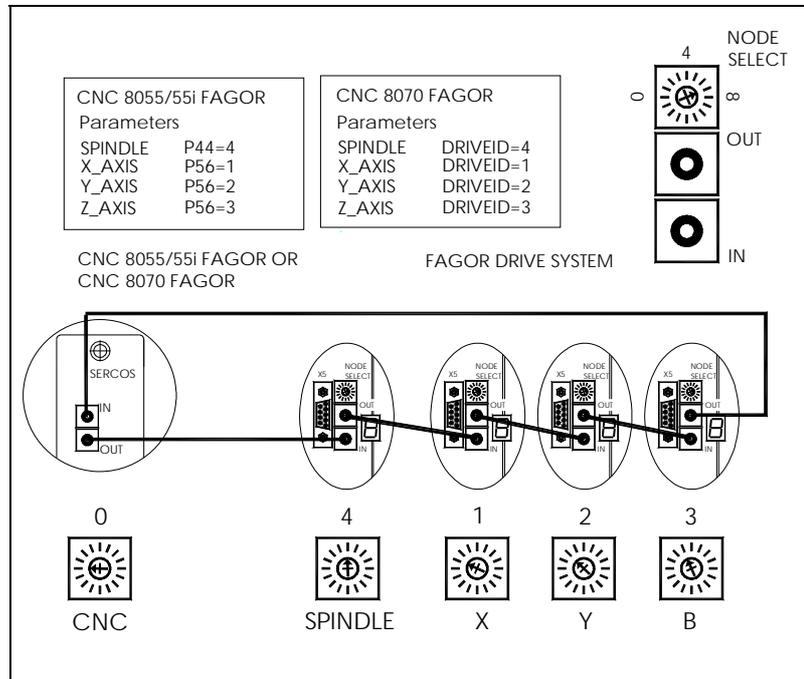


FIGURE S7.4

SERCOS interface communication. 8055/55i CNC or 8070 CNC and drive modules



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7.2 Other 8055/55i CNC parameters

The analog velocity command at the 8055/55i CNC is adjusted by means of parameters PROGAIN, FFGAIN, DERGAIN, ACFGAIN, MAXVOLT1... 4.

PROGAIN PROportional GAIN

Parameter P23 (on axes and spindles).

Proportional gain. It is the constant that sets the ratio between the velocity command and the following error (axis lag). The main component of the velocity command is proportional to the following error and to this parameter PROGAIN.

It must be adjusted !

Shaft.

PROGAIN indicates the millivolts of velocity command desired for a following error of 1 mm.

Spindle.

PROGAIN provides the desired velocity command in millivolts for a following error of 1° (only when the spindle works in M19 mode or rigid tapping).

V. valid	Remarks
0 ... 65535 mV/mm	1000 mV/mm (by default). In mV/degree for spindle.

DERGAIN DERivative GAIN

Parameter P24 (on axes and spindles).

Derivative gain. It gives an additional component to the velocity command. Its function depends on parameter ACFGAIN:

Condition	Remarks
If ACFGAIN = NO	DERGAIN is the constant that sets the ratio between the velocity command the variation of the following error every 10 ms.
If ACFGAIN = YES	DERGAIN is the constant that sets the ratio between the velocity command and the variation of speed every 10 ms..

If for example ACFGAIN = NO, then:

Shaft	DERGAIN provides the mV of command corresponding to a variation of following error of 1 mm in 10 ms.
Spindle	DERGAIN provides the mV of command for a change of 1° of following error in 10 ms. Only when the spindle is working in M19 mode or rigid tapping.

V. valid	Remarks
0 ... 65535 mV/(mm/10 ms)	0 mV/ (mm/10ms) (by default)

FFGAIN Feed Forward GAIN

Parameter P25 (on axes and spindles).

Shaft	Defines the percentage of additional command due to the programmed feedrate.
Spindle	Defines the percentage of additional command due to the programmed feedrate. Only when the spindle is working in M19 mode or rigid tapping.

V. valid	Remarks
0 ... 100	0 (by default)

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PARAMETER SETTING OF THE CNC-DRIVE SYSTEM
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PARAMETER SETTING OF THE CNC-DRIVE SYSTEM
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ACFGAIN AC Forward GAIN

Parameter P46 (on axes) and P42 (on spindles).

Determines whether the axis machine parameter DERGAIN is applied to the variations in following error or to the variations of the programmed feedrate. See the DERGAIN function.

V. valid	Remarks
No	about following error.
Yes	on variation of programmed speed.

MAXVOLT MAXimum VOLTage

Parameter P37 (on axes),

Provides the value of the analog voltage of velocity command for G00FEED.

V. valid	Remarks
0 ... 9999 mV	9500 mV (by default)

For axis drives using SERCOS interface, this parameter must always be set to 9500.

MAXVOLTn MAXimum VOLTage gear n

Parameters P37 ... P40 for n=1 ... 4 (on spindles).

Provides the value of the analog voltage of velocity command for the maximum speed of the gear n.

V. valid	Remarks
0 ... 9999 mV	9500 mV (by default)

These parameters are described in the installation manual of the 8055/55i CNC.

The ways to calculate them are also applicable to generate the digital SERCOS (digital) velocity command.

This command is transmitted through fiber optics in motor rpm.

This command conversion from a (mV) to a digital command requires some parameters to be sent at the 8055/55i CNC as well as at the drive.

PITCH Parameter P7 (on axes).

Defines the resolution of the linear encoder when the axis feedback is fed to the CNC (DRIBUSLE=0). It does not define the ballscrew pitch which is set with the previous parameter PITCHB.

ABSOFF Parameter P53 (on axes).

Parameter necessary when using absolute feedback. Check the installation manual of the 8055/55i CNC.

MAXGEAR1 Parameter P2 (on spindles).

MAXGEAR2 Parameter P3 (on spindles).

MAXGEAR3 Parameter P4 (on spindles).

MAXGEAR4 Parameter P5 (on spindles).

Parameters that indicate the maximum spindle speed in each range (gear). These parameters are necessary for the automatic gear change. Check the installation manual of the 8055/55i CNC.

When not using all 4 gears, use the lower ones and set the unused gears to the same value as the highest of the ones used.

INPREV1 Parameter P72 (on spindles).

INPREV2 Parameter P74 (on spindles).

INPREV3 Parameter P76 (on spindles).

INPREV4 Parameter P78 (on spindles).

Parameters that indicate the input spindle speed for the gear ratios in each range (gear). Check the installation manual of the 8055/55i CNC.

The equivalent parameter at the drive is NP121.



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- OUTPREV1** Parameter P73 (on spindles).
- OUTPREV2** Parameter P75 (on spindles).
- OUTPREV3** Parameter P77 (on spindles).
- OUTPREV4** Parameter P79 (on spindles).

Parameters that indicate the output spindle speed for the gear ratios in each range (gear). Check the installation manual of the 8055/55i CNC.

The equivalent parameter at the drive is NP122.

The following sections show how to set them.

On axis drives

The CNC communicates to the drive the desired motor speed in rpm (MS) calculated as follows:

- With SERCOS interface

$$MS = \frac{f \text{ [PROGAIN, FFGAIN, ...]}}{\text{[mV]}} \times \frac{G00FEED}{MAXVOLT} \times \frac{1}{NP123} \times \frac{NP121}{NP122} \quad \text{[rev/min motor]}$$

NP121, NP122 and NP123 are parameters of the drive

Hence, for a proper setup of the system, proceed as follows:

At the Drive:

- Set drive parameters NP121, NP122 and NP123 according to the gear ratios installed.
- SP20 and SP21 are ignored.

At the CNC:

- Set MAXVOLT = 9500, that is 9.5 V.
- Calculate the PROGAIN constant based on a command of 9500 mV. Hence:

$$PROGAIN = \frac{9500}{EdS} = \frac{9500 \cdot Kv \cdot 1000}{G00FEED} \quad \text{[mV/mm]}$$

where:

EdS (mm)	Following error at a G00FEED
Kv	Constant that reflects the relationship between G00FEED and EdS: for Kv = 1, EdS is 1 mm for a feedrate of 1 m/min. for Kv = 2, EdS is 0.5 mm for a feedrate of 1 m/min.

Feedback parameters setting with.

DRIBUSLE=0	Using external feedback requires that all the feedback parameters to be set at the CNC. PITCH (P7), NPULSES (P8), DIFFBACK (P9), SINMAGNI (P10) FBACKAL (P11), REFPULSE (P32), IOTYPE (P52), ABSOFF (P53) and EXTMULT (P57). They are located in the parameter table for each axis at the 8055/55i CNC.
DRIBUSLE=1	The drive communicates the motor speed to the 8055/55i CNC through SERCOS using digital commands. Therefore, the feedback characteristics will be set by the parameters of the drive. At the 8055/55i CNC, the parameters mentioned earlier are ignored.
DRIBUSLE=2	The drive communicates the motor speed to the 8055/55i CNC through SERCOS using digital commands. Therefore, the feedback characteristics will be set by the parameters of the drive. At the 8055/55i CNC, the parameters mentioned earlier are ignored.

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PARAMETER SETTING OF THE CNC-DRIVE SYSTEM

Other 8055/55i CNC parameters



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On spindle drives in open loop

The 8055/55i CNC communicates to the spindle drive the desired motor speed in rpm (MS) calculated as follows:

- With SERCOS interface

$$MS = \frac{\text{programmed speed} \times \frac{MAXVOLTn}{MAXGEARn}}{[mV]} \times \frac{SP21}{SP20} \quad [rev/min \text{ motor}]$$

SP20 and SP21 are parameters of the drive

Hence, for a proper setup of the system, proceed as follows:

At the Drive:

- Set drive parameters SP20 and SP21 with the maximum motor speed values in that application and 9500 mV respectively.
- Always set gear ratios NP121, NP122 and the ballscrew pitch NP123. If DRIBUSLE=2, also set NP131, NP132, NP133. If the external feedback is square, also set PP5.

At the CNC:

- Set the MAXGEARn parameters of the 8055/55i CNC with the maximum tool speed value for that parameter set n.
- Set MAXVOLTn according to the equation:

$$MAXVOLTn = \frac{MAXGEARn \times \text{Gear ratio}}{(rev/min \text{ motor})} \times \frac{SP21}{SP20} \quad (mV)$$

SP20 and SP21 are parameters of the drive

$$\text{Ratio} = \text{Gear ratio} = \frac{N \text{ motor}}{N \text{ tool}}$$

Example spindle in open loop.

A machine has three gear ratios: 4/1, 2/1 and 1/1. The maximum motor speed is 4000 rpm, and the maximum tool speeds are: 1000, 2000 and 3800 rpm in each parameter set.

Following the steps indicated earlier:

SP21	4000
SP20	9500
MAXGEAR1	1000 rpm.
MAXGEAR2	2000 rpm.
MAXGEAR3	3800 rpm.

The MAXVOLTn parameters will be:

MAXVOLT1	1000 · (4/1) · (9500/4000) mV = 9500 mV
MAXVOLT2	2000 · (2/1) · (9500/4000) mV = 9500 mV
MAXVOLT3	3800 · (1/1) · (9500/4000) mV = 9025 mV

Feedback parameters setting with.

DRIBUSLE=0	Using external feedback requires all the feedback parameters to be set at the 8055/55i CNC. NPULSES (P13), DIFFBACK (P14), FBACKAL (P15), REFPULSE (P32).
DRIBUSLE=1	The drive communicates the motor speed to the 8055/55i CNC through SERCOS using digital commands. Therefore, the feedback characteristics will be set by the parameters of the drive. At the 8055/55i CNC, the parameters mentioned earlier are ignored.
DRIBUSLE=2	The drive communicates the motor speed to the 8055/55i CNC through SERCOS using digital commands. Therefore, the feedback characteristics will be set by the parameters of the drive. At the 8055/55i CNC, the parameters mentioned earlier are ignored.

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PARAMETER SETTING OF THE CNC-DRIVE SYSTEM
Other 8055/55i CNC parameters



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On spindle drives in closed loop, M19 or rigid tapping

The 8055/55i CNC communicates to the spindle drive the desired motor speed in rpm (MS) calculated like for the axes:

- With SERCOS interface

$$MS = \frac{f [\text{PROGAIN, FFGAIN, ...}]}{[\text{mV}]} \times \frac{SP21}{SP20} \quad \left[\frac{\text{rev}}{\text{min motor}} \right]$$

SP20 and SP21 are parameters of the drive

Hence, for a proper setup of the system, proceed as follows:

At the Drive:

- Set drive parameters SP20 and SP21 with the maximum motor speed values in that application and 9500 mV respectively.
- Set parameters NP121, NP122 and NP123 according to the gear ratios installed.

At the 8055/55i CNC:

- Set the MAXGEARn parameters of the 8055/55i CNC with the maximum tool speed value for that parameter set n.
- Set MAXVOLTn according to the equation:

$$\text{MAXVOLTn} = \frac{\text{MAXGEARn} \times \text{Gear ratio}}{(\text{rev/min motor})} \times \frac{SP21}{SP20} \quad (\text{mV})$$

SP20 and SP21 are parameters of the drive

$$\text{Ratio} = \text{Gear ratio} = \frac{N \text{ motor}}{N \text{ tool}}$$

Also:

At the 8055/55i CNC:

- Set constants PROGAIN, DERGAIN, ...

For example: Two 8055/55i CNC parameters:

REFEED1 (P34)	Maximum angular speed in M19 (°/min)
REFEED1 (P35)	Max. angular speed of the tool when searching home in M19.

and two concepts similar to MaxGear y MaxVolt used earlier:

MG_M19	Maximum tool turning speed in M19 (rpm).
MV_M19	Analog voltage for REFEED1 (mV).

PROGAIN is calculated as follows:

$$\text{PROGAIN} = \frac{MV_M19}{EdS} = \frac{MV_M19 \cdot Kv \cdot 1000}{\text{REFEED1}} \quad (\text{mV}^\circ)$$

where:

$$MV_M19 = \frac{\text{MAXVOLT1}}{\text{MAXGEAR1}} = \frac{\text{REFEED1}}{360} \quad (\text{mV})$$

and

$$\text{REFEED1} = \text{MG_M19} \cdot 360 \quad (^\circ/\text{min})$$

and where:

EdS	Following error at a REFEED1 speed
Kv	Constant that reflects the relationship between REFEED and EdS: for Kv = 1, EdS is 1° for a feedrate of 1000 °/min. for Kv = 1, EdS is 0.5° for a feedrate of 1000 °/min.

7.

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Example for a spindle in closed loop

A machine has three gear ratios: 4/1, 2/1 and 1/1. The maximum motor speed is 4000 rpm, and the maximum tool speeds are: 1000, 2000 and 3800 rpm in each parameter set.

Following the steps indicated earlier:

SP21	4000
SP20	9500
MAXGEAR1	1000 rpm.
MAXGEAR2	2000 rpm.
MAXGEAR3	3800 rpm.

The MAXVOLTn parameters will be:

MAXVOLT1	$1000 \cdot (4/1) \cdot (9500/4000) \text{ mV} = 9500 \text{ mV}$
MAXVOLT2	$2000 \cdot (2/1) \cdot (9500/4000) \text{ mV} = 9500 \text{ mV}$
MAXVOLT3	$3800 \cdot (1/1) \cdot (9500/4000) \text{ mV} = 9025 \text{ mV}$

And:

- Set the MAXGEARn parameters of the 8055/55i CNC with the maximum tool speed value for that parameter set n.
- The maximum tool speed in this mode is: 100 rpm.
- The maximum tool speed when searching home is 50 rpm.
- The following error must be 1° for every 1000°/min ($K_v = 1$).
- A gear ratio of 1 is the right one to work with spindle orientation M19, since MAXGEAR1 is the next value up from the 100 rpm foreseen for M19.

Therefore:

$$\begin{aligned} \text{REFEED1} &= 100 \cdot 360 = 36000 \text{ (°/min)} \\ \text{REFEED2} &= 50 \cdot 360 = 18000 \text{ (°/min)} \\ \text{MV_M19} &= \frac{9500}{1000} \cdot \frac{36000}{360} = 950 \text{ (mV)} \\ \text{EdS} &= 36^\circ \text{ for the } 36000 \text{ (°/min) of REFEED1} \\ \text{PROGAIN} &= \frac{950 \cdot 1 \cdot 1000}{36000} = \frac{950}{36} = 26.38 \text{ (mV/°)} \end{aligned}$$

Parameter PROGAIN does not admit decimals. Therefore, in this example, in order to keep accuracy, we can use another parameter to change the units for PROGAIN:

- When GAINUNIT (P041) = 0, PROGAIN must be set to 26.
- When GAINUNIT (P041) = 1, PROGAIN must be set to 2638.

These can be found in the spindle parameter table of the 8055/55i CNC.

Feedback parameters setting with.

WITH SERCOS INTERFACE

DRIBUSLE=0	Using external feedback requires that all the feedback parameters to be set at the CNC. NPULSES (P13), DIFFBACK (P014), FBACKAL (P15) and REFPULSE (P32). They are located in the parameter table for each axis a the 8055/55i CNC.
DRIBUSLE=1	When not using an external encoder, the motor encoder may be used by setting DRIBUSLE=1 at the 8055/55i CNC. At the drive, the existing gear ratios must be set using GP6(F00717), NP121(S00121), NP122(S00122). Other parameters such as GP2 (F00701), NP123 (S00123), PP76 (S00076) and PP55 (S00055) must also be taken into account. At the 8055/55i CNC, the feedback parameters mentioned earlier will be ignored.



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Warning. When working with DRIBUSLE=1, the motor feedback is only useful to work in M19 and/or rigid tapping when the spindle only has one gear and the gear ratio meets one of these two conditions:

- ❑ The gear ratio is 1/1. The spindle reference mark (I0) is the I0 of the motor feedback.
- ❑ The gear ratio is of the n/1 type where n is an integer (no decimals). In this case, a microswitch must be used for selecting a particular reference pulse (I0) among the n signals generated by the motor encoder per spindle turn.

DRIBUSLE=2	When using direct feedback, either an external encoder or linear encoder, the value of DRIBUSLE = 2 at the 8055/55i CNC. When adjusting the drive, parameters GP10 (F00719), PP115 (S00115), NP117 (S00117), NP118 (S00118), NP131 (F00130), NP132 (F00131), NP133 (F00132) must be taken into account. On the other hand, other parameters such as PP76 (S00076) and PP55 (S00055) must also be set.
-------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------



Warning. When working with DRIBUSLE=2, it is highly recommended to set the parameters for motor feedback according to the drive parameters indicated in the section "With DRIBUSLE=1" in order to avoid possible conflict. Véase PP5 ActualPositionMonitoringWindow.

7.

PARAMETER SETTING OF THE CNC-DRIVE SYSTEM
Other 8055/55i CNC parameters



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7.3 Considerations at the drives

Having a SERCOS interface makes some drive parameters unnecessary..

Remember that if neither the encoder simulation board nor the I/O board are installed, their associated parameters are not needed either.

When using SERCOS interface

Drive parameters NP121 (S00121), NP122 (S00122) and NP123 (S00123) must always be properly set.

Also, if CNC parameter DRIBUSLE=2, parameters NP131 (F00130), NP132 (F00131) and NP133 (F00132) must also be set besides the ones mentioned earlier.

Do not forget to set drive parameter PP5 (S00391) with a value other than zero as a monitoring system especially if the external feedback is square.

Example 1. Setting parameters NP121, NP122 and NP123.

If 5 turns of the motor generate 3 turns of the ballscrew NP121, NP122 and NP123, parameters must be set as follows:

NP121=5 and NP122=3

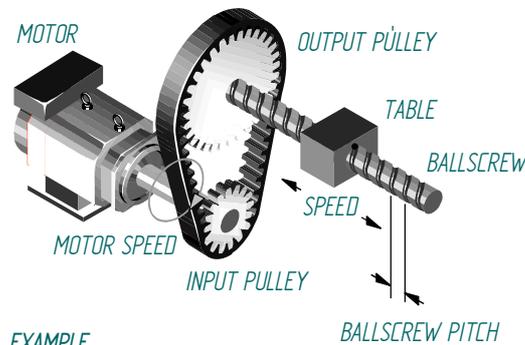
If it is a linear axis where for each ballscrew turn, the table moves 4 mm:

NP123 = 4 mm (at the WinDDSSetup set NP123=4)

If it is a rotary axis where each turn of the output pulley means a 360° turn:

NP123 = 360° (at the WinDDSSetup set NP123=360)

Example 2. Setting parameters NP121, NP122 and NP123.



EXAMPLE

Diameter of the output pulley = 25.75 mm

Diameter of the input pulley = 15.3 mm

NP121=2575 revolutions

NP122=1530 revolutions

Gear ratio = 2575/1530 = 1.683

Ballscrew pitch = 5 mm

NP123 = 5 mm

FIGURE S7.5

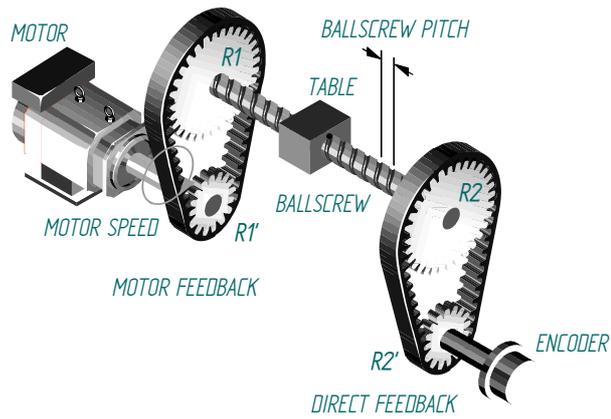
Gear ratio between the motor shaft and the ballscrew of the machine.

Example 3. Setting parameters NP131, NP132 and NP133.

When using a toothed belt and external encoder attached to a 10mm-pitch ballscrew and a gear ratio of 2:1, the parameters must be set as follows:

NP121=2,	NP122=1,	NP123=10
NP131=1,	NP132=1,	NP133=10

Example 4. Setting parameters NP131, NP132 and NP133.



EXAMPLE

Rotary axis with 40 gear reduction and external encoder attached with a toothed belt whose gear ratio is 2:1.

- | | |
|----------------------|----------------------|
| NP121=40 turns | NP131=2 turns |
| NP122=1 turn | NP132=1 turn |
| NP123= 360° per turn | NP133= 360° per turn |

NP123 and NP133 do not require values when the axes are rotary. Internally, it will assume a value of 360° per turn.

FIGURE S7.6

Linear movement of the axis per revolution of the direct feedback encoder.

7.

PARAMETER SETTING OF THE CNC-DRIVE SYSTEM
 Considerations at the drives



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7.4 Control signals PLC 8055/55i - drive

7.4.1 Signals from the PLC 55/55i to the drive

The drive Speed Enable and Drive Enable can now be controlled from the PLC 8055/55i through the SERCOS ring. To do that, the PLC 50/55i now offers two output logic variables.

SPENAn (SPeed ENAbLe n) (n = 1, ... 7) (M5110, M5160, M5210, M5260, M5310, M5360 and M5410).

SPENAm (SPeed ENAbLe m) (m = S, S2, AS) (M5462, M5487 and M5449).

Function: Identifies the electrical signal Speed Enable of connector X2 of the drive.

Valid values:
 0 Disables the velocity command.
 The motor with 0 velocity command.
 1 Enables the velocity command.
 The motor follows the velocity command.

DRENAn (DRive ENAbLe n) (n = 1, ... 7) (M5111, M5161, M5211, M5261, M5311, M5361 and M5411).

DRENAm (DRive ENAbLe m) (m = S, S2, AS) (M5463, M5488 and M5450).

Function: Identifies the electrical signal Drive Enable of connector X2 of the drive.

Valid values:
 0. Disables the drive. Motor with no torque.
 1. Enable the drive.

The Speed Enable function at the drive will be activated when the SPENA is activated or the electrical signal Speed_Enable is activated at the corresponding pin of the drive's connector X2. If it is a modular drive, it can also be activated when the electrical signal System Speed Enable is activated at the corresponding pin of connector X6 (on RPS power supplies) or X2 (on the rest of FAGOR power supplies). Likewise, the Drive Enable function with DRENA and the electrical signal Drive Enable. See **FIGURE S7.7**.



Warning. The safety standard (EN 60204-1) requires having the stop category 0 available; it is a stop without control that immediately interrupts the energy supply to the motor and, therefore, the motor stops by friction. It also requires that the stop be independent from the software, although some software systems are recently accepted that are safe according to standards EN 954, IEC 61508, IEC 62061. Consequently, although the DRENA mark of the SERCOS interface is used, the hardware control over the Drive Enable electrical signal must not be eliminated. Use the methods described in chapter 9, "Integrated safety" of the "dds-hardware" manual.

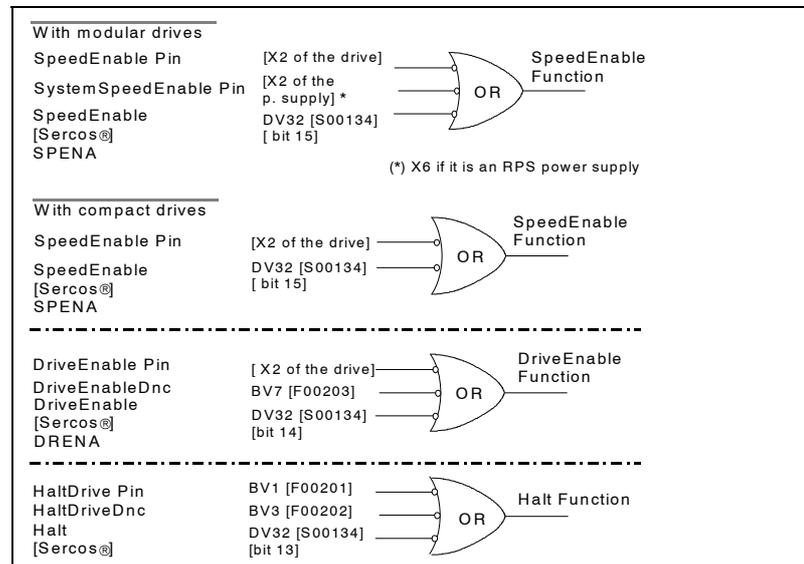


FIGURE S7.7

Control signals PLC 8055/55i - drive.

7.

PARAMETER SETTING OF THE CNC-DRIVE SYSTEM
Control signals PLC 8055/55i - drive



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7.4.2 Signals from the drive to the PLC 55/55i

The drive offers two bits to the PLC 55/55i to indicate the operating status:

DRSTAFn (DRive STAtus Firstn) (n = 1, ... 7, S, S2, AS) (M5603, M5653, M5703, M5753, M5803, M5853 and M5903 for the axes; M5953, M5978 and M5557 for the spindles).

DRSTASn (DRive STAtus Second n) (n = 1, ... 7, S, S2, AS) (M5604, M5654, M5704, M5754, M5804, M5854 and M5904 for the axes; M5954, M5979 and M5556 for the spindles).

Function: They are the bits indicating the drive status to the PLC. This way, the PLC program will handle the drive control signals depending on its status.

Valid values: 0 and 1 with the meaning of the [TABLE S7.1](#).



Warning. As a general rule, the PLC assigns the ID numbers to all the axis variables in the following order: X, Y, Z, U, V, W, A, B and C. The SERCOS ID numbers (DRIBUSID, Node_Select) assigned to the drives have nothing to do with this.

So, if the machine has three axes (e.g.: X, Y, B):

- ❑ variables SPENA1, DRENA1, and bits DRSTAF1 and DRSTAS1 will correspond to the X axis, those with the index 2 to the Y axis and those of the index 3 to the B axis.
- ❑ The variables with the S, S1 and AS index will correspond to the main, second and auxiliary spindle respectively.

The installation manual of the 8055/55i CNC also mentions these PLC variables.

TABLE S7.1 Signals from the drive to the PLC of the 8055/55i.

DRSTAF	DRSTAS	Status	Action
0	0	The drive is not ready. Do not apply mains power to the power supply.	Check the 24 V DC and/or solve the errors.
0	1	The drive is ready to receive power at the bus. The Drive OK contact is closed.	Apply mains power to the power supply.
1	0	The drive is ready to attend to the control signals.	Enable the drive using Speed Enable and Drive Enable.
1	1	Drive Enable and Speed Enable functions activated. The motor follows the command.	Govern the motor with the command.

7.

7.4.3 Programming example for the Fagor PLC 8055/55i

This programming example governs the drive's control signals depending on its status and other two variables.

; A machine has two axes (X, Z) and a spindle (S)

; The Z axis is vertical and it is not compensated. It has a brake controlled by the O20 signal.

7.

PARAMETER SETTING OF THE CNC-DRIVE SYSTEM
Programming example for the Fagor PLC 8055/55i

; DRIVE STATUS MANAGEMENT

```

;
DRSTAF1 = B1R101 ; X axis drive status
DRSTAS1 = B0R101
;
DRSTAF2 = B1R102 ; Z axis drive status
DRSTAS2 = B0R102
;
DRSTAFS = B1R103 ; Spindle drive status
DRSTASS = B0R103
;
CPS R101 GE 1 = M101 ; X axis drive OK.
CPS R102 GE 1 = M102 ; Z drive OK.
CPS R103 GE 1 = M103 ; Spindle drive OK.
M101 AND M102 AND M103 = M123 ; All the drives are ready
; The machine can be powered up
    
```

; MANAGING EMERGENCIES

```

;
M123 AND I1 ; Emergency inputs
/AND (other conditions) = / EMERGEN
/EMERGEN AND /ALARM
AND (other conditions) = O1 ; Emergency output
    
```

; MANAGING AXIS ENABLE

```

;
CPS R101 GE 2 = M111 ; The X axis drive has power
CPS R102 GE 2 = M112 ; Z axis drive has power
M111 AND M112 = M133
; All the axis drives ok and with power
M111 AND NOT LOPEN AND O1 ; X axis enable
AND (other) = SERVO1ON = SPENA1 ; Speed Enable of the X axis
= TG3 1 300
T1 = DRENA1 ; Drive Enable with a 300 ms delayed disconnection for the
; emergency stops
;
M112 AND NOT LOPEN AND O1 AND (others)
; Z axis (vertical) enable
= TG3 2 400 = O20 ; Brake controlling signal
T2 = DRENA2 = SERVO2ON = SPENA2
; Speed and Drive Enable with a 400 ms delayed disconnection
; to avoid dropping the axis
    
```

; MANAGING SPINDLE ENABLE

```

;
CPS R103 GE 2 = M113 ; The spindle drive has power
M3 OR M4 = SET M140 ; Request for spindle rotation
M2 OR M5 OR M30 OR RESETOUT OR NOT O1 = RES M140
; Cancellation of spindle rotation
M19 = SET M119 ; Request for M19
M2 OR M3 OR M4 OR M5 OR M30 OR RESETOUT OR NOT O1 = RES M119
; Cancel M19
(M140 OR (M119 AND NOT LOPEN)) AND M113 = SPENAS = TG3 3 4000
T3 = DRENAS ; 4-second delayed disconnection for emergency stops
SPENAS AND (M119 OR RIGID) AND NOT LOPEN = SERVOSON
; M19 or rigid tapping , close the loop
    
```

; MANAGING FEED HOLD AND STOP

```

;
M113 AND (others) = / FEEDHOL
    
```



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7.5 SERCOS communication with the 8070 CNC

The 8070 CNC has some general configuration parameters similar to those of the Fagor drive.

These parameters must be set so they are consistent with the ones set at the drive.

They are:

OPMODEP Similar to drive parameter AP1 (S00032) PrimaryOperationMode.
Give this parameter a value consistent with that of AP1 at the drive.

LOOPTIME Similar to drive parameter QP1 (S00001) ControlUnitCycleTime.
Give this parameter a value consistent with that of QP1 at the drive.

Other parameters must also be set for each axis. They are:

DRIVETYPE Indicates the type of interface being used.
To connect the 8070 CNC with Fagor drives, DRIVETYPE= SERCOS

TELEGRAMTYPE Indicates the type of telegram used in SERCOS communication

Set TELEGRAMTYPE= 4

DRIVEID Identifies the drive in the SERCOS.
Set this parameter with the same value as the one selected at the drive's thumb-wheel.

NPULSES

PITCH Parameters that determine feedback resolution.

The 8070 can work with a resolution of a tenth of a micron. Hence, the relationship between these two parameters must be:

$$\frac{\text{PITCH}}{\text{NPULSES} \times 4} = 0.1 \mu$$

7.

PARAMETER SETTING OF THE CNC-DRIVE SYSTEM
SERCOS communication with the 8070 CNC

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7.5.1 Parameter unification. 8070 CNC and drive with SERCOS interface

During the SERCOS initialization, on 8070 CNC power-up and when validating the machine parameters of the axes, the 8070 CNC updates the following parameters at the drive.

Parameters NP121, NP122, NP131 and NP133 of each set of the 8070 CNC will be sent to the relevant set of the drive. The rest of the sets of the drive keep the parameters of the default set of the 8070 CNC.

Understanding the table

CNC

List of CNC machine parameters.

DRIVE

List of drive parameters that are equivalent to each CNC parameter.

Pos/Vel

It indicates whether writing the parameter at the drive is conditioned by the type of configuration SERCOS, position (pos) or velocity (vel).

Feedback

It indicates whether writing the parameter at the drive is conditioned by the type of axis feedback, motor feedback or direct feedback.

7.

TABLE S7.2 Parameter unification. 8070 CNC and drives with SERCOS interface.

CNC	DRIVE	pos/vel	Feedback	Remarks
AXISTYPE + AXISMODE	PP76			PP76=65; Linear axis. PP76=66; Rotary without module. PP76=194; Rotary with module.
PROGAIN	PP104			
I0TYPE	PP115 (bit 1,5)		Direct	B1=0, B5=0; If I0 normal. B1=1, B5=0; If increasing distance-coded I0. B1=1, B5=1; If decreasing distance-coded I0.
NPULSES2	PP115 (bit 0)		Direct	B0=0; Direct rotary feedback (NPULSES<>0). B0=1; Direct linear feedback (NPULSES == 0).
AXISCH + LOOPCH	PP115 (bit 3)	pos	Direct	B3=0; Direct feedback reading (AXISCH==LOOPCH). B3=1; Direct feedback reading (AXISCH<>LOOPCH).
AXISCH	PP55 (bit 0, 2, 3)	pos		B1=0, B2=0, B3=0; It does not change the feedback reading sign (AXISCH==NO). B1=1, B2=1, B3=1; It changes the feedback reading sign (AXISCH==YES).
REFDIREC + DECINPUT + FBACKSRC	PP147 (bit 0) PP147 (bit 5) PP147 (bit 3) PP147 (bit 1)			B0=0; Positive homing direction. B0=1; Negative homing direction. B5=0; There is a home switch. B5=1; There is no home switch. B3=0; Motor feedback. B3=1; Direct feedback. B1=0; The DECEL signal of the CNC always uses positive logic.
REFEED1	PP41			
REFEED2	PP1			
REFVALUE	PP52 PP54	pos pos	Motor Direct	
REFSHIFT	PP150 PP151	pos pos	Motor Direct	

Meaning of symbols: <> Other than ; == Equal to.

7.

PARAMETER SETTING OF THE CNC-DRIVE SYSTEM

Parameter unification. 8070 CNC and drive with SERCOS interface



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TABLE S7.3 Parameter unification. 8070 CNC and drives with SERCOS interface. (cont.)

7.

PARAMETER SETTING OF THE CNC-DRIVE SYSTEM

Parameter unification. 8070 CNC and drive with SERCOS interface

CNC	DRIVE	pos/vel	Feedback	Remarks
ABSOFF	PP177 PP178		Motor Direct	Only when using distance-coded I0's. Only when using distance-coded I0's.
I0CODD11 I0CODD12	PP166 PP165			Only when using distance-coded I0's. Only when using distance-coded I0's.
BACKLASH	PP58	pos		
BACKANOUT	PP2	pos		
BACKTIME	PP3	pos		Only if BACKANOUT <> 0.
INPUTREV	NP121.x			It affects all the gears.
OUTPUTREV	NP122.x			It affects all the gears.
PITCH	NP123			
INPUTREV2	NP131.x		Direct	It affects all the gears. Only when using rotary feedback (NPULSE2<>0).
OUTPUTREV2	NP132.x		Direct	It affects all the gears. Only when using rotary feedback (NPULSE2<>0).
PITCH2	NP133		Direct	Only when using rotary feedback (NPULSE2<>0).
NPARSETS	GP6			
Limits ON	PP55 (bit 4)			B4=1; Check the limits. B4=0; Do not check the limits. - For spindles, rotary axes with module and when both parameters LIMIT+ and LIMIT- are set to 0.
MODLIMUP	PP103			Only if it is a spindle or a rotary axis with module. It always writes 360.
SZERO	SP42			Only if it is a spindle.
INPOSW	PP57			
MAXFLWE	PP159			Only if following error monitoring is active.

Meaning of symbols: <> Other than ; == Equal to.

TABLE S7.4 Parameter unification. 8070 CNC and drives with SERCOS interface. (cont.)

CNC	DRIVE	pos/vel	Feedback	Remarks
Direct feedback type	GP10			GP10=0; Direct feedback is not being used. GP10=1; TTL signal (SINMAGNI==0). GP10=2; Vpp signal (SINMAGNI<>0).
NPULSES PITCH2 Resolution of the direct feedback	NP117 NP117		Direct Direct	Only if it is rotary encoder (NPULSES<>0). Only if it is a linear encoder (NPULSES==0).
PITCH2 Resolution of linear direct feedback	NP118		Direct	Only if it is a linear encoder (NPULSES==0).
FBACKDIFF	PP5	pos	Direct	
FBMIXTIME	PP16	pos	Direct	

Meaning of symbols: <> Other than ; == Equal to.

7.

PARAMETER SETTING OF THE CNC-DRIVE SYSTEM
Parameter unification. 8070 CNC and drive with SERCOS interface



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7.

PARAMETER SETTING OF THE CNC-DRIVE SYSTEM



A large grid for parameter settings, consisting of 20 columns and 30 rows. A pencil icon is located in the top right corner of the grid.



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PARAMETER SET AND GEAR RATIOS

8

The Fagor servo drive system is configured by means of a parameter table. Some of these parameters are **arrays** of the eight elements, ordered with endings numbered from zero up. One of these **arrays** is, for example: SP1.0, SP1.1, SP1.2, SP1.6 and SP1.7. The parameters extended into **arrays** are organized in two groups called **parameter set** and **gear ratios**.

FIGURE S8.1 shows the organization of the table.

8.1 Terminology used

Parameter set

Refers to the set of parameters of the drive which determine the setup of the drive and are grouped by the same ending.

Example.

The parameter set **ZERO** consists of CP20.0, IP1.0, SP1.0 ... SP10.0, SP20.0, SP21.0, SP40.0, SP41.0, SP60.0 ... SP65.0, SP80.0 and SP100.0.

Each parameter set may configure the same drive differently. This choice may be made by just changing the active set.

A C axis must be adjusted using parameter set 7.

Gear

Refers to the purely mechanical ratio regardless of how the parameters have been set.

- Gear 0** refers to **out of gear**, no transmission.
- Gear 1** is the lowest gear with the greatest speed reduction.
- Gear 2 and the rest** will be higher gears.

Gear ratio

Refers to the set of drive parameters grouped by the same ending and that informs the drive of the motor - machine transmission (gear) ratio.

Example.

Gear ratio TWO consists of NP121.2 and NP122.2. The choice can be made by just changing the active ratio.

They are numbered from gear ratio 0 to 7.

The gear ratio parameters inform of the gear in operation according to:

Gear ratio 0	Gear 1
Gear ratio 1	Gear 2
Gear ratio 2	Gear 3 ...

Any parameter may be edited at any time, (8 sets and 8 gear ratios). The <backup> and <restore> operations affect the whole parameter table.

Each time, only one those **sets** and one of those **gear ratios** determine the operation of the system. They are the set and gear ratio active at the time.

All set - gear ratio combinations are possible.

Important parameters:

GP4	SetNumber	Number of useful sets
GP6	GearRatioNumber	Number of useful gear
GV21	ParameterSetActual	Active set
GV25	GearRatioActual	active gear ratio

FIGURE S8.1 shows an example.

Parameters GP4 and GP6 limit the number of sets and gear ratios that can be activated.

Example.

With GP4 = 4 the values of active set are limited to between 0 and 3.

Assigning a motor ID to the GV10 variable resets the whole parameter table to their default values. Particularly, GP4=1 and GP6=1, hence leaving set 0 and gear ratio 0 as the only ones that can activated.

Turning the drive back up sets GV21=0 and GV25=0.

The next sections describe the operation of these two subsets.

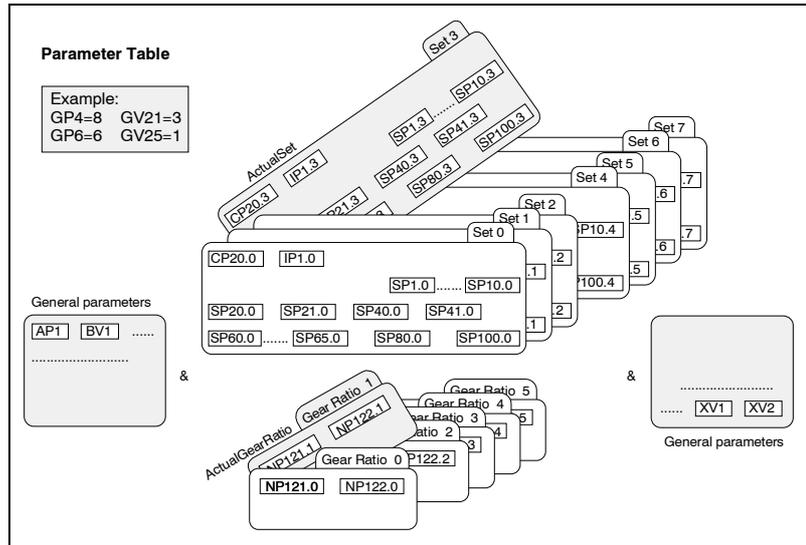


FIGURE S8.1

Set of parameters and gear ratios.



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8.2 Parameter set

The active set may be changed by means of external digital signals or through the SERCOS interface.

8.2.1 Set change through digital inputs

Running status:

Parameter **GP4** sets the number of useful sets ($1 \leq GP4 \leq 8$).

Variable **GV21** informs of which is the currently active set ($0 \leq GV21 \leq GP4$).

Boolean variables to change the active set:

Variables **GV32**, **GV31** and **GV30** are used to preset the new active set.

GV22 registers this preset.

The **GV24 - Strobe** - variable lets or not change the active set.

GV23 - Acknowledge - is the acknowledgment of the set change.

The default value of all three preselection variables is zero.

The default value of the Strobe signal is 1 (active).

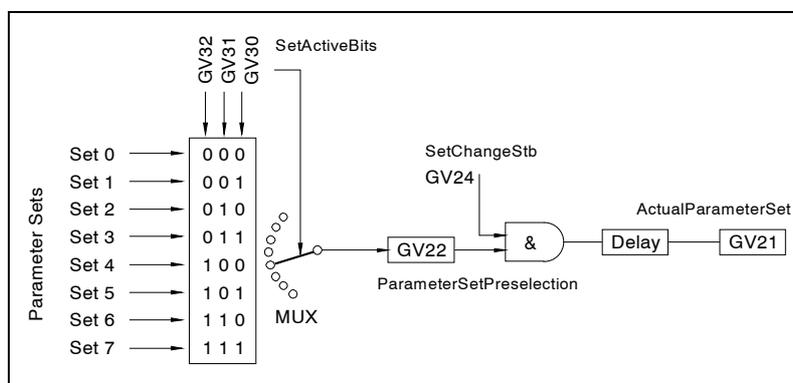


FIGURE S8.2

Set change via digital inputs.

Set change procedure

- Assign to inputs IP10-13 the Boolean variables to be governed.
- Use these digital inputs to preselect the new set that will be active.
- Activate the **strobe** signal by means of the electrical signal assigned to GV24.

The **strobe** signal GV24 may be deactivated with a delay or as a result of an up flank (leading edge) of the **Acknowledge** GV23.

FIGURE S8.3 shows an example of this.

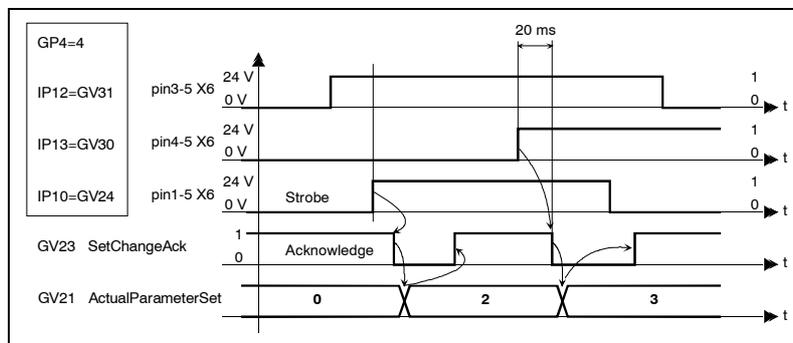


FIGURE S8.3

Set changing procedure.

8.

PARAMETER SET AND GEAR RATIOS
Parameter set



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Operation with the Strobe always active

GV24 **strobe** will stay active if it is not assigned to a digital input.

This way the change of sets is handled directly without control signals, with GV32-30. In order to avoid possible disturbances or rebounds on those electrical signals, they should maintain their new values for at least 20 ms.

FIGURE S8.4 shows an example of this.

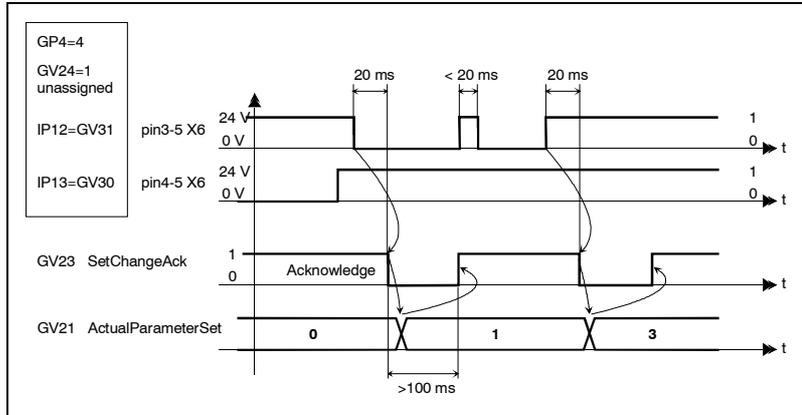


FIGURE S8.4

Operation with the strobe always active.

The active set may be changed while the motor is running. If the motor is turning faster than the limit established by the new parameter set, the speed will decrease automatically until the value of such limit is reached and only then, the new parameter set will become effective. The ramp used to make this change of speed will be the one determined by the previous set.

Acknowledge signal for a set change set

This signal is used as confirmation. It will take a zero value at the up flank (leading edge) of the **strobe** signal and it will recover its value of 1 when the change has been made.

Even when the new set is the same as the previous one, this acknowledge signal GV21 will be zero for 100 ms.

See FIGURE S8.5.

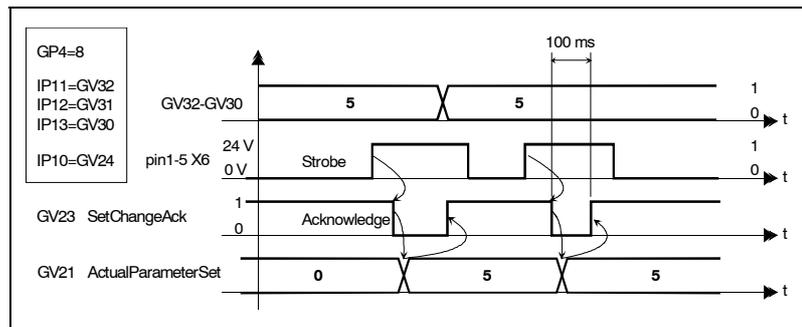


FIGURE S8.5

Acknowledge signal for a set change set.



8.

PARAMETER SET AND GEAR RATIOS

Set change through digital inputs



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8.2.2 Set change through SERCOS interface

The procedure is identical and parallel to the change of gear ratio. See the sections on changing gear ratios through SERCOS.

A very important aspect to bear in mind when changing sets using these two interfaces is:



Very important. To change a parameter set through SERCOS interface, the variables GV24, GV30, GV31 and GV32 must not be assigned to a digital input.

8.2.3 Gear ratio

□ **With SERCOS interface**

See section: Considerations on the drives of the previous chapter.

The mechanical maneuver in the machine gear box will be accompanied by a change of active gear ratio.



Very important. The command to change gears is given through the SERCOS interface. This change cannot be handled through digital inputs.

Running status:

- Parameter **GP6** sets the number of useful gear ratios ($1 \leq GP6 \leq 8$).
- Variable **GV25** informs which is the current gear ratio ($0 \leq GV25 \leq GP6$).
- Variable **GV26** registers the preselected gear ratio.

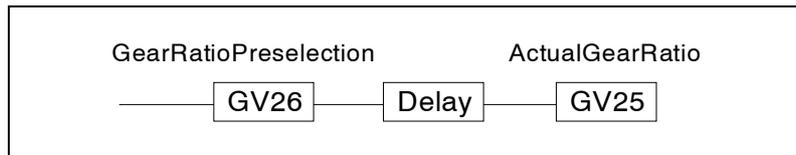


FIGURE S8.6

Variables GV25 and GV26.

8.2.4 Gear change through SERCOS interface

Change procedure via SERCOS also applicable to the change of sets. The CNC changes gear ratios by means of commands M41, M42, M43 and M44. By setting parameter AUTOGEAR (P006) to "YES", the CNC will automatically generate the previous M codes according to the selected speed. If AUTOGEAR="NO", the user must include these M codes into the part - program.

Procedure

First, determine the number of useful sets and gears by writing into these parameters:

GP4	F00703	SetNumber
GP6	F00717	GearRatioNumber

Write into the CNC variables which the new set and new gear ratio will be:

- SETGEX, SETGEY, SETGEZ, ... for the axes
- SETGES for the main spindle
- SSETGSfor the second spindle

The four least significant bits of these variables register the active gear and the other four the active set as shown in the diagram below:

Bit 7 6 5 4	Bit 3 2 1 0
0 0 0 0 Set 0 → GV21=0	0 0 0 0 → Reduction 0 → Range 1 → GV25=0
0 0 0 1 Set 1 → GV21=1	0 0 0 1 → Reduction 1 → Range 2 → GV25=1
0 0 1 0 Set 2 → GV21=2	0 0 1 0 → Reduction 2 → Range 3 → GV25=2
...	...



PARAMETER SET AND GEAR RATIOS
Set change through SERCOS interface



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PARAMETER SET AND GEAR RATIOS
Gear change through SERCOS interface

These writings are done through the service channel (slow). This channel is accessed via part - program instructions, from the PLC channel or from the user channel.

The PLC mark (SERPLCAC - SERCOS PLC Acknowledge) serves as a confirmation of the change. It will stay active from when a new set or gear ratio is requested with the previous variables (SETGEX, ...) until the drive assumes the new values for its GV21 ActualParameterSet and GV25 ActualGearRatio parameters.

While this mark is active, no other SETGE* change can be requested because the command would be lost.

Ex. of a PLC program for a gear change at the main spindle

Example of a spindle with SERCOS interface

The spindle has two ranges and works in open loop.

It does not use external feedback, but that of the motor itself, that is DRIBUSLE=1. Therefore, to display the real S at the CNC, one must change the gear ratio at the drive with each range change at the machine.

The drive of the main spindle is identifier with the number 3 of the Sercos ring. SERCOSID=3 in the parameter table of the main spindle S.

Set PLC parameter P28 (SRR700) = 3.33172.

33172 is the SERCOS identifier of the variable DV11 (F00404).

This makes register R700 (associated with parameter P28) contain the variable DV11 <FagorDiagnostics> of the main spindle through which we know the GV25 <ActualGearRatio> and GV21 <ActualParameterSet>.

The spindle table must be defined at the CNC

Spindle in open loop with three ranges.

Feedback is defined with DRIBUSLE=1

DRIBUSID=3

Two gear ratios an a single parameter set must be defined at the drive

Gear ratio 0	Gear 1	Parameter set 0
Gear ratio 1	Gear 2	
GP4=1		
GP6=2		

PROGRAMMING EXAMPLE FOR THE GEAR CHANGE AT THE MAIN SPINDLE

```

;
; Information on the resources used:
;
; I41 = Detector for first gear (M41)
; I42 = Detector for second gear (M42)
; I79 = <Drive OK> spindle drive
;
; O141 = Electric valve to activate the first gear (M41)
; O142 = Electric valve to activate the second gear (M42)
;
; M41 = Decoding <M41> from CNC: Change to first gear
; M42 = Decoding <M42> from CNC: Change to second gear
;
; With parameter PLC P28 (R700) = 3.33172, we define identifier
; SERCOS Fagor Diagnostics, because in this case, at the spindle DRIBUSID = 3
; B10R700 = SV3 This bit is activated when the spindle speed is lower than
; the Nminimum (SP40).
;
;
CY1
;
END
;
PRG
REA
;

```



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; DRIVE STATUS

```

;
DRSTAFS = B1R104
DRSTASS = B0R104 ; Spindle drive status
;
CPS R104 GE 1 = M104 ; Spindle OK.
;
M104 ; Drive OK (by software)
AND I79 ; Drive OK (by hardware)
= M200 ; Drive OK
;
CPS R104 GE 2 = M114 ; Spindle drive under power
;
I1 AND M200 = / EMERGEN ; Emergency to the CNC
/EMERGEN AND /ALARM = O1; Emergency contact to the electrical cabinet
;

```

; GEAR CHANGE

```

;
M2047 = AND R 700 $0F R45 ; Read variable GV25 <ActualGearRatio>
;
B9R700 = TG2 30 200 ; Confirmation delay N = 0
B10R700 = TG2 31 200 ; Confirmation delay N = Nmin
T30 = M155 ; N = 0
T31 = M156 ; N = Nmin
I41 AND NOT I42 = TG2 41 200; Confirmation delay, 1st gear
I42 AND NOT I41 = TG2 42,200; Confirmation delay, 2nd gear
;
T41 = GEAR1 ; Confirmation of 1st gear of the machine
T42 = GEAR2 ; Confirmation of 2nd gear at the machine
;
M114 AND M41
AND NOT GEAR1
= SET M141 ; Request for change into first gear
M114 AND M42
AND NOT GEAR2
= SET M142 ; Request for change into second gear
;
M141 OR M142 = M150 ; Spindle gear change in progress
= TG2 10 5000
;
T10 = SET MSG10 ; < gear change time exceeded >
RESETOUR OR NOT O1= RES MSG10
;
;
M150 AND M156 = MOV 100 SANALOG = PLCCNTL
; Gear change oscillation ( 100 · 0.3 = 30 mV )
PLCCNTL AND M2011 = SPDLEREV ; Reversal in gear change
;
;
M141 AND NOT SERPLCAC ; request and free service channel
= SET M241 ; latching the request for drive's first gear ratio
NOT M242 AND GEAR1
AND NOT CPS R45 EQ $00 ; Gear 1 does not match drive gear ratio
AND NOT SERPLCAC
= SET M341 ; latching the request for drive's second gear ratio
;
M241 OR M341 = M146
DFU M146 = MOV $00 R41
= CNCWR (R41, SETGES, M1000) ; Request for drive's first gear ratio
;
M146 AND CPS R45 EQ $00
AND NOT SERPLCAC AND GEAR1
= RES M141 = RES M241
= RES M341 ; Confirmation of the change into first gear
;
M142 AND NOT SERPLCAC ; Request and free service channel
= SET M242 ; Latching the request for drive's second gear ratio
NOT M241 AND GEAR2
AND NOT CPS R45 EQ $01 ; Gear 2 does not match drive gear ratio
AND NOT SERPLC
= SET M342
;
M242 OR M342 = M147
DFU M147= MOV $01 R41

```

8.

PARAMETER SET AND GEAR RATIOS
Gear change through SERCOS interface

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PARAMETER SET AND GEAR RATIOS
 Gear change through SERCOS interface

```

= CNCWR (R41, SETGES, M1000) ; Request for drive's 2nd gear ratio
;
M242 AND CPS R45 EQ $01
AND NOT SERPLCAC AND GEAR2
= RES M142 = RES M242
= RES M342 ; Confirmation of the change into second gear
;
T10 OR NOT O1 OR RESETOUT ; Cancellation of gear change request
= RES M141 = RES M142 = RES M241
= RES M242= RES M341 = RES M342
;
M241 AND O1 AND M156 = O141 ; Activate the electrovalve for the
; change to 1st gear
M242 AND O1 AND M156 = O142 ; Activate the electrovalve for the
; Change to 2nd gear
;

```

; ENABLING THE DRIVE

```

;
M3 OR M4 = SET M140 ; Request for spindle rotation
M2 OR M5 OR M30
OR NOT O1 OR RESETOUT = RES M140; Cancellation of spindle rotation
;
(M140 OR PLCNTL)
AND M114 ; Drives under power
AND (Closed-door conditions) ; Door closed
= SPENAS = TG3 3 400 ; Enabling the spindle analog
T3 = DRENAS ; Enabling the spindle drive
;

```

; AUXEND, /XFERINH, /FEEDHOLD

```

;
DFU STROBE OR DFU TSTROBE
OR DFU T2STROBE OR DFU MSTROBE
= TG1 1 100 ; Confirmation pulse STROBES
;
NOT T1
AND NOT M150 ; Gear change in progress at the drive
= AUXEND ; M, S, T functions being executed
;
NOT M241 AND NOT M242 ; Gear change in progress at the drive
= /XFERINH ; Locked CNC block reading
= /FEEDHOLD ; Feedhold for CNC axes
;
END

```

PLC program for a parameter set change

The following example shows how to work with in both spindle and C axis mode with the same drive.

The drive of the main spindle (S) is identifier with the number 3 of the SERCOS ring.

A different set of parameters must be defined at the drive (since it is a C axis, it must be the last set, i.e. set 7). In C axis mode, the machine must work at its lowest gear (highest gear ratio) and the drive must be indicated accordingly (gear ratio 0).

Parameter setting:

GP4=8	To enable the activation of set 7.
GP6=1	To work (in this example) only with gear ratio 0.

Two tables must be defined at the CNC

Spindle table	DRIBUSID=3
C axis table	Spindle in closed loop working as an axis

Set the external feedback (DRIBUSLE=0) with all the necessary parameters.

DRIBUSID=3.



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When using the same motor as C axis or as a spindle, both CNC tables must have the same DRIBUSID parameter value.

Set PLC parameter P28 (SRR700) = 3.33172.

33172 is the SERCOS identifier of the variable DV11 (F00404).

This makes register R700 (associated with parameter P28) contain the variable DV11 <FagorDiagnostics> of the main spindle through which we know the GV25 <ActualGearRatio> and GV21 <ActualParameterSet>.

PLC PROGRAMMING EXAMPLE FOR THE SET CHANGE AT THE MAIN SPINDLE (C AXIS)

```

;
; Information on the resources used:
;
; I79 = <Drive OK> spindle drive (C axis)
;
; With parameter PLC P28 (R700) = 3.33172, we define identifier
; SERCOS Fagor Diagnostics, because in this case, at the spindle DRIBUSID=3
;
CY1
;
END
;
PRG
REA
;

```

; DRIVE STATUS

```

;
DRSTAFS = B1R104
DRSTASS = B0R104 ; Spindle drive status
DRSTAF3 = B1R105
DRSTAS3 = B0R105 ; C axis drive status
;
; The DRSTAFS and DRSTASS signals behave like the DRSTAF3 and DRSTAS3
; signals
;
CPS R104 GE 1 = M104 ; Spindle OK.
CPS R105 GE 1 = M105 ; C axis OK.
;
M104 AND M105 ; Drives OK ( by software )
AND I79 ; Drives OK ( by hardware )
= M200 ; Drives OK
;
CPS R104 GE 2 = M114 ; Spindle drive under power
CPS R105 GE 2 = M115 ; C axis drive under power
;
I1 AND M200 = / EMERGEN ; Emergency to the CNC
/EMERGEN AND /ALARM = O1; Emergency contact to the electrical cabinet
;

```

; C AXIS

```

;
M2047 = AND R700 $FF R45 ; Mask to get GV21 and GV25
; ; GV21: active parameter table
; ; GV25: active gear ratio
;
DFU CAXIS = SET M251 ; C axis request
;
M115 AND M251 AND NOT M262
AND NOT SERPLCAC ; Free user channel
= SET M252 ; Permission to write the parameter table at the drive
;
DFU M252 = MOV $77 R41
= CNCWR (R41, SETGES, M1000) ; Selects the parameter table 7 at the drive
;
CPS R45 GE $77 AND NOT CAXIS
= SET M261 ; End of C axis mode
;
M115 AND M261 AND NOT M252
AND NOT SERPLCAC

```



PARAMETER SET AND GEAR RATIOS
Gear change through SERCOS interface



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PARAMETER SET AND GEAR RATIOS
Gear change through SERCOS interface

```

= SET M262      ; Permission to write the parameter table at the drive
;
DFU M262
= MOV $00 R41
= CNCWR (R41, SETGES, M1000) ; Selects the parameter table 0 at the drive

M252 AND CPS R45 EQ $77      ; C axis parameter table selected
AND NOT SERPLCAC
= RES M251
= RES M252
;
M262 AND CPS R45 EQ $00      ; Spindle parameter table selected
AND NOT SERPLCAC
= RES M261
= RES M262
;
CAXIS AND NOT M251 = SET CAXSEROK ; C-axis confirmation to the CNC via
; SERCOS Ready
NOT CAXIS AND NOT M261 = RES CAXSEROK
;

```

; ENABLING THE DRIVE

```

;
CAXSEROK      ; C axis active
AND M115      ; Drivers under power
AND (Closed-door conditions) ; Door closed
AND NOT LOPEN
= TG3 58 4000
= SPENA3      ; Speed enable of the C axis
= SERVO3ON    ; Enabling the C axis
;
T58 = DRENA3      ; C axis drive enable
;
M3 OR M4 = SET M140      ; Request for spindle rotation
M2 OR M5 OR M30
OR NOT O1 OR RESETOUT = RES M140 ; Cancellation of spindle rotation
;
((M140 OR PLCCNTL)
OR (CAXIS AND NOT CAXSEROK))
AND M114      ; Drives under power
AND (Closed-door conditions) ; Door closed
= SPENAS = TG3 3 4000 ; Enabling the spindle analog
T3 = DRENAS   ; enabling the spindle drive
;

```

; AUXEND, /XFERINH, /FEEDHOLD

```

;
DFU STROBE OR DFU TSTROBE
OR DFU T2STROBE OR DFU MSTROBE
= TG1 1 100 ; Confirmation pulse STROBES
;
NOT T1 AND
NOT SERPLCAC ; Parameter set change in progress
= AUXEND     ; M, S, T functions being executed
;
NOT SERPLCAC ; Parameter set change in progress
= /XFERINH   ; CNC block reading locked
= /FEEDHOLD  ; Feedhold for CNC axes
;
END

```



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HANDLING INTERNAL VARIABLES

9

There are two ways to monitor internal variables of the drive module at all times. Through:

- electrical signals through the analog or digital outputs.
- the PC application, WinDDSSetup.

Example.

To monitor the power of the asynchronous motors (variable TV50) and the motor torque on the synchronous ones (variable TV2) through the analog outputs and to see if the motor is stopped (variable SV5) through a digital output: Hence:

OP1=TV50	Power variable through channel 1, pins 10/11 of X7.
OP3=10000	Ten thousand decawatts for every 10 Volts (10kW /V)
OP2=TV2	Torque variable through channel 2, pins 8/9 of X7.
OP4=1000	A thousand deciNm per 10 V (10 Nm/V).
OP10=SV5	Contact between pins 6/7 of X6 closed if the motor is stopped.

See Status > Digital I/O on the menu bar of the WinDDSSetup

9.1 Digital electrical signals for PLC or PLC operation

Four internal Boolean variables of the drive can be taken to the digital outputs offered by connector X6 of the A1 card; these digital outputs may participate in the maneuver of the electrical cabinet.

The variables often chosen are:

Speed < Nx	SV3=nFeedbackMinorNx. See SP40.#
Command speed	SV4=nFeedbackEqualNCommand. See SP41.#
motor stopped	SV5=nFeedbackEqual0. See SP42
Torque < Tx	TV10=TGreaterTx. See TP1

See Status > Operation Status on the menu bar of the WinDDSSetup

Example.

OP12=TV10	The contact between pins 10/11 will be closed if the motor torque exceeds the threshold value Tx set by parameter TP1.
OP10=SV5	The contact between pins 6/7 is closed if the motor is stopped.



Refer to chapter 3. "Drive modules" of the "dds-hardware" manual, the electrical limitations of the contacts so as not to exceed these values.

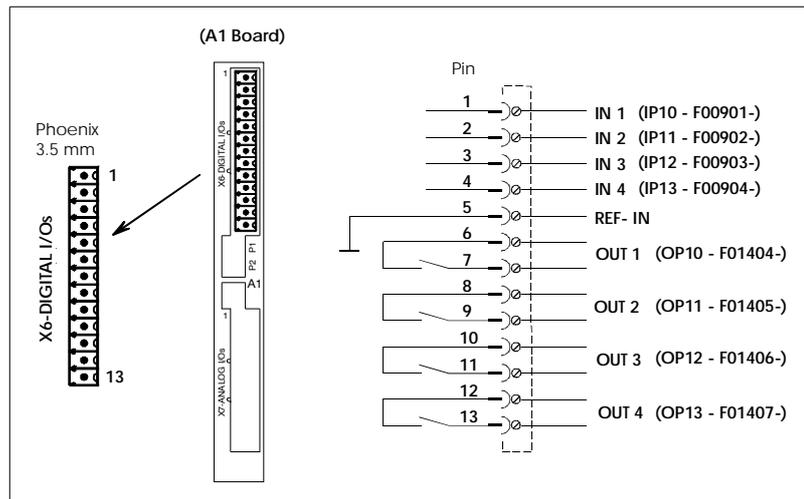


FIGURE S9.1

Digital electrical signals for PLC or maneuver.

9.

HANDLING INTERNAL VARIABLES
Digital electrical signals for PLC or PLC operation



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9.2 Analog signals for the dial

Two internal variables can be represented permanently on the machine's operator panel by means of a volt-meter.

The variables often monitored are, in drives of:

SPINDLE	TV50. Delivered power.
AXIS	TV2. Motor Torque.
BOTH	TV3. Portion of available power being developed by the motor. It is given in a value-per-thousand format and is valid for synchronous and asynchronous motors in any duty cycle.

Example 1.

If, for example, a volt-meter is installed with +5 V DC dial range and it is scaled from 0% to 100%. We wish to use it to represent the percentage of power being used with respect to the available power. The setting will be:

OP2=TV3	Fraction of power used with respect to the maximum power available, channel 2, pins 8/9 of connector X7.
OP4=2000	2000 d% / 10 V = 1000 d% / 5 V. (TV3 in d%)

Example 2.

If, for example, a volt-meter is installed with +12 V DC dial range and it is scaled from 0% to 200%. We wish to use it to represent the percentage of rated power (S1) being developed. If the spindle motor has a rated power (S1) = 11 kW, the adjustment will be:

OP1=TV50	Power feedback, channel 1, pins 10/11 of connector X7.
OP3=1833	1833 dW / 10 V (TV50 in dW) 11 kW x 2 x (10/12) = 18.33 kW = 1833 dW

The needle never reaches the top of the scale (12 V) because the maximum output voltage will be 10 V. When running at its maximum power in S6 (16 kW) the dial will show 8.72 V.



If OP3 and OP4 are evaluated with values that are too small, the electrical signal will saturate when reaching 10 V.

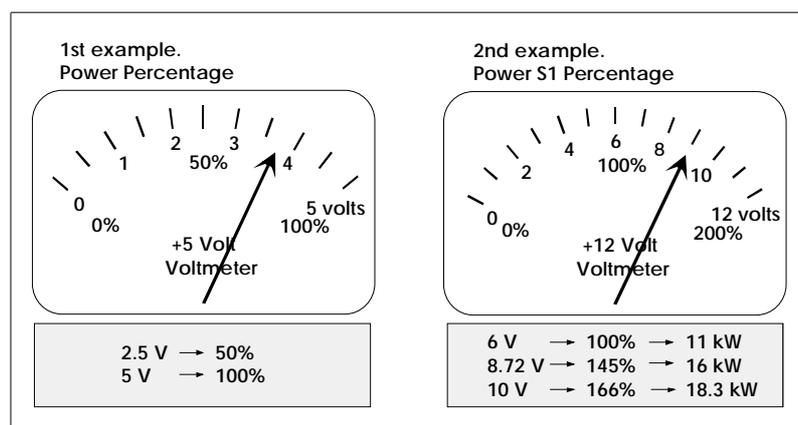


FIGURE S9.2

Volt-meter measurements in examples 1 and 2.

9.

HANDLING INTERNAL VARIABLES
Analog signals for the dial



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9.3 Handling internal variables



VÍA SERCOS

All the features described here require the following software: 8055/55i CNC versions 01.01 (mill) and 02.01 (lathe) and later. Drive versions 03.01 and later.

Communication channels

The data exchange between the CNC and the drives takes place at every position loop. The more data is exchanged the more overloaded the SERCOS transmission will be.

Therefore, it is recommended to limit these registers and, after the setup, leave only the ones absolutely necessary.

Likewise, some data must be transmitted at every position loop (commands, feedback, etc.) and other data may be transmitted at several loops (monitoring, etc.). Since the CNC must know the priority of such transmissions, from now on, we will use the terms "cyclic channel" and "service channel" when referring to the way the data is transmitted via SERCOS.

Hence, we will refer to:

□ Cyclic channel (fast)

The information transmitted through this channel **is updated** at every position loop. This data has the commands, the feedback, etc. Each variable read or written at the drive is included in this information package. Every loop time (cycle time) the CNC transmits to the drive, through this channel, the WordControl (Speed Enable, Drive Enable, Homing Enable, bit handshake) and the velocity command. The drive transmits to the CNC the Status Word and the position value.

In order not to overload the interface, the number of affected drive variables must be limited to the minimum necessary.

The synchronous access to a variable is always done by the cyclic channel.

□ Service channel (slow)

The data transmitted via this channel **is transmitted** every so many position loops (monitoring, etc.). This channel is accessed via part-program instructions, from the PLC channel or from the user channel.

The asynchronous access to a variable is always done by the service channel.

9.

9.3.1 Variables of the drive to be read from the PLC

Cyclic channel

These variables are:

VARIABLE	SERCOS	ATTRIBUTE	NAME
DV9	00012	S00012	Class2Diagnostics (warnings)
DV10	00013	S00013	Class3Diagnostics (op.Status)
SV2	00040	S00040	VelocityFeedback
PV51	00051	S00051	PositionFeedback1
TV2	00084	S00084	TorqueFeedback
CV3	33079	F00311	CurrentFeedback
DV11	33172	F00404	FagorDiagnostics
IV1	33673	F00905	AnalogInput1
IV2	33674	F00906	AnalogInput2
IV10	33675	F00907	DigitalInputs
TV50	34468	F01700	PowerFeedback
TV3	34469	F01701	PowerFeedbackPercentage

Identify the parameter to be read in one of the parameters P28-P67 of the PLC table.

Use an "n.i" where "n" is the drive identifier in the Sercos ring and "i" is the Sercos identifier of the drive parameter.

Example.

PLC parameters P28-P67 are associated with registers:

P28 with R700	P29 with R701	P30 with R702	...
---------------	---------------	---------------	-----

Reading example: Set P28 = 4.33172 in the CNC machine parameters. This way, PLC register R700 will contain the value of the variable DV11 (F00404) that belongs to the drive identifier with the SERCOS number 4.

9.

HANDLING INTERNAL VARIABLES
Variables of the drive to be read from the PLC

FAGOR 

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9.3.2 Drive variables to be written from the PLC

Cyclic channel

Use PLC machine parameters P68-P87 associated with registers:

P68 with R800	P69 with R801	P70 with R802	...
---------------	---------------	---------------	-----

The drive variables which can be written from the PLC are:

VARIABLE	SERCOS	ATTRIBUTE	NAME
OV1	34176	F01408	DA1Value
OV2	34177	F01409	DA2Value
OV10	34178	F01410	DigitalOutputs
SV1	00036	S00036	VelocityCommand

Variable SV1 (S00036) can only be written for axes set as DRO axes (DRO mode).

Reading example : Set P69=1.34176 in the CNC machine parameters. This way, the value of OV1 of the drive identified as SERCOS number 1 may be assigned to PLC register R801.

Now setting ... = MOV 8000 R801 the analog output of channel 1 (pins 11/10 of connector X7) will output 2441 mV.

Voltage = Register x 0.3 V

9.
HANDLING INTERNAL VARIABLES
Drive variables to be written from the PLC



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9.3.3 Drive variables to be read or written

Service channel

This channel can only be accessed through a high - level block of the part - program, PLC channel or user channel. Use CNC **global parameters** P100-P299.

All " non - string " type variables can be accessed.

▣ From the part-program or user channel

Reading example: ... (P100=SVARX 40)

Parameter P100 will be assigned the value of the X axis motor speed; that is: SV2 (S00040) VelocityFeedback.

If, for example, the speed is 200 rpm, P100 must assume the value of 200000.

Reading example: ... (SVARZ 36=P110)

It will assign the value of parameter P110 to the Z axis SV1 (S00036) VelocityCommand .

If, for example, P110 = 3500000, the command will be 350 rpm.

Parameter = Speed (rpm) x 10000.

▣ From the PLC channel

Reading example: ... = CNCEX ((P100=SVARX 40),M1)

Writing example: ... = CNCEX ((SVARZ 36=P100),M1)

9.

HANDLING INTERNAL VARIABLES
Drive variables to be read or written

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9.3.4 Drive variables to be read from the CNC

Cyclic channel

The drive variables that may be read from the CNC are:

VARIABLE	SERCOS	ATTRIBUTE	NAME
CV3	33079	F00311	CurrentFeedback
DV9	00012	S00012	Class2Diagnostics (warnings)
DV10	00013	S00013	Class3Diagnostics (Op. Status)
DV11	33172	F00404	FagorDiagnostics
IV1	33673	F00905	AnalogInput1
IV2	33674	F00906	AnalogInput2
IV10	33675	F00907	DigitalInputs
IV11	33676	F00908	DigitalInputsCh2
PV51	00051	S00051	PositionFeedback1
PV53	00053	S00053	PositionFeedback2
PV130	00130	S00130	ProbeValue1PositiveEdge
PV131	00131	S00131	ProbeValue1NegativeEdge
PV153	34076	F01308	PositionFeedback12
PV179	00179	S00179	ProbeStatus
PV189	00189	S00189	FollowingError
PV190	34773	F02005	PosErrorBetweenFeedbacks
PV191	34777	F02009	FollowingError1
PV192	34778	F02010	FollowingError2
PV193	34779	F02011	FollowingError12
PV205	00405	S00405	Probe1Enable
PV209	00409	S00409	Probe1PositiveLatched
PV210	00410	S00410	Probe1NegativeLatched
QV30	33495	F00727	FiberDistErrCounter
SV2	00040	S00040	VelocityFeedback
SV9	34382	F01614	PositionCommandDelta
SV10	34383	F01615	PositionFeedback1Delta
SV11	34384	F01616	PositionFeedback2Delta
SV12	34385	F01617	ObserverVelocity
TV2	00084	S00084	TorqueFeedback
TV3	34469	F01701	PowerFeedbackPercentage
TV4	34680	F01912	VelocityIntegralAction
TV5	34681	F01913	TorqueFeedforward
TV50	34468	F01700	PowerFeedback
TV51	00385	S00385	ActivePower
TV92	00092	S00092	BipolarTorqueForceLimit
XV10	34800	F02032	GeneralVariable32A
XV11	34801	F02033	GeneralVariable32B
XV12	34802	F02034	ReadPLCMarksGroup
XV13	34803	F02035	WritePLCMarksGroup

9.

HANDLING INTERNAL VARIABLES
Drive variables to be read from the CNC



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9.3.5 Drive variables to be written from the CNC

Cyclic channel

The variables that may be written from the CNC are:

VARIABLE	SERCOS	ATTRIBUTE	NAME
OV1	34176	F01408	DA1Value
OV2	34177	F01409	DA2Value
OV10	34178	F01410	DigitalOutputs
OV11	34181	F01413	DigitalOutputsCh2
PV47	00047	S00047	PositionCommand
PV48	00048	S00048	AdditivePositionCommand
PV136	00336	S00336	InPosition
PV200	00400	S00400	HomeSwitch
PV201	00401	S00401	Probe1
PV205	00405	S00405	Probe1Enable
QV30	33495	F00727	FiberDistErrCounter
SV1	00036	S00036	VelocityCommand
SV37	00037	S00037	AdditiveVelocityCommand
TV81	00081	S00081	AdditiveTorqueCommand
TV92	00092	S00092	BipolarTorqueForceLimit
XV10	34800	F02032	GeneralVariable32A
XV11	34801	F02033	GeneralVariable32B
XV12	34802	F02034	RealPLCMarksGroup
XV13	34803	F02035	WritePLCMarksGroup

9.

HANDLING INTERNAL VARIABLES
Drive variables to be written from the CNC

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FEATURES FOR THE MOTOR

10

10.1 Motor power reduction

This feature is aimed at asynchronous motors and may be used **to obtain a specific constant power in a wide range of speeds**.

Sometimes, it is interesting to avoid the gear box for the spindle of the machine. This requires a servo drive that outputs constant power starting at very low speeds.

For this type of applications, a motor must be selected whose rated power **exceeds** the one demanded by the application.

Hence, when applying the gear ratio, a wider constant-power area may be obtained whose value is the one required by the application and from a lower speed up to a higher speed; in other words, it increases the speed range of the motor where it outputs the **constant power** needed by the application.

The parameter used to obtain this reduction is:

TP22	F01914	MotorPowerReduction
------	--------	---------------------

See section "T group. Torque and power" in chapter 13 of this manual.



Remember that in drive software version older than 06.01 this parameter TP22 was known as MP22.

Example.

A motor is to be mounted on the machine offering 5 kW in S1 at 500 rpm and higher. Which FM7 motor could be selected from the Fagor catalog considering that the power reduction may be applied ?

Solution

The asynchronous spindle motor FM7-A150-□□□□-E02 of the Fagor catalog offers a rated power of 15 kW in S1 and 22 kW in S6-40%. The base speed at which the motor actually starts providing all this power is 1500 rpm.

If the maximum power is limited to 1/3 of its capacity, which is the one the application requires (5 kW in S1), the effective base speed is also reduced in 1/3; i.e. 500 rpm. This effect is controlled with parameter TP22 that can only be modified from the Fagor access level. In this case, you would set TP22=33.



Limiting the power at the motor does not mean that it can be controlled with a smaller drive. However, the power demanded from the power supply will be lower.



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10.

FEATURES FOR THE MOTOR
 Motor power reduction

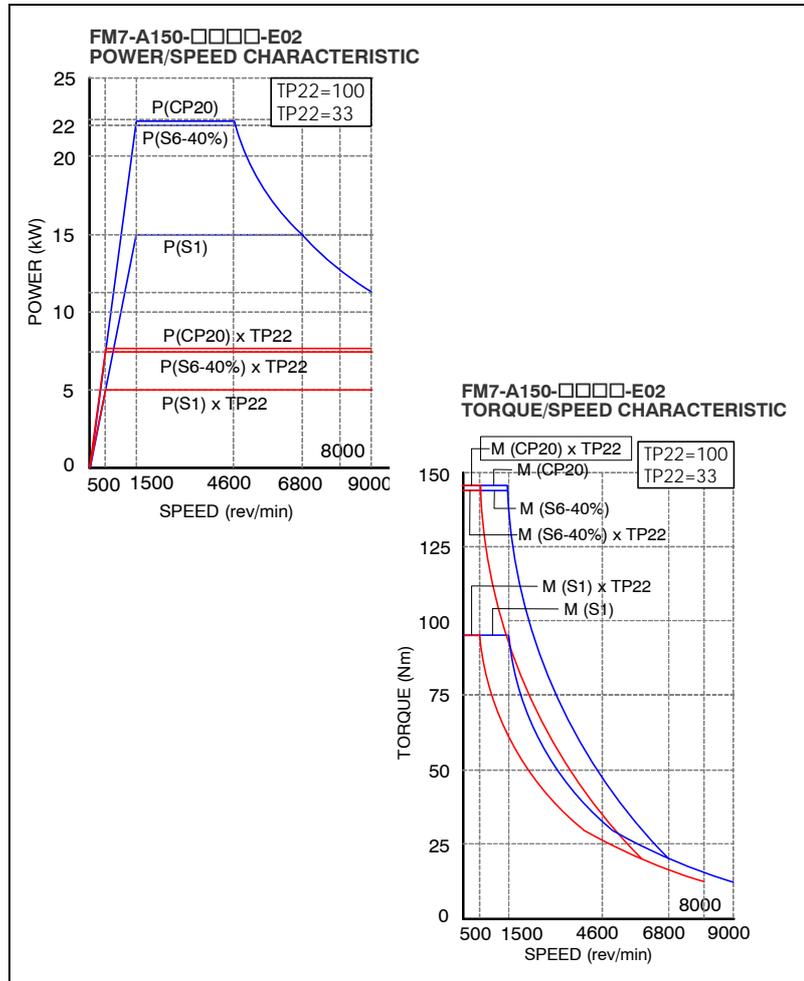


FIGURE S10.1
Power limit. Parameter TP22.

Important. Bear in mind that when having several choices to select the motor, **one must consider the one requiring a drive of smaller power.**

Setting of TP22

The value to assign to parameter TP22 to apply the gear ratio is obtained from the formula:

$$TP22 = (P_{ap} / P_{CP20}) \times 100$$

where:

- P_{ap} Power required by the application
- P_{CP20} Power corresponding to the current value given to CP20.

By default:

- $CP20 = 1.50 \times I_n$ in asynchronous motors (except FM7)
- $CP20 = 1.35 \times I_n$ in FM7 spindle motors

Note that the value of the rated current I_n of the motor is given by parameter MP3.



If the rated current I_n of the motor exceeds the maximum current of the drive (in any duty cycle), then the default value of CP20 will be value of the maximum current that the drive can output.



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10.2 Halt function

Activating the Halt function means setting the velocity command to zero while keeping the rotor locked (with torque).

As opposed to the effect of deactivating the Speed Enable function, the Halt function does not free the motor when it has stopped it.

It may be **activated** by an electrical signal at any of the digital inputs of the drive by means of a monitoring program through the serial line or through the SERCOS interface.

The Halt function is activated (stops the motor) when:

- when applying zero volts at the electrical input assigned to variable BV1 (F00201), or
- when requested from the monitoring program (variable BV3 (F00202) = 0), or
- when requested from the PLC of the CNC via SERCOS (bit 13 of variable DV32 (S00134) is set to 0).

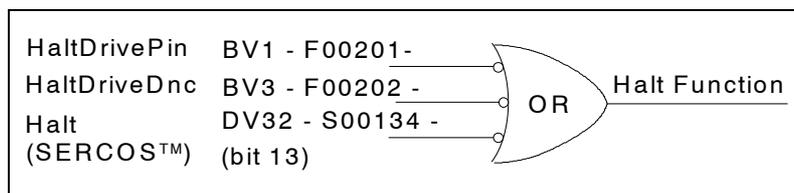


FIGURE S10.2

Halt function.

By programming drive variable BV1, one of the four digital inputs of connector X6 can perform the Halt function. To make the motor stop more smoothly, its deceleration can be limited with parameter SP65 (with SP70=1, SP100=1).

Example.

Next, a programming example and a graphic to show how it works.

IP10	F00090	= BV1 (F00201)
SP70	F01610	= 1
SP100	F01611	= 1
SP65	F01609	= 500 rad/s ²

This way, when pin 1 (referred to pin 5) of connector X6 receives **zero volts**, BV1 (F00201) will assume the zero value and the Halt function will be activated. The motor will stop with a maximum acceleration of 500 rad/s² and will lock up. With 24 volts at that pin, the servo drive will continue to follow the velocity command.

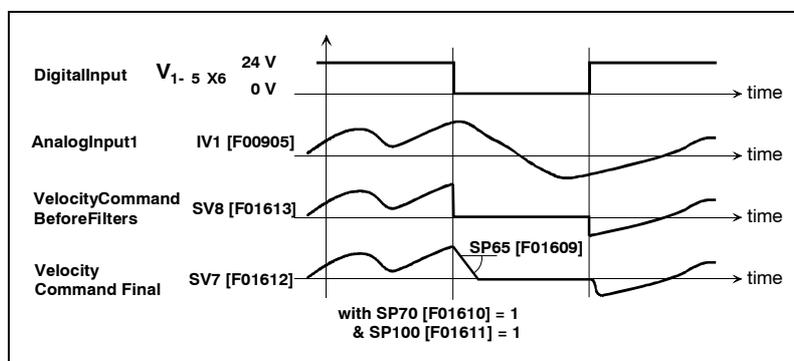


FIGURE S10.3

Graph for the example.

10.

FEATURES FOR THE MOTOR
Halt function



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10.3 Motor stop due to torque overload

From drive software version 02.04 and later include a new feature especially designed for spindle drives although it is also available for axes.

This feature makes it possible to detect the stopping of the motor due, for example, to a stuck tool and it issues an error message.

Operation

When the drive detects that the speed of the motor is below the threshold set by GP8 (F00236) and the internal current command is close to its maximum CP20 (F00307), an internal clock starts timing.

If the time elapsed in these conditions (torque overload) exceeds the value set in GP7 (F00235), it triggers error code **E203**.

If the internal torque command drops below its maximum value or the motor speed is resumed, the internal timer is reset back to zero.

Parameters

GP7	O	F00720	OverloadTimeLimit
-----	---	--------	-------------------

Function: Maximum time set to operate under overload conditions. Exceeding this time value in these conditions activated error code **E203**.

See parameter **GP8**.

Valid values: 0 ... 10 000 ms.
Setting GP7 = 0 disables the detection.

Default value: 200 ms.

GP8	O	F00721	OverloadVelocityThreshold
-----	---	--------	---------------------------

Function: Sets the speed threshold under which the motor is considered to be stopped in terms of overload detection. See parameter **GP7**.

Valid values: 0 ... 60 000 rpm.

Default value: For spindle motors: 100 rpm.
For axis motors: maximum speed nmax in rpm.

Generated errors

203	Torque overload error
205	Motor without voltage for the demanded conditions

Refer to the section of chapter **14. ERROR CODES AND MESSAGES** of this manual for further information on these two errors.

10.

FEATURES FOR THE MOTOR
Motor stop due to torque overload



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10.4 Flux reduction without load

Drive software version 03.06 and later include this feature for spindle drives.

With this feature, it is possible to reduce the magnetizing current while the motor turns without load, with less noise and less heat.

Note that this reduction of the magnetizing current does not affect the supplied power because it will increase automatically when requiring motor torque.

The parameter used to obtain this reduction is:

FP40.#	F00622.#	FluxReduction
---------------	----------	---------------

See section: "F group" of chapter 13 of this manual.



Warning. Since the setting of the flux and maximum motor torque has a delay, it is not recommended to use this flux reduction on motors used to feed the axes.

This parameter is expanded in **eight sets** of values for adapting it with each gear change.

10.

FEATURES FOR THE MOTOR
Flux reduction without load

10.5 Auto-adjustment of the rotor resistance value

Drive software version 06.01 and later include this feature for asynchronous drives.

This feature helps improve the behavior of an asynchronous motor regardless of the variations of the rotor resistance due to temperature & frequency.

This auto-adjustment consists in estimating the value of this resistance at all times while watching those variations.

There are two parameters for auto-adjusting the value of the rotor resistance:

FP30	F00612	RotorResistanceEstimationActive
FP31	F00613	RotorFixedTemperature

See section: "F group. Flux" of chapter 13 of this manual.

The estimated value of this resistor may be obtained in different ways depending on the motor being used (whether it has a temperature sensor or not) and the parameters will be set as follows:

□ **Determine whether the estimation is activated or not**

FP30=1	It activates the estimation
FP30=0	Cancels the estimation

□ **Determine whether the motor has a temperature sensor or not**

MP14=2	With a KTY84-130 sensor
MP14=3	With an FM7 sensor
MP14=5	With a linear sensor

□ **Determine the fixed temperature of the rotor**

MP31=0	If it has a sensor
MP31=T	If it has no sensor. T = fixed temp. (e.g. 75 °C)

Observe that they are not on-line parameters.

To make any change effective, execute the "validate" command using GC4 or by clicking on the corresponding icon of the WinDDSSetup. To save the new values permanently in flash memory besides assuming the changes, execute the "save in flash" command using GC1 or clicking the corresponding icon of the WinDDSSetup.

10.

FEATURES FOR THE MOTOR
 Auto-adjustment of the rotor resistance value



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10.6 Electrical position on motor startup



Only applicable to synchronous motors.

Very important. Before executing this feature, bear in mind the following considerations:

Warnings



- If the shaft is blocked by the brake, **unblock it before** enabling the torque.
- When having a vertical axis with counterweight, do not use this feature for any reason.
- When having tandem or gantry axes, each motor must move the axis on its own in order to use this feature.

Its purpose is to control a synchronous spindle, it is also necessary to know the relative position of the magnets (joined to the rotor) with respect to the stator on startup, i.e. its **electrical position**. Some motors have sensors with a system that measures the absolute position in a full revolution and, therefore, can determine the electrical position on startup. Others do not have such intelligent sensors and do not know the absolute position. They require an estimated calculation of the electrical position on motor startup.

10.

FEATURES FOR THE MOTOR
Electrical position on motor startup

10.6.1 Startup without absolute position in a full revolution

Warning. Feature developed in drive software version 06.10 and has been improved in version 06.18. In both versions, this feature is carried out by executing the GC7 command, although in version 06.10 it was always executed automatically on each start-up of the drive and in version 06.18 one can choose whether to execute it automatically or manually using parameter GP2.



Important note. When using an encoder (integrated into the motor itself) that does not provide the absolute position, at least in a whole revolution, GP2 must always be properly set before starting the drive up to establish that the GC7 command must always be executed to estimate an electrical position on start-up in order to move the motor in a controlled way. If it is not to be executed automatically, make sure that you do it manually from the WinDDSSetup before powering it up so as not to lose control of motor.

Then, if GP2 has been set so GC7 is executed on start-up, the following must be done before the start-up procedure:

- Disable the motor brake by PLC (if it has a brake).
- Enable all the necessary signals so the drive can move the motor, such as DRENA, SPENA, etc.

Now, in the startup procedure, so the drive can automatically estimate the electrical position (internal execution of the GC7 command) and prevent the motor from running away, you must set:

GP2	F00701.#	Feedback1Type													
B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
1	x	x	x	x	x	x	x	x	0	1	1	1	x	x	x

The setting of GP2 using the bits method (B15=1) is enabled as well as the initial automatic calculation of the rho every time the drive is powered up executing the GC7 command automatically.

Depending on which encoder you're using, set the rest of the bits as indicated in chapter 5 of this manual on how to set feedback parameters using the bits method.

Note that this procedure causes a slight movement of the motor.



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If the GC7 command is not to be executed automatically on start-up, set GP2 as indicated here:

GP2		F00701.#		Feedback1Type															
B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0				
1	x	x	x	x	x	x	x	x	0	0	0	0	x	x	x				



Danger. If GP2 is set like this, the initial rho estimation will not be carried out which can cause the motor to run away if it is not executed manually from the WinDDSSetup before applying power to the unit.

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FEATURES FOR THE MOTOR

Startup without absolute position in a full revolution

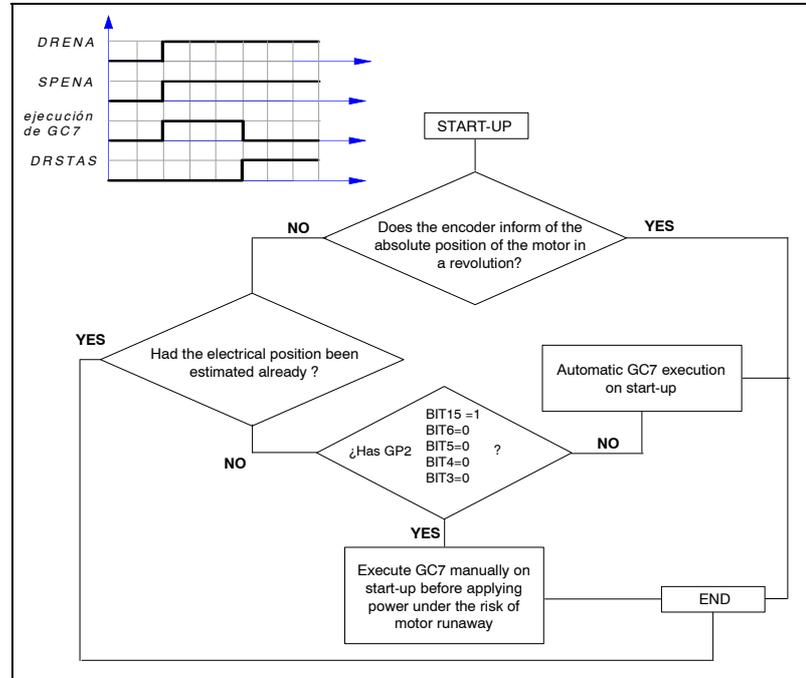


FIGURE S10.4

Estimating the electrical position (rho) of a motor on power-up.

If an error occurs while executing the GC7 command; in other words, the execution has not been successful, the command itself will return a feedback error.

Observe that GV15 will not be set to 1.

See **E158** and **E813** in chapter 14. **ERROR CODES AND MESSAGES** of this manual for further information on the errors that may be activated while executing this command.



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How to solve unsuccessful executions of the GC7 command

The GC7 command **estimates** the electrical position when powering up a synchronous motor without absolute position feedback in 1 revolution so it can be moved in a controlled way.

GC7	F01524	AutoPhasingOnline
------------	--------	-------------------

An error code **E158** error during the execution of the GC7 command means that the movement exceeds the maximum value set in PP160 (F01303) MonitoringWindowPosEleCalc.

To solve this situation, increase the value set in PP160.

Remember that error code E158 may be reset and does not deactivate PWM.

An error code **E813** during the execution of the GC7 command means that the initial electrical position has not been estimated successfully.

Remember that error code E813 may be reset and deactivates PWM.

The user (after a prior analysis of the system) can solve this type of situation by properly setting these parameters:

CP21.#	F00319.#	PeakCurrentAutophasingOnline
CP22.#	F00320.#	NominalCurrentAutophasingOnline
CP23	F00321	AutophasingOnlineFastSlope
CP24	F00322	AutophasingOnlineSlowSlope

See (parameter set) in chapter 13. **PARAMETERS, VARIABLES AND COMMANDS.**

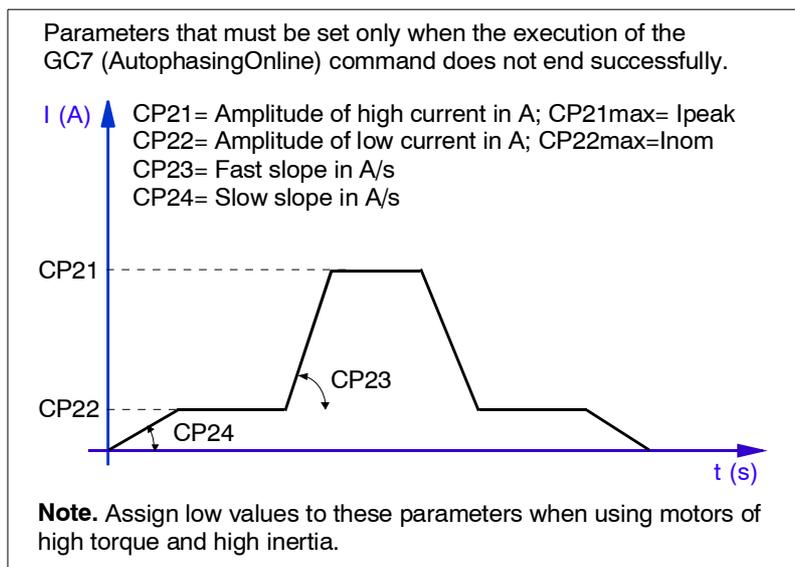


FIGURE S10.5

Parameters that must be set when the GC (AutophasingOnline) command has not been successfully executed (error code E813).

If after readjusting these parameters, you still haven't been able to execute the GC7 command successfully; in other words, the motor does not move or it does not move properly, you can also use these parameters:

CP26	F00324	I0electSlowVelocity
CP27	F00325	I0electFastVelocity

See the meaning of these parameters in chapter 13. **PARAMETERS, VARIABLES AND COMMANDS.**

10.

FEATURES FOR THE MOTOR
Startup without absolute position in a full revolution



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10.

FEATURES FOR THE MOTOR
Continuous latching with Stegmann encoders (ref.E1)

Remarks.

Remember that the GC7 command will usually be executed successfully in most situations using the default values of all these parameters.

Besides the previous four parameters, it may also be necessary to readjust these two parameters when using motors of high torque and moving large inertias.

If readjusting the previous four parameters has not solved the problem, decrease the value CP27 gradually in these cases without changing the value of CP26.

You may have to readjust some of the previous four parameters properly too.

If this still doesn't solve the problem, keep decreasing the value of CP27 even until it is the same as that of CP26.

Observe that there is no exact adjusting procedure to follow and, depending on each situation, you must observe the behavior of the system and change the values of these parameters gradually and accordingly.

Updating the electrical position value (rho) executing GC8

GC8	F01525	ElectricPositionCorrection
------------	--------	----------------------------

If so wishes, the user can also execute the GC8 command automatically on power-up; GC8 updates the real electrical position value (real rho) which is not the value estimated when executing GC7.

The GC3 command must be executed at least once in the lifetime of the machine before executing the GC8 command in order to ensure that the rho value stored in RP5 is correct.

Now, in the startup procedure, so the drive can automatically update the electrical position (rho) every time it goes through the reference mark (I0) as long as the internal execution of the GC8 command is active, set:

GP2	F00701.#	Feedback1Type
------------	----------	---------------

B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
1	1	x	x	x	x	x	x	x	x	x	x	x	x	x	x

The setting of GP2 using the bits method (B15=1) is enabled as well as the automatic update of the rho when it goes through the reference mark when the drive is powered up (B14=1) executing the GC8 command automatically. Depending on which encoder you're using, set the rest of the bits as indicated in chapter 5 of this manual on how to set feedback parameters using the bits method.

10.6.2 Continuous latching with Stegmann encoders (ref.E1)

Warning. Feature developed in drive software version 06.23. It requires a CAPMOTOR-2 board. It is transparent to the user.

It is executed automatically on power-up with Stegmann encoders (ref.E1) and it allows returning the position value of the reference mark I0 when going through it, therefore monitoring for any possible pulse counting (reading) losses.

10.6.3 Refresh the electrical position when going through the first reference mark (I0) with encoders having C and D signals

Warning. Feature developed in drive software version 06.23. It requires a CAPMOTOR-2 board. It is transparent to the user.

It is executed automatically on power-up with C and D signal encoders and it corrects the deviation of the position estimated on motor start-up when going through the first reference mark (I0).



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10.7 User motor with linear temperature sensor

Warning. Feature developed in drive software version 06.15 for synchronous and asynchronous motors having a linear temperature sensor.

Its purpose is to make it possible to monitor accurately enough the temperature of a user (non-Fagor) motor that has a linear temperature sensor. One must set the linear relationship between the resistance and the temperature of the linear sensor and provide the drive only with the value of the resistance of the linear sensor at 25°C (77°F) and at a maximum operating limit temperature set for the motor.

The parameters used to set this linear resistance-temperature ratio characteristic of the linear sensor are:

MP14	F01210	MotorTempSensorType
MP45	F01242	MotorTempSensorR25
MP46	F01243	MotorTempSensorR_MP41
MP41	F01237	MotorMaximumTemperature

and they are set as follows:

- **Determine that the motor has a linear temperature sensor**

MP14=5	Motor with linear temperature sensor
---------------	--------------------------------------

- **Determine the resistance value R of the sensor at 25°C (77°F)**

This value is obtained from the "resistance-temperature" characteristics chart provided by the manufacturer of the linear sensor.

MP45	Linear sensor resistance at 25°C (77°F)
-------------	-----------------------------------------

- **Determine the value of the max. limit temperature Tmax set for running the motor**

MP41	Maximum operating temperature of the motor
-------------	--------------------------------------------

- **Determine the resistance value of the sensor at this max. temperature set in MP41**

This $R_{T_{max}}$ value is obtained from the "resistance-temperature" characteristics chart provided by the manufacturer of the linear sensor.

MP46	Linear sensor resistance at maximum motor operating temperature (MP41)
-------------	------------------------------------------------------------------------

Note. Parameters MP45 and MP46 are only operational when setting MP14=5.

Observe that they are not on-line parameters.

To make any change effective, execute the "validate" command using GC4 or by clicking on the corresponding icon of the WinDDSSetup.

To save the new values permanently in flash memory besides assuming the changes, execute the "save in flash" command using GC1 or clicking the corresponding icon of the WinDDSSetup.

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FEATURES FOR THE MOTOR
User motor with linear temperature sensor



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See all these parameters shown in **FIGURE S10.6** and refer to section: "Motor" of chapter 13 of this manual for more information on them.

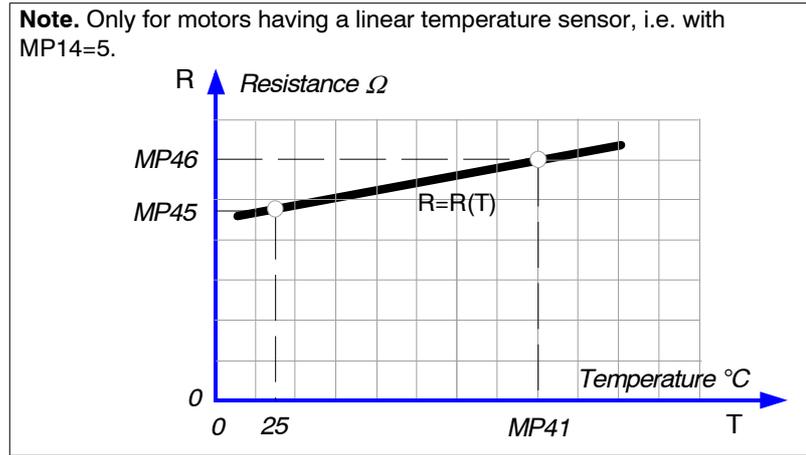


FIGURE S10.6

Example of "resistance-temperature" characteristic chart (straight line) of a PTC linear temperature sensor integrated into the motor itself

10.

FEATURES FOR THE MOTOR

User motor with linear temperature sensor



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SETTING UP AN ASYNCHRONOUS SPINDLE



11.1 Asynchronous motor with motor feedback

From drive version 06.10 on, there is a software capable of controlling an asynchronous motor of up to 1 kHz with GP1= 4000 or up to 2 kHz with GP1=8000. That is, for an asynchronous motor with two pairs of poles, the maximum speeds that may be controlled will be 30000 and 60000 rpm respectively.

The formulae to obtain the controllable speed ω_{max} depending on the number of pairs of poles of the motor (MP5) are::

With GP1=4000 Hz; $\omega_{max}= 60 \times (1\text{kHz} / \text{MP5})$ in rpm

With GP1=8000 Hz; $\omega_{max}= 60 \times (2\text{kHz} / \text{MP5})$ in rpm

Remember that GP1 (F00700) PwmFrequency is the parameter that reflects the switching frequency of the IGBT's and MP5 (F01201) Motor-PolesPairs the number of pairs of poles of the motor.

The way the parameters of an asynchronous motor are set will be different depending on whether it is a Fagor motor or a user motor (non-Fagor).

However, there is a previous parameter setting, common to all of them, that should be done first.

First observe that:



Setting the parameters of a drive to control an asynchronous spindle motor with and (<non-sensorless> vector control) does not permit configuring the system to work with direct feedback. Under these conditions, the system can only be configured to work with motor feedback.

Proceed now with the prior parameter setting as indicated:

- ❑ **Select the IGBT switching frequency:** depending on the maximum speed of the motor and its number of pairs of poles.

Parameter setting:

GP1=4000	Up to ω_{max} =30000 rpm with MP5=2
GP1=8000	Up to ω_{max} =60000 rpm with MP5=2

- ❑ **Identify the temperature sensor** of the motor.

Parameter setting:

MP14	MotorTempSensorType
------	---------------------

Note that to control an asynchronous user motor, a Fagor drive must know the temperature sensor of the motor.

- Estimate the rotor resistance.

Parameter setting:

FP30	RotorResistanceEstimationActive	Activate or not the rotor resistance estimate.
FP31	RotorFixedTemperature	Determine the fixed temperature of the rotor:

For further detail, see the section "automatic adjustment of the rotor resistance value" of chapter 10 in this manual.

- Identify the motor feedback.

Parameter setting:

GP2.#	Feedback1Type	Motor feedback type
NP116	ResolutionOfFeedback1	Motor feedback resolution

Note that to control an asynchronous user motor, a Fagor drive must know the feedback of the motor.

For further detail on all these parameters, see chapter 13. **PARAMETERS, VARIABLES AND COMMANDS** in this manual. Then, proceed to set up any asynchronous motor semi-automatically as shown in the following diagram.

It makes it easier to set up the motor.

11.

SETTING UP AN ASYNCHRONOUS SPINDLE
Asynchronous motor with motor feedback

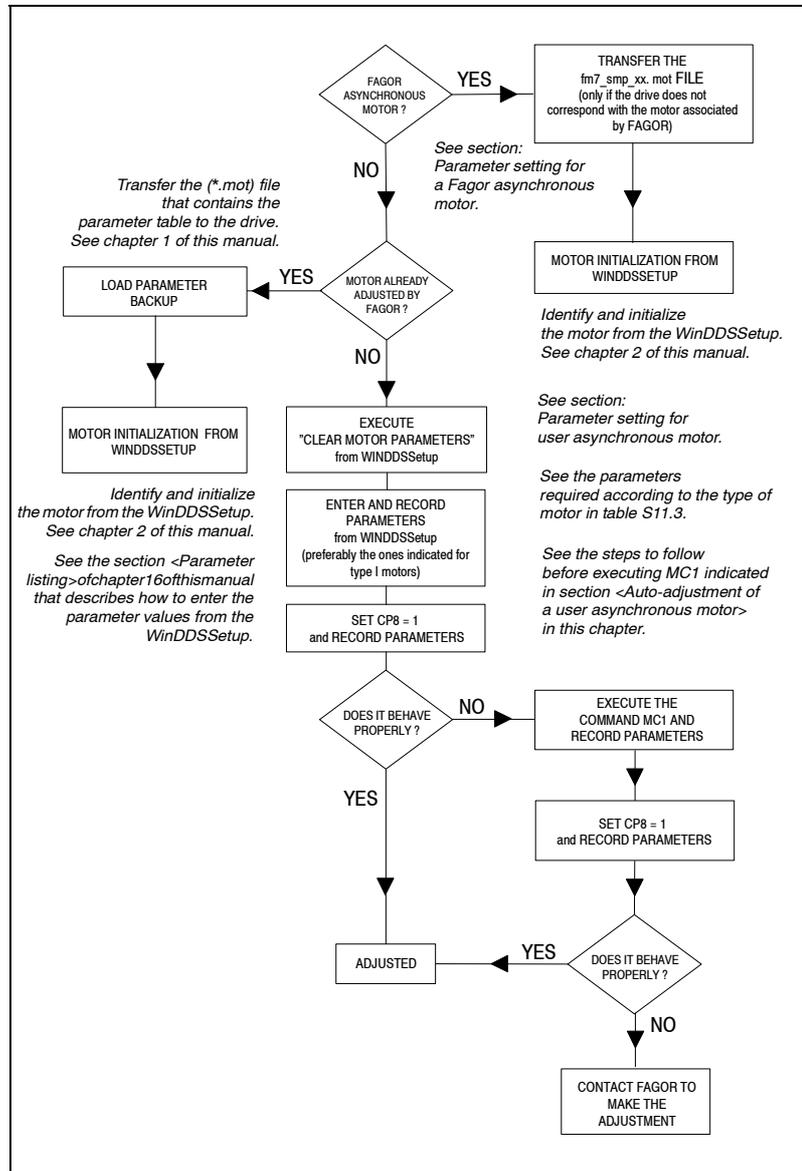


FIGURE S11.1

Diagram of the procedure to set up any asynchronous motor automatically.



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After initializing, in order for the drive that governs it to start up properly, none of the parameters listed on the user motor column - type I - of **TABLE S11.4** must be zero.

On Fagor motors, this condition will always be verified, but on user motors, some of them might assume a zero value. The drive display will then show error code **E502**.

Clicking on the relevant icon of the WinDDSSetup opens the SPY window that shows the parameters that have not been initialized and still have a zero value. They all must be initialized in order to remove the error.

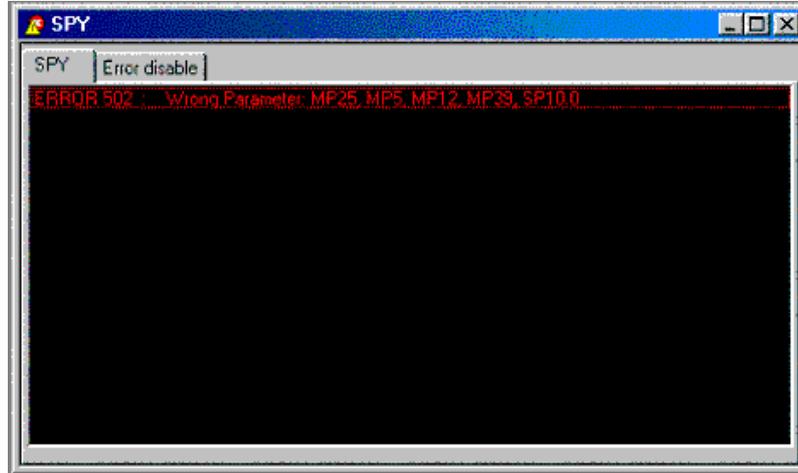


FIGURE S11.2

Displaying not initialized parameters in the Spy window. Error code **E502**.

11.

SETTING UP AN ASYNCHRONOUS SPINDLE
Asynchronous motor with motor feedback

FAGOR

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11.1.1 Parameter setting for a Fagor asynchronous motor

A FAGOR asynchronous motor is any motor with the label FM7, FM9 or SPM on its identification reference.

All FAGOR asynchronous spindle motor is associated with a particular drive. This drive associated with the motor is always shipped with a file "FM9_□□.mot" containing the parameter table of the motor associated with it.

Sometimes, the user may be interested in installing (for any reason) a drive other than the one that actually corresponds with the motor. He must then transfer another <*.mot> file different from the one stored in the drive (by default) with the version.

This file must be transferred with the WinDDSSetup application and it must be identified by the digits "_□□" that represent the maximum (peak) current of the associated drive. So, if for example, the drive to be installed with an FM7 motor has a peak current of 25 A, the file to be transferred will be fm7_spm_25.mot.

TABLE S11.1 fm7_spm_□□.mot files containing the parameter table of FM7 and SPM families of Fagor asynchronous motors.

Drive associated with an asynchronous motor	Name of the file containing the parameter table of the associated motor
SPD 1.25	fm7_spm_25.mot
SPD 1.35	fm7_spm_35.mot
SPD 2.50	fm7_spm_50.mot
SPD 2.75	fm7_spm_75.mot
SPD 2.85	fm7_spm_85.mot
SPD 3.100	fm7_spm_100.mot
SPD 3.150	fm7_spm_150.mot
SPD 3.200	fm7_spm_200.mot

TABLE S11.2 FM9_□□.mot files containing the parameter table of the FM9 family of Fagor asynchronous motors.

Drive associated with an asynchronous motor	Name of the file containing the parameter table of the associated motor
SPD 3.150	FM9_150.mot
SPD 3.200	FM9_200.mot

Once this file has been transferred (if necessary), write in MP1 the ID of the motor whose parameters are to be set, hence modifying the necessary parameters.

To transfer a <*.mot> file to the drive and then identify the motor, see the sections "transferring <*.mot> files" and "motor identification" in chapters 1 and 2 of this manual.

Remember that the peak currents of the drives for asynchronous spindle motors are described in the section on "technical data" of chapter 3 in the "dds-hardware" manual.

11.

SETTING UP AN ASYNCHRONOUS SPINDLE
Parameter setting for a Fagor asynchronous motor



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SOFTWARE

(Soft 06.2x)

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11.1.2 Parameter setting for a user asynchronous motor

A user asynchronous motor is any asynchronous motor not covered in FAGOR's motor catalog. The term "NON-FAGOR motor" or "0 motor" will be used from now on to refer to them.

When using a non-Fagor asynchronous motor, in general the <*.mot> file mentioned earlier will be missing except particular Siemens™ models for which there are Siemens_□□.mot files and for some spindles from other manufacturers with Cabezales_Varios_□□.mot files

All these and those non-Fagor motors that have been adjusted by Fagor will follow the same parameter setting procedure as Fagor motors as described in the previous section.

The rest will require setting the parameters of the motor manually.

In this parameter setting process that must be carried out manually entering the known motor parameters one by one. Depending on the type of motor, the known parameters might not be the same ones that is why there are 4 different ways to manually set the parameters of an asynchronous non-Fagor motor depending on the known parameters available.

The motor types and the known parameters for each type are described later on.

Parameter setting procedure

The process is initiated **by selecting the M group (motor)** at the WinDDS-Setup program for PC in the parameters setting window (modification mode).



(a)

Using an OEM access level or higher, a window is displayed showing the motor selection icon^(a) as long as the MotorType (MP1) has been previously selected.

Note that for a BASIC access level, this icon^(a) is not shown in the window. It cannot be selected and, therefore, the motor parameters cannot be set.



(b)

Pressing this button^(a) displays the < **Motor selection** > window. Use the vertical scroll bar to locate the field < **Clear motor parameters** > and validate it pressing the icon^(b) that appears in the upper right hand corner of this window.

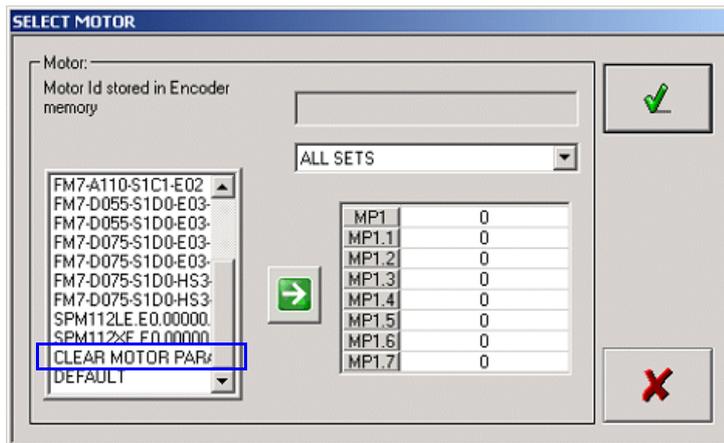


FIGURE S11.3

Selecting < **Clear motor parameters** > for MP1.

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Parameter setting for a user asynchronous motor



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Doing this initializes the following parameters to zero:

TABLE S11.3 Parameters initialized to zero after entering < **Clear motor parameters** > in MP1.

Parameter	Name
MP1	MotorType
MP3	MotorContinuousStallCurrent
MP5	MotorPolesPairs
MP6	MotorRatedSupplyVoltage
MP7	MotorPowerFactor
MP9	MotorSlip
MP10	MotorStatorResistance
MP11	MotorStatorLeakageInductance
MP12	MotorNominalPower
MP14	MotorTempSensorType
MP21	MotorPhasesOrder
MP25	MotorRatedSpeed
MP26	MotorMaximumSpeed
MP27	MotorRotorResistance
MP28	MotorRotorLeakageInductance
MP29	MotorMagnetizingInductance
MP30	MotorInductanceFactor1
MP31	MotorInductanceFactor2
MP32	MotorInductanceFactor3
MP33	MotorInductanceFactor4
MP34	MotorInductanceFactor5
MP35	MotorInductanceFactor6
MP36	MotorInductanceFactor7
MP37	MotorInductanceFactor8
MP38	MotorInductanceFactor9

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According to the known data (available on the motor characteristics plate) four different 4 types of parameter setting: Hence:

TABLE S11.4 Different types of parameter settings depending on the known data of the user motor.

Parameter name	Type I	Type II	Type III	Type IV
MotorContinuousStallCurrent	MP3	MP3	MP3	MP3
MotorPolesPairs	MP5	MP5	MP5	MP5
MotorRatedSupplyVoltage			MP6	MP6
MotorPowerFactor				MP7
MotorSlip	MP9	MP9	MP9	MP9
MotorStatorResistance	MP10	MP10	MP10	
MotorStatorLeakageInductance	MP11	MP11	MP11	
MotorNominalPower	MP12	MP12	MP12	MP12
MotorRatedSpeed	MP25	MP25	MP25	MP25
MotorMaximumSpeed	MP26	MP26	MP26	MP26
MotorRotorResistance	MP27			
MotorRotorLeakageInductance	MP28			
MotorMagnetizingInductance	MP29			
MotorNoLoadCurrent	MP39	MP39	MP39	
MotorNoLoadVoltage		MP40		
MotorInductanceFactor1	MP30	MP30	MP30	MP30
MotorInductanceFactor2	MP31	MP31	MP31	MP31
MotorInductanceFactor3	MP32	MP32	MP32	MP32
MotorInductanceFactor4	MP33	MP33	MP33	MP33
MotorInductanceFactor5	MP34	MP34	MP34	MP34
MotorInductanceFactor6	MP35	MP35	MP35	MP35
MotorInductanceFactor7	MP36	MP36	MP36	MP36
MotorInductanceFactor8	MP37	MP37	MP37	MP37
MotorInductanceFactor9	MP38	MP38	MP38	MP38

The motors whose parameters are to be set must be one of the types according to the known data. After entering the values (one by one) they are saved permanently into flash.



The parameters of FAGOR asynchronous motors may be set either as FAGOR motors or as user motors (0 motor).

Remember that before autoadjusting the user asynchronous motor, you must set parameters CP20 (F00307) CurrentLimit and SP10 (S00091) VelocityLimit with the right values.

Explanatory notes

In order to simplify the setting of your motor parameters, it may be necessary to explain how to set some of these parameters whose values cannot be entered immediately because they must be calculated previously.

How to set MP9

In general and according to the motor manufacturer, the slip value to be used to set MP9 is not given explicitly on the characteristics plate. The data to be used to set MP9 very rarely given directly. Further more, motor manufacturers do not even provide the same data for getting the slip value.

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 Parameter setting for a user asynchronous motor

Hence, the data appearing on the characteristics plate may be:

□ The slip value in rpm

This is a very exceptional case. The characteristics plate of SPM series FAGOR asynchronous motors provides the slip value directly. The value shown is just the one to be assigned to MP9. If it has a FAGOR motor or a user (NON-FAGOR) motor that provides the data this way, set MP9 with this value as shown in the example.

Example.

Manufacturer's data: FAGOR
Slip 55 rev/min
Motor slip

Set:
 MP9 = 55

□ The slip frequency in Hz.

The characteristics plate of FAGOR asynchronous motors (FM7 and FM9 series) does not provide the slip value directly. It offers the value of the slip frequency f_s in Hz. Setting MP9 with this value is a mistake. The value to be assigned to MP9 is given by ω_s obtained from the expression

Manufacturer's data: FAGOR
 f_s (in Hz)
Motor slip frequency

Set:
 $MP9 = \omega_s = (60 \cdot f_s) / (p/2)$ (in rev/min)

where:

ω_s	Slip speed in rpm
f_s	Slip frequency in Hz
p	Nr of poles.

Note that the number of poles of an FM7 or FM9 Fagor motor is 4; that is two pairs of poles. If you have a NON-FAGOR motor, read the value on the characteristics plate and if you don't have this data, ask the motor manufacturer.

If you have a FAGOR motor or a user (NON-FAGOR) motor that provides the data this way, set MP9 as shown in the example.

Example.

Manufacturer's data: FAGOR
 $f_s = 1.5$ Hz
Motor slip frequency

Set:
 $MP9 = \omega_s = (60 \cdot 1.5) / (4/2) = 45$ rev/min
 MP9 = 45



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□ **The rotor speed in rpm**

The characteristics plate of other user (NON-FAGOR) asynchronous motors provides the rotor speed ω_r in rpm. Setting MP9 with this value is a mistake. The value to be assigned to MP9 is given by ω_s obtained from the expression:

Manufacturer's data: NO FAGOR
 ω_r (in rev/min)
Rotor speed

Set:
 $MP9 = \omega_s = \omega - \omega_r = (60 \cdot f) / (p/2) - \omega_r$ (in rev/min)

where:

ω_s	Slip speed in rpm
ω	Motor base speed in rpm.
f	Frequency of the motor supply voltage
ω_r	Rotor speed in rpm
p	Nr of poles.

Read the value for the number of poles on the characteristics plate of the user (NON-FAGOR) motor and if you don't have this data, ask the motor manufacturer. The following example considers a 4-pole motor with a motor supply voltage frequency f = 50 Hz.

If you have a user (NON-FAGOR) motor that provides the data this way, set MP9 as shown in the example.

Example.

Manufacturer's data: NO FAGOR
 $\omega_r = 1470$ (in rev/min)
Rotor speed

Set:
 $MP9 = \omega_s = \omega - \omega_r = (60 \cdot f) / (p/2) - \omega_r$ (in rev/min)
 $MP9 = \omega_s = (60 \cdot 50) / (4/2) - 1470 = 30$ rev/min
 $MP9 = 30$

□ **Frequency of the motor supply voltage**

The characteristics plate of some user (NON-FAGOR) asynchronous motors provides the value of the motor supply voltage frequency f in Hz. **Setting MP9 with this value is a mistake.** The value to be assigned to MP9 is given by ω_s obtained from the expression:

Manufacturer's data: NO FAGOR
f (in Hz)
Motor supply voltage frequency

Note: Base speed ----> ω^1 (in rev/min)

Set:
 $MP9 = \omega_s = \omega - \omega^1 = (60 \cdot f) / (p/2) - \omega^1$ (in rev/min)

where:

ω_s	Slip speed in rpm.
ω^1	Motor base speed in rpm.
ω	Speed of the rotating sinusoidal magnetic field generated by the currents of the stator at the f frequency in rpm.
f	Frequency that the motor supply voltage must have to reach the speed ω in Hz.
p	Nr of poles.

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Read the value for the number of poles on the characteristics plate of the user (NON-FAGOR) motor and if you don't have this data, ask the motor manufacturer. We are considering a 4-pole motor here.

If you have a user (NON-FAGOR) motor that provides the data this way, set MP9 as shown in the example.

Example.

Manufacturer's data: NO FAGOR
 $f = 133.9 \text{ Hz}$
 $\omega^j = 4000 \text{ rev/min}$
 $MP9 = \omega_s = [60 f / (p/2)] - \omega^j \text{ (in rev/min)}$
 $MP9 = \omega_s = [60 \cdot 133.9 / (4/2)] - 4000 = 17 \text{ rev/min}$
 $MP9 = 17$

How to set MP30, ... MP38

For any user motor, the manufacturer provides the gain of the mutual inductance Δ_{Lh} . Obtain the values of parameters MP30, etc based on the provided value. MP38, points of the magnetic saturation curve of the stator iron. Follow this example to obtain these parameters based on the L_h gain value.

Example.

If the gain of the mutual inductance given by the manufacturer is $\Delta_{Lh} = 120\%$, obtain the values to set parameters MP30 ... MP38.

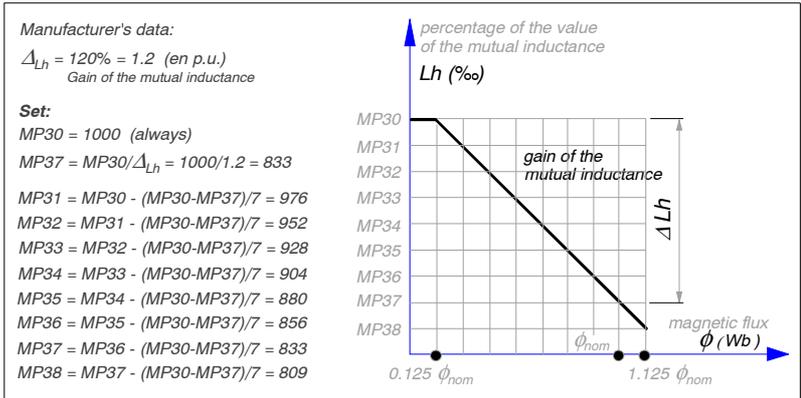


FIGURE S11.4

Set MP30 ... MP38 based on the gain of the mutual inductance Δ_{Lh} .



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11.1.3 Auto-adjustment of an asynchronous user motor

From version 06.08 on, there is a software capable of obtaining an initial parameter setting when adjusting a high speed spindle or asynchronous spindle motor supplied by the OEM, once the motor's electrical parameters have been identified.



Warning. This feature needs the parameters of asynchronous motors defined as type I in the previous **TABLE S11.4**. If the type of motor is other than type I, find out what type it is and enter all the known parameters. This autoadjustment will calculate automatically and internally the missing ones as compared to those of type I.

This feature is useful when using NON-FAGOR asynchronous motors

The characteristic plate of all asynchronous motors classified as type I have (depending on the regulation) all the parameters required by this application.

After having set the feedback parameters and those of the user motors described in the previous section, using the auto-adjustment application for the asynchronous motor will provide the adjustments of the current loop, flux loop and BEMF.

Later on, the velocity loop must be adjusted manually as well as the position loop if so required.



The adjustment obtained with this feature is valid to move a motor up to twice its base speed. For higher speeds, it must be adjusted manually.

The command used to auto-adjust the synchronous motor is:

MC1	F01238	MotorElectricalParametersIdentification
------------	--------	-----------------------------------------

Important note. GP1 must be set to 4000 Hz so the auto-adjustment is carried out properly when executing the command MC1.

Note that:

- After entering the user motor parameters (type I NON-FAGOR motors) the motor must move adequately.
- Executing the MCI command calculates even better the electrical parameters of the motor, especially parameter MP10.

Preparation

Before executing the command to auto-adjust the asynchronous motor, the following operations must be carried out.

□ **Configure the feedback**

Take the signal to connector X4 of the drive.

Parameters to consider:

GP2	F00701	Feedback1Type
NP116	S00116	ResolutionOfFeedback1

□ **Set the parameters of the user motor**

Set GP7=0
(disable the overload time limit).

Configure MP1 = Clear motor parameters
(from the WinDDSSetup). See **FIGURE S11.3**.

Enter, one by one, the values of all the parameters indicated in **TABLE S11.3** for the asynchronous motor of the type being used.

These values are given on the characteristics plate of the motor and they're all known.



Warning. Error code **E508** will be issued if the MC1 command is executed without having carried these two steps out.

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Auto-adjustment of an asynchronous user motor

□ **Other parameters**

The following must also be set:

MP14	F01210	MotorTempSensorType
MP21	F01217	MotorPhasesOrder



Warning. Make sure that the connection of phases U, V and W is consistent with the value given to MP21 so the motor turns clockwise (viewed from the shaft).

□ **Initialization**

The following parameters must also be initialized:

CP16	SeriesInductance	On high speed spindles
AP1=2	PrimaryOperationMode	Velocity control

To determine whether CP16 must be initialized or not and, if so, obtain its value, see the section "calculation of the serial inductance" in this chapter.



Warning. Error code **E508** will be issued if AP1 is not initialized as AP1=2.

CP8 = 1	CurrentLoopGainsCalculation
----------------	-----------------------------

The drive will automatically evaluate the parameters related to the adjustment of the current loop, flux loop and BEMF based on the electrical parameters identified after executing the MC1 command.

□ **Save the parameters using the command GC1**

Remember that before starting with the identification process and the execution of the MC1 command, verify that the motor turns correctly with no load at 60 rev/min and at 1500 rev/min.

Particular

Before executing the MC1 command to auto-adjust the asynchronous motor for the identification, the **motor may be coupled to or uncoupled from the mechanical transmission.**

□ **Power it up and enable the torque**



Warning. The user must know that when executing the MC1 command the motor will turn at its rated speed.

□ **Execute the MC1 command**

This command will respond to the drive's execution machine. It is executed normally, either from the PC through the standard interface of the WinDDSSetup or from the CNC.

While executing the MC1 command, the motor goes into vibration for an instant.

After its execution, it will identify the values of the resistance, inductance, the motor's saturation curve and rms current without load.



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All these parameters are indicated in the following table:

MP10	MotorStatorResistance
MP11	MotorStatorLeakageInductance *
MP27	MotorRotorResistance
MP28	MotorRotorLeakageInductance *
MP29	MotorMagnetizingInductance *
MP30	MotorInductanceFactor1
MP31	MotorInductanceFactor2
MP32	MotorInductanceFactor3
MP33	MotorInductanceFactor4
MP34	MotorInductanceFactor5
MP35	MotorInductanceFactor6
MP36	MotorInductanceFactor7
MP37	MotorInductanceFactor8
MP38	MotorInductanceFactor9
MP39	MotorNoLoadCurrent

(*) Before setting these parameters, read the remarks offered in the next section.

How to set MP11, MP28 and MP29

Parameters are self-induction coefficients (L) and must be set in mH (milli-henries). However, some manufacturers of non-Fagor asynchronous motors provide this data with the inductive reactance value (X_L) instead of the self-induction coefficient (L); in other words, in Ω (Ohms). Therefore, before setting these parameters, you must convert the Ohms into Henries using this formula:

$$L = \frac{X_L}{\omega} = \frac{X_L}{2\pi f}$$

where:

X_L = Inductive reactance in Ohms (Ω).

ω = Rated electrical speed in rad/s.

f = Rated electrical frequency in Hertz (Hz = cycles/s).

$$f = MP5 \cdot \frac{[MP25 \text{ (in rev/min)} + MP9 \text{ (in rev/min)}]}{60}$$

L = Auto-induction coefficient in Henries (H).

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Auto-adjustment of the loops

□ **Remove power**

Needed to be able to save parameters.

□ **Restore GP7**

Give GP7 the desired value for the application.

Note that this parameter was set to zero before executing the MC1 command.

□ **Save parameters**

Executing the MC1 identification command (remember that CP8 was set to 1), it will only be necessary to save the parameters with the GC1 command so the drive calculates the values of the PI adjusting parameters:

□ **Of the current loop**

CP1	S00106	CurrentProportionalGain
CP2	S00107	CurrentIntegralTime
CP3	S00300	CurrentFeedbackDerivativeGain
CP4	S00301	CurrentAdaptationProportionalGain
CP5	S00302	CurrentAdaptationIntegralTime

□ **Of the flux loop**

FP1	S00600	MotorFluxProportionalGain
FP2	S00601	MotorFluxIntegralTime

□ **Of the back electromotive force (bemf)**

FP20	S00602	MotorBEMFProportionalGain
FP21	S00603	MotorBEMFIntegralTime

Recommendations

We recommend:

- Execute the MC1 command twice.
- Perform a second identification when the motor is at working temperature, if it does not have a temperature sensor.

Note that the greater the current supplied by the drive, the more accurate the identification will be.



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11.2 < Sensorless > asynchronous motor

The purpose of this feature implemented in drive software version 06.14 is to **control the speed of an asynchronous motor without motor feedback**. It is mainly aimed at low-end non-Fagor motors and may be applied both on spindle motors and axis motors.

Note. The term <sensorless> will be used throughout this document to refer to an asynchronous motor without motor feedback.

The interest of this application is mainly economical since < sensorless > motors are less expensive because they do not have motor feedback or feedback cable. On the other hand, it will let the user troubleshoot possible poor feedback performance.



Thanks to this application, a <sensorless> motor can achieve the same dynamic performance as the asynchronous motor with motor feedback except at speeds under 30 rpm.

11.

11.2.1 Parameter setting for a <sensorless> motor

The parameters to be set at a drive for governing a sensorless motor are:

□ Identify the asynchronous motor as sensorless motor

Set AP2 = 1 where:

AP2 = 1	AsynchronousRegulationType
---------	----------------------------

Note. With synchronous motors, always set AP2=0.



Important. For any modification of parameter AP2 will only be effective after doing a soft-reset at the drive. Remember that **executing the "validate" command will not be enough**. If this is not done, the WinDDSSetup will warn about it with a message.

Also observe that:

- With asynchronous motor and AP2=1, GP1 may be set to 8000 because motor feedback is not being used.
- If AP2=1, it is possible to connect the direct feedback (e.g. with GP10=1) and observe its value by displaying the variable **PV53**.

□ Identify the motor feedback

Parameter setting:

GP2.# = 7	Feedback1Type	Without motor feedback
-----------	---------------	------------------------

Note that setting the motor feedback this way prevents feedback error messages.



Important. Although in this version GP2 has sets, it is not possible to change sets with different feedbacks. All the sets of GP2 must be set with the same value; otherwise, an error will be issued for this parameter.

Observe that:

- Setting GP2=7 when using a synchronous motor activates error code **E502** in the Spy window of the WinDDSSetup indicating that MP50 and AP2 have been set wrong. To prevent the error, change the setting of any of them.
- Setting GP2=7 and AP2=0 when using a asynchronous motor activates error code **E502** in the Spy window of the WinDDSSetup indicating that GP2 and AP2 have been set wrong. To prevent the error, change the setting of any of them.

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Parameter setting for a <sensorless> motor

- Setting GP=7 prevents A and B signal errors even when the feedback board and feedback cable have been installed and any of them or both of them are defective.

□ Identifying the temperature sensor

Parameter setting:

MP14=4	MotorTempSensorType	Without temperature sensor
---------------	---------------------	----------------------------

Note that setting the temperature sensor this way prevents temperature error messages.

□ Identifying the home search.

Parameter setting:

PP147 (bits 5 & 6)=1	Homing Parameter	The home-switch and the reference mark are not evaluated
--------------------------------	---------------------	----------------------------------------------------------

Note that setting the home search this way prevents home search error messages. Observe that home search cannot be performed because it is impossible to provide a position coordinate.

Also, version 06.14 includes the following parameters:

FP50	MRASProportionalGain
FP51	MRASIntegralTime
FP60	FilterForStatorFluxEstimationOfVoltage

See chapter 13 of this manual for all the information on these parameters.

Procedure

- Set the parameters of the motor following the procedure shown in the automatic setup diagram of any asynchronous motor specified in **FIGURE S11.1** of chapter 11 in this manual.
- Parameters AP2, GP2, MP14 as well as bits 5 and 6 of PP147 **MUST BE SET** with the values indicated at the beginning of this section.
- Set parameter SP50=0 or when deactivating this first order low-passing filter for speed feedback always do it with a cutoff frequency value greater than 2000 Hz.
- Keep parameters FP50, FP51 and FP60 at their default values.

When observing an unstable dynamic performance of the motor:

- Decrease the value of FP51 until it becomes stable.
- Increase the value of FP50 without making the motor dynamics vibrate.
- Increase the value of FP51 without making the motor dynamics vibrate.
- Keep FP60 at its default value.

If you cannot obtain the proper adjustment by following this procedure, contact Fagor Automation S. Coop.



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11.2.2 Other applications

This feature, that may be used to control a sensorless motor, has other applications on asynchronous motors that do have motor feedback. Hence:

- **A long production halt may be prevented** when running into motor feedback problems (i.e. the feedback board, the feedback cable or the feedback device itself) by setting the motor as sensorless.

This option may be considered as a temporary solution while repairing the defective element of the feedback as long as the restriction of not having to home is met and a lower degree of servo regulation is assumed (e.g. in roughing operations).



Warning. In a situation of this kind, if the motor has a Klaxon type thermistor, a motor over-temperature may be detected by the PLC of the electrical cabinet. This in turn will activate its aperture ensuring the life of the motor windings. When using another type of sensor (e.g. KTY84-130), it will be necessary to have at least the two wires of the feedback cable connected between the motor and the drive (if the cable has been connected due to a possible failure) to ensure the life of the winding.

- **It is possible to diagnose whether the anomalous performance of the motor** is due to a defective element of the motor feedback or not. The diagnosis of the feedback status must be interpreted as a whole.

Parameter setting:

GP2=2	Feedback1Type	Square TTL encoder on an FM7 motor
AP2=1	AsynchronousRegulation Type	Sensorless control

and verify that this feedback is reading (counting) properly by displaying the variable **PV51**.

If a feedback error occurs, use the errors shown at the drive's display to find the element of the feedback assembly that is malfunctioning.

11.3 Calculating the serial inductance

When using high speed spindles, the value of the motor leak inductance is low. In order for the spindle regulation to perform properly, this leak inductance value must be higher than a certain minimum value. Otherwise, a three-phase inductance must be installed in series between the motor and the drive.

Then, you must first ask yourself whether the leak inductance of the motor is higher than the minimum value according to the formula:

$$0.005182 \cdot \frac{V_0}{I_0} \cdot \frac{N_{max}^2}{F_{pwm}^2} \cdot \frac{P}{N_{base}} \cdot \Delta_{Lh} - (L_1 + L_2) > 100 \mu H$$

If this formula is not met, no serial inductance will be necessary. Now, if it is met, it will be necessary and its value will be given by:

$$L_{series} = 0.005182 \cdot \frac{V_0}{I_0} \cdot \frac{N_{max}^2}{F_{pwm}^2} \cdot \frac{P}{N_{base}} \cdot \Delta_{Lh} - (L_1 + L_2)$$

where:

Term	Description	Units	Parameter
V_0	Voltage with no load (phase-phase)	Vrms	MP40
I_0	Current without load	Arms	MP39
N_{max}	Maximum speed	rpm	MP26
F_{pwm}	PWM frequency	Hz	GP1
p	Number of pairs of poles	-----	MP5
N_{base}	Base speed	rpm	MP25
Δ_{Lh}	Gain of the mutual inductance	-----	MP30 / MP37
L_1+L_2	Sum of leak inductance (phase-neuter) of stator and rotor	H	MP11+MP28
L_{series}	Serial inductance	H	CP16



Warning. It is recommended to use a PWM frequency of 8 kHz (instead of 4 kHz) to avoid having to install a three-phase coil. However, this may mean to have to install a larger drive due to the current derating and, consequently, lower power than the drive can provide.

When purchasing a three-phase inductance, the manufacturer must be provided with the following characteristics:

Inductance value	L_{series}	H
Pulsating frequency to calculate L_{serial}	F_{pwm}	kHz
Motor rated current (in S1)	I_{S1}	A

11.

12.1 Synchronous spindle versus asynchronous spindle

Until now, the spindle applications have been carried out using asynchronous motors with a squirrel-cage rotor usually referred to as induction motors. However, nowadays, asynchronous motors with permanent magnets are being used for these applications. The main reason for this new trend is the better features of synchronous spindles versus asynchronous ones. Among them:

- ❑ **Greater torque density.** Greater torque for the same active volumen.
- ❑ **Shorter acceleration time.** Shorter time needed to accelerate for the same amount of inertia.
- ❑ **Less rotor losses.** Less rotor losses for the same rated current and, therefore, greater efficiency and smaller spindle dilatations.



Warning. Before installing a synchronous spindle, carefully read the section "voltage protection module" of chapter **15. PROTECTIONS** in this manual in order to find out whether it will be necessary or not to install a voltage protection module (between the motor and the drive) so as not to cause any damage at the drive.

12.2 Conditions for controlling it

12.

If from software version 06.10 on it was possible to control a synchronous motor with permanent magnets in spindle applications (synchronous spindle) of up to 10000 rpm, from software version 06.20 on it is possible to control a synchronous motor of up to 1 kHz with GP1=4000 or up to 2 kHz with GP1=8000. That is, for a synchronous motor (with or without reluctance torque) with two pairs of poles (MP5=2), the maximum speeds that may be controlled will be 30000 and 60000 rpm respectively.

The formulae to obtain the controllable speed ω_{max} depending on the number of pairs of poles of the motor (MP5) are:

With GP1=4000 Hz; $\omega_{max} = 60 \times (1\text{kHz} / \text{MP5})$ in rpm

With GP1=8000 Hz; $\omega_{max} = 60 \times (2\text{kHz} / \text{MP5})$ in rpm

Remember that GP1 (F00700) PwmFrequency is the parameter that reflects the switching frequency of the IGBT's and MP5 (F01201) MotorPolesPairs the number of pairs of poles of the motor. Check with which of these two GP1 values the motor performs better.

Although FAGOR has synchronous motors in its catalog, they do not meet the requirements for spindle applications. This means that any synchronous motors governed by a Fagor drive must be treated as a **user motor** (non-Fagor) and meet, at least, **all** the following requirements:

- Have a feedback known by a Fagor drive, e.g. 1 Vpp.
- Have a temperature sensor known by a Fagor drive, e.g. KTY84-130.
- Have a FAGOR spindle drive - ref. SPD or SCD - that can provide a rated current greater than the rated current of the motor.

Remember that the largest FAGOR spindle drive is the SPD 3.250. Its rated current in duty cycle S1 is 170 A and in S6-40% is 221 A.

Therefore, if its synchronous motor is going to be used in a spindle application and its rated current is greater than the indicated values, no FAGOR drive can be selected to govern it.

- **Never** set this parameter configuration:

MP50=0	The connected motor is synchronous
GP1=8000	Switching frequency of the IGBT's is 8 kHz
GP10 other than 0	It uses direct feedback

To solve this conflict, change the parameter setting of one of them.

Usually, this situation never occurs because gear ratios are rarely used on high speed spindles and direct feedback is not used.

12.3 Parameter setting for a user asynchronous spindle motor

A user synchronous spindle is a synchronous motor used in an application that uses a spindle and it does not appear in the Fagor catalog. From now on, the terms "NON-FAGOR" and "0 motor" will be used indistinctly when referring to a user motor.

When using a synchronous spindle motor, the drive that is going to control it will never have the <*.mot> file stored by default; and therefore, will not have the motor's own parameter table (unless Fagor has adjusted earlier already). This is why the motor parameters must be **set manually**.

In this parameter setting process (that must be done manually), a set of known motor parameters must be set one by one; they will all be provided by the manufacturer of the motor. The parameters involved in this process are described later on in [TABLE S12.2](#).

Procedure

Before setting the parameters of the motor, make sure that a software version for a spindle has been installed, not for an axis, and set **MP50 = 0** (synchronous) whose default value is 1.

It is highly recommended to set the rest of parameters for the motor feedback.

The motor feedback of the synchronous spindle must be known by the Fagor drive. The motor feedback signal is transmitted through the feedback cable to connector X4 of the drive.

Parameters to consider:

GP2.#	F00701	Feedback1Type
NP116	S00116	ResolutionOfFeedback1

Once these parameters have been set to the right values using the WinDDS-Setup, start setting the motor's own parameters.

For that:



Select the M group (motor), from the parameter setting window (modification mode) of the adjustment program WinDDSSetup.

- (a) An OEM access level or higher, displays a window showing the motor selection icon ^(a).

This happens if parameter MP1 (S00141) MotorType has been selected earlier.

Note that the window does not show the icon ^(a) for a BASIC access level. It cannot be selected and, therefore, the motor parameters cannot be set.

Pressing the button ^(a) shows the < **motor selection** > window.

Since the parameters will be set manually, a user motor requires resetting to zero all the parameters indicated in [TABLE S12.2](#).

To do this, set **MP1 = Clear motor parameters** (from WinDDSSetup). See [FIGURE S12.1](#).

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SETTING UP A SYNCHRONOUS SPINDLE
Parameter setting for a user asynchronous spindle motor

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(b)

Use the vertical scroll bar of the left window to locate the field **<Clear motor parameters>** on the displayed list. Activate either the only selection arrow (all the sets) or one of the selection arrows (set by set) to assign "clear motor parameters" to MP1 x and validate by pressing the icon^(b) that appears on the upper right hand side of that window.

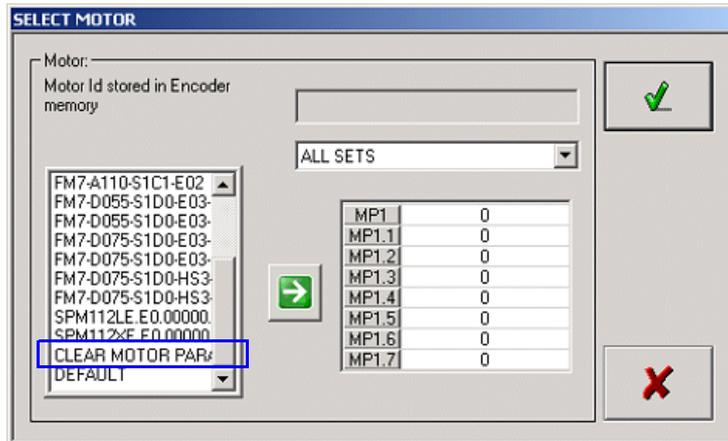


FIGURE S12.1

Selecting **< Clear motor parameters >** for MP1.

Once this process has been completed, **the following parameters** will have been reset to zero among others:

TABLE S12.1 Parameters initialized to zero after entering **< Clear motor parameters >** in MP1.

Parameter	ID SERCOS	Name
MP1	F01210	MotorType
MP3	S00111	MotorContinuousStallCurrent
MP5	F01201	MotorPolesPairs
MP6	F01202	MotorRatedSupplyVoltage
MP7	F01203	MotorPowerFactor
MP10	F01206	MotorStatorResistance
MP11	F01207	MotorStatorLeakageInductance (*)
MP12	F01208	MotorNominalPower
MP14	F01210	MotorTempSensorType
MP25	F01221	MotorRatedSpeed
MP26	F01222	MotorMaximumSpeed

* Note that for a synchronous motor, MP11 represents the inductance of the motor stator and not the leak inductance because leak inductance is not applicable to these motors. Bear this warning in mind when referring to parameter MP11 in this chapter.

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SETTING UP A SYNCHRONOUS SPINDLE
Parameter setting for a user asynchronous spindle motor



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Now, set all the following parameters one by one manually using WinDDS-Setup:

TABLE S12.2 Parameters that must be set when setting up a synchronous spindle.

MP1	F01210	MotorType
MP3	S00111	MotorContinuousStallCurrent
MP5	F01201	MotorPolesPairs
MP10	F01206	MotorStatorResistance
MP11	F01207	MotorStatorLeakageInductance (*)
MP12	F01208	MotorNominalPower
MP14	F01210	MotorTempSensorType (**)
MP25	F01221	MotorRatedSpeed
MP26	F01222	MotorMaximumSpeed

* Read the note on the previous page.
 ** **Motor temperature sensor.** The temperature sensor of the synchronous spindle must be known by the FAGOR drive. The two wires of the sensor are included in the feedback cable and it will be connected to connector X4 of the drive.

Also set the specific parameters of a synchronous parameters. These parameters appear in software version 06.10; for further detail refer to chapter **13. PARAMETERS, VARIABLES AND COMMANDS** in this manual.

MP42	F01239	StartingSpeedForFielweakening
MP43	F01240	Ke_VoltageConstant
MP50=0	F01282	SynchronousAsynchronous

Important. The values for setting drive parameters MP42 and MP43 will be supplied by the manufacturer of the motor. Also, for a synchronous spindle, **always** set **MP50 = 0**.

Once these parameters are set, save them into the drive's flash memory so they are stored permanently.

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SETTING UP A SYNCHRONOUS SPINDLE
 Parameter setting for a user asynchronous spindle motor



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12.4 Startup process

To control a synchronous spindle, it is also necessary to know the relative position of the magnets (joined to the rotor) with respect to the stator on startup, i.e. its **electrical position**.

If the selected motor does not have an encoder with a system to measure the absolute position in a full revolution, it will be necessary to estimate its value on startup because the drive will need this information to control the motor. See section "Electrical position on motor startup" of chapter 10 in this manual that describes the feature that makes this estimate.

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SETTING UP A SYNCHRONOUS SPINDLE

Startup process



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12.5 Loop setting

12.5.1 Current loop adjustment

Adjust the current PI means finding the best values of CP1 (Kp) and CP2 (Ti) depending on the motor set in drive's parameter MP1.

Parameter to be considered:

CP8 = 1	F00317	CurrentLoopGainsCalculation
----------------	--------	-----------------------------

If CP8 is set to 1 in a drive that is going to govern a non-Fagor synchronous motor; when starting up the drive, it will automatically calculate the values of CP1 (Kp) and CP2 (Ti) from the values used to set MP10 (R) and MP11 (L), hence adjusting the current loop. This will actually happen this way if the following conditions are met:

- The motor being considered is a user motor, non-Fagor.
- CP8=1 and also, parameters MP10 (F01206) MotorStatorResistance and MP11 (F01207) MotorStatorLeakageInductance are other than zero

Therefore,

1. **Verify that CP8 = 1** and if the following have not been set::

MP10.#	F01206	MotorStatorResistance
MP11.#	F01207	MotorStatorLeakageInductance

do it ! The values of these parameters will be supplied by the manufacturer of the motor.

Remember that all the motor parameters should've been set already.

2. **Record parameters** using the icon of the WinDDSSetup or executing the command GC1 and a later "soft-reset" executing the command GV11.
3. **Start the drive up again**

The new startup will activate the automatic calculation of the PI of the current loop and will set CP1 and CP2 with the right values.

4. **Record parameters again** to store in the drive's flash memory the values of CP1 and CP2 obtained.
5. **Then do a "soft-reset"** executing the command GV11.

The PI of the current loop will then be adjusted.

12.5.2 Adjustment of the velocity loop

The velocity loop will be adjusted by following the considerations defined for any motor and already described in chapter 4. **THE VELOCITY DRIVE** in this manual.

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SETTING UP A SYNCHRONOUS SPINDLE



A large grid for technical drawing or calculation, with a pencil icon in the top right corner.



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PARAMETERS, VARIABLES AND COMMANDS

13

13.1 Notations

Notation used

(Group)	(Type)	(Index)	(.Set)
---------	--------	---------	--------

Group.

Identifying character of the logic group to which the parameter or variable belongs.

The parameter groups are:

TABLE S13.1 Groups of parameters, variables and commands.

Nr	Function	Group	Letter
1	Operating mode	Application	A
2	Control signals	Terminal box	B
3	Current control loop	Current	C
4	Error diagnosis	Diagnosis	D
5	Encoder simulator	Encoder	E
6	Flux control loop	Flux	F
7	General of the system	General	G
8	System hardware	Hardware	H
9	Analog and digital inputs	Inputs	I
10	Temperatures and voltages	Monitoring	K
11	Motion Control and PLC	MC and PLC	L
12	Motor properties	Motor	M
13	Mechanical elements	Mechanical	N
14	Analog and digital outputs	Outputs	O
15	Position loop	Position	P
16	System communication	SERCOS communication	Q
17	Rotor sensor properties	Rotor	R
18	Velocity control loop	Speed:	S
19	Torque and power parameters	Torque	T
20	Parameter setting assistance	Miscellaneous	X

Type.

Character identifying the type of data which the information corresponds to. May be:

P Parameter: It defines the operation of the system.

V Variable: Legible and modifiable dynamically.

C Command: Executes a particular action.

The difference between parameter and variable consists in that the former has a programmable initial value and, unless exceptions, any modification of its value will only be effective if it is validated. See the command "validate **GC4**" and its icon associated with the WinDDSSetup application



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Index.

Number identifying the parameter or the variable within the group to which it belongs.

Set.

Set of parameters that can configure a system differently. Many of the parameters are subdivided into sets.

The term "sets" is only applicable to parameters not to variables. See "Sets of parameters and gear ratios" in chapter 8 of this manual.

Definition examples.

SP40.4	S group	parameter (P)	Nr 10, set 4
CV21	C group	variable (V)	Nr 21
GC1	G group	command (C)	Nr 1

Identification.

The description of each identifier and of the data type (parameter, variable or command) shown later on, represents symbolically, with characters, certain important characteristics to bear in mind for each of them.

They mean the following:

TABLE S13.2 Description of the identifiers.

Parameter set	#	Parameter extended in sets
Immediate effect	*	Parameter modifiable ON LINE
Modifiable variable	W	Variable modifiable from any level
Access level	F	Fagor
	O	OEM
		User (basic)
Sign	s	With sign
related to the motor	M	Value determined by MotorType (MP1)
Motor type	S	Synchronous only
	A	Asynchronous only
Motor application	AX	Only as an axis
	SP	Only as a spindle

Note that the WinDDSSetup application may be used **to display** the value of any parameter or variable regardless of the available access level.

The value of any **parameter may be changed** using the relevant access code. Its access level to modify it is given by the label, F (Fagor), O (OEM) or blank (basic), next to the parameter name.

The value of any **variable may be changed** using the relevant access code. Its access level to be modified is given by the label, F (Fagor), O (OEM) or W (basic), next to the variable name.



Observe that a variable may be modified from the basic level (without an access code) if it is labeled with a W. If the access level is more restrictive (OEM or Fagor) it will be labeled with the <O> or <F> symbol respectively and it may only be modified using the relevant access code. If there is no label, it can only be read, not modified.

The **ID** (identifier number) shown between brackets for each parameter, variable or command corresponds to the standard SERCOS interface. All the ones starting with the letter S (e.g.: S109) belong to that standard. For the Fagor parameters (e. g.: F1612) their Standard SERCOS identifier is obtained by adding 32768 to their numerical index. e. g.: Parameter F24 according to the standard SERCOS interface is S (24+32768); in other words: S32792.

The SERCOS ID for parameters extended in sets is obtained by adding 4096 to each set. Hence, i.e. considering SP1, the SERCOS ID for SP1.0 is S100, S4196 for SP1.1, S8289 for SP1.2 etc.

The Fagor parameters extended in sets will be affected by the two considerations mentioned earlier.

Example 1.

MP4	FMS	S00109	MotorPeakCurrent
-----	-----	--------	------------------

This nomenclature means the following:

- Parameter of the motor group (is identified by **MP4**)
- Cannot be extended into sets (the # symbol that indicates it is not shown).
- Cannot be modified ON LINE (the * symbol that indicates it is not shown).
- It can only be modified from the Fagor Access level (it is identified by **FMS**).
- Unsigned (the **s** symbol that indicates it is not shown).
- Parameter related to the motor and determined by MP1 (MotorType) (it is identified by **FMS**).
- It can only be used with synchronous motors (it is identified by **FMS**).
- It can be used both in axis and spindle applications (it carries neither the AX nor the SP identifier)
- Its SERCOS ID identifier is 109 (it is identified by (**S00109**))

Example 2.

SV7	s	F01612	VelocityCommandFinal
-----	---	--------	----------------------

This nomenclature means the following:

- Variable of the "velocity" group (it is identified by **SV7**)
- Read-only (neither the **W**, the **O** nor the **F** symbol is shown).
- Signed (the **s** symbol that indicates it is shown).
- Since it is a Fagor variable (identified by F01612) its SERCOS identifier ID is obtained by adding $1612 + 32768 = 34380$ (ID shown as (**S34380**)).

Example 3.

HV1	(AX)	S00110	S3LoadCurrent
-----	------	--------	---------------

This nomenclature means the following:

- Variable of the "hardware" group (it is identified by **HV1**)
- Read-only (neither the **W**, the **O** nor the **F** symbol is shown).
- Unsigned (the **s** symbol that indicates it is not shown).
- It may be used both with synchronous and asynchronous motors (it does not carry the exclusivity label A or S)
- To be used only in motor applications as an axis (as indicated by the label AX).
- Since it is a Fagor variable (identified by (F01612)) its SERCOS identifier ID is obtained by adding $1612 + 32768 = 34380$ (ID shown as (**S34380**)).



Note that the physical units and ranges given for the parameters and variables of this chapter are the ones used by the PC application WinDDSSetup running under Windows.

13.

13.

Notes

The term "stop" with its category appears throughout this chapter. Integrated Safety, of the ""dds-hardware" manual already defined these terms, they are repeated here as notes so the user can know at all times what it is talking about when mentioning a stop or emergency stop and its category without having to refer to the manual mentioned earlier.

In a stop as well as in an emergency stop, the goal is to stop the moving elements of the machine. The difference consists in that the emergency stop is always caused by some imminent risk for people and is activated directly by a human action. This chapter will always mention the "stop", but bearing in mind that if it is caused by direct human action (e.g. pressing the E-stop) in a situation of imminent danger, where it says "stop" it will mean "emergency stop".

Also, depending on how the stop is carried out, we will have a **stop**:

Category 0. Uncontrolled stop. The power supply to the machine's servo system is turned off immediately. It is caused by:

- Deactivating the Drive Enable signal or
- Activating of an error that requires category 0. It means an error that cancels the PWM.

Category 1. Controlled stop. The power supply to the machine's servo system is maintained until it stops and it then turns it off. It is caused by:

- Deactivating the Speed Enable signal or
- Activating of an error that requires category 1. It means an error that cancels the PWM after stopping.

Category 2. Controlled stop. The power supply to the machine's servo system is kept on even after it has stopped. It is caused by:

- Activating the Halt signal.

13.2 Groups of parameters, variables and commands

13.2.1 A group. Application

AP1	O	S00032	PrimaryOperationMode
-----	---	--------	----------------------

Function: It sets how it works in terms of system configuration.

TABLE S13.3 Parameter AP1. Meaning of its bits.

Bit	Function
3	It sets the activation of feed-forward (when working with position command). = 0 Position control with following error (feed-forward OFF). = 1 Position control without following error (feed-forward ON).
2, 1, 0 (LSB)	They determine whether it is a velocity command or a position command also depending on the type of feedback. = 001 Reserved. = 010 Velocity command (without position loop). = 011 Position command with motor feedback. = 100 Position command with direct feedback. = 101 Position command with both types of feedback.

Default value: 000011 binary (= 3 in decimal), position command with motor feedback and feed-forward OFF.

See chapters 3, 4 and 5 of this manual for further detail on these concepts.

AP2	OA	S00033	AsynchronousRegulationType
-----	----	--------	----------------------------

Function: Type of control of the asynchronous motor.

Valid values:

0. Vector control by rotor flux orientation. This control is used with speed feedback.
1. "Sensorless" vector control based on the voltage model.

Default value: 0. Vector control by rotor flux orientation.

Version: Operative from version 06.14 on.

Note. When using synchronous motors, always set AP2=0.



Important. For any modification of parameter AP2 will only be effective after doing a soft-reset at the drive. Remember that: **"Validating" is not enough!** If this is not done, the WinDDSetup will warn about it with a message.

AP5	O	F02001	PlcPrgScanTime
-----	---	--------	----------------

Function: It sets the repetition period of the PLC's main module (PRG).

Valid values: 4, 8, 12, 16 or 20 ms. (4 ms by default).

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13.2.2 B group. Non-programmable inputs - outputs

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PARAMETERS, VARIABLES AND COMMANDS
B group. Non-programmable inputs - outputs

It groups the variables related to non-programmable hardware control signals and the logic variables associated with the Halt and Drive Enable functions through the serial line. Activating the Halt function means setting the velocity command to zero while keeping the rotor locked (with torque) and generates a **category 2** stop. It can be activated through an electrical signal at one of the digital inputs of the drive, by the monitoring program through the serial line or through the SERCOS interface. The Halt function is activated (stops the motor) when applying zero volts at the electrical input assigned to the BV1 variable, when requested from the WinDDSSetup (variable BV3 = 0) or when requesting from the PLC of the CNC via SERCOS (bit 13 of DV32 is set to 0 Volts).

BV1	O	F00201	HaltDrivePin
-----	---	--------	--------------

Function: It controls the Halt function through an electrical signal. BV1 is assigned to parameter IP10-IP13 corresponding to the digital input that will work as Halt.

Default value: 1. Not being used.

Example.

IP11 = BV1 (digital input 2 carries out the Halt function; i.e. applying 0V at pin 2 with respect to pin 5, activates the Halt function and carries out a **category 2** stop).

BV3	O	F00202	HaltDriveDnc
-----	---	--------	--------------

Function: It controls the Halt function through the serial line.

Default value: 1 Not being used.

Example.

BV3=0 (activates the Halt function).

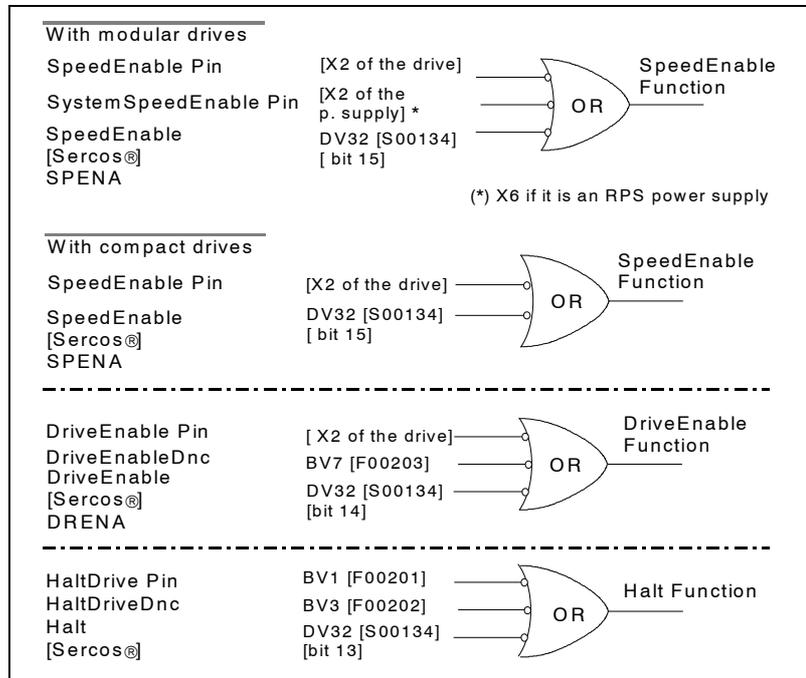


FIGURE S13.1

It controls the Halt function through the serial line.

Activating the Drive Enable function lets the current circulate through the motor. It can be deactivated through an electrical signal at control connector X2 of the drive, by the WinDDSSetup program through the serial line or through the SERCOS interface.



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The Drive Enable function is activated (cancels motor torque) when applying zero volts at the electrical input assigned to the BV1 variable, when requested from the WinDDSSetup (variable BV7=0) or when requesting from the PLC of the CNC via SERCOS (bit 14 of DV32 at the PLC is set to 0 V).

BV7	O	F00203	DriveEnableDnc
-----	---	--------	----------------

Function: It controls the Drive Enable function through the serial line.

Default value: 1. Not being used.

Example.

BV7=0 (cancels the Drive Enable function, cancels motor torque).

BV14		F00204	NotProgrammableOs
------	--	--------	-------------------

Function: It indicates the logic values of the electrical signals of the drive's control. 24V at the electrical input mean a logic 1 at the bits of this variable.

TABLE S13.4 Variable BV14. Meaning of its bits.

Bit	Function
4 (MSB)	PS STATUS (at the intermodular bus X1)
3	Error reset
2	DR. OK (at the microprocessor, at the pins of X2)
1	Speed Enable & System Speed Enable (drive and power supply)
0 (LSB)	Drive Enable

Example.

BV14=18 (10010 in binary). Indicates that Lsc_Status and Speed Enable & System Speed Enable are active

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PARAMETERS, VARIABLES AND COMMANDS
B group. Non-programmable inputs - outputs



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13.2.3 C group. Current

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PARAMETERS, VARIABLES AND COMMANDS
C.group. Current

CP1.#	*OM	S00106.#	CurrentProportionalGain
-------	-----	----------	-------------------------

Function: Value of the proportional gain of the current loop.
Valid values: 0.00 ... 327.67 V/A.
Version: Modified in software version 06.10.

CP2.#	*OM	S00107.#	CurrentIntegralTime
-------	-----	----------	---------------------

Function: Value of the integral gain of the current loop.
Valid values: 0.000 ... 32.767 ms.
Version: Modified in software version 06.10.

CP3.#	*FMA	F00300.#	CurrentFeedbackDerivativeGain
-------	------	----------	-------------------------------

Function: Value of the derivative gain of the current loop.
Valid values: 0 ... 8000 μ s.
Version: Modified in software version 06.10.

CP4.#	*FMA	F00301.#	Current AdaptationProportionalGain
CP5.#	*FMA	F00302.#	

Function: Adaptation of the value of the proportional - integral action of the current PI.
Valid values: 10.0 ... 1000.0 %. The PI action at low speed may go from 1/10 up to ten times the action at high speed. $(CP4 \cdot CP1)/1000$ must be smaller than the maximum value that CP1 can take. $(CP5 \cdot CP2)/1000$ must be smaller than the maximum value that CP2 can take.
Default value: 50.0% (constant integral action at any speed). 100.0% (constant integral action at any speed).
Version: Modified in software version 06.10.

CP6.#	FMA	F00303.#	CurrentAdaptationLowerLimit
-------	-----	----------	-----------------------------

Function: It is the upper limit in rpm of the speeds considered low.
Valid values: Lower than CP7.
Version: Modified in software version 06.10.

CP7.#	FMA	F00304.#	CurrentAdaptationUpperLimit
-------	-----	----------	-----------------------------

Function: It is the lower limit in rpm of the speeds considered high.
Valid values: Lower than SP10 and higher than CP6.
Version: Modified in software version 06.10.



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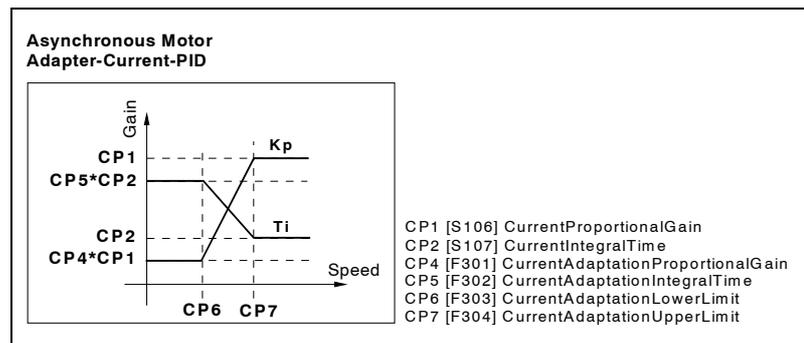


FIGURE S13.2

Graphic interpretation of these parameters.

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PARAMETERS, VARIABLES AND COMMANDS
C group. Current

CP8	F	F00317	CurrentLoopsGainCalculations
-----	---	--------	------------------------------

Function: This parameter may be used to automatically calculate the values of CP1 (Kp) and CP2 (Ti) from MP10 (R) and MP11 (L) for adjusting the current loop **on non-Fagor synchronous motors** and adjusting the current loop, flux loop and BEMF on **non-Fagor asynchronous motors**.

Valid values: CP8=0 (off)
CP8=1 (on)

Default value: 0.

Version: Operative from version 06.01 on.
Expanded from software version 06.08 on

CP9.#	*OA	F00318.#	CurrentLoopBandwidth
-------	-----	----------	----------------------

Function: Bandwidth of the current loop of an asynchronous motor at zero speed. The drive uses it in its internal calculations to **maintain** this bandwidth at high rpm.

Valid values: Minimum value: CP9 = 0 (disabled)
Maximum value: CP9 = 8000 Hz

Default value: 1 000 Hz.

Version: Operative from version 06.10 on.

CP16	FA	F00316	SeriesInductance
------	----	--------	------------------

Function: This parameter only applies when using high speed spindles with very low leak inductance. In order to properly control the current loop, a three-phase inductance must be inserted between the drive and the motor, in series with that of the motor, so as to increase the leak inductance. The minimum value of the motor leak inductance will be 100 μH. The value of the CP16 will be Lserial. To calculate this value refer to the section: "Calculating the serial inductance" in this chapter 6.

Valid values: 0.0000 ... 10 000.0000 mH.

Default value: 0.0000.

Version: Operative from version 06.01 on.

CP20.#	O	F00307.#	CurrentLimit
--------	---	----------	--------------

Function: Limit of the current command that reaches the system's current loop. See the internal configuration diagram. This value is forced by the user.

Valid values: 0.0 ... 300.0 Arms. Depends on the drive connected.

Default value: On servo drive systems with an FXM or FKM servomotor, parameter CP20 takes the lowest value of the ones given by the motor and drive peak currents.

If the motor is an SPM, FM7 or FM9, it takes the value of the drive's maximum current.

CP21.#	Os	F00319.#	PeakCurrentAutophasingOnline
--------	----	----------	------------------------------

Function: High current amplitude during the execution of the command GC7 (AutophasingOnline). See [FIGURE S13.3](#).

Valid values: - 0.1 ... 300.0 Arms.

Default value: 0.0.

Version: Operative from version 06.18 on.



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PARAMETERS, VARIABLES AND COMMANDS
C.group. Current

CP22.#	Os	F00320.#	NominalCurrentAutophasingOnline
--------	----	----------	---------------------------------

Function: Low current amplitude during the execution of the command GC7 (AutophasingOnline). See **FIGURE S13.3**.

Valid values: - 0.1 ... 300.0 Arms.

Default value: 0.0.

Version: Operative from version 06.18 on.

CP23	O	F00321	AutophasingOnlineFastSlope
------	---	--------	----------------------------

Function: Slope of the current ramp with which the amplitude of the high current is reached during the execution of the command GC7 (AutophasingOnline). See **FIGURE S13.3**.

Valid values: 0 ... 1 000 A/s.

Default value: 0.

Version: Operative from version 06.18 on.

CP24	O	F00322	AutophasingOnlineSlowSlope
------	---	--------	----------------------------

Function: Slope of the current ramp with which the amplitude of the low current is reached during the execution of the command GC7 (AutophasingOnline). See **FIGURE S13.3**.

Valid values: 0 ... 1000 A/s.

Default value: 0.

Version: Operative from version 06.18 on.

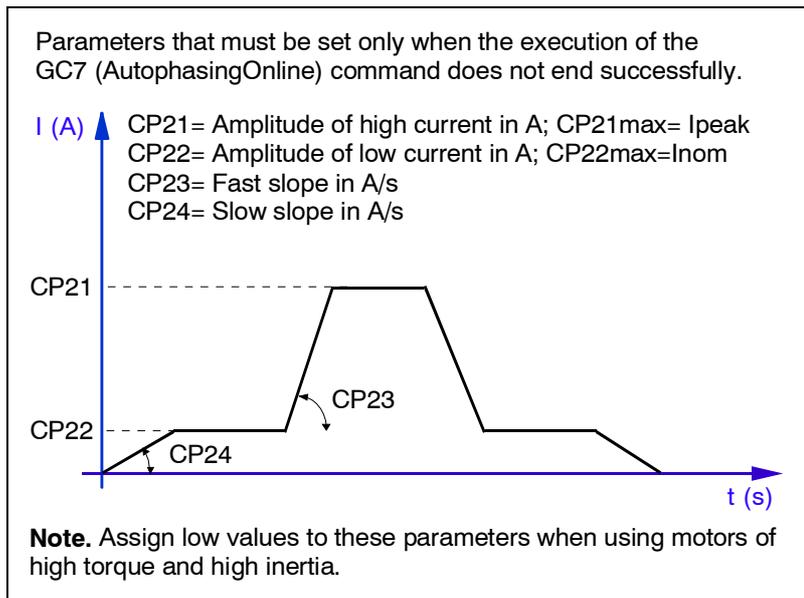


FIGURE S13.3

Parameters that must be set when the GC7 (AutophasingOnline) command has not been successfully executed.

CP26	Os	F00324	I0electSlowVelocity
------	----	--------	---------------------

Function: Slow electrical velocity in the execution of commands GC3 (Autophasing) and GC7 (AutophasingOnline).

Remember that the electrical speed equals the mechanical speed multiplied by the number of pairs of poles.

Valid values: - 3 200.000 ... 3 200.000 mrpm.

Default value: 15.000 mrpm.

Version: Operative from version 06.18 on.



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CP27	Os	F00325	I0electFastVelocity
------	----	--------	---------------------

Function: Fast electrical velocity in the execution of commands GC3 (Autophasing) and GC7 (AutophasingOnline).

Remember that the electrical speed equals the mechanical speed multiplied by the number of pairs of poles.

Valid values: - 3 200.000 ... 3 200.000 mrpm.

Default value: 60.000 mrpm.

Version: Operative from version 06.18 on.

CP30.#	*O	F00308.#	CurrentCommandFilterType
--------	----	----------	--------------------------

Function: This parameter may be used to select filter 1 and/or 2 of the current command and set the type of filter for each of them. They may be set as low-passing filter or notch filter.

Hence, attending to bits 4, 5, 6 and 7 of this parameter and remembering that the least significant bit is bit 0:

TABLE S13.5 Parameter CP30. Meaning of its bits.

Bit	Function
4	Enable/disable filter 1. = 0 Disabled. = 1 Enabled.
5	Type selection for filter 1. = 0 Low-passing. = 1 Notch.
6	Enable/disable filter 2. = 0 Disabled. = 1 Enabled.
7	Type selection for filter 2. = 0 Low-passing. = 1 Notch.

The rest of the bits are reserved. To know all the possible configurations, see Parameter setting for the current filters of chapter 3 of this manual.

Valid values: 0 ... 240.

Default value: 0.

Version: Operative from version 06.01 on.

CP31.#	*O	F00312.#	CurrentCommandFilter1 Frequency
--------	----	----------	------------------------------------

Function: Cutoff frequency of current command filter 1.

Valid values: 0 ... 4 000 Hz.

Default value: 0.

CP32.#	*O	F00313.#	CurrentCommandFilter1 Damping
--------	----	----------	----------------------------------

Function: Depending on the type of filter 1 selected:

Low passing filter: Damping factor of current command filter in thousandths.

Notch filter: Width of the break frequency in Hz.

Valid values: 0 ... 8 000 (non-dimensional).

Default value: 1 000.

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PARAMETERS, VARIABLES AND COMMANDS
C group. Current



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PARAMETERS, VARIABLES AND COMMANDS
C.group. Current

CP33.#	*OS	F00314.#	CurrentCommandFilter2 Frequency
--------	-----	----------	------------------------------------

Function: Cutoff frequency of current command filter 2.
Valid values: 0 ... 4 000 Hz.
Default value: 0.
Version: Operative from version 06.01 on.

CP34.#	*OS	F00315.#	CurrentCommandFilter2 Damping
--------	-----	----------	----------------------------------

Function: Depending on the type of filter 2 selected:
Low passing filter: Damping factor of current command filter in thousandths.
Notch filter: Width of the break frequency in Hz.
Valid values: 0 ... 8 000 (non-dimensional).
Default value: 1 000.
Version: Operative from version 06.01 on.

CV1	s	F00309	CurrentUFeedback
CV2	s	F00310	CurrentVFeedback

Function: Display the value of the feedback of the current going through phases U / V.
Valid values: - 200.0 ... 200.0 A (instant values).

CV3		F00311	CurrentFeedback
-----	--	--------	-----------------

Function: Display the rms current circulating through the motor.
Valid values: 0.0 ... 200.0 Arms (rms value).

CV10	Fs	F00305	CurrentUOffset
CV11	Fs	F00306	CurrentVOffset

Function: Compensation of the current feedback offset of phase U / V.
Valid values: - 5 000 ... 5 000 (depends on the drive connected).
Default value: 0. This value is measured and adjusted at the factory.



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13.2.4 D group. Diagnosis

DP142	O	S00142	ApplicationType
-------	---	--------	-----------------

Function: Informative parameter. It contains the type of application the drive is dedicated to (e.g.: spindle, rotary axis).

DV1		S00011	Class1Diagnostics (Errors)
-----	--	--------	------------------------------

Function: The DV1 variable contains a numerical data coded into 16 binary bits and represents the error status as shown by the attached table. Bit (from most to least significant), name, coded on the display and face plate of the module.

TABLE S13.6 Parameter DV1. Meaning of its bits.

Bit	Name	Error
15 (MSB)	ManufacturerSpecificError	Rest.
14	Class1Reversed	
13	TravelLimit	
12	CommunicationError	E400 → E499
11	ExcessiveFollowingError	E156
10	PowerSupplyPhaseError	
9	UnderVoltageError	E307
8	OverVoltageError	E304, E306
7	OverCurrentError	E212
6	ErrorInElectronicCommunicationSystem	E213 → E214
5	FeedbackError	E600 → E699
4	ControlVoltageError	E100 → E105
3	CoolingErrorShutdown	E106
2	MotorOvertempShutdown	E108
1	AmplifierOvertempShutdown	E107
0 (LSB)	OverloadShutdown	E201, E202, E203

Bit 0 → No error, Bit 1 → Error

Example.

DV1= 32804 (100000000100100 in binary). It indicates the existence of a FeedbackError, a MotorOvertempShutdown and a ManufacturerSpecific Error.

DV9		S00012	Class2Diagnostics (Warnings)
-----	--	--------	------------------------------

Function: The DV9 variable contains a numerical data coded into 16 binary bits and represents the warning status as shown by the attached table. Bit (from the most to the least significant).

TABLE S13.7 Parameter DV9. Meaning of its bits.

Bit	Name	Warning
15	ManufacturerSpecificBit *	The rest
14	Reserved	
13	TargetPositionOutsideTheTravelZone	A13
12, ..., 4	Reserved	
3	CoolingErrorShutdown	A3
2	MotorOvertempShutdown	A2
1	AmplifierOvertempShutdown	A1
0 (LSB)	OverloadShutdown	A0

* Any other warning issued that does not appear in this table, e.g. A189, sets bit 15 of DV9 to 1.

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D group. Diagnosis



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D group. Diagnosis

Example.

DV9=8 (000000000001000 in binary). It indicates the existence of the CoolingErrorShutdown warning.

DV10		S00013	Class3Diagnostics (OperationStatus)
------	--	--------	-------------------------------------

Function: The DV10 variable contains a numerical data coded into 16 binary bits and represents the status of the logic marks (operating status) as shown by the attached table. Bit (from the most to the least significant).

TABLE S13.8 Parameter DV10. Meaning of its bits.

Bit	Mark	Meaning
15, 14, 13, 12	Reserved	
11, 10, 9, 8	Reserved	
7	TV60 (S00337)	TV50 > TP2
6	PV136 (S00336)	PV189 > PP57
5	Reserved	
4	Reserved	
3	TV10 (S00333)	TV2 > TP1
2	SV3 (S00332)	SV2 < SP40
1	SV5 (S00331)	SV2 < SP42
0 (LSB)	SV4 (S00330)	SV2 = SV1

Example.

DV10=14 (000000000001110 in binary). It indicates the activation of SV5, SV3 and TV10.

DV11		F00404	FagorDiagnostics
------	--	--------	------------------

Function: The DV11 variable contains a numerical data coded into 16 binary bits and represents the status of some of the most interesting variables at the drive. See attached table. Bit (from the most to the least significant).

TABLE S13.9 Parameter DV11. Meaning of its bits.

Bit	Variable	Meaning
15, 14, 13	Reserved	
12	TV60 (S00337)	PGreaterPx
11	TV10 (S00333)	TGreaterTx
10	SV3 (S00332)	NFeedbackMinorNx
9	SV5 (S00331)	NFeedbackEqual0
8	SV4 (S00330)	NFeedbackEqualNCommand
7, 6, 5, 4	GV21 (S00254)	ParameterSetActual
3, 2, 1, 0	GV25 (S00255)	GearRatioActual

Example.

DV11=1280 (0000010100000000 in binary). It indicates an operation with set 0, follows the command properly, is not stopped, is under the Nx, Tx, and Px threshold.

DV14		F00405	ErrorsInDncFormat
------	--	--------	-------------------

Function: It permits reading all the errors active at the very instant. See chapter 14. **ERROR CODES AND MESSAGES** of this manual.



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DV31		S00135	DriveStatusWord
------	--	--------	-----------------

Function: The DV31 variable contains a numerical data coded into 16 binary bits and represents the system status as shown by the attached table. This variable communicates with the CNC through the SERCOS interface. Bits 15 and 14 are assigned to PLC variables DRSTAF and DRSTAS respectively.

TABLE S13.10 Parameter DV31. Meaning of its bits.

Bit	Meaning	Possible values	
15, 14	Power & Torque Status	Bits (15,14) (0,0) (0,1) (1,0) (1,1)	Meaning DoingInternalTest ReadyForPower PowerOn TorqueOn

They indicate at which point of the start-up sequence the drive is.

13	Error		
12	WarningChangeBit		
11	OperationStatusChangeBit		
9, 8	ActualOperationMode	Bits (9,8) (0,0) (0,1) (1,0) (1,1)	Meaning InPrimaryMode InSecondary1Mode InSecondary2Mode InSecondary3Mode
7	RealTimeStatusBit1		
6	RealTimeStatusBit0		
5	ChangeBitCommands		
4 ... 0	Reserved		

Example.

DV31 =11479 (0010110011010110 in binary). It indicates that the internal test (DoingInternalTest) is in progress, it has an error, etc.

DV32		S00134	MasterControlWord
------	--	--------	-------------------

Function: The DV32 variable contains a numerical data that in 16-bit binary code represents the status of the various control signals that the CNC sends to the drive through SERCOS interface. See attached table. Bit (from the most to the least significant). This variable is communicated to the via the SERCOS interface. Bits 15 and 14 correspond to the value of digital outputs SPENA and DRENA respectively in the PLC of the CNC 8055/55i.

TABLE S13.11 Variable DV32. Meaning of its bits.

Bit	Name
15	Speed Enable (SPENA)
14	Drive Enable (DRENA)
13	Halt
12, ..., 0	Reserved

Example.

DV32=57344 (1110000000000000 in binary). The CNC enables the drive so the motor turns according to the velocity command.

DC1		S00099	ResetClass1Diagnostics
-----	--	--------	------------------------

Function: Resets the errors shown at the display.

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PARAMETERS, VARIABLES AND COMMANDS
D group. Diagnosis



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13.2.5 E group. Encoder simulator

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PARAMETERS, VARIABLES AND COMMANDS
E group. Encoder simulator

EP1	O	F00500	EncoderSimulatorPulsesPerTurn
-----	---	--------	-------------------------------

Function: Number of pulses generated by the encoder simulator per rotor revolution.

Valid values: 1 ... 16 360 pulses per turn, (integer).

Default value: 1250 pulses per turn.

Note that when using square wave motor feedback (TTL), EP1 must be set equal to NP1 16, otherwise, error code **E502** will be issued.

EP2	O	F00501	EncoderSimulatorI0Position
-----	---	--------	----------------------------

Function: Rotor position where the encoder simulator generates the reference pulse signal (I0). This parameter may be modified with the EC1 command from the WinDDS-Setup application.

Valid values: 1 ... EP1. (Integer number).

Default value: 1.

EP3	O	F00502	EncoderSimulatorDirection
-----	---	--------	---------------------------

Function: This parameter is used to select the turning direction of the simulated encoder.

Valid values: 0/1 Clockwise / counterclockwise, respectively.

Default value: 0 Clockwise.

EC1	O	F00503	EncoderSimulatorSetI0
-----	---	--------	-----------------------

Function: Executing this command sets the position of the marker pulse signals in the current physical position of the rotor.

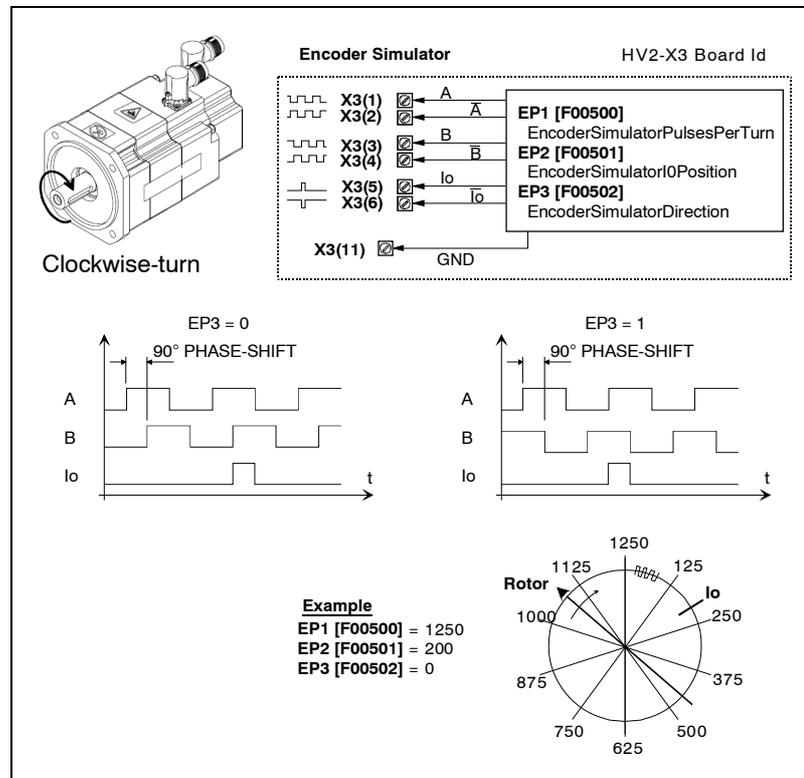


FIGURE S13.4
Description of the parameters of the E group: Encoder simulator.



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13.2.6 F group. Flux

FP1.#	*OMA	F00600.#	MotorFluxProportionalGain
-------	------	----------	---------------------------

Function: Value of the proportional gain of the flux loop.

Valid values: 0.0 ... 3 200.0 A/Wb.

Default value: Depends on the motor connected.

Version: Modified in software version 06.10.

FP2.#	*OMA	F00601.#	MotorFluxIntegralTime
-------	------	----------	-----------------------

Function: Value of the integral time of the flux loop.

Valid values: 0.0 ... 3 200.0 ms.

Default value: Depends on the motor connected.

Version: Modified in software version 06.10.

FP20.#	*OMA	F00602.#	MotorBEMFProportionalGain
--------	------	----------	---------------------------

Function: Value of the proportional gain of the BEMF.

Valid values: 0.000 ... 32.000 mWb/V.

Default value: Depends on the motor connected.

Version: Modified in software version 06.10.

FP21.#	*OMA	F00603.#	MotorBEMFIntegralTime
--------	------	----------	-----------------------

Function: Value of the integral time of the BEMF (back Electro Motive Force).

Valid values: 0.0 ... 3 200.0 ms.

Default value: Depends on the motor connected.

Version: Modified in software version 06.10.

FP30	FA	F00612	RotorResistanceEstimationActive
------	----	--------	---------------------------------

Function: Activate rotor resistance estimate. Rotor resistance varies by the effect of temperature and rotor turning speed variations. To activate the estimation of the new resistance value, the power must be 20% greater than the rated value and this parameter must be set to 1.

Valid values: 0/1 Off/On.

Default value: 1 Activated (On)

Version: Operative from version 06.01 on.

FP31	FA	F00613	RotorFixedTemperature
------	----	--------	-----------------------

Function: Fixed temperature of the rotor. The rotor resistance value will be the one corresponding to the temperature indicated in this parameter and will only be taken into account if the estimation is not activated or there is no temperature sensor (MP14≠2 or 3).

Valid values: 0.0 ... 150.0 °C.

Default value: 0.0 °C.

Version: Operative from version 06.01 on.

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PARAMETERS, VARIABLES AND COMMANDS
F group. Flux

FP40.#	FA	F00622.#	FluxReduction
--------	----	----------	---------------

Function: Percentage reduction of flux level. It indicates the percentage of the magnetizing current circulating through the motor when it has no load. It reduces motor noise and heat when turning without load. Use a value of 1 000% to cancel the effect of this parameter.

Valid values: 1 ... 1 000%.

Default value: 1 000%.

FP50	*A	F00624	MRASProportionalGain
------	----	--------	----------------------

Function: Value of the proportional gain of the PI used to estimate the speed. Only applicable when AP2=1, i.e. sensorless control for an asynchronous motor.

Valid values: 0 ... 32 767 (rad/s) / Wb².

Default value: 500 (rad/s) / Wb².

Version: Operative from version 06.14 on.
Modified from software version 06.15 on

FP51	*A	F00625	MRASIntegralTime
------	----	--------	------------------

Function: Value of the integral gain of the PI used to estimate the speed. Only applicable when AP2=1, i.e. sensorless control for an asynchronous motor.

Valid values: 0.0 ... 3 276.7 ms.

Default value: 20.0 ms.

Version: Operative from version 06.14 on.

FP60	*OA(SP)	F00626	FilterForStatorFluxEstimation OfVoltageModel
------	---------	--------	-------------------------------------------------

Function: Cutoff frequency of the voltage model filter.

Valid values: 1 ... 8 000 Hz.

Default value: 2 Hz.

Version: Operative from version 06.14 on.

FV1	A	F00623	BEMF
-----	---	--------	------

Function: BEMF value.

Units: Volts.



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13.2.7 G group. General

GP1	O	F00700	PwmFrequency
-----	---	--------	--------------

Function: It selects the switching frequency of the IGBT's. This frequency determines the times of the servo loop and of the vector control loop. Observe that this parameter may be modified at OEM level.

Valid values: 4 000 and 8 000 Hz.

Default value: 4 000 Hz (for synchronous and asynchronous motors).

GP2.#	O	F00701.#	Feedback1Type
-------	---	----------	---------------

Function: Motor feedback type.

Valid values:

0. Stegmann sinusoidal encoder
1. Resolver
2. Square-wave TTL encoder
5. Heidenhain encoder (ERN 1387) for Siemens motors, 1FT6 family.
6. Sinusoidal encoder (for spindles only)
7. Without feedback

Default value: 0. Stegmann sinusoidal encoder

Note. If your feedback device is not among the ones listed here, you must set GP2 using the bits method and have version 06.18 or later. For further detail, see section "Feedback on the motor. Parameter setting" of chapter 5 of this manual.

Valid values: 0 ... 65 535.

GP3	O	F00702	StoppingTimeout
-----	---	--------	-----------------

Function: After deactivating the Speed Enable and after the GP3 time has elapsed, if the motor has not stopped, it cancels the torque automatically and issues error code **E004**. If the motor stops before exceeding the time period set in GP3, it also cancels the torque but does not issue an error.

Valid values: 0 ... 65 535 ms. Depends on the motor.

Default value: 500 ms (on axes) and 5 000 ms (on spindles).

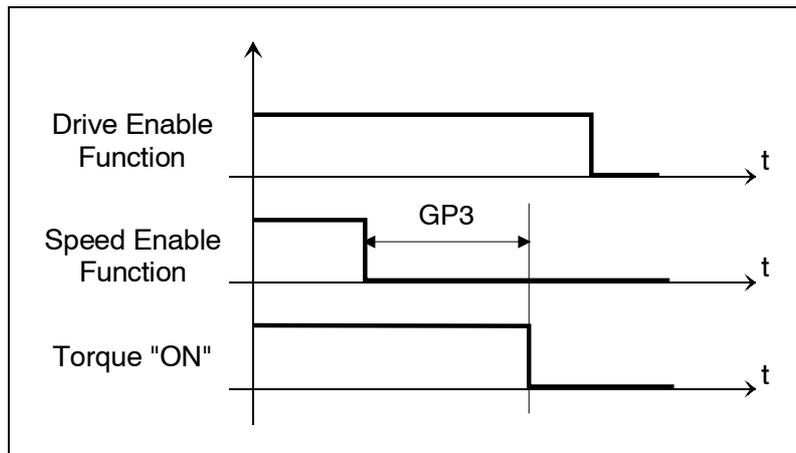


FIGURE S13.5

Illustrative detail of the definition of parameter GP3. Stopping time.

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GP4	O	F00703	SetNumber
-----	---	--------	-----------

Function: Number of sets of useful parameters. The useful sets must be numbered from zero on. Only a limited number of sets may be activated with this parameter.

Valid values: 1 ... 8 From one set up to all of them.

Default value: 1 A single set.

GP5	O	F00704	ParameterVersion
-----	---	--------	------------------

Function: It stores the version of the drive parameter table. **It is a read-only parameter.**

GP6	O	F00717	GearRatioNumber
-----	---	--------	-----------------

Function: Number of useful gear ratios. The useful gear ratios must be increased from zero on. Only a limited number of gear ratios may be activated with this parameter.

Valid values: 1 ... 8 From one gear ratio up to all of them.

Default value: 1 A single reduction.

GP7	O	F00720	OverloadTimeLimit
-----	---	--------	-------------------

Function: Maximum time set to operate under overload conditions. Exceeding this time value in these conditions activated error code **E203**.

See parameter **GP8**.

Valid values: 0 ... 10 000 ms.
Setting GP7 = 0 disables the detection.

Default value: 200 ms.

GP8	O	F00721	OverloadVelocityThreshold
-----	---	--------	---------------------------

Function: Sets the speed threshold under which the motor is considered to be stopped in terms of overload detection. See parameter **GP7**.

Valid values: 0 ... 60 000 rpm.

Default value: For spindle motors: 100 rpm.
For axis motors: nmax in rpm.
Note: nmax is the maximum motor speed.

GP9	O	S00207	DriveOffDelayTime
-----	---	--------	-------------------

Function: After a category 1 stop, the deactivation of the drive's PWM is delayed the amount of time indicated in GP9. It is useful on axes not compensated with a holding brake. See the section "Electrical cabinet drawings" of chapter 10 of the dds-hardware manual

Observe that this delay given in GP9 does not affect the Drive Enable function.

Valid values: 0.0 ... 6 553.5 ms.

Default value: 0.0 After a category 1 stop, the motor torque is eliminated.



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GP10	O	F00719	Feedback2Type
------	---	--------	---------------

Function: It sets the type of electrical signal received from the direct feedback through connector X3.

Valid values:	0. There is no direct feedback.
	1. Square TTL signal.
	2. 1 Vpp sinewave signal.
	3. Signal from a Stegmann feedback device.
	4. TTL square signal with SSI communication.
	5. 1 Vpp signal with SSI communication.

The options GP10=4 and GP10=5 activate the direct feedback option with SSI communication. They differ in the type of incremental signal of the feedback device. In terms of incremental signals it is the same as GP10=1 and GP10=2, respectively. Therefore, the parameters for the incremental signals are set in exactly the same way.

Default value: 0. There is no direct feedback.

Note. If your feedback is not among the ones listed here, you must set GP10 using the bits method and have version 06.18 or later. For further detail, see section "Direct feedback. Parameter setting" of chapter 5 of this manual.

Valid values: 0 ... 65 535.

GV2		S00030	ManufacturerVersion
-----	--	--------	---------------------

Function: Display of the current version and the type of drive (axis or spindle).

GV3		F00705	FlashParameterChecksum
-----	--	--------	------------------------

Function: It informs on the parameter checksum.

GV4		S00380	DCBusVoltage
-----	--	--------	--------------

Function: It informs about the voltage of the power bus in (volts).

GV5		F00706	CodeChecksum
-----	--	--------	--------------

Function: It informs on the software checksum.

GV6		F00723	RamParameterChecksum
-----	--	--------	----------------------

Function: It informs on the checksum of the parameters contained in RAM memory.

GV8		F00707	AcessLevel
-----	--	--------	------------

Function: It informs about the current access level of the user.

Valid values:	1. Basic (user).
	2. OEM.
	3. Fagor.

GV9		S00140	DriveType
-----	--	--------	-----------

Function: It informs about the drive's sales reference.

Valid values: All the possible ones according to the codes given in chapter 12 of the "dds-hardware" manual.



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GV10	O	S00262	LoadDefaultsCommand
------	---	--------	---------------------

Function: Motor identification and initialization. Assigning an identifying reference of a particular motor to this variable - see chapter 12 of the "dds- hardware" manual - sets the parameters related to the motor to govern it and the rest of the parameters to their default values. See the section "Motor identification" in chapter 2 of this manual.

Valid values: The references appearing in chapter 12 of the "dds- hardware" manual for motors.

GV11	W	F00708	SoftReset
------	---	--------	-----------

Function: Variable for executing a software reset. See section "initialization process, reset" of chapter 1. **PREVIOUS KNOWLEDGE** in this manual.

GV13		F00709	PowerBusStatus
------	--	--------	----------------

Function: It indicates whether there is voltage or not at the power

Valid values:

0. There is no voltage.
1. There is voltage.

GV14	F	F00710	PowerVoltageMinimum
------	---	--------	---------------------

Function: While there is torque, if the bus voltage is lower than GV14, it activates error code **E307** or error **E003**.

Valid values: 0 ... 880 V.

GV15	S	F00725	AutophasingOnlineDone
------	---	--------	-----------------------

Function: It informs on whether the absolute electrical position has been calculated on power-up or not using the command GC7 (F01524) AutophasingOnline.

Valid values: 1 / 0 Yes / No.

Version: Operative from version 06.10 on.

GV21		S00254	ParameterSetActual
------	--	--------	--------------------

Function: It informs about the active parameter set currently used by the system.

Valid values: 0 ... 7 (8 possible sets).

Default value: 0. (set 0).

GV22	W	S00217	ParameterSetPreselection
------	---	--------	--------------------------

Function: It determines the parameter set that will be active when receiving the admission signal (GV24).

Valid values: 0 ... 7. (8 possible sets).

Default value: 0. (set 0).

GV23	F	F00711	ParameterSetAck
------	---	--------	-----------------

GV24	W	F00712	ParameterSetStb
------	---	--------	-----------------

Function: Variables related to changing the active set. GV24 must be set to 1 (Strobe) in order to be able to change the set using GV30, GV31 and GV32. When the set change is effective, the drive shows it through variable GV23. If GV24 is not assigned to any digital input, it keeps the value of 1 (active) and, therefore, the changes in GV30, GV31 and GV32 have an immediate effect on the active set.

Valid values:

0. Inactive.
1. Active.



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GV25		S00255	GearRatioActual
------	--	--------	-----------------

Function: It indicates which is the active gear ratio in the software.
Valid values: 0 ... 7 (8 possible gear ratios).
Default value: 0 (gear ratio 0).

GV26	W	S00218	GearRatioPreselection
------	---	--------	-----------------------

Function: It determines which will be the active gear ratio (software) when the change is carried out via SERCOS.
Valid values: 0 ... 7. (8 possible gear ratios).
Default value: 0. (gear ratio 0).

GV30	W	F00713	ParameterSetBit0
GV31	W	F00714	ParameterSetBit1
GV32	W	F00715	ParameterSetBit2

Function: Boolean variables that make up the active set identifying number. GV32 is the most significant bit (MSB) and GV30 the least significant (LSB). For the change of active set to be effective, the GV24 variable must be enabled. Assigning these four variables to parameters IP10-IP13 makes it possible to control which is the active set using electrical signals.
Valid values: 0/1 Assigned to the IP, they correspond to (0/24 V DC).

Example.

GV32=1, GV33=1 and GV30=0 represent set 6.

GC1		S00264	BackupWorkingMemory Command
-----	--	--------	-----------------------------

Function: Execution of the parameter transfer from RAM to FLASH.

GC3		F01523	AutoPhasing
-----	--	--------	-------------

Function: Command to be used when replacing an encoder or a resolver on axis motors to adjust the relative position of its reference signal (zero mark) with respect to the motor EMF. For further information, see the section "Replacing the encoder or resolver" in chapter 1 of the manual for AC servo motors AC - FXM and FKM -.

GC4		S00220	OfflineParameterValidation
-----	--	--------	----------------------------

Function: Command that validates any modification of an off-line parameter without having to save it. It does not store the change permanently in Flash memory. This command is especially useful for faster setup.

Version: Operative from version 06.01 on.

GC5		F00614	AutoCalculate
-----	--	--------	---------------

Function: Execution of the auto-setting of the inertia in off-line mode. By executing this command, it calculates parameter NP1 (relationship between the load inertia and that of the motor's rotor) and friction parameters TP10, TP11, TP12 and TP13. See section: "Auto-setting of inertia in off-line mode" in chapter 5 of this manual.

Version: Operative from version 06.01 on.

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GC6		F00615	HomeSwitchAutoCalculate
-----	--	--------	-------------------------

Function: Command that uses the PV1 value obtained in the first home search to calculate the right value so the simulated output of the home switch is in the optimum position and stores in parameter PP4.

Version: Operative from version 06.02 on.

GC7	S	F01524	AutophasingOnline
-----	---	--------	-------------------

Function: Electrical position estimating command (position of the rotor magnets with respect to the stator). It will be executed automatically when starting up a synchronous motor if bits s6, 5, 4, 3 of parameter GP2 are 0,1,1,1 respectively and if there is no feedback measuring the absolute position within one revolution. It can also be executed manually from the WinDDSSetup if necessary. To verify that it has really been executed successfully, the variable **GV15** (F00725) Autophasing OnlineDone will read "1".

If it has not been executed successfully, set parameters CP21, CP22, CP23, CP24, CP26 and CP27 properly.

See section - **Electrical position on motor startup** - in chapter 10 of this manual.

Version: Operative from version 06.10 on.
Modified from software version 06.18 on

GC8	S	F01525	ElectricPositionCorrection
-----	---	--------	----------------------------

Function: Command whose execution updates the real (not the estimated) rho value when passing through the reference mark (I0).

See section - **Electrical position on motor startup** - in chapter 10 of this manual.

Version: Operative from version 06.18 on.



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13.2.8 H group. Hardware

HV1	(AX)	S00110	S3LoadCurrent
-----	------	--------	---------------

Function: It identifies the current of an axis drive module (current for a synchronous motor in duty cycle S3 with a running factor of 5% and a cycle time of 10 seconds)

Valid values: See the relevant tables of chapter 3: "Drive modules" of the "dds-hardware" manual.

Version: Modified from software version 06.03 on

HV2	(SP)	F00804	S6LoadCurrent
-----	------	--------	---------------

Function: It identifies the current of a spindle drive module (current for a synchronous or asynchronous motor in duty cycle S6 with a running factor of 15% and a cycle time of 1 minute).

Valid values: See the relevant tables of chapter 3. "Drive modules" of the "dds-hardware" manual.

Version: Operative from version 06.03 on.

HV4		F00801	DriveMaxCurrent
-----	--	--------	-----------------

Function: It stores the value of the maximum current of the drive module appearing in the reference of its characteristics plate. See figure.

HV4 stores the value given by the reference in the indicated position

AXD 1.□ - A1-1-B

This current value is associated with the maximum current that the IGBT's of the unit can provide, but it does not match exactly.

Observe that the following equation must always be verified: **CP20 ≤ HV4**.

Valid values: 8 ... 300 Arms.

Version: Operative from software version 06.22 on.

HV9		F00806	ModularOrCompact
-----	--	--------	------------------

Function: It indicates whether the drive is modular or compact.

Valid values:	0. Modular.
	1. Compact.

HV10		F00290	VsMSC
------	--	--------	-------

Function: It informs of the different hardware possibilities.

HV11		F00291	FlashManufacturerCode
------	--	--------	-----------------------

Function: It indicates the code of the manufacturer of the Flash memory used in the drive.

HV13		F00293	SERCOSRS422Id
------	--	--------	---------------

Function: This variable presents the identifier number of the switch on the SERCOS board or on the RS-422 board depending on which one is being used. It may be used to view the status of the rotary selector switch at all times without having to reset the drive.

HV21		F00800	MotorVoltage
------	--	--------	--------------

Function: Rms voltage on the line or between motor phases.

Valid values: 0 ... 1 000 V.

Version: Operative from version 06.01 on.

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PARAMETERS, VARIABLES AND COMMANDS
H group. Hardware



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13.2.9 I group. Inputs

13.

PARAMETERS, VARIABLES AND COMMANDS
I group. Inputs

IP1.#	O	F00900.#	AnalogReferenceSelect
-------	---	----------	-----------------------

Function: It selects the analog input used as velocity command.

Valid values:

1. Analog input 1 (by default).
2. Analog input 2.

IP5	O	F00909	DigitalInputVoltage
-----	---	--------	---------------------

Function: Its 4 least significant bits configure the digital inputs of the drive 8I - 16O and 16I - 8O to operate with an input voltage of 24 V DC.
The card with connectors X6 and X7 cannot be configured by this parameter.

Bits 0 and 1 configure the inputs of slot SL1.

- bit 0 → configures inputs I1-I8.
- bit 1 → configures inputs I9-I16.

Bits 2 and 3 configure the inputs of slot SL2.

- bit 2 → configures inputs I17-I24.
- bit 3 → configures inputs I25-I32.

Valid values: 0. Inputs configured for 24 V DC. (by default in all four bits).

IP10	O	F00901	I1IDN
IP11	O	F00902	I2IDN
IP12	O	F00903	I3IDN
IP13	O	F00904	I4IDN

Function: It contains the identifiers of the parameters or variables that will assigned the logic value of the electrical signal received by the drive through:

Pin 1 (referred to pin 5) → IP10
Pin 2 (referred to pin 5) → IP11
Pin 3 (referred to pin 5) → IP12
Pin 4 (referred to pin 5) → IP13

Default value: 0. Not assigned to any variable.

Example.

- IP10 = GV24 (pin 1 referred to pin 5 is the Strobe for selecting the sets).
- IP11 = BV1 (pin 2 referred to pin 5 carries out the hardware Halt function).
- IP12 = 0 (pin 3 referred to pin 5 does not carry out any function).

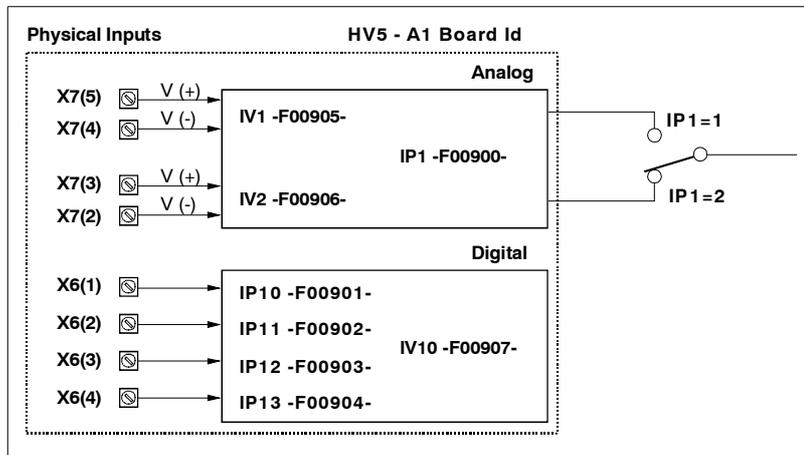


FIGURE S13.6

It controls the Halt function through the serial line.



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IV1	s	F00905	AnalogInput1
IV2	s	F00906	AnalogInput2

Function: These two variables monitor the input voltage through analog input 1 (pins 4-5 of X7) and analog input 2 (pins 2 -3 of X7). Its value cannot be modified because they are read-only variables.

Valid values: - 10,000 ... 10,000 V.

IV10	O	F00907	DigitalInputs
------	---	--------	---------------

Function: Variable IV10 contains a number whose binary code represents the status of the digital inputs of slot SL1.

➔ If slot SL1 is occupied by connectors X6 and X7, these inputs are the ones associated with parameters IP10-13 (four digital inputs).

➔ If slot SL1 is occupied by one of the input/output cards 16DI-8DO or 8DI-16DO, these inputs represent PLC resources I1-I16.

Valid values: 0 ... 15.

Example.

Reading of IV10=3 (0011 in binary). It means that inputs 1 and 2 of connector X6 are active (receive 24 V DC) and inputs 3 and 4 are inactive (0 V DC).

IV11	O	F00908	DigitalInputsCh2
------	---	--------	------------------

Function: Variable IV11 contains a number whose binary code represents the status of the digital inputs of slot SL2.

Slot SL1 can only be occupied by some of the input/output cards 16DI-8DO or 8DI-16DO. When using the PLC, these inputs represent its resources I17-I32.

Example.

Reading of IV11=30 (00011110 in binary). It means that inputs I18, I19, I20 are active and the rest of the inputs are inactive (0 V DC).

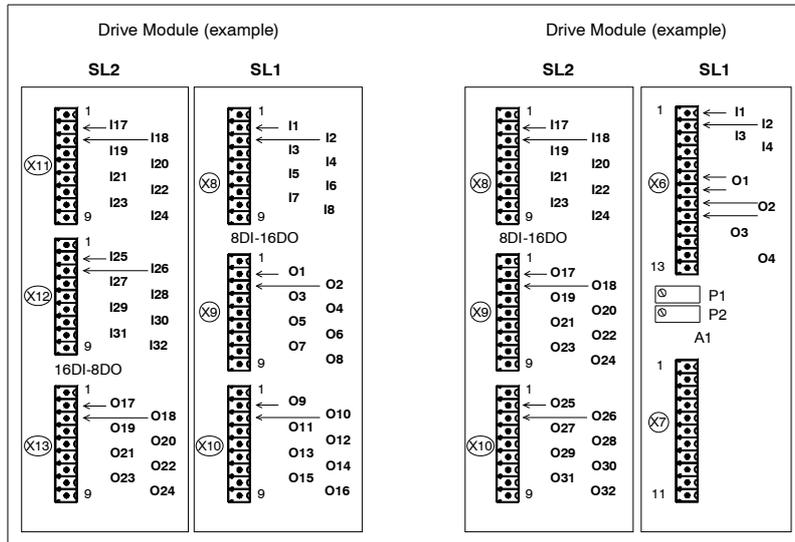


FIGURE S13.7

Inputs - outputs at slots SL1 and SL2.

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PARAMETERS, VARIABLES AND COMMANDS
I group. Inputs



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13.2.10 K group. Monitoring

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PARAMETERS, VARIABLES AND COMMANDS
K group. Monitoring

KP1	F(AX)	F01112	DriveI2tErrorEfect
-----	-------	--------	--------------------

Function: It determines whether the I²t error causes the motor to stop or limits its current to its rated value.

Valid values:

0. Stops the system.
1. Limits the current circulating through the motor to its rated value.

Default value: 0. Stops the system.

KP2	O	F01113	ExtBallastResistance
-----	---	--------	----------------------

Function: It contains the Ohm value of the external Ballast resistor of a compact drive. It is useful for the I²t protection of that resistor.

Valid values: 0.0 ... 6 553.5 Ω.

Default value: 0.0.

KP3	O	F01114	ExtBallastPower
-----	---	--------	-----------------

Function: It contains the power value of the external Ballast resistor of a compact drive. It is useful for the I²t protection of that resistor.

Valid values: 0 ... 65 535 W.

Default value: 0.

KP4	O	F01116	ExtBallastEnergyPulse
-----	---	--------	-----------------------

Function: It contains the value of the energy pulse that may be dissipated through the external Ballast resistor of a compact drive. It is useful for the I²t protection of that resistor.

Valid values: 0 ... 400 000 J.

Default value: 0.

Important note. When installing an external braking resistor larger than the one supplied by Fagor with SCD spindle drives because the application requires it, set parameters KP2, KP3 and KP4 as shown by the following table:

Resistor	KP2	KP3	KP4
ER+TH-24/1100	240	950	60000
ER+TH-18/1100	180	950	60000
ER+TH-18/2200	180	2000	120000
ER+TH-18/1100+FAN	180	2000	120000
ER+TH-18/1500+FAN	180	3000	180000
ER+TH-18/2000+FAN	180	4000	240000
RM-15 (discontinued)	180	1500	75000

KV2		F01100	DriveTemperature
KV4	W	F01101	DriveTemperatureErrorLimit

Function: Read/Write the limits set by the user for the warning and error of the drive's temperature.

Valid values: 5.0 ... 100.0 °C.

KV5	W	S00201	MotorTemperatureWarningLimit
KV6		S00383	MotorTemperature
KV8	W	S00204	MotorTemperatureErrorLimit



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Function: Read/Write the limits set by the user for the warning and error of the motor's temperature.
 Note that KV6 is not applicable to motors that have a triple temperature sensor; i.e. FXM and SPM motors.

Valid values: for KV5 & KV8: 0.0 ... 150.0 °C.
 for KV6: 5.0 ... 150.0 °C.

KV9	W	S00202	Cooling TemperatureWarningLimit
KV12	W	S00205	Cooling TemperatureErrorLimit

Function: Read/Write the limits set by the user for the warning and error of the heatsink temperature.

Valid values: 0.0 ... 110.0 °C.

KV10		F01102	CoolingTemperature
KV20	s	F01103	SupplyPlus5V
KV21	s	F01104	SupplyPlus8V
KV22	s	F01105	SupplyPlus18V
KV23	s	F01106	SupplyMinus5V
KV24	s	F01107	SupplyMinus8V
KV25	s	F01108	SupplyMinus18V

Function: Monitoring of heatsink temperature (°C) and power supply voltages (V) present at the module.

KV32	(AX)	F01109	I2tDrive
------	------	--------	----------

Function: Variable used internally by the system. It measures the internal load level of the calculation of the I²t at the drive in percentage used over the maximum. A value greater than 100% in this variable activates error code **E202**.

KV36	F(AX)	F01111	I2tMotor
------	-------	--------	----------

Function: Variable used internally by the system. It measures the internal load level of the calculation of the I²t at the drive in percentage used over the maximum. A value greater than 100% in this variable activates error code **E201**.

KV40	F	F01115	I2tCrowbar
------	---	--------	------------

Function: Shows the load percentage on the external Ballast resistor of a compact drive. It is useful for the I²t protection of that resistor. A value greater than 100% in this variable activates error code **E301**.

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PARAMETERS, VARIABLES AND COMMANDS
K group. Monitoring



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SOFTWARE

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13.2.11 L group. Motion Control

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LP1	O	F02301	SecondCamSwitchStart
-----	---	--------	----------------------

Function: This parameter determines which is the first cam that belongs to the second CamSwitch. Hence:

- LP1=0 indicates that there is only the first Cam-Switch and therefore all 8 cams will belong to it.
- LP1=1 indicates that there is only the second Cam-Switch and therefore all 8 cams will belong to it.
- LP1=2 ... 8 defines the first cam that will be part of the second CamSwitch, hence setting the cam distribution between the two.

Example.

For LP1=3, it sets that cams 1 and 2 would belong to the first CamSwitch and the rest (up to 8) will belong to the second CamSwitch.

Valid values: 0 ... 8.

Default value: 0.

LP10	*	F02310	ProcessBlockMode
------	---	--------	------------------

Function: In Motion Control programs, it defines the dynamic link applied between positioning blocks not specified by the L parameter (LINK).

Valid values:

0. NULL.
1. NEXT.
2. WAIT_IN_POS.
3. PRESENT.

Default value: 0 (NULL at zero speed).

LP11	*	F02311	FeedrateOverrideLimit
------	---	--------	-----------------------

Function: It sets the maximum value for the feedrate multiplier registered in variables LV108 (S00108) Feedrate Override.

Valid values: 0 ... 250%.

Default value: 250%.

LP12	*s	F02312	PositioningVelocityDefault
------	----	--------	----------------------------

Function: In Motion Control programs, it defines the positioning feedrate applied between in motion blocks not specified by the V parameter (Velocity).

Valid values: -214 748.3647 ... 214 748.3647 m/min.

Default value: 10.0000 m/min.

LP22	*s	F02322	JogVelocity
------	----	--------	-------------

Function: It is used as value assigned to parameter V (Velocity) inside the Motion Control application (*.mc) in the JOG module. Feedrate for all the movements in (jog) mode.

Valid values: -214 748.3647 ... 214 748.3647 m/min.

Default value: 5.0000 m/min.



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LP23	*s	F02323	JogIncrementalPosition
------	----	--------	------------------------

Function: Distance moved per each movement in incremental jog mode with each up-flank of the JOG signals. It is used as the value assigned to parameter D (Distance) in the incremental JOG movements programming in the jog module of the Motion Control program.

Valid values: - 214 748.3647 ... 214 748.3647 mm (linear axes).
- 214 748.3647... 214 748.3647 degrees (rotary axes).

Default value: 1.0000 mm (linear axes), 1.0000° (rotary axes).

LP25	*	F02325	InPositionTime
------	---	--------	----------------

Function: Parameter related to the positioning blocks with L= WAIT_IN_POS. This link finishes the movement at zero speed, waits for the target position to be reached and for it to remain in that position for a time period indicated by parameter InPositionTime.

Valid values: 0 ... 65 535 ms.

Default value: 10 ms.

LP40	*	F02340	SynchronizationMode
------	---	--------	---------------------

Function: When the drive works in position, this parameter sets the type of synchronization.

Valid values:

0. Speed synchronization.
1. Position synchronization.

Default value: 1. Position synchronization.

LP41	*	F02341	SynchronizationAcceleration
------	---	--------	-----------------------------

Function: This parameter defines the synchronization acceleration and sets the maximum acceleration for the velocity and position adaptation stages from when the synchronization process begins until it is completed.

Valid values: 0.0000 ... 200.0000 m/s².

Default value: 2.0000 m/s².

LP42	*	F02342	SynchronizationVelocity
------	---	--------	-------------------------

Function: This parameter defines the synchronization speed and sets the maximum velocity for the position adaptation in position synchronization.

Valid values: 0.0000 ... 214 748.0000 m/min.

Default value: 15.0000 m/min.

LP47	*	F02347	SynchronizationTimeout
------	---	--------	------------------------

Function: This parameter sets the maximum time it can take to reach the InSynchronization status. If it takes more than this time to reach synchronization, it will issue error code **E919** of Kernel execution.

Valid values: 0 ... 2 147 483 647 ms.

Default value: 10 000 ms.

Remember that to disable the synchronization timeout, parameter "LP47 (F02347) SynchronizationTimeout" must be set to the proper maximum value (2 147 483 647).



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LP59		F02359	SynchronizationMasterSource
------	--	--------	-----------------------------

Function: This parameter may be used to select the source for the master axis position.

Valid values:

0. PV53 (S00053) PositionFeedback2.
1. LV245 (S00245) LeadDrive1AngularPosition.

Default value: 0.

LP60	Os	S00060	PosSwitch1On
LP61	Os	S00061	PosSwitch1Off

Function: When the axis is positioned within the range defined by these two parameters, output Nr 1 of the Cam-Switch will be active.

Valid values: -2 147 483 647 ... 2 147 483 647 mm (linear axes).
-2 147 483 647 ... 2 147 483 647 ° (rotary axes).

Default value: 0.

LP62	Os	S00062	PosSwitch2On
LP63	Os	S00063	PosSwitch2Off
LP64	Os	S00064	PosSwitch3On
LP65	Os	S00065	PosSwitch3Off
LP66	Os	S00066	PosSwitch4On
LP67	Os	S00067	PosSwitch4Off
LP68	Os	S00068	PosSwitch5On
LP69	Os	S00069	PosSwitch5Off
LP70	Os	S00070	PosSwitch6On
LP71	Os	S00071	PosSwitch6Off
LP72	Os	S00072	PosSwitch7On
LP73	Os	S00073	PosSwitch7Off
LP74	Os	S00074	PosSwitch8On
LP75	Os	S00075	PosSwitch8Off

Function: Same for outputs Nr 2, 3, 4, 5, 6, 7 and 8 of the Cam-Switch.

LP143.#	*O	S00393.#	ModuloCommandMode
---------	----	----------	-------------------

Function: On rotary axes and working in module format - see bit 7 of parameter **PP76**, the interpretation of the position command depends on this parameter.

Bit	Meaning
15 (MSB)...2	Reserved
1,0 (LSB)	= 00 Clockwise rotation = 01 Counterclockwise rotation = 10 Via the shortest path (by default) = 11 Reserved

Valid values: 0 ... 2.

Default value: 2.



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PARAMETERS, VARIABLES AND COMMANDS
L group. Motion Control

LP183	*	S00183	SynchronizationVelocity Window
-------	---	--------	--------------------------------

Function: This parameter sets the synchronization speed window. This way, during the speed synchronization mode, if the difference between the synchronization speed calculated for the slave axis and the velocity feedback is within this window, the InSynchronization mark (F02346) will be activated indicating that synchronization has been reached.

Valid values: 0.0000 ... 214 748.3647 m/min.

Default value: 0.3000 m/min.

LP228	*	S00228	SynchronizationPosition Window
-------	---	--------	--------------------------------

Function: This parameter sets the synchronization position window. This way, during the position synchronization mode, if the difference between the synchronization position calculated for the slave axis and the position feedback is within this window, the InSynchronization mark (F02346) will be activated indicating that synchronization has been reached.

Valid values: 0.0000 ... 214 748.3647 mm (for linear axes).
0.0000 ... 214 748.3647 ° (for rotary axes).

Default value: 1.0000 mm (linear axes), 1.0000° (rotary axes).

LP236	*s	S00236	LeadDrive1Revolutions
-------	----	--------	-----------------------

Function: This parameter defines the number of revolutions of the master axis needed to set the transmission ratio.

Valid values: -2 147 483 647 ... 214 748 3647.

Default value: 1.

LP237	*s	S00237	SlaveDriveRevolutions1
-------	----	--------	------------------------

Function: This parameter defines the number of revolutions of the slave axis needed to set the transmission ratio.

Valid values: -2 147 483 647 ... 2 147 483 647.

Default value: 1.

LV2	O	F02302	CamSwitchCompile
-----	---	--------	------------------

Function: If the ON/OFF points of any of the cams of any Cam-Switch is changed, the drive must be informed that it can then read the values of the parameters that have changed. This report is needed in order for the changes to be taken into account it is given by writing this variable with a 1 or a value other than 0. If there are no changes and it assumes the values saved in the drive, it will not be necessary to write anything onto it because the drive will do that automatically.

Valid values: 0 and 1.

Default value: 0.

LV13	W	F02313	KernelOperationMode
------	---	--------	---------------------

Function: It indicates which is the operating mode of the Kernel.

Valid values:

0. Automatic mode (by default after starting up the drive).
1. Jog mode.



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LV14	W	F02314	KernelAutoMode
------	---	--------	----------------

Function: It indicates which is the execution mode of the kernel for the automatic mode and for the jog mode.

Valid values:

0. Continuous (by default)
1. Single block
2. Instruction by instruction

LV15	W	F02315	KernelStartSignal
------	---	--------	-------------------

Function: Digital signal whose up flank (transition from 0 to 1) starts the execution of the Motion Control program in automatic or jog mode. Using the START signal to start the execution is always necessary after powering the system up or after activating the STOP or RESET signals. It is also necessary to generate an up flank of this signal to resume the execute when using the "single block" mode or the "instruction by instruction" mode.

LV16	W	F02316	KernelStopSignal
------	---	--------	------------------

Function: Digital signal whose up flank (transition from 0 to 1) momentarily interrupts the motion block and stops the motor. This signal does not complete the block, it only interrupts it so when the START, LV15 (F02315) KernelStartSignal is activated again, it goes on with the remaining portion of the block.

LV17	W	F02317	KernelResetSignal
------	---	--------	-------------------

Function: Digital signal whose up flank (transition from 0 to 1) resets the execution of the Motion Control program. This signal stops the execution, restores the initial conditions and the drive is ready waiting for a new start-up signal LV15 (F02315) KernelStartSignal.

LV18	W	F02318	KernelAbortSignal
------	---	--------	-------------------

Function: Digital signal whose up flank (transition from 0 to 1) definitely interrupts the motion block and stops the motor. This signal considers the block completed and the drive goes on executing the Motion Control program.

LV19	W	F02319	KernelManMode
------	---	--------	---------------

Function: It indicates the operating submode within the jog mode (LV13=1).

Valid values:

0. Continuous submode (by default).
1. Incremental submode.

LV20	W	F02320	JogPositiveSignal
------	---	--------	-------------------

Function: Digital signal used in the JOG module of the Motion Control application (*.mc) to activate the jog movement in the positive direction.

LV21	W	F02321	JogNegativeSignal
------	---	--------	-------------------

Function: Digital signal used in the JOG module of the Motion Control application (*.mc) to activate the jog movement in the positive direction.



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LV24		F02324	FeedrateOverrideEqualZero
------	--	--------	---------------------------

Function: Digital signal that indicates that the "Feedrate Override" value on the machine is zero and, therefore, the motor could not be moved at all.

LV26	Ws	F02326	ProgramPositionOffset
------	----	--------	-----------------------

Function: This variable may be used to set an offset with respect to the machine reference point and may be applied to absolute positioning blocks in the Motion Control program. The ZERO instruction updates (refreshes) this variable with the current position feedback value.

Valid values: - 214 748.3647 ... 214 748.3647 mm (linear axes)
- 214 748.3647 ... 214 748.3647 ° (rotary axes)

LV27		F02327	KernellInitError
------	--	--------	------------------

Function: Index that shows the exact meaning of error code E900. This error comes up when initializing the Motion Control program and appears at the drives Status Display. It cancels the system initialization process and does not allow to run the MC software.

Valid values:

0. There are no initialization errors.
1. *.MCC application not loaded into memory.
2. Wrong *.MCC application file.
3. *MCC application file too large (maximum 8 kB).
4. Using a nonexistent drive variable.
5. Too many drive variables.
6. PLC resource cannot be accessed.
7. Too many PLC marks.
8. Too many PLC registers.
9. Too many PLC counters.
10. Code checksum error.
11. Internal error when initializing the drive table.
12. Internal error when initializing variable indexes.
13. Error in synchronization parameters.

LV28		F02328	KernelExecError
------	--	--------	-----------------

Function: Variable that groups the execution errors of the Motion Control program (E901-E923). These errors are communicated through the status display of the drive. They interrupt the execution of the program but do not prevent the MC software from running, hence being possible to check values of variables and parameters.

Valid values:

0. There are no errors.
1. Division by zero (error E901 on the status display).
2. Array size exceeded (error 902, ...).
3. Excessive call nesting limit.
4. Error when writing a variable.
5. Internal error when reading a variable.
6. Internal error when writing a variable.
7. Overflow when evaluating an expression.
8. Battery overflow.
9. Low battery.
10. Overflow when calculating a position.
11. Absolute positioning without homing.

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12. An attempt has been made to write in a PLC
13. Unknown Pcode.
14. Target Position is greater than ModuleValue.
15. The path programmed for the block has exceeded the maximum value permitted.
16. Failure when executing the HOME command.
17. Position limit overrun.
18. Velocity limit overrun
19. Synchronization TimeOut.
20. Cam initializing error.
21. Cam not ready
22. Wrong Jerk value.
23. The time "ts" taken to accelerate from zero to a maximum value exceeds 255 cycles (about 1 s).

LV30	F02330	KernelExecutionState
------	--------	----------------------

Function: Variable that shows the execution status. This way, the debugging software will periodically check the value of this variable with two possible values.

Valid values:

0. Execution interrupted.
1. Execution on.

LV31	F02331	KernelExecutionPoint
------	--------	----------------------

Function: Variable that shows the execution point of the application; in other words, the line number of the source file that is being executed. When the execution is running, its value will vary; however, if it is interrupted, it will indicate the point where the execution has been interrupted.

LV32	F02332	KernelExecutionPcode
------	--------	----------------------

Function: Variable where the Pcode number being executed is returned. If the execution is interrupted, it will show where it has been interrupted.

LV33	F02333	KernelApplicationPars
------	--------	-----------------------

Function: Variable that returns the names and indexes for each user parameter used in the motion control applications loaded into the drive in that instant.

Example.

When the drive reads the LV33 variable, it returns a string of ASCII characters showing, for each user parameter, the name followed by its corresponding index in the user variable table. The separator character is the blank space, ' '.
"TABLA_POS (16) 1 TIEMPO_OUTPUT 17".

LV34	F02334	KernelApplicationVars
------	--------	-----------------------

Function: Variable that returns the names and indexes for each user variable used in the motion control application loaded into the drive in that instant.



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Example.

When the drive reads the LV34 variable, it returns a string of ASCII characters showing, for each user variable, the name followed by its corresponding index in the user variable table. The separator character is the blank space, ' '.
 "INDICE (18) CONTADOR 19 TEMP-AUX 20".

LV35	Ws	F02335	BlockTravelDistance
------	----	--------	---------------------

Function: Variable that returns the value of the total distance to travel of the current positioning block or that of the last one that has been executed if there is none in progress. Its value is updated every time it begins executing a new positioning block.

Valid values: -214 748.3647 ... 214 748.3647 mm (linear axes)
 -214 748.3647 ... 214 748.3647 ° (rotary axes).

LV36	Ws	F02336	BlockCoveredDistance
------	----	--------	----------------------

Function: Variable that returns for each given instant the total distance traveled in the current positioning block or that of the last one that has been executed if there is none in progress. Its value is updated by the interpolator in each interpolation cycle.

Valid values: - 214 748.3647 ... 214 748.3647 mm (linear axes)
 - 214 748.3647 ... 214 748.3647 ° (rotary axes).

LV43	Ws	F02343	GearRatioAdjustment
------	----	--------	---------------------

Function: The transmission ratio is given by dividing parameter LP237 (S00237) SlaveDriveRevolutions1 by LP236 (S00236) LeadDrive1Revolutions and it remains constant throughout the whole operation. This variable may be used to fine-tune the transmission ratio while the system is running.

Valid values: - 0.9999 ... 0.9999.
Default value: 0.0000.

LV44	Ws	F02344	SynchronizationVelocityOffset
------	----	--------	-------------------------------

Function: This variable may be used to set the velocity offset value and change the velocity of the slave axis independently from that of the master axis.

Valid values: - 214 748.3647 ... 214 748.3647 m/min.

LV45	Ws	F02345	SynchronizationPositionOffset
------	----	--------	-------------------------------

Function: This variable may be used to set the position offset value and change the position of the slave axis independently from that of the master axis.

Valid values: - 214 748.3647 ... 214 748.3647 mm (linear axes)
 - 214 748.3647 ... 214 748.3647 ° (rotary axes).

LV46		F02346	InSynchronization
------	--	--------	-------------------

Function: Mark that indicates whether synchronization has been reached or not. When synchronization is reached, a logic 1 is activated.

Valid values: 0 and 1.

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LV48	Ws	F02348	MasterOffset1
------	----	--------	---------------

Function: Master axis position offset. Value that is subtracted from the master axis position to calculate the entry position of table 1 of the electronic cam.

Valid values: - 214 748.3647 ... 214 748.3647 mm (linear axes)
- 214 748.3647 ... 214 748.3647 ° (rotary axes).

Default value: 0.

Version: Operative from version 06.01 on.

LV49	W	F02349	MasterScale1
------	---	--------	--------------

Function: For a cam type:

Position-position: it defines the master axis position range according to table 1 of the electronic cam.

Position-time: it defines the time range or total duration of the cam function defined in table 1 of the electronic cam.

Valid values: 0.0000 ... 214 748.3647.

Units: For a position - position type cam: in degrees.
For a position - time type cam: in seconds.

Default value: 360.0000.

Version: Operative from version 06.01 on.

LV50	Ws	F02350	SlaveOffset1
------	----	--------	--------------

Function: Slave axis position offset according to table 1 of the electronic cam.

Valid values: - 214 748.3647 ... 214 748.3647 mm (linear axes)
- 214 748.3647 ... 214 748.3647 ° (rotary axes).

Default value: 0.

Version: Operative from version 06.01 on.

LV51	W	F02351	SlaveScale1
------	---	--------	-------------

Function: Slave axis position range according to table 1 of the electronic cam.

Valid values: 0.0000 ... 214 748.3647 mm (linear axes).
0.0000 ... 214 748.3647 ° (rotary axes).

Default value: 360.0000 mm (linear axis), 360.0000° (rotary axis).

Version: Operative from version 06.01 on.

LV52	Ws	F02352	MasterOffset2
------	----	--------	---------------

Function: Master axis position offset. Value that is subtracted from the master axis position to calculate the entry position of table 2 of the electronic cam.

Valid values: - 214 748.3647 ... 214 748.3647 mm (linear axes)
- 214 748.3647 ... 214 748.3647 ° (rotary axes).

Default value: 0.0000.

Version: Operative from version 06.01 on.



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LV53	W	F02353	MasterScale2
------	---	--------	--------------

Function: For a cam type:

Position-position: it defines the master axis position range according to table 2 of the electronic cam.

Position-time: it defines the time range or total duration of the cam function defined in table 2 of the electronic cam.

Valid values: 0.0000 ... 214 748.3647.

Units: For a position - position type cam: in degrees.
For a position - time type cam: in seconds.

Default value: 360.0000.

Version: Operative from version 06.01 on.

LV54	Ws	F02354	SlaveOffset2
------	----	--------	--------------

Function: Slave axis position offset according to table 2 of the electronic cam.

Valid values: - 214 748.3647 ... 214 748.3647 mm (linear axes)
- 214 748.3647 ... 214 748.3647 ° (rotary axes).

Default value: 0.0000.

Version: Operative from version 06.01 on.

LV55	W	F02355	SlaveScale2
------	---	--------	-------------

Function: Slave axis position range according to table 2 of the electronic cam.

Valid values: 0.0000 ... 214 748.3647 mm (linear axes).
0.0000 ... 214 748.3647 ° (rotary axes).

Default value: 360.0000 mm (linear axis), 360.0000 ° (rotary axis).

Version: Operative from version 06.01 on.

LV108	W	S00108	FeedrateOverride
-------	---	--------	------------------

Function: Multiplying factor applied to the positioning speed in all programmed movements. The value that this variable can take is limited by parameter LP11 (F02311) Feedrate OverrideLimit. In any case, the velocity will be limited to the value given by SP10 (S00091) VelocityLimit.

Valid values: It varies between 0% and the value indicated by LP11 (F02311) Feedrate OverrideLimit.

LV158	Ws	S00258	TargetPosition
-------	----	--------	----------------

Function: Final position for the current positioning block. Note that in the current operating mode, the final position specified in the MOVE instruction being executed is copied to the LV158 (S00258) TargetPosition.

Valid values: - 214 748.3647 ... 214 748.3647 mm (linear axes)
- 214 748.3647 ... 214 748.3647 ° (rotary axes).

LV159	W	S00259	PositioningVelocity
-------	---	--------	---------------------

Function: Maximum positioning speed for the current positioning block (in module). Note that in the current operating mode, the positioning speed specified in the MOVE instruction being executed is copied to the LV159 (S00259) PositioningVelocity variable.

Valid values: 0.0000 ... 214 748.3647 m/min.

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LV160	W	S00260	PositioningAcceleration
-------	---	--------	-------------------------

Function: Maximum acceleration applied to all the positioning blocks (in module). See the note of LV193.
Valid values: 0.0010 ... 200.0000 m/s².
Version: Modified in software version 06.18.

LV193	O	S00193	PositioningJerk
-------	---	--------	-----------------

Function: Maximum jerk limit for all the positioning blocks (in module).
Valid values: 0.0500 ... 1 000.0000 m/s³.
Default value: 0.0000 (jerk cancellation).

Note that for LV160 values < 0.0500 m/s², the LV193 variable is set to zero automatically to minimize positioning errors. There is also a time limit, $t_s=255$ cycles (approx. 1 s) to reach the acceleration and, therefore, no combination of acceleration and jerk is admitted. Error code E923 is issued when exceeding the t_s limit value. Certain combinations of acceleration and jerk values may cause small overshooting errors that will be considered admissible.

Version: Modified in software version 06.18.

LV215		S00315	PositioningVelocityGreaterLimit
-------	--	--------	---------------------------------

Function: Mark that activates when the positioning speed programmed for the current positioning block exceeds the limit given by SP10 (S00091) VelocityLimit.
Valid values: 0 and 1.

LV223		S00323	TargetPositionOutsideOfTravelRange
-------	--	--------	------------------------------------

Function: Mark that activates when the target position indicated in the current positioning block is off the position limits given by parameter PP49 (S00049) PositivePositionLimit or PP50 (S00050) NegativePositionLimit.
Valid values: 0 and 1.

LV242		S00342	TargetPositionAttained
-------	--	--------	------------------------

Function: Mark indicating that the interpolator has reached the target position; in other words, it is activated when the position command PV47 (S00047) PositionCommand reaches LV158 (S00258) TargetPosition.
Valid values: 0 and 1.

LV243		S00343	InterpolatorHalted
-------	--	--------	--------------------

Function: Marks that indicates that the interpolation has stopped (the position command does not vary); but the current operating block has not been completed.
Valid values: 0 and 1.

LV245	Ws	S00245	LoadDrive1AngularPosition
-------	----	--------	---------------------------

Function: Variable that may be used to know the absolute position of the master axis with respect to the reference point of the slave axis.
Valid values: - 214748.3647...214748.3647 mm (for linear axes)
 - 214748.3647...214748.3647 ° (rotary axes).

LC1		F02300	BackupMCPAr
-----	--	--------	-------------

Function: Motion control parameter backup.



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13.2.12 M group. Motor

MP1.#	O	S00141.#	MotorType
-------	---	----------	-----------

Function: Motor identification and initialization. Assigning to this parameter a reference indicating a particular motor - see chapter 12 of the "dds-hardware" - sets the motor governing parameters. See section: "Motor identification" in chapter 2 of this manual.

To govern a user motor (non-Fagor motor) or to modify any of these M parameters, the value given to MP1 must start with the character 0 (e.g. 0supermotor).

Valid values: The references appearing in chapter 12 of the "dds-hardware" manual for motors.

Version: Modified in software version 06.10.

MP2	FMS	F01200	MotorTorqueConstant
-----	-----	--------	---------------------

Function: Torque constant of the synchronous motor, (motor torque according to the rms current).

Valid values: 0.1 ... 1 000.0 Nm/Arms.

MP3.#	FM	S00111.#	MotorContinuousStallCurrent
-------	----	----------	-----------------------------

Function: Stall current. On asynchronous motors, this current is the same as the rated current of the motor. They are different on synchronous motors.

Valid values: 0.0 ... 200.0 Arms. Depends on the motor connected.

Version: Modified in software version 06.10.

MP4	FMS	S00109	MotorPeakCurrent
-----	-----	--------	------------------

Function: Peak current of the synchronous motor. This current value must NEVER be exceeded in the motor.

Valid values: 0.1 ... 300.0 Arms. Depends on the motor connected.

MP5.#	FM	F01201.#	MotorPolesPairs
-------	----	----------	-----------------

Function: Number of pairs of poles.

Valid values: 0 ... 99. (Integer number).

Version: Modified in software version 06.18.

MP6.#	FM	F01202.#	MotorRatedSupplyVoltage
-------	----	----------	-------------------------

Function: Rated motor voltage.

Valid values: 0 ... 460 V.

Note that for a synchronous motor, this parameter is just for information purposes, **it is not used in the control.**

Version: Modified in software version 06.10.

MP7.#	FMA	F01203.#	MotorPowerFactor
-------	-----	----------	------------------

Function: Power factor of the asynchronous motor.

Valid values: 0.000 ... 0.999.

Version: Modified in software version 06.10.

MP9.#	FMA	F01205.#	MotorSlip
-------	-----	----------	-----------

Function: Slip of the asynchronous motor.

Valid values: 0.0 ... 6 000.0 rpm.

Version: Modified in software version 06.10.

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PARAMETERS, VARIABLES AND COMMANDS
M group. Motor

MP10.#	FM	F01206.#	MotorStatorResistance
--------	----	----------	-----------------------

Function: Phase-neuter resistance of the stator at 20 °C.
Valid values: 0.000 ... 10 000.000 Ω.
Version: Modified in software version 06.10.

MP11.#	FM	F01207.#	MotorStatorLeakageInductance
--------	----	----------	------------------------------

Function: Phase-neuter leak inductance of the stator of an asynchronous motor.

Note that for a synchronous motor, this parameter represents the inductance of the motor stator and not the leak inductance because leak inductance is not applicable to these motors.

Valid values: 0.0000 ... 10 000.0000 mH.
Version: Modified in software version 06.10.

MP12.#	FM	F01208.#	MotorNominalPower
--------	----	----------	-------------------

Function: Rated power.
Valid values: 0.0 ... 200.0 kW.
Version: Modified in software version 06.10.

MP13	FM	F01209	MotorThermalTimeConstant
------	----	--------	--------------------------

Function: Thermal time constant of the motor.
Valid values: 1 ... 200 min.

MP14	FM	F01210	MotorTempSensorType
------	----	--------	---------------------

Function: Identifies the motor temperature sensor.
 On Fagor motors

- Valid values:**
- | |
|-----------------------------------------------------------------------|
| 0. Sensor incorporated on SPM and FXM motors overtemperature (yes/no) |
| 1. Sensor incorporated on AXM motors |
| 2. Sensor incorporated on FKM, FM9 (KTY84-130) motors |
| 3. Sensor incorporated on FM7 motors |
| 4. Sensorless |

On non-Fagor motors

5. Sensor incorporated on user motors. See section "User motor with linear temperature sensor" in chapter 10 of this manual.

Version: Modified in software version 06.15.

MP15	FM	F01211	MotorShaft
------	----	--------	------------

Function: It offers information on the type of axis installed at the motor.

Valid values:

On FXM motors: MP15=0 (the shaft has a standard keyway). MP15=1 (the shaft has no keyway)

On SPM motors: MP15=0 (normal shaft) MP15=1 (shaft sealed against oil from the gear box) MP15=2 ... 9 (special shaft upon request)

On FM7 motors: MP15=0 (the shaft has a standard keyway). MP15=1 (the shaft has no keyway)

This parameter is set during the motor identification process.



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MP16	FM	F01212	MotorBrake
------	----	--------	------------

Function: This parameter determines whether the motor has a brake or not.

Valid values:

0. It does not have a brake.
1. It has a brake.

This parameter only applies to synchronous motors since none of the asynchronous motor models have a brake.
This parameter is set during the motor identification process.

MP17	FMS	F01213	MotorFan
------	-----	--------	----------

Function: This parameter determines whether the motor has a fan or not.

Valid values:

0. It does not have a fan.
1. It has a fan.

This parameter only applies to synchronous motors since all the asynchronous motor models have a fan.
This parameter is set during the motor identification process.

MP18	FMA	F01214	MotorMounting
------	-----	--------	---------------

Function: This parameter indicates how the motor is mounted. The bearings of this motor are designed for this type of mounting.

Valid values:

On SPM motors: MP18=0 (horizontal IM B3/B5). MP18=1 (vertical with shaft facing down IM V1/V5). MP18=2 (vertical with shaft facing up IM V3/V6).
On FM7 motors: MP18=3 Regardless of the mounting method.

This parameter is set during the motor identification process.

MP19	FMA	F01215	MotorBalancing
------	-----	--------	----------------

Function: It indicates the balancing degree of the motor.

Valid values:

On SPM motors: MP19=0 (standard balancing degree "S"). MP19=1 (balancing degree "SR").
On FM7 motors: MP19=2 (balancing degree "V10"). MP19=3 (balancing degree "V5"). MP19=4 (balancing degree "V3").

This parameter is set during the motor identification process.

MP20	FMA	F01216	MotorBearings
------	-----	--------	---------------

Function: This parameter indicates the type of bearings.

Valid values:

On SPM motors: MP20=0 (Normal bearings). MP20=1 (high speed bearings).
On FM7 motors: MP21=1 (always).

This parameter is set during the motor identification process.

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PARAMETERS, VARIABLES AND COMMANDS
M group. Motor



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PARAMETERS, VARIABLES AND COMMANDS
M group. Motor

MP21	FM	F01217	MotorPhasesOrder
------	----	--------	------------------

Function: Power phase inversion.

Valid values:

On SPM motors: MP21=0 (always).
On FM7, FXM, FKM motors MP21=1 (inverts the phases).

This parameter is set during the motor identification process.

Default value: 0.

Version: Modified in software version 06.23.

MP23.#	FMA	F01219.#	MotorCircuitConnection
--------	-----	----------	------------------------

Function: Winding connection type in FM7 motors, series E03 and HS3.

Valid values: 0/1 Y (star) / Delta (triangle).

Default value: 0. Star (Y).

Version: Operative from version 06.18 on.

MP24	FM	F01220	MotorMomentumOfInertia
------	----	--------	------------------------

Function: Motor inertia.

Valid values: 0.1 ... 100 000.0 kg/cm².

Default value: 1.0 kg/cm².

MP25.#	FM	F01221.#	MotorRatedSpeed
--------	----	----------	-----------------

Function:

Synchronous: Rated speed. Asynchronous: Base speed. Over this speed, it is in the constant power zone.

Valid values:

Synchronous: MP25 must be lower than SP10, otherwise, error code E500 will come up. Asynchronous: MP25 must be lower than MP26.

Version: Modified in software version 06.10.

MP26	FM	F01222	MotorMaximumSpeed
------	----	--------	-------------------

Function: Maximum motor speed.

Valid values:

MP26 must be equal to or greater than SP10, otherwise, error code E500 will come up.

Version: Operative from version 06.01 on.
Modified in software version 06.10.

MP27.#	FMA	F01223.#	MotorRotorResistance
--------	-----	----------	----------------------

Function: Phase-neuter resistance of the rotor at 20°C.

Valid values: 0.000 ... 10 000.000 Ω.

Default value: 0.000 Ω.

Version: Operative from version 06.01 on.
Modified in software version 06.10.

MP28.#	FMA	F01224.#	MotorRotorLeakageInductance
--------	-----	----------	-----------------------------

Function: Phase-neuter leak inductance of the rotor.

Valid values: 0.0000 ... 10 000.0000 mH.

Default value: 0.0000 mH.

Version: Operative from version 06.01 on.
Modified in software version 06.10.



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MP29.#	FMA	F01225.#	MotorMagnetizingInductance
--------	-----	----------	----------------------------

Function: Magnetizing inductance.
Valid values: 0.0000 ... 10 000.0000 mH.
Default value: 0.0000 mH.
Version: Operative from version 06.01 on.
 Modified in software version 06.10.

MP30.#	FMA	F01226.#	MotorInductanceFactor1
MP31.#	FMA	F01227.#	MotorInductanceFactor2
MP32.#	FMA	F01228.#	MotorInductanceFactor3
MP33.#	FMA	F01229.#	MotorInductanceFactor4
MP34.#	FMA	F01230.#	MotorInductanceFactor5
MP35.#	FMA	F01231.#	MotorInductanceFactor6
MP36.#	FMA	F01232.#	MotorInductanceFactor7
MP37.#	FMA	F01233.#	MotorInductanceFactor8
MP38.#	FMA	F01234.#	MotorInductanceFactor9

Function Values of the magnetic saturation curve of the stator iron.
Valid values: 0.1 ... 100.0%.
Default value 100% (for MP30, MP31, MP32, MP33, MP34)
 90% (for MP35), 80% (for MP36), 70% (for MP37) and 60% (for MP38).
Version: Operative from version 06.01 on.
 Modified in software version 06.10.

For further detail, see **FIGURE S11.4** of section "setup of an asynchronous spindle" of chapter 11 in this manual.

MP39.#	FM	F01235.#	MotorNoLoadCurrent
--------	----	----------	--------------------

Function: Motor rms current without load.
Valid values: 0.0 ... 200.0 Arms.
Default value: 0.0 Arms.
Version: Operative from version 06.01 on.
 Modified in software version 06.10.

MP40.#	FMA	F01236.#	MotorNoLoadVoltage
--------	-----	----------	--------------------

Function: Motor phase-phase rms voltage without load.
Valid values: 0 ... 460 Vrms.
Default value: 0 Vrms.
Version: Operative from version 06.01 on.
 Modified in software version 06.10.

MP41	FM	F01237	MotorMaximumTemperature
------	----	--------	-------------------------

Function: It sets the maximum temperature for the motor. A zero value in this parameter means that the temperature limit will not be checked.
Valid values: 0.0 ... 500.0 °C.
Default value: 145.0 °C (for user motors).
 Value given by its corresponding motor table (for FXM, FKM, AXM, SPM, FM7 and FM9 motors).

Warning. Do not modify the value of this parameter given by the FXM and FKM motor tables (*.mot files)

Version: Modified from software version 06.03 on

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PARAMETERS, VARIABLES AND COMMANDS
M group. Motor



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PARAMETERS, VARIABLES AND COMMANDS
M group. Motor

MP42	FMS	F01239	Starting SpeedForFieldweakening
------	-----	--------	---------------------------------

Function: Speed at which a synchronous motor working as spindle motor will begin increasing its magnetic field or magnetic flux".

Valid values: 10 ... 60 100 rpm.

Default value: 10 rpm.

Version: Operative from version 06.10 on.

MP43	FMS	F01240	Ke_VoltageConstant
------	-----	--------	--------------------

Function: BEMF (in volts) generated between each pair of phases of the stator winding per every 1000 rpm of the motor. This parameter is used to reduce the magnetic flux on synchronous spindle motors. If MP43=0, the magnetic flux will not be reduced.

Valid values: 0 ... 400 V/(1000 rpm).

Default value: 0 V.

Version: Operative from version 06.10 on.

MP44.#	FM	F01241.#	MotorContinuousStallTorque
--------	----	----------	----------------------------

Function: Motor stall torque.

Valid values: 0.0 ... 3200.0 Nm.

Default value: 0.0 Nm.

Version: Operative from version 06.14 on.
Modified in software version 06.18.

MP45	FM	F01242	MotorTempSensorR25
------	----	--------	--------------------

Function: Resistance value at 25°C (77°F) for a linear sensor (MP14=5) incorporated in a motor. Obtain this data from the curve supplied by the manufacturer of the sensor.

Valid values: 0.0 ... 1 000 000.0 Ω.

Default value: 60.3 Ω.

Version: Operative from version 06.15 on.

See section "User motor with linear temperature sensor" in chapter 10 of this manual.

MP46	FM	F01243	MotorTempSensorR_MP41
------	----	--------	-----------------------

Function: Resistance value for a maximum temperature established for the motor (set in MP41) for a linear sensor (MP14=5) incorporated in a motor. Obtain this data from the curve supplied by the manufacturer of the sensor.

Valid values: 0.0 ... 1 000 000.0 Ω.

Default value: 129.8 Ω.

Version: Operative from version 06.15 on.

See section "User motor with linear temperature sensor" in chapter 10 of this manual.



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MP50	OM	F01282	SynchronousAsynchronous
------	----	--------	-------------------------

Function: It determines whether the motor being governed by the drive is synchronous or asynchronous.

Valid values:

Synchronous: MP50=0
Asynchronous: MP50=1

Default value:

MP50=0 on AXD and ACD drives
MP50=1 on SPD and SCDdrives

Version: Operative from version 06.10 on.

MC1	OA	F01238	MotorElectricalParameters Identification
-----	----	--------	---------------------------------------------

Function: After executing this command, it will identify the values of the resistance, inductance, the motor's saturation curve and rms current without load specified in the following parameters:

- MP10.** MotorStatorResistance
- MP11.** MotorStatorLeakageInductance
- MP27.** MotorRotorResistance
- MP28.** MotorRotorLeakageInductance
- MP29.** MotorMagnetizingInductance
- MP30.** MotorInductanceFactor1
- MP31.** MotorInductanceFactor2
- MP32.** MotorInductanceFactor3
- MP33.** MotorInductanceFactor4
- MP34.** MotorInductanceFactor5
- MP35.** MotorInductanceFactor6
- MP36.** MotorInductanceFactor7
- MP37.** MotorInductanceFactor8
- MP38.** MotorInductanceFactor9
- MP39.** MotorNoLoadCurrent

See section: For further detail, see section: "Setup of an asynchronous spindle" of chapter 11 in this manual.

Version: Operative from version 06.08 on.

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PARAMETERS, VARIABLES AND COMMANDS
M group. Motor



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13.2.13 N group. Mechanics

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NP1	*OM	F02200	ReducedActuatedMomentumOf InertiaPercentage
-----	-----	--------	---------------------------------------------

Function Parameter that shows the relationship between the load inertia and that of the motor rotor. To calculate this ratio, bear in mind the mechanical transmission ratio between the load movement and the motor rotation.

This parameter is a required for internally managing the acceleration feed-forward in the position loop.

Valid values: 0.00 ... 1 000.00%.

Default value: 0.00%.

NP116	O	S00116	ResolutionOfFeedback1
-------	---	--------	-----------------------

Function: Resolution of the linear motor feedback (connector X4).
If the motor feedback is a resolver with a pair of poles, after setting GP2=1, automatically by default, NP116 sets to 1.
If the number of pairs of poles of the resolver is other than 1 (e.g.: there are 3), MP1 will be set as user motor, GP2=1 and NP116 =3.

Valid values: 1 ... 131 072.

Default value: 1024 pulses per turn.

Version: Operative from version 06.01 on.
Expanded in software version 06.05.

NP117	O	S00117	ResolutionOfFeedback2
-------	---	--------	-----------------------

Function: Resolution of the linear direct feedback (connector X3).
With a linear encoder. Grading pitch of the glass or steel tape in μm . For FAGOR models, it may be 20, 40 or 100 μm , depending on model. **With rotary encoder.** Number of pulses per turn. For further detail, see section "[Feedback with reference marks and distance-coded reference marks](#)" of chapter 5 of this manual.

Valid values: 1 ... 2 147 483 647.

Default value: 2048 pulses per turn of the rotary encoder.

NP118	O	S00118	ResolutionOfLinearFeedback
-------	---	--------	----------------------------

Function: Signal period of the linear encoder used as direct feedback. **Important note.** Not necessary to set it when using a rotary encoder; i.e, it is ignored.
The signal period of the linear encoder is set in μm . Its value will result from: NP117 / Multiplying factor.
Refer to the table in section "[Feedback with reference marks and distance-coded reference marks](#)" in chapter 5 of this manual for the multiplying factor corresponding to the FAGOR linear encoder being installed.

Valid values: 0.1 ... 50 000.0.

Default value: 20.0.



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NP121.#	O	S00121.#	InputRevolutions
NP122.#	O	S00122.#	OutputRevolutions

Function: They define the gear ratio between the motor shaft and the final axis moved by the machine. E.g.: If when the motor shaft turns 5 times, the machine leadscrew turns 3 times, the parameters will show the following values:

NP121=5 and NP122=3

Valid values: 1 ... 32 767.

Default value: 1 turn in both parameters (direct coupling).

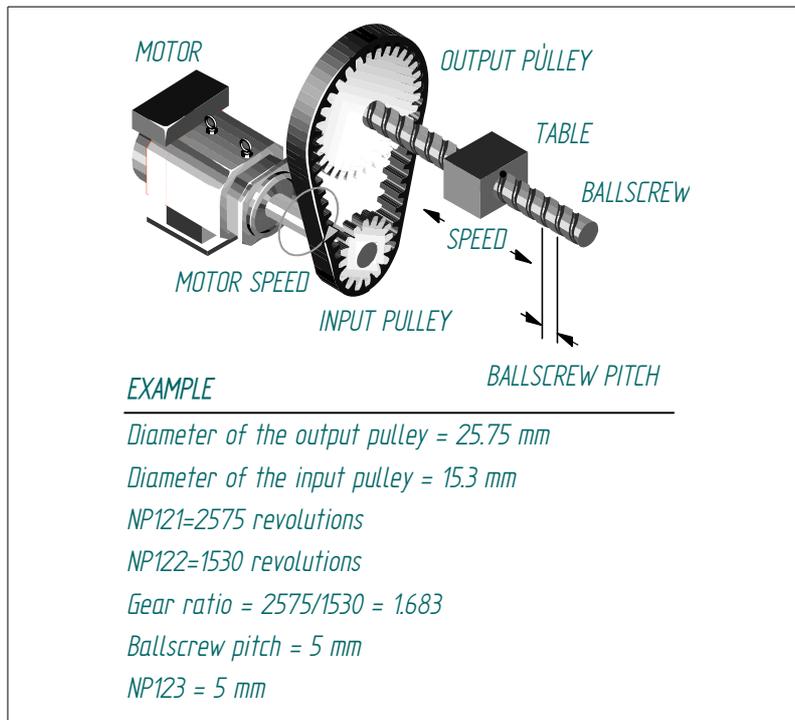


FIGURE S13.8

Gear ratio between the motor shaft and the ballscrew of the machine.

NP123	O	S00123	FeedConstant
-------	---	--------	--------------

Function: It defines the gear ratio between the linear movement of the machine and the axis moving it. E.g.: if the table moves 4 mm for every turn of the leadscrew, this parameter must be set (NP123=4). For a rotary axis (NP123=360), which means 360° per turn.

Valid values: 0.1000 ... 214 748.3647 mm (linear axes).
 0.1000 ... 214 748.3647 degrees (rotary axes)

Default value: 10.0000 mm (linear) or 10.0000 ° per turn (rotary).

NP131.#	O	F00130.#	InputRevolutions2
NP132.#	O	F00131.#	OutputRevolutions2

Function: They define the gear ratio between the direct feedback and the movement of the load. e. g.: If 5 turns of the encoder shaft of the direct feedback are due to 3 turns of the machine leadscrew, the values of these parameters must be:

NP131=5 and NP132=3

Valid values: 1 ... 32 767.

Default value: 1 turn in both parameters (direct coupling).

13.

PARAMETERS, VARIABLES AND COMMANDS

N group. Mechanics



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PARAMETERS, VARIABLES AND COMMANDS
N group. Mechanics

NP133	O	F00132	FeedConstant2
-------	---	--------	---------------

Function: It defines the lineal displacement per each turn of the direct feedback encoder. Hence, for:

Rotary machines: This parameter is not applicable.

Linear Machines with direct feedback (GP10 ≠ 0), rotary (PP115, bit 0 = 0) and linear scaling (PP76, bits 1,0 = 01), then if:

R1 = R2 the linear movement versus the encoder turns is the same and NP133 = value of the mechanical leadscrew pitch.

R1 ≠ R2 the linear movement per encoder turn is not the same and NP133 must be set so the direct feedback is set properly.

Valid values: 0.0000 ... 214 748.3647 mm (linear axes)
0.0000 ... 214 748.3647 degrees (rotary axes).

Default value: 10.0000 mm (linear) or 10.0000° per turn (rotary).

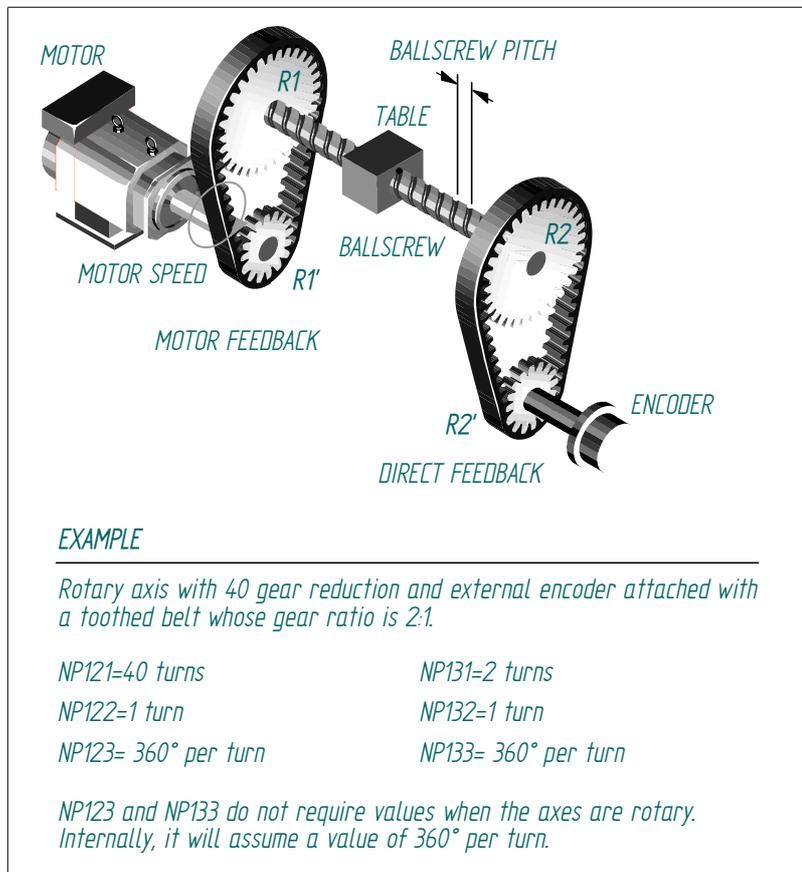


FIGURE S13.9

Lineal movement of the axis per revolution of the direct feedback encoder.

Version: Modified from software version 06.02 on

Example 1.

Motor drive with toothed belt and external encoder attached to the leadscrew. Gear ratio 2:1 Ballscrew pitch: 10 mm.

NP121=2	NP122=1	NP123=10
NP131=1	NP132=1	NP133=10



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Example 2.

In a Motion Control application (cylindrical rollers) with measuring wheel.

NP121=5	NP122=2	NP123=100
NP131=1	NP132=1	NP133=314.15



When updating the version, NP133 will assume the value that NP123 had before the installation. When setting machine up, set NP133 with the pitch value of the mechanical leadscrew.

NP165	*O	S00165	DistanceCodedReference Dimension1
-------	----	--------	--------------------------------------

Function: When the linear feedback device has distance-coded reference marks (I0), this parameter indicates the gap between **two consecutive distance-coded reference marks (I0)**. See chapter 5, section: "Linear feedback with distance coded reference marks" of this manual.

Valid values: 1 ... 2 147 483 647.

Default value: 1 001.

Version: Modified in software version 06.10.

NP166	*O	S00166	DistanceCodedReference Dimension2
-------	----	--------	--------------------------------------

Function: Whether the linear feedback **has distance-coded reference marks or not**, this parameter indicates the gap between **two consecutive I0's**; in other words, the number of full waves of the incremental signal between I0's.

Examples 1 and 2 of section: "Feedback with reference marks I0 - subsection: Setting of NP166" in chapter 5 of this manual describes in detail which values must be used to set NP166.

Important. Note that NP166 **must be set whether distance-coded I0's are used or not**, as long as I0's are being used. The drive uses it internally to test the gap between I0's generating error code **E253** if no I0 is detected in two turns.

Valid values: 1 ... 2 147 483 647.

Default value: 1 000.

Version: Modified in software version 06.10.

13.2.14 O group. Analog and digital outputs

13.

PARAMETERS, VARIABLES AND COMMANDS
O group. Analog and digital outputs

OP1	*O	F01400	DA1IDN
OP2	*O	F01401	DA2IDN

Function: They identify the internal analog variables of the drive that will be reflected at the electrical outputs and will be affected by the OP3 and OP4 gains respectively. Channel 1 (pins 10-11 of X7) and channel 2 (pins 8-9 of X7). Set OP1 and/or OP2 to a value of "0" to allow forcing the value of the electrical signals using variables OV1 and/or OV2.

Valid values: Name of any parameter or variable.

Default value: SV1 for OP1 and SV2 for OP2.

OP3	*Os	F01402	DA1ValuePer10Volt
OP4	*Os	F01403	DA2ValuePer10Volt

Function: They define the gains of channel 1 (pins 10 - 11 of X7) and channel 2 (pins 8-9 of X7). These gains are given through the value of the variable corresponding to 10V at the output.

Units: Those of the variable being displayed.

Valid values: -2 147 483 647 ... 2 147 483 647.

Default value: 1 000.

Important note. With version 06.15 or later, when programming OP1=SV2, OP2=SV1, both OP3 and OP4 must be set in internal units, i.e. in decimals. This is because from version 06.15 on, SV1 and SV2 are 32-bit variables.

Example.

Being OP1=SV2 (VelocityFeedback in 10^4 rpm) and OP3=3000x 10^4 . This means that when SV2 = 3000x 10^4 rpm, the analog output will be 10 V at pins 10 - 11 of X7. It will keep this (10^4 rpm)/volt ratio for the whole ± 10 V range.

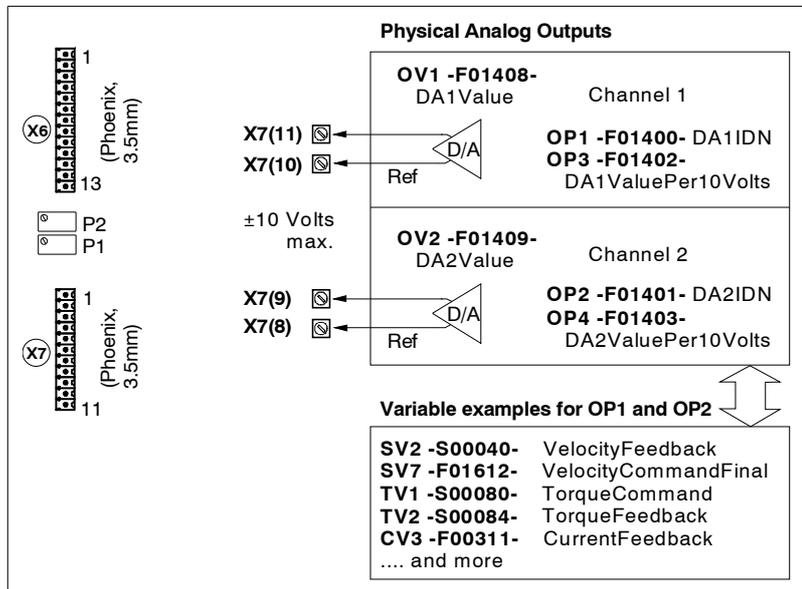


FIGURE S13.10

Using those parameters.



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OP5	O	F01411	Prog_OutIDN
-----	---	--------	-------------

Function: It identifies the Boolean variable represented at the digital Prog_OUT output of the compact drive (pins 8-9 of connector X2).

Default value: 0 (unassigned). In this situation, Prog_Out may be forced using OV5.

Example.

OP5 = TV100 (the contact closes when there is torque).

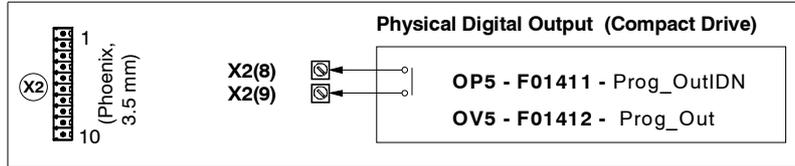


FIGURE S13.11

Using this parameter.

OP10	O	F01404	O1IDN
OP11	O	F01405	O2IDN
OP12	O	F01406	O3IDN
OP13	O	F01407	O4IDN

Function: It identifies the Boolean variables of the system that will be represented at the digital outputs 1, 2, 3 and 4 at pins (6, 7), (8, 9), (10, 11) and (12, 13) of connector X6.

Units: Name of the parameter or variable to be displayed, as long as it is Boolean.

Default value: 0 (unassigned).

Example.

OP11=TV100 (the contact between pins 8 and 9 closes when there is torque).

OV1	Os	F01408	DA1Value
OV2	Os	F01409	DA2Value

Function: These variables may be used to force the value of the electrical signal at the analog outputs of connector X7. These signals can only be forced when these outputs (OP1, OP2) have been assigned a value of 0.

OV1 reflects the value of the output through channel 1 (pins 11 and 10 of connector X7).

OV2 reflects the value of the output through channel 2 (pins 9 and 8 of connector X7).

Valid values: - 10.000 ... 10.000 V.

Example.

Being OP1=0, set OV1=2 and there will be 2 V between pins 11 and 10 of X7.



Note that reading these variables makes no sense.

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PARAMETERS, VARIABLES AND COMMANDS
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PARAMETERS, VARIABLES AND COMMANDS
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OV5	O	F01412	Prog_Out
-----	---	--------	----------

Function: The OV5 variable contains the binary data that represents the output status Prog_OUT of the compact drive with work modes:

In read mode:
Value of the digital output Prog_OUT.

In write mode:
Value that output is forced to if OP5 does not have any function assigned to it (OP5 = 0).

Valid values: 0 and 1.

Example.

It reads OV5=1 being OP5=TV100. It means that there is torque. Writing OV5 = 1 while OP5 = 0 closes the Prog_OUT contact.

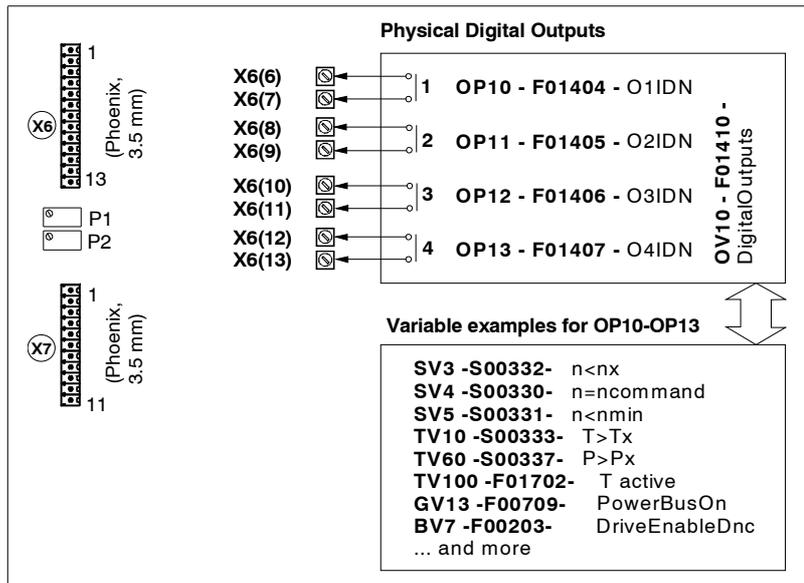


FIGURE S13.12

Using these variables.

OV10	O	F01410	DigitalOutputs
------	---	--------	----------------

Function: Variable OV10 contains a number whose binary code represents the status of the digital outputs of slot SL1.

If slot SL1 is occupied by connectors X6 and X7, these outputs are the ones associated with parameters OP10-OP13. At the PLC, these outputs represent resources O1-O4.

if slot SL1 is occupied by one of the input/output cards (16DI-8DO, 8DI-16DO), OV10, they represent PLC resources O1-O16.

In read mode:
Value of the digital outputs.

In write mode:
Values use to force the digital outputs that do not functions associated by the parameters OP10 - OP13.

Valid values: 0 ... 655 353.

Default value: 0 (unassigned).



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Example.

Read in OV10=11 (1011 in binary). It means that outputs 1, 2 and 4 of connector X6 are activated and output 3 is inactive. Contacts (6, 7), (8, 9) and (12, 13) will be closed and contact (10, 11) will be open.

Writing this same data, forces these positions to the contacts if nothing has been assigned to OP10-OP13.

OV11	O	F01413	DigitalOutputsCh2
------	---	--------	-------------------

Function: Variable OV11 contains a number whose binary code represents the status of the digital outputs of slot SL2.

At the PLC, the value of OV11 refers to resources O17-O32.

In read mode:
Value of the digital outputs.

In write mode:
Values that the digital outputs are forced to.

Valid values: 0 ... 65 535.

Default value: 0 (unassigned).

Example.

Read in OV11=35 (00100011 in binary). Means that resources O17, O18 and O22 are active and the rest inactive.

Writing this same data, forces the activation or deactivation of these resources.

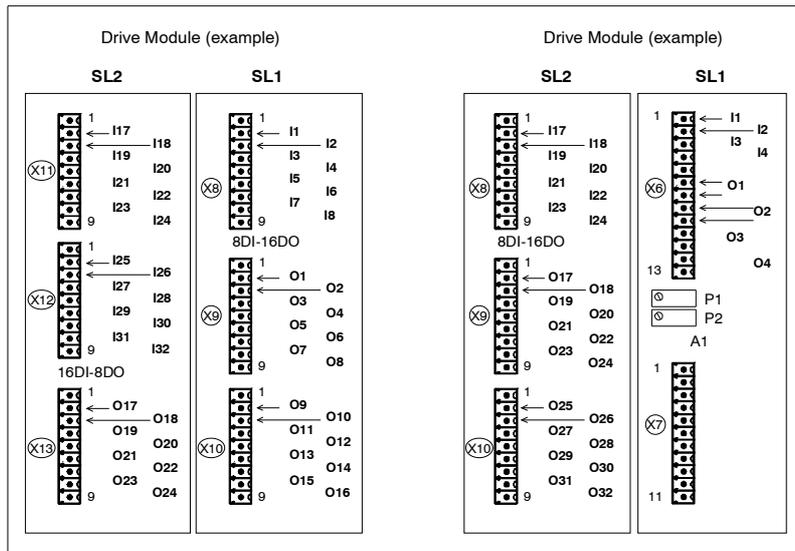


FIGURE S13.13

Digital inputs and outputs associated with the connectors of the boards located in slots SL1 and SL2.

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PARAMETERS, VARIABLES AND COMMANDS
O group. Analog and digital outputs



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13.2.15 P group. Position loop

13.

PARAMETERS, VARIABLES AND COMMANDS
P group. Position loop

PP1.#	O	F01300.#	HomingVelocitySlow
-------	---	----------	--------------------

Function: It is the slow speed of the homing process controlled from the drive itself. It is necessary when the home search is controlled from the drive. PC148 (S00148) DriveControlledHoming active.

Valid values: 0.0000 ... 214 748.3647 rpm of the motor.

Default value: 100.0000 rpm of the motor.

PP2	*Os	F01301	BacklashPeakAmplitude
-----	-----	--------	-----------------------

Function: **Amplitude** of the additional pulse provided internally by the drive to the velocity command to make up for the backlash of the load-leadscrew in movement reversals. Applicable in configurations with position control and direct feedback.

Units: Those of the variable being displayed.

Valid values: - 1 000.0000 ... 1 000.0000 rpm of the motor.

Default value: 0.0000 rpm.

PP3	*O	F01302	BacklashPeakTime
-----	----	--------	------------------

Function: **Duration** of the additional pulse provided internally by the drive to the velocity command to make up for the backlash of the load-leadscrew in movement reversals. Applicable in configurations with position control and direct feedback.

Valid values: 0 ... 100 ms.

Default value: 0.

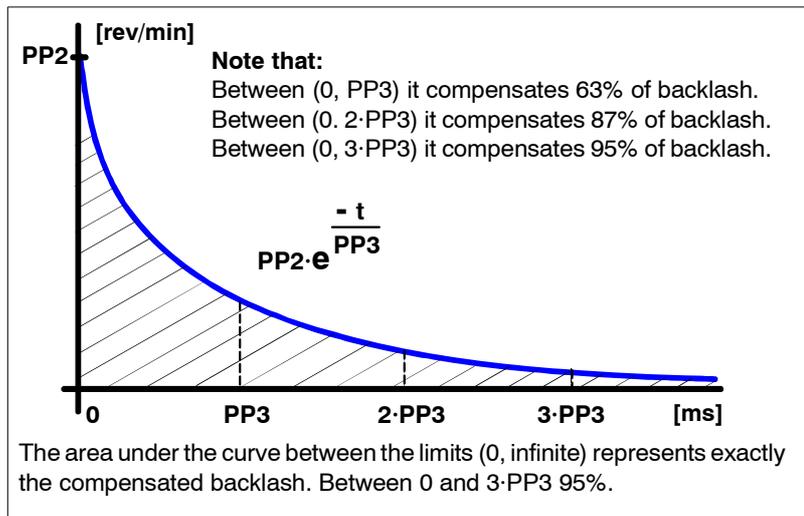


FIGURE S13.14

Compensation of backlash due to a reversal peak when reversing the moving direction.

PP4		S00299	HomingSwitchOffset
-----	--	--------	--------------------

Function: Distance that the home switch must be shifted (by software) to avoid reference mark repeatability problems when searching home. See the **GC6** command.

Valid values: 0.0000 ... 214 748.3647 mm (linear axes)

0.0000 ... 214 748.3647 ° (rotary axes)

Default value: 0.0000.

Version: Operative from version 06.02 on.



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PP5	Os	S00391	Actual PositionMonitoringWindow
-----	----	--------	------------------------------------

Function: Maximum error allowed between the motor feedback and the direct feedback. This way, when comparing the value of the direct position feedback (this difference may be viewed in PV190), if its deviation exceeds the value set in this parameter PP5 for more than 20 ms, the drive issues error **E157 ExcessiveActual Position-Difference - DV11 (S00011), bit 11 -**.

Its purpose is to offer an additional safety margin in applications that use an external measuring system. Therefore, it is recommended to set it with a value other than zero when using external square-wave feedback because there are no other monitoring systems for this case.

If PP5=0, The error will not be monitored.

Valid values: - 0.0001 ... 214 748.3647 mm (for linear axes)
- 0.0001 ... 214 748.3647 ° (rotary axes)

Default value: 0.0000 (there is no error monitoring).

Note that from version 06.09. it is possible to set parameter PP5=0.0001 making the motor feedback and the direct feedback independent. Hence, the difference error between feedbacks is not monitored and they are not equaled when searching home. This makes it possible to connect to the direct feedback a linear encoder or other feedback device that may be read by a CNC or a PLC and work accordingly.

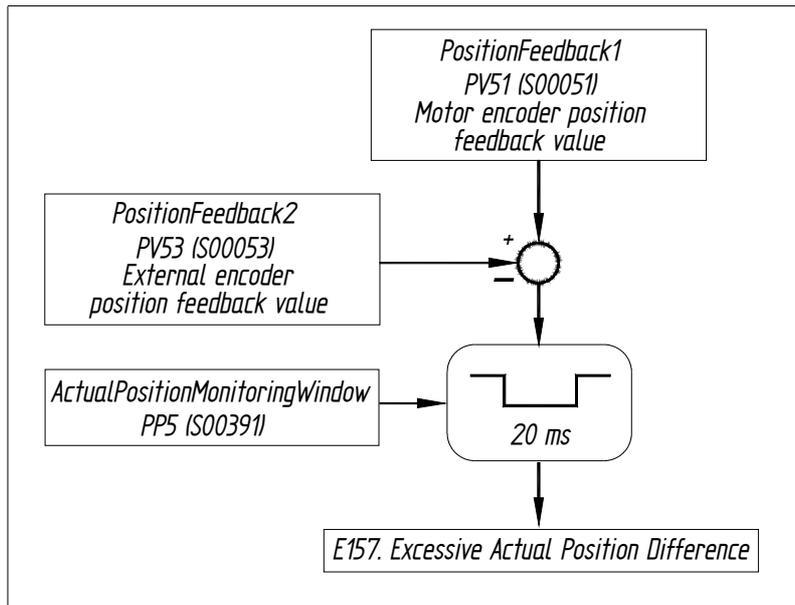


FIGURE S13.15

Max. error allowed between the motor feedback and the direct feedback.

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PARAMETERS, VARIABLES AND COMMANDS
P group. Position loop



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PP13	*O	F01304	BacklashPeakDelay
------	----	--------	-------------------

Function: Using position control and motor feedback or direct feedback, when receiving the command to reverse the moving direction from the CNC, this parameter may be used to **delay the compensation for the reversal** (backlash and reversal peak), in time.

The delay is set in ms and the drive will internally round up the time set in PP13 to the nearest lower value multiple of the loop time.

Note that if PP13=0, the reversal compensation will be applied exactly after receiving the movement reversing command; in other words, without delay in the reversal compensation just like it has been done until version v.06.10.

For further detail, see the section "Backlash compensation" of chapter 5 in this manual.

Valid values: 0.000 ... 32.000 ms.

Default value: 0.000.

Version: Operative from version 06.10 on.

PP14	*Os	F01305	BacklashPeak2Feedback Displacement
------	-----	--------	------------------------------------

Function: When using position control and direct feedback, this parameter sets **the distance** (in mm or degrees) that the table to travel (after the movement reversal) before the drive considers that it has reached the other end of the backlash and commands to **cancel the exponential compensation of the backlash due to reversal peak**.

All the details in the section "Improved table-lead screw backlash compensation due to movement reversal peak when using direct feedback. Exponential compensation cutoff" in chapter 5 of this manual.

Valid values: - 0.0001 ... 214 748.3647 mm (linear axes).
- 0.0001 ... 214 748.3647 ° (rotary axes).

Default value: **PP14=0** in version 06.10 and later versions.
PP14= 0.0001 when replacing a version older than 06.10 with a 06.10 or newer,

Version: Operative from version 06.10 on.

PP15	*O	F01306	ReversalHysteresis
------	----	--------	--------------------

Function: Using position control and with any feedback (motor or direct), this parameter sets **how much the position command can vary** (amplitude of hysteresis) after receiving a movement reversing command before the drive commands to **compensate for the reversal** (backlash and reversal peak).

Hence, e.g. if set to 5 μm (set PP15 = 0.0005 mm at the WinDDSSetup if it is a linear axis), the drive will not activate the reversal compensation as long as the table has not moved back at least this value no matter how many reversals there are in between.

Note that if PP15 = 0, the reversal peak compensation will **always** be applied after receiving the movement reversing command; in other words, without amplitude of hysteresis just like it has been done until version 06.10.



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All the details in section "Hysteresis in the compensation (by reversal peak) command after detecting a reversal of the axis moving direction" of chapter 5 in this manual.

Valid values: 0.0000 ... 214 748.3647 mm (linear axes)
0.0000 ... 214 748.3647 ° (rotary axes).
Default value: 0.0000 mm (linear axes), 0,0000 ° (rotary axes).
Version: Operative from version 06.10 on.

PP16	*S	F02007	PositionFeedbackAdaptation TimeConstant
------	----	--------	--------------------------------------------

Function: Value of the adaptation time constant between the two position feedbacks (direct and motor) when controlling position with direct feedback (linear encoder) on a machine with large mechanical backlash that generate vibration and instability. It sets the delay between the coordinates of the rotary and linear encoders that are inserted into the position loop. A zero value indicates that the position loop is always closed with the linear encoder and a high value (3200) indicates that it is always closed with the rotary encoder.

Valid values: 0.0 ... 3 200.0 ms.
Default value: 0.0.
Version: Operative from software version 06.12 on.

PP20.#	*sS	F02020.#	DynamicDeformationFrequency
--------	-----	----------	-----------------------------

Function: Frequency for compensating the path deviation suffered by the tool tip due to the elastic deformation originated dynamically at high speed on the transmission elements (leadscrews, pulleys, etc.) or elastic couplings of a machine. For further detail, see the section "elastic deformation compensation when coupling an axis" of chapter 5. Position drive.

Valid values: - 220.00 ... 220.00 Hz

Note. In a compensation of elastic deformation of a coupling of an axis, positive frequency values must be used when the real path exceeds the one programmed at the CNC; i.e. the deviation is by excess and negative values when it is by defect.

Default value: 0.00 Hz.
Version: Operative from version 06.16 on.

PP41.#	O	S00041.#	HomingVelocityFast
--------	---	----------	--------------------

Function: It sets the fast speed of the homing process controlled from the drive itself. This parameter is necessary when the homing search is controlled from the drive. PC148 (S00148) DriveControlledHoming active.

Valid values: 0.0000 ... 214 748.3647 rpm of the motor.
Default value: 200.0000 rpm of the motor.

PP42.#	O	S00042.#	HomingAcceleration
--------	---	----------	--------------------

Function: It sets the acceleration applied in the homing process controlled from the drive itself. This parameter is necessary when the homing search is controlled from the drive. PC148 (S00148) DriveControlledHoming active.

Valid values: 0.000 ... 2 147 483.647 rad/s².
Default value: 60.000 rad/s².

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PARAMETERS, VARIABLES AND COMMANDS
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PP49	Os	S00049	PositivePositionLimit
PP50	Os	S00050	NegativePositionLimit

Function: These two parameters delimit the permitted area (no exit) for the axis movements. These limits are taken into consideration only if a home search has been carried out previously, i.e. bit 0 of PV203 (S00403) Position-FeedbackStatus = 1 (the DriveControlledHoming command has been executed). If the "PV47 (S00047) PositionCommand" variable generates a movement of the axis that sends it beyond the permitted zone, it will issue error **E150**.
If the variable LV158 (S00258) TargetPosition exceeds the position limits, the drive will activate bit 13 Target-PositionOutsideTheTravelZone of DV9 (S00012) Class2Diagnostics (Warnings).

Valid values: - 214 748.3647 ... 214 748.3647 mm (linear axes)
- 214 748.3647 ... 214 748.3647 ° (rotary axes)

Default value: for linear axes:
PP49 = 214 748.3647 mm
PP50 = - 214 748.3647 mm
for rotary axes:
PP49 = 214 748.3647 °
PP50 = - 214 748.3647 °

PP52	*Os	S00052	ReferenceDistance1
------	-----	--------	--------------------

Function: With motor feedback, this parameter describes the distance between the machine reference zero and the machine reference point. It is similar to parameter **REFVALUE (P53)** of the axes of the 8055/55i CNC.

Valid values: - 214 748.3647... 214 748.3647 mm (for linear axes)
- 214 748.3647... 214 748.3647 ° (rotary axes).

Default value: 0.0000.

PP54	*Os	S00054	ReferenceDistance2
------	-----	--------	--------------------

Function: With direct feedback, this parameter describes the distance between the machine reference zero and the machine reference point. It is similar to parameter **REFVALUE (P53)** of the axes of the 8055/55i CNC.

Valid values: - 214 748.3647... 214 748.3647 mm (for linear axes)
- 214 748.3647... 214 748.3647 ° (rotary axes).

Default value: 0.0000.

PP55	O	S00055	PositionPolarityParameters
------	---	--------	----------------------------

Function: 16-bit register that may be used to **invert the sign** of the various position data.



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When the drive closes the position loop

Bits 2 and 3 modify the sign of the monitored position feedback, but **do not affect** the operation of the loop. These bits cannot be used to solve a positive feedback problem (axis runaway).

This case is solved by using bit 3 of "PP115 (S00115) PositionFeedback2Type". See **FIGURE S13.16**.

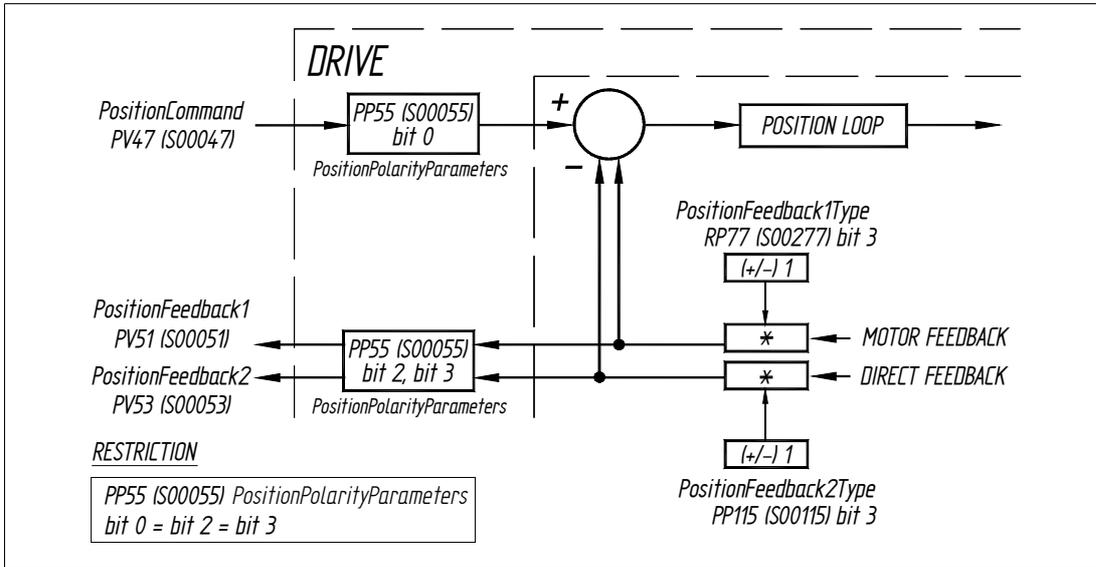


FIGURE S13.16

PP55 when the drive closes the position loop.

When the CNC closes the position loop

Bits 2 and 3 modify the sign of the monitored position feedback and **affect** the operation of the loop. These bits **may be used** to solve a positive feedback problem (runaway) besides bit 3 of "PP115 (S00115) PositionFeedback2Type". See **FIGURE S13.17**.

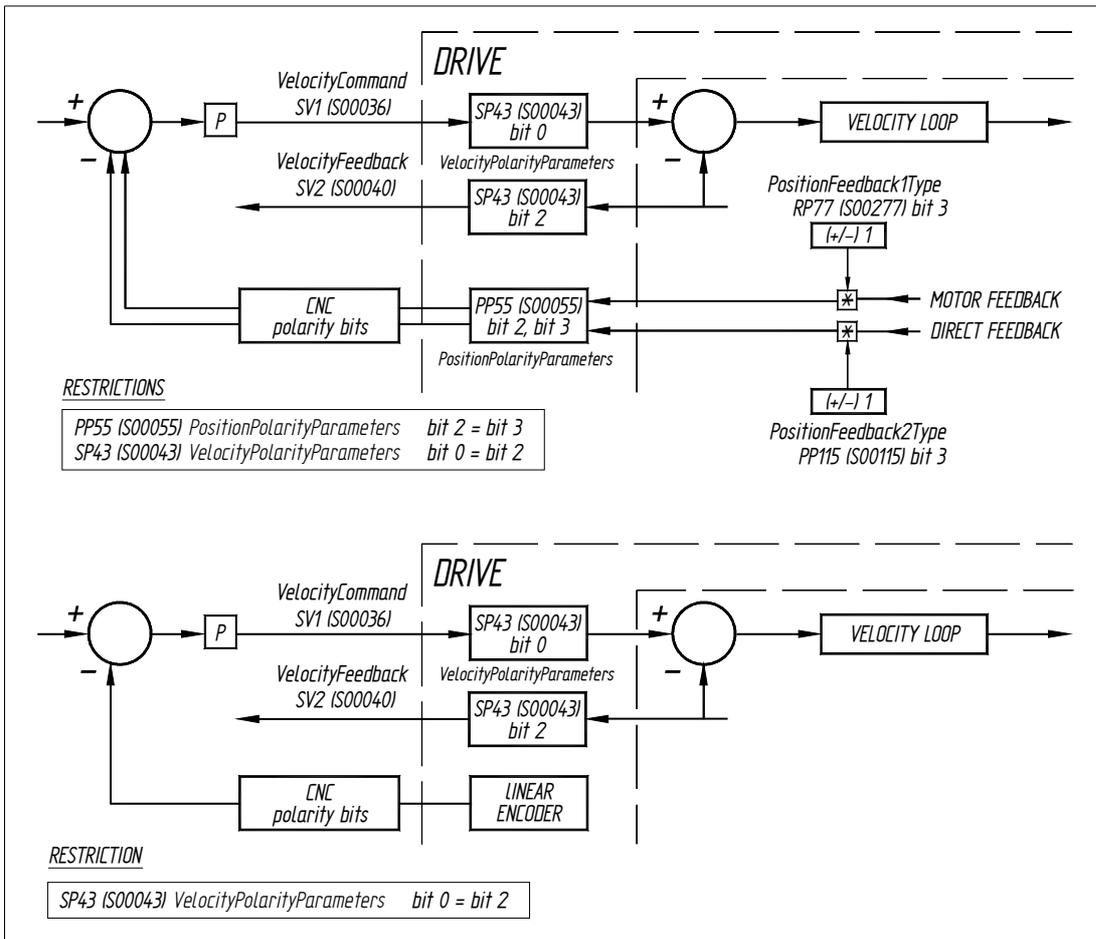


FIGURE S13.17

PP55 when the CNC closes the position loop.

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PARAMETERS, VARIABLES AND COMMANDS
P group. Position loop

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Important. The following convention is set: For rotary axes: If the sign of the position command variation is positive, the rotation is set clockwise.

TABLE S13.12 Parameter PP55. Meaning of its bits.

Bit	Function
4	Position limits. = 0 Off. = 1 On (by default). See parameters PP49 and PP50 .
3	Sign of the value of the direct feedback position. = 0 Not inverted. = 1 Inverted (by default).
2	Sign of the value of the motor feedback. = 0 Not inverted. = 1 Inverted (by default).
1	Reserved
0 (LSB)	Sign of the position command value. = 0 Not inverted. = 1 Inverted (by default).

PP57	O	S00057	PositionWindow
------	---	--------	----------------

Function: It sets the difference allowed between the real and final position LV158 (S00258) TargetPosition for considering that the axis is in position. The drive will then activate parameter PV136 (S00336) InPosition during the execution of the command.

Valid values: 0.0000 ... 214 748.3647 mm (linear axes).
0.0000 ... 214 748.3647 degrees (rotary axes).

Default value: 0.1000 mm on linear axes.
0.1000° on rotary axes over 360°.

PP58	*Os	S00058	Backlash
------	-----	--------	----------

Function: **Using position control and motor feedback**, this parameter may be used to compensate the load - lead-screw backlash.

From version v.06.10 on, this parameter can also be used with position control when using direct feedback (linear encoder) to compensate the backlash of the reader head of the linear encoder when reversing the movement of the axis.

Important clarifying note:

When upgrading to version 06.10 or newer, if the system is not configured **with position control and direct feedback (linear encoder)** and PP58 was set to a value other than 0, it is automatically set to zero so it keeps behaving the same way (for safety). See the section "backlash compensation" of chapter 5 of this manual for a more detailed description of this parameter.

Warning. This value must only be registered either at the parameter of the drive or at the equivalent one of the CNC, **never at both at the same time**, the other parameter must be set to 0.

Valid values: - 3.2767 ... 3.2767 mm (for linear axes)
- 3.2767 ... 3.2767 ° (for rotary axes over 360°).

Default value: 0.0000.

Version: Expanded in software version 06.10.

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PARAMETERS, VARIABLES AND COMMANDS
P group. Position loop

PP59	*Os	F01307	Backlash12
------	-----	--------	------------

Function: It is set with the value of the backlash between feed-backs (given by the PV190 variable) as long as the system has been configured to work **with position control command and both feedbacks** (AP1=5 or AP1=13).

The drive will use the value of this parameter internally to set the percentage of the product PP2·PP3 will be applied in the backlash compensation by reversal peak when detecting a relative movement between feedbacks before a movement reversal.

See the section "Compensation of the backlash between both feedbacks in a movement reversal" of chapter 5 "Adjustment of the position servo system" in this manual.

Valid values: - 3.2767 ... 3.2767 mm (for linear axes)
- 3.2767 ... 3.2767 ° (for rotary axes over 360°).

Default value: 0,0000.

Version: Operative from version 06.10 on.

PP76		S00076	PositionDataScalingType
------	--	--------	-------------------------

Function: 16-bit register that configures the measuring scale for the positioning. All of them must be zero except bit 6 (always set to 1) and bit 7 that sets the activation/deactivation of the module format in the commands received.

TABLE S13.13 Parameter PP76. Meaning of its bits.

Bit	Function
15 (MSB), 14, 13, 12, 11, 10, 9, 8	Reserved = 0
7	Format. = 0 Absolute. = 1 Module. See parameter PP103 . Make sure that the CNC defines that axis in the same way (module or linear format)
6	The position command refers to: = 1 The position of the load. always !
5, 4, 3, 2	Reserved
1, 0 (LSB)	Position command scaling method. = 01 Linear scaling (by default). = 10 Rotary scaling.

PP103	Os	S00103	ModuleValue
-------	----	--------	-------------

Function: Module value. If bit 7 of PP76 selects the module format, this parameter defines the range of the position data being used.

Valid values: 0.0001 ... 214 748.3647 mm (linear axes).
0.0001 ... 214 748.3647 ° (rotary axes).

Default value: 360 °. Normally used on rotary axes.

PP104.#	*	S00104.#	PositionKvGain
---------	---	----------	----------------

Function: It sets the value of the proportional command Kv in the position loop. It is similar to parameter PROGAIN (P23) of the axes of the 8055/55i CNC. It is given in m/min of programmed velocity command per mm of following error.

Valid values: 0.00 ... 327.67 (m/min)/mm.



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The 16 bits will be interpreted in this order:

B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
-----	-----	-----	-----	-----	-----	----	----	----	----	----	----	----	----	----	----

TABLE S13.14 Parameter PP115. Meaning of its bits.

Bit	Function
15 (MSB), 14, 13, 12, 11, 10, 9, 8, 7	- Reserved -
6	It indicates the type of feedback. = 0 Incremental feedback. = 1 Absolute feedback.
5	Structure of distance-coded reference marks (I0's). = 0 Positive count in positive direction. = 1 Negative count in positive direction.
4	Reserved
3	Feedback direction. = 0 Not inverted. = 1 Inverted.
2	Reserved
1	It indicates whether the feedback device has distance-coded I0's or not. = 0 Without distance-coded I0's. = 1 With distance-coded I0's. See NP165 and NP166 .
0 (LSB)	It indicates the type of feedback. = 0 Rotary encoder See NP117 . = 1 Linear encoder. See NP118 .

PP147	*	S00147	HomingParameter
-------	---	--------	-----------------

Function: It is a 16-bit register that sets the mechanical and electrical relationship between the homing procedure and the machine installation, the CNC or the drive. When the home search is controlled by the drive, only bits 0, 1, 2, 3, 5 and 6 will be applicable. When the home search is controlled by the CNC only bits 1, 2, 3 and 4 are applicable.

TABLE S13.15 Parameter PP147. Meaning of its bits.

Bit	Function
15 (MSB), 14, 13, 12, 11, 10, 9, 8, 7	- Reserved -
6	Evaluation of the reference mark (I0). = 0 The home switch is evaluated (by default). = 1 The I0 is not evaluated.
5	Evaluation of the home switch. = 0 The home switch is evaluated (by default). = 1 The home switch is not evaluated.
4	Reserved
3	Feedback used. = 0 Motor feedback (by default). = 1 Direct feedback.
2	Home switch connection.
1	Home switch signal logic. = 0 Pressing the home switch sets the PLC input to 1 (positive logic, by default). = 1 Pressing the home switch sets the PLC input to 0.
0 (LSB)	Moving direction. = 0 Positive. The motor shaft turns clockwise (by default). = 1 Negative. The motor shaft turns counterclockwise.

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PARAMETERS, VARIABLES AND COMMANDS
P group. Position loop



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Very important. Note that -PP147 (S00147) HomingParameter, bit 3 - **MUST** always be set even when using absolute feedback (without home search) to indicate whether motor feedback or direct feedback will be used to home the machine.

If it is a Sensorless, bits 5 and 6 of this parameter must be necessarily set to 1 to avoid a home search error.

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PARAMETERS, VARIABLES AND COMMANDS
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PP150	*Os	S00150	ReferenceOffset1
-------	-----	--------	------------------

Function: Parameter that gives the position of the machine reference point with respect to the reference mark (I0), depending on motor feedback. It is the same as parameter REFSHIFT (P47) of the axes of the 8055/55i CNC.

Valid values:
- 214 748.3647...214 748.3647 mm (for linear axes)
- 214 748.3647... 214 748.3647 ° (rotary axes).

Default value: 0.0000.

PP151	*Os	S00151	ReferenceOffset2
-------	-----	--------	------------------

Function: Parameter that gives the position of the machine reference point with respect to the reference mark (I0), depending on direct feedback. It is the same as parameter REFSHIFT (P47) of the axes of the 8055/55i CNC.

Valid values:
- 214 748.3647... 214748.3647 mm (for linear axes)
- 214 748.3647... 214 748.3647 ° (rotary axes).

Default value: 0.0000.

PP159	O	S00159	MonitoringWindow
-------	---	--------	------------------

Function: It sets the permissible following error range. If this is greater than the value given by PP159, the drive issues error **E156** (too much following error) DV1 (S00011), bit 11 -. If this parameter is set to "0", the following error will not be monitored.

It is important to set it to a value other than zero to prevent the axes from running away.

The CNC also monitors the maximum following error allowed by setting its corresponding parameter in the parameter table of each axis at the CNC.

Valid values:
0.0000 ... 214 748.3647 mm (linear axes).
0.0000 ... 214 748.3647 ° (rotary axes).

If PP159=0, the following error will not be monitored.

Default value: 3.0000 mm (linear axes) or 3.0000 ° (rotary axes).

PP160	OsS	F01303	MonitoringWindowPosEleCalc.
-------	-----	--------	-----------------------------

Function: This parameter limits the maximum movement allowed while executing the command "GC7 (F01524) AutophasingOnline" that is executed automatically when powering up a synchronous motor without absolute feedback to estimate its electrical position.

Valid values:
- 0.0001 ... 214 748.3647 mm (linear axes)
- 0.0001 ... 214 748.3647 ° (rotary axes)

Default value: - 0.0001

Version: Operative from version 06.10 on.



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PP169	O	S00169	ProbeControlParameter
-------	---	--------	-----------------------

Function: Probe controlling parameter. It determines which probes and which flanks are activated by the procedure command of the probing cycle.

TABLE S13.16 Parameter PP169. Meaning of its bits.

Bit	Function
0	Probe 1 (positive flank). = 0 Positive flank inactive. = 1 Positive flank active.
1	Probe 1 (negative flank). = 0 Negative flank inactive. = 1 Negative flank active.
4	Probe 1 signal selection. = 0 Direct feedback for Probe 1. = 1 Motor feedback for Probe 1.
5	Probe 1 physical input selection. = 0 X4, pins 3 (+) and 12 (-). = 1 X3, pins 5 (+) and 6 (-).

Note. The rest of the bits are reserved.

Note that if no flank is set, it will not work.

Valid values: 0 ... 63.

Default value: 0.

PP177	*Os	S00177	AbsoluteDistance1
-------	-----	--------	-------------------

Function: For motors with absolute encoder -see **RV5** variable, it indicates the distance between the zero coordinate of the drive and the theoretical zero coordinate according to the absolute encoder feedback. See chapter 5 of this manual, section "absolute feedback".

Valid values: - 214 748.3647 ... 214 748.3647 mm (with linear axis)
- 214 748.3647...214 748.3647 ° (rotary axes).

Default value: 0.

PP178	*Os	S00178	AbsoluteDistance2
-------	-----	--------	-------------------

Function: For absolute direct feedback this parameter indicates the difference between the zero coordinate of the drive and the theoretical coordinate according to that absolute feedback. See chapter 5 of this manual, section: "absolute feedback".

Valid values: - 214 748.3647 ... 214 748.3647 mm (with linear axis)
- 214 748.3647...214 748.3647 ° (rotary axes).

Default value: 0.0000.

PP216.#		S00296.#	Velocity FeedForwardPercentage
---------	--	----------	-----------------------------------

Function: It sets the how much velocity feed-forward is applied. It is similar to parameter FFGAIN (P25) of the axes of the 8055/55i CNC. It indicates the % of velocity command anticipated to the movement and it does not depend on the amount of following error (open loop).

Valid values: 0.00 ... 120.00 %.

Default value: 0.00 %. The feed-forward effect is not applied.

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PARAMETERS, VARIABLES AND COMMANDS
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PP217.#		S00348.#	Acceleration FeedForwardPercentage
---------	--	----------	---------------------------------------

Function: It sets the how much acceleration feed-forward is applied in position control and in velocity control. It is similar to parameter ACFGAIN (P26) of the axes of the 8055/55i CNC.

Valid values: 0.0 ... 120.0 %.

Default value: 0.0 %. The feed-forward effect is not applied.

PV1	*s	S00298	HomeSwitchDistance
-----	----	--------	--------------------

Function: Variable that determines the exact distance to move the home switch in a home search where the reference mark detection risks not being repeatable. The optimum distance is the mid point between two consecutive reference marks (I0) because in this area the fluctuations of the on/off flank of the home switch are not risky.

Valid values: - 214 748.3647... 214 748.3647 mm (with linear axis)
- 214 748.3647... 214 748.3647 ° (rotary axes).

Version: Operative from software version 06.02 on.

PV47	Ws	S00047	PositionCommand
------	----	--------	-----------------

Function: Position command applied to the position loop in each cycle of the control loop. The drive transfer a value to the CNC for display.

Valid values: - 214 748.3647 ... 214 748.3647 mm (with linear axis)
- 214 748.3647...214 748.3647 ° (rotary axes).

PV48	Ws	S00048	AdditivePositionCommand
------	----	--------	-------------------------

Function: Variable used when requiring an additional position value and the drive has been configured as position control. The value of this variable is added to the position command value of the drive.

Valid values: - 214 748.3647 ... 214 748.3647 mm (with linear axis)
- 214 748.3647... 214 748.3647 ° (rotary axes).

Version: Operative from version 06.10 on.

PV51	s	S00051	PositionFeedback1
PV53	s	S00053	PositionFeedback2

Function: The drive transfer this data to the CNC to display the position command, the position feedback through the motor feedback and through the direct feedback.

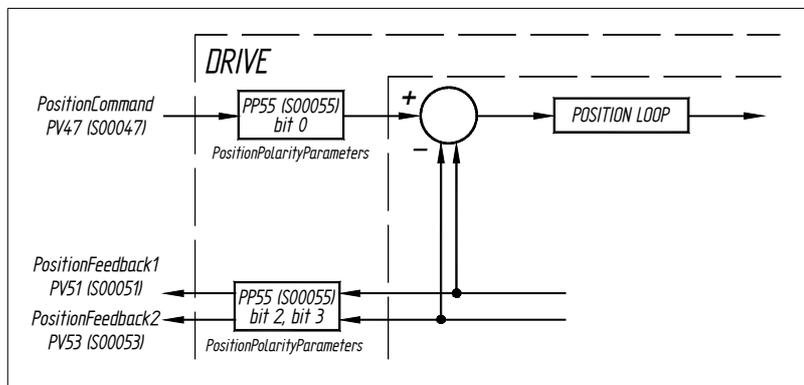


FIGURE S13.19
PV51 and PV53.



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PV130	s	S00130	ProbeValue1PositiveEdge
-------	---	--------	-------------------------

Function: Depending on the value of bit 4 of parameter PP169, the drive stores the value of the position motor feedback or direct feedback in this variable after the positive flank (leading edge) of the INDEX input signal.

Valid values: - 214 748.3647 ... 214 748.3647 mm (with linear axis)
- 214 748.3647...214 748.3647 ° (rotary axes).

PV131	s	S00131	ProbeValue1NegativeEdge
-------	---	--------	-------------------------

Function: Depending on the value of bit 4 of parameter PP169, the drive stores the value of the position motor feedback or direct feedback in this variable after the negative flank (leading edge) of the INDEX input signal.

Valid values: - 214 748.3647... 214 748.3647 mm (with linear axis)
- 214 748.3647...214 748.3647 ° (rotary axes).

PV136		S00336	InPosition
-------	--	--------	------------

Function: Mark that activates when the axis has reached the target position "LV148 (S00258) TargetPosition". This positioning allows a margin given by parameter "PP57 (S00057) PositionWindow".

Valid values: 0 (by default) and 1.

PV153	sS	F01308	PositionFeedback12
-------	----	--------	--------------------

Function: This variable makes it possible to use the "combined feedback" feature with an 8055/55i CNC or an 8070 CNC (in speed). Hence, having configured the drive in velocity control (S00032 = xxx010, i.e. AP1=2), this variable registers the combination (adaptation) between the motor feedback (rotary encoder) and the direct feedback (linear encoder) using parameter PP16 as the adaptation time constant, it may be sent to the CNC via SERCOS to close the loop.

Version: Operative from software version 06.12 on.

PV173	s	S00173	MarkerPositionA
-------	---	--------	-----------------

Function: In the home searching process, when the drive detects the I0 signal, it saves the value of the PositionFeedback 1/2 (not yet homed) in this variable.

Valid values: - 214 748.3647 ... 214 748.3647 mm (with linear axis)
- 214 748.3647... 214 748.3647 ° (rotary axes).

PV174	s	S00174	MarkerPositionB
-------	---	--------	-----------------

Function: In the home searching process, when the drive detects the second distance-coded I0 signal, it saves the value of the "PositionFeedback 1/2" in this variable.

Valid values: - 214 748.3647... 214 748.3647 mm (with linear axis)
- 214 748.3647...214 748.3647 ° (rotary axes).

PV175	Ws	S00175	DisplacementParameter1
-------	----	--------	------------------------

Function: Offset of the coordinate system after the home search carried out by the drive (with motor feedback).

Valid values: - 214 748.3647 ... 214 748.3647 mm (with linear axis)
- 214 748.3647... 214 748.3647 ° (rotary axes).

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PARAMETERS, VARIABLES AND COMMANDS
P group. Position loop



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PV176	Ws	S00176	DisplacementParameter2
-------	----	--------	------------------------

Function: Offset of the coordinate system created after the home search carried out by the drive (with direct feedback).

Valid values: - 214 748.3647 ... 214 748.3647 mm (with linear axis)
- 214 748.3647...214 748.3647 ° (rotary axes).

PV179		S00179	ProbeStatus
-------	--	--------	-------------

Function: If the drive stores one or more measurement values while the procedure command "PC170 (S00170) Probing CycleProcedureCommand" is activated, it automatically sets the bit assigned in ProbeStatus. If the CNC resets "PV205 (S00405) Probe1Enable", the drive resets bits 0 and 1 of the ProbeStatus. The drive resets all the bits of ProbeStatus when the CNC cancels the procedure command of the probing cycle PC170.

Its structure is:

TABLE S13.17 Variable PV179. Meaning of its bits.

Bit	Function
0	Probe1PositiveLatched. = 0 Not captured. = 1 Captured
1	Probe1NegativeLatched. = 0 Not captured. = 1 Captured.

Valid values: 0 ... 3.

PV189	s	S00189	FollowingError
-------	---	--------	----------------

Function: It registers the difference between the position command and the position feedback "PV189 = PV47 - PV51/53".

FollowingError = PositionCommand - PositionFeedback 1/2

Units: Tenths of microns on linear movements.
Tenthousandths of a degree on rotary movements.

PV190	s	F02005	PosErrorBetweenFeedbacks
-------	---	--------	--------------------------

Function: This variable may be used to display the error (difference) between the value of the direct feedback (PV53) and that of the motor feedback (PV51). Initially, they both store the same value of the load position because their values are the same when starting up the drive. Both feedbacks set the value of the load position. There is no point in displaying this variable when not using direct feedback.

PV191	s	F02009	FollowingError1
-------	---	--------	-----------------

Function: This variable may be used to display the amount of error (difference) between the position command value (PV47) and the position value given by the motor feedback (PV51).

PV192	s	F02010	FollowingError2
-------	---	--------	-----------------

Function: This variable may be used to display the amount of error (difference) between the position command value (PV47) and the position value given by the direct feedback (PV53). There is no point in displaying this variable when not using direct feedback.



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PV193	s	F02011	FollowingError12
-------	---	--------	------------------

Function: This variable may be used to display the amount of error (difference) between the position command value (PV47) and the position value given by the combined feedback (PV153). There is no point in displaying this variable when not using direct feedback.

PV200	O	S00400	HomeSwitch
-------	---	--------	------------

Function: This binary variable represents the logic state of the home switch. For that, this variable must be associated with one of the digital inputs of the drive that will be connected to the switch.

Example.

If the PLC is not used, assign the variable PV200 to parameter IP10 (pins 1 and 5 of X6).

If the PLC is used, the instruction may be I1= BOS400.

Valid values: 0. Switch inactive.
1. Switch active (the axis is positioned on the switch).

PV201	O	S00401	Probe1
-------	---	--------	--------

Function: Variable used to assign an identifier to physical input INDEX (external signal). This makes it possible to assign a status bit to this variable. The drive checks and updates this variable only if:

PC170 is active.
PC205 is active.

Its structure is:

Bit 0 = 0 Index inactive.
Bit 0 = 1 Index active.

Valid values: 0 and 1.

PV203		S00403	PositionFeedbackStatus
-------	--	--------	------------------------

Function: The drive activates this binary variable to inform that it interprets the position feedback as being referred to the machine reference zero point. The variable deactivates when executing the command:

PC148 (S00148) DriveControlledHoming.

and reactivates when it is executed successfully. Also, the variable reactivates when the drive loses its reference to machine zero.

Valid values: 0. Position data referred to any point.
1. Position data referred to machine zero.

PV204	W	S00404	PositionCommandStatus
-------	---	--------	-----------------------

Function: Variable used internally by the system. It indicates whether the position command is referred to machine reference zero or not.

Valid values: 0. Not referred to machine reference zero.
1. Referred to machine zero.

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PARAMETERS, VARIABLES AND COMMANDS
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PV205	O	S00405	Probe1Enable
-------	---	--------	--------------

Function: Variable used to assign an identifier to Probe1Enable. This makes it possible to assign a control bit to this variable. The drive checks this variable only if:

PC170 is active.

For a new cycle with the same flank of Probe1, the CNC will activate PV205 to 1.

Its structure is:

Bit 0=0, Probe1 disabled.
Bit 0=1, Probe1 enabled.

Valid values: 0 and 1.

PV207	O	S00407	HomingEnable
-------	---	--------	--------------

Function: Enabling of the Homing function. The drive considers this HomingEnable function only if the home search is controlled from the CNC, i.e. using the command:

PC146 (S00146) NCCControlledHoming.

Valid values: 0. Home search disabled.
1. Home search enabled.

PV208		S00408	Reference MarkerPulseRegistered
-------	--	--------	------------------------------------

Function: This binary variable is activated when the drive detects the reference mark (I0) during home search. At that instant, the drive saves PositionFeedback (not yet homed) in MarkerPosition A.

Valid values: 0 and 1.

PV209		S00409	Probe1PositiveLatched
-------	--	--------	-----------------------

Function: Variable used to assign an identifier to Probe1PositiveLatched. This makes it possible to assign a status bit to this variable. The drive sets this bit to zero only if:

PC170 is active.
PV205 is set to 1.

The positive flank of Probe1 is captured. The drive stores the position feedback value in PV130.

Its structure is:

Bit 0 = 0, Probe1 positive not captured
Bit 0 = 1, Probe1 positive captured.

Valid values: 0 and 1.

PV210		S00410	Probe1NegativeLatched
-------	--	--------	-----------------------

Function: Variable used to assign an identifier to Probe1NegativeLatched. This makes it possible to assign a status bit to this variable. The drive sets this bit to zero only if:

PC170 is active.
PV205 is set to 1.

The negative flank of Probe1 is captured. The drive stores the position feedback value in PV131.

Its structure is:

Bit 0=0, Probe1 negative not captured.
Bit 0=1, Probe1 negative captured.

Valid values: 0 and 1.



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PC150	W	F02003	ChangePosFB12
-------	---	--------	---------------

Function: This command can only be executed when the operating mode AP1 is assigned a value of 5 or 13. Initially, in this operating mode, the position will be regulated through motor feedback. If this command is executed with a value of 3, it switches to direct feedback. Under these conditions, the command will return a value of 7. When canceling the command with a value of 0, it will switch to regulating the position with motor feedback.

This command should be executed or canceled while the motor is stopped.

Valid values: 0 ... 3.

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13.2.16 Q group. SERCOS communication

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PARAMETERS, VARIABLES AND COMMANDS
Q group. SERCOS communication

QP1	*	S0001	ControlUnitCycleTime
-----	---	-------	----------------------

Function: Read parameter that indicates every how long the drives close the loop.

Valid values: 1000 ... 8000 ms.

Default value: 4000 ms.

QP11		F02000	SERCOSMBaud
------	--	--------	-------------

Function: It sets the transmission speed through the SERCOS ring. The CNC has a similar parameter with SERCOS → SERSPEED (P120). Both speeds (at the CNC and at the drive) must be the same in order to establish communication.

Valid values:

TABLE S13.18 Parameter QP11. Valid values with SERCOS interface.

→ When having a SERCOS board (4 MBd), then:

Value of QP11	Transmission speed (rate)
QP11 = 0	4 MBd (by default).
QP11 = 1	2 MBd

→ When having a SERCOS board (16 MBd), then:

Value of QP11	Transmission speed (rate)
QP11=0	4 MBd *
QP11=1	2 MBd *
QP11=2	2 MBd
QP11=4	4 MBd
QP11=8	8 MBd
QP11=16	16 MBd

*To be compatible with previous versions of the SERCOS board.

Default value: (with or without SERCOS board of 16 MBd)

QP11=0	4 MBd
--------	-------

Every time a transmission baudrate is selected with the "boot" button of the drive, the selected value is registered in parameter QP11.

Version: Modified from software version 06.05 on Expanded in software version 06.08.

QP12	*O	F02002	SERCOSTransmissionPower
------	----	--------	-------------------------

Function: It defines the SERCOS power, i.e. the light power transmitted through the optical fiber.

TABLE S13.19 Parameter QP12. Valid values.

Value of QP12	Cable length L (in meters)
QP12 = 2	$L < 7$
QP12 = 4	$7 \leq L < 15$
QP12 = 6	$L \geq 15$

Valid values: Only 2, 4 or 6

Default value: 2.

When using a SERCOS board of up to 16 MBd, the values given in the following table must be considered. Observe its compatibility with the previous table for the values of 2, 4 and 6.



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TABLE S13.20 Parameter QP12. Valid values with SERCOS board of up to 16 MBd.

Value of QP12	Cable length L (meters)
QP12 = 1, 2 or 3	$L < 7$
QP12 = 4	$7 \leq L < 15$
QP12 = 5 or 6	$15 \leq L < 30$
QP12 = 7	$30 \leq L \leq 40$
QP12 = 8	$L > 40$

Valid values: 1 ... 8.
Default value: 1.
Version: Operative from version 06.08 on.



Warning. For sections longer than 40 meters, use the fiber optic cable with a glass core (ref. SF0-V-FLEX-XX).

QP13	F02004	IdOffset
------	--------	----------

Function: It may be used to identify in the system (address) more axes than the 15 that may be selected using the rotary switch of the drive. The real identifier of the axis is the number selected at the rotary switch + (15 times the value of QP13). Its function is effective when using a SERCOS ring as well as when the system has a tree type structure with a RS-422 serial line. If the rotary switch is in the 0 position, regardless of the value entered in QP13, the communication will be established as serial RS-232 line. See the examples in the "identification" sections of chapter 7 of the "dds-hard-ware" manual.

Valid values: 0 ... 8.
Default value: 0.

QP15	F02008	SerialProtocol
------	--------	----------------

Function: This parameter may be used to select the type of communications protocol with the position of the rotary switch of the RS-422 board.

ROTARY SWITCH POSITION	VALUE OF QP15	TYPE OF PROTOCOL
 position 0	QP15 = -	DNC (RS-232)
 position other than 0	QP15 = 0	DNC (RS-422)
 position other than 0	QP15 = 1	ModBus (Modo RTU) (RS-422)
 position other than 0	QP15 = 2	ModBus (Modo ASCII) (RS-422)

RTU MODE: Binary data coding according to standard RTU.
 ASCII MODE: ASCII data coding.

FIGURE S13.20

Communication protocol selection.



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PARAMETERS, VARIABLES AND COMMANDS
Q group. SERCOS communication

QV1	F	F00716	TMODE_Select
-----	---	--------	--------------

Function: Variable useful to test the SERCOS ring hardware.

Valid values:

0	Normal operating mode.
1	Zero Bit String.
2	Continuous light output.

QV30	F	F00727	FiberDistErrCounter
------	---	--------	---------------------

Function: Variable that may be used to troubleshoot SERCOS communication. It is a counter that counts the distortion errors and it indicates the number of times that a distortion error has come up in the SERCOS communication during phase 4 (the initialization of the CNC-drives system communication has not been completed).

Valid values: 0 ... 65 535.



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13.2.17 R group. Rotor sensor

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PARAMETERS, VARIABLES AND COMMANDS
R group. Rotor sensor

RP1	*O	F01500	Feedback1SineGain
RP2	*O	F01501	Feedback1CosineGain

Function: Compensation (proportional gain mode) of the amplitude of the sine/cosine signal that goes from the motor feedback to the drive.

Valid values: 1 500 ... 3 070.

Default value: 2 032.

RP3	*Os	F01502	Feedback1SineOffset
RP4	*Os	F01503	Feedback1CosineOffset

Function: Compensation (offset mode) of the sine/cosine signal that goes from the motor feedback to the drive.

Valid values: - 2 000 ... 2 000.

Default value: 0

RP5	O	F01504	Feedback ParameterRhoCorrection
-----	---	--------	------------------------------------

Function: Parameter that corrects the shift between the magnetic shaft of the sensor and the motor's rotor shaft (between the I0 signal and the magnets). The motors are shipped out mechanically adjusted from the factory and, usually, it is not necessary to manipulate this parameter.

Note. Only for sensors without memory.

Valid values: 0 ... 65 535.

Default value: 0.

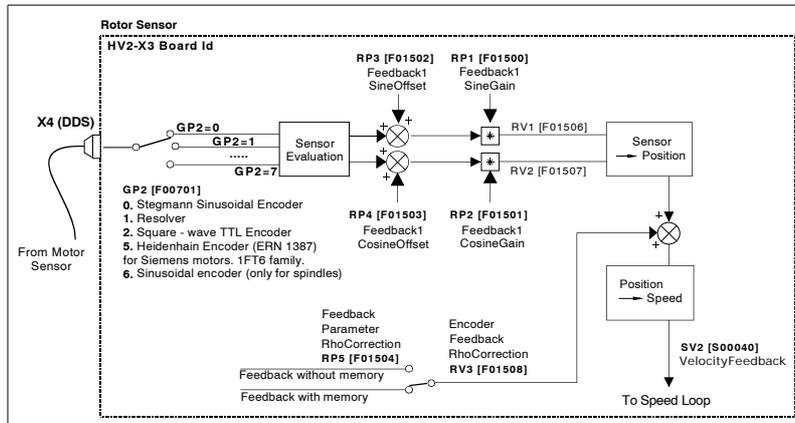


FIGURE S13.21

Diagram showing the action of these parameters.

RP6.#	O	F01505.#	FeedbackErrorDisable
-------	---	----------	----------------------

Function: It may be used to inhibit the communication from the possible feedback errors (group 6xx).

Valid values:

0.	Normal operation. If there is any malfunction, the error comes up.
1.	The feedback errors that may come up are not displayed.

Default value: 0.



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PARAMETERS, VARIABLES AND COMMANDS
R group. Rotor sensor

RP7	O	F01499	FeedbackIOWidth
-----	---	--------	-----------------

Function: Parameter to set the I0 width when using the U signal from a linear or rotary encoder that uses U, V and W signals as I0.

Note. It is essential to set this parameter correctly in order to apply the rho correction properly on both flanks.

Valid values: 0... 65 535.
360 electrical degrees (1 pair of poles) → RP7=65 535
180 electrical degrees (2 pairs of poles) → RP7=32 767

Default value: 0.

Version: Operative from version 06.15 on.

RP8	O	F01518	I0DistanceTest
-----	---	--------	----------------

Function: It determines whether to check or not the repeatability of the reference mark signal of the feedback device in each revolution and which feedback will be used.

Valid values: 0. Do not check the repeatability of the reference
1. Check the repeatability of the reference mark when using motor feedback.
2. Check the repeatability of the reference mark when using direct feedback.

Default value: 0. Do not check the repeatability of the reference mark.

Important. Make sure that feedback used to check I0 repeatability and to set RP8 matches the feedback used to reference the machine as set in bit 3 of parameter PP147. So, when setting RP8=1, make sure that PP147.bit3=0 and if RP8=2 check that PP147.bit3=1. If you don't do this, the I0 repeatability test will not be carried out.

Version: Operative from software version 06.20 on.

RP9	O	F01519	I0Margin
-----	---	--------	----------

Function: It sets the number of pulses permitted as a margin of error to consider OK to check that the reference mark signal repeats the distance in each revolution of the feedback device.

Valid values: 0, ..., 100.

Default value: 2.

Version: Operative from software version 06.20 on.

RP51	O	F01550	Feedback2SineGain
RP52	O	F01551	Feedback2CosineGain

Function: Compensation (proportional gain mode) of the amplitude of the sine/cosine signal that goes from the direct feedback to the drive.

Valid values: 1 500 ... 3 070.

Default value: 2 032.

RP53	Os	F01552	Feedback2SineOffset
RP54	Os	F01553	Feedback2CosineOffset

Function: Compensation (offset mode) of the sine/cosine signal that goes from the direct feedback to the drive.

Valid values: - 2 000 ... 2 000.

Default value: 0.



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RP60	O	F02360	SSIClockFrequency
------	---	--------	-------------------

Function: Frequency supported by the drive's clock with SSI communications.

Valid values: 59 ... 7 500 kHz.

Default value: 150 kHz.

Version: With SSI. Operative from version 06.08 on.
With EnDat™. Operative from version 06.21 on.

RP61	O	F02361	SSIDataLength
------	---	--------	---------------

Function: SSI data size in bits.

Valid values: 8 ... 32 bits.

Default value: 32 bits.

Version: With SSI. Operative from version 06.08 on.
With EnDat™. Operative from version 06.21 on.

RP62	O	F02362	SSIDataFormat
------	---	--------	---------------

Function: SSI data format.

Bit 0=0 → Binary code.
Bit 0=1 → Gray code.
Bit 1=0 → Normal.
Bit 1=1 → Fir-tree.
All other bits are reserved.

Valid values: 0 ... 3.

Default value: 0.

Version: With SSI. Operative from version 06.08 on.
With EnDat™. Operative from version 06.21 on.

RP63	O	F02363	SSIFeedbackResolution
------	---	--------	-----------------------

Function: Resolution value of the **absolute linear feedback device** (in $d\mu\text{m}$) with SSI digital communication protocol. Hence, if the resolution is $1\ \mu\text{m}$, RP63 will be 10, not 1.

Valid values: 1 ... 2 147 483 647 $d\mu\text{m}$.

Default value: 1 $d\mu\text{m}$.

If the **absolute feedback device is rotary** (encoder), this parameter must indicate the number of bits per encoder revolution. Its units are bits.

Version: With SSI. Operative from version 06.08 on.
With EnDat™. Operative from version 06.21 on.

RP64	O	F02364	SSIFCheck
------	---	--------	-----------

Function: It determines whether the 5-bit CRC (Cyclic Redundancy Check) is carried out or not.

Valid values: 0/1. No/yes

Default value: 0. No.

Version: With SSI.
Operative from software version 06.20 on.

13.

PARAMETERS, VARIABLES AND COMMANDS
R group. Rotor sensor



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PARAMETERS, VARIABLES AND COMMANDS
R group. Rotor sensor

RP77	O	S00277	PositionFeedback1Type
------	---	--------	-----------------------

Function: identifies different aspects of the motor feedback. Bit 3 may be used to solve a positive feedback problem (runaway) when the drive closes the position loop.

Note that when the CNC closes the position loop, bit 3 of parameter PP55 is also involved.

The 16 bits will be interpreted in this order:

B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
-----	-----	-----	-----	-----	-----	----	----	----	----	----	----	----	----	----	----

TABLE S13.21 Parameter RP77. Meaning of its bits.

Bit	Function
15 (MSB), 14, 13, 12, 11, 10, 9, 8, 7	- Reserved -
6	It indicates the type of feedback. = 0 Incremental feedback = 1 Absolute feedback
5	Reserved
4	Reserved
3	It indicates the counting direction = 0 Not inverted. = 1 Inverted.
2	Reserved
1	Reserved
0 (LSB)	It indicates the type of feedback. = 0 Rotary encoder See NP117 . = 1 Linear encoder. See NP118 .

Valid values: 0 ... 255.

Default value: 0.

RV1	s	F01506	FeedbackSine
RV2	s	F01507	FeedbackCosine

Function: Sine and cosine of the feedback that goes from the motor to the drive as internal system variables.

Valid values: - 32 768 ... 32 767.

Note. From software version 06.03 on, when using square-wave motor feedback, these two variables may have incremental square-wave signals for display and diagnostics.

RV3	F	F01508	FeedbackRhoCorrection
-----	---	--------	-----------------------

Function: Variable that can be used to display position shift between the sensor's shaft and the motor's rotor shaft. The motors are factory set and the value of this variable is stored in the encoder memory. The execution of the EC1 command acts upon that value saved into the encoder.

Valid values: 0 ... 65 535.

RV4		F01509	FeedbackRadius
-----	--	--------	----------------

Function: Variable that may be used to display the radius of the circle formed by the RV1 and RV2 signals.

Valid values: 0 ... 32 767.

RV5		F01515	StegmannType
-----	--	--------	--------------

Function: This variable contains a 16-bit numerical data. The most significant bits indicate the type of encoder installed at the motor according to the following table:



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TABLE S13.22 Variable RV5. Meaning of its bits.

Bits	Name	Meaning
7 - 0	02H	Encóder SinCos
	07H	Multi-turn absolute SinCos encoder
	12H	Encóder SinCoder
	27H	Multi-turn absolute Sincoder encoder
15 - 8		Reserved

RV6		F01510	EncoderError
-----	--	--------	--------------

Function: Variable that contains a list of feedback errors for the exclusive use of Fagor technicians.

RV7		F01511	StegmannMotorType
-----	--	--------	-------------------

Function: The encoder of the motors stores in its memory the motor identifying reference. This RV7 variable reflects in the drive's memory the sales reference saved in the encoder. See the sales references in chapter 12 of the "dds-hardware" manual. RV7 will keep that value as long as the motor is not changed.

Valid values: The sales references of the motors appearing in chapter 12 of the "dds-hardware" manual.

RV8	F	F01512	CircleAdjust
-----	---	--------	--------------

Function: Variable to set the activation of the circle adjustment. This adjustment consists in setting parameters RP1, RP2, RP3 and RP4 to the proper values so the motor runs more quietly. It is called "circle adjustment" because the sine and cosine signals handled by software (RV1 and RV2) must be mathematically correct, i.e. they generate a perfect circle. **This procedure can only be applied to encoders, not to resolvers.** See **chapter 2** of this manual.

Valid values:
 0. Adjustment in progress.
 1. Adjustment completed.

RV9	W	F01514	Feedback1ErrCounter
-----	---	--------	---------------------

Function: This variable may be used to count the failures (they do not have to be consecutive) that occur on incremental signals with motor feedback (e.g.: those caused by noise). See error code **E605** of the error listing of chapter 14 of this manual.

Valid values: 0 ... 2 147 483 647.

Version: Operative from version 06.02 on.

RV10	s	F01517	FeedbackRhoDisplacement
------	---	--------	-------------------------

Function: Variable useful when adjusting the rho when using a resolver or an incremental encoder. It may be used to display the angular displacement of the feedback with respect to the shaft. When turning one with respect to the other (the rotor being locked) this variable will change its value dynamically. The rho will be adjusted when its value reaches zero.

Valid values: - 32 768 ... 32 767. (mechanical degrees).

Default value: 0 (rho adjusted).

Version: Operative from version 06.03 on.

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PARAMETERS, VARIABLES AND COMMANDS
R group. Rotor sensor



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PARAMETERS, VARIABLES AND COMMANDS
R group. Rotor sensor

RV11		F01521	SerialNum
------	--	--------	-----------

Function: Serial number recorded in a Stegmann SinCos or Sin-Coder encoder.
E. g. E10008911. See note further below.

Version: Operative from software version 06.20 on.

RV12		F01522	ProgramVer
------	--	--------	------------

Function: Program version recorded in a Stegmann SinCos or SinCoder encoder.
E. g. SINCOD_7.HEX. See note further below.

Version: Operative from software version 06.20 on.

RV13		F01526	Date
------	--	--------	------

Function: Recording date of a Stegmann SinCos encoder. E. g. 01.10.08. See note further below

Version: Operative from software version 06.20 on.



Note. The data of the Stegmann SinCoder encoder must always be read from the variables RV11, RV12 and RV13 while the drive is NOT under power.

RV14		F01527	TempEncoder
------	--	--------	-------------

Function: Temperature in °C of a Stegmann SinCos encoder. E. g. 10.

Version: Operative from software version 06.20 on.

RV15		F01528	EncoderEEPR_Size
------	--	--------	------------------

Function: Size of the EEPROM memory (in bytes) of a Stegmann SinCos encoder. E. g. 256.

Version: Operative from software version 06.20 on.

RV16		F01529	EncoderType
------	--	--------	-------------

Function: Type of Stegmann encoder. May be:

- SinCos E0
- SinCos Multi A0
- SinCos E2 or E3
- SinCoder E1
- SinCoder Multi A1

Version: Operative from software version 06.20 on.

RV17	F	F01531	DataFile2
------	---	--------	-----------

Function: Write variable of free-text (e.g. a reference) so as to later record (executing the RC3 command) the content of this variable into the field 2 of a Stegmann encoder. See note further below.

Version: Operative from software version 06.20 on.

RV18	F	F01532	DataFile3
------	---	--------	-----------

Function: Write variable of free-text (e.g. a serial number) so as to later record (executing the RC3 command) the content of this variable into the field 3 of a Stegmann encoder. See note further below.

Version: Operative from software version 06.20 on.



The fields 2 and 3 of the Stegmann SinCoder encoder must always be recorded with the contents of variables RV17 and RV18 while the drive is NOT under power.



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RV51	s	F01556	Feedback2Sine
RV52	s	F01557	Feedback2Cosine

Function: Sine and cosine of the feedback that goes from the direct feedback to the drive as internal system variables.

Valid values: - 32 768 ... 32 767.

RV54		F01559	Feedback2Radius
------	--	--------	-----------------

Function: Variable that may be used to display the radius of the circle formed by the RV51 and RV52 signals.

Valid values: 0 ... 32 767.

RV59	W	F01516	Feedback2ErrCounter
------	---	--------	---------------------

Function: This variable keeps track of the failures (they do not have to be consecutive) that occur on incremental signals with direct feedback (e.g.: those caused by noise). See error code **E608** of the error listing of chapter 14 of this manual.

Valid values: 0 ... 4 294 967 295.

Version: Operative from version 06.02 on.

RC1	O	F01513	Encoder ParameterStoreCommand
-----	---	--------	----------------------------------

Function: Its features are:

If SinCos encoder, it formats the encoder in the same way as the SinCoder is formatted. The formatting of the latter is fixed. Memory wise, it works the same with either SinCos or SinCoder.

It registers the encoder offset (only for asynchronous motors).

It registers the motor id set in MP1.

It registers the id version (internal use only).

RC2	O	F01520	ReadEncoderData
-----	---	--------	-----------------

Function: This command may be executed to save the data of the installed Stegmann SinCos or SinCoder encoder into variables RV11, RV12 and RV13. See the function of these variables for further detail.

Version: Operative from software version 06.20 on.

RC3	O	F01530	StoreEncoderData
-----	---	--------	------------------

Function: This command may be executed to record in fields 2 and 3 of a Stegmann SinCos or SinCoder encoder, the text stored in variables RV17 and RV18.

Version: Operative from software version 06.20 on.

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13.2.18 S group. Speed

13.

PARAMETERS, VARIABLES AND COMMANDS
S group. Speed

SP1.#	*	S00100.#	VelocityProportionalGain
SP2.#	*	S00101.#	VelocityIntegralTime

Function: Value of the proportional / integral action of the velocity PI.

Valid values: SP1: 0 ... 16384 mArms/(rpm).
SP2: 0,0 ... 1638.4 ms.

Important. The value of the integral action SP2 must be lowered in a factor of x16.

SP4.#	*	S00211.#	Velocity AdaptationProportionalGain
SP5.#	*	S00212.#	Velocity AdaptationIntegralTime

Function: Adaptation of the proportional / integral action of the PI at low speeds. SP4 is a factor by which SP1 is multiplied when the motor turns at a low speed. SP5 is the factor by which SP2 is multiplied at low speeds.

Valid values: 25.0 ... 400.0%. The action of the PI at low speeds may go from 25% to 400% of the action at high speeds. SP4-SP1/100 must be smaller than the maximum value that SP1 can take. SP5-SP2/100 must be smaller than the maximum value that SP2 can take.

Default value: 100.0%. Constant proportional / integral action at any speed.

SP6.#	O	S00209.#	VelocityAdaptationLowerLimit
-------	---	----------	------------------------------

Function: It is the upper limit of the speeds considered low.

Valid values: It must be lower than SP7 in rpm.

Default value: 10% of SP10 in rpm.

SP7.#	O	S00210.#	VelocityAdaptationUpperLimit
-------	---	----------	------------------------------

Function: It is the lower limit of the speeds considered high.

Valid values: It must be lower than SP10 in rpm.
It must be higher than SP6 in rpm.

Default value: 80% of SP10 in rpm.

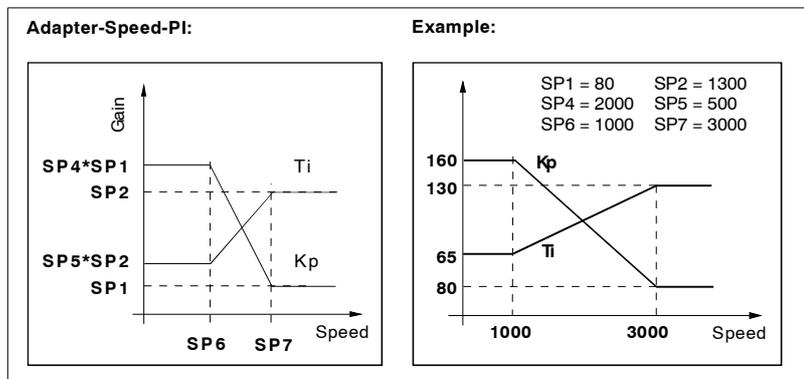


FIGURE S13.22

Graphic illustration shown the values of these parameters.



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SP10.#	O	S00091.#	VelocityLimit
--------	---	----------	---------------

Function: Maximum value that the variable SV7 (VelocityCommandFinal) can take.
If SV2 (VelocityFeedback) is 12% higher than the value of this parameter, it issues error code **E200** (overspeed).

Valid values: 1 ... 60 000 rpm. Depends on the motor connected.

Default value:	Synchronous: 110% of MP26 (MotorMaximumSpeed)
	Asynchronous: 100% of MP26 (MotorMaximumSpeed)

SP13.#	*O	F01601.#	VelocityIntegralResetThreshold
--------	----	----------	--------------------------------

Function: Parameter that disables the integral action of the velocity PI.
If the reference speed is lower than the value indicated in SP13 it disables the integral action of the velocity PI. SP13 = 0 disables the application.

Valid values: 0.0000 ... 1 000.0000 rpm.

Default value: 0.0000 rpm.

Version: Modified in software version 06.24.

SP15	*	F01598	SpeedObserverFrequency
------	---	--------	------------------------

Function: Cutoff frequency of the low passing filter of the estimator used to correct the estimated velocity.

Valid values: 0.0 ... 3000.0 Hz.

Default value: 125.0 Hz.

Version: Operative from software version 06.12 on. [Modified in software version 06.25.](#)

SP16	*	F01599	SpeedObserverDamping
------	---	--------	----------------------

Function: Damping factor of the low passing filter of the estimator used to correct the estimated velocity.

Valid values: 0.100 ... 30.000.

Default value: 1.000.

Version: Operative from software version 06.12 on. [Modified in software version 06.25.](#)

SP17	*	F01600	SpeedObserverEnable
------	---	--------	---------------------

Function: Parameter to activate or deactivate the estimator within the velocity loop.

Valid values: 0/1 Off/On.

Default value: 0 Deactivated (Off).

Version: Operative from software version 06.12 on.

SP20.#		F00031.#	VoltageRpmVolt
--------	--	----------	----------------

Function: Parameter SP20 and SP21 set the necessary ratio between the analog command and the motor speed. They correspond to the reference of the CNC concept G00 Feed.

Valid values: 1.000 ... 10.000 V.

Default value: 9.500 V.

SP21.#		F00081.#	RpmRpmVolt
--------	--	----------	------------

Function: See parameter [SP20.#](#).

Valid values: 10 ... 60 000 rpm. Depends on the motor connected.

Default value: 95% of the default value of SP10.

13.

PARAMETERS, VARIABLES AND COMMANDS
S group. Speed



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PARAMETERS, VARIABLES AND COMMANDS
S group. Speed

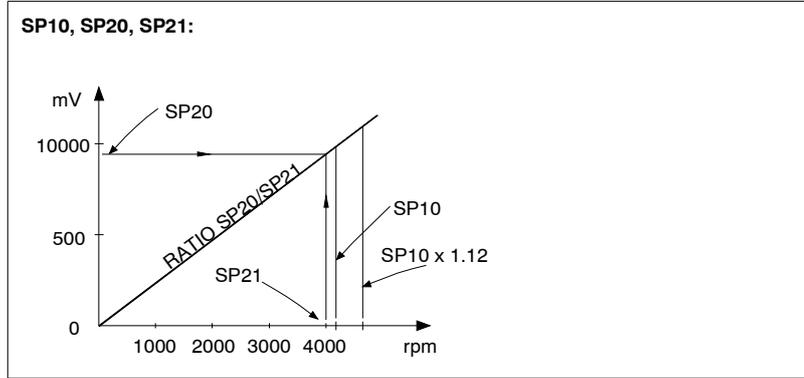


FIGURE S13.23

Graphic illustration shown the values of these parameters.

SP30	*s	F01603	AnalogInputOffset1
SP31	*s	F01604	AnalogInputOffset2

Function: Compensation of the offset of analog inputs 1 and 2 respectively.
Valid values: - 8 190 ... 8 190 mV.
Default value: 0.

SP40.#	O	S00125.#	VelocityThresholdNx
--------	---	----------	---------------------

Function: Velocity level under which logic mark $n_{\text{feedback}} < n_x$ activates.
 The logic mark is the SV3 variable. It may be used to know when the speed exceeds a particular value. This denomination n_x corresponds to the one defined by SERCOS. In the machine-tool environment, it is referred to as n_{min} .

Example.

We would like to know in a particular application when a motor exceeds 400 rpm. This parameter is set to 400. When the motor exceeds this speed, the associated mark SV3 is deactivated to 0.

Valid values: 0 ... SP10 rpm.
Default value: 20 rpm.

SP41.#	O	S00157.#	VelocityWindow
--------	---	----------	----------------

Function: Velocity window assigned to logic mark $n_{\text{feedback}} < n_{\text{command}}$.
 The value assigned to this parameter determines the margin of this window by excess or by defect.
 The logic mark is the SV4 variable. This mark is used to know when the real speed of a motor (n_{feedback}) has reached the supplied command (n_{command}) within the margins of that window SP41.

Valid values: 0 ... 12% of parameter SP10 rpm.
Default value: 20 rpm.



FIGURE S13.24

Velocity window.



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SP42	O	S00124	StandStillWindow
------	---	--------	------------------

Function: The velocity window for logic mark nfeedback=0. The logic mark is the SV5 variable.

Example.

In a particular application, we would like to know when the speed of the motor is lower than 10 rpm. Set SP42 = 10. When the motor does not exceed this speed, the associated mark SV5 is activated.

Valid values: 0 ... SP10 rpm.

Default value: 20 rpm.

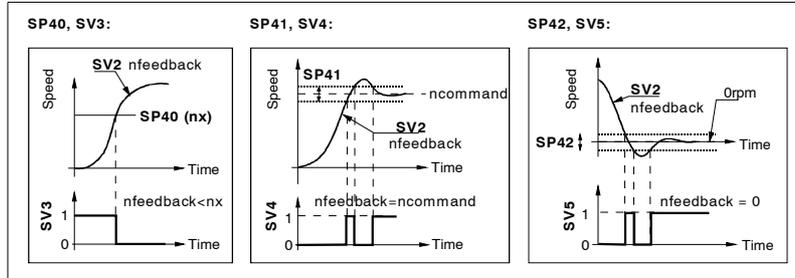


FIGURE S13.25

Graphic illustration shown the values of these parameters.

SP43	O	S00043	VelocityPolarityParameters
------	---	--------	----------------------------

Function: This parameter is used to change the polarity of the analog command when regulating with velocity command, both internally and for display. But not to change the sign of the velocity feedback where only the displayed data will be changed, not the internal value.

The motor will turn clockwise when the velocity command is positive and no command reversal has been programmed. **In position**, it changes internally neither the sign of the command nor that of the feedback. It does change in terms of monitoring.

This parameter cannot be used to solve a positive feedback problem (runaway) originated because the direct feedback is counting in the wrong direction. This case is solved using parameter PP115 (S00115) Position Feedback2Type.

TABLE S13.23 Parameter SP43. Meaning of its bits.

Bit Nr	Function
15 (MSB), ... 3	Reserved
2	Velocity feedback value. = 0 Not inverted. = 1 Inverted.
1	Reserved
0 (LSB)	Velocity command value. = 0 Not inverted. = 1 Inverted.

SP44		S00044	VelocityDataScalingType
------	--	--------	-------------------------

Function: Parameter that has to do with the type of scaling.

TABLE S13.24 Parameter SP44. Meaning of its bits.

Bit Nr	Function
15 (MSB), ... 2	Reserved
1, 0 (LSB)	Scaling method. = 10 Rotary.

Valid values: 2.

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PARAMETERS, VARIABLES AND COMMANDS
S group. Speed



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PARAMETERS, VARIABLES AND COMMANDS

S group. Speed

SP50	*O	F02014	Velocity FeedbackFilterFrequency
------	----	--------	-------------------------------------

Function: This parameter sets the cutoff frequency of the first order low-passing filter inserted in the velocity feedback.

Valid values:

0 ... 4000 Hz with sinusoidal encoder.
0 ... 1000 Hz with resolver.

Default value: 160 Hz in any motor with resolver feedback.
800 Hz in any synchronous motor without resolver feedback.
400 Hz in any asynchronous motor without resolver feedback.

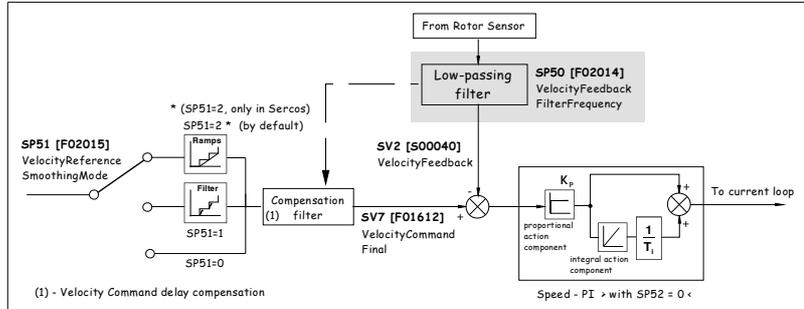


FIGURE S13.26

Location of low-passing filter SP50 in the control diagram.

SP51	*O	F02015	Velocity ReferenceSmoothingMode
------	----	--------	------------------------------------

Function: In velocity mode (e.g.: with the 8055 CNC), this parameter damps the velocity command and generates intermediate commands between those sent out by the CNC.

Valid values:

0. Deactivated.
1. Activate a first order filter of the velocity command.
2. Activate the velocity ramps (only in SERCOS)

Default value: 2. Activate velocity ramps.

Important. Remember that if SP80=0 and SP100=1, then setting SP51=2 will have no effect.

Version: Modified in software version 06.02.

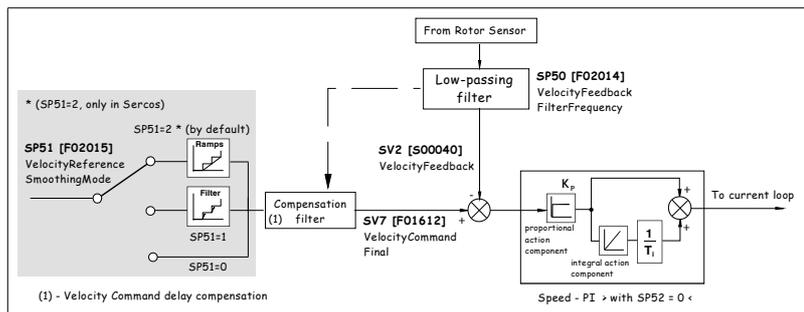


FIGURE S13.27

Velocity command damping filter in the control diagram.



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SP52	*O	F02017	VelocityLoopTimeConstant
------	----	--------	--------------------------

Function:

Parameter that may be used to model the velocity loop with a 1st order time constant. It is represented in the loop with a 1st order delay element P-T1. This parameter is inserted before the integral controller to compensate for the delay due to the velocity loop. Its value is set in ms. The right value makes the system more stable and it dampens its response.

Hence, it modifies the velocity loop with respect to software versions older than 06.08 when **SP52 ≠ 0**. This new loop integrates a velocity error estimate, not the error itself. It improves system stability resulting a damper response (less oscillating).

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PARAMETERS, VARIABLES AND COMMANDS
S group. Speed

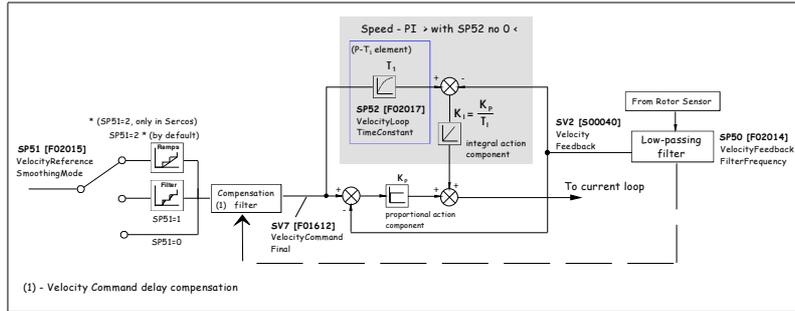


FIGURE S13.28

Structure of the velocity loop with SP52 other than 0.

Warning. A poor adjustment of parameter SP52 may make the control loop unstable.

Valid values: 0,0 ... 100,0 ms.

Default value: 0,0.

With **SP52=0** the structure of the velocity loop is the same as that of software versions older than 06.08. See **FIGURE S13.29**.

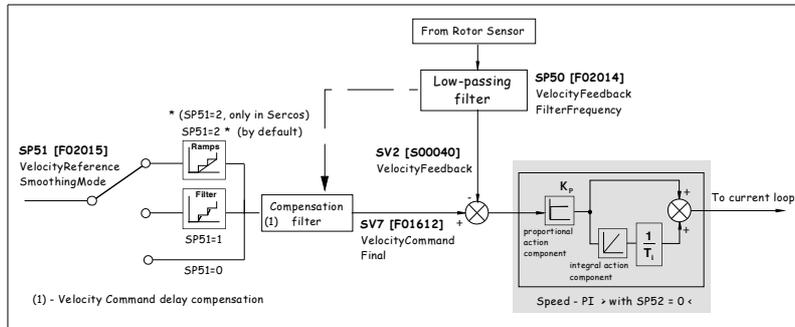


FIGURE S13.29

Structure of the velocity loop with SP52 = 0.

Version: Modified in software version 06.08.



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SP60.#	O	S00138.#	AccelerationLimit
SP62.#	O	F01606.#	AccelerationLimit2
SP64.#	O	F01608.#	AccelerationLimit3

Function: They define, with SP61 and SP63, the velocity command filtering ramps SV8. SP80 must be 0 in order for them to be effective.

SP60 is also useful in Jerk limitation mode.

Units: rad/s². The conversion is 1 rad/s² = 9.5492 rpm/s = 0.009545 rpm/ms.

Valid values: for SP60: 1.000 ... 2 147 486.647 rad/s².
for SP62 and SP64: 0 ... 32 767 rad/s².

Default value: 1 000.

SP61.#	O	F01605.#	AccelerationLimitVelocity2
SP63.#	O	F01607.#	AccelerationLimitVelocity3

Function: Velocity limit until which the acceleration 1/2 is active. They define, with SP60, SP61 and SP62 the ramps for filtering the velocity commands SV8. SP80 must be 0 in order for them to be effective.

Valid values: 0 ... 60 000 rpm.

Default value: 1 000 rpm.

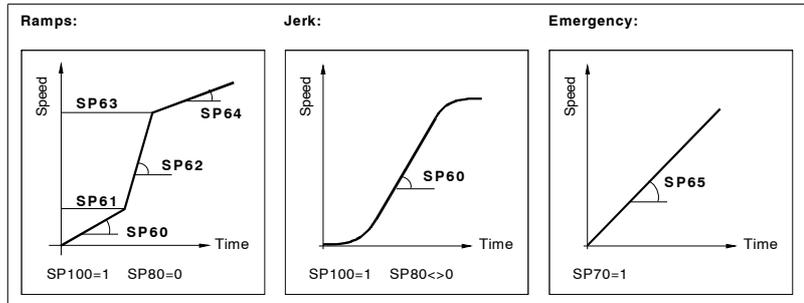


FIGURE S13.30

Graphic illustration shown the values of these parameters.

SP65.#	O	F01609.#	EmergencyAcceleration
--------	---	----------	-----------------------

Function: It limits the acceleration of the velocity command to stop the motor. A zero value cancels its limiting effect. SP70 must be 1 in order the SP65 limit to be applied in a stop.

Default value: For asynchronous motors: SP65 = 1000 rad/s².
For synchronous motors: For asynchronous motors, the user will calculate SP65 (with k = 0.8 as recommended value) as per the formula:
 $SP65 \leq k \cdot (CP20 \cdot MP2) / [MP24 \cdot (1 + 0.01 \cdot NP1)]$ where NP1 will be the value obtained by executing the command GC5 (AutoCalculate).
Depending on the application, k may take values within the $0.8 \leq k \leq 1$ range; the recommended value is k = 0.8.

Remember that the value to assign to SP65 must be equal to or smaller than the value obtained from the previous formula.

Units: rad/s². The conversion is 1 rad/s² = 9.5492 rpm/s = 0.009545 rpm/ms.

Valid values: 1.000 ... 2 147 483.647 rad/s².

Version: Modified in version 06.01.



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PARAMETERS, VARIABLES AND COMMANDS
S group. Speed

SP70	O	F01610	AccelerationOnEmergency
------	---	--------	-------------------------

Function: It determines whether the acceleration limitation given by SP65 is applied or not if there is a stop due to the cancellation of the Speed Enable (category 1 stop) or due to the activation of the Halt function (category 2 stop) or due to the activation of an error ("category 1 or 2" stop depending on whether the PWM is disconnected before or after the stop).

Valid values:

0. Ramps are not applied.
1. Ramps are applied.

Default value: 0. Ramps are not applied.

SP71	O	F01618	VelFollowMargin
------	---	--------	-----------------

Function: Threshold (maximum excess margin) in % of the motor speed with respect to the value given by the reference emergency ramp. Exceeding this threshold for a time period longer than the setting of SP72 activates error code **E160**. See **FIGURE S13.31**. SP71=0 disables ramp monitoring in emergency stop and the associated error code **E160**.

Valid values: 0, ..., 100 %.

Default value: 10 %.

Version: Operative from software version 06.20 on.

SP72	O	F01619	VelTimeMargin
------	---	--------	---------------

Function: Maximum time period that the speed threshold set in SP71 may be exceeded in the actual evolution of the braking operation before error code **E160** is activated. See **FIGURE S13.31**.

Valid values: 4, ..., 1000 ms.

Default value: 20 ms.

Version: Operative from software version 06.20 on.

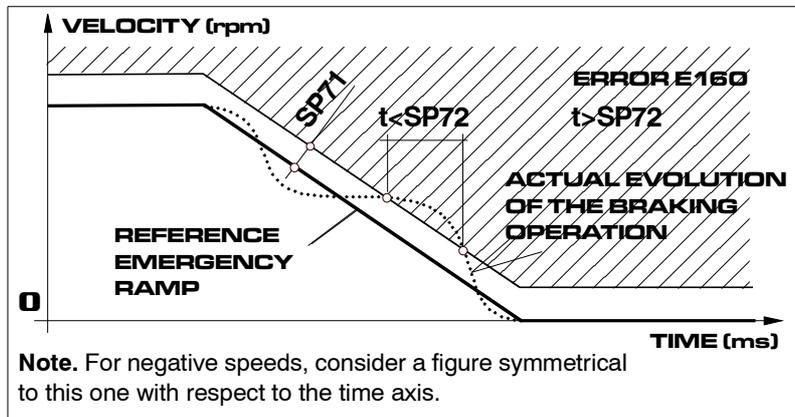


FIGURE S13.31

Emergency ramp watch while braking.

SP80.#	O	S00349.#	JerkLimit
--------	---	----------	-----------

Function: It limits the command jerk, i.e. how quickly the acceleration changes. It acts in conjunction with the acceleration limit SP60.

To cancel the effect of this limitation, set SP80=0.

Units: rad/s^3 . The conversion is $1 \text{ rad/s}^3 = 9.5492 \text{ rpm/s}^2$

Valid values: 0 ... 2 147 484 647 rad/s^3 .

Default value: 10 000 rad/s^3 .



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PARAMETERS, VARIABLES AND COMMANDS
S group. Speed

SP100.#	O	F01611.#	AccelerationLimitOn
---------	---	----------	---------------------

Function: It activates or cancels as a whole the command limitations and filters (ramps, jerk). It does not affect the limitation of the emergency acceleration.

Valid values: 0/1 Off/On.

Default value: 0. Limits off.

SV1	Ws	S00036	VelocityCommand
SV2	s	S00040	VelocityFeedback

Function: The drive transfer this data to the CNC to display the value of the velocity command and feedback.

Valid values: - 60 000.0000 ... 60 000.0000 rpm.

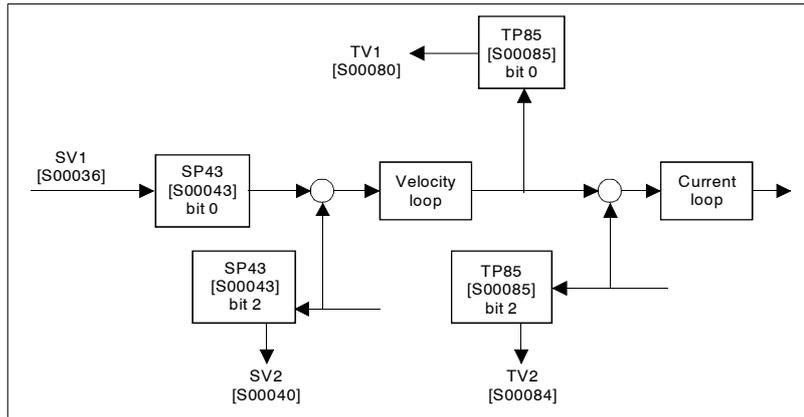


FIGURE S13.32

Graphic illustration shown the values of these parameters.

SV3		S00332	nFeedbackMinorNx
-----	--	--------	------------------

Function: Boolean logic mark associated with nfeedback < n_x. See parameter **SP40.#**.

Valid values: 0/1. No/Yes.

SV4		S00330	nFeedbackEqualNCommand
-----	--	--------	------------------------

Function: In velocity servo control, it is the Boolean logic mark associated with nfeedback = ncommand, i.e. when the SV2 value is within the range SV1±SP41, SV4 is activated to 1. See parameter **SP41.#**.

Valid values: 0/1. No/Yes.

SV5		S00331	nFeedbackEqual0
-----	--	--------	-----------------

Function: Boolean logic mark associated with nfeedback = 0. See parameter **SP42**.

Valid values: 0/1. No/Yes.

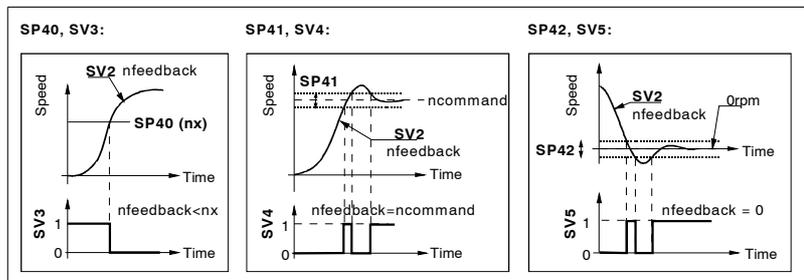


FIGURE S13.33

Graphic illustration shown the values of these parameters.



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SV7	s	F01612	VelocityCommandFinal
-----	---	--------	----------------------

Function: It reflects the value of the velocity command after limitations, ramps, etc.

Units: rpm.

Valid values: - 60 000.0000 ... 60 000.0000 rpm.

SV8	s	F01613	VelocityCommandBeforeFilters
-----	---	--------	------------------------------

Function: It reflects the value of the velocity command before limitations, ramps, etc.

Units: rpm.

Valid values: - 60 000.0000 ... 60 000.0000 rpm.

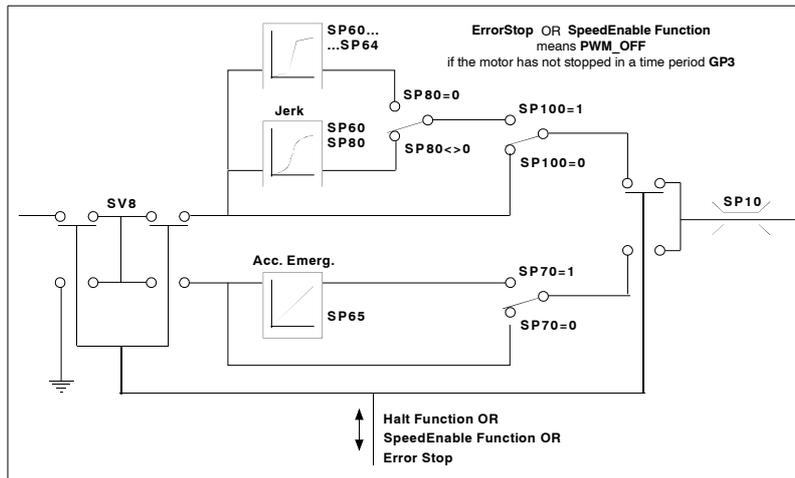


FIGURE S13.34

Graphic illustration shown the values of these parameters.

SV9	s	F01614	PositionCommandDelta
-----	---	--------	----------------------

Function: It may be used to display the position increments (position delta) of the command per cycle time.

Valid values: -2 147 484 647 ... 2 147 484 647 mm (for linear axes).
-2 147 484 647 ... 2 147 484 647 degrees (rotary axes).

Default value: 0.

SV10	s	F01615	PositionFeedback1Delta
SV11	s	F01616	PositionFeedback2Delta

Function: Load velocity measured with motor feedback or with direct feedback respectively.

Valid values: - 2 147 483.647, ..., 2 147 483.647 m/min.

Version: Operative from version 06.01 on.

SV12	s	F01617	ObserverVelocity
------	---	--------	------------------

Function: Variable that may be used to display the value of the estimated speed in rpm.

Valid values: - 60 000.0000 ... 60 000.0000 rpm.

Version: Operative from software version 06.12 on.

SV37	Ws	S00037	AdditiveVelocityCommand
------	----	--------	-------------------------

Function: Variable that stores an additional velocity value that is added to the velocity command.

Valid values: - 60 000.0000 ... 60 000.0000 rpm.

Version: Operative from version 06.10 on.

13.

PARAMETERS, VARIABLES AND COMMANDS
S group. Speed



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13.2.19 T group. Power and torque

13.

PARAMETERS, VARIABLES AND COMMANDS
T group. Power and torque

TP1	Os	S00126	TorqueThresholdTx
-----	----	--------	-------------------

Function: Torque threshold described by the user to activate logic mark TV10.

Units: Fraction of the rated value of the motor torque.

Valid values: 0.0 ... 100.0%. Depends on the drive connected.

Default value: 5.0%.

TP2	Os	S00158	PowerThresholdPx
-----	----	--------	------------------

Function: Power threshold described by the user to activate logic mark TV60. This threshold is given in a fraction of the motor power.

The motor power is:

In a synchronous motor, the product of 3 elements:

MP2 (F01200) MotorTorqueConstant.
MP3 (S00111) MotorContinuousStallCurrent.
MP25 (F01221) MotorRatedSpeed.

In an asynchronous motor:

MP12 (F01208) MotorNominalPower

Units: Fraction of the rated value of the motor power.

Valid values: 0.1 ... 100.0%.

Default value: 5.0%.

TP10	*OS	F01902	ConstantPositiveTorque Compensation
------	-----	--------	-------------------------------------

Function: Constant friction compensation in the positive direction of the velocity. It is a constant value for all the positive reference speeds.

Valid values: 0.0 ... (Max. torque of the drive = CP20 x MP2) Nm.

Default value: 0.0 Nm.

Version: Modified in software version 06.24.

TP11	*OS	F01903	ConstantNegativeTorque Compensation
------	-----	--------	-------------------------------------

Function: Constant friction compensation in the negative direction of the velocity. It is a constant value for all the negative reference speeds. It is set in absolute values.

Valid values: 0.0 ... (Max. torque of the drive = CP20 x MP2) Nm.

Default value: 0.0 Nm.

Version: Modified in software version 06.24.

TP12	*OS	F01904	DynamicPositiveTorque Compensation
------	-----	--------	------------------------------------

Function: Compensation of the dynamic friction in the positive direction of the velocity. It is the value of the compensation with the reference speed equal to SP10. It is directly proportional to other positive reference speeds. See previous figure.

Valid values: 0.0 ... (Max. torque of the drive = CP20 x MP2) Nm.

Default value: 0.0 Nm.

Version: Modified in software version 06.24.



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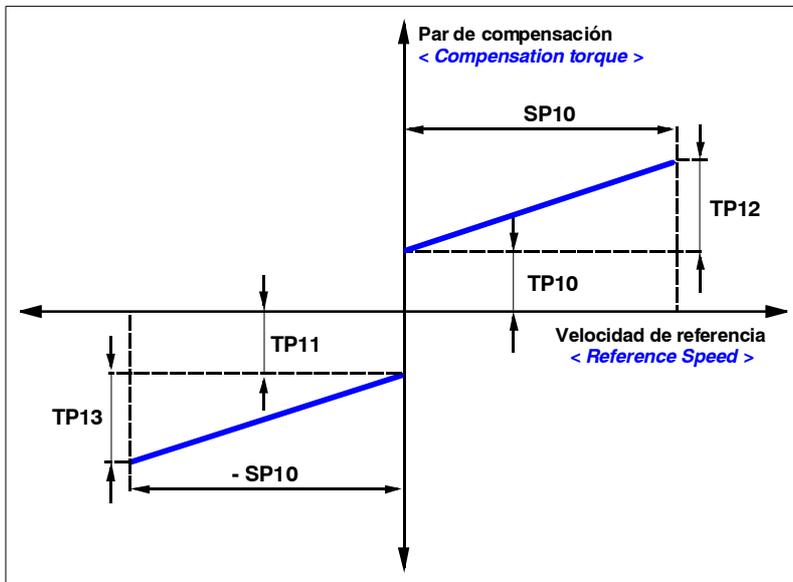


FIGURE S13.35

Graphic illustration shown the values of these parameters.

TP13	*OS	F01905	DynamicNegativeTorque Compensation
------	-----	--------	------------------------------------

Function: Compensation of the dynamic friction in the negative direction of the velocity. It is the value of the compensation with the reference speed equal to - SP10. It is directly proportional to other negative reference speeds. It is set as an absolute value, i.e. in positive, although the compensation has a negative value.

Valid values: 0.0 ... (Max. torque of the drive = CP20 x MP2) Nm.

Default value: 0.0 Nm.

Version: Modified in software version 06.24.

TP14	*OS	F01908	TorqueCompensation TimeConstant
------	-----	--------	---------------------------------

Function: Time constant of the torque compensation. Before applying the torque compensation, it goes through a low-passing filter. This filter better represents the friction behavior in velocity direction changes. The constant friction suddenly changes when changing the sign of the reference speed. When it goes through the filter, it smoothens the compensation torque without jerking the system and improving friction behavior. A 0 value cancels the friction compensations.

Valid values: 0.0 ... 3200.0 ms.

Default value: 0.0 ms.

Version: Modified in software version 06.15.

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PARAMETERS, VARIABLES AND COMMANDS

T group. Power and torque



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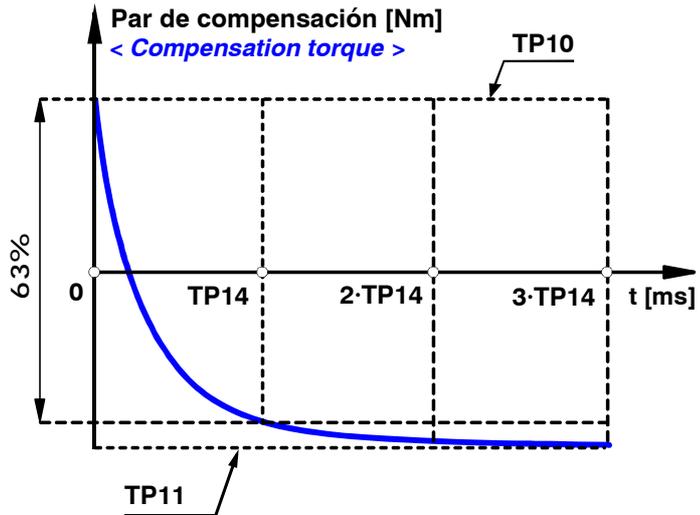
(Soft 06.2x)

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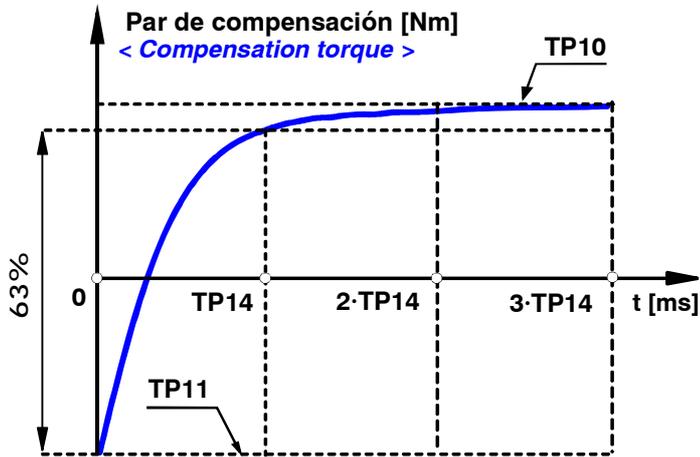
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PARAMETERS, VARIABLES AND COMMANDS
T group. Power and torque

Torque compensation when going from a positive speed value to a negative speed value.



Torque compensation when going from a negative speed value to a positive speed value.



Note that:

- Between (0, TP14) it sets 63% of torque compensation.
- Between (0, 2·TP14) it sets 87% of torque compensation.
- Between (0, 3·TP14) it sets 95% of torque compensation.

FIGURE S13.36

Graphic illustration shown the values of these parameters.

TP15	*OsS	F01909	TorqueCompensation SpeedHysteresis
------	------	--------	---------------------------------------

Function:

Amplitude of the hysteresis in friction torque compensation.
Note that with TP15=0, the drive internally sets a fixed amplitude of hysteresis of about SP10/10000 to compensate the friction as it has been done until version 06.10. Remember that SP10 corresponds to the maximum speed of the application.

For further detail, see the section "Improved friction compensation" of chapter 5 in this manual.

Valid values:

- 1 000.0000 ... 1 000.0000 rpm.

Default value:

0.0000 rpm.

Version:

Operative from version 06.10 on.



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TP22	*FA	F01914	MotorPowerReduction
------	-----	--------	---------------------

Function: Percentage reduction of power level. It is used to reduce power when requiring a wide range of speeds at constant power. The rated power of the selected motor must be greater than what the application requires in order to be able to provide the required power even at very low speed.

The same for high speed. The range where the motor outputs the application's minimum power is wider than when using a motor whose rated power is what the application requires.

Valid values: 0.0 ... 100.0%.

Default value: 100.0%.

Version: Operative from version 06.01 on.

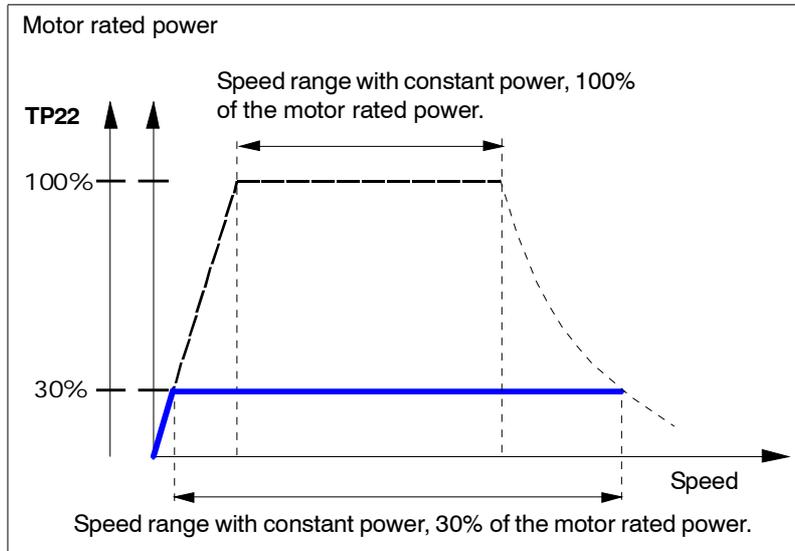


FIGURE S13.37

Graphics showing this parameter.

TP85	O	S00085	TorquePolarityParameters
------	---	--------	--------------------------

Function: This parameter is used to change the sign of certain torque data in specific applications. It will only change the sign of the monitored data, but not internally. The motor turns clockwise when the torque command is positive and no command reversal has been programmed. This parameter cannot be used to solve a positive feedback problem (runaway) originated because the direct feedback is counting in the wrong direction. This case is solved using parameter PP115 (S00115) PositionFeedback2Type.

TABLE S13.25 Parameter TP85. Meaning of its bits.

Bit Nr	Function
15 (MSB), ... 3	Reserved
2	Torque feedback value. = 0 Not inverted. = 1 Inverted.
1	Reserved
0 (LSB)	Torque command value. = 0 Not inverted. = 1 Inverted.

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PARAMETERS, VARIABLES AND COMMANDS
T group. Power and torque



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TP86		S00086	TorqueScalingParameters
------	--	--------	-------------------------

Function: This parameter indicates the units to write and read the torque value, besides other aspects. It is initialized with the value indicating that the torque is referred to the motor, i.e. 0. The units are given in % of the rated motor torque. See variables TV1 and TV2.

Remember that currently this parameter TP86 is initialized with all its bits to "0" and it is a **read-only** parameter, i.e. **it cannot be modified**.

Valid values: 0.
Version: Operative from version 06.01 on.

TV1	s	S00080	TorqueCommand
TV2	s	S00084	TorqueFeedback

Function: The drive transfer this data to the CNC to display the value of the torque command and feedback.
Valid values: - 1 000.0 ... 1 000.0%.
Units: They are read and/or written as % of the rated torque according to TP86.

The rated torque is obtained:

Motor type	Rated motor torque
Synchronous	MP2 (Nm/Arms) x MP3 (Arms).
Asynchronous	(MP12 (kW) x 1000 x 60) / (2π x MP25 (rpm))

TV3	s	F01701	PowerFeedbackPercentage
-----	---	--------	-------------------------

Function: Instantaneous display of the power percentage used with respect to the maximum power available in the servo system (motor, drive, current limit) at that speed.
Valid values: 0.0 ... 3276.7%.

TV4	s	F01912	VelocityIntegralAction
-----	---	--------	------------------------

Function: Output of the velocity PI integrator. When the acceleration is not extremely high, it is the same as the friction torque. When compensating for friction, the value of this variable must be reduced to near zero.
Valid values: - 1 000.0 ... 1 000.0 Nm.

TV5	sS	F01913	TorqueFeedforward
-----	----	--------	-------------------

Function: Variable that stores the total value of the compensated torque [sum of the compensated torque due to acceleration (acceleration feed-forward) and the compensated torque due to friction] in % of the rated torque. Comparing the value of this variable with that of the real torque (given as % of the rated torque in the variable TV2) gives an idea of how much is left to compensate in the movement.
Valid values: - 1 000.0 ... 1 000.0%.
Version: Operative from version 06.10 on.



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TV10		S00333	TGreaterTx
------	--	--------	------------

Function: Logic mark indicating that the torque TV2 is greater than a threshold value TP1. See parameter **TP1**.

Valid values:

= 0	TV2 < TP1
= 1	TV2 > TP1

TV50	s	F01700	PowerFeedback
------	---	--------	---------------

Function: Displaying the real value of the total active power supplied by the motor, i.e. its useful power. The sign depends on whether the motor is accelerating (+) or braking (-).

Valid values: - 100.00 ... 100.00 kW.

TV51	sA	S00385	ActivePower
------	----	--------	-------------

Function: Display of the real value of the total active power supplied by the drive; in other words, the useful power supplied by the asynchronous motor plus the sum of all the power losses in the motor itself and in the cables. The sign of this variable depends on whether the motor is accelerating (+) or braking (-).

Valid values: -2 147 483.647, ..., 2 147 483.647 W.

Version: Operative from version 06.15 on.

TV60		S00337	PGreaterPx
------	--	--------	------------

Function: Logic mark indicating that the power TV50 is greater than a threshold value TP2. See parameter **TP2**.

Valid values:

= 0	TV50 < TP2.
= 1	TV50 > TP2.

TV81	Ws	S00081	AdditiveTorqueCommand
------	----	--------	-----------------------

Function: Variable with an additional function to control the torque at the drive whose value is added to the value of the torque command and whose units are given in % of the rated torque.

Valid values: - 1 000.0 ... 1 000.0%

Version: Operative from version 06.10 on.

TV92	O	S00092	BipolarTorqueForceLimit
------	---	--------	-------------------------

Function: Limit of maximum torque that motor can provide. It is given in % of the maximum limit indicated by parameter CP20 (current limit).

Valid values: 0 ... 1 000.

Default value: 1 000.

TV100		F01702	TorqueStatus
-------	--	--------	--------------

Function: It indicates whether there is torque or not.

Note that there is torque when braking !
The error causing it to brake does not disable the torque.

Valid values: 0/1 There is no torque / There is torque.

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PARAMETERS, VARIABLES AND COMMANDS

T group. Power and torque



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13.2.20 X group. Miscellaneous

XV1		F01900	One
XV2		F01901	Zero

Function: These variables are used to force a 1 or 0 through a logic output. This way, write a 0 so a digital input does not carry out any function.

Example.

OP10=XV1 It forces a logic 1 at the digital output.
 IP12=0 Removes the digital input from any function.

XV10	Ws	F02032	GeneralVariable32A
XV11	Ws	F02033	GeneralVariable32B

Function: 32-bit variables used to display CNC variables. It is also possible to write in them from the CNC using SERCOS. This way, they are available at the drive so they can be monitored and display on the WinDDSSetup.

They are normally used to display the following error. A PLC program assigns the variable to be monitored to the SERCOS ID so these variables may be selected on the oscilloscope.

XV12	W	F02034	ReadPlcMarksGroup
XV13	W	F02035	WritePlcMarksGroup

Function: Variables that may be used to share information in real time between the PLC of the 8055/55i CNC and the drive. They make it possible read and write marks through SERCOS Communication.

Note that if these variables are set in the 8055/55i's fast channel, the PLC of the CNC can read and write these marks as if they were its own registers with the logic delay of the SERCOS loop.

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PARAMETERS, VARIABLES AND COMMANDS
 X group. Miscellaneous



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13.3 Glossary of parameters, variables and commands

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00012	DV9	Class2Diagnostics (Warnings)	257
00013	DV10	Class3Diagnostics (OperationStatus)	258
00030	GV2	ManufacturerVersion	265
00032	AP1	PrimaryOperationMode	249
00033	AP2	AsynchronousRegulationTime	249
00036	SV1	VelocityCommand	336
00037	SV37	AdditiveVelocityCommand	337
00040	SV2	VelocityFeedback	336
00041	PP41	HomingVelocityFast	303
00042	PP42	HomingAcceleration	303
00043	SP43	VelocityPolarityParameters	331
00044	SP44	VelocityDataScalingType	331
00047	PV47	PositionCommand	312
00048	PV48	AdditivePositionCommand	312
00049	PP49	PositivePositionLimit	304
00050	PP50	NegativePositionLimit	304
00051	PV51	PositionFeedback1	312
00052	PP52	ReferenceDistance1	304
00053	PV53	PositionFeedback2	312
00054	PP54	ReferenceDistance2	304
00055	PP55	PositionPolarityParameters	304
00057	PP57	PositionWindow	306
00058	PP58	Backlash	306
00060	LP60	PosSwitch1On	276
00061	LP61	PosSwitch1Off	276
00062	LP62	PosSwitch2On	276
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00064	LP64	PosSwitch3On	276
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00084	TV2	TorqueFeedback	342
00085	TP85	TorquePolarityParameters	341
00086	TP86	TorqueScalingParameters	342
00091	SP10	VelocityLimit	329
00092	TV92	BipolarTorqueForceLimit	343
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Glossary of parameters, variables and commands



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00110	HV1	S3LoadCurrent	269
00111	MP3	MotorContinuousStallCurrent	285
00115	PP115	PositionFeedback2Type	308
00116	NP116	ResolutionOfFeedback1	292
00117	NP117	ResolutionOfFeedback2	292
00118	NP118	ResolutionOfLinearFeedback	292
00121	NP121	InputRevolutions	293
00122	NP122	OutputRevolutions	293
00123	NP123	FeedConstant	293
00124	SP42	StandStillWindow	331
00125	SP40	VelocityThresholdNx	330
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00134	DV32	MasterControlWord	259
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00157	SP41	VelocityWindow	330
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00165	NP165	DistanceCodedReferenceDimension1	295
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PARAMETERS, VARIABLES AND COMMANDS
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Activating any of the errors listed in this chapter causes some effects on the system that depend on the chosen type of communication interface.

Analog interface

The activated error code is shown on the drive's display.

SERCOS interface

The activated error code is shown on the drive's display.

The CNC screen displays this error code.

The CNC may display the errors listed in this chapter as well as the codes and texts of SERCOS communication errors.

The drive activates bit 13 of the variable DV31 (S00135).

The drive activates the bit corresponding to the error in the variable DV31 (S00135).

CNC actions

- ❑ It interrupts program execution.
- ❑ It stops the movement of the axes and spindles.
- ❑ Marks /ALARM and O1 are set to zero. These marks must be present in the PLC program that will handle this emergency without having to know which error has been activated.

The system cannot start working until all the errors detected by the drive have been eliminated.

They may be:

Errors that can be reset

Definition. Errors that can be eliminated with a "reset" after eliminating their cause.

Procedure. The errors may be "reset" through pin 1 "ERROR RESET" of connector X2 of the power supply module, (connector X6 if it is an RPS power supply). On compact drives (that integrate the power supply) through pin 3 of connector X2.

When using SERCOS communications interface, the errors are reset like any other CNC error.

Errors that cannot be reset

Definition. Errors that cannot be eliminated with a "reset" after eliminating their cause; in other words, the previous procedure cannot be used to eliminate them.

Procedure. Eliminate the cause for the error and when eliminated, turn the unit back on.

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The errors that cannot be reset are:

TABLE S14.1 Errors that cannot be reset.

E001	E002	E005	E006	E007	E008	E009	E010	E031	E050
E051	E052	E053	E054	E055	E100	E101	E102	E103	E104
E105	E109	E211	E216	E305	E410	E501	E502	E503	E504
E505	E506	E507	E508	E604	E605	E606	E607	E608	E700
E701	E702	E703	E704	E705	E706	E707	E800	E801	E802
E803	E804	E805	E807	E808	E809	E810	E811	E812	E813
E814	E816	E817	E900						

Activating any of the errors both "resettable" and "non-resettable" causes a category 1 stop.

Errors that deactivate PWM

Definition. Errors that interrupt the current circulating through the motor windings.

Procedure. Eliminate the cause for the error and when eliminated, turn the unit back on.

They are errors that deactivate PWM:

TABLE S14.2 Errors that cut the current circulation through the motor.

E002	E004	E005	E006	E007	E109	E160	E200	E202	E203
E211	E212	E213	E214	E215	E216	E302	E303	E304	E306
E314	E315	E316	E410	E500	E501	E502	E503	E504	E506
E507	E508	E604	E605	E606	E607	E608	E609	E700	E701
E702	E703	E704	E705	E706	E707	E801	E802	E803	E804
E806	E807	E808	E809	E810	E811	E813			

Activating any of the errors mentioned in **TABLE S14.2** causes a category 0 stop.



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14.1 Meaning of error codes and solutions

E001	Internal. Contact Fagor Automation S. Coop.
E002	Internal. Contact Fagor Automation S. Coop.
E003	If there is torque, the power bus drops. Possible drop on any of the three-phase lines or any of the drives failed. Check the proper condition of the lines and drives and restart the system up.
E004	The stopping time limit established in GP3 has been exceeded. Attempt of a category 1 stop. The system tries to stop the motor at full torque, but it cannot do it in a time period shorter than the one set in parameter GP3. The delay when eliminating pulses is the same as the maximum time period permitted for braking, before considering E004 because it cannot stop in the established time period or parameter SP42 (that determines when the motor is stopped) is too short. Bear in mind that zero speed (total lack of velocity) does not exist, there is always a minimum amount of speed noise due to feedback. May be: <ul style="list-style-type: none"> □ The load is too large for the motor to stop in the timeframe set by GP3. Hence, increase the value of this parameter. □ The velocity threshold or window SP2 considered as zero may be too small. Hence, increase the value of this parameter. □ The module may be performing poorly and is unable to stop the motor. Failure at the drive module.
E005	Code checksum error. The checksum of the loaded program code is not correct. Load the software again. If the problem persists, either the RAM, FLASH memories or the loaded code may be defective. Contact Fagor Automation S. Coop.
E006	Error on the SERCOS board. Replace the SERCOS board. If the error persists, replace the VeCon board.
E007	Failure of the clock of the SerCon board.
E008	Failure due to corrupted SerCon memory.
E009	Non-volatile data loss.
E010	Damaged non-volatile data.
E031	Internal. Contact Fagor Automation S. Coop.

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E050-55	"Internal PLC compilation" error.
	Refer to the chapters about the PLC in the "dds-mc" manual that describe the meaning of this error. Correct the program.
E066-69	PLC execution error.
	Refer to the chapters about the PLC in the "dds-mc" manual that describe the meaning of this error.
E100	Internal +5V out of range.
E101	Internal -5V out of range.
E102	Internal +8V out of range.
E103	Internal -8V out of range.
E104	Internal +18V out of range.
E105	Internal -18V out of range.
E106	Extreme temperature at the heatsink (of the IGBT's).
	The drive is carrying out a task that overheats the power devices. Stop the system for several minutes and decrease the effort demanded from the drive.
E107	Drive overheated (CPU board).
	The temperature of the drive enclosure is too high. Decrease ambient temperature.
E108	Motor overheated.
	The motor temperature measuring cables (position sensor cable) or the temperature sensor are in poor condition. The application demands high current peaks. Stop the system for several minutes and decrease the effort demanded from the drive. Fan the motor.
E109	Over-voltage at the digital inputs.
	The digital inputs of the drive receive a voltage higher than what they've been set for. Check the configuration (parameter IP5) and the electrical voltage applied.
E110	Low IGBT heatsink temperature.
	The drive is under a temperature equal to or lower than 0 °C, in other words, too low. Bring the temperature up. Maybe the sensor or the cable is defective.
E150	Travel limit overrun.
	The travel limits set by parameters PP49 and PP50 have been exceeded. Activating this error opens the DR_OK contact at the drive. After restoring power to the servo drive system, the axis may be moved to the permitted zone.



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Check the limit values and the programming of movements so it does not happen again.

From version 06.03 on, after completing a home search, the software checks the initial coordinates. This error will come up (when regulating in position or velocity) if the coordinate obtained (PV53 or PV51, whichever the case may be) is out of limits and they are enabled (PP55.4=1).

E152

Command module exceeded.

Being the command in module format, a command has been received whose value exceeds the module set by parameter PP103.

Check the value of this parameter and that of its equivalent parameter at the CNC.

Make sure that they both work in the same command mode.

E153

Too much increase in the position command.

The path required by the position command generates a velocity command that is too high, i.e. the feedrate programmed at the CNC is higher than the maximum value given in SP10 (maximum value that the velocity command may reach after limits, ramps, etc.). The programmed feedrate is m/min and SP10 in rev/min. The formula to unify the units to m/min is:

$$\text{Programmed Feedrate} > \text{SP10} \cdot \frac{\text{NP122} \cdot \text{NP123}}{\text{NP121}}$$

Decrease the demands on the path in terms of required speed; i.e. decrease the programmed feedrate or change the gear ratio.

E154

Feed-forward speed command too high.

The path required by the position command causes a feed-forward velocity command that is too high.

Decrease the demands on the path in terms of required speed.

E155

Feed-forward acceleration command too high.

The path required by the position command causes a feed-forward acceleration command that is too high.

Decrease the demands on the path in terms of required acceleration.

E156

Too much following error (axis lag).

The servo system follows the position command with a "PV189 FollowingError" greater than what is allowed by the "PP159 MonitoringWindow"

Check the settings of all the aspects affecting the following error as well as the value given to parameter PP159.

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E157

Too much difference in actual (real) position.

This error may come up with position or velocity control and whenever parameter PP5 is enabled.

It occurs when the deviation or difference between the values of the motor feedback and direct feedback exceeds, for at least 20 ms, the maximum permissible error set in parameter PP5 (ActualPositionMonitoring Window).

Check the setting of parameter PP5 (range too small).
Check that the difference between the values of PV190 and PP5 are not disproportionate. If it is, either the feedback parameters are set wrong, or the connection cables, feedback devices, etc. are in poor condition or damaged.

E158

Excessive position deviation when calculating the electrical position with the GC7 command.

Greater movement than the maximum indicated in parameter "PP160 (F01303) MonitoringWindowPos EleCalc" during the execution of the command GC7. Remember that this command **estimates** the electrical position when powering up a synchronous motor without absolute position in 1 revolution. This error may be disabled.

Increase the value set in PP160.

E159

Wrong reading (counting) direction when executing the GC3 command.

Phases swapped in the power cable, in the motor feedback or in both.

This error may be reset.

Correct the order of the phases in the cable connection.

E160

Following error in the emergency ramp while braking.

Error indicating that the stop does not follow the emergency ramp provided while braking within the limits set in parameters SP71 and SP72. Error that can be reset.

Adjust the braking demands of your machine and/or set the mentioned parameters accordingly.

E200

overspeed.

The motor speed has exceeded the value of SP10 in a 12%.

Check the cables of the position sensor or of the motor power.

Maybe, the velocity loop is not adjusted properly.

Reduce the overshoot of the velocity response.

E201

Motor overload.

The I²t protection of the motor went off.

The duty cycle is greater than the motor can provide.

E202

Drive overload.

The I²t protection of the drive went off.

The duty cycle is greater than the drive can provide.



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E203

Torque overload error.

- A. The motor has locked up and it could not turn freely. With high motor torque, the turning speed has not exceeded GP8 for a time period longer than GP7.
Free the motor and if the error comes up again for no reason, increase the values of GP7 and/or GP8. To cancel this error and prevent it from coming up again, set GP7=0
- B. Verify that:
 - Two phases have not been swapped and that the power cables make good contact.
 - The feedback cable is not defective and the pin-to-pin connection is correct (especially if the user has made the cable).
 - The value of NP116 (with 0 motors) is correct.
 - The value of RV3 (or RP5 when using a resolver) is correct.

E205

The motor has no voltage for the demanded work conditions.

- A. The motor does not have enough voltage to provide the demanded torque. With high motor torque, the turning speed has not exceeded GP8 for a time period longer than GP7.
Increase the voltage at the motor or decrease the demanded work conditions and if the error comes up again for no reason, increase the values of GP7 and/or GP8. To cancel this error and prevent it from coming up again, set GP7=0
- B. Verify that:
 - There is no loose phase while the motor is stopped.
 - See speeds close to the rated speed in the torque-speed curve of the corresponding motor in the motor manual and observe that this situation occurs for the required torque and speed conditions. Therefore:
Increase the value of the mains voltage if you don't wish to change these work conditions or decrease the acceleration value or the maximum feedrate value.
 - Do the verifications listed in section B of error code **E203**.

Note that up to software version 06.11, error code **E205** generated a category 0 stop. From version 06.12, it sets a category 1 stop.

E206

Velocity command.

The velocity command received (in velocity loop) exceeds the maximum command of the SP10 motor.

E211

Internal.

Contact Fagor Automation S. Coop.

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E212	Over-current. Too much current has been detected circulating through the drive module. The drive is running poorly. Reset the error, because the parameter settings may be wrong causing current overshooting.
E213	Under-voltage at the driver of the IGBT. Low supply voltage has been detected at the IGBT triggering circuits of the drive module. The driver of the IGBT or the IGBT itself may be defective. Reset the error and if it persists, contact Fagor Automation S. Coop.
E214	Short-circuit. A short-circuit has been detected at the drive module. Reset the error and if it persists, the power cable connecting sequence may be wrong or they may touch each other causing the short-circuit. The parameters may be wrong or the drive may be faulty. Contact Fagor Automation S. Coop.
E215	Power bus voltage too high (hardware). The hardware of the drive module has detected that the voltage at the power bus is too high. The connection bridge of the internal ballast is missing (see these connectors). Poor connection if an external ballast is used. The Ballast resistor is burned. Disconnect the power supply and check the proper connection of the Ballast circuit. Check that the power bus plates are tightly fastened. See errors codes E304 and E306 .
E216	Internal. Contact Fagor Automation S. Coop.
E250	Home search error. Contact Fagor Automation S. Coop.
E251	DriveControlledHoming command error Contact Fagor Automation S. Coop.
E253	I0 not found in two turns. Make sure that NP166 has been set properly as well as the encoder parameters and/or position parameters Verify that the feedback cable, the encoder itself or the drive's hardware are not defective.
E254	Distance-coded I0's read wrong. Check the installation of the linear encoder and reader head of the direct feedback.
E255	Error when changing the feedback after executing the PC150 command (feedback change). Check that parameter AP1 is set to 5 or 13.



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E256**Reference mark signal distance error per turn of the feedback device.**

Error indicating the lack of repeatability of the reference mark signal at each revolution of the feedback device. Some pulses are being lost and/or the measurement provided by the feedback device is wrong. Error that can be reset.

Check that the connection and the cables are OK.

Check that the number of pulses permitted as margin of error is not too low. Increase the value of RP9 slightly and see if the error occurs again.

If the error persists, the feedback device may be defective. Replace it.

E300**Over-temperature at the heatsink of the power supply or of the compact module.****E301****Over-temperature at the Ballast circuit of the power supply or of the compact module.**

The temperature of the heatsink or ballast circuit of the power supply module is too high.

Stop the system for several minutes and decrease the effort demanded from the drive.

E302**Short-circuit at the ballast of the power supply module.**

Contact Fagor Automation S. Coop.

E303**Supply voltage of the Ballast circuit driver out of range.**

Contact Fagor Automation S. Coop.

E304**The voltage of the power bus of the PS is too high.**

The power supply has detected that the voltage at the power bus is too high.

The internal ballast may be disconnected (see power supply module)

If an external ballast is used, maybe it is not connected.

Disconnect the power supply and check the proper condition of the lines.

See errors codes [E215](#) and [E306](#).

E305**Protocol error in the interface between the power supply and the drive.**

Communication errors have been detected between the power supply module and the drive through the internal bus. Error that cannot be reset.

Contact Fagor Automation S. Coop.

Regenerative power supplies XPS can detect a group of errors that drives (with version 03.05 or older) cannot show on their status display.

In this situation, the XPS define the errors using different LED combinations on their faceplate. The attached table shows these combinations to help interpret these errors.

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ERROR CODES AND MESSAGES
Meaning of error codes and solutions

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TABLE S14.3 Definition of errors according to the combined illumination of the LED's. XPS power supplies.

XPS			ERROR
Red	Amber	Green	Description
I	OFF	OFF	Power supply without errors. Line voltage missing.
OFF	OFF	OFF	DC bus loading in progress
ON	OFF	OFF	Over-voltage at the DC bus
ON	OFF	OFF	Low voltage at the driver of the Crowbar IGBT
ON	OFF	OFF	Short-circuit at the Crowbar IGBT
ON	OFF	OFF	Over-temperature at the heatsink
ON	OFF	ON	Consumption over-current
ON	ON	OFF	Regeneration over-current
ON	ON	ON	Short-circuit on the inverter's High Side IGBT
ON	ON	I	Low voltage at the inverter's High Side IGBT.
ON	I	ON	Short-circuit on the inverter's Low Side IGBT
ON	I	I	Low voltage at the inverter's Low Side IGBT.

I = Intermittent (flashing)

TABLE S14.4 Definition of errors according to the combined illumination of the LED's. PS-xxA power supplies.

PS-xxA			ERROR
Red	Amber	Green	Description
I	OFF	OFF	Power supply without errors. Line voltage missing.
OFF	OFF	OFF	DC bus loading in progress
ON	OFF	OFF	Over-voltage at the DC bus
ON	OFF	OFF	Failed startup. The power supply does not start up properly
ON	OFF	OFF	Low voltage at the driver of the Crowbar IGBT
ON	OFF	OFF	Short-circuit at the Crowbar IGBT
ON	OFF	OFF	Over-temperature at the Crowbar resistor (temperature of the
ON	OFF	OFF	Over-temperature at the heatsink
ON	OFF	OFF	Crowbar resistor overload

I = Intermittent (flashing)

E306

Power bus voltage too high (software).

The software of the drive module has detected that the voltage at the power bus is too high.

See errors codes **E215** and **E304**.

E307

Power bus voltage too low (software).

The mains voltage is lower than the permissible value (rated voltage < 380 V AC).

Disconnect the power supply and check the proper condition of the lines.

The application demands high current peaks and the mains supply line has too much impedance.

Check that the power bus plates are tight and the fuse of the power supply.

E308

Over-current in the regeneration circuit.

Contact Fagor Automation S. Coop.

E309

Short-circuit on the high side IGBT.

Contact Fagor Automation S. Coop.

E310

Low voltage at the driver of the high side IGBT.

Contact Fagor Automation S. Coop.



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E311	Short-circuit on the low side IGBT. Contact Fagor Automation S. Coop.
E312	Low voltage at the driver of the low side IGBT. Contact Fagor Automation S. Coop.
E313	Consumption over-current. The current required from the power supply is too high. Decrease the demands of the work cycle.
E314	Crowbar overload error. I ² t protection of the Crowbar resistor.
E315	Power supply start-up failure. The power supply has not started up properly. If the power supply is a PS-25x, check the condition of the ballast resistor. For any power supply, check that it is in perfect condition.
E316	The DC bus of a compact drive took too long to charge. The charge time of the DC bus (SoftStart type) in a compact drive has exceeded the 4 seconds set to consider that this task has been carried out properly. Verify that: <ul style="list-style-type: none"> □ The crowbar (internal or external) is properly connected. □ The internal crowbar / Soft start resistor is in perfect condition and properly connected. □ The internal current limiting fuse in Soft Start / Crowbar is in perfect condition. Note: This error cannot be disabled.
E403	MSTfault.
E404	MDTfault.
E405	Err_InvalidPhase.
E406	Err_PhaseUpshift.
E407	Err_PhaseDownshift. The errors of the 400 series refer to various communication problems through the fiber optic ring. Check the ring connections and the identification of each module.
E410	Err_RuidoEntraAISerconReset. Noise gets in through the internal bus connection cable that reset the SerCon but not the VeCon2 .
E411	Wrong telegram received
E412	SERCOS synchronization error. The master element (CNC) sends a synchronism message in every cycle (usually every 4 ms) that synchronizes the drives. If they cannot be synchronized or lose their synchronism, it causes this error. Maybe the CNC has not sent this message or if it has, it did it at the wrong time. Check the transmission cable or verify that the transmission is not noisy.

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E500

Incoherent parameters.

See error code **E502**.

E501

Parameter checksum error.

It has been detected that the parameter checksum is not correct. Probably, the software version has been changed and the new version requires a different number of parameters. Error that cannot be reset.

Before this error, the drive assumes the default values of the parameters. The user has two options:

- ❑ Validate the default values. Just save the parameters again.
- ❑ Restore the previous values. The parameters must be loaded into RAM and analyzed with the PC.

If the user considers them to be valid, he can validate them by saving them.

E502

Wrong parameter.

Some parameter has the wrong value.

Activating this icon of the WinDDSetup bar opens a window on the screen like the one shown in the figure for displaying all the parameters whose values are wrong.

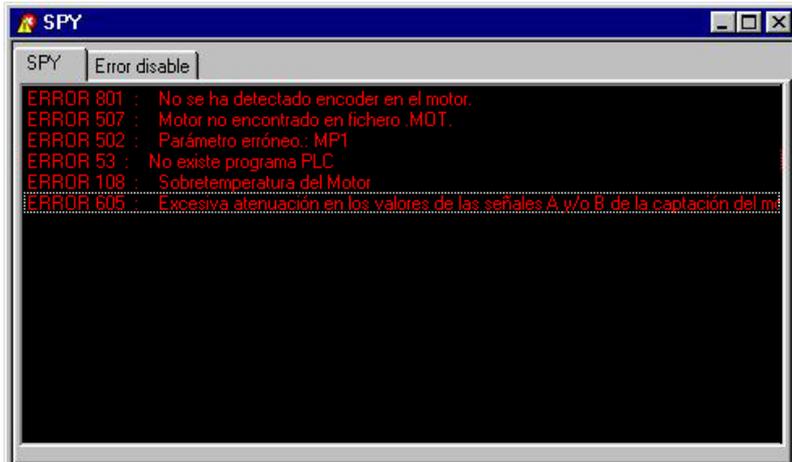


FIGURE S14.1

SPY window. Error code E502.

Some parameter has the wrong value.

Activating this icon of the WinDDSetup bar opens a window on the screen like the one shown in the figure for displaying all the parameters whose values are wrong.

In general, it is easy to recognize the mistake made when setting the parameter or parameters that generate error code **E502** which comes up in the window in most situations; but there are some that are not that intuitive. Hence, e.g. when showing as a wrong parameter:

EP1: Make sure that when using the square-wave motor feedback, its value coincides with the number of pulses of that feedback, i.e. EP1=NP116. Available from software version 05.xx on.

NP133: Make sure that when using direct rotary feedback and linear scaling, parameter NP133 is not zero. If it is zero, enter the value of the leadscrew pitch.

NP117: When using direct feedback (GP10 ≠ 0) and it is rotary (bit 0 of PP115=0 → encoder), make sure that the ratio.

$$NP133 \times 10000 \times 2^{10} / NP117$$



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is an integer. If it is not, an error will occur in parameter NP117. If it is in a situation of this kind, see how to solve it in the section "direct feedback" of chapter 5 of this manual.

E503	<p>The default motor values table is wrong.</p> <p>This error does not come up in software versions 03.01 or newer.</p> <p>This table has not been saved. This table must be saved.</p>
E504	<p>Wrong parameter in SERCOS phase 2.</p> <p>Wrong parameter in phase 2 of the SERCOS protocol. Identify the parameter in the "SPY" window of the WinDDSetup following the indicates already given for error code E502.</p> <p>Correct all the wrong parameters displayed.</p>
E505	<p>Connected motor different from the one adjusted in Flash memory.</p> <p>The parameters of the RAM memory of the drive have been set for the new motor connected. However, the parameter setting stored in Flash memory corresponds to another motor; i.e. the MP1 value in Flash and in RAM are not the same.</p> <p>This error does not interrupt the normal operation of the drive.</p> <p>Save the parameters in Flash to work with the connected motor.</p>
E506	<p>*.mot file not found.</p>
E507	<p>Motor not found in the *.mot file.</p> <p>While loading the software version, make sure to activate the option "load after the version" in the <motor table> that shows the "configuration" window appearing on the screen after pressing the icon shown in the next figure.</p>



Activate this option if error code E507 comes up after loading the version.

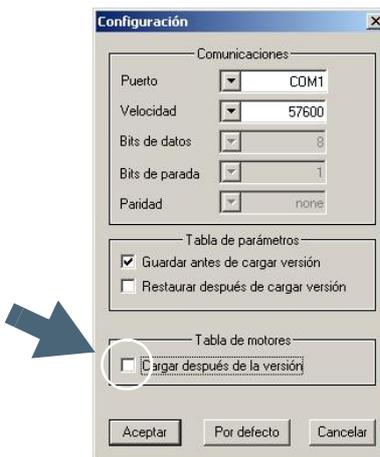


FIGURE S14.2

"Configuration" window. The option - Load after the version -, not activated in the <Motor table> field can cause error code E507.

E508	<p>Wrong parameter in SERCOS phase 4.</p> <p>Wrong parameter in phase 4 of the SERCOS protocol. Identify the parameter in the "SPY" window of the WinDDSetup following the indicates already given for error code E502.</p> <p>Correct all the wrong parameters displayed.</p>
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E604	Saturation in A and/or B signals of the motor feedback.
	<p>The cables, the feedback or the motor feedback board (connector X4) is defective. Parameters RP1, RP2, RP3, RP4 are too high. Check the condition of the cable, feedback device, card or decrease the value of these parameters.</p>
E605	Alarm in the feedback signals. Too much damping in A and/or B signals of the motor feedback.
	<p>The cables, the feedback or the feedback board (connector X4) is defective. Parameters RP1, RP2, RP3 or RP4 are too low. Verify that four consecutive errors have not occurred in the signals of the feedback device being used. See the RV9 variable. Check the condition of the cable, feedback device, X4 card or increase the value of the said parameters.</p>
E606	Excessive dispersion in the rotor sensor signals.
	<p>The quality of the signal has deteriorated. Defective rotor sensor cable, encoder, X4 card or ground connection. Check the cable, the encoder, the X4 card and the ground connections.</p>
E607	Saturation in A and/or B signals of the direct feedback.
	<p>The cables, the feedback or the direct feedback board (connector X3) is defective. Parameters RP51, RP52, RP53 or RP54 are too high. Check the condition of the cable, feedback device, card or decrease the value of these parameters.</p>
E608	Alarm in the feedback signals. Too much damping in A and/or B signals of the direct feedback.
	<p>The cables, the feedback or the direct feedback board (connector X3) is defective. Parameters RP51, RP52, RP53 or RP54 are too small. Verify that four consecutive errors have not occurred in the signals of the feedback device being used. See the RV59 variable. Check the condition of the cable, feedback device, X3 card or increase the value of the said parameters.</p>
E609	Damaged temperature cable.
E610 - E611	- See errors codes E814 and E815 -
<p>Note. If your display shows error code E610 or E611, your software version is older than 06.12 For further information on both, refer to error codes E814 and E815 of this manual that replace the previous two from the software version mentioned earlier on.</p>	
E700	Error identifying the RS232 board.
E701	Error identifying the VeCon board.
E702	There is no SERCOS board. There is no I/O board.
	<p>Check whether the node selector is at "0" or in an intermediate position that does not correspond to any node.</p>
E703	Wrong I/O board version.
E704	The AD has been selected wrong on the I/O board.



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E705	Error identifying the power board.
E706	Error identifying the motor feedback board.
E707	Error identifying the encoder simulator board.
	Error series 700 refers to the wrong operation of the hardware or to the lack of necessary boards. Contact Fagor Automation S. Coop.
E801	Encoder not detected (with motor feedback).
	Make sure that the feedback is connected and in excellent condition. Make the GP2 value coherent with the type of feedback installed. For example, parameter GP2 may have a value of "0" (sinusoidal encoder) while the motor feedback is a resolver. Contact Fagor Automation S. Coop.
E802	Communication error with the encoder (with motor feedback).
E803	Encoder not initialized (with motor feedback).
E804	Defective encoder (with motor feedback).
	Contact Fagor Automation S. Coop.
E805	Encoder detected (with motor feedback).
	The drive has been set (parameter GP2) with a resolver; but the motor feedback is not of this type. Maybe the motor has an encoder instead of a resolver. Make the GP2 value coherent with the type of feedback installed. Contact Fagor Automation S. Coop.
E806	Home search error with SinCoder.
	Contact Fagor Automation S. Coop.
E807	Defective C and D signals.
	The values of signals C and D of the SinCoder encoder are wrong and may be detected. Error that may be disabled. Note that this error may appear besides error code E605 when using a defective feedback cable (that outputs A and B signals). Contact Fagor Automation S. Coop.
E808	Encoder not detected (with direct feedback).
	Make sure that the feedback is connected and in excellent condition. Make the value of parameter GP10 coherent with the type of feedback installed as direct feedback. Contact Fagor Automation S. Coop.
E809	Communication error with the encoder (with direct feedback).
E810	Encoder not initialized (with direct feedback).
E811	Defective encoder (with direct feedback).
	Contact Fagor Automation S. Coop.
E812	Encoder detected (with direct feedback).
	Make the GP10 value coherent with the type of feedback installed. Contact Fagor Automation S. Coop.

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E813	Error when initializing the electrical position.
	Set parameters CP21, CP22, CP23, CP24, CP26 and CP27 properly.
E814	Error at the signals of the Fagor absolute linear encoder.
	Wrong absolute signals. Strange data has been read in the absolute position. Error that cannot be disabled.
	Incoherent RP64 parameter setting between the installed absolute feedback device and whether there is CRC not.
	Check the feedback cable and its connection.
	Make sure that RP64 has been set =1 if the linear encoder has CRC.
	Contact Fagor Automation S. Coop.
E815	Error indicating that the signals of the Fagor absolute linear encoder are unstable.
	The axis is moving while starting the drive up and the absolute position cannot be read correctly. Error that cannot be disabled.
E816	Error, motor feedback C and D signals unstable.
	The C and D signals reaching the drive through its CAPMOTOR-X board from the motor feedback device are not stable.
	First check that the motor is not moving when starting the drive.
	Check that the signals from the feedback device are valid and that the feedback cable is in good condition.
	If so, replace the CAPMOTOR-X board of the drive and check if the error comes up again.
	If the feedback device does not send these signals correctly or the cable is in bad shape, replace them.
	If the card fails, replace it.
	If everything is fine and the error still comes up, contact Fagor Automation S. Coop.
	This error cannot be reset.
E817	CRC checking error.
	The CRC of the connected FAGOR absolute linear encoder has not been identified by the drive. Error that cannot be reset.
	Check that the connection and the cables are OK.
	If everything is fine and the error still comes up, contact Fagor Automation S. Coop.
E900	Initialization error in the MC program.
E9xx	Execution errors in the MC program.
	Check the meaning of these errors in the "dds-mc" manual.



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14.2 Meaning of warning codes and solutions.

When it comes to a warning on the seven-segment display, it displays an A instead of an E that represents errors. The warnings indicate that the drive is approaching an error limit.

A.001	Inside temperature. Prior to error code E107 .
A.002	Motor temperature. Prior to error code E108 . Only on FM7 asynchronous spindle motors
A.003	Extreme temperature at the heatsink. Prior to error code E106 . The warning temperature KV1, KV5 or KV9 respectively has been exceeded
A.005	Velocity limit overrun. Prior to error code E917.
A.013	Position limit overrun. Prior to error code E918.

Version 06.05 offers the warnings listed next:

A.182	WarSinchronizationT3in165.
A.183	WarSinchronizationT3inDSP.
A.184	WarSinchronizationT4in165.
A.185	WarSinchronizationCubicInterp.
A.186	WarSinchronizationDeltaIniError.

When any of these internal warnings come up, contact Fagor Automation S. Coop directly.

A.189	GP10 = 0 when having the direct feedback board installed. This warning indicates that the drive is not using the direct feedback board that it is installed in it; i.e. parameter GP10 has been set with a zero value (no direct feedback) but the drive has a direct feedback card installed in it.
--------------	----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Until version 06.09 included, if the board has the direct feedback card, the position provided by it is calculated even if GP10 has been set to 0 (no direct feedback). With versions 06.10 and newer, it does not.

Therefore this warning allows diagnosing this behavior when updating from versions 06.09 or older to later versions.

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Meaning of warning codes and solutions.



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14.3 Troubleshooting

14.

The purpose of this section is to help solve certain typical problems that might come up when installing the servo drive system from the first software version.

The synchronous motor runs away. The axis with encoder simulator runs away.

Wrong offset of the encoder's absolute position or resolver mounted wrong.

Change the encoder signal counting direction.

Change parameter EP3.

Motor with sinusoidal encoder set for square-wave encoder.

Change GP2.

The synchronous motor does not turn smoothly. It jerks incoherently.

The power phases between the drive and the motor are not properly wired.

The signal phases between the drive and the rotor sensor are not properly wired.

The synchronous motor has low torque.

Check the system's current limit, CP20.

The offset of the encoder's absolute position is wrong.

The encoder or resolver has moved from its correct position.

The synchronous motor is overheated.

The offset of the encoder's absolute position is wrong

Motor sized wrong. Vertical axis not compensated. Too much friction.

After setup and the drive being activated, the motor does not move.

Resolver feedback has been selected, but an encoder is being used, instead.

Change GP2.

The motor does not move correctly and it is very noisy.

The shield of the resolver cable is not connected to connector X4 of the drive module (pin 26).

The motor moves, but is very noisy and it seems to jerk while the rotor is stopped.

The shield of the encoder cable makes electrical contact with the side of the motor.

The following error varies depending on motor speed.

It is due to the effect of the variable PI depending on speed (SP1, SP2, SP4, SP5, SP6, SP7). Adjust it so it does not behave this way. Remember that the a very small amount of following error is only required while machining, not while just positioning.

The motor makes noise and heats up.

The resolver or encoder is positioned wrong. The shield of the encoder cable or of the resolver cable is not connected.

The Ballast kicks in for no apparent reason.

The motor cable has a ground leak.

The motor loses torque, cannot reach the speed, does not position properly and does not repeat position.

The encoder is loose and its rotor shifts with respect to the rotor of the motor.

The asynchronous motor loses control and oscillates.

Under low load conditions and when requesting high acceleration (>>than the rated value for the motor).

The solution is to insert an acceleration ramp for a smoother speed evolution (SP60, SP61, SP62, SP63 and SP64).

The asynchronous motor is weak.

Low current limit (CP20).

While the drive is active, the spindle vibrates at random. It is not possible to obtain same speeds in opposite directions when changing the sign of the command.

The ground connection may be bad or there is a leak on the cable carrying the command signal.

The gear box generates noise.

The motor adjustment is too lively. Correct the PI values (SP1 and SP2) to dampen it down further. The command must be continuous. Add ramps to the command signal, limit the jerk (ramps in S) or install an external filter.

The spindle moves correctly, but it is very noisy

The asynchronous motor connection is not correct.

It has a triangle connection instead of a star connection.

The shield of the encoder cable is loose on the motor side.

The motor makes a strange noise when turning as if it were due to noisy feedback.

The shield of the rotor sensor cable is making contact with the motor body.

14.**ERROR CODES AND MESSAGES**

Troubleshooting

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This chapter describes the various limitations and monitoring that the drive carries out to protect the servo system against excessive temperature and current.

15.1 Protections of the drive

The elements setting the current limit through the drive are power semiconductors (IGBTs). Fagor drives have IGBT's with a maximum admissible (IGBTs) current between 8 A and 175.5 A.

The IGBT's of the drive may be damaged if:

- ❑ The current exceeds the permitted peak value.

To prevent this, the drive limits the current command it will attend to ($i_{command}$) and watches the real instantaneous current (i_{real}).

See the section " peak current limitation at the drive" later on in this chapter.

- ❑ The drive works with over - demanding duty cycles that cause the I_{rms} to exceed the maximum permitted. This causes the IGBTs to overheat.

To prevent this, there are two protections:

1. Some thermal sensors located on the heat - sink watch the actual temperature of these power semiconductors.

See the section "temperature sensor at the heatsink" later on in this chapter.

2. The drive estimates this rms current using the integral of the product I^2t . With this integral, an estimated value of the IGBT temperature is obtained.

See the section "permanent duty cycles permitted to the drive, I^2t product calculation" later on in this chapter.

15.1.1 Limitation of its peak current

The user can adjust the value of parameter CP20 (F00307) to limit the current command. This way, the drive will never attend to current commands exceeding the I_{peak}.

Parameter setting

See CP20 < I_{peak}:

Bear in mind that:

- On synchronous motors → I_{peak} = I_{igbt}
- On asynchronous → I_{peak} = value given in the manual of the motor.
- If (I_{real} > 1.6 · I_{IGBT}) → it issues error code **E212**.

Warning. Exceeding this limit would damage the IGBT's !

In versions 04.10 and 05.10 and later, certain particular currents are calculated for every cycle defined (see load cycles of the drive for asynchronous motors in chapter 3 of the "dds-hardware") manual.

These values are the ones assuring the right performance of the drive at an ambient temperature of 40°C (104°F). This is not a theoretical limitation. It does not calculate the I_{2t} nor the integration of the current circulating through the drive in such a way that when the described limits are exceeded it issues an error or reduces the current of the drive.

This limitation is carried out by **monitoring the heatsink temperature**. That way, when reaching a pre-established value, it issues the heatsink over-temperature error code **E106** and it generates a torqueless stop at the drive.

Each drive has a different temperature limit obtained through load tests.

The advantages of limiting the current cycles this way are:

- For room temperature over 40°C (104°F) the drive is properly protected.
- For room temperature under 40°C (104°F) more demanding current cycles may be obtained, in other words, better performance may be obtained from the same drive.

There are two ways to avoid unpredictable heatsink temperature errors:

- Monitoring the possibility of appearing a heatsink over-temperature warning. This warning is issued when the heatsink temperature is 5 °C below the temperature that triggers the error.
- Monitoring the heatsink temperature and compare it with the error limit. It % value of the drive's load may be displayed on the screen. Using this feature at the CNC requires using variables KV10 (F01102) CoolingTemperature and KV12 (S00205) CoolingTemperatureErrorLimit.

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PROTECTIONS
Limitation of its peak current



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15.1.2 Temperature sensors on the heatsink

There is a temperature sensor at the drive's heatsink whose value is displayed in the KV10 (F01102) variable.

KV10	F01102	CoolingTemperature
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Function: Monitoring of the heatsink temperature (°C).

Units: Tenths of °C.

15.

PROTECTIONS
Temperature sensors on the heatsink

15.1.3 Permanent duty cycles allowed to the drive. I²t calculation

Chapter 3 of the "dds-hardware" manual indicates which is the maximum current allowed for permanent duty cycles S1. The higher the ambient temperature, the lower the capabilities of the drive. Hence, the operator must decrease the demands in the duty cycles.

This effect of the temperature is called power "derating".

The figures below include derating examples. The duty cycle S1 supposes a constant load that heats the system to its highest temperature allowed. The S3-5% cycle reproduces intermittent work conditions in 10 s periods, with $t_c = 0.5$ s. and $t_v = 9.5$ s.

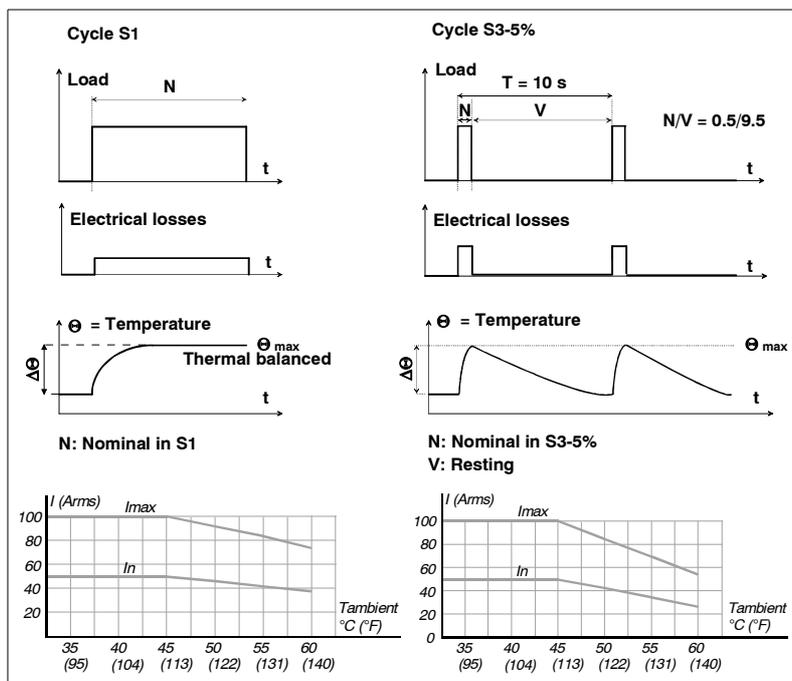


FIGURE S15.1

Duty cycles and derating examples for an AXD 3.100.

The S6-40% cycle reproduces intermittent work conditions in 10 minute periods, with $t_c=4$ min and $t_v=6$ min and the S6-15% reproduces intermittent work conditions in 60-second periods with time values of $t_c=10$ s and $t_v=50$ s.



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PROTECTIONS

Permanent duty cycles allowed to the drive. I²t calculation

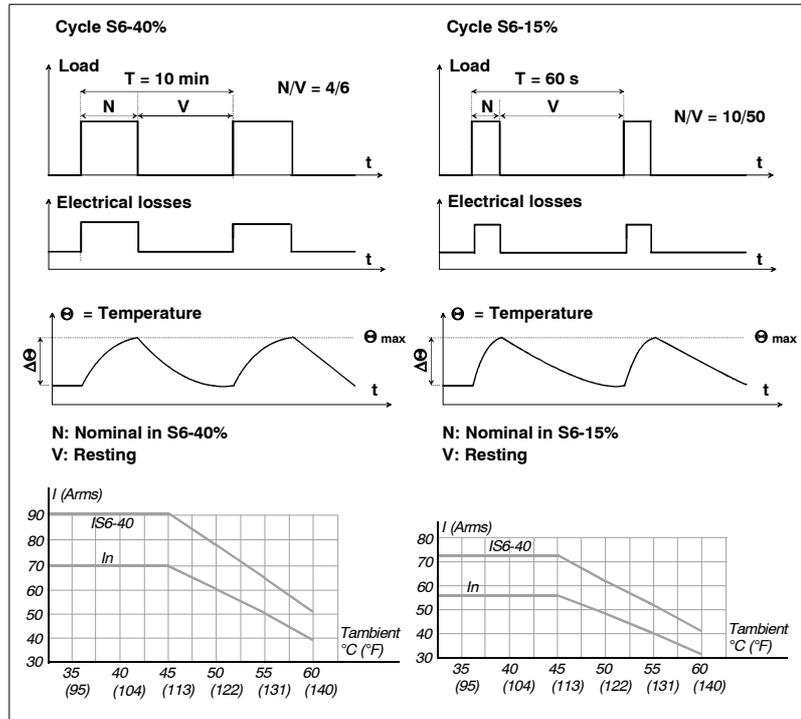


FIGURE S15.2

Duty cycles and derating examples for an SPD 3.100.

The drive estimates the temperature of the IGBT's based on the rms current circulating through them.

The following equation calculates the rms current:

$$I_{rms} = \int_{(t + \tau)}^t I^2 dt$$

This temperature estimate is based on the calculation that this manual will refer to as I²t. Exceeding this time value by a set value activates error code **E202** - DriveOverload -.

For a system with some particular IGBT's, the drive allows rms current (estimated by calculating the I²t):

For synchronous motors → $I_{rms} = 0.5 I_{IGBT}$

For asynchronous motors → $I_{rms} =$ value given in the manual of the motor.

Calculating the I²t implies an ambient temperature of 40°C (104°F). For temperatures of up to 60°C (140°F) (the maximum allowed) and since the driver does not know the actual ambient temperature, this protection may not be sufficient. In this case and if the operator would use a cycle which would exceed the derating, it could damage the drive.

As soon as it is possible to vary the frequency of the PWM, the maximum limit of the I²t allowed it will adapt automatically in order to consider the losses in the commutations corresponding to each frequency.

Equivalent duty cycles

These drives will also admit any other equivalent duty cycles whose rms current is the one permitted in its derating graph.

FIGURE S15.3 shows an example of two equivalent duty cycles.



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The integral of the I^2t is the same in both cases even when the integral of the it product is greater in the second case (b).

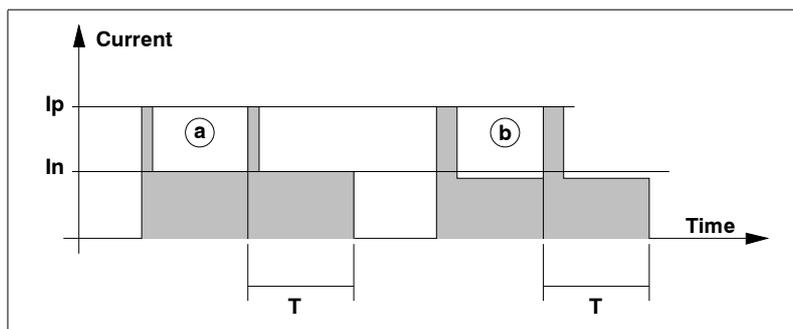


FIGURE S15.3
Equivalent duty cycles.

Drive cycle for synchronous motors

The synchronous drive withstands cycles equivalent to the one shown in the figure below:

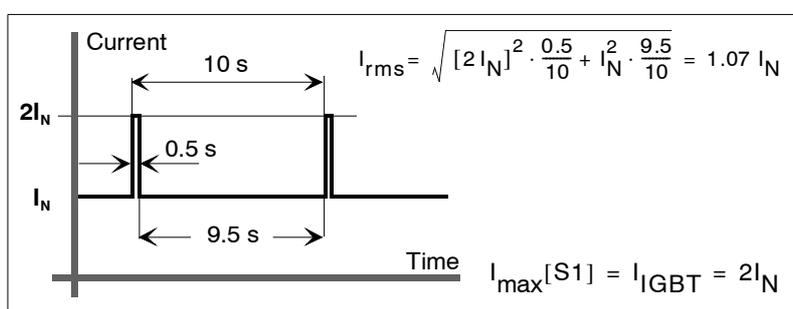


FIGURE S15.4
Drive cycles for an asynchronous motor.

Where I_N is the rated current given in the tables below for each drive in amperes:

TABLE S15.1 Currents on modular drives for synchronous motors. $f_c=4$ kHz.

With internal fan	Drive for synchronous motor (as axis)							
Models	AXD MMC 1.08	AXD MMC 1.15	AXD MMC 1.25	AXD MMC 1.35	AXD MMC 2.50	AXD MMC 2.75	AXD MMC 3.100	AXD MMC 3.150
I S1= I_N Arms	4	7.5	12.5	17.5	23.5	37.5	50	75
Imax S1 Arms	8	15	25	35	47	75	100	150
Dissipated power W	33	69	88	156	225	270	351	536

TABLE S15.2 Currents on modular drives for synchronous motors. $f_c=8$ kHz.

With internal fan	Drive for synchronous motor (as axis)							
Models	AXD MMC 1.08	AXD MMC 1.15	AXD MMC 1.25	AXD MMC 1.35	AXD MMC 2.50	AXD MMC 2.75	AXD MMC 3.100	AXD MMC 3.150
I S1= I_N Arms	4	7.5	12.5	17.5	23.5	37.5	50	75
Imax S1 Arms	8	15	25	35	47	75	100	150
Dissipated power W	44	89	132	195	305	389	510	840

f_c : IGBT switching frequency.

As long as the IGBT's are below their rated working temperature (e.g. on start - up) they will be allowed some more demanding initial cycles.

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PROTECTIONS
Permanent duty cycles allowed to the drive. I^2t calculation



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PROTECTIONS

Permanent duty cycles allowed to the drive. I²t calculation

Drive's load cycles for asynchronous motors

For versions older than 04.09 and 05.09 (included), the asynchronous drive withstands indefinitely cycles equivalent to its rated (nominal) current I_N which is also the maximum it can supply ($I_{peak} = I_N$). The maximum current limitation is enough to protect asynchronous drives and, therefore, there is no need to calculate I^2t .

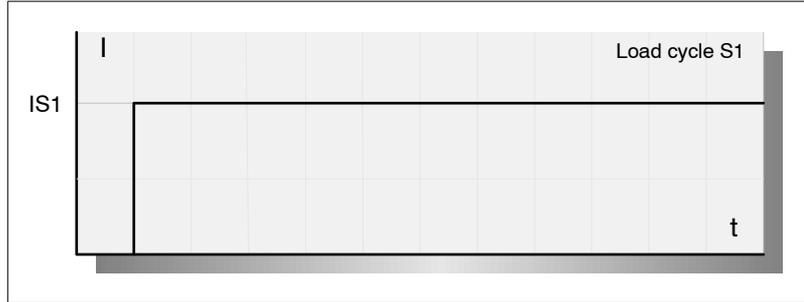


FIGURE S15.5

Load cycle S1.

where $I_{S1} = I_N$ is the rated (nominal) current and for each drive is:

TABLE S15.3 Currents on modular drives for synchronous or asynchronous motors. $f_c = 4$ kHz.

With internal fan	Drive for synchronous or asynchronous motor (as spindle)									
Models	SPD 1.15	SPD 1.25	SPD 1.35	SPD 2.50	SPD 2.75	SPD 2.85	SPD 3.100	SPD 3.150	SPD 3.200	SPD 3.250
$I_{S1} = I_N$ Arms	10.5	16	23.1	31	42	50	70	90	121	135
$0.7 \times I_N$ Arms	7.3	11.2	16.1	21.7	29	35	49	63	84.7	94.5
I_{S6-40} Arms	13.7	20.8	30	40.3	54.6	65	91	117	157.3	175.5
Dissipated power W	98	110	195	349	289	432	496	626	1163	1333

TABLE S15.4 Currents on modular drives for synchronous or asynchronous motors. $f_c = 8$ kHz.

With internal fan	Drive for synchronous or asynchronous motor (as spindle)									
Models	SPD 1.15	SPD 1.25	SPD 1.35	SPD 2.50	SPD 2.75	SPD 2.85	SPD 3.100	SPD 3.150	SPD 3.200	SPD 3.250
$I_{S1} = I_N$ Arms	10.5	13	18	27	32	37	56	70	97	108
$0.7 \times I_N$ Arms	7.3	9.1	12.6	18.9	22.4	25.9	39.2	49.7	67.9	75.6
I_{S6-40} Arms	11.6	16.9	23.4	35.1	41.6	48.1	72.8	91.0	126.1	140.4
Dissipated power W	98	130	201	350	333	438	546	668	1187	1344

f_c : IGBT switching frequency.

Note. The indicated dissipated power values for the spindles correspond to the operation at rated current in S1 mode.

For newer versions than 04.09 and 05.09, the current values in S1 are decreased and the S6-40% cycle is the most commonly used when selecting the spindle motor.

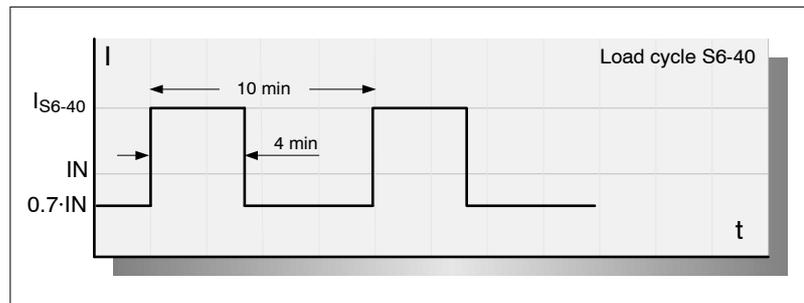


FIGURE S15.6

Load cycle S6-40%.



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Usually, the drive associated with the motor is chosen so it is capable of supplying enough current for the motor to reach this cycle.

This cycle tries to reproduce the intermittent work conditions in periods of 10 minutes, with 4 minutes with load and 6 minutes without load. The current available at low portion of the cycle must be enough to provide the motor with magnetizing current. The 0.7 value comes from the ratio between the magnetizing current and the rated current in most asynchronous motors.



When in a real application the heatsink overheats, it is always possible to decrease the current in the low portion of the cycle. Use parameter **FP40.#** (F00622) FluxReduction that sets the desired % of magnetizing current when the motor turns without load. By default, it has a value of 100%.

Note that it must be 100% in C axis applications.

Load cycle S1 with peak current I_{max} admits greater acceleration peaks since higher maximum currents are provided.

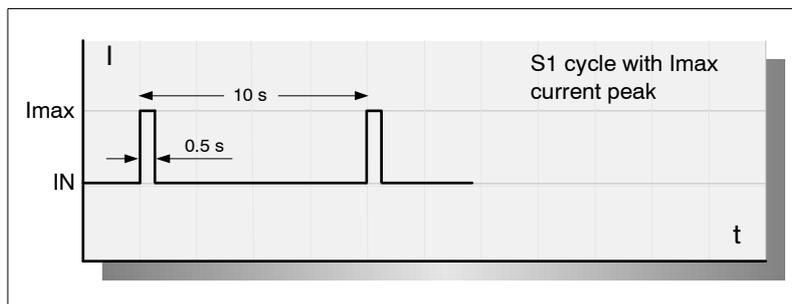


FIGURE S15.7

Load cycle S1 with current peak I_{max} .

The duration of the cycle admitting the maximum current is 10 seconds; enough in most cases to accelerate the spindle to its maximum work speed. Since this current may be extremely high, the portion of the cycle where the motor turns without load is proportionally greater than in the S6-40% cycle. Likewise, the total duration of the cycle is shorter (60 s)

The current with no load corresponds to the motor magnetizing current ($0.7 \times I_n$).



Note that when using parameter **FP40.#** (F00622) FluxReduction, the current of the lower portion of the cycle will decrease in the same proportion.

The values of these currents for SPD modular drives are given in Amperes in the previous tables.

15.

PROTECTIONS

Permanent duty cycles allowed to the drive. I^2t calculation



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15.2 Voltage protection module

When using a **synchronous spindle motor**, it may reach high speeds beyond which the voltage that may be generated at the power bus (DC bus) can originate higher currents than the power semiconductors or **IGBT's** can withstand and can damage the drive module.

The maximum power voltage input at the DC bus so it doesn't damage the drive is 900 V DC; hence, it must comply with:

$$\sqrt{2} \cdot k_E \cdot \Omega < 900 \text{ V DC}$$

where:

k_E Motor voltage constant in V/rpm .

Ω Maximum rotor speed in the application in rpm.

These high speeds may be reached when loosing the motor turning control due, for example, to a voltage drop in an emergency and not being able to return the braking energy.

The voltage protection module that must be installed between the motor and the drive separated by less than 1.5 meters - see manufacturer's data - detects when the EMF induced at the stator windings is too high and short-circuits the three phases of the motor dissipating the kinetic energy of the motor through a resistor.



Note that the voltage protection module is not always required when using a synchronous spindle. It will depend on the motor conditions and how it is used.

Note. Fagor does not provide voltage protection modules.

Respect the installation characteristics and technical data provided by the manufacturer of the voltage protection module.

15.

PROTECTIONS
Voltage protection module

15.3 Protections of the motor

The mechanical power limit of a motor corresponds with a set value, among other causes, by the maximum temperature allowed in its stator windings and by the duty cycle.

As with the protection of the drives, the protection of the motors is watched in three modes at the same time:

- The current must not exceed the permitted peak value.
To prevent this, the drive limits the current command which it will attend to ($i_{command}$) and it watches the real instantaneous current (i_{real}).
See the section "peak current limitation at the motor" in this chapter.
- In permanent duty cycles, the motor temperature is monitored by:
 1. Thermal sensors located in the motor.
See the section "temperature sensor in the motor" in this chapter.
 2. Estimating the rms current based on the integral of the I^2t product.
See the section "permanent duty cycles allowed to the motor. I^2t " product calculation in this chapter.

15.3.1 Limitation of its peak current

The user can adjust the value of parameter **CP20.#** (F00307) to limit the current command. Hence, the drive will never attend to current commands greater than MP4 (S00109) that is the maximum peak current allowed through the motor.

This maximum peak current is shown in the motor tables of the corresponding motor manual. This data only sets a preventive current limit by thermal characteristics.

CP20 < MP4 where MP4 (S00109) is an exclusive parameter of synchronous motors. With asynchronous motors, the current command is not monitored.

15.3.2 Temperature sensors

FXM and SPM (now discontinued) motors have a triple PTC-over-temperature sensor that helps detect whether there is over-temperature or not in the windings of each phase of the stator. It is connected to the drive through two wires included in the feedback cable of the motor itself. Error code **E108** will be issued when reaching the limit temperature allowed at the motor. This temperature is 150°C (302°F) for "class F" winding.

Remember that the SPM asynchronous motor has a Klixon switch that opens when reaching 150°C (302 °F) and it must be included in the emergency line of the electrical cabinet.

FKM synchronous motors as well as FM9 motors have a single KTY84-130 sensor.

FM7 asynchronous motors have a simple NTC thermistor.

For further information on the identification of the sensor in a Fagor motor, refer to parameter **MP14** in the "dds-software" manual.

The most important characteristics of these temperature sensors are described in the manual of the corresponding motor.

15.3.3 This offers a temperature estimate. I^2t calculation

The drive software offers a procedure to calculate the integral I^2t applied to both the synchronous and asynchronous motors.

The permanent monitoring of the I^2t product tolerates any equivalent duty cycle that causes the same maximum temperature as the one generated in duty cycle S1 with a time constant given by parameter **MP13** (F01209) MotorThermalTimeConstant.

15.

PROTECTIONS
Protections of the motor

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PROTECTIONS

This offers a temperature estimate. I^2t calculation

However, the overheating caused by very high peak currents cannot be modeled with the I^2t calculation. In this case, the over temperatures are detected by the temperature sensors.

Synchronous motors

The manual of the corresponding motor indicates its rated current and maximum peak currents.

Asynchronous motors

The manual for the corresponding motor shows the maximum currents in the motor in duty cycles S1 and S6. An increase of ambient temperature and the altitude will force the user to decrease the demand of the cycles.

15.4 External monitoring of the real I²t levels

The user may know the **effort level of the drive** by checking the value of the I²t product through the variable:

real value: **KV32** F01109 I²tDrive

The user may know the **effort level of the motor** by checking the value of the I²t product through the variable:

real value: **KV36** F01111 I²tMotor

These values are given as percentage used over the maximum.

In software versions older than 04.01, the units were absolute and two more parameters were used.

To determine whether a duty cycle demands a bearable degree of effort indefinitely from the servo system (drive + motor), it has to be brought to the rated running temperature and then execute that cycle.

By editing these variables KV32 and KV36, it is possible to simulate an increase of the temperature of the servo. Later, execute a test cycle.

The I²t calculation will determine whether the servo system withstands or not that particular cycle.

Using the oscilloscope integrated into the WinDDSSetup it is possible to display these variables during the cycle in the trial process. Use the displayed graph to calculate the I²t and check whether the drive can withstand it or not.

15.

PROTECTIONS
External monitoring of the real I²t levels

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15.5 Protection of the external ballast resistor

From software version 03.07 on, the drive internally calculates the I²t product the Ballast resistor of the compact modules (ACD and SCD).

Compact module uses an external Ballast resistor

If the compact drive module uses an external Ballast resistor, the drive must be "informed" of the electrical characteristics of the resistor via parameters:

KP2	O	F01113	ExtBallastResistance
-----	---	--------	----------------------

Function: It contains the Ohm value of the external Ballast resistor of a compact drive. This parameter is useful for the I²t protection of this resistor.

Valid values: 0 ... 6 553.5 Ω.

Default value: 0.0.

KP3	O	F01114	ExtBallastPower
-----	---	--------	-----------------

Function: It contains the power value of the external Ballast resistor of a compact drive. This parameter is useful for the I²t protection of this resistor.

Valid values: 0 ... 65 535 Ω.

Default value: 0.

KP4	O	F01116	ExtBallastEnergyPulse
-----	---	--------	-----------------------

Function: It contains the value of the energy pulse that may be dissipated through the external Ballast resistor of a compact drive. This parameter is useful for the I²t protection of this resistor.

Valid values: 0 ... 400 000 J.

Default value: 0.

KV40	F	F01115	I2tCrowbar
------	---	--------	------------

Function: Shows the load percentage on the external Ballast resistor of a compact drive. It is useful for the I²t protection of this resistor. A value greater than 100 % in this variable activates error code **E301**.

Compact module without external Ballast resistor

If the compact drive module does not use an external Ballast resistor, the software knows the characteristics of the resistors of each model of compact drive modules and keeps an eye on the I²t value on its own.



If any of the KP2, KP3 or KP4 parameter is set to 0, the I²t protection will be carried out according to the characteristics of the internal resistors of the modules. If all three parameters KP2, KP3 and KP4 are set to 65 535 the I²t protection will be disabled.

15.

PROTECTIONS
Protection of the external ballast resistor

15.6 Protection against a mains phase drop

From drive software 03.07 on and with MSC board version 06A or later, the compact modules (ref. ACD and SCD) monitor the presence of all three mains phases.

Should any them drop for over 10 ms, error code **E003** will be triggered.

15.**PROTECTIONS**
Protection against a mains phase drop**FAGOR** **DDS
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PROTECTIONS



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16.1 System requirements and compatibility

Before installing the program, make sure that your equipment has at least all the features required to execute WinDDSSetup.

- Pentium 133 PC, compatible or better.
- Super VGA 800x600 monitor with 256 colors, although we recommend a Super VGA 1024x768.
- CD-ROM unit 4x or faster to install the program.
- Mouse or pointer device.
- 32 Mb of RAM memory, 64 Mb recommended.
- 36 Mb of free hard disk memory (30 Mb for the installation and 6 Mb for the exchange file).
- Printer or graphic plotter (optional).
- Compatible with all Windows operating systems: Windows 9x, Windows NT, Windows 2000, Windows XP, Windows Vista and Windows 7.

Note. If any of the operating systems mentioned earlier has already been installed on your pc, you can install the WinDDSSetup application without any problems as long as the requirements mentioned earlier are met.

When updating, the new version should not be installed in the same directory as the current. Indicate a different path when so requested during the installation. Once the current version is installed, transfer your personal files to the directory where the new version has been installed. Verify that everything works fine and then remove the older version.

Before installing the program, all the applications should be closed, even the virus detection programs.

16.2 Before installing WinDDSSetup under Windows Vista

If your operating system is Windows(r) Vista, deactivate the control of user accounts (UAC) before installing the WinDDSSetup. For that, go to Start > Control panel > User accounts > Activate or Deactivate the control of user accounts and deactivate the option "Use the control of user accounts (UAC) to help protect the equipment".

Then, restart your PC to assume the new configuration.

Then access through an account with administrator privileges and install the WinDDSSetup software following the installation steps described in the next section.

16.3 Installation process



Insert the CD-ROM in the corresponding unit. If the < automatic execution > option is activated, the < v xxxx win.exe > program will be loaded automatically. If not, use the Windows explorer to find this file in the CD-ROM and execute it. This file is in the WinDDSSetup folder.

It shows the welcome screen suggesting to follow all the instructions to install the software.

Click on < OK > .

By default, the program files will be copied in the folder c:\WinDDSSxx.xx. If you prefer, you can select a different path by clicking on the < **B**rowse> cell.

Clicking on OK will start the installation process. Several screens and a dialog box will inform on the process of copying the necessary files to execute WinDDSSetup.

16.
WINDDSSetup
Installation process

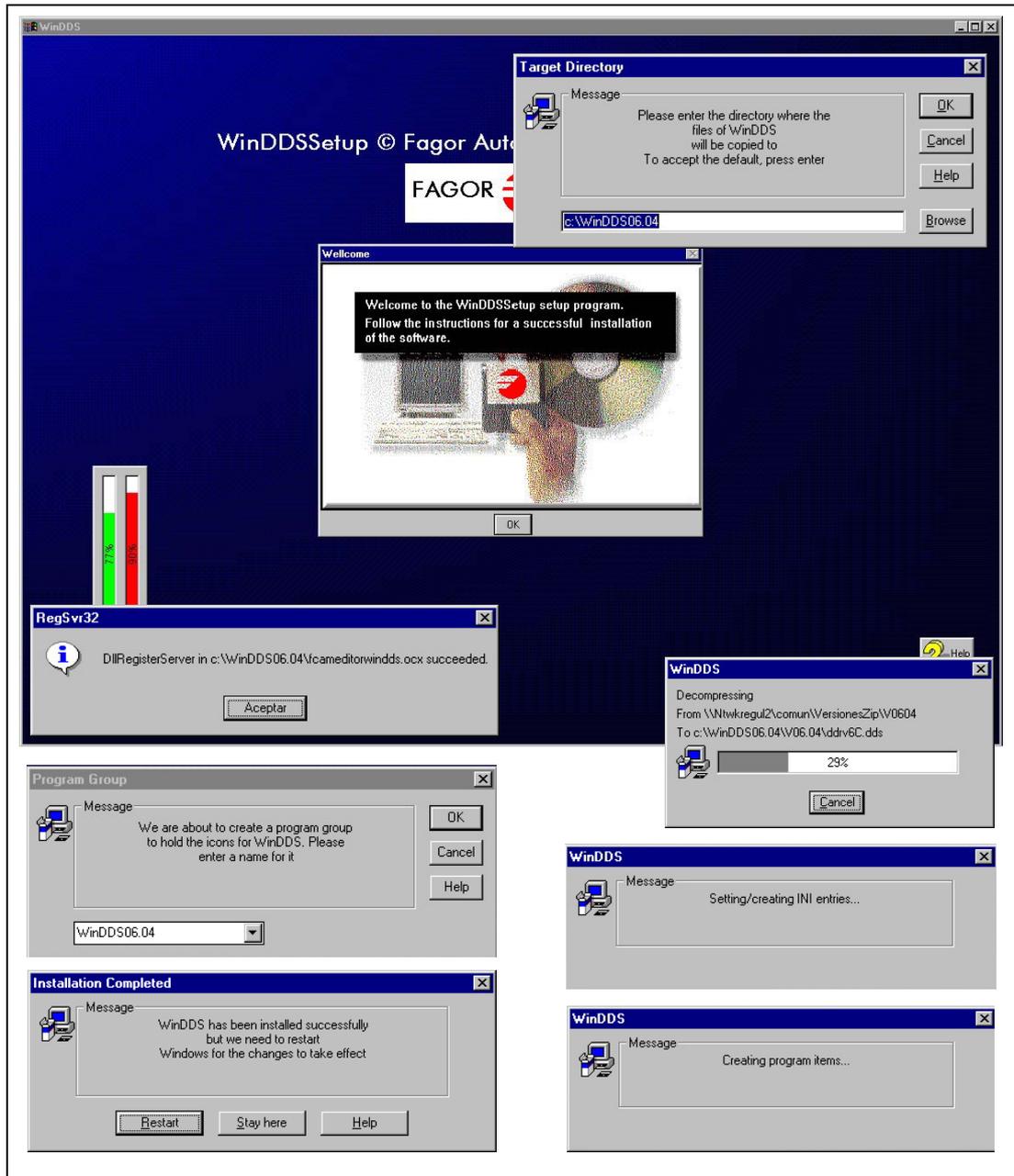


FIGURE S16.1
Screens appearing during the installation of the WinDDSSetup.



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There is no need to restart the PC after the installation in order to execute the WinDDSSetup.

16.4 General description of the screen

The information of the WinDDSSetup screen is laid out as follows:

After initiating the WinDDSSetup application from the menu Start > Programs > WinDDSSxx.xx > WinDDSSetup.exe, it displays the general screen of the WinDDSSetup.

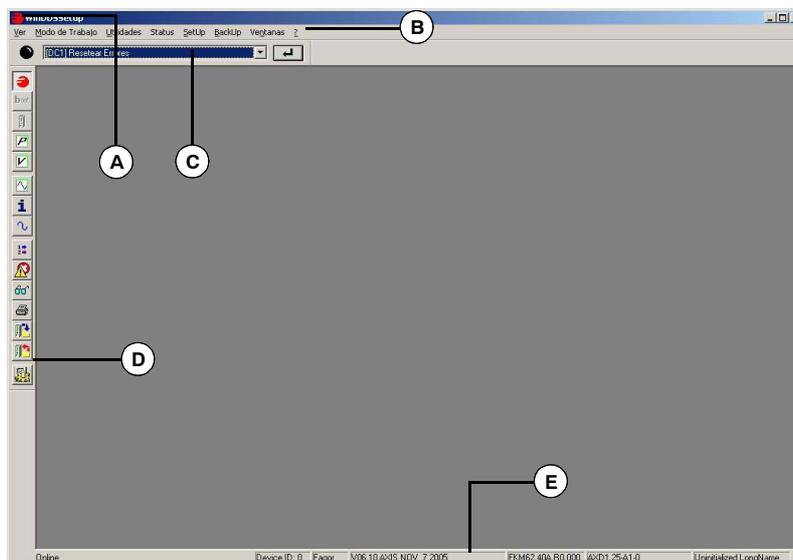


FIGURE S16.2

General screen of the WinDDSSetup. **A.** Control menu box. **B.** Control menu. **C.** Command bar. **D.** Tool bar. **E.** Status bar.

A. Control menu box. Selecting this box (click on the Fagor icon at the upper left with the left mouse button) accesses the standard menu (A) of Windows applications being possible to close, move, minimize or maximize the window.



B. Menu bar. the various menus of this applications may be accessed from this area. Most of the commands of the menus may be carried out directly by clicking on their associated icons on the tool bar.

C. Command bar. The commands may be executed from this drop list.

D. Tool bar. Each icon of this bar performs a particular function. The function carried out by each of them will be described in detail later on.

E. Status bar. This bar shows whether the PC and the drive are connected (on line) or not (off line), the ID of the drive it is communicating with, the access level, software version, whether it is an axis or a spindle drive, the ID of the motor associated with the drive and the ID of the connected drive itself.

16.4.1 Menu bar

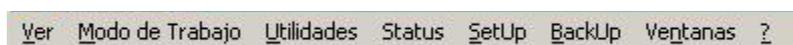


FIGURE S16.3

Menu bar.

16.

WINDDSSetup
 General description of the screen



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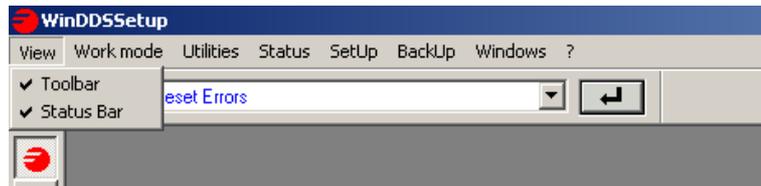
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WINDDSSetup
Menu bar

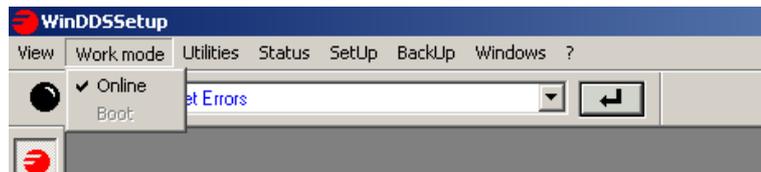
□ View



Its drop menu offers the following options:

- **T**oolbar. It displays or hides the tool bar^(D). See [FIGURE S16.2](#).
- **S**tatus Bar. It displays or hides the status bar^(E). See [FIGURE S16.2](#).

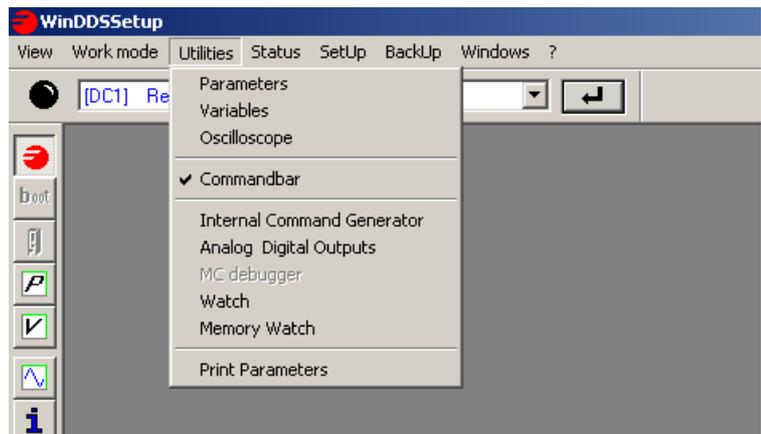
□ Work mode



Its drop menu offers the following options:

- **O**nline. It turns on or off the WinDDSSetup connection with the drive. The PC and the drive must be previously connected through the RS232 serial line.
- **B**oot. It turns on or off the loading of the software into the drive. When on line, this option will be disabled. The PC and the drive must be connected through the RS232 and it must be off line before carrying out a < boot >.

□ Utilities



Its drop menu offers the following options:

- Configure Parameters
- Configure Variables
- Oscilloscope
- Command bar
- Generator
- D/A Outputs
- MC debugger
- Monitor
- See memory
- Print parameters



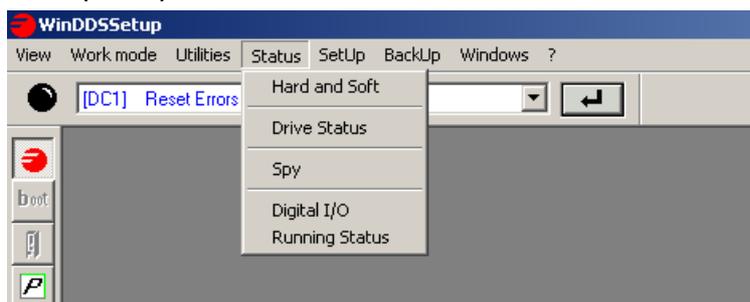
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All these menu options have their associated icon on the tool bar. To know their utility, see the description of their corresponding icon.

□ **Status (Status)**



Its drop menu offers the following options:

- Hard and Soft
- Drive Status
- Spy

All these menu options have their associated icon on the tool bar. To know their utility, see the description of their corresponding icon.

- Digital IO's

Note that it does not have an equivalent icon on the tool bar.

This dialog box shows:

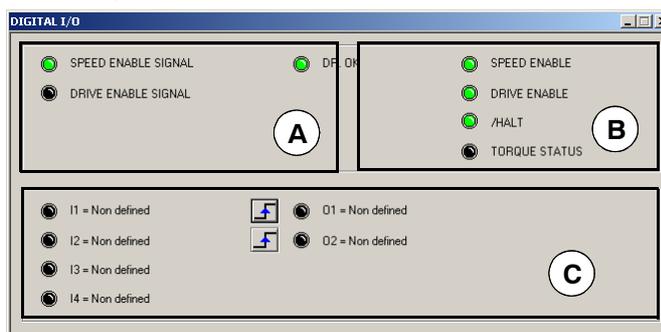


FIGURE S16.4

Status > Digital I/O.

Zona A. The LED's displayed in this area of the window indicate the activation (on) or deactivation (off) of the logic values of the electrical control signals of the drive. Every LED represents the status of a particular bit of the variable BV14 <NotProgrammableIOs> and the status of the digital output PROG OUT given by the variable OV5. The next table indicates what each LED represents:

TABLE S16.1 Variable BV14. Meaning of its bits.

Bit	Name
4	LSC STATUS (at the intermodular bus X1)
3	ERROR RESET
2	DR OK (at the microprocessor, at the pins of X2)
1	SPEED ENABLE SIGNAL
0	DRIVE ENABLE SIGNAL

TABLE S16.2 Variable OV5. Meaning.

Status	Event
OV5=0	PROG OUT contact open (LED off)
OV5=1	PROG OUT contact closed (LED on)

Note that the window in this figure shows some LED's, but it may appear other different ones in other situations.

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WINDDSSSETUP
Menu bar

Zona B. The LED's displayed in this area of the window indicate the status of various control signals that the CNC sends out to the drive through the SERCOS interface. Each LED represents the status of a particular bit of the variable DV32 <MasterControlWord> and the status of the logic mark TV10 that indicates that the torque (TV2) is greater than a certain threshold value (TP1). The next table indicates what each LED represents:

TABLE S16.3 Variable DV32. Meaning of its bits.

Bit	Name
15	Speed Enable (SPENA)
14	Drive Enable (DRENA)
13	Halt

TABLE S16.4 Variable TV10. Meaning.

Status	Event
TV10=0	TV2 < TP1 (LED off)
TV10=1	TV2 > TP1 (LED on)

Zona C. The LED's displayed in this area correspond to the bits that represent the status of the digital inputs and outputs of slot SL1. See the meaning of these variables in chapter 13 of this manual.

- Running Status

Note that it does not have an equivalent icon on the tool bar.

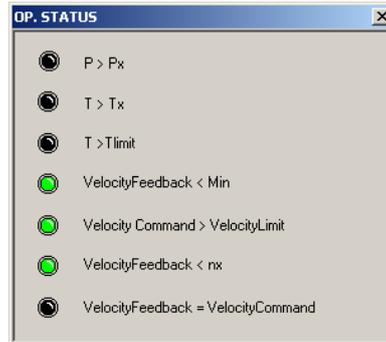


FIGURE S16.5

Status > Running Status.

The LED's displayed in this dialog box represent the activation (on) or deactivation (off) of the logic marks (operation status) according to the bits of the variable DV10.

The next table indicates what each LED represents:

TABLE S16.5 Variable DV10. Meaning of its bits.

Bit	Mark	Meaning	
7	TV60	TV50 > TP2	P > Px
5	Reserved	TV2 > a function value of CP20	T > Tlim
4	Reserved	SV1 SP10	VelocityCommand > VelocityLimit
3	TV10	TV2 > TP1	T > Tx
2	SV3	SV2 < SP40	VelocityFeedback < nx
1	SV5	SV2 < SP42	VelocityFeedback < Min
0	SV4	SV2=SV1	VelocityFeedback=VelocityCommand



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SetUp (Setup)

Its drop menu offers the following options:



FIGURE S16.6

Setup > Preferences...

- Preferences ...

Note that it does not have an equivalent icon on the tool bar.

This dialog box, depending on the active tab may be used to establish certain considerations. See **FIGURE S16.7**.

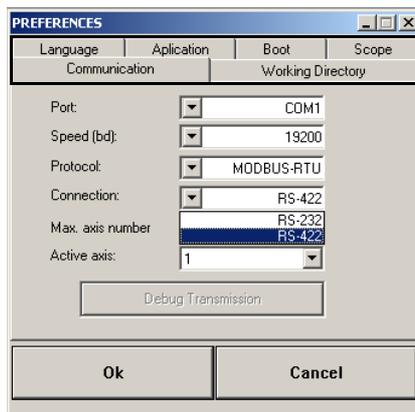


FIGURE S16.7

Setup > Preferences ...

Hence, activating the tab:

<Language>

It is possible to choose the language for the whole application. The available languages are Spanish and English.



FIGURE S16.8

Setup > Preferences... > Language.

<Application>

It may be used to establish a certain behavior when initiating a WinDDSSetup session. Any change made in this dialog box has an immediate effect.

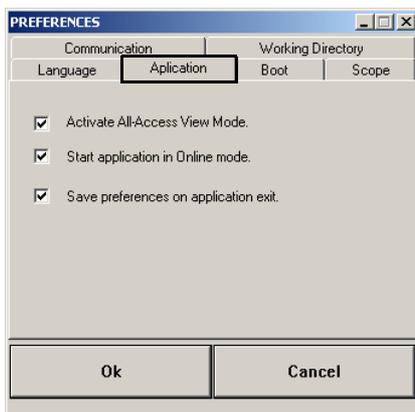


FIGURE S16.9

Setup > Preferences... > Application.

- ❑ **< Activate all - access view mode >**: when activating this property, the windows for configuring parameters and variables show a list of all the parameters and variables of the drive, regardless of the available access level. Only those allowed by the relevant access level may be modified. They may be recognized because they do not have an identifier "key" next to their names. If not activated, it only lists the parameters and variables that the relevant access level allows modifying.
- ❑ **< Start application in online mode >**: when this property is activated, every time a new session is initiated with the WinDDSSetup, it tries to connect with the drive according to the latest considerations made in the <preferences> window.
- ❑ **< Save preferences on application exit >**: when this property is activated, every time the WinDDSSetup session is closed, it saves all the choices made in the <preferences> window. When initiating the application again, it will behave according to the <preferences> chosen in the previous session.

Boot

It may be used to set the type of "boot" (software loading) when initiating a session with the WinDDSSetup.

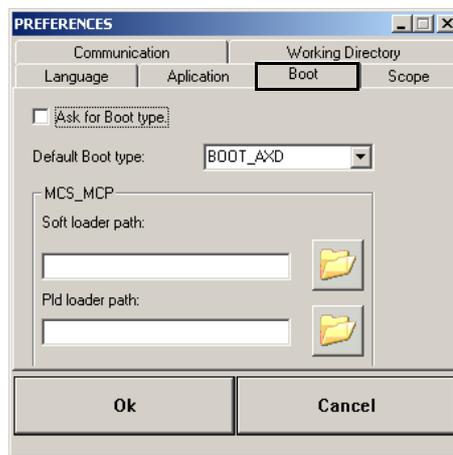


FIGURE S16.10

SetUp > Preferences...> Boot.

- ❑ **< Ask for Boot type >**: when activating this property, every time a new session is initiated with the WinDDSSetup, it displays the <BootType> window requesting the type of boot (boot AXD, boot MCS_MCP, etc.) to be carried out. If the user prefers not to be asked this question every time a <boot> is carried out, he must deactivate this box and must select the default <boot> in the drop list located further down.

<Scope>:

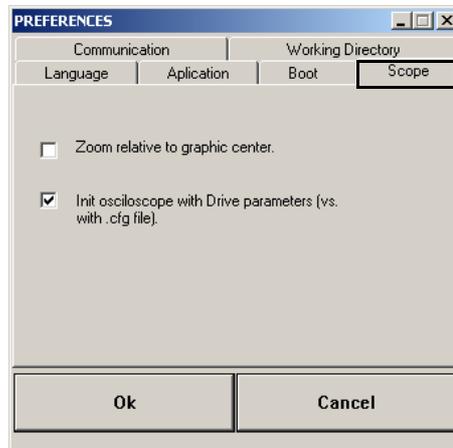


FIGURE S16.11

SetUp > Preferences...> Oscilloscope.

It may be used to set some default properties of the oscilloscope when initiating a session with the WinDDSSetup. Any change made in this dialog box has an immediate effect.

- **<Zoom relative to graphic center>**: Activating it allows the use to zoom in or out in the oscilloscope window to enlarge or reduce the oscillograph with respect to the graphic center, not with respect to the signal zero. When not activating it, the zoom is referred to the signal zero and the signal usually goes out of the image.
- **<Init Oscilloscope with Drive parameters (vs. with. cfg file) >**: If activated, when initiating the <oscilloscope> application, it reads the parameters of the drive. If not activated, it reads the parameters stored in the file oscilo.ocg.

<Communication>

It may be used to set all the default characteristics of the communication between the PC and the drive when initiating a new session with the WinDDSSetup. Any change made in this dialog box has an immediate effect.

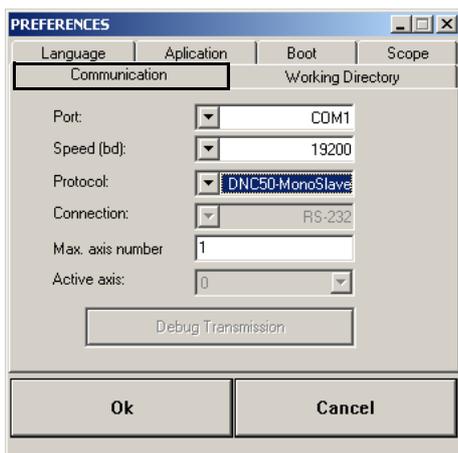


FIGURE S16.12

SetUp > Preferences...> Communications.

- **<Port>**. Communication port selection.
Options: COM1 or COM2.
- **<Speed (bd)>**. Communication speed selection. Options: 9600 or 19200.
- **<Protocol>**: Communication protocol selection.
Options: DNC50 - Monoslave, DNC50 - Multislave, MODBUS-RTU or MODBUS-ASCII.
- **<Connection>**. Selection of the RS-232 or RS422 serial line connection having selected the MODBUS RTU or ASCII protocol.
- **<Max. axis number (n)>**. Number of drives connected to the master element, such as a PC or an ESA video terminal.
- **<Active axis>**. Selection of the drive involved in the communication.
The entered value selects the drive that has a matching node number.

All the applications that may be executed from WinDDSSetup (oscilloscope, wave generator,...) will refer to the drive specified in the field "active axis", except those that allow to specifically indicate the number of axes using a <Watch> (monitoring) window.

In order to avoid problems when transmitting the system, the following considerations must be borne in mind while always checking whether there is an RS-422 or an RS-232 connection at each drive and the node assigned to it using the rotary switch.

16.

WINDDSSetup
Menu bar

Cases where transmission will be established:

RS422 (n>1)	Communication with several drives in RS-422 mode The communications protocol in RS-422 mode for several axes will be the DNC50. The node number assigned to each drive using the rotary switch identifies it with that number and it must be other than zero.
RS422 (n=1)	Communication with a single drive in RS-422 mode The communications protocol in RS-422 mode for several axes will be the DNC50. The node number assigned to each drive using the rotary switch identifies it with that number and it must be other than zero.

Note that to establish communication with **a single drive** in **RS-422** mode, it must be done using the DNC50 protocol for several axes. Enter a **value > 1** in the field "maximum number of axes". The WinDDSSetup will run a previous check acknowledging that there is only one axis.

RS232 (n=1)	Communication with a single drive in RS-232 mode The communications protocol in RS-232 mode for a single axis will be the DNC50. The drive MUST BE assigned node number ZERO.
--------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

The status bar of the general window of the WinDDSSetup at the bottom shows the active axis which is the one set in the "active axis" field of the dialog box <preferences>.

<Work directory >

It may be used to select the default directory when initiating a WinDDSSetup session.

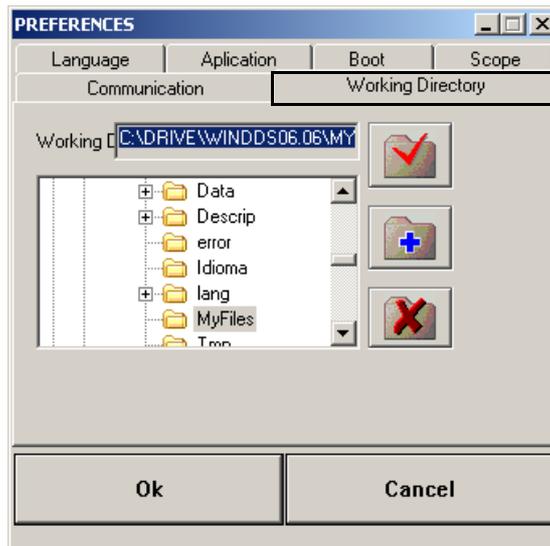


FIGURE S16.13

SetUp > Preferences...> Work directory.



This icon may be used to assign a folder or directory selected from the list in the default work directory. Pressing this button after having selected the directory will display the word "Directory" in the box.



This icon is used to create a new folder or directory.



This icon is used to delete the folder or directory selected from the list.

- Access level ...

Note that it does not have an equivalent icon on the tool bar.

The parameters, variables and commands of the drive are organized by access levels. See chapter 13 of this manual.

These levels are:

- Basic level - USER - .
- Intermediate level - OEM - .
- Maximum level - FAGOR - .

To access each parameter, the drive must be set up at the access level required by that parameter.

To change the access level from the WinDDSSetup, execute the option **Access level ...** on the **SetUp** menu. The status bar (bottom of the window) shows the currently active level.

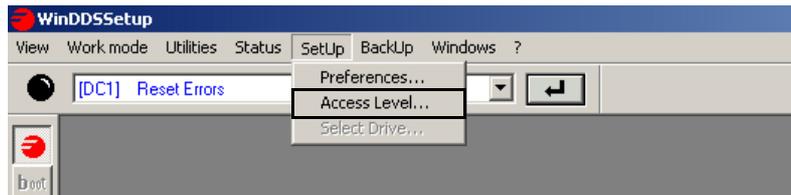


FIGURE S16.14

SetUp > Access level...

The access to each level requires a password.

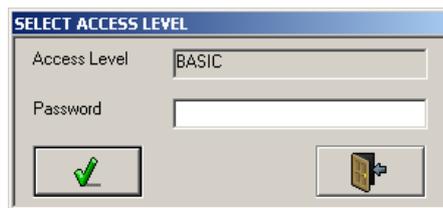


FIGURE S16.15

"Password" text box to change the access level.

- The USER level is the basic level. On power up, the drive access this level by default, hence not requiring password.

At USER level, it is possible to access a group of parameters that slightly modify the behavior of the drive depending on the application developed.

Note that the user can only access the basic level.

- The OEM level is an intermediate access level.

At OEM level, it is possible to access a large group of parameters depending on the motor being connected which set how the electronics of the drive is adapted to that particular motor and to the particular application being developed.

Note that the installer of the Fagor servo drive system will have access restricted to the OEM level.

- The **FAGOR level** allows full access to all system variables, parameters and commands.

At Fagor level, it is also possible to access a group of parameters depending on the electronics of the drive and that are factory sets.

Note that only Fagor Automation technicians and those of the manufacturing process can access the FAGOR level.

- Select the drive ... : Command equivalent to the one given by pressing the SELECT DEVICE icon.

This menu options have their associated icon on the tool bar. To know their utility, see the description of their corresponding icon.

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WINDDSSetup
Menu bar

□ **BackUp (BackUp)**

Its drop menu offers the following options:

- **DRV** → PC... : command equivalent to the one given by pressing the DRIVE / PC BACKUP icon.
- **PC** → DRV ... : command equivalent to the one given by pressing the PC / DRIVE BACKUP icon.

All these menu options have their associated icon on the tool bar. To know their utility, see the description of their corresponding icon.

□ **Windows**

Its drop menu offers the following options:

- Cascade:
- Horizontal Tile:
- Vertical tile:
- Align icons:

□ **? (?)**

Its drop menu offers the following options:

- **H**elp subjects:
- **U**sing Help:
- **A**bout WinDDSSetup ... : It shows the version and creation date of the application.



FIGURE S16.16

About WinDDSSetup ...

16.4.2 Command bar



FIGURE S16.17

Command bar.

Its drop menu offers the following commands:

DC1	Reset errors
EC1	Set I0 of the encoder simulator
GC1	Transfer parameters from RAM to FLASH
GC10	Initialize parameters
GC3	Autophasing
GC4	Validate
GC5	Calculate friction and inertia
GC6	Home switch auto-calibration
GC7	AutophasingOnline
GV11	Soft Reset
LC1	Save MC parameters
MC1	Identify the electrical parameters of the motor
PC150	Change the active feedback
RC1	Save parameters into the encoder

To execute a command, it must be first selected in the text drop list and then press the <enter> button on its right.

16.4.3 Tool bar

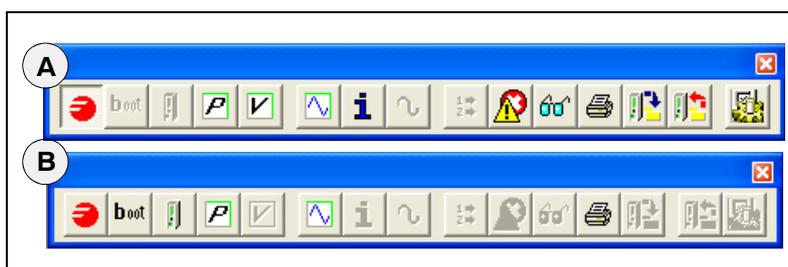


FIGURE S16.18

Tool bar: **A.** Icons enabled with connection (on line). **B.** Icons enabled without connection (off line).



CONNECTION

Activating this icon allows establishing communication between the WinDDSSetup and the drive connected to the PC through the serial line.

Before pressing this icon, the status bar shows the word "offline" on a gray background. After pressing the icon, the status bar shows the following words:

- Connecting ...
- Trying Drive 0 at 19200 baud.
- Reading values in RAM.
- Online (on green background).

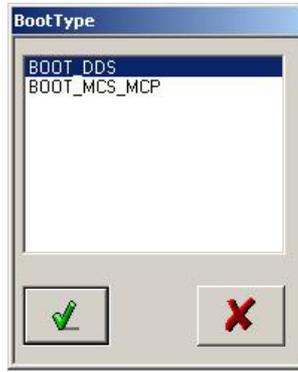


BOOT

The BOOT icon allows installing or updating a new software version at the drive. Clicking this icon displays the "BootType" window.

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WINDDSSSETUP
Tool bar



After accepting with the OK button, the next time the <boot> button is pressed from the initial screen of the WinDDSSetup, it will no longer show the dialog box **BootType**. It will assume directly by default the option defined in this window, which in this case is a BOOT_DDS as can be seen in the figure on the right.

From this dialog box, it is possible to select the connected drive model. This box is shown the first time by default.

From then on, from **SetUp> Preferences> Boot**, it will be possible to indicate the type of **boot** to be carried out by default and also deactivate "request type of boot".



Then, it shows the BootStrap window. The software version is loaded or updated at the drive from this window.

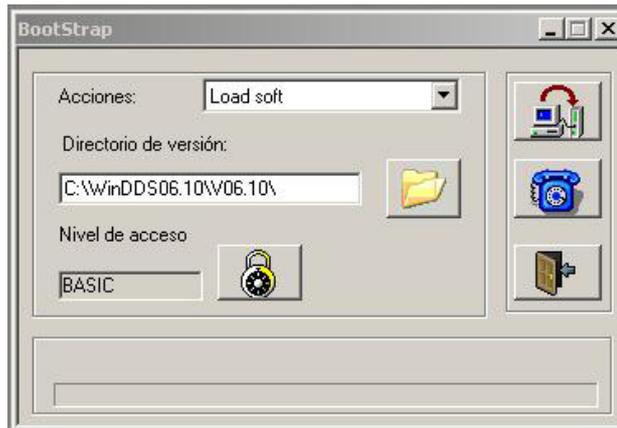


FIGURE S16.19

<BootStrap> window.



FIND DIRECTORY

Clicking this icon displays the <version folder> window. In folder Vxx.xx, locate the file: **módulos.cfg**. Select this file and click **Open**.

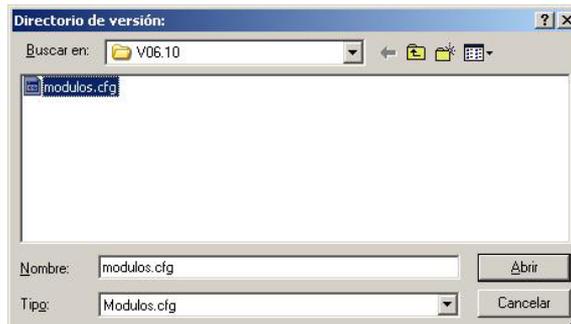


FIGURE S16.20

<Version folder> window.



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LOAD SOFTWARE (from the PC to the drive)

Clicking this icon displays the <Instructions> window. Follow the steps indicated here. The buttons this window refers to are on the front panel of the drive.



FIGURE S16.21

<Instructions> window.

After accepting it, it will start executing the process of loading the software from the PC to the drive.

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Tool bar

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Icons of the BootStrap window

Using the icons of the BootStrap window it is possible to set other considerations for the software loading process. Here is a brief explanation about them:



PASSWORD

Clicking this icon displays a window that requests a password to exit from the basic access level and have other possible loading actions shown in the <actions> drop list.



FIGURE S16.22

< boot password > window.

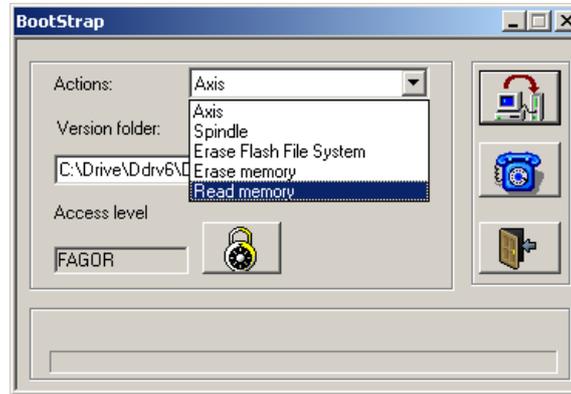


FIGURE S16.23

<actions> drop list of the <BootStrap> window. Only with Fagor access level.



CONFIGURATION

Clicking this icon shows the <configuration> dialog box. From this box, it is possible to configure certain details that must be considered when loading the software version.

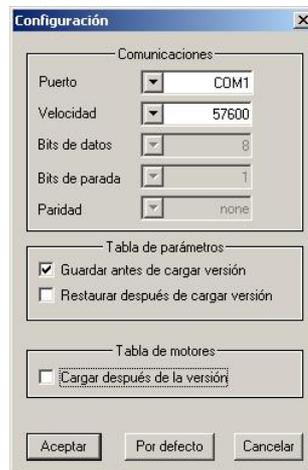


FIGURE S16.24

<Configuration> window.

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WINDDSSetup
Tool bar



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□ **Communications**

This option determines the port and its communication speed as well as the other elements shown here.

□ **Parameter table**

It offers two choices:

- **Save before loading version**, if the drive already had a parameter table and you wish to keep it saved at the PC when updating the software version.
- **Load after loading version**, to restore from the PC to the drive the parameter table previously saved at the PC.

□ **Motor table**

It offers two choices:

- **Load after loading version**, if when updating the software you wish to load the motor file (*.mot) associated with the drive, which, by default will be an fxm_fkm_xx.mot for an axis drive (AXD or ACD) or an fm7_spm_xx.mot or FM9_xx.mot for a spindle drive (SPD or SCD).

This option may be used to send new motor settings out to the field without having to change the software version.



SELECT DEVICE

Associated with the menu: **SetUp (SetUp) > Select drive ...**

Clicking this icon is only possible in off line mode. The expanded window informs to the WinDDSSetup about the drive model, software version and associated motor (synchronous or asynchronous). In on-line mode, this icon is disabled because the drive is connected and it provides this information directly to the WinDDSSetup.

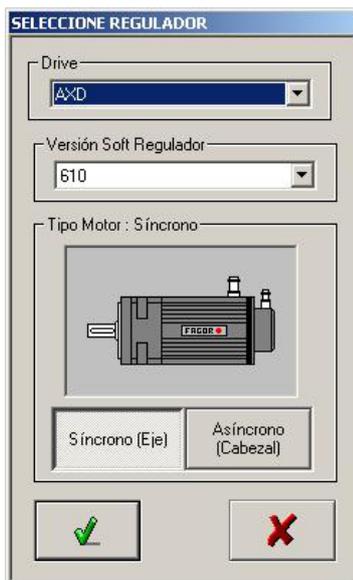


FIGURE S16.25

<Select device> window. It can only be enabled in off-line mode.



PARAMETER LISTING

This icon appears enabled both in off-line mode (without connection) and in on-line mode (with connection). Clicking this icon shows a window named <parameter setting (modification mode)> when in on-line mode.

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WINDDSSSETUP
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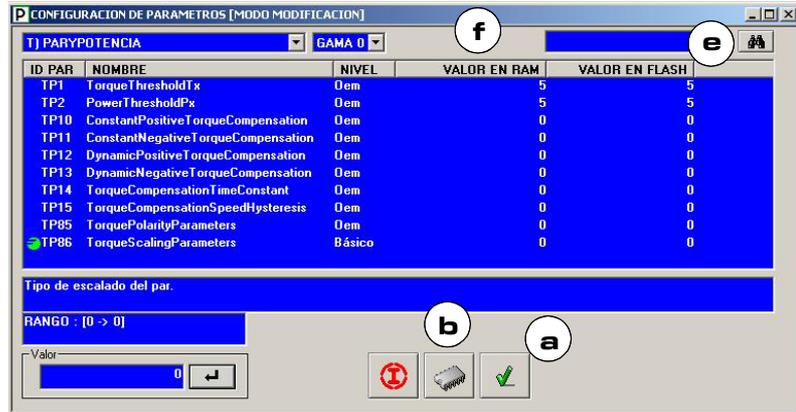


FIGURE S16.26

Parameter setting window. In on-line mode.

a. "Validate" icon. b. "Save into flash" icon.

or <parameter setting (editing mode)> when in off-line mode.

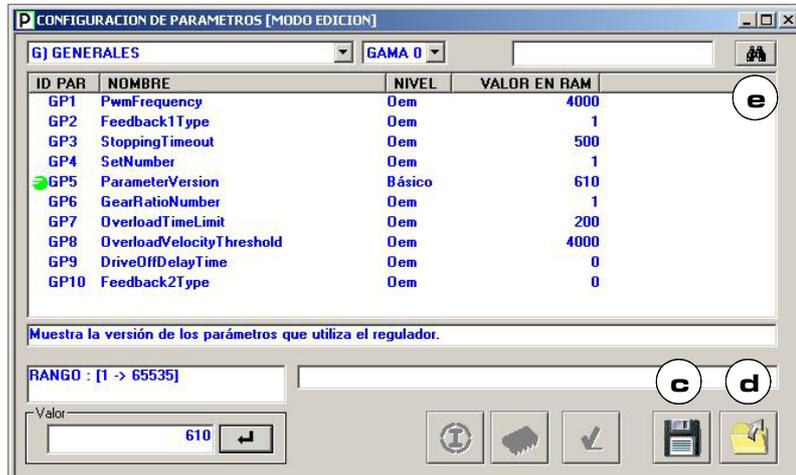


FIGURE S16.27

Parameter setting window. In off-line mode.

Inside, it shows a list of parameters of the drive. To edit one of them, it must be located and then selected. There are several ways to locate it:

- ❑ Selecting the <ALL> option from the drop list using the arrow and moving the vertical scroll bar if it is not displayed directly on the screen.
- ❑ Using the arrow to locate and selecting the specific **group** the parameter or variable belongs to from the drop list. The list displayed on the screen displays will obviously be smaller. The list displayed on the screen displays will obviously be smaller.
- ❑ Type the parameter (e.g.: GP5) in the search text box and press the **FIND** ^(e) icon.

Once found, select it by clicking on it (the Fagor logo will appear on its left) and enter the desired value typing it in the <VALUE> list box. To make this change effective, press the <ENTER> button on its right and then the **VALIDATE** ^(a) icon.

This value will be saved into the RAM memory of the drive (see the column **VALUE IN RAM** in the window).

To save the change permanently, press the **SAVE INTO FLASH** ^(b) button.

Note that in off-line mode, only the parameter table of the PC is modified, whereas in on-line mode the parameter table of the drive is also modified.



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Hence, it is possible to edit parameters from the PC in off-line mode and send the parameter table with the changes to a user that has the equipment in a different geographical area so he can replace, in on-line mode, the parameter table of his drive with the one modified and sent to him. This file has the extension (*.par).

Hence, in off-line mode, the window has the icons **SAVE**^(c) and **RESTORE**^(d) for saving or opening the file with parameter table again.

With OEM or FAGOR access level

The window < parameter setting (modification mode) > changes if it is not the basic access level and it may be used to identify and initialize a motor by selecting the M < Motor > group.

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WINDDSSETUP
Tool bar



FIGURE S16.28

Parameter setting window. M < Motor> group selection.



MOTOR SELECTION

This icon appears when previously selecting parameter MotorType (MP1) and the OEM or FAGOR access level from the list in the window. See [FIGURE S16.29](#).

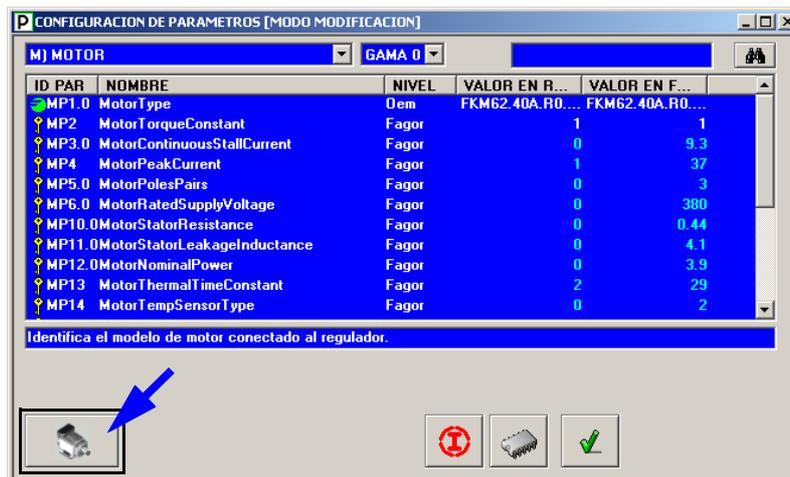


FIGURE S16.29

Motor selection icon.

Pressing the icon will display the window < **select motor** > with a list of all the motor models that may be governed by the drive depending on the (*.mot) loaded (by default) in the drive software.



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Hence, an "AXD 1.25" drive will have, by default, an "fxm_fkm_25.mot" file with all the possible motor references that may be governed by it and are shown in the following window.



FIGURE S16.30

Window for selecting a synchronous axis motor for a particular drive.

An "SPD 1.25" drive will have, by default, an "fm7_spm_25.mot" file with all the possible motor references that may be governed by it and are shown in the window.

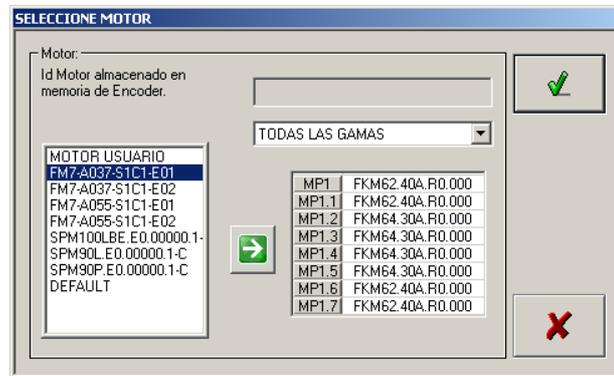


FIGURE S16.31

Window for selecting an asynchronous spindle motor for a particular drive.

For further details on how to configure, identify and initialize the motor from these windows as well as how to use the sets, see chapter 2: Motor identification.

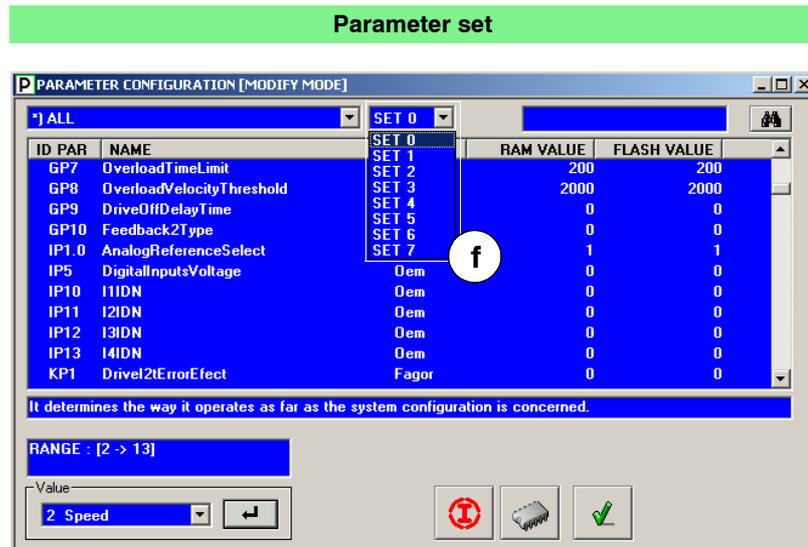


FIGURE S16.32

Parameter set.

This window < parameter setting (modifying mode) > also shows a drop list (with an arrow)^(E) that shows the existing sets. When selecting one of these sets, it identifies on the parameter list the ones that belong to the chosen set.



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Note the set identifying digit after the parameter ID (see the example in the figure that if set 3 is selected, parameter PP1.3 ends with <□□□.3>).

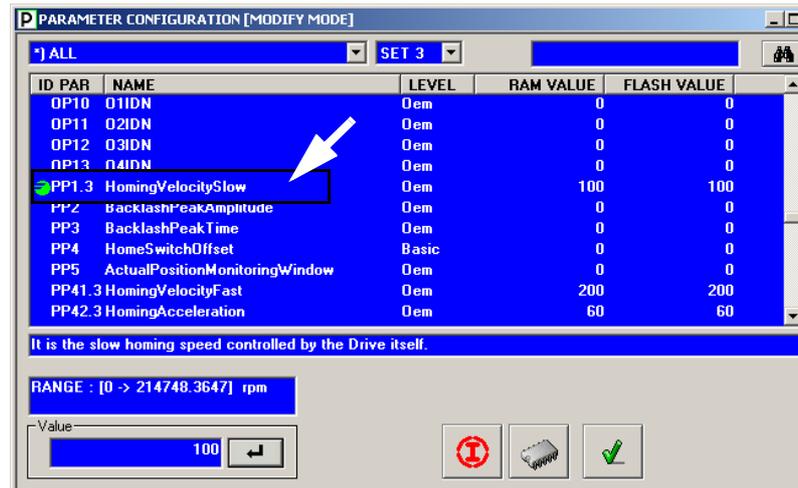


FIGURE S16.33

Identifying parameters that belong to the selected set.



LIST OF VARIABLES

This icon appears enabled only in on-line mode (with connection). Pressing this button shows a window named <variable setting>.

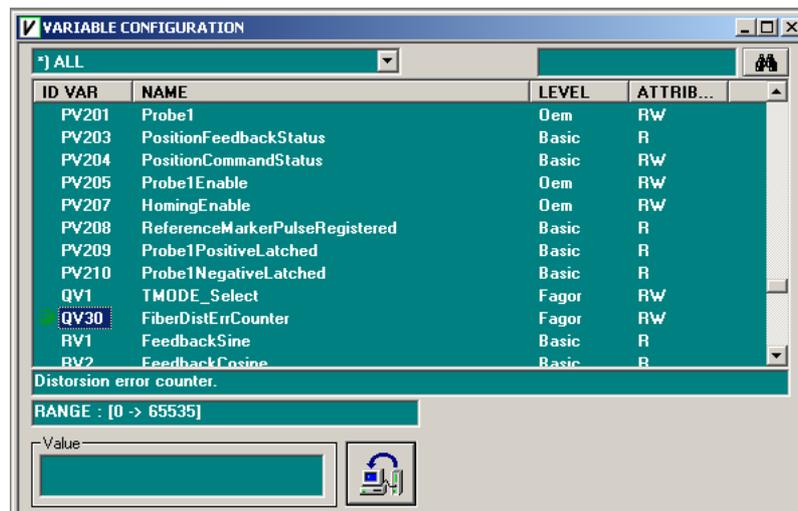


FIGURE S16.34

Variable setting window.

Inside, it shows a list of variables of the drive.

This window may be used to:

- Read and/or edit variables that are read/write (note their R/W indicator on the attribute column).
- Read variables that are read-only (note their R indicator on the attribute column).

Observe that when entering the cursor in the <VALUE> box, the icon on its left changes its looks indicating the direction of the data exchange depending on whether the selected variable is read only (R) from the drive or read/write (RW) towards the drive.

See the icons:

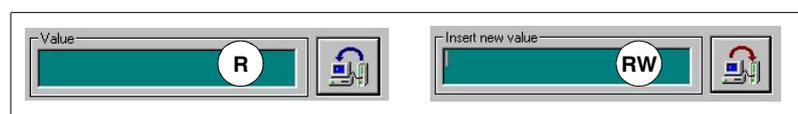


FIGURE S16.35

R. Read variable. RW. Read/write variable.

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WINDSSSETUP
Tool bar



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The way the variables are found and selected is the same as the way the parameter setting window, except that here it lists the variables of the drive.

PV201 Probe1

The "key" symbol appearing next to the parameter or variable ID in its corresponding window means that it cannot be modified in that access level.



The icons for VALIDATE and SAVE INTO FLASH were already described in chapter 1. **PREVIOUS KNOWLEDGE**



HARD/SOFT INFORMATION

Activating this icon shows an informative window like this:



FIGURE S16.36

Information about the software and hardware of the drive connected as well as the identifier of the motor connected to the drive.



FUNCTION GENERATOR

Activating this icon permits generating commands internally. It can only be enabled at OEM or FAGOR access levels, not at the basic level. Pressing this button shows the window <internal velocity command generator> with the following fields:

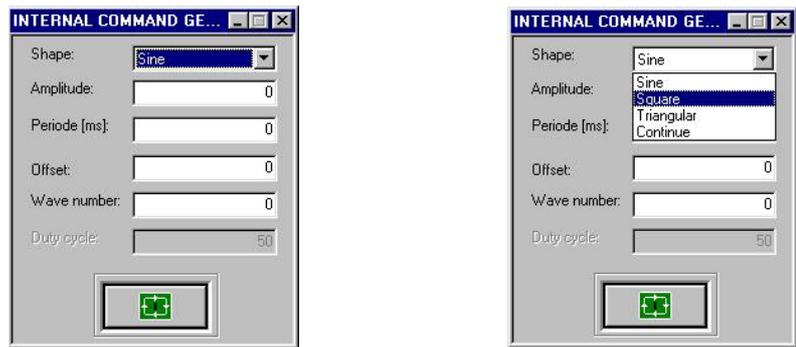


FIGURE S16.37

Internal velocity command generator.

The text fields of this window may be used to determine the waveform, its amplitude, period and other specifications.

Example.

For a square wave, whose velocity command amplitude is 500 rpm and its period is 152 ms. The following graph is obtained by programming the channels so as to observe variables WV5 and SV2 (oscilloscope mode):

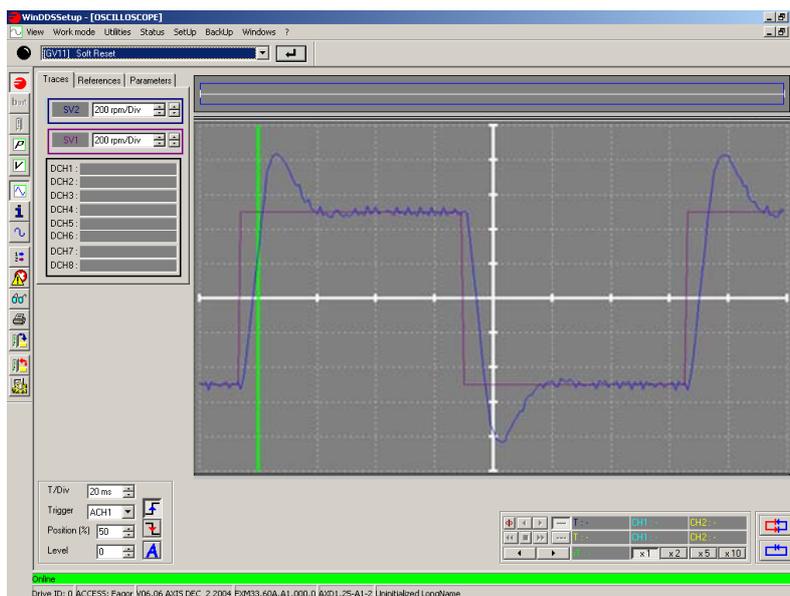


FIGURE S16.38

Oscillograph according to the data specified for the internal velocity command signal.

Note that the motor will move trying to follow the programmed command.

The range for each field are:

Amplitude	- 32768 ÷ 32767
The period	1 ÷ 32764
The offset	- 32768 ÷ 32767
The number of	0 ÷ 65535
The duty cycle	1 ÷ 99

The internal velocity command generator is activated and deactivated with the following buttons:



FIGURE S16.39

A. Activate velocity command generator. **B.** Deactivate velocity command generator.

1 ➔
2 ➔

ANALOG OUTPUTS

Activating this icon shows a dialog box that permits programming two analog outputs and take out any internal variable of the drive.

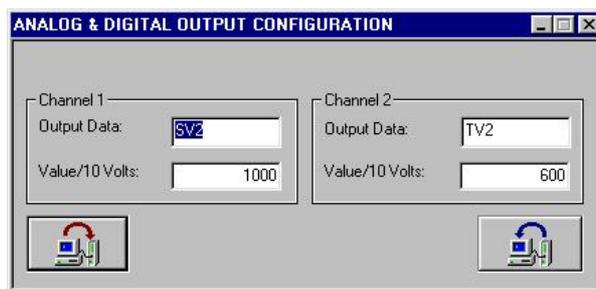


FIGURE S16.40

Programming of the two analog outputs.

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WINDDSSETUP
Tool bar

The variables may be selected in the <Output data> text box of channels 1 and 2. These variables are selected in the drive parameters OP1 and OP2. Also, the values of these variables for the 10V DC of analog output are set in the <Value/10 volts> text boxes of channels 1 and 2. These values are stored in drive parameters OP3 and OP4.

Example.

The analog outputs are useful as adjusting tools. Hence, with an oscilloscope connected to these outputs, it is possible to monitor those internal variables of the drive and check overshooting, stabilizing times, accelerations, system stability, etc.

To display the torque and instant speed signals:

OP1=SV2	Actual speed, channel 1 (pins 10/11 of X7)
OP2 = TV2	Actual torque, channel 2 (pins 8/9 of connector X7)
OP3=1000	1000 (rpm) / 10 V
OP4=600	600 dNm / 10 V

See **FIGURE S16.40** that shows how to enter this data.



ERROR STATUS

Clicking this icon shows the (SPY) window that can display the list of errors occurred at the drive, **in the order they came up** which may sometimes facilitate the diagnosis.

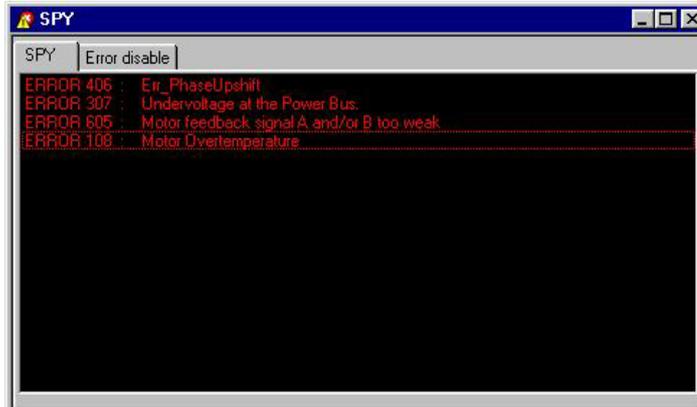


FIGURE S16.41

SPY window. List of errors.

To disable a particular error shown in the SPY window, it could be done from the "Error disable" tab.

Note that only the resettable errors may be disabled although this list also shows the non-resettable ones.

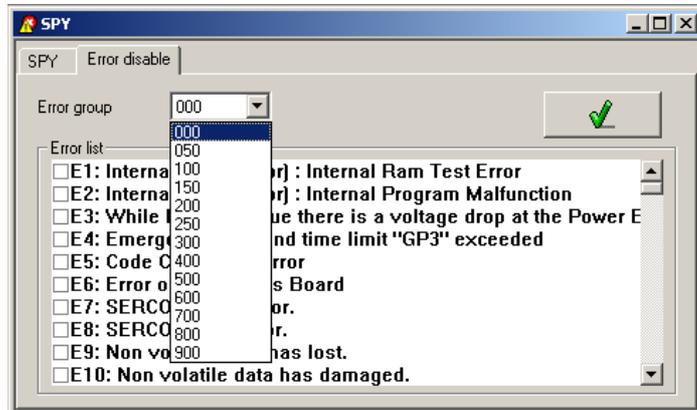


FIGURE S16.42

SPY window. Error disabling.



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Locate the group it belongs to on the droplist <Error group> and mark the ID to the left of the error on the error listing.

Note that this option requires an OEM or FAGOR user access.

Then, execute the DC1 command (reset errors) to make error disabling effective.

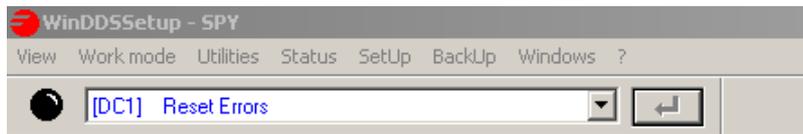


FIGURE S16.43

Execute the DC1 command. Reset errors.



MC PROGRAM DEBUGGER

Clicking this icon displays the <debugger> window for debugging Motion Control applications. It shows groups of files to be debugged, of application execution command activating functions and of break-points setting functions.

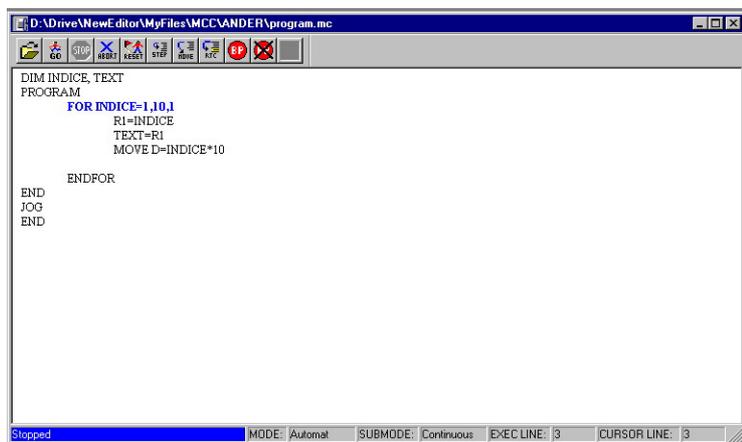


FIGURE S16.44

Debugger Window.

Debugging commands and break points

This tool bar located at the top of the **DEBUGGER** window has the following icons:



DISPLAY SOURCE CODE

Activating this icon from the <debugger> window lets the user open a window to display the source code of the application to be debugged. He can set break points and if the execution is interrupted, see on which code line it has been interrupted. The source code is debugged at high level, not at pseudocode level. The display window shows the status of the application on the <status bar> indicating whether it is running or not and on which it has stopped (if it has).

The debugging software obtains this data by accessing two Motion Control software variables that indicate on one hand the execution status LV30 (F02330) KernelExecutionState and on the other the execution point where it was interrupted LV31 (F02331) KernelExecutionPoint.

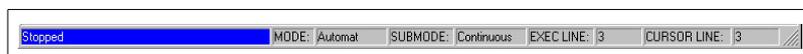


FIGURE S16.45

Status-bar.

16.
WINDSSSETUP
Tool bar



DDS SOFTWARE

(Soft 06.2x)

Ref.1109

16.

WINDDSSSETUP
Tool bar

Debugging



GO
It may be used to launch the application.



STOP
To stop the execution of the application immediately.



RESET
It interrupts the execution immediately, <resets> the application to be debugged and positions the cursor at the beginning.



ABORT
It interrupts and finishes the positioning block at any time without waiting for the target position to be reached.



STEP
It runs the application step by step where the high level instructions may be executed one by one.



MOVE
To execute positioning blocks one at a time.

Break points



RTC
It sets a cursor-defined stop point for the application.



BP
It activates and deactivates the break points on the current line of the application.



NOT BP
It eliminates all the break points from the current application.

Removes all the break points of the application The MC software implements two mechanisms of this sort for debugging MC applications:

- The break points BP (**B**reak **P**oint).
- The execution up to the RTC (**R**un **T**o **C**ursor) cursor.

The BP's set the application interruption points so the execution stops every time it reaches those points. Up to 8 break points may be set simultaneously.

The RTC also sets an application interruption point so the execution stops when reaching this point for the first time and it is then deactivated. Only one element of this type may be set every time the execution is started.

To set a BP, the operator must select the desired program line and activate the corresponding icon at the tool bar; that line will be highlighted permanently. This BP will be deactivated by selecting this line again and clicking this button.

If the operator wants to quickly remove all the BP's, he must activate the icon of the tool bar that shows the letters BP crossed out.

To set an RTC again, place the cursor on the program line and activate the "RTC" button of the tool bar.



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MONITORING

Clicking this icon at the window displays the <watch> window where the operator may access the variables of the application during debugging (while reading and while writing). This window offers the possibility to select the variables to be displayed and to display the values of the selected variables.

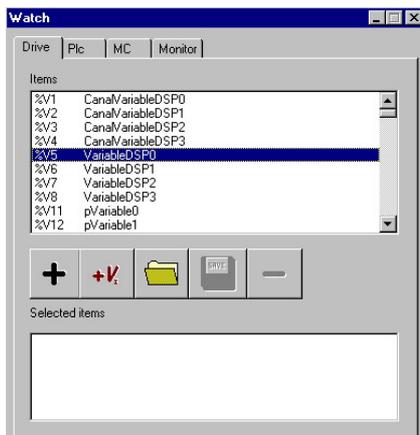


FIGURE S16.46

Watch window.

As may be observed in the <Watch> window, besides selecting parameters and variables of the drive, it also offers the possibility to select the variables of the PLC and the MC. They may be monitored together if so desired.

Note that for the <PLC> and <MC> labels to be displayed in this window, the connected drive must be either an MMC or a CMC model.

From the point of view of the MC software, the user variables and arrays are registers of a table and they are identified by their index in the table. However, when debugging an MC application, the user may display them by the names given to them when editing the application.

Therefore, if a particular application is not opened to be debugged, the drive will know the MC user variables by their generic name as shown in the window above.

However, when opening a particular MC application to debug it, the debugging software will recognize the particular names that the operator gave to the variables and it will display those names. See [FIGURE S16.47](#).

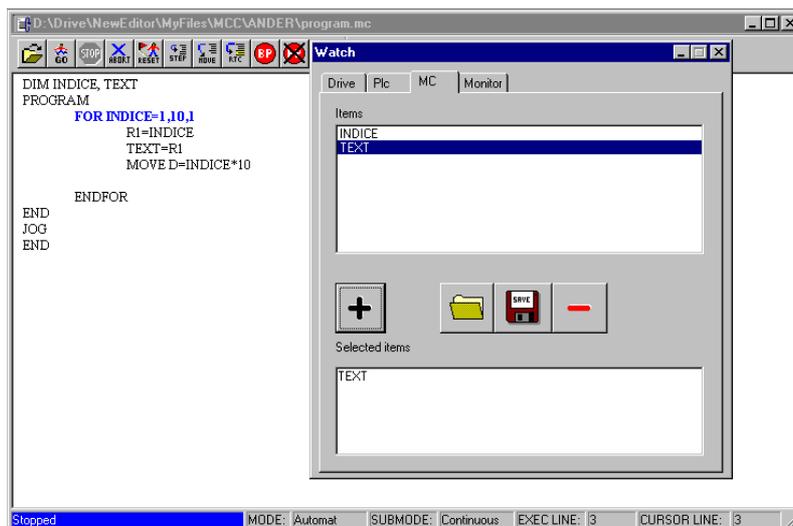


FIGURE S16.47

Recognizing the names of user assigned variables.



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SOFTWARE

(Soft 06.2x)

Ref.1109

16.

WINDDSSSETUP
Tool bar

The <Watch> window offers the <Monitor> tab that when activated shows a set of field boxes and permits displaying at the same time the selected MC and PLC variables as well as the variables and commands of the drive.

Each text field corresponds to one of the selected variables or commands and shows the value that the drive stores of each one of them in that very instant.

All this will be executed after pressing the button displayed in this window.

Some of these variables show a set value, others offer values that vary in time according to the data supplied by the drive regardless of whether the application program is running or not.

Up to 10 variables and commands may be selected and they will be displayed in the established selecting order. Each variable will be selected from its tab depending on whether it is an MC, PLC or DRIVE variable.

Besides, the values of these variables may be changed by writing directly in the field box of the variable and pressing the <RETURN> key.

FIGURE S16.48. shows an illustrative image of this situation.

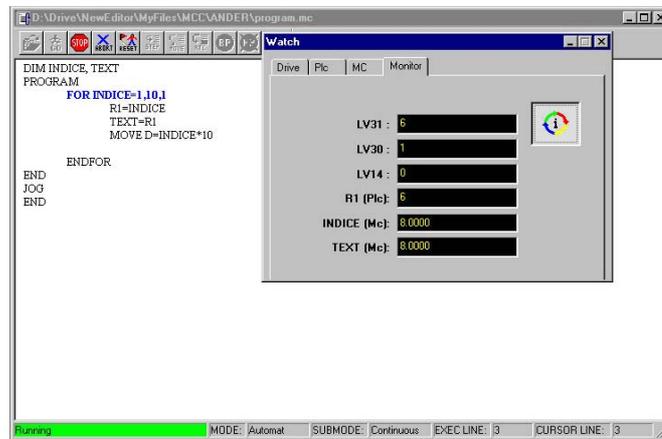


FIGURE S16.48

Watch window. <Monitoring> tab.

To load a new configuration of variables to be displayed and save the changes made on them from the <monitoring> dialog box, click with the right mouse button under the <monitoring> tab to show a window like this one:

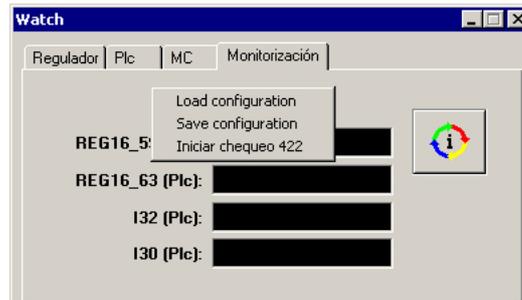


FIGURE S16.49

Load and save new configurations.

Clicking on <Load configuration> displays a window for finding a file with the configuration of the variables to be displayed.

Clicking <Save configuration> displays a window for saving the modified file with either the same name replacing the original file or with another name leaving the original file intact.

PRINT

Clicking this icon shows a window used to accept or reject printing.



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SOFTWARE

(Soft 06.2x)

Ref.1109



DRIVE / PC BACKUP

Clicking this icon allows saving a known drive configuration. Pressing this button shows the window <Drive backup →File> from where the operator can store the type of file and the number of the file to be saved in the PC. The loading direction is from the flash memory of the drive to the hard disk of a PC.



PC / DRIVE BACKUP

Clicking this icon allows loading (copying) a known configuration to a new drive. Pressing this button shows the window <File backup → Drive> from where the operator can select the type of file and the number of the file to be loaded from the PC to the drive. The loading direction is from the hard disk of a PC to the flash memory of the drive.

The file type may be:

TYPE	EXTENS.	MEANING
Parameters	*.par	Parameter table of the drive
PLC files	*.pcd	Compiled PLC programs
MC files	*.mcc	Compiled MC programs
MCP files	*.mcp	Parameter table of MC applications
CFG files	*.cfg	Configuration files
MOT files	*.mot	Motor parameter table
CAM files	*.cam	Cam profile tables

Once the MC or PLC applications have been compiled, they may be loaded and downloaded avoiding possible conflicts when accessing the serial line between the editing and debugging applications. This function sends the MC, PLC application file, parameters table, etc. in the same way as the drive parameters are sent. This application is stored in the flash memory of the drive.

Since the drive accesses these files on power - up, any changes made to the MC or PLC program must be validated WinDDSSetup resets the drive to update its RAM with the modified parameters. The figure below shows the window for loading files into the drive:



FIGURE S16.50

<File backup →Drive> Window.

Once the desired file type and name has been selected, it is loaded into the drive by clicking on Open.

OSCILLOSCOPE



This icon is used to activate the <Oscilloscope> tool of the WinDDSSetup application that may be accessed from its main window. It displays the following screen.

16.
WINDDSSSETUP
Tool bar

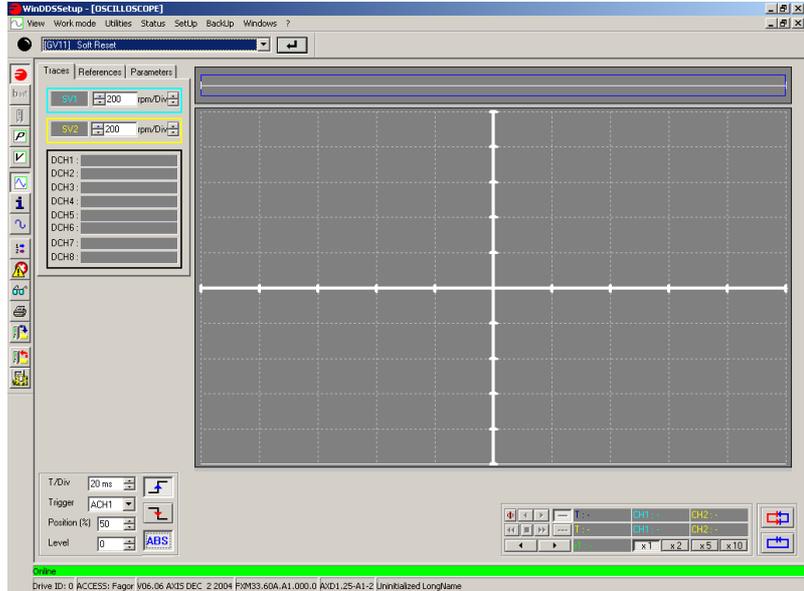


FIGURE S16.51

Oscilloscope window.

This tool of the WinDDSSetup may be used to display on the oscillograph the behavior of two drive variables over time.

It offers two **channels** for the variables to be displayed. Use the arrow buttons of the dialog box to select the value of the variable for each channel:

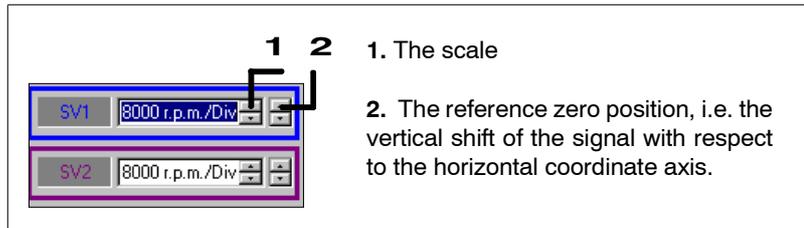


FIGURE S16.52

Capture channels.

To assign a variable to a channel, expand the dialog box that appears on the screen and click the left mouse button on that capture channel. In this box, use the scroll bar to select the group the variable belongs to and if the drop list doesn't show it, search it with the vertical scroll bar.

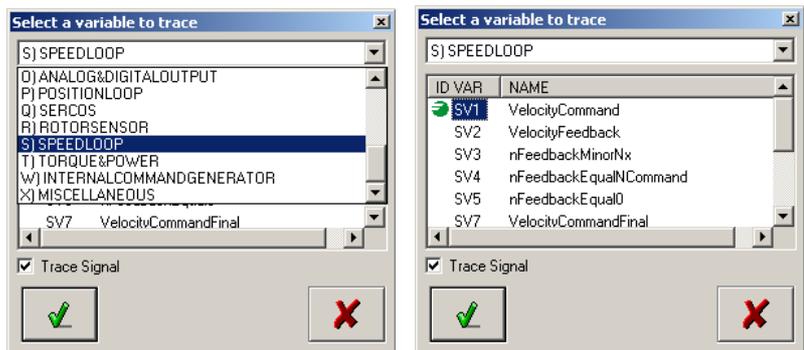


FIGURE S16.53

Selection box for the variable assigned to a capture channel.



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(Soft 06.2x)

Ref.1109

Once the group has been selected, it displays all the variables that belong to it; the desired variable may then be selected by simply clicking on it.

Observe that, marking or not the **<Trace> (Trace Signal)** option of this window implies activating or deactivating the capture channel to which the selected variable is assigned.

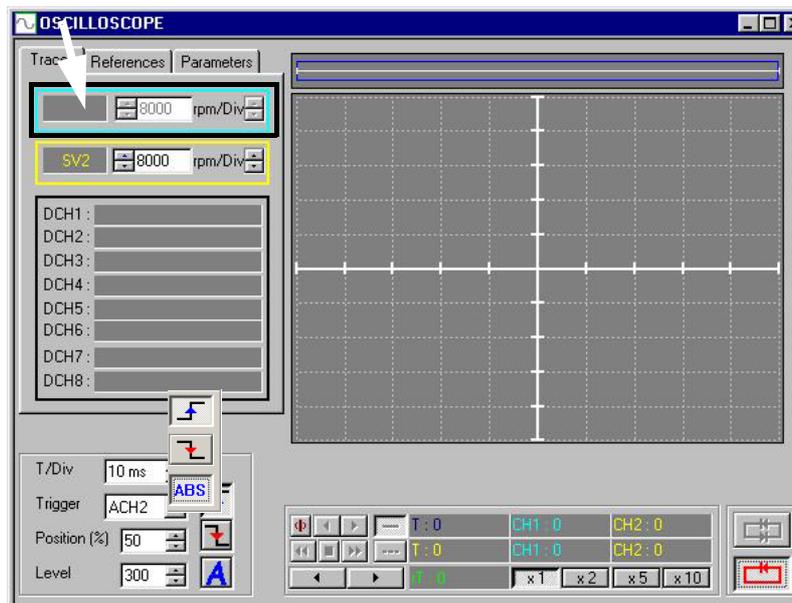
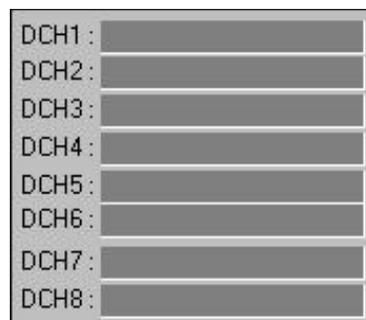


FIGURE S16.54

Not marking the **<Trace> (Trace Signal)** option deactivates the channel. Note that the first capture channel is deactivated (the name of the variable assigned to the channel is not displayed).

It also has eight digital channels that are useful to know the behavior of a particular bit of the variable selected in any of the two channels.

They appear on the screen as follows:



Clicking the left button of the mouse on the panel for the digital channels displays a window with two expandable boxes that permit selecting the digital channel and the bit of the variable of the selected channel whose behavior is to be monitored over time.

FIGURE S16.55

Digital channels.

The dialog box looks like this:

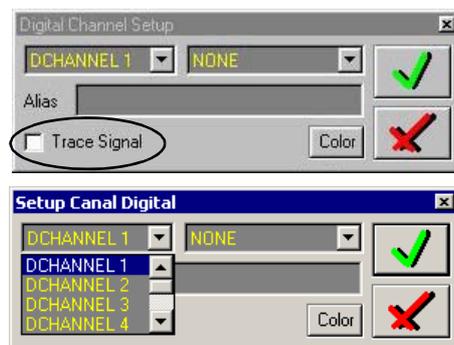


FIGURE S16.56

Digital Channel Setup boxe. Configuration of the selected digital channel.

16.
WINDDSSSETUP
Tool bar

It shows a field called **Alias** where an arbitrary set of characters may be entered; this set of character will later appear before the variable identifier (bit) in the selected digital channel.

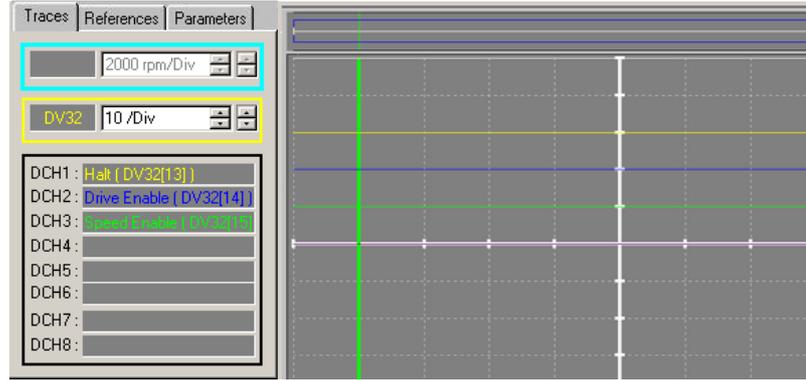


FIGURE S16.57

Visual result after applying an Alias for digital channels DCH1, DCH2 and DCH3 where the **<Trace> (Trace Signal)** option was marked in its configuration window **<Digital Channel Setup>**.

Activating the **<Trace> (Trace Signal)** option permits displaying it on the oscillograph and the Alias - ID var (bit) in the selected digital channel.

It is also possible to set the time/division, analog channel to be considered when activating the trigger, up-flank, down-flank or automatic trigger position on the oscillograph and the trigger activation level in absolute mode (defining an interval given by about the value of the assigned level) with the fields of the oscilloscope window:

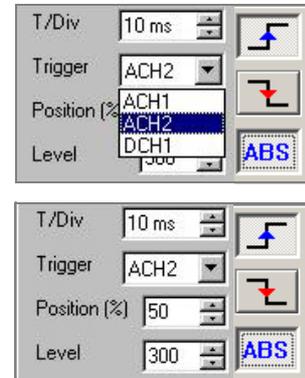


FIGURE S16.58

T/Div, trigger, position and level fields.



It sets the trigger by up-flank for the level set in the text box labeled **<level>**.



It sets the trigger by down-flank for the level set in the text box labeled **<level>**.



It sets the trigger by up-flank, down-flank or both (depending on whether any or both previous buttons have been activated) for the absolute value of the level set in the text box labeled **<level>**.



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Example.

For the sinusoidal signal of the figure, see the trigger activation points depending on the buttons activated.

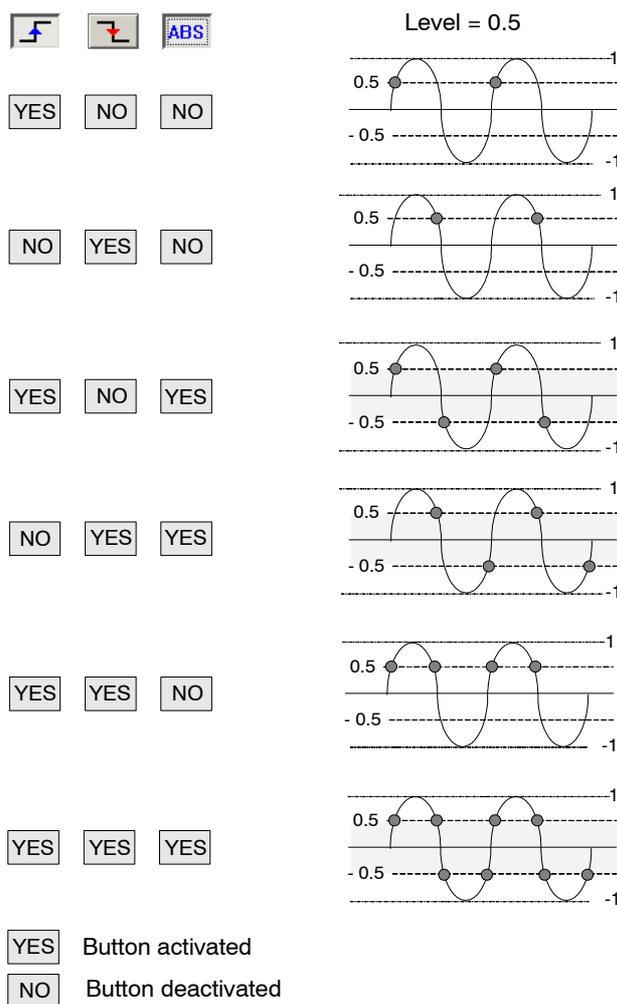


FIGURE S16.59

Trigger activation points depending on the buttons activated.

Note that if the three buttons are deactivated or only the ABS button is activated, it will be triggered automatically and immediately like in older versions than 06.10.

In order to obtain numerical data of the signals shown on the oscillograph, the oscilloscope window shows the following panel that offers all the possible options.

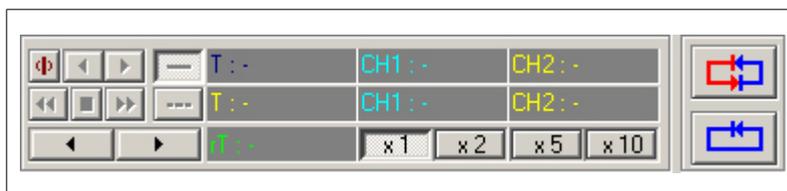


FIGURE S16.60

Oscilloscope control panel.

Hence, it is possible to:

- activate two reference cursors.
- manipulate their positions on the oscillograph.
- enlarge the image of a capture.
- display numerically the signal intersections with the active cursors.
- display the temporary relative references between the active cursors and between each cursor.

16.

WINDDSSETUP
Tool bar



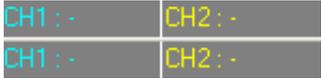
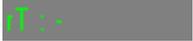
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- display the position where the trigger is activated.

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WINDDSSETUP
Tool bar

	Activate / deactivate both cursors
	Cursor selection
	Left / right movement of the selected cursor
	Left / right movement of both cursors simultaneously
	Time / division reduction in the indicated proportions
	Displays for the values of the intersections between the signals shown on the oscilloscope and the active cursors.
	Relative time between cursor 1 and the trigger position.
	Relative time between cursor 2 and the trigger position.
	Relative time between cursor 1 and cursor 2
	Continuous sampling
	Single capture

It is also interesting to be able to set the axes (X and Y), cursors and trigger position when displaying all these elements on the screen.

This is possible by clicking the right button of the mouse on the screen if the oscilloscope to select and enter the values chosen by the operator in the various fields of the dialog box that comes up when selecting **<Graph Setup>** .

Also, the drop menu offers options such as print, save and load data, save and load configurations and adjust scale. See the following figure:

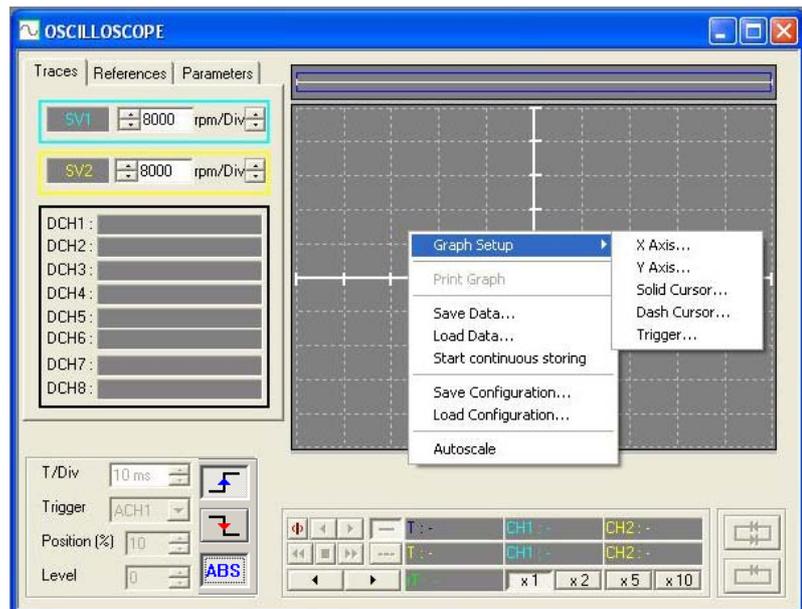


FIGURE S16.61

Graph Setup.

From:

- Graph Setup > X Axis ...** It configures attributes of the horizontal X axis, grid dimensions, logarithmic scale, color, style, line width, etc.



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- ❑ **Graph Setup > Y Axis ...** It configures attributes of the vertical Y axis, grid dimensions, logarithmic scale, color, style, line width, etc.
- ❑ **Graph Setup > Line cursor...** it sets the color of the line cursor.
- ❑ **Graph Setup > dashed cursor...** it sets the color of the dashed cursor.
- ❑ **Graph Setup > Trigger ...** it sets the color of the trigger.

It opens windows like those of **FIGURE S16.62** to set the attributes this way.

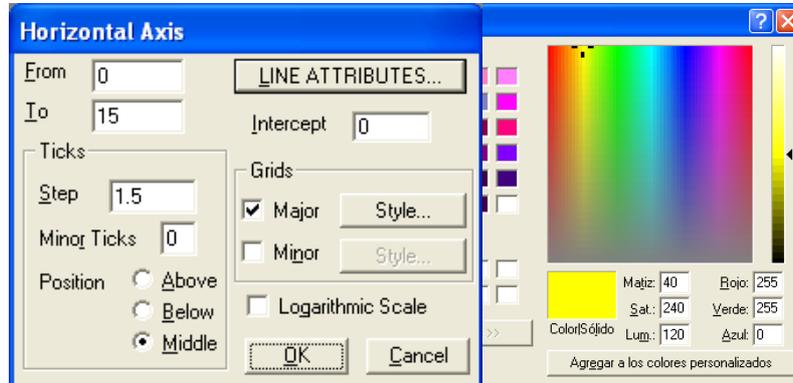


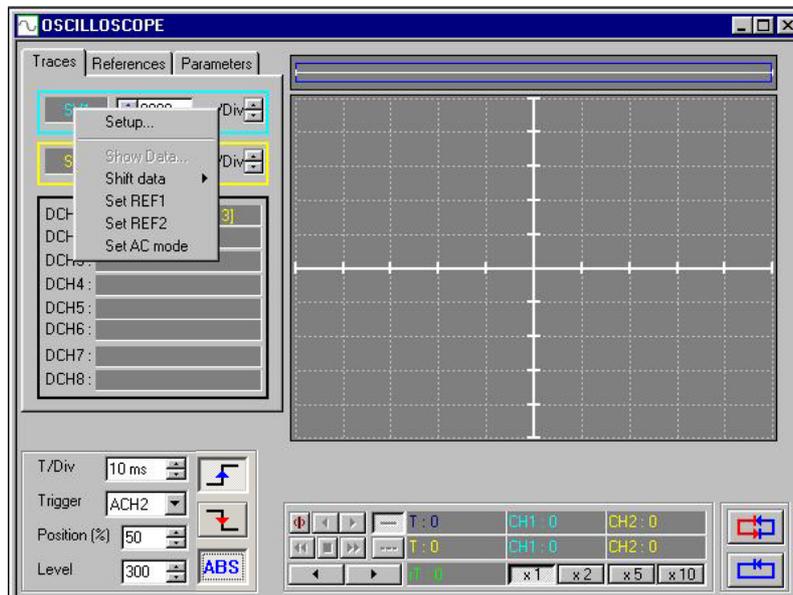
FIGURE S16.62

Windows to define attributes of the axes, cursors and trigger

- ❑ **Print graph** prints on paper the oscillograph shown on the screen.
- ❑ **Save data ...** to save the capture points into a (*.m) text file.
- ❑ **Load Data ...** to load a (*.m) text file with the points of a previously saved capture.
- ❑ **Begin saving ...** a number of captures is being saved into a file. This number must be previously set in the text box "**number of traces to save**" that appears on the screen after activating this option. The saving of the captures may be ended in this menu with the option "**End saving**".
- ❑ **Save Configuration ...** the oscilloscope configuration may be saved into a (*.ocg) file. trigger, variables of each channel, number of samples...
- ❑ **Load Configuration ...** a (*.ocg) file may be loaded with an oscilloscope configuration file: trigger, variables of each channel, number of samples previously saved.
- ❑ **Adjust scale** selects one of the predefined scales so the signal is enlarged to the maximum without exceeding the borders of the graphic.

It is also possible to set the way to display the behavior of the variable assigned to each channel on the oscillograph.

Clicking on the right mouse button on each one of the two capture channels of the oscilloscope and selecting **<Setup>** on the drop menu shown (see figure),



It shows one or the other window used to set the different attributes to represent the signal for that channel.

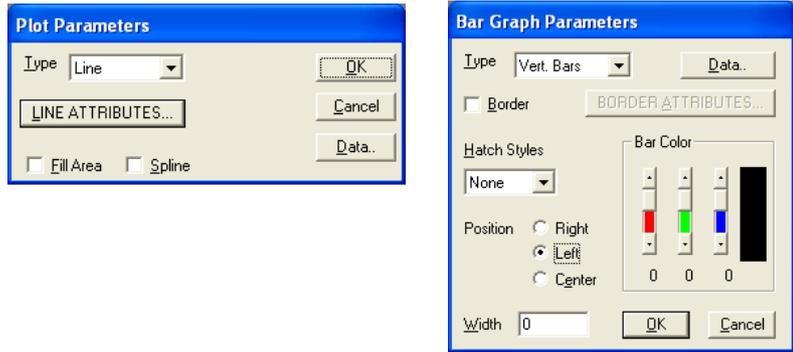


FIGURE S16.64

Windows to define the Plot parameters and bar graphics

Selecting **<Shift Data>** from the same drop menu (only enabled when the variable assigned to the channel is a 32-bit variable permits displaying 16 of them by selecting them at the expandable window.

Hence, selecting 0 bits will display the first 16 and the bit string move as you select the number of bits.

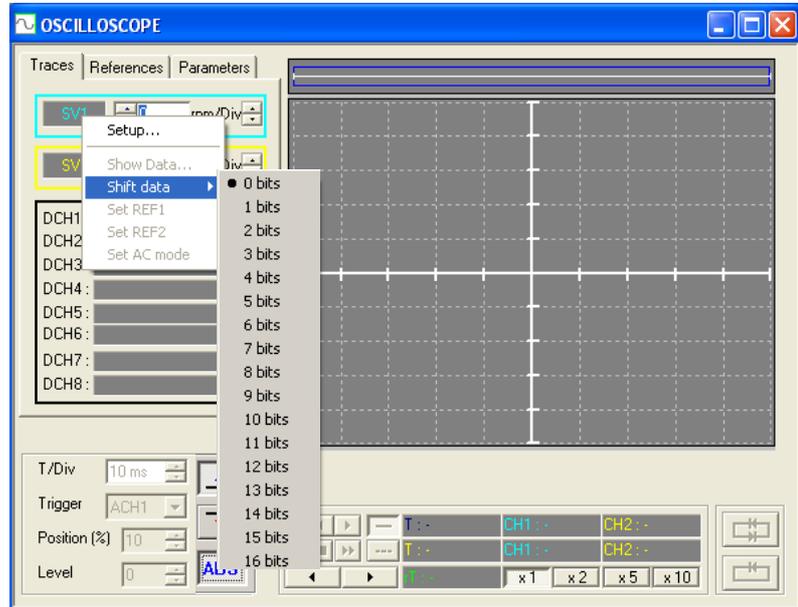


FIGURE S16.65

Drop menu **<Shift Data>**.

There are also two channels referred to as **reference channels** whose only way to have a trace is by getting it from one of the two capture channels.

To load a trace from a file into one of the reference channels, it must be loaded to a capture channel first, and then transferred to the desired reference channel.

If any of the reference channel already has a reference trace, it won't be possible to change the trigger conditions, the number of samples nor the sampling period in order to prevent the traces sharing the screen from being taken under different conditions.

Clicking the right button of the mouse on the name of the variable of the capture channel to be transferred (**<Traces>** tab activated) expands a menu for selecting the destination reference channel for the captured trace (select REF1 or REF2).

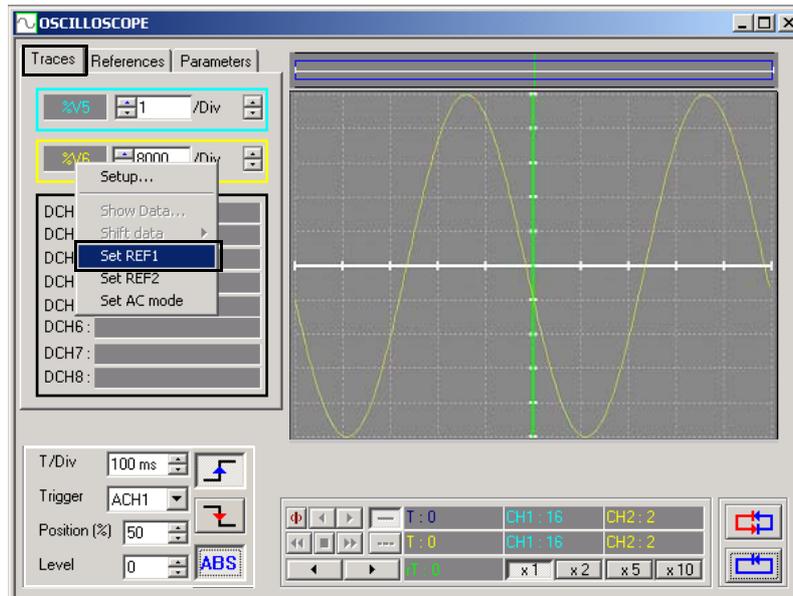


FIGURE S16.66

Transfer menu with trace captured in channel 1 to reference channel 1 using REF1

The traced captured in channel 1 is loaded as a reference trace 1 when activating REF1 of the expanded menu. Activating the <References> tab, it is possible to verify that the captured trace is located in the first reference channel.

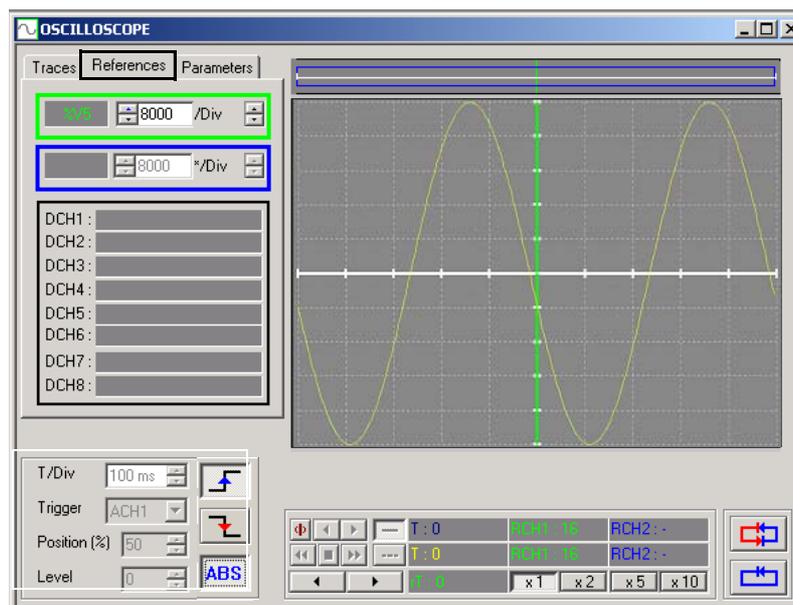


FIGURE S16.67

Trace captured in the reference channel 1.

It also has a **configurable list of parameters** for the adjustment that expands by activating the <parameters tab>. This makes it possible to change the adjustments at the oscilloscope window setting the desired adjustment parameters from this option.

The dual-column table shown there can display the value of each **parameter** at that time by keying the name of the parameter on the left column, in **capital letters** (eg. AP1) and pressing ENTER. Its value will appear on the right column.

Its value may be changed by keying its new value in the same box and pressing ENTER.

16.
WINDDSSSETUP
Tool bar

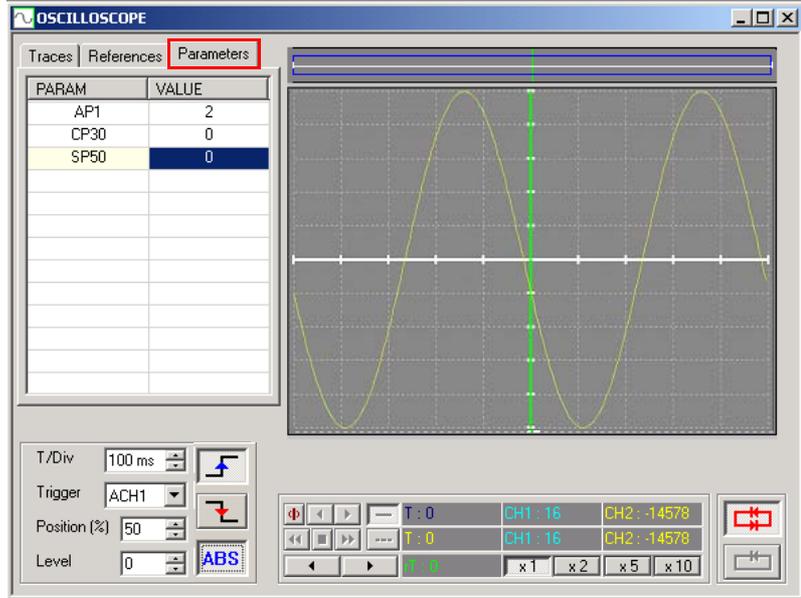


FIGURE S16.68

<Parameters> tab. Configurable parameter list for adjustment.

The parameter list is stored with the oscilloscope configuration; therefore, it may be recalled from this file. A click of the right mouse button on the oscillograph expands a menu that allows saving or loading the list configured with the adjustment parameters.

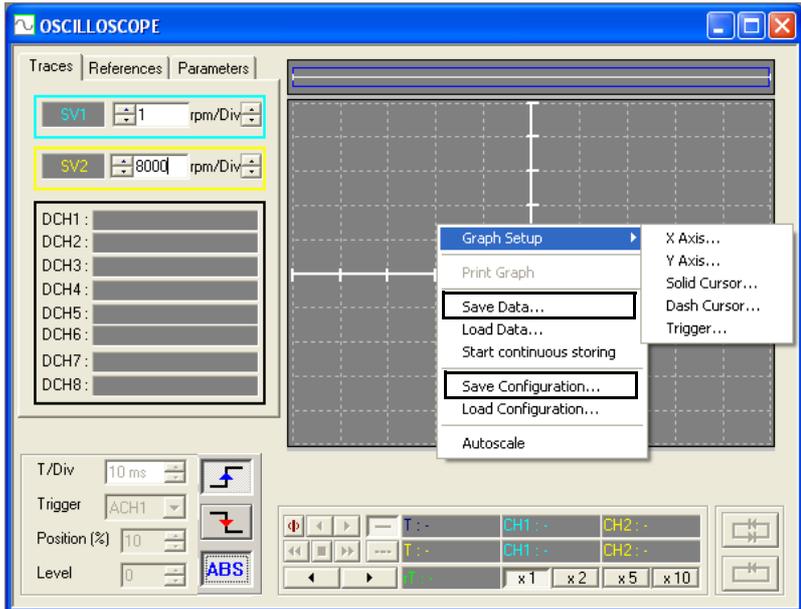


FIGURE S16.69

Save the list of parameters in a file using the option to <save data>.

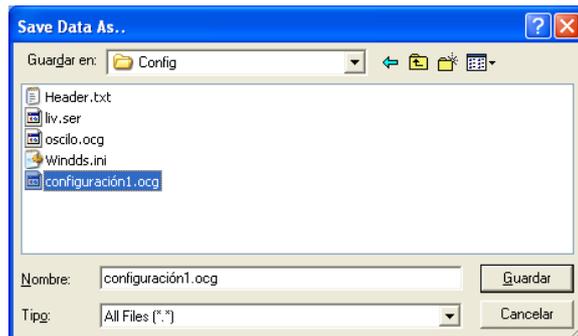


FIGURE S16.70

Window <save trace data as... >.



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Note that if the set is not specified in the parameter name, it implies working with its set 0.

Variables can also be included. However, it must be borne in mind that the value displayed is a result of an initial reading and is not continuously refreshed.

Both the capture channels and the reference channels may be displayed in **"DC mode"** or in **"AC mode"**.

Either mode may be selected from the menu used to transfer a trace from a capture channel to a reference channel.

This menu is expanded by clicking the right button of the mouse on each of the two capture channels.

The DC mode shows the signal with its real values and the AC mode subtracts from the real value of the signal the average value of all the points of a taken sample.

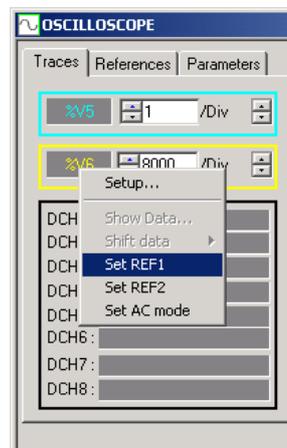


FIGURE S16.71
Drop Menu for selecting either the AC or DC mode.

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WINDDSSETUP
Tool bar



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APPENDICES

RPS REGULATED POWER SUPPLIES

A. Error codes & messages, warnings and solutions



**RPS
SOFTWARE**

(Soft 01.0x)

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ERROR CODES & MESSAGES ON RPS POWER SUPPLIES



On RPS regenerative regulated power supplies, their status display can show the error codes or warning codes described in this appendix.

The system will not start running until all the errors detected by the power supply or all the drives installed next to it have been eliminated.

They may be:

Errors that can be reset

Definition. Errors that can be eliminated with a "reset" after eliminating their cause.

Procedure. The errors may be "reset" through pin 1 (connector X6) of the RPS power supply module.

Errors that cannot be reset

Definition. Errors that cannot be eliminated with a "reset" after eliminating their cause; in other words, the previous procedure cannot be used to eliminate them.

Procedure. Eliminate the cause for the error and when eliminated, turn the unit back on.

The errors that cannot be reset are:

TABLE SA.1 Errors that cannot be reset.

E005	E211	E701	E705						
------	------	------	------	--	--	--	--	--	--

Activating any of the errors both "resettable" and "non-resettable" causes a category 1 stop.

Errors that deactivate PWM

Definition. Errors that interrupt the current circulating through the motor windings.

Procedure. Eliminate the cause for the error and when eliminated, turn the unit back on.

They are errors that deactivate PWM:

TABLE SA.2 Errors that cut the current circulation through the motor.

E003	E005	E100	E101	E102	E104	E105	E107	E211	E212
E213	E214	E300	E304	E306	E307	E308	E315	E316	E317
E318	E501	E502	E701	E705	E900	E901	E902	E903	E904
E905	E906	E907	E909						

Activating any one error that deactivates PWM generates a category 0 stop.



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A.1 Meaning of error codes and solutions

A.

ERROR CODES & MESSAGES ON RPS POWER SUPPLIES
Meaning of error codes and solutions

E003	While there is voltage at the power bus, an error has occurred in any of the drives supplied by the RPS module.
	Locate the drive having the error (see the status display of each drive) and depending on the error code displayed on it, proceed as described in the section "listing of error messages" of the drive documented in chapter 14 of this manual.
E005	Program code checksum error.
	The checksum of the loaded program code is not correct. Load the software again. If the problem persists, either the RAM, FLASH memories or the loaded code are defective. Contact Fagor Automation S. Coop.
E100	Internal +5 V out of range.
E101	Internal -5 V out of range.
E102	Internal +3,3 V out of range.
E104	Internal +15 V out of range.
E105	Internal -15 V out of range.
E107	Power supply overheated (CPU board).
	The temperature of the enclosure of the RPS regulated power supply is too high. Decrease ambient temperature.
E211	Internal. Fatal error.
	Contact Fagor Automation S. Coop.
E212	Over-current.
	Too much current has been detected circulating through the RPS power supply module. Improper RPS operation. Reset the error, because the parameter settings may be wrong causing current overshooting.
E213	Under-voltage at the driver of the IGBT.
	Low supply voltage has been detected at the IGBT triggering circuits of the RPS power supply module. The driver of the IGBT or the IGBT itself may be defective. Reset the error and if it persists, contact Fagor Automation S. Coop.



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E214	Short-circuit.
	<p>A short-circuit has been detected at the RPS power supply module.</p> <p>Reset the error and if it persists, the power cable connecting sequence may be wrong or they may touch each other causing the short-circuit.</p> <p>The parameters may be wrong or the power supply may be faulty.</p> <p>Contact Fagor Automation S. Coop.</p>
E300	Over-temperature at the power heatsink of the RPS power supply.
	<p>The temperature of the heatsink of the RPS power supply module is too high.</p> <p>Stop the system for several minutes and decrease the effort demanded from the system.</p>
E304	Power bus voltage too high (hardware).
	<p>The power supply has detected that the voltage at the power bus is too high.</p> <p>It may require installing an external Ballast circuit.</p> <p>Disconnect the power supply and check the proper condition of the lines.</p> <p>See error code E306.</p>
E306	Power bus voltage too high (software).
	<p>The software of the RPS module has detected that the voltage at the power bus is too high.</p> <p>See error code E304.</p>
E307	Power bus voltage too low (software).
	<p>The mains voltage is lower than the permissible value (rated voltage < 380 V AC).</p> <p>Disconnect the power supply and check the proper condition of the lines.</p> <p>The application demands high current peaks and the mains supply line has too much impedance.</p> <p>Check that the power bus plates are tightly fastened.</p>
E308	Opening of the integrated-safety relay
	<p>Pin 4 "PWM Enable" of connector X6 is not receiving 24 VDC or, if it is, the relay is not closing. It may be defective.</p> <p>Contact Fagor Automation S. Coop.</p>
E315	It took too long to charge the power bus.
	<p>Contact Fagor Automation S. Coop.</p>
E316	Maneuver error.
	<p>There is no jumper (short-circuit) between pins NS1 and NS2 of connector X3.</p> <p>The bus is short-circuited and the minimum voltage value set in GP8 that must be reached when charging has not been reached in the amount of time set in GP7.</p>



ERROR CODES & MESSAGES ON RPS POWER SUPPLIES
 Meaning of error codes and solutions



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E317	<p>The activation time for the SoftStart signal and PwmOn signal is the same.</p> <p>It prevents destroying the resistor used to preload the Bus voltage because the activation time of the SoftStart signal and the PwmOn signal is the same. Contact Fagor Automation S. Coop.</p>
E318	<p>The activation time for the SoftStart signal and StatusLscOn signal is the same.</p> <p>Activating this error prevents destroying the resistor used to preload the Bus voltage because the activation time of the SoftStart signal and the StatusLscOn signal is the same. Contact Fagor Automation S. Coop.</p>
E501	<p>Parameter checksum error.</p> <p>It has been detected that the parameter checksum is not correct. Probably, the software version has been changed and the new version requires a different number of parameters.</p>
E502	<p>Wrong parameter.</p> <p>Some parameter has the wrong value.</p>
	<p>Activating this icon of the WinDDSSetup bar opens a window on the screen for displaying all the parameters whose values are wrong.</p>
E701	<p>Error identifying the VeCon board.</p>
E705	<p>Error identifying the power board.</p> <p>Error series 700 refers to the wrong operation of the hardware or to the lack of necessary boards.</p> <p>Contact Fagor Automation S. Coop.</p>
E900	<p>Hardware error.</p> <p>Contact Fagor Automation S. Coop.</p>
E901	<p>Internal.</p> <p>Contact Fagor Automation S. Coop.</p>
E902	<p>Mains voltage out of range.</p> <p>The mains voltage feeding the RPS module is not in the 400-10% to 460 +10% range.</p>
E903	<p>Phase missing in the power line.</p> <p>The three power phases are not being detected. Make sure that the power connections are properly made.</p>
E904	<p>Phase missing in the auxiliary power supply line.</p> <p>The three power phases are not being detected in the supply line of the integrated power supply. Make sure that the connections are properly made.</p>
E905	<p>The sequences of the phases in the power stage and in the line input are not the same.</p> <p>Make sure that the sequence of the phases at the main power connector (1) is exactly the same as in the voltage line input (2). See FIGURE H2-39 of the "dds-hardware" manual for further detail.</p>
E906	<p>Internal.</p> <p>Contact Fagor Automation S. Coop.</p>



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E907

Internal.

Contact Fagor Automation S. Coop.

E909

Mains voltage uncompensated.

Contact Fagor Automation S. Coop.

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A.2 Meaning of the warning codes

When it comes to a warning on the seven-segment status display of the RPS power supply, it displays an A instead of an E that represents errors. The warnings indicate that the RPS module is approaching an error limit.



ERROR CODES & MESSAGES ON RPS POWER SUPPLIES
Meaning of the warning codes

A.001	Over-temperature at the VeCon board of the RPS power supply.
A.003	Over-temperature at the power heatsink of the RPS power supply.
A.004	There is mains voltage and PWM Enable signal (pin 4 of X6) is not activated.
A.315	The DC bus charging time (SoftStart type) has exceeded the maximum value set.
A.706	Wrong configuration of the bus command voltage (dip switches).
A907	Internal. Contact Fagor Automation S. Coop.
A.908	Internal. Contact Fagor Automation S. Coop.



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