SERVO DRIVE SYSTEM
General Manual

FAGOR

DDS

Software
v.06.xx

SERVO DRIVE
SYSTEM MANUAL

Ref. 0506 (in.)

Title:	Servo Drive System
Type of documentation:	Description, installation and start-up of the Fagor DDS digital servo drive system.
Model:	Servo drive system. General manual. (in.)
Manual reference:	0506
Software:	v.06.09
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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.

EVOLUTION

Manual version	Items
9702	First version
9707	*PS -65, RM-15, CM-60, APS -24, AXD / SPD 3.xx*
9802	Compact 8, 25, 50, 75, DDS PROG MODULE Software 02.xx *Halt signal via digital input. Range expansion, (C axis)* *Sercos interface (connection and parameters)*
9810	XPS - 25, XPS - 65 Software 03.xx *Sincoder feedback (E1). Motor identification at the encoder. Description of the XPS. 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	*New fanned motors FXM.* *New SPM 180M motor.* *New products (mains voltage 460 Vac).* *Description and installation of the XPS.* *New drive AXD / SPD 1.35* *EMK filters* Software 03.03 *Full motor identification.* *Drive off Delay time, GP9*
0002 **[only in CD Rom]**	*SPMxx.1 Motors* *PS-25B3 and PS-25B4* *Resistances ER* *WinDDSSetup* *Improved AXD / SPD 1.15.* *Digital I/O boards* Software 04.01 (preliminary) *Current filter* *Position Loop* *Feedforward, homing, backlash compensation.* *Following error control, modulo format* *Direct feedback*
0103	Software 04.01 (final) *Motion parameters in the L group*

Manual version	Items
0112	*FXM motors at 400 - 15% Vac* *MMC and CMC drives* *ACD / SCD 1.08 / 1.15 drive [compact]* *Crowbar resistor: ER-18/1800 and ER-18/2200* *RS-422 interface for MMC and CMC drives* Software 04.02 *On-line feedback change* *Axis synchronization* *Index* *DNC50 communication protocol*
0303	*New drive: SPD 2.85* *New drive: SPD 3.200* *New capacitor module: CM 1.60 (replaces the previous CM 60)* *New spindle motors: FM7 (E01 and E02 versions)* Software 04.03 *New checksum parameters: GV3 and GV6* *New variables for communication between the PLC of the 8055 CNC and the PLC of the drive: XV12 & XV13* *New parameter to select the power supply of the master in synchronization: LP59* Software 04.04 *New variable to read the rotary switch: HV13* *Reversal peak with an exponential shape* Software 04.05 (with Vecon board) and 05.05 (with Vecon II board) *New parameter QP13 to increase the number of axes accessible via RS422.* *New variable for torque control (on-line): TV92* Software 04.06 and 05.06 *FM7 motors (E01 version). They recognize the Motor ID of these motors.* Software 04.07 and 05.07 *FM7 motors (C axis and maximum speed).* *New ModBus protocol in RS-422* Software 04.08 and 05.08 *FM7 motors (E02 version)* *Drive-CNC synchronism detection via Sercos channel (error E412).* Software 04.09 and 05.09
0305	*New encoder E3 (similar to E2 but with tapered shaft).* Software 04.10 and 05.10 *New maximum currents that can circulate through the spindle drives.*

Manual version	Items
0310	Software 06.01 *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 have been eliminated: MP8* *New parameters: CP16, TP86, MP41* *Autoadjustment of the rotor resistance value: Parameters FP30 and FP31.* *Command to validate parameters off line: GC4.* *Command to execute the inertia auto-adjustment: GC5 (off-line).* *Offsets of feedback signals: RP1 ... RP4 and their equivalent RP51 ... RP54 are now on-line.* *New variables SV10 and SV11* *New units for TV1 and TV2* *Velocity ramps: SP51= 2* *Adjustable PWM*
0403	*From February of 2004 on, compact drive modules ACD 2.50, SCD 2.50, ACD 2.75, SCD 2.75, CMC 2.50, CMC 2.75 and the programming module DDS PROG MODULE will no longer be in Fagor Automation' catalog. However, all the documentation regarding them is kept in this manual just in case the user has already purchased any of these modules.* 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.*

Manual version	Items
0405	From this version on, the EMK mains filters are discontinued and replaced by DLC filters. 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.* *Spindle home search with gear ratio other than 1:1.*
0407	Software 06.04 *Error correction.*
0410	New Sercos® board (transmission rates of up to 16Mbaud) Software 06.05 *Calculation of serial inductance for high speed spindles.* *Modification of permitted values 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 a resolver.*
0501	Software 06.06 *Error correction.* *E205: The motor has no voltage for the demanded work conditions.*
0504	Software 06.07 *Error correction.* Software 06.08 FAGOR absolute linear encoders *Reading protocol of FAGOR absolute linear encoders.* *Expanded parameter GP10.* *New parameter: RP60, RP61, RP62 and RP63.* *E610: ErrWrongAbsSignals.* *E611: ErrUnstableAbsSignals.* *Identification of R and L in asynchronous motors.* *New variable: FV1.* *New velocity loop: Parameter involved, SP52.* *<< Default >> option as motor ID.* ***WinDDSSetup:** Parameter setting assistance for the DDS system. New help tool for configuring an application.*

Manual version	Items
0506	Software 06.09 Modifications in the home search feature when using a spindle reference mark and transmission ratio other than 1:1. PP5 = -1. Both feedbacks independent.

RELATED DOCUMENTATION

Product selection	
English	Fagor Motors and Drives Ordering Handbook

Quick Reference	
English	Fagor Modular Drives and Motors Quick Reference
English	Fagor Compact Drives and Motors Quick Reference

Servo drive description, installation and adjustment	
Spanish English	Sistema de regulación DDS ☞ DDS Drive System
Spanish English	Fagor Motion Control DDS - MC DDS - MC System

Motor description and installation	
Spanish English	Motor AC de cabezal: SPM SPM AC Spindle Motor
Spanish English	Motor AC de cabezal: FM7 FM7 AC Spindle Motor
Castellano Inglés	Motores AC de eje: FXM y FKM FXM and FKM AC Axis Motor

DECLARATION OF CONFORMITY

Manufacturer: **FAGOR AUTOMATION S.COOP.**

Barrio de San Andrés 19; C.P. 20500, Mondragón - Guipúzcoa - SPAIN.

We hereby declare, under our responsibility that the product:

Fagor
[Servo Drive System]

Consisting of the following modules and accessories:

Power Supplies: XPS-25, XPS-65, PS-25A, PS-25B3, PS-25B4, PS-65A and APS-24
Modular Drives: AXD / SPD 1.08, 1.15, 1.25, 1.35, 2.50, 2.75, 2.85,3.100, 3.150,3.200
Compact Drives: ACD / SCD 1.08, 1.15, 1.25
Modular positioning drive MMC: 1.08, 1.15, 1.25, 1.35, 2.50, 2.75, 3.100, 3.150.
Compac positioning drive CMC: 1.08, 1.15, 1.25
Accessory Modules: RM-15, ER, CM 1.60, CHOKES
Power supply filter: DLC 3042 and DLC 3130
Motors: Brushless AC Fagor FXM and FKM
and Spindle asynchronous Fagor SPM and FM7

mentioned on this declaration, meet the requirements:

SAFETY:

EN 60204-1:	Machine safety. Electrical equipment of the machines.

ELECTROMAGNETIC COMPATIBILITY:

EN 61800-3:	EMC directive for servo drive systems.
EN 61000-4-2:	Electrostatic discharges.
EN 61000-4-3:	(26 MHz to 1000 MHz) - Radiated radio frequency electromagnetic fields -.
EN 61000-4-4:	Burst and fast Transients.
EN 61000-4-5:	Power surges.

According to the European Directives 73/23/EEC on Low Voltage (modified by the 93/68/EEC directive), 98/37/CEE on Machinery Safety and 92/31/CEE on Electromagnetic Compatibility. (EN 61800-3: 1996, Specific Regulation on Electromagnetic Compatibility for Servo Drive Systems).

Fagor Automation, S. Coop. Ltda.
Director Gerente

Fdo.: Julen Busturia

In Mondragón, March 20th, 2005

WARRANTY TERMS

INITIAL WARRANTY:

All products manufactured or marketed by FAGOR 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 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 our 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 or 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 to determine whether a repair is to be considered under warranty.

EXCLUDING CLAUSES:

The repair will take place at our facilities. Therefore, all shipping expenses as well as travelling expenses incurred by technical personnel are NOT under warranty even when the unit is under warranty.

This 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.

If once the service call or repair has been completed, the cause of the failure is not to be blamed the FAGOR product, 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.

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.

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

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.

Use the right mains cables.

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

Avoid electrical shocks.

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

Ground connection.

In order to avoid electrical 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.

Before turning the unit on, make sure that it is connected to ground.

In order to avoid electrical shocks, make sure that it has been connected to ground.

Ambient conditions.

Respect the limits of temperature and relative humidity indicated in the technical characteristics of this manual.

Do not operate this unit in explosive environments.

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

Working environment.

These electrical units are ready to be used in industrial environments and comply with the current directives and regulations of the European Community.

GENERAL INDEX

2. INSTALLATION 1

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B. LISTING OF ERROR MESSAGES, WARNINGS AND SOLUTIONS 1

C. FAGOR PRODUCT REFERENCES 1

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User notes:

ELECTRONIC MODULES

1

Introduction

The Fagor Servo Drive System has a modular stackable design.

It is connected directly to three - phase mains of 50/60 Hz with a rated voltage between 400 Vac -10% and 460 Vac +10%. It supplies the motors with three - phase 400 - 4.5% Vac and variable frequency to control its speed.

Depending on the user's needs, it may consists of the following elements:

Non regenerative power supply

PS. Module in charge of converting the alternating current of mains into dc voltage for the drives.

Regenerative power supply

XPS. Power supply with the possibility to return energy to mains.

Modular drive

AXD, SPD. Digital modules that can control the velocity and position of a synchronous and asynchronous motor.

MMC. They can also generate a path.

Compact drive

ACD, SCD. Autonomous modules to control the velocity and position of a synchronous and an asynchronous motor respectively.

CMC. They can also generate a path.

Auxiliary power supply module

APS 24. Module in charge of supplying 24 Vdc to the control circuits of the rest of the modules.

Capacitor modules

CM 1.60. Increases the capability of the bus and it serves as a temporary energy buffer.

Resistor module

RM -15, ER To facilitate a great energy dissipation while braking.

Programming module

DDS PROG MODULE.

Connected to the drive module through the serial line, it allows displaying and programming its internal parameters. It has an internal nonvolatile memory and the possibility to send and receive parameter tables.

Mains filter

DLC. Additional module to protect mains and the drive system against mutual disturbances. Optional although absolutely necessary for complying with the European Directive on Electromagnetic Compatibility 92/31/CE or International standard CEI IEC 1800-3.

Note: *These DLC filters have replaced the previous EMK filters (currently discontinued).*

The following illustrations show all these elements: power supplies, modular drives in three possible sizes, compact drives, programming module, auxiliary power supply, capacitor and resistor modules as well as the mains filter.

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This system has been manufactured in accordance with the EN 60204 - 1 standard in compliance with European Directive 72/12/CE on Low Voltage.

Outside looks

Non - regenerative power supplies

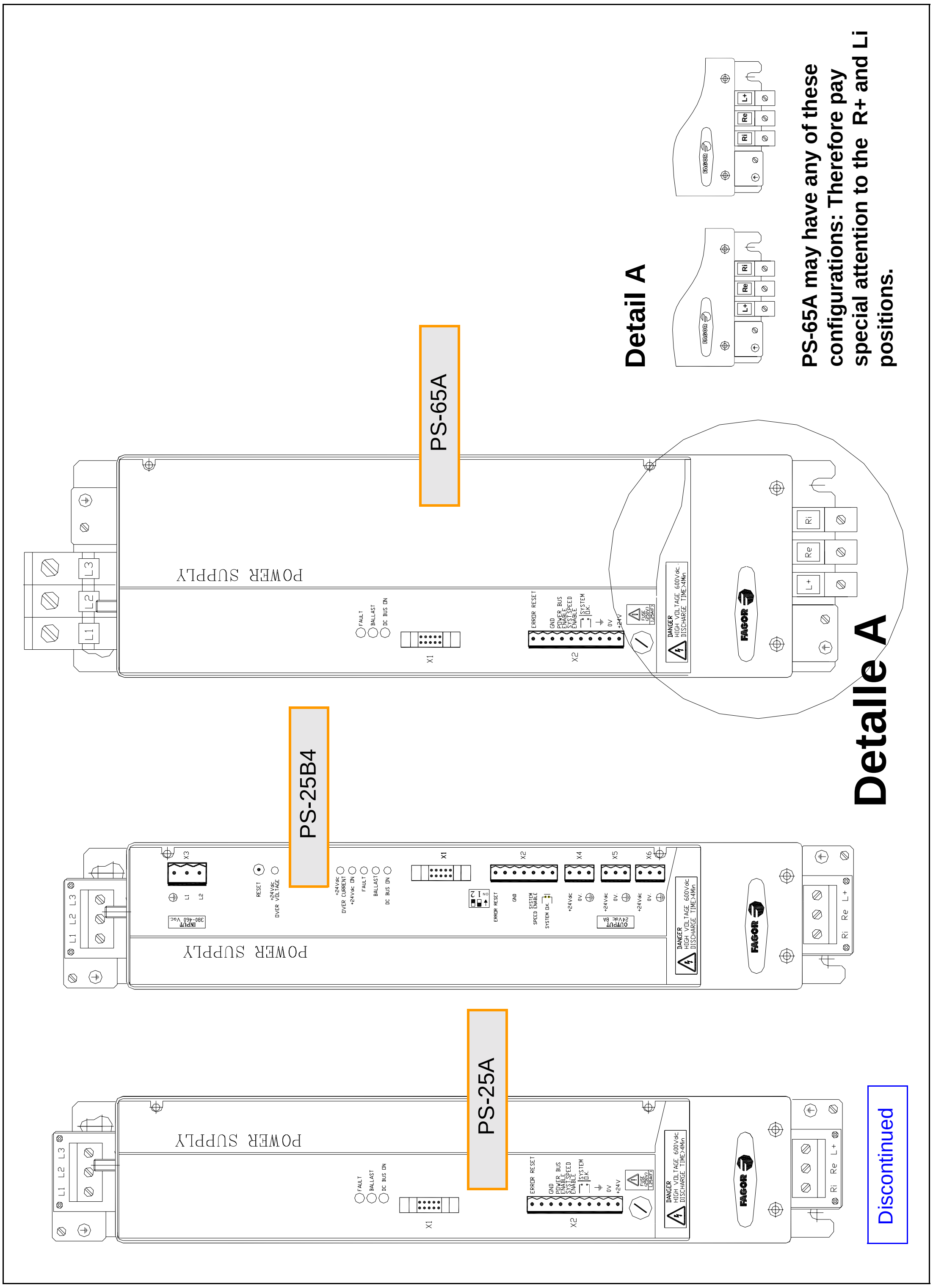


fig.1 Non-regenerative power supplies.

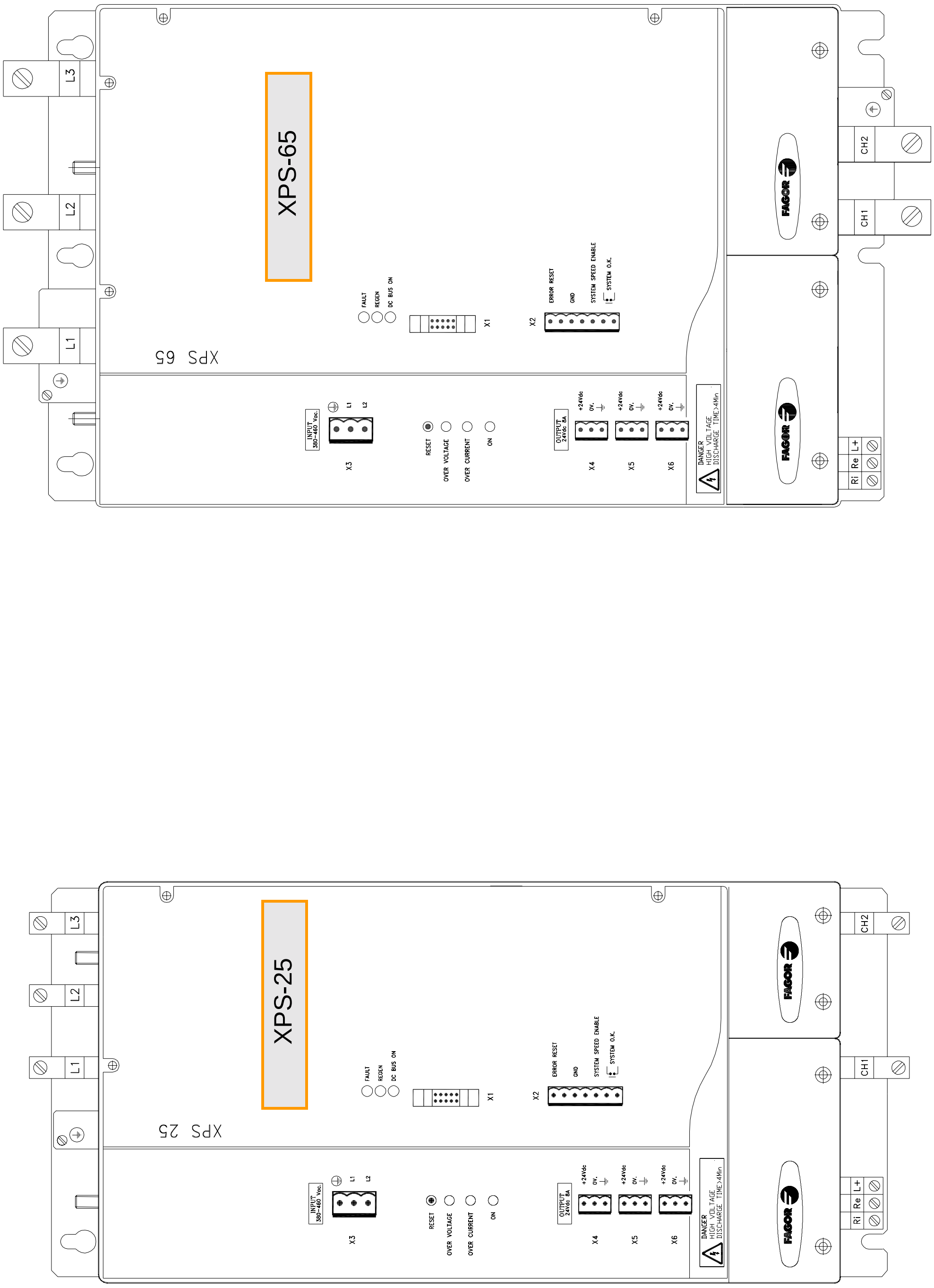


fig.2 Regenerative power supplies.

fig.3 "AXD / SPD" modular drives.

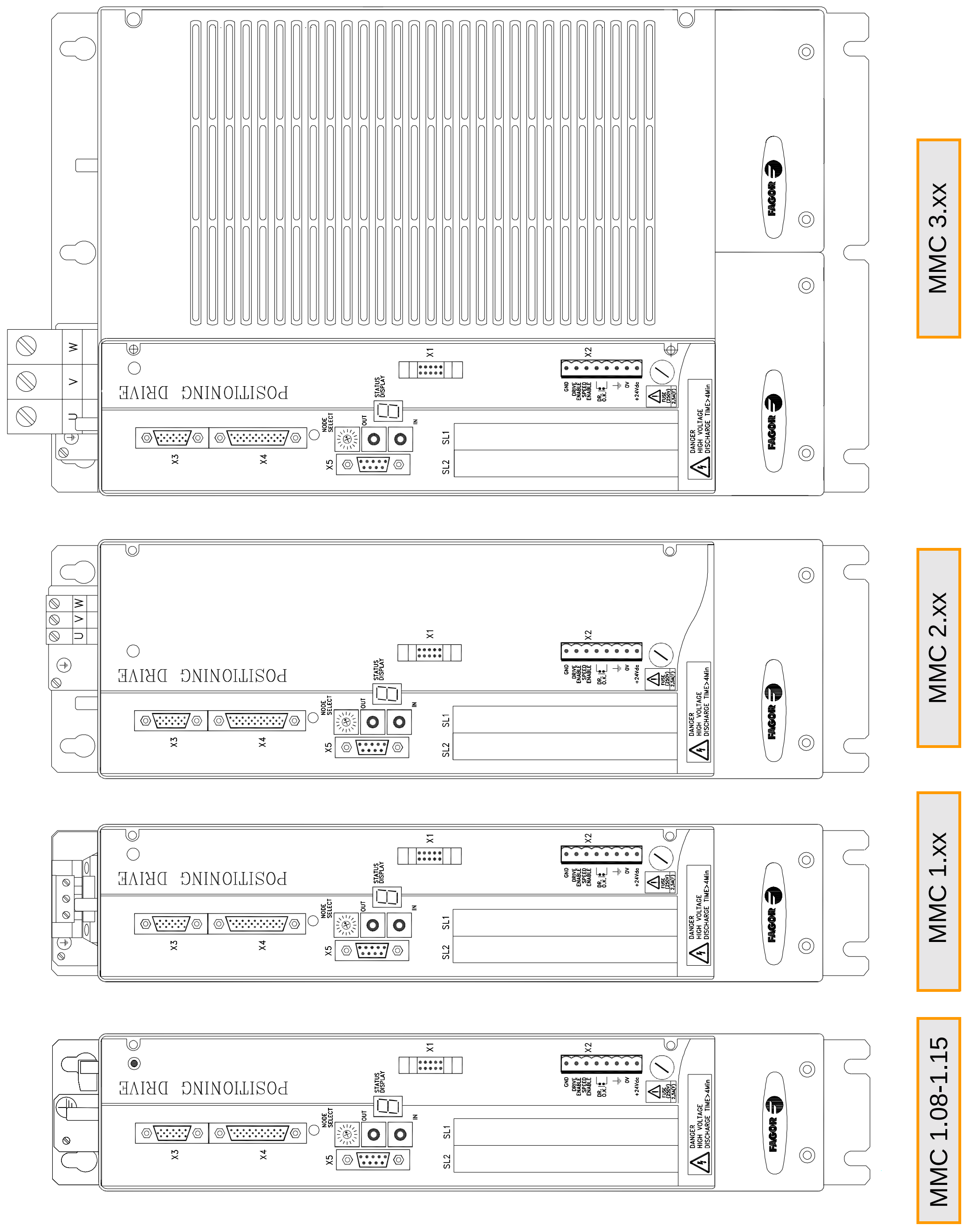


fig.4 MMC modular drives.

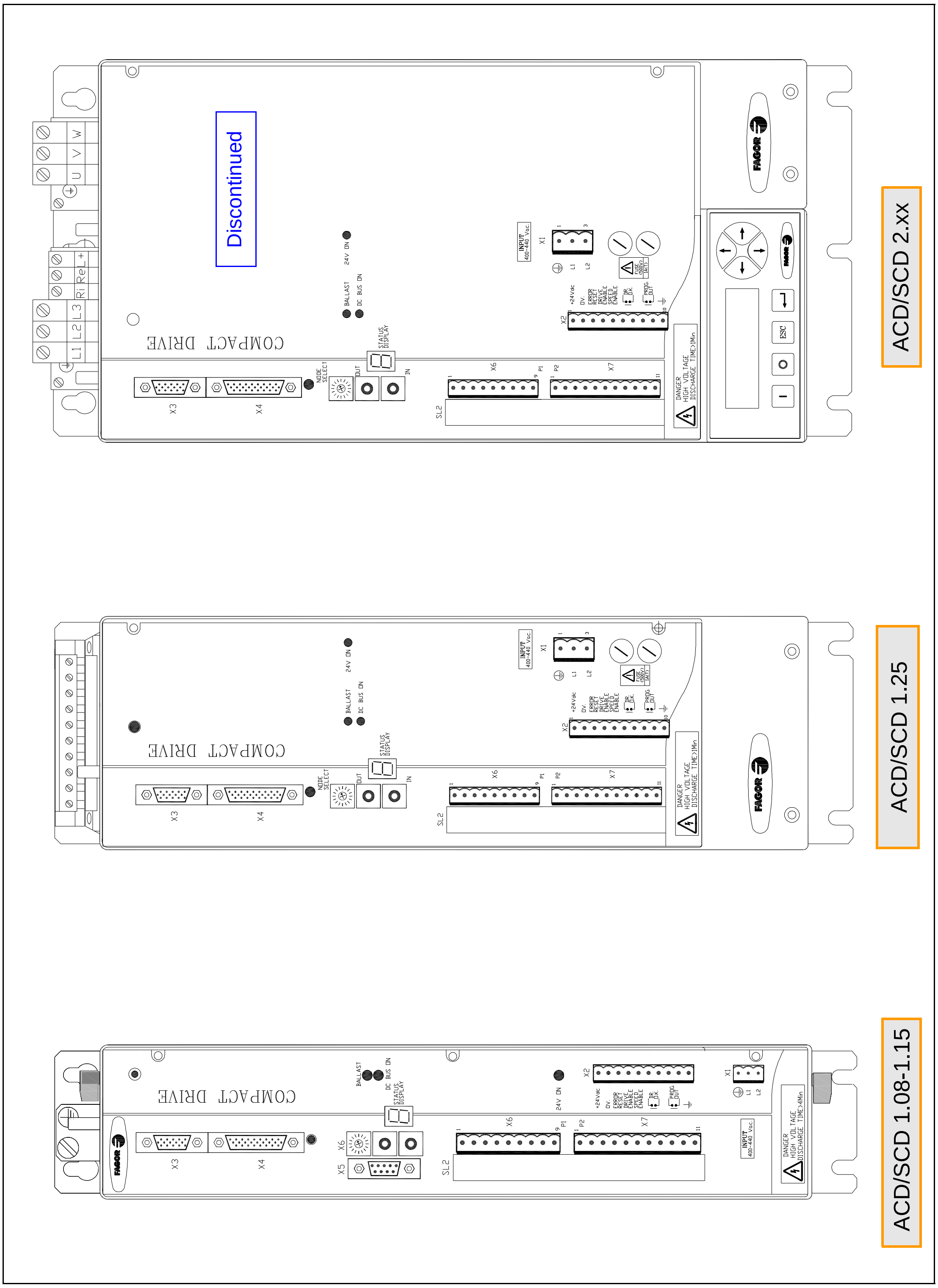


fig.5 "ACD / SCD" compact drives

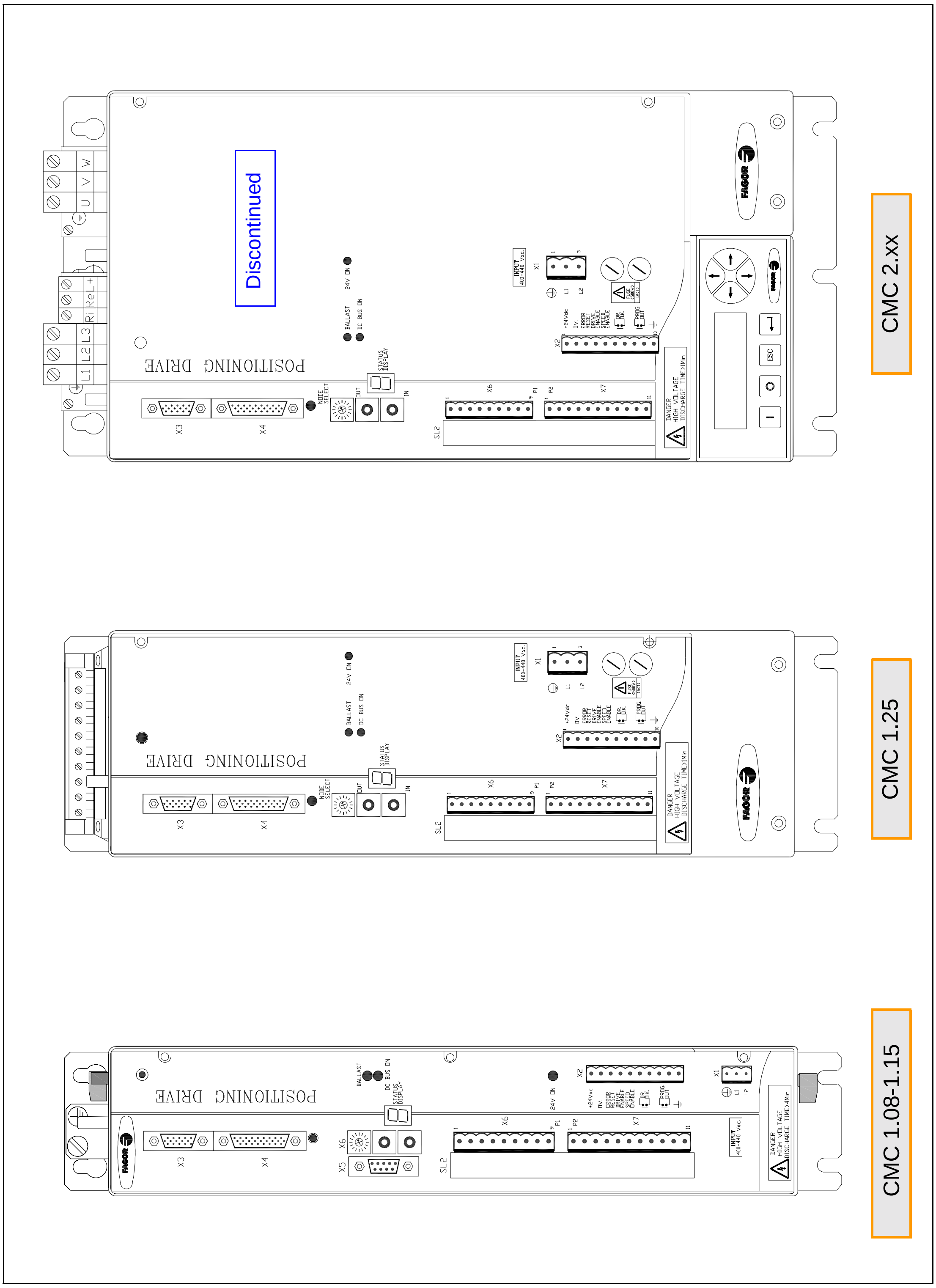


fig. 6 CMC compact drives

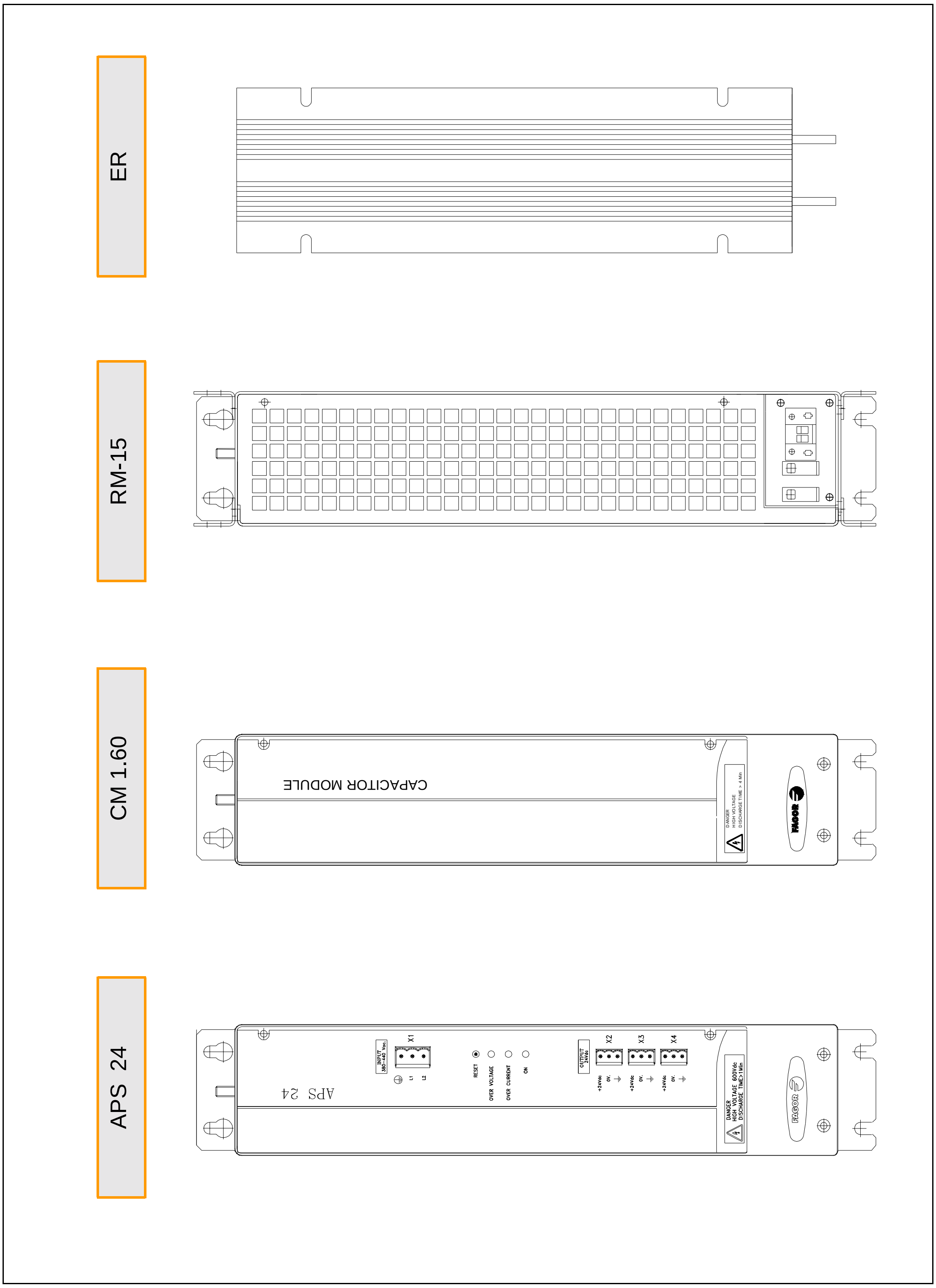


fig. 7 APS 24, CM 1.60, RM -15 and ER

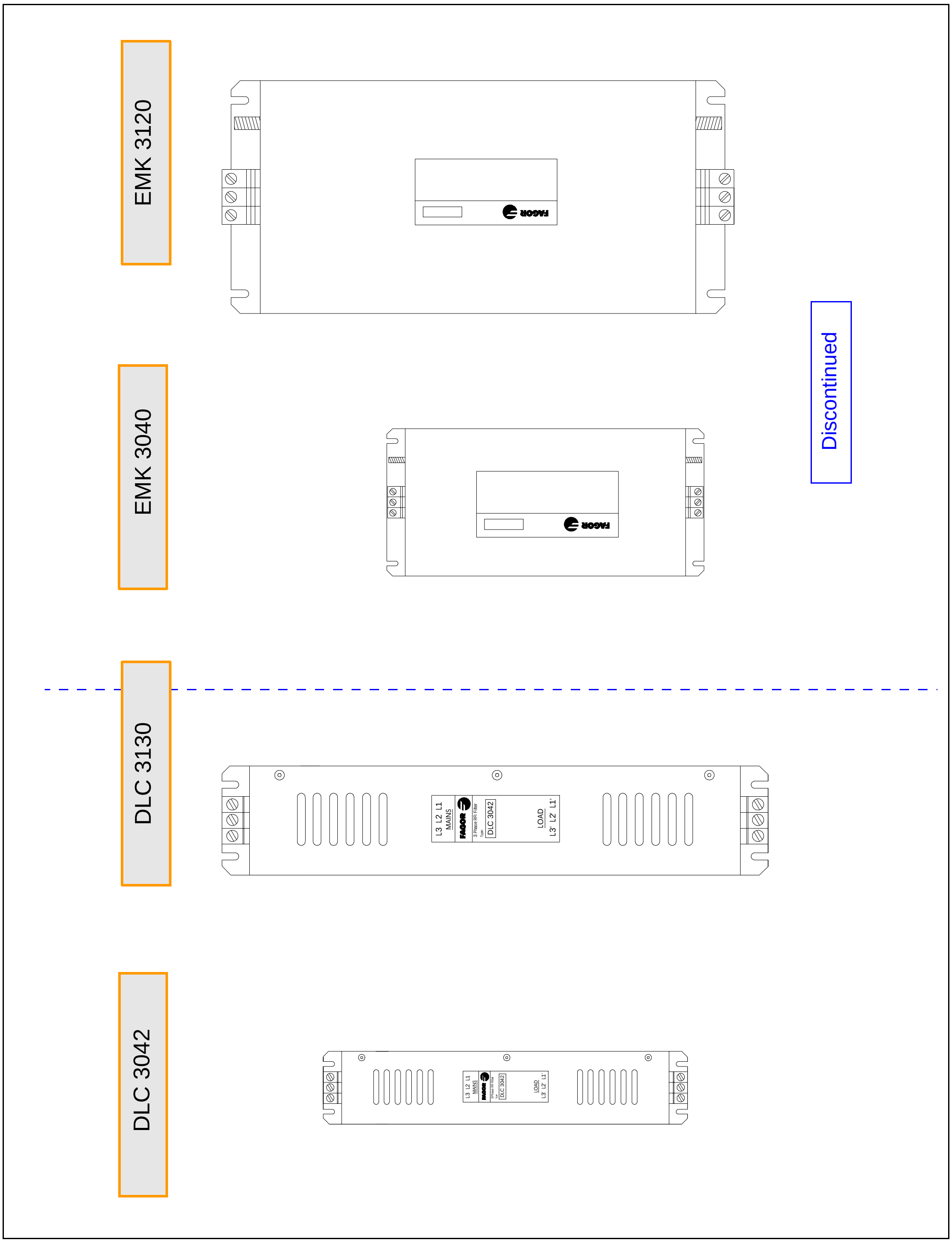


fig. 8 Mains filters: DLC 3042 and DLC 3130.
Filters EMK 3040 and EMK 3120 are discontinued.

Power supply module

They are directly connected to 400-460 Vac, 50/60 Hz mains provide a dc voltage output of about 600 Vdc depending on mains power. This voltage supplies to the drive modules through what we call power bus.

These power supplies also handle the energy excess accumulated at the power bus usually due to motor braking.

We call them **non-regenerative power supplies** when this excess of energy is dissipated as heat on certain electrical resistors.

We call them **regenerative power supplies** when this excess of energy is returned to mains. This option reduces the consumption of the electrical signal without generating additional heat.

Non - regenerative power supplies

They are the ones referred to as **PS-25A** (discontinued)**, PS-25B3** (discontinued)**, PS-25B4** and **PS-65A,** and provide 25 and 65 kW to the drive respectively. They admit a voltage range between 400 Vac to 460 Vac.

The previous PS-25 and PS-65 only admitted 400 Vac.
See appendix D.

Regenerative power supplies

They are referred to as **XPS-25** and **XPS-65,** (25 and 65 kW) and they can continuously return to mains (regenerate) 20 and 50 kW respectively.

They admit a voltage ranging from 400 Vac to 460 Vac.

When energy regeneration is activated, the **REGEN** lamp turns on. The module also has a little Ballast Circuit for dissipating energy in an emergency. That is, when there is no mains voltage and the overvoltage alarm goes off.

These modules also offer an auxiliary 24 Vdc power supply for the control circuits of the drive modules.

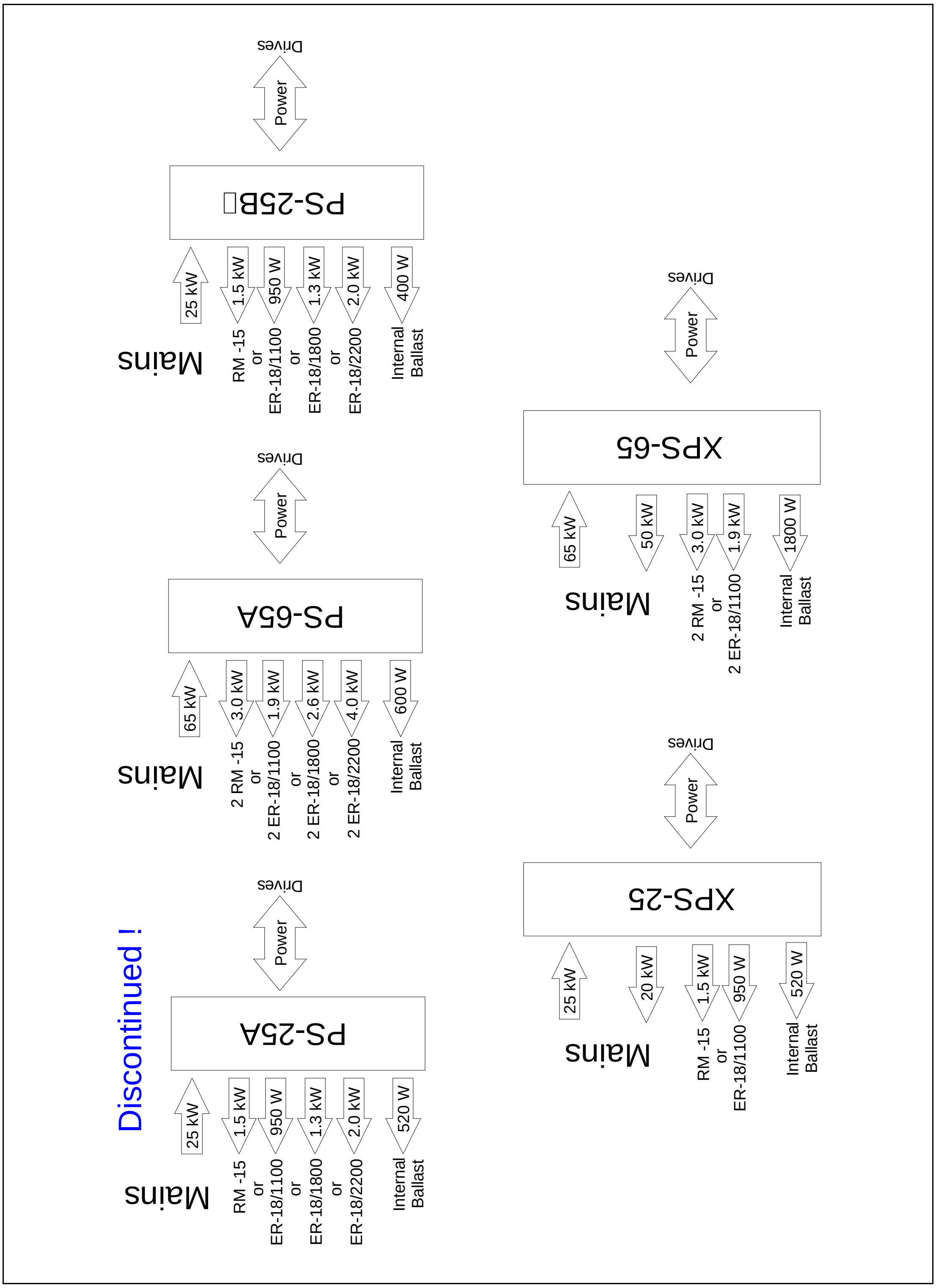


fig. 9 Power values of power supplies

General charact. of the non - regenerative power supplies

	PS-25A module (discontinued)	PS-65A module
Power supply (Vmains)	Three-phase 50/60 Hz, with a voltage range between 400 Vac -10% and 460 Vac +10% **	
Mains power consumption	38 Arms	100 Arms
Maximum connection cable section	10 mm^2	50 mm^2
Power bus voltage $VBUS_{NOM}$	567.5 Vdc / 650 Vdc	
Rated (peak) output current *	45 A (135 A, 1 s)	120 A (360 A, 1 s)
Rated (peak) output power	25 kW (75 kW, 1 s)	65 kW (95 kW, 1 s)
Power for the module control circuit	24 Vdc (between 21 Vdc and 28 Vdc)	
Consumption of the module control circuit itself	1 A at 24 V (24 W)	
Internal Ballast resistance (power) *	18 . (520 W)	9 . (600 W)
Energy pulse to be dissipated	18 kWs (0.6 s)	36 kWs (0.6 s)
Ballast circuit ON/OFF	768 Vdc / 760 Vdc (712 Vdc / 704 Vdc) ***	
Minimum external Ballast resistance	18 .	9 .
Filter capacity	705 µF, 900 Vdc	750 µF, 900 Vdc
Energy stored in the capacitors	$0.5\ C \cdot V^2$	
Maximum "System OK" contact voltage	125 Vac , 150 Vdc	
Maximum "System OK" contact current	2 A	
Module width	77 mm (3.03 in)	117 mm (4.61 in)
Module weight	6.8 kg (15 lb)	9.9 kg (22 lb)
Power dissipated at maximum load	160 W	275 W

* See derating curves in case of high temperatures
** Previous power supplies PS- xx only admitted Vmains of 400 Vac
*** When the module is set for Vmains = 400 Vac , as same PS- xx

table 1 Electrical requirements

	PS-25A module (discontinued)	PS-65A module
Ambient temperature *	5°C / 45°C (41°F / 113°F)	
Storage temperature	- 20°C / 60°C (- 4°F / 140°F)	
Maximum humidity	< 90% (non condensing at 45°C / 113°F)	
Maximum altitude without loss of features	1000 meters (3281 ft) above sea level	
Operating vibration	0.5 G	
Shipping vibration	2 G	
Sealing	IP 2x	
Protections	Overvoltage, heat-sink temperature, hardware error, Ballast overload	

* See derating curves in case of high temperatures.

table 2 Ambient conditions and other requirements

PS-25A and PS-65A power supplies admit a mains voltage of up to 460 Vac . The rest of their characteristics, connectors and so forth of previous PS-25 and PS-65 are identical.

See appendix D for compatibility with the drives.

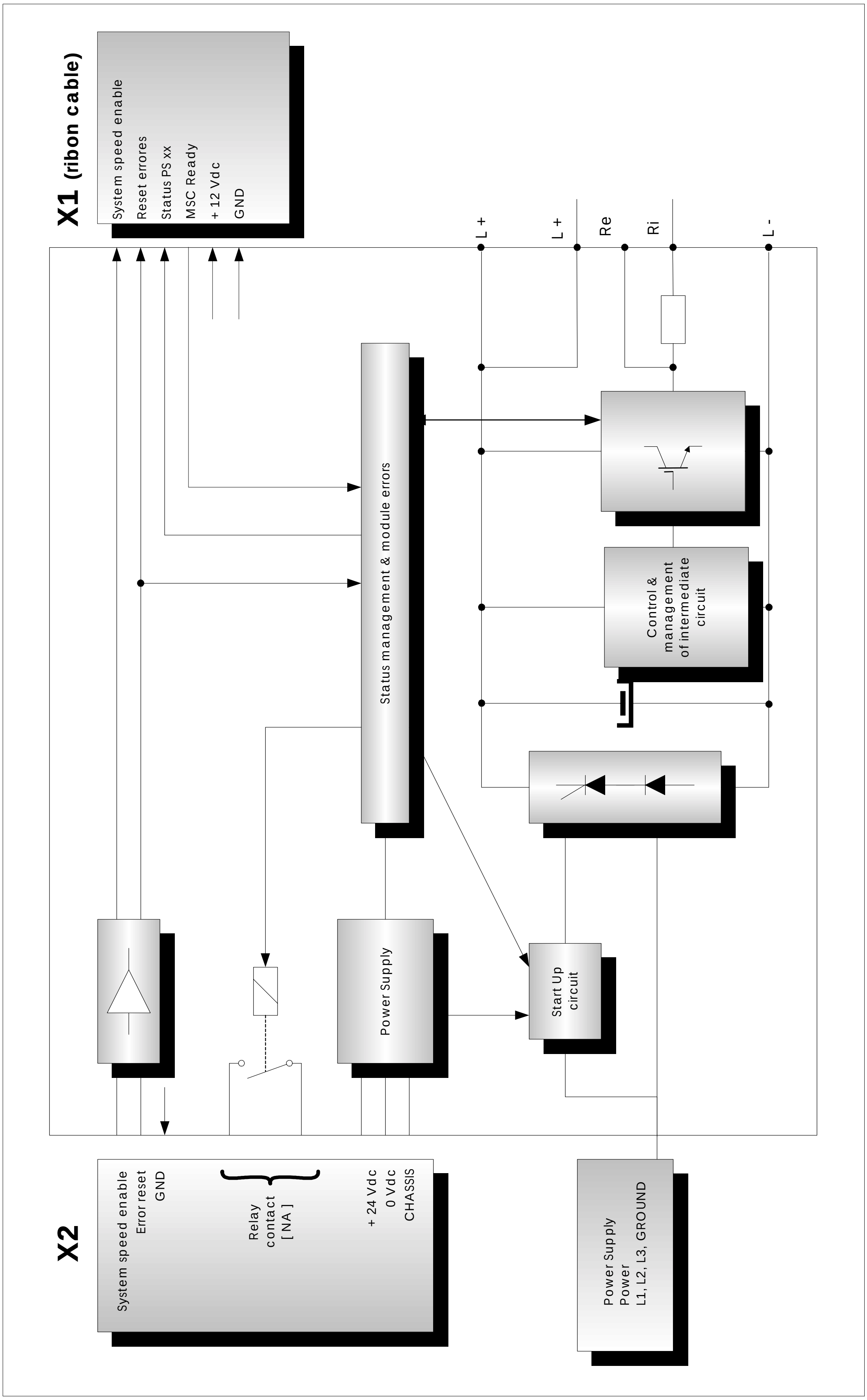


fig. 10 Block diagram of modules: PS - 25A and PS - 65A

	PS-25B3 * / PS-25B4 modules
Power supply (Vmains)	Three - phase 50/60 Hz, with a voltage range 400 Vac -10% and 460 Vac +10% **
Mains power consumption	38 Arms
Maximum connection cable section	10 mm^2
Power bus voltage $VBUS_{NOM}$	567.5 Vdc / 650 Vdc
Rated (peak) output current ****	45 A (135 A, 1 s)
Rated (peak) output power	25 kW (75 kW, 1 s)
Internal Ballast resistance (power) ****	16.5 . (500 W)
Energy pulse to be dissipated	6 kWs (0.2 s)
Ballast circuit on / off	768 Vdc / 760 Vdc (712 Vdc / 704 Vdc) ***
Minimum external Ballast resistance	16.5 .
Filter capacity	705 μF, 900 Vdc
Energy stored in the capacitors	$0.5\ C \cdot V^2$
Maximum "System OK" contact voltage	125 Vac, 150 Vdc
Maximum "System OK" contact current	2 A
Module width	77 mm (3.03 in)
Module weight	6.0 kg (13.2 lb)
Power dissipated at maximum load	180 W
Output voltage, maximum current	24 Vdc (5%), 10 A
Input voltage	Between 400 Vac (-10%) and 460 Vac (+10%) 50 / 60 Hz
Mains consumption	0.72 A (400 Vac) ; 0.63 A (460 Vac)
Maximum Inrush current	23.9 A (460 Vac)
Bus consumption	0.485 A (567.5 Vdc) ; 0.44 A (650 Vdc)
Bus maximum voltage	790 Vdc

* The **PS-25B3** admits up to 460 V_{ac}, but the activation levels for the overvoltage alarm and crowbar are those of the 400 Vac.

** The previous PS- xx power supplies only admitted a mains voltage 400 Vac.

*** When the module is selected to work at 400 Vac , like the **PS- 25B3**, or like the previous PS-xx

**** Refer to the derating curves for high temperatures.

table 3 Electrical requirements

	PS-25B3 * / PS-25B4 modules
Ambient temperature ****	5°C / 45°C (41°F / 113°F)
Storage temperature	- 20°C / 60°C (- 4°F / 140°F)
Humidity	< 90% (non condensing at 45°C / 113°F)
Maximum altitude without loss of features	1000 meters (3281 ft) above sea level
Operating vibration	0.5 G
Shipping vibration	2 G
Sealing	IP 2x
Protections	Overvoltage, heat-sink temperature, hardware error, Ballast overload.

* The **PS-25B3** admits up to 460 Vac, but the activation levels for the overvoltage alarm and crowbar are those of the 400 Vac.

**** When the module is set for Vmains = 400 Vac.

table 4 Ambient conditions and other requirements

The PS - 25B3 and PS - 25B4 power supplies a mains voltage of up to 460 Vac , however, for the PS-25B3 the values for activating the overvoltage alarm and crowbar are those of the 400 Vac models.

See appendix D to know about compatibility with the drives.

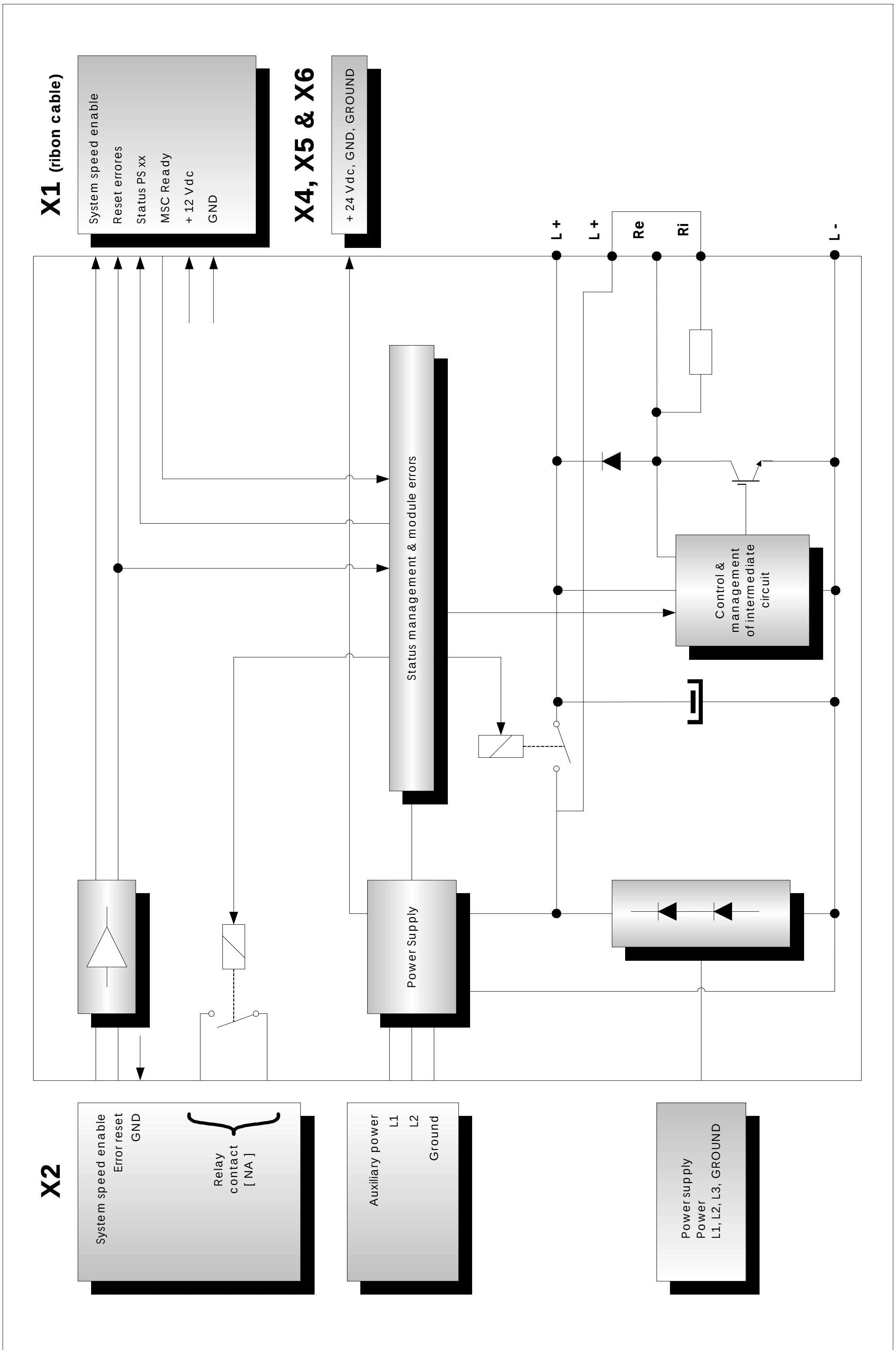


fig. 11 Block diagram of the "PS - 25Bx" module

General characteristics of the regenerative power supplies

	XPS-25 module	XPS-65 module
Power supply (Vmains)	Three - phase 50/60 Hz, with a voltage range between 400 Vac -10% and 460 Vac +10%	
Mains power consumption	38 Arms	100 Arms
Maximum connection cable section	16 mm ^{2}	50 mm ^{2}
Voltage of the power bus $VBUS_{NOM}$	567.5 Vdc / 650 Vdc	
Rated (peak) output current *	45 A (100 A, 1 s)	120 A (120 A, 1 s)
Rated (peak) output power	25 kW (55 kW, 1 s)	65 kW (108 kW, 1 s)
Regenerating circuit ON/OFF voltage	Vmains x 1.414 + 30 V	
Rated regenerated current (returned to mains)*	25 Arms	62 Arms
Rated regenerated power (returned to mains)	20 kW	50 kW
Related choke	CHOKE XPS-25	CHOKE XPS-65
Choke - drive cable [max length: 2 m (80 in)]	16 mm ^{2}	50 mm ^{2}
Output voltage of the auxiliary power supply	24 Vdc ± 5%	
Maximum current supplied	8 A at 24 V (192 W)	
Mains consumption for 24 Vdc generation	0.72 A (400 Vac) - 0.63 A (460 Vac)	
Internal Ballast resistance (Power)*	18 . (520 W)	9 . (1800 W)
Energy pulse that could be dissipated	18 kWs (0.6 s)	50 kWs (1 s)
Ballast circuit on / off voltage	765 Vdc / 755 Vdc (616 Vdc / 608 Vdc) **	
Minimum external Ballast resistance	18 .	9 .
Filter capacity	1175 µF, 900 Vdc	2115 µF, 900 Vdc
Energy stored in the capacitors	$0.5\ C \cdot V^2$	

* See derating curves in case of high temperatures.
** When the module is set for Vmains = 400 Vac

Maximum “System OK“ contact voltage	125 Vac , 150 Vdc	
Maximum “System OK” contact current	2 A	
Module width	194 mm (7.64 in)	234 mm (9.21 in)
Module weight	14 kg (31 lb)	19 kg (42 lb)
Power dissipated at maximum load	180 W	350 W

table 5 Electrical requirements

	XPS-25 module	XPS-65 module
Ambient temperature *	5°C / 45°C (41°F / 113°F)	
Storage temperature	- 20°C / 60°C (- 4°F / 140°F)	
Humidity	< 90% (non condensing at 45°C / 113°F)	
Maximum altitude without loss of features	1000 meters (3281 ft) above sea level	
Operating vibration	0.5 G	
Shipping vibration	2 G	
Sealing	IP 2x	
Protections	Overvoltage, overcurrent, hardware error, ambient temperature.	

* See derating curves in case of high temperatures.

table 6 Ambient conditions and other requirements

Block diagram of the XPS-25 and XPS-65

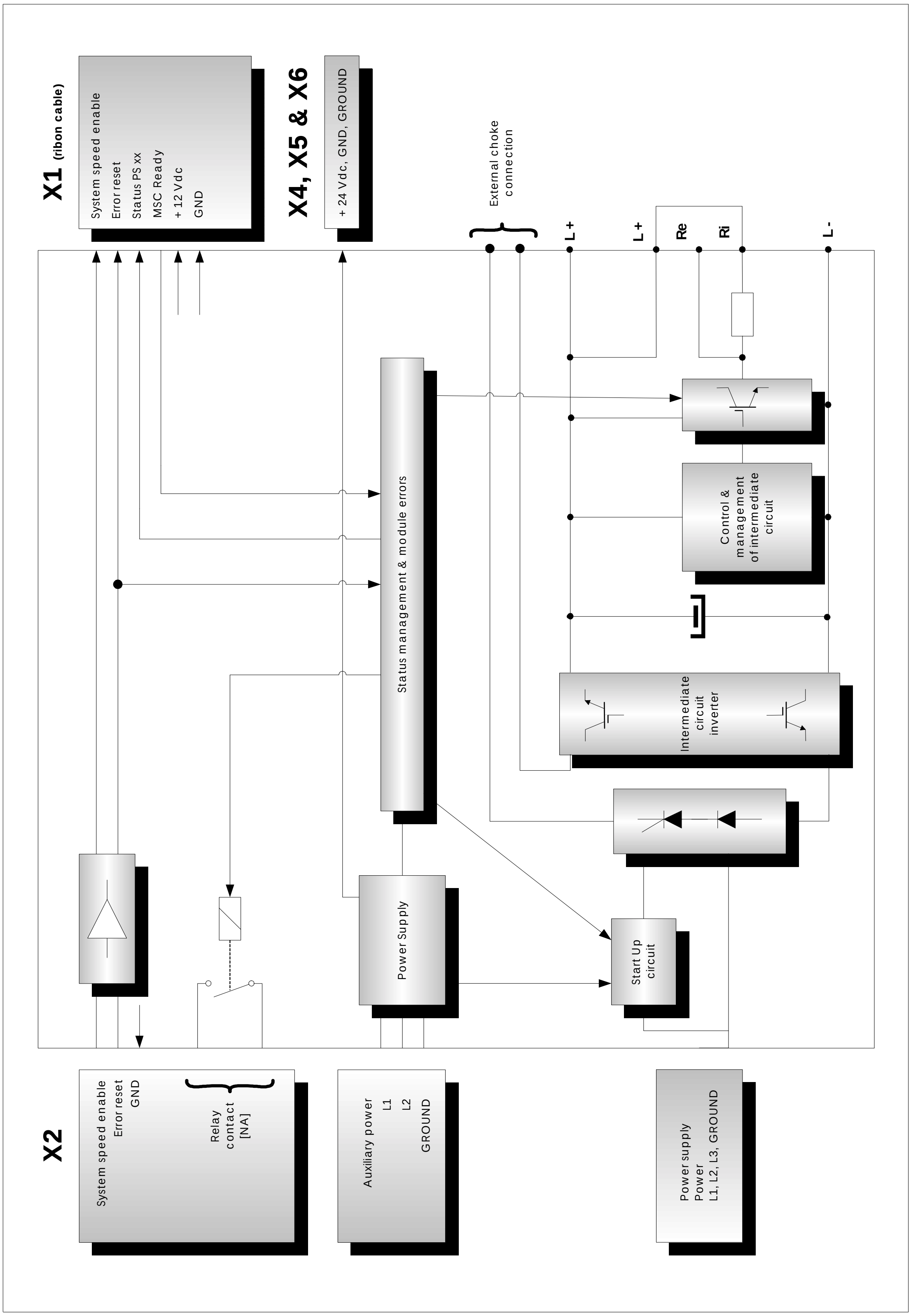


fig. 12 Block diagram of the "XPS - 25 and XPS - 65" modules

Power supply connectors

1. Power connectors for mains.

2. Power connectors for the external Ballast resistor.

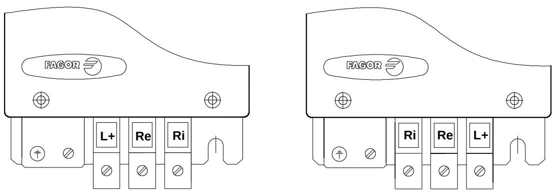


fig. 13 Power connectors for the external Ballast resistor connection

Power supplies PS - 25A and PS - 25Bx can only have the configuration on the right and it is impossible to make a mistake when connecting the external Ballast resistor. However, there are two possible configurations for the PS-65A. Consequently, special attention must be paid to the L+ and Ri positions when connecting an external Ballast resistor.

3. Ground connector for the cable hose from mains and intermodular chassis connections.

4. Lamps indicating the status of the main power supply:

- **FAULT blinking**, indicates that there is no error and that one or more phases of mains is missing.
- **FAULT on**, indicates an error (specified on the drives display).
- **FAULT off**, indicates that there is neither an error or missing mains phases.
- **BALLAST** it comes on when the energy dissipating Ballast circuit is activated.
- **DC BUS ON** comes on when the module offers all its power at the Bus.

And at the XPS:

- **REGEN** comes on when the module is working in Energy Regenerating mode.

5. Power Bus supplyng power to the drive modules through metal bars.

6. Connectors for the inductance needed on XPS models.

7. Lamps indicating the status of the auxiliary power supply and reset button:

  - **RESET** initializes the auxiliary 24 Vdc power supply after and overvoltage error.
  - **OVER VOLTAGE** indicates an overvoltage error at the 24 Vdc output.
  - **OVER CURRENT** indicates and overcurrent error at the 24 Vdc output.
  - **ON** it comes on when the 24 Vdc is available.

X1 Connector intermodular communications. Internal Bus.

X2 Connector providing access to the basic control signals.

X3 Input connector supplying to the internal auxiliary power supply for mains.

X4, X5 and **X6** Output connectors of the auxiliary power supply offering 24 Vdc.

Note: The location of these connectors is shown with this numeric reference in the illustrations:

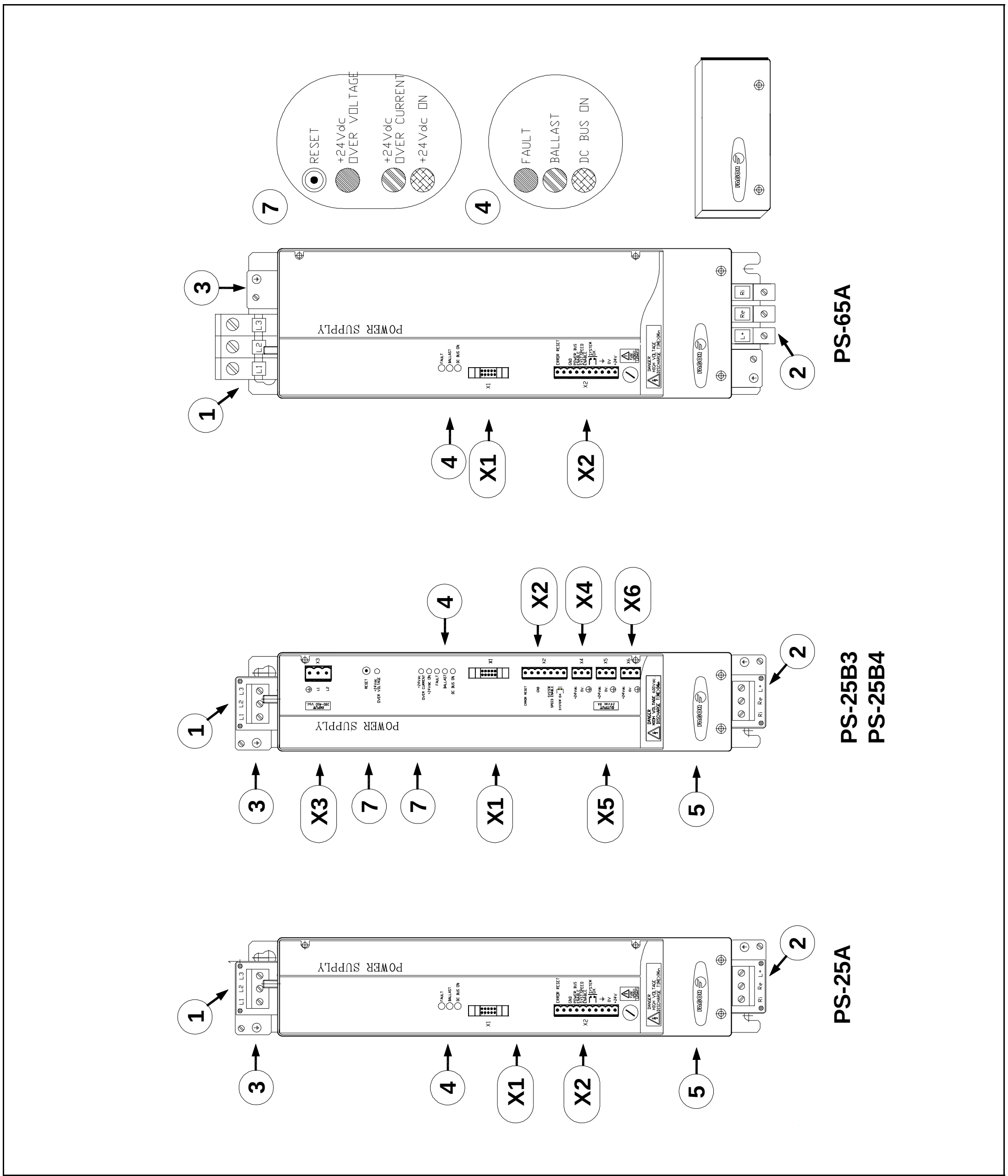


fig. 14 Connectors at the non-regenerative power supplies

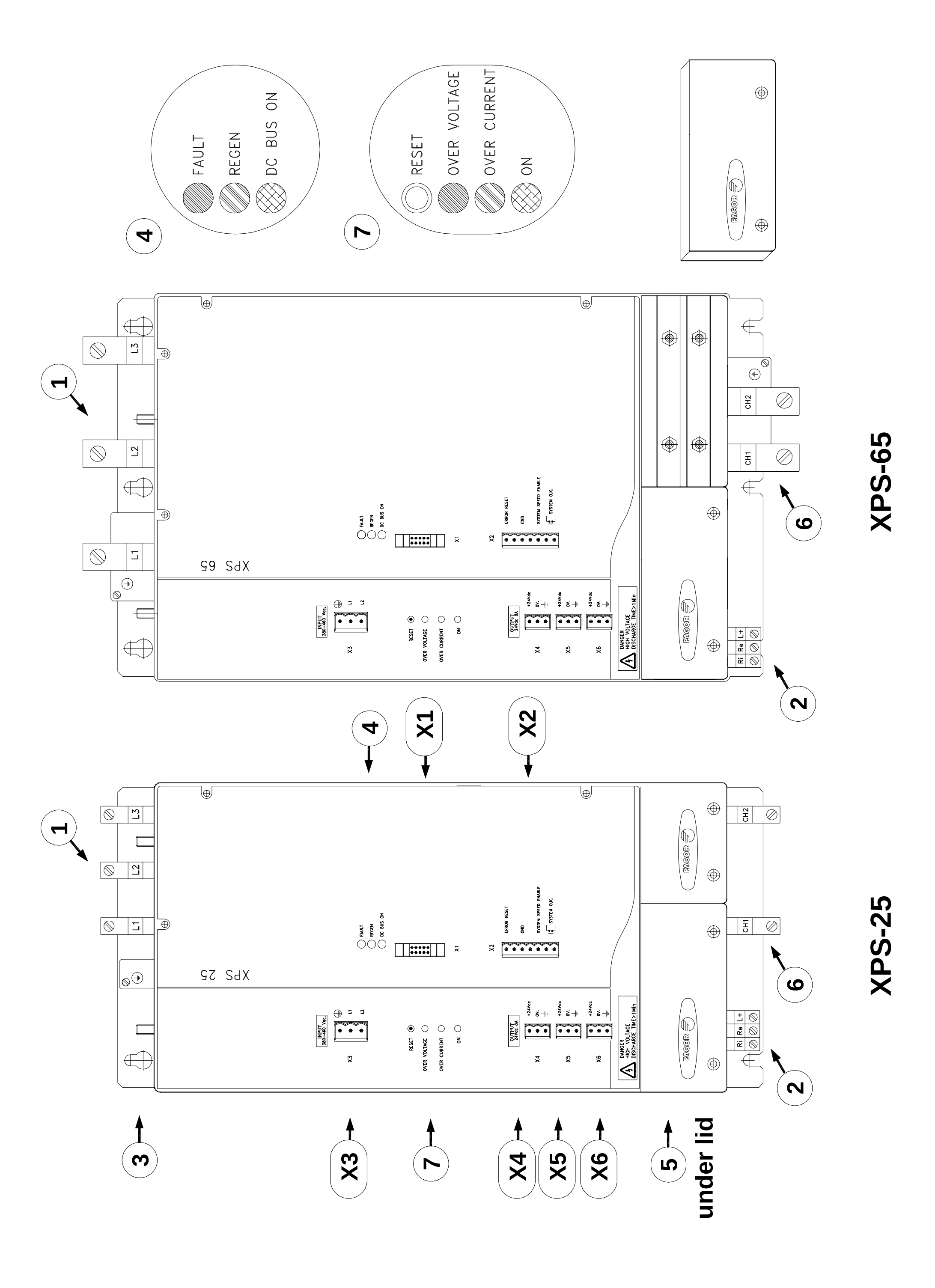
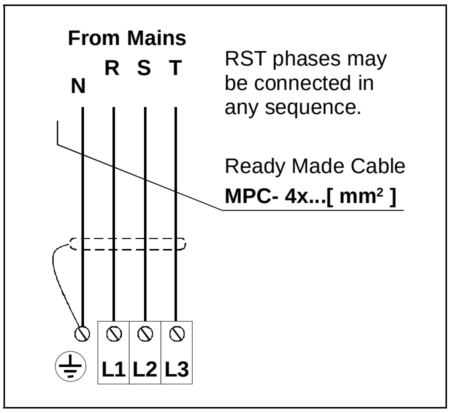


fig. 15   Connectors at the regenerative power supplies

Power connectors of the power supplies

Terminal strip for connection to mains.



They phases may be connected in any sequence.

The ground connection of the cable shields is made from the vertical plate next to the terminal strip.

fig. 16 Terminal strip for mains connection

	PS-25A	PS - 25B3 PS - 25B4	XPS-25	PS - 65A XPS - 65
Gap between terminals (mm)	10.16	10.16	12.1	18.8
Max. tightening torque (N·m)	1.5	1.5	2	7
Maximum section (mm^2)	10	10	16	50

table 7 Data of the terminal strip for mains connection

The equipment must be protected with fuses on the three-phase line L1, L2 and L3 as instructed on the chapter 2.

Terminal strip for the external Ballast resistor.

The drive is supplied from factory with a wire jumper between terminals Ri and L+. This configures the power supply to work with its internal Ballast resistor.

If the internal resistor cannot handle enough power, it could be set up to work with an external resistor. The following diagram shows the configuration for an external resistor

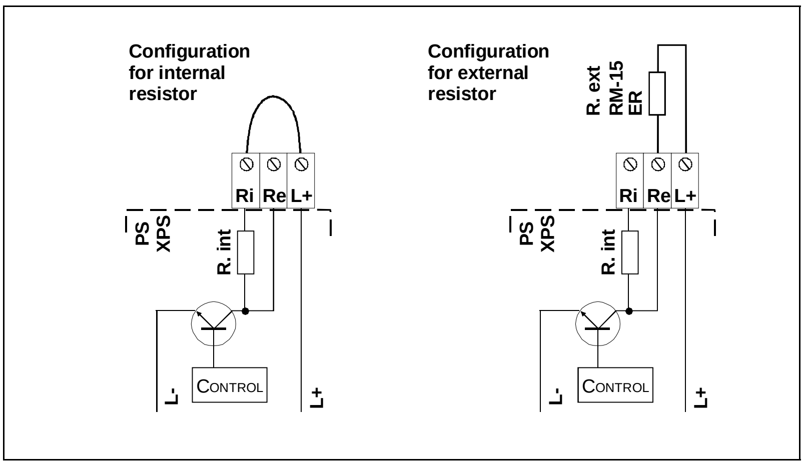


fig. 17 Configurations with internal and external resistors

	PS-25A	PS - 25B3 PS - 25B4	PS - 65A	XPS-25 XPS-65
Gap between terminals (mm)	10.16	10.16	10.16	8.1
Max tightening torque (N·m)	1.5 | 1.7	1.5 | 1.7	1.5 | 1.7	1
Maximum section (mm^2)	10	10	10	4

table 8 Data of the terminal strip for the external Ballast connection

If this jumper between Ri and L+ is eliminated and no external resistor is connected, error 215 or 304 will be issued. In the case of the PS-25B3 and PS-25B4 modules, the power bus will not be loaded.

The **PS-25A** and **PS-65A** modules have two switches on top next the terminal strip for mains connection. With these two switches, it is possible to select up to 3 different crowbar resistors (ER-18/1100, ER-18/1800, ER-18/2200) and also disable the **i²t** protection (when using an internal resistor or an RM-15 module) that have their own thermal protection.

Note: The PS-25B4 have these two sitches on their front panel next to the X1 connector.

The resistor must be selected according to the following table:

SWITCH 1	SWITCH 2	RESISTOR
ON	ON	ER - 18/1100
OFF	ON	ER - 18/1800
ON	OFF	ER - 18/2200
OFF	OFF	Disabled

table 9 External resistor selection

where the switches are shown in fig. 18:

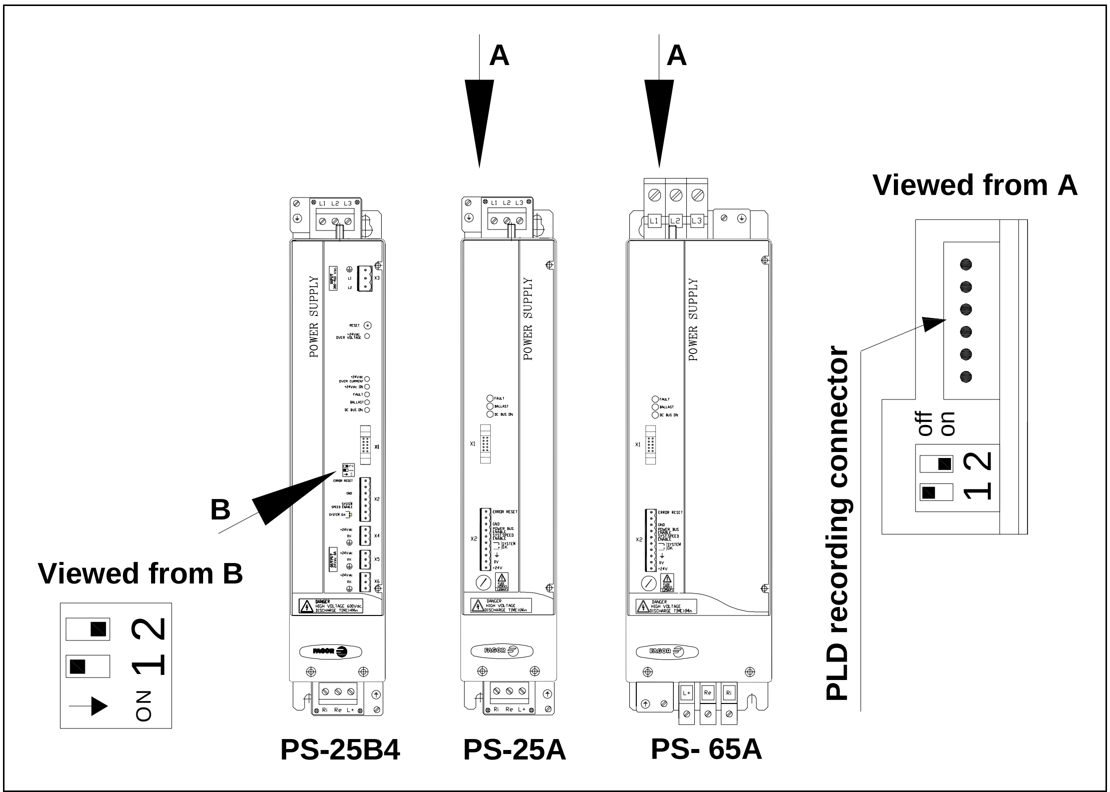


fig. 18 External Ballast resistor selecting switches

The power supply carries a protection against over - temperatures which triggers error 301 when reaching 105°C (221°F).

The power being dissipated by these resistors depends on the ambient temperature according to the following derating curves.

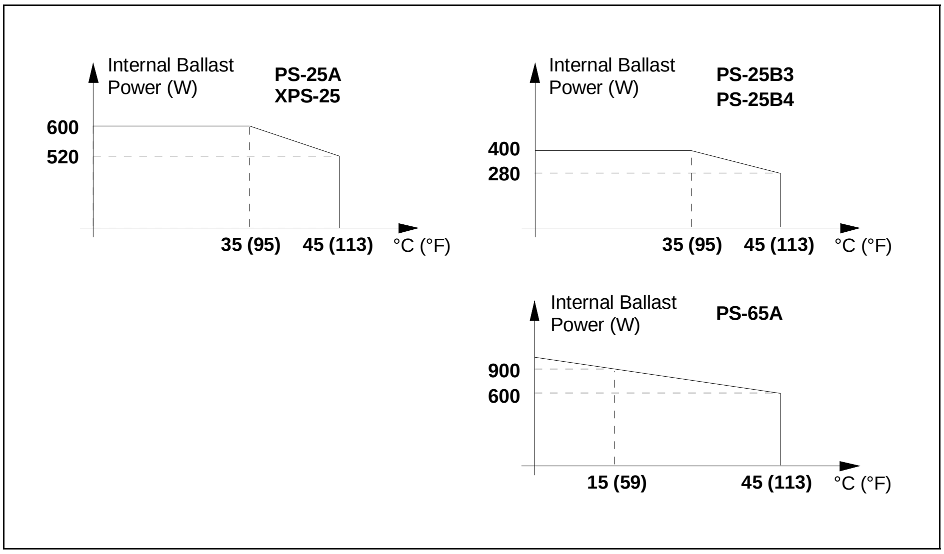


fig. 19 Power that may be dissipated through the internal resistor depending on the ambient temperature

Regenerative power supplies (**XPS)** also have a small Ballast Circuit for dissipating energy in case of an emergency. This emergency is issued when there is no connection to mains the Ballast circuit activating value is exceeded (see general characteristics table).

The performance of the Ballast resistor of the (XPS-65) does suffer at high temperatures.

Connection terminals for the Power Bus.

At the bottom of the module. covered by screwed on lid, there are the connection terminals for the power Bus. This bus supplies a DC voltage of about 600 Vdc (when the mains voltage is 400 Vac) for the drive modules.

Two plates are supplied with each module to joint the terminals of the adjacent modules. The fastening torque at these terminals must be between 2.3 and 2.8 N·m.

Fagor power supplies have a **(Soft Start)** for charging this power bus.

The soft start begins when two necessary and sufficient conditions are met:

- No errors at the modules connected to that power supply through the internal bus (X1).
- Presence of the three phases at the input of the power supply module.

In the case of the PS-25B3 and PS-25B4 power supplies, it will be enough to have all three phases of mains.

The start process begins when the **FAULT** lamps stops blinking and it is over, the **DC BUS ON** lamp comes on.

Before handling these leads, proceed in the following order:

- Stop the motors
- Disconnect the mains voltage at the electrical cabinet
- Wait, before handling these leads. The power supply module needs time to decrease the voltage of the power bus down to safe values (< 60 Vdc). The green DC BUS ON light off does not mean that it is safe to handle the power bus. The discharge time is about 4 minutes depending on the number of elements connected.

The power buses of different power supply modules must never be connected in parallel.

Inductive filter (choke) connection terminals.

The inductive filter or choke must only be used or regenerative power supplies (**XPS**).

The **XPS-25** and **XPS-65** power supplies offer the connection terminals labeled **CH1** and **CH2** at the bottom of the module for connecting the inductive filter. See attached table 10.

This inductance is a must to filter the current circulating from the power bus to mains.

Fagor supplies the **CHOKE XPS-25** and **CHOKE XPS-65** for this application.

Use cables with the maximum section allowed (16 and 50 mm^2) y and shorter than 2 meters (6 feet). They do not have to be shielded.

	CHOKE XPS - 25	CHOKE XPS - 65
Max. tightening torque (N·m)	2	7
Maximum cable section (mm^2)	16	50

table 10 Data of the Choke connection terminals

The inductance is an absolute must for the operation of a regenerative power supply.

Installing a filter with an inductance other than the one recommended in the general characteristics table may cause severe damage to the unit.

X1 connector (internal bus)

Interconects all the elements of the servo drive system. All the modules powered with the same power supply must be connected to this bus and it is required to run it. **The bus must not be disconnected while the system is running.**

A ribbon cable is provided with each module (power supply or drive) for this connection.

When using two power supply modules within the same servo system, each group must carry its own internal bus.

X2 connector (control)

This connector is used to control the power supply module**.**

The internal circuits of the non-regenerative **PS-xxA** require an external 24 Vdc supply. That's why their **X2** connector has three more terminals. An 1.25 A fuse protects the internal circuits.

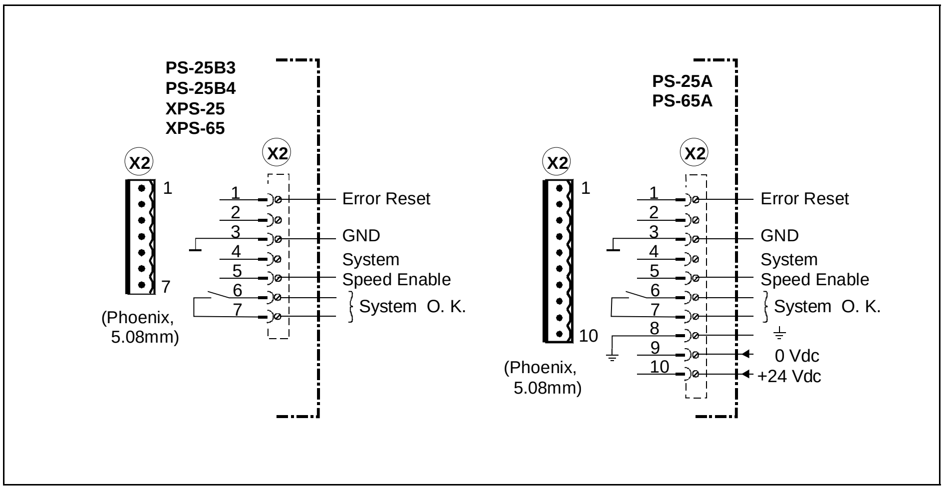


fig. 20 X2 connector (control)

The next table shows the signals and other considerations related to each pin:

1	Error RESET	System error reset input (24 Vdc ; 4.5 - 7 mA)
2	Not connected	---------------
3	GND	0 volts reference for digital inputs Error RESET (1) and System Speed Enable (5)
4	Not connected	---------------
5	System Speed Enable	General system speed enable (24 Vdc ; 4.5 - 7 mA)
6	System Ok	Contact indicating module status Opens when fault: Limit1 A at 24 V
7	System Ok	
8	CHASSIS	Chassis connection - only on PS - xxA -models
9	0 Vdc	Voltage for control circuits - only on PS - xxA - between 21 and 28 Vdc Maximum consumption 1 A.
10	+ 24 Vdc	

table 11 X2 connector pinout

Procedure to turn on the power supply module:

1. At the PS-xxA models.

Supply 24 Vdc to the control circuits of the module through connector X2 (pins 9 and 10).

1. At the XPS , PS-25B3 and PS-25B4.

Apply power to the Auxiliary Power Supply from mains through connector X3 (pins 2 and 3). These will power the control circuits of the module and provide 24 Vdc at connectors X4, X5 and X6.

2. The power supply module will check the system status.

If the status is correct:

The **System OK** contact is closed (pins 6 and 7). This contact will stay closed as long as the control circuits are powered and no error is detected in any system module.

The red **FAULT** lamp will blink (no error, no phases yet).

If the status is not correct:

The red **FAULT** lamp will turn on.

3. Apply power to the power supply from mains through the power connectors on top pf the module.

The soft start will begin.

The red **FAULT** lamp will turn off.

4. After 4 seconds, the green **DC BUS ON** lamp will turn on indicating that the DC voltage is now available at the power bus.

If an error occurs at the power supply module or at any drive module it supplies to, the system will act as follows:

The green **DC BUS ON** light will go off.

The red **FAULT** light will stay on.

It will eliminate the voltage supply to the power bus (it does not eliminate the capacitors charge).

With the **Error RESET** input (pin 1), it is possible to eliminate the errors at the drives constituting the system (see appendix B, resettable errors) and it acts as follows:.

It will normally be at 0V. When activated (24 V) the errors existing in the memory of each one of the system modules will be deleted.

If the cause of the error persists, the corresponding module will show it again. If the error is serious, it can only be eliminated by powering the unit down and back up.

The **System Speed Enable** input (pin 5) is related to the Speed Enable input of the drive modules.

System Speed Enable, must normally be at 24 Vdc.

If the System Speed Enable pin is set to 0 Vdc, all servo drives connected to the power supply through the same internal bus will brake their motors at maximum torque and once stopped or the limit time (programmable by parameter GP3) has elapsed, the motor torque is removed.

The consumption of each input is between 4,5 and 7 mA.

Connectors X3, X4, X5 and X6 (XPS and PS -25Bx)

All four connectors belong to the Auxiliary Power Supply**.**

X3 receives power from mains.
It admits between 400 Vac and 460 Vac.

This power supply generates 24 Vdc to feed the control circuits of the module itself.

Also, up to 8 A of dc voltage are supplied through **X4**, **X5** and **X6**. These three connectors are identical and offer greater connecting flexibility.

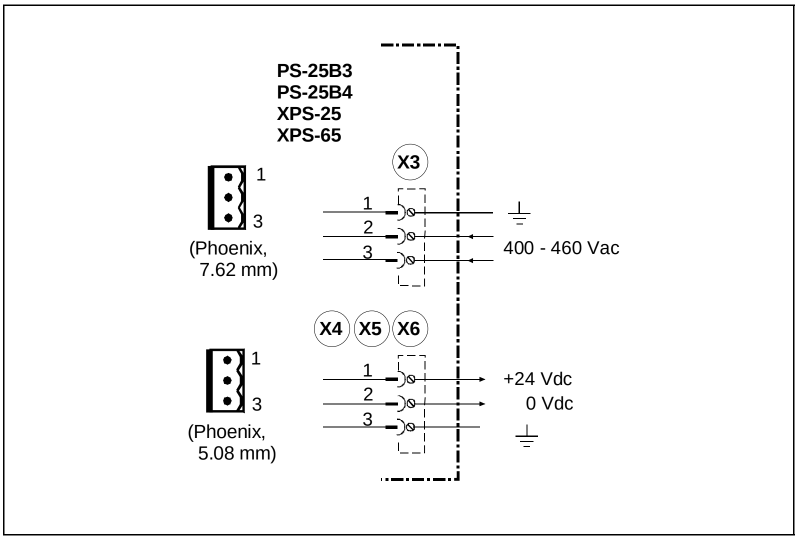


fig. 21 Connectors X3, X4, X5 and X6 (for power supplies XPS and PS-25Bx).

In case of micro - surges or total loss of mains power, this module guarantees stable and maintained 24 Vdc while the emergency braking of the motor. This is a must for the machine to comply with the **CE** seal.

Modular drive

They are modular **AXD** and **MMC** drives specifically designed for controlling axes (synchronous motors) and **SPD** drives for spindles (asynchronous motors).

This chapter is common to both models because their external characteristics: dimensions, connectors, ... are the same.

Technical data

Internal ventilation	AXIS DRIVE (synchronous)									
Currents at f_c = 4 kHz (A)	AXD 1.08	AXD 1.15	AXD 1.25	AXD 1.35	AXD 2.50	AXD 2.75		AXD 3.100	AXD 3.150	
I S1 (= I_N) (Arms)	4	7.5	12.5	17.5	23.5	31.5		50	62	
I max (Arms) (S3-5%)	8	15	25	35	47	63		100	124	
Dissipated current (W)	33	69	115	156	225	285		513	617	

table 12 Axis drives. fc = 4 kHz

Internal ventilation	AXIS DRIVE (synchronous)									
Currents at f_c = 8 kHz (A)	AXD 1.08	AXD 1.15	AXD 1.25	AXD 1.35	AXD 2.50	AXD 2.75		AXD 3.100	AXD 3.150	
I S1 (= I_N) (Arms)	4	7.5	12.5	17.5	23.5	31.5		50	62	
I max (Arms) (S3-5%)	8	15	25	35	47	63		100	124	
Dissipated current (W)	44	89	148	195	305	395		695	847	

table 13 Axis drives. fc = 8 kHz

Internal ventilation	SPINDLE DRIVE (asynchronous)									
Currents at f_c = 4 kHz (A)			SPD 1.25	SPD 1.35	SPD 2.50	SPD 2.75	SPD 2.85	SPD 3.100	SPD 3.150	SPD 3.200
I S1 (= I_N) (Arms)			16	23.1	31	42	50	70	90	121
0.7 x I_N (Arms)			11.2	16.17	21.7	29	35	49	63	84.7
I S6 - 40% (Arms)			20.8	30.03	40.3	54.6	65	91	117	157.3
I max (Arms) (S6-15%)			22	32	45	65	72.5	91	140	170
Dissipated current (W)			146	195	349	390	432	724	904	1163

table 14 Spindle drives. fc = 4 kHz

Internal ventilation	SPINDLE DRIVE (asynchronous)									
Currents at f_c = 8 kHz (A)			SPD 1.25	SPD 1.35	SPD 2.50	SPD 2.75	SPD 2.85	SPD 3.100	SPD 3.150	SPD 3.200
I S1 (= I_N) (Arms)			13	18	27	32	37	56	71	97
0.7 x I_N (Arms)			9.1	12.6	18.9	22.4	25.9	39.2	49.7	67.9
I S6 - 40% (Arms)			16.9	23.4	35.1	41.6	48.1	72.8	92.3	126.1
I max (Arms) (S6-15%)			17.8	24.9	39.1	65	53.6	72.8	110.4	136.5
Dissipated power (W)			145	201	350	395	438	743	930	1187

table 15 Spindle drives. fc = 8 kHz

MMC drives (working as axes) have the same currents as AXD drives.

fc : IGBT switching frequency

The dissipated power values for the spindles correspond to the operation at rated current in S1 mode.

See the load duty cycle for axis and spindle modular drives in the corresponding section of this chapter.

The following table shows other electrical, mechanical and ambient conditions:

	AXD / SPD / MMC									
	1.08	**1.15**	**1.25**	**1.35**	**2.50**	**2.75**	**2.85**	**3.100**	**3.150**	**3.200**
Power voltage input	542 - 800 Vdc									
Power to control circuits	24 Vdc (between 21 Vdc and 28 Vdc)									
Consumption on these circuits (24 Vdc)	0.9 A				1.25 A			2 A		
Speed feedback	Encoder / Resolver									
Controlling method	PWM, AC sinewave, Vector Control									
Communications	Serial line to connect to a PC									
Interface	Standard analog or digital via Sercos® (in all models) Serial line RS232/RS422 (only in MMC drives)									
Status display	7-segments display									
Protections	Overvoltage, overcurrent, overspeed, heat-sink temperature, ambient temperature, motor temperature, hardware error, overload ...									
Speed range with analog input	1 : 8192									
Current bandwidth	800 Hz									
Speed bandwidth	100 Hz (depends of the motor/drive)									
Ambient temperature	5°C / 45°C (41°F / 113°F) From 40°C (104°F). See derating curves.									
Storage temperature	- 20°C / + 60°C (- 4°F / + 140°F)									
Sealing	IP2x									
Max. humidity	< 90% (non condensing at 45°C / 113°F)									
Operating vibration	0.5 G									
Shipping vibration	2 G									
Weight kg (lb)	5.5 [12.13]		6 (13.2)	6.5 (14.3)	9 (19.8)	9 (19.8)	10 (22.0)	16.5 (36.4)	17 (37.5)	19.5 (43.0)

table 16 Other technical data

Load duty cycles

Load cycle S1

Continuous duty. Operation with constant load and long enough to achieve thermal balance.

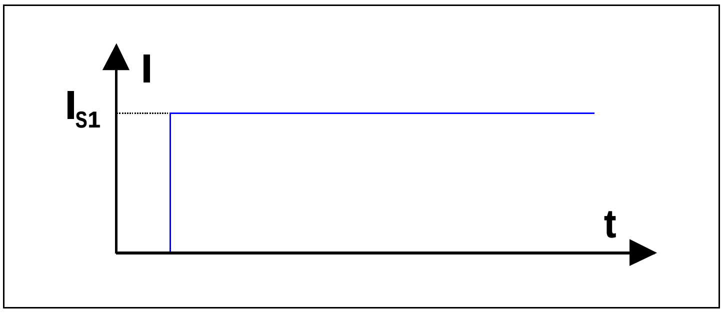


fig. 22 Load cycle S1.

Load cycle S3 - 5%

Periodic intermittent duty. Succession of identical duty cycles, each with a rest period. In this duty cycle, the overheating effect of the start-up current is negligible.
The 5% running factor means that for 10 second cycle, it works at constant current (IS3) for 0.5 s and it rests (0 A) for 9.5 s.

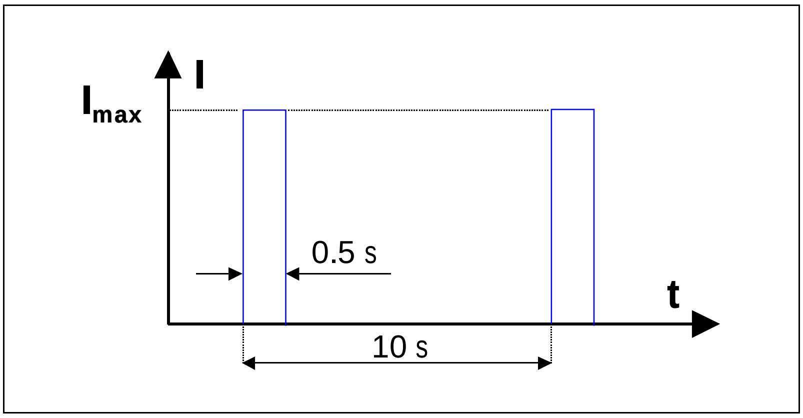


fig. 23 Load cycle S3 - 5%.

Load cycle S6 - 40%

Periodic uninterrupted duty cycle with intermittent load. Succession of identical duty cycles, each with a running period under constant load and another period without load. There is no rest period.
The 40% running factor indicates that for a 10 minute cycle, it works at constant current for 4 minutes (S6 - 40%) and without load for 6 minutes (with magnetizing current = 0.7 x rated current).

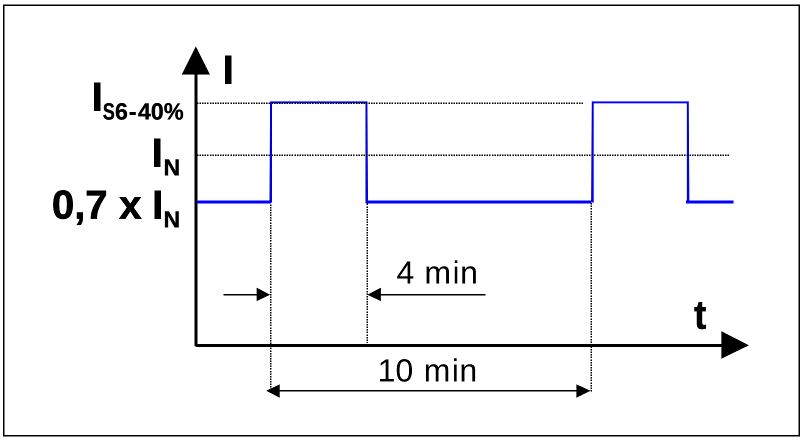


fig. 24 Load cycle S6 - 40%.

Load cycle S6 - 15%

Periodic uninterrupted duty cycle with intermittent load. Succession of identical duty cycles, each with a running period under constant load and another period without load. There is no rest period.
The 15% running factor indicates that for a 60-second cycle, it works at constant current for 10 seconds (IS6 - 15%) and without load for 50 seconds (with magnetizing current = 0.7 x rated current).

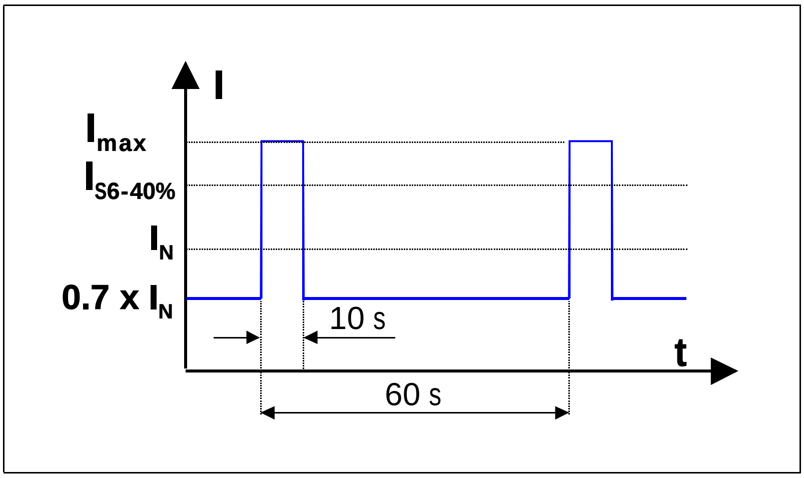


fig. 25 Load cycle S6 - 15%.

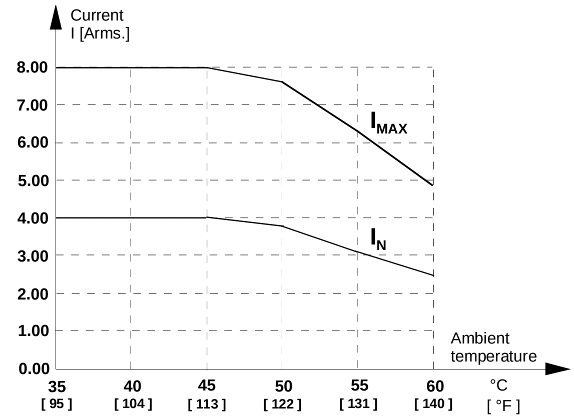
Current derating

Axis drives:

The following graphs show the maximum rms current in continuous S1 and intermittent S3 (5%) duty cycles depending on the switching frequency of the power transistors in a temperature range between 5 °C and 60 °C.

See the load cycles in the previous section.

☐ FOR SWITCHING FREQUENCY f_c = 4 kHz:

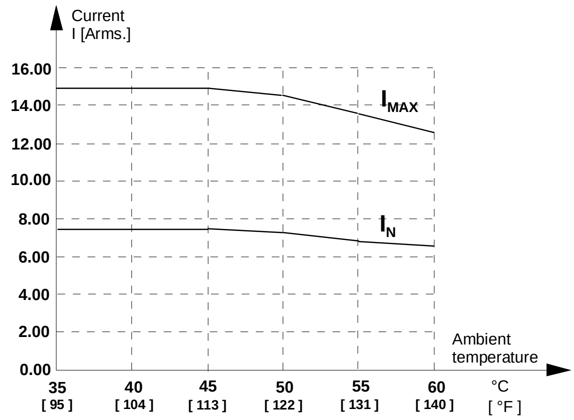


AXD 1.08 & MMC 1.08

Tª ambient		I_N	I_{MAX}
°C	°F	Arms	Arms
35	95	4,0	8,0
40	104	4,0	8,0
45	113	4,0	8,0
50	122	3,8	7,6
55	131	3,1	6,3
60	140	2,4	4,8

I_N is the rated current in duty cycle S1
I_{MAX} es the maximum current in duty cycle S3-5%. See load cycle S3-5%.

fig.26 Current derating. AXD 1.08 and MMC 1.08. fc = 4 kHz

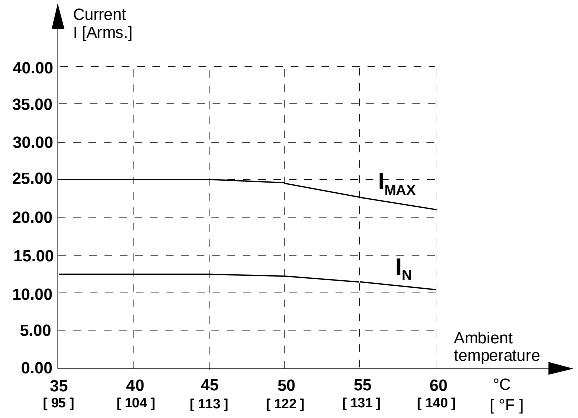


AXD 1.15 & MMC 1.15

Tª ambient		I_N	I_{MAX}
°C	°F	Arms	Arms
35	95	7,5	15,0
40	104	7,5	15,0
45	113	7,5	15,0
50	122	7,3	14,7
55	131	6,8	13,6
60	140	6,3	12,6

I_N is the rated current in duty cycle S1
I_{MAX} es the maximum current in duty cycle S3-5%. See load cycle S3-5%.

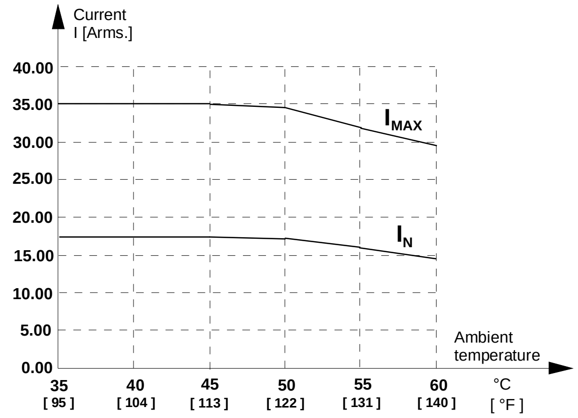
fig.27 Current derating. AXD 1.15 and MMC 1.15. fc = 4 kHz



AXD 1.25 & MMC 1.25			
Tª ambient		I_N	I_{MAX}
°C	°F	Arms	Arms
35	95	12,5	25,0
40	104	12,5	25,0
45	113	12,5	25,0
50	122	12,2	24,5
55	131	11,4	22,8
60	140	10,5	21,1

I_N is the rated current in duty cycle S1
I_{MAX} es the maximum current in duty cycle S3-5%. See load cycle S3-5%.

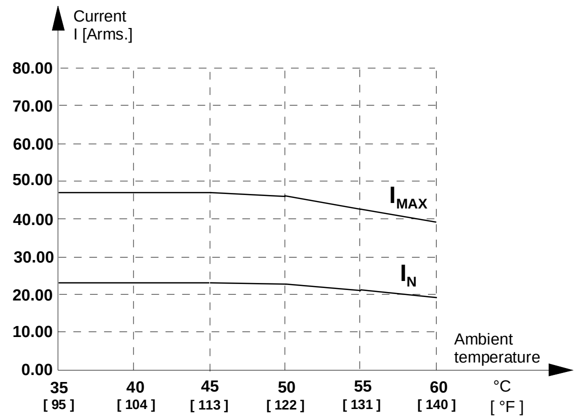
fig.28 Current derating. AXD 1.25 and MMC 1.25. fc = 4 kHz.



AXD 1.35 & MMC 1.35			
Tª ambient		I_N	I_{MAX}
°C	°F	Arms	Arms
35	95	17,5	35,0
40	104	17,5	35,0
45	113	17,5	35,0
50	122	17,3	34,5
55	131	16,0	32,1
60	140	14,8	29,5

I_N is the rated current in duty cycle S1
I_{MAX} es the maximum current in duty cycle S3-5%. See load cycle S3-5%.

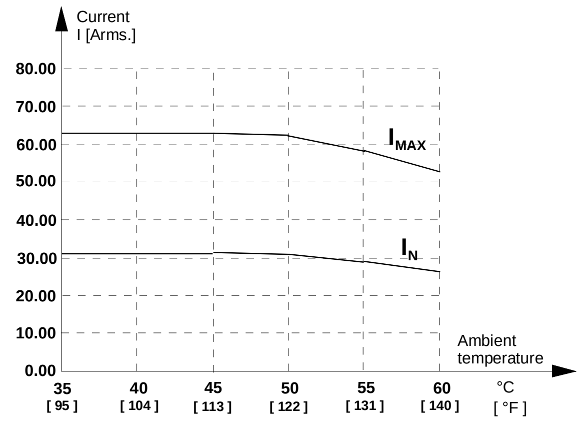
fig.29 Current derating. AXD 1.35 and MMC 1.35. fc = 4 kHz.



AXD 2.50 & MMC 2.50			
Tª ambient		I_N	I_{MAX}
°C	°F	Arms	Arms
35	95	23,5	47,0
40	104	23,5	47,0
45	113	23,5	47,0
50	122	23,2	46,5
55	131	21,5	43,0
60	140	19,7	39,5

I_N is the rated current in duty cycle S1
I_{MAX} es the maximum current in duty cycle S3-5%. See load cycle S3-5%.

fig.30 Current derating. AXD 2.50 and MMC 2.50. fc = 4 kHz.

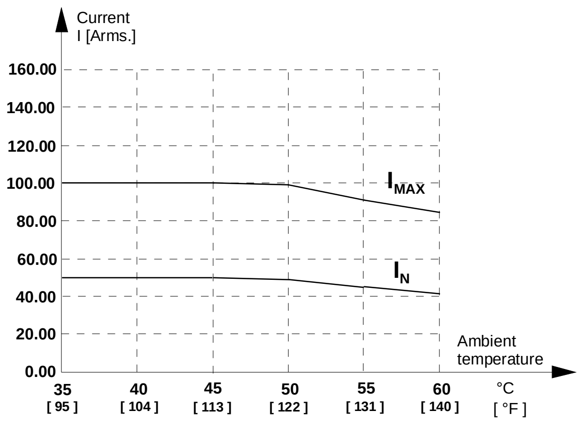


AXD 2.75 & MMC 2.75			
Tª ambient		I_N	I_{MAX}
°C	°F	Arms	Arms
35	95	31,5	63,0
40	104	31,5	63,0
45	113	31,5	63,0
50	122	31,4	62,9
55	131	28,9	57,8
60	140	26,3	52,7

I_N is the rated current in duty cycle S1

I_{MAX} es the maximum current in duty cycle S3-5%. See load cycle S3-5%.

fig.31 Current derating. AXD 2.75 and MMC 2.75. fc = 4 kHz.

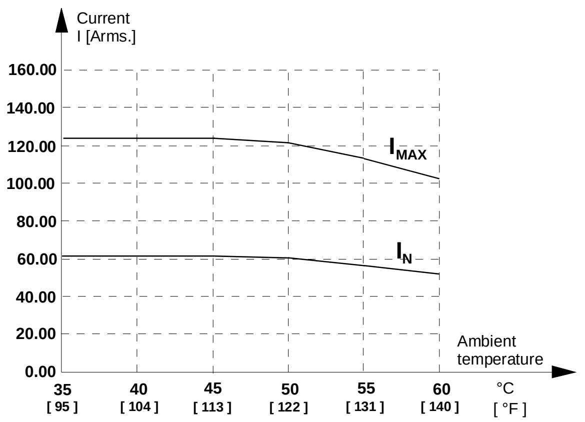


AXD 3.100 & MMC 3.100			
Tª ambient		I_N	I_{MAX}
°C	°F	Arms	Arms
35	95	50,0	100,0
40	104	50,0	100,0
45	113	50,0	100,0
50	122	49,6	99,2
55	131	45,9	91,8
60	140	42,1	84,2

I_N is the rated current in duty cycle S1

I_{MAX} es the maximum current in duty cycle S3-5%. See load cycle S3-5%.

fig.32 Current derating. AXD 3.100 and MMC 3.100. fc = 4 kHz.



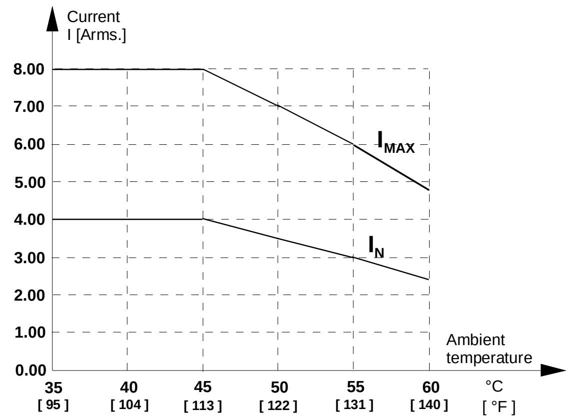
AXD 3.150 & MMC 3.150			
Tª ambient		I_N	I_{MAX}
°C	°F	Arms	Arms
35	95	62,0	124,0
40	104	62,0	124,0
45	113	62,0	124,0
50	122	61,4	122,8
55	131	56,7	113,3
60	140	51,8	103,6

I_N is the rated current in duty cycle S1

I_{MAX} es the maximum current in duty cycle S3-5%. See load cycle S3-5%.

fig.33 Current derating. AXD 3.150 and MMC 3.150. fc = 4 kHz.

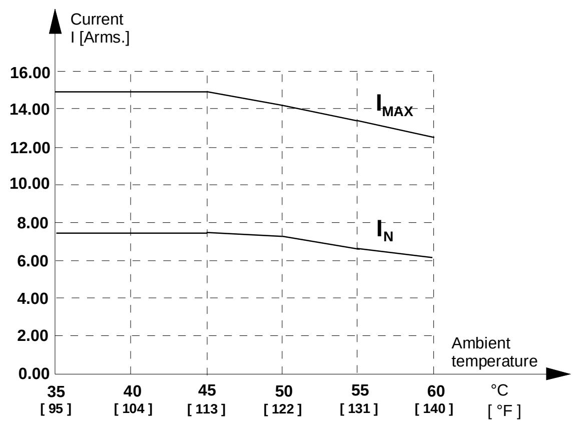
☐ FOR SWITCHING FREQUENCY f_c = 8 kHz:



AXD 1.08 & MMC 1.08			
Tª ambient		I_N	I_{MAX}
°C	°F	Arms	Arms
35	95	4,0	8,0
40	104	4,0	8,0
45	113	4,0	8,0
50	122	3,5	6,9
55	131	2,9	5,9
60	140	2,4	4,8

I_N is the rated current in duty cycle S1
I_{MAX} es the maximum current in duty cycle S3-5%. See load cycle S3-5%.

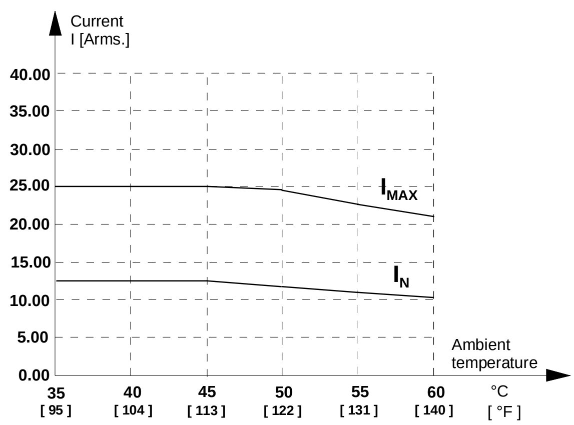
fig.34 Current derating. AXD 1.08 and MMC 1.08. fc = 8 kHz.



AXD 1.15 & MMC 1.15			
Tª ambient		I_N	I_{MAX}
°C	°F	Arms	Arms
35	95	7,5	15,0
40	104	7,5	15,0
45	113	7,5	15,0
50	122	7,1	14,3
55	131	6,7	13,4
60	140	6,3	12,5

I_N is the rated current in duty cycle S1
I_{MAX} es the maximum current in duty cycle S3-5%. See load cycle S3-5%.

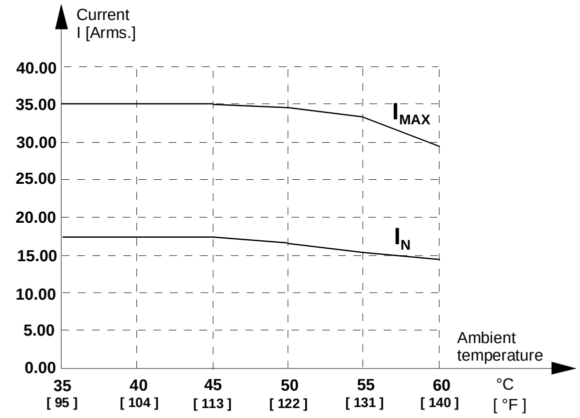
fig.35 Current derating. AXD 1.15 and MMC 1.15. fc = 8 kHz.



AXD 1.25 & MMC 1.25			
Tª ambient		I_N	I_{MAX}
°C	°F	Arms	Arms
35	95	12,5	25,0
40	104	12,5	25,0
45	113	12,5	25,0
50	122	11,9	23,7
55	131	11,2	22,3
60	140	10,5	20,9

I_N is the rated current in duty cycle S1
I_{MAX} es the maximum current in duty cycle S3-5%. See load cycle S3-5%.

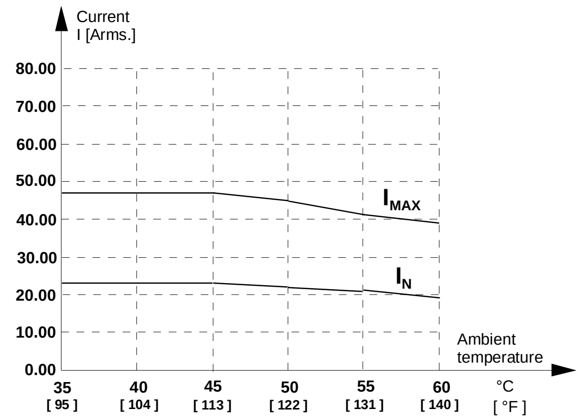
fig.36 Current derating. AXD 1.25 and MMC 1.25. fc = 8 kHz.



AXD 1.35 & MMC 1.35			
Tª ambient		I_N	I_{MAX}
°C	°F	Arms	Arms
35	95	17,5	35,0
40	104	17,5	35,0
45	113	17,5	35,0
50	122	16,6	33,3
55	131	15,6	31,3
60	140	14,7	29,3

I_N is the rated current in duty cycle S1
I_{MAX} es the maximum current in duty cycle S3-5%. See load cycle S3-5%.

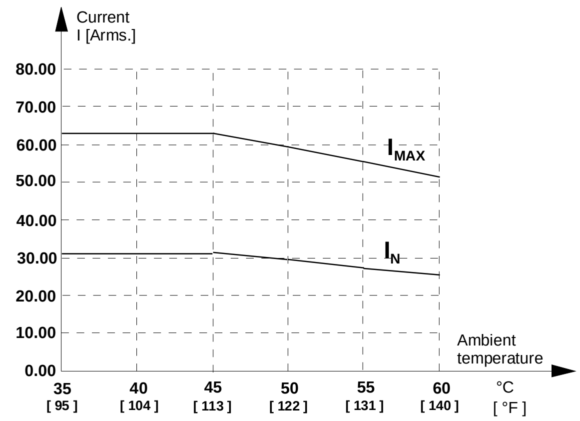
fig.37 Current derating. AXD 1.35 and MMC 1.35. fc = 8 kHz.



AXD 2.50 & MMC 2.50			
Tª ambient		I_N	I_{MAX}
°C	°F	Arms	Arms
35	95	23,5	47,0
40	104	23,5	47,0
45	113	23,5	47,0
50	122	22,2	44,4
55	131	20,8	41,7
60	140	19,5	38,9

I_N is the rated current in duty cycle S1
I_{MAX} es the maximum current in duty cycle S3-5%. See load cycle S3-5%.

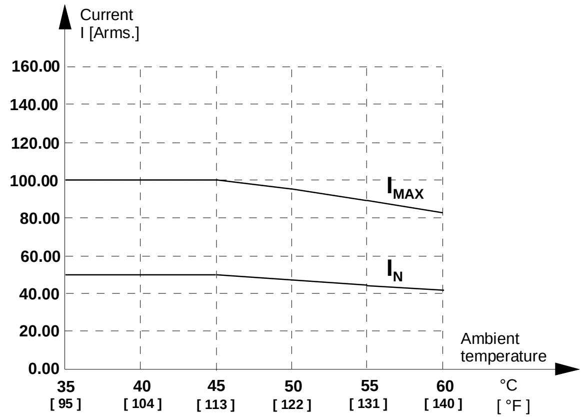
fig.38 Current derating. AXD 2.50 and MMC 2.50. fc = 8 kHz.



AXD 2.75 & MMC 2.75			
Tª ambient		I_N	I_{MAX}
°C	°F	Arms	Arms
35	95	31,5	63,0
40	104	31,5	63,0
45	113	31,5	63,0
50	122	29,7	59,4
55	131	27,8	55,6
60	140	25,9	51,7

I_N is the rated current in duty cycle S1
I_{MAX} es the maximum current in duty cycle S3-5%. See load cycle S3-5%.

fig.39 Current derating. AXD 2.75 and MMC 2.75. fc = 8 kHz.



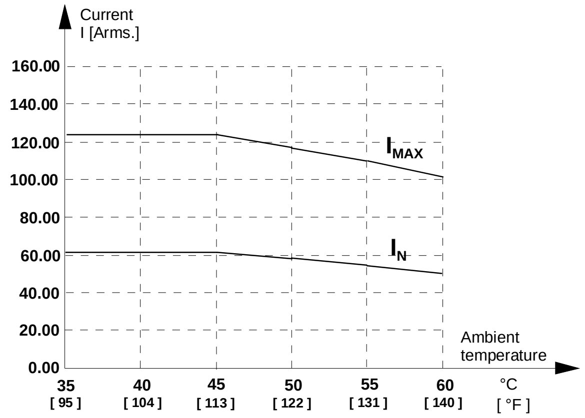
AXD 3.100 & MMC 3.100

Tª ambient		I_N	I_{MAX}
°C	°F	Arms	Arms
35	95	50,0	100,0
40	104	50,0	100,0
45	113	50,0	100,0
50	122	47,6	95,2
55	131	44,7	89,4
60	140	41,7	83,4

I_N is the rated current in duty cycle S1

I_{MAX} es the maximum current in duty cycle S3-5%. See load cycle S3-5%.

fig.40 Current derating. AXD 3.100 and MMC 3.100. fc = 8 kHz.



AXD 3.150 & MMC 3.150

Tª ambient		I_N	I_{MAX}
°C	°F	Arms	Arms
35	95	62,0	124,0
40	104	62,0	124,0
45	113	62,0	124,0
50	122	58,7	117,4
55	131	55,0	110,1
60	140	51,3	102,6

I_N is the rated current in duty cycle S1

I_{MAX} es the maximum current in duty cycle S3-5%. See load cycle S3-5%.

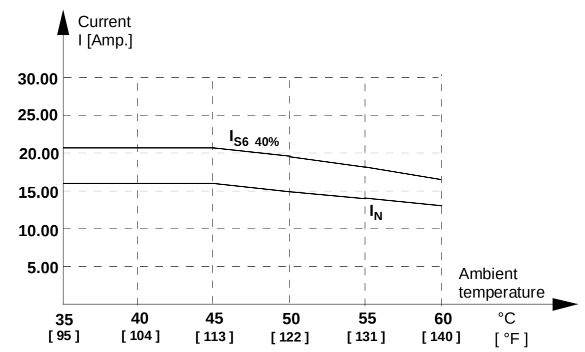
fig.41 Current derating. AXD 3.150 and MMC 3.150. fc = 8 kHz.

Spindle drives:

The following graphs show the maximum rms current in continuous S1 and intermittent S6 (40%) duty cycles depending on the switching frequencies of the power transistors in a temperature range between 5°C and 60°C.

See the load cycles in the previous section.

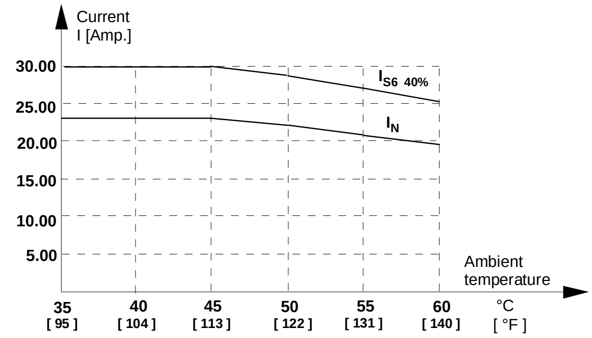
◘ FOR SWITCHING FREQUENCY f_c = 4 kHz:



SPD 1.25

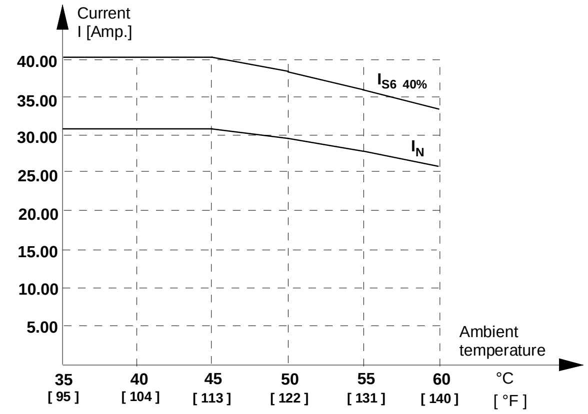
Tª ambient		I_n	$I_{S6\ 40\%}$
°C	°F	Arms	Arms
35	95	16,0	20,8
40	104	16,0	20,8
45	113	16,0	20,8
50	122	15,0	19,5
55	131	13,9	18,1
60	140	12,8	16,7

fig.42 Current derating. SPD 1.25. fc = 4 kHz.



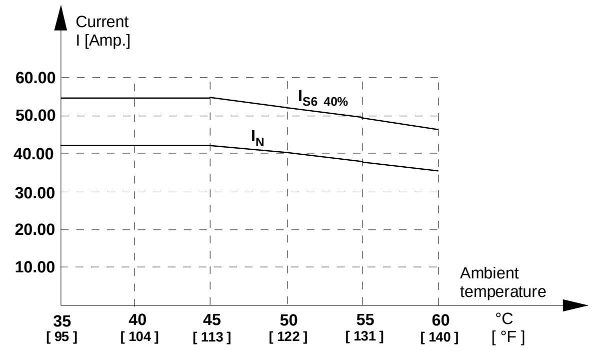
SPD 1.35			
Tª ambient		I_n	$I_{S6\ 40\%}$
°C	°F	Arms	Arms
35	95	23,1	30,0
40	104	23,1	30,0
45	113	23,1	30,0
50	122	22,0	28,6
55	131	20,7	26,9
60	140	19,4	25,3

fig.43 Current derating. SPD 1.35. fc = 4 kHz.



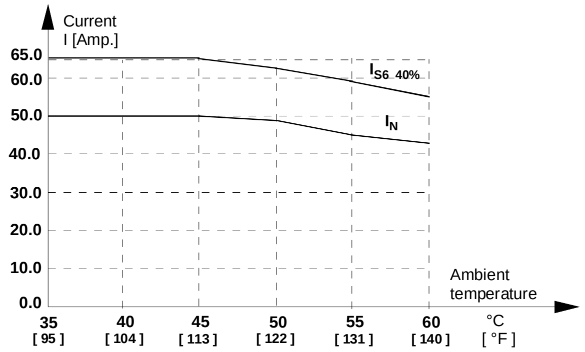
SPD 2.50			
Tª ambient		I_n	$I_{S6\ 40\%}$
°C	°F	Arms	Arms
35	95	31,0	40,3
40	104	31,0	40,3
45	113	31,0	40,3
50	122	29,5	38,3
55	131	27,7	36,0
60	140	25,9	33,6

fig.44 Current derating. SPD 2.50. fc = 4 kHz.



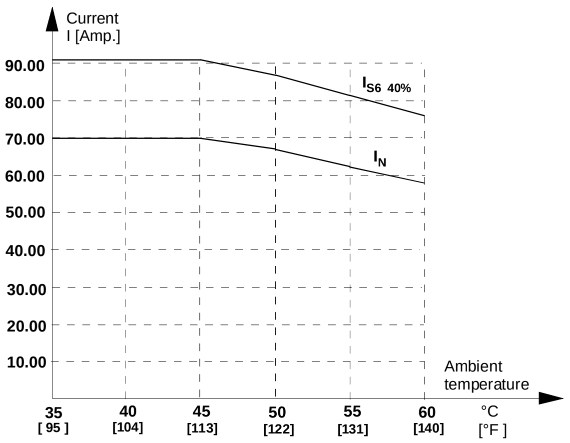
SPD 2.75			
Tª ambient		I_n	$I_{S6\ 40\%}$
°C	°F	Arms	Arms
35	95	42,0	54,6
40	104	42,0	54,6
45	113	42,0	54,6
50	122	40,1	52,1
55	131	37,8	49,2
60	140	35,6	46,2

fig.45 Current derating. SPD 2.75. fc = 4 kHz.



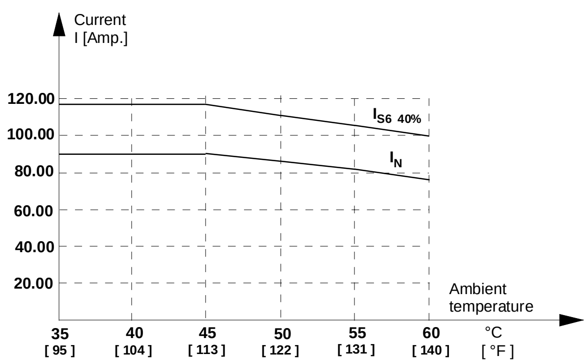
SPD 2.85			
Tª ambient		I_n	$I_{S6\ 40\%}$
°C	°F	Arms	Arms
35	95	50,0	65,0
40	104	50,0	65,0
45	113	50,0	65,0
50	122	48,2	62,6
55	131	45,3	58,9
60	140	42,4	55,1

fig.46 Current derating. SPD 2.85. fc = 4 kHz.



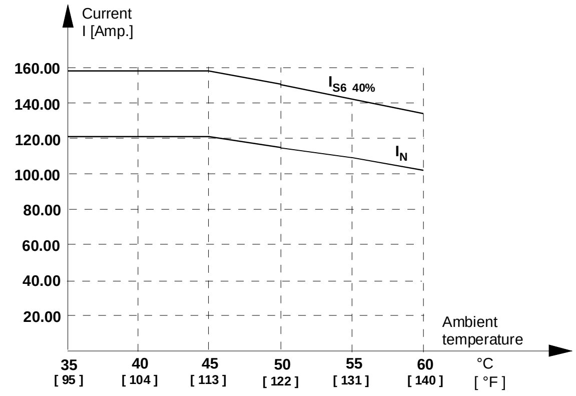
SPD 3.100			
Tª ambient		I_n	$I_{S6\ 40\%}$
°C	°F	Arms	Arms
35	95	70,0	91,0
40	104	70,0	91,0
45	113	70,0	91,0
50	122	66,8	86,9
55	131	62,9	81,7
60	140	58,8	76,4

fig.47 Current derating. SPD 3.100. fc = 4 kHz.



SPD 3.150			
Tª ambient		I_n	$I_{S6\ 40\%}$
°C	°F	Arms	Arms
35	95	90,0	117,0
40	104	90,0	117,0
45	113	90,0	117,0
50	122	86,1	112,0
55	131	81,4	105,8
60	140	76,6	99,6

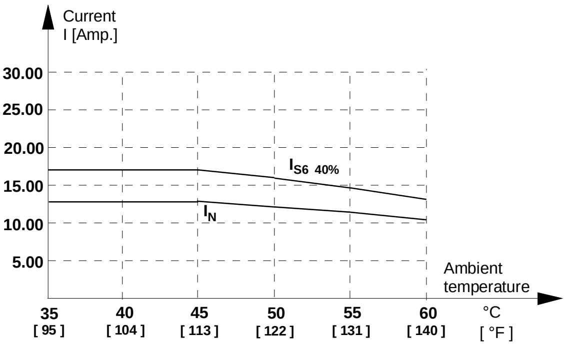
fig.48 Current derating. SPD 3.150. fc = 4 kHz.



SPD 3.200			
Tª ambient		I_n	$I_{S6\ 40\%}$
°C	°F	Arms	Arms
35	95	121,0	157,3
40	104	121,0	157,3
45	113	121,0	157,3
50	122	115,6	150,2
55	131	109,3	142,1
60	140	102,9	133,7

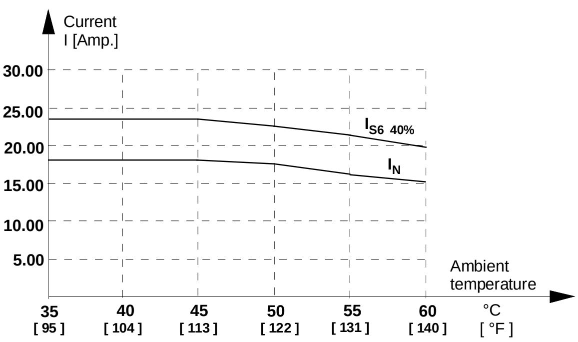
fig.49 Current derating. SPD 3.200. fc = 4 kHz.

☐ FOR SWITCHING FREQUENCY f_c = 8 kHz:



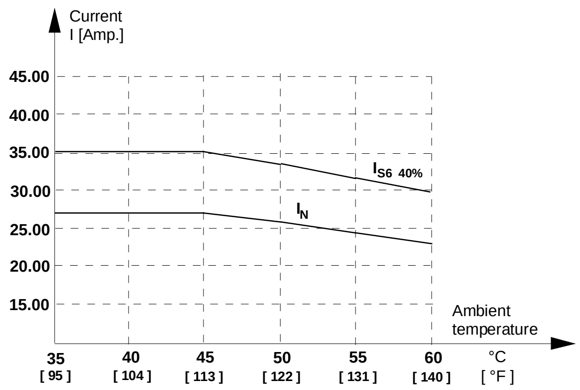
SPD 1.25			
Tª ambient		I_n	$I_{S6\ 40\%}$
°C	°F	Arms	Arms
35	95	13,0	16,9
40	104	13,0	16,9
45	113	13,0	16,9
50	122	12,4	16,1
55	131	11,4	14,8
60	140	10,4	13,6

fig.50 Current derating. SPD 1.25. fc = 8 kHz.



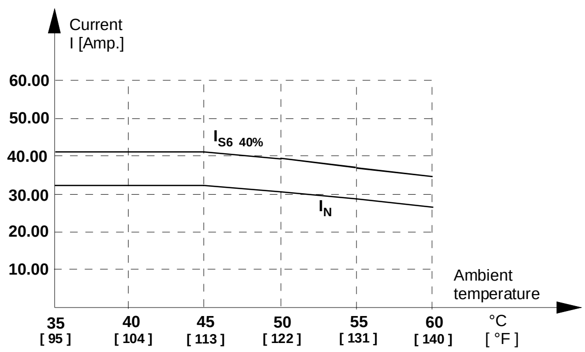
SPD 1.35			
Tª ambient		I_n	$I_{S6\ 40\%}$
°C	°F	Arms	Arms
35	95	18,0	23,4
40	104	18,0	23,4
45	113	18,0	23,4
50	122	17,4	22,6
55	131	16,3	21,3
60	140	15,3	19,8

fig.51 Current derating. SPD 1.35. fc = 8 kHz.



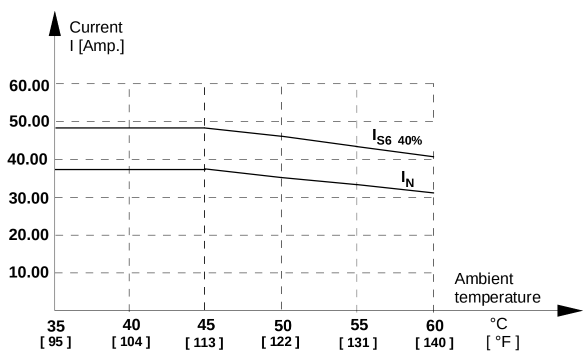
SPD 2.50			
Tª ambient		I_n	$I_{S6\ 40\%}$
°C	°F	Arms	Arms
35	95	27,0	35,1
40	104	27,0	35,1
45	113	27,0	35,1
50	122	25,9	33,7
55	131	24,4	31,7
60	140	22,9	29,8

fig.52 Current derating. SPD 2.50. fc = 8 kHz.



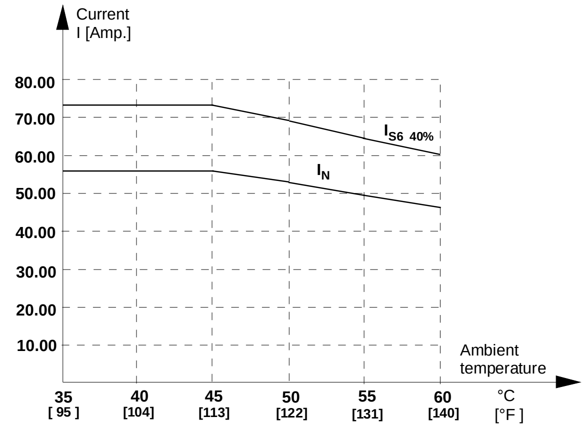
SPD 2.75			
Tª ambient		I_n	$I_{S6\ 40\%}$
°C	°F	Arms	Arms
35	95	32,0	41,6
40	104	32,0	41,6
45	113	32,0	41,6
50	122	30,5	39,7
55	131	28,7	37,3
60	140	26,8	34,9

fig.53 Current derating. SPD 2.75. fc = 8 kHz.



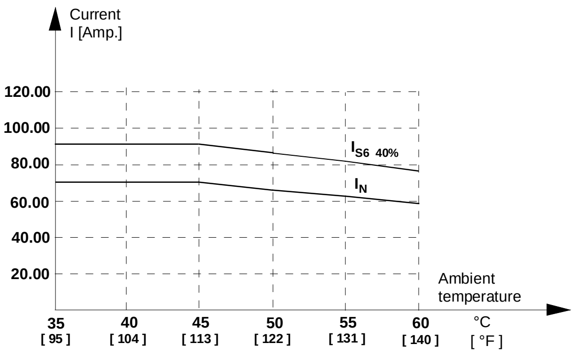
SPD 2.85			
Tª ambient		I_n	$I_{S6\ 40\%}$
°C	°F	Arms	Arms
35	95	37,0	48,1
40	104	37,0	48,1
45	113	37,0	48,1
50	122	35,5	46,1
55	131	33,3	43,3
60	140	31,0	40,3

fig.54 Current derating. SPD 2.85. fc = 8 kHz.



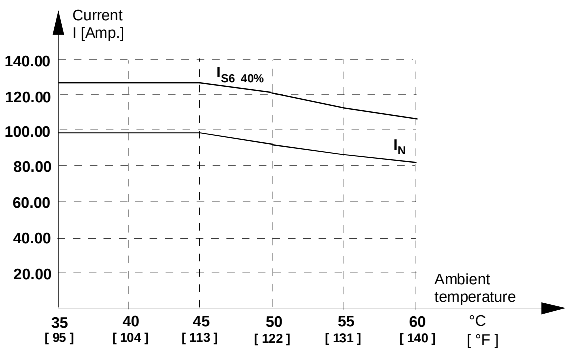
SPD 3.100			
Tª ambient		I_n	$I_{S6\ 40\%}$
°C	°F	Arms	Arms
35	95	56,0	72,8
40	104	56,0	72,8
45	113	56,0	72,8
50	122	52,9	68,8
55	131	49,5	64,3
60	140	46,0	59,8

fig.55 Current derating. SPD 3.100. fc = 8 kHz.



SPD 3.150			
Tª ambient		I_n	$I_{S6\ 40\%}$
°C	°F	Arms	Arms
35	95	71,0	92,3
40	104	71,0	92,3
45	113	71,0	92,3
50	122	67,1	87,3
55	131	63,1	82,1
60	140	59,1	76,8

fig.56 Current derating. SPD 3.150. fc = 8 kHz.

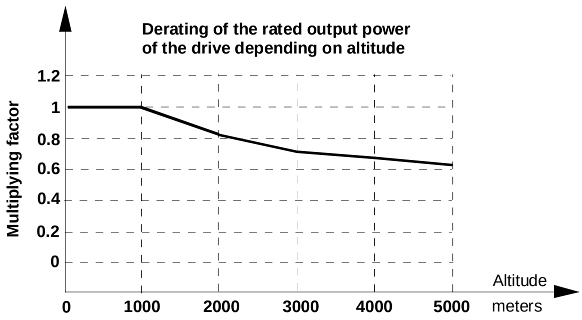


SPD 3.200			
Tª ambient		I_n	$I_{S6\ 40\%}$
°C	°F	Arms	Arms
35	95	97,0	126,1
40	104	97,0	126,1
45	113	97,0	126,1
50	122	92,1	119,8
55	131	86,7	112,7
60	140	81,2	105,6

fig.57 Current derating. SPD 3.200. fc = 8 kHz.

Power derating

The following graphs show the variation suffered by the output rated power of the modular drive (for all its models) depending on the installation altitude over sea level.



Output rated power radio

Altitude (m)	Multiplying factor (no units)
0	1.00
1000	1.00
2000	0.82
3000	0.71
4000	0.65
5000	0.62

fig.58 Power derating depending on altitude.

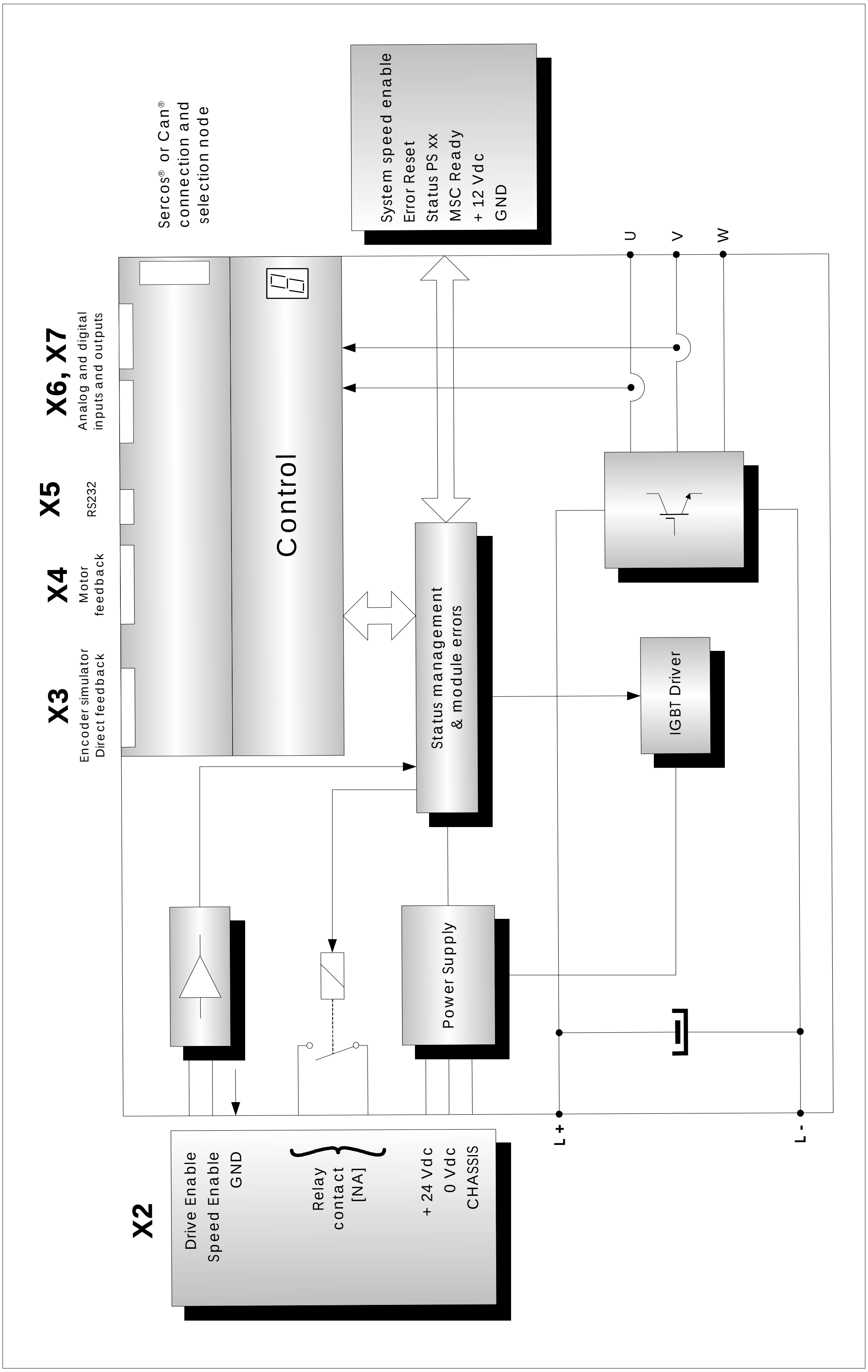


fig. 59 Block diagram of the AXD and SPD modules

Connectors of the modular drive

The next figure shows the elements appearing on the front plate of the modular drive:

1. Power connectors for motor connection.

2. 2,5 A [F] / 250V fast fuse
To protect the internal control circuits

3. Sercos® interface connectors.

4. Status Display. Shows status information for the drive itself or the relevant code when there is an error.

5. Power connectors at the bottom to power the drive module.

X1. Connector for module interconnection through the internal bus. This connection is describes in detail in the section corresponding to the power supply. If during system setup on maintenance, any module is constantly generating an error, the whole system is completely disabled. To temporarily ignore this error, disconnect the internal bus of that module and keep the other ones connected.

A connector is supplied with each module for connecting it to the bus.

X2. Connector for the basic control signals.

X3. Connector with two possible uses:

- as output of the encoder simulator.
- as input of a second feedback for the position loop.

X4. Motor feedback connector. Encoder or resolver.

X5. RS232 serial line connector

X6. RS232/RS422 serial line connector [only for MMC drives].

SL1. Slot for cards: A1, 16DI-8DO and 8DI-16DO.

SL2. Slot for cards: 16DI-8DO and 8DI-16DO.

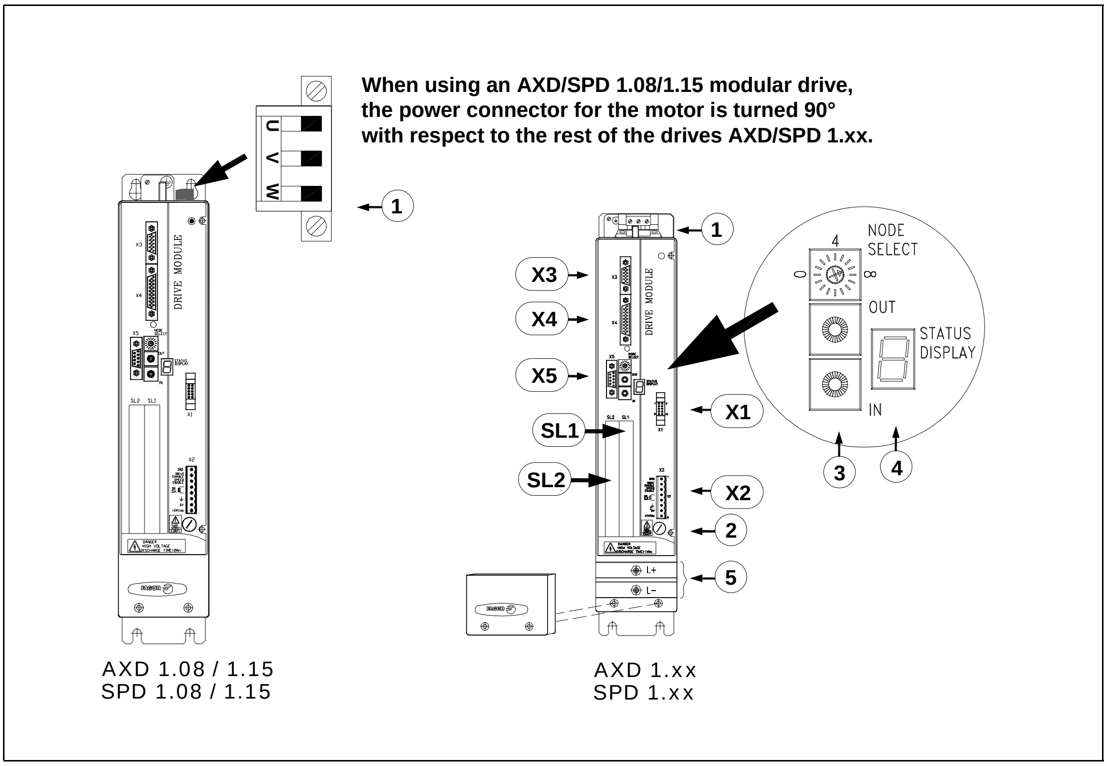


fig. 60 Modular-drive connectors

The modular drives used in Motion Control [**MMC**] system have an X6 connector to communicate with other devices such as PC or an video terminal ESA [VT] through an RS-232/RS-422 serial line. These modular drives X6 connector, see chapter 6 in this manual.

A modular MMC drive may have the X6 connector for RS-232/RS-422 serial communication with a PC, ESA video terminal or with other drives. In that case, it will not have the X5 connector for RS-232 because X6 can be used for this type of communication.

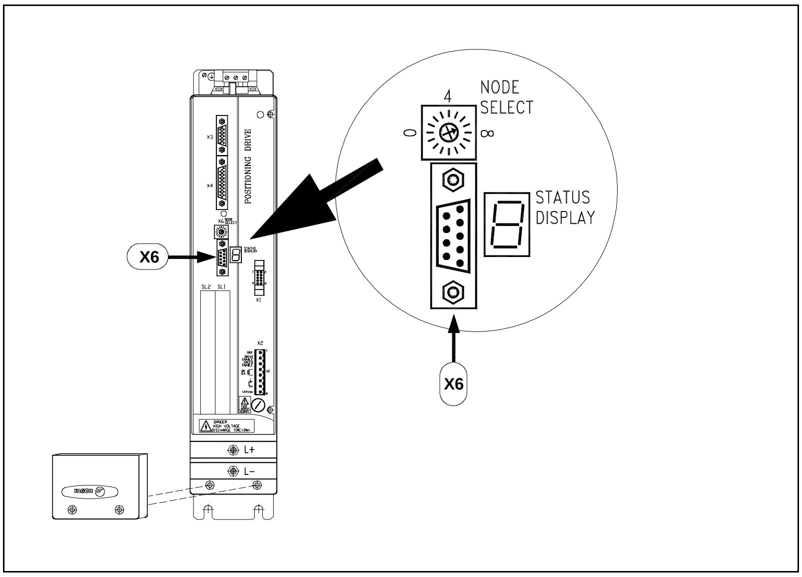


fig. 61 X6 connector of the MMC modular drive

Another possible option will be not to incorporate the X6 connector and use the X5 connector for the RS-232 serial communication and connector 3 for Sercos® interface.

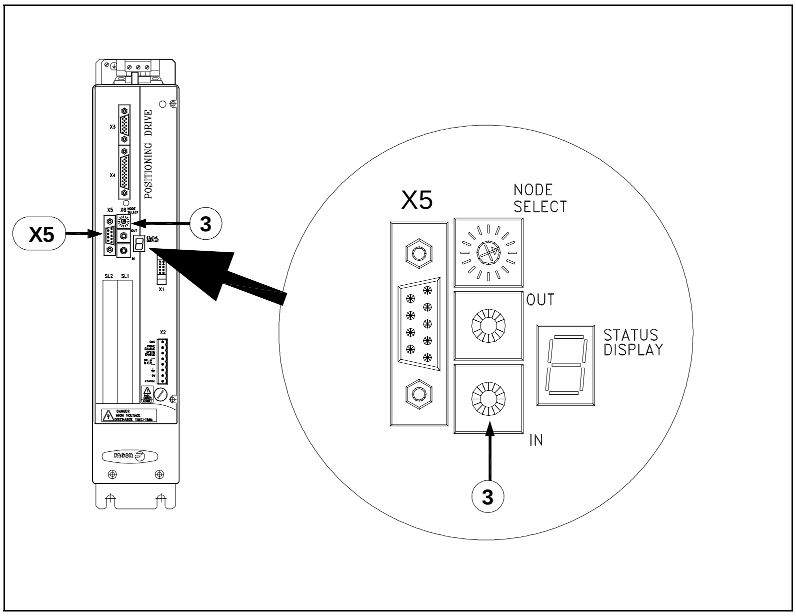


fig. 62 X5 connector & Sercos®interface of the MMC modular drive

Power connectors

The upper connectors are for connecting the motor.

The ground connection of the cable shields in made from the vertical plate next to the connectors.

The bottom connectors corresponds to the power bus input. The drive needs 456-800 Vdc which can vary depending on the mains voltage and the load. The power supply module is in charge supplying this voltage.

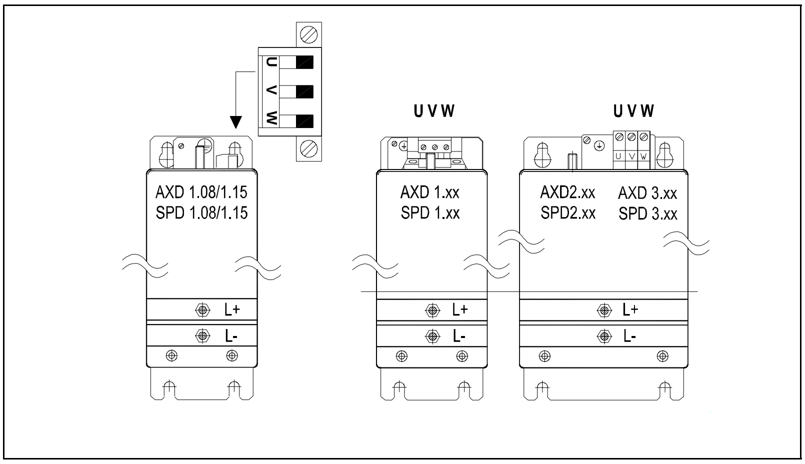


fig. 63 Power connector at the modular drives

2 plates are supplied with each module for this connection and another one for connecting the chassis with each other.

	AXD/SPD 1.08 / 1.15	AXD/SPD 1.25	AXD/SPD 1.35	AXD/SPD 2.xx	AXD/SPD 3.100	AXD/SPD 3.150	SPD 3.200
Gap between terminals (mm)	7.62	7.5	8.1	10.1	15.1	18.8	18.8
Max. tightening torque (N·m)	0.6	0.6	1	1.7	7	7	7
Maximum section (mm^2)	2.5	4	4	10	25	50	50

table 17 Power connector data

When connecting the drive module and its corresponding motor, connect terminal U of the drive module with the terminal corresponding to the U phase of the motor as well as terminals V - V, W - W and ground - ground.

Otherwise, it might not perform properly. The cable must have a metal shield which must be connected to the ground terminal of the drive and not to that of the motor in order to comply with EEC directives.

Before handling these terminals, proceed as follows:

1. Disconnect the mains voltage at the electrical cabinet.
2. Wait, before handling these terminals.

The power supply module takes about 4 minutes [depending on the number of elements connected] to bring the power bus voltage down to safe values (< 60 Vdc). The green **DC BUS ON** light off does not mean that we can handle the power bus.

Compact drive

There are compact drives specifically designed to control axes ACD and CMC[for synchronous motors] and spindles SCD [for asynchronous motors].

The Fagor compact drive has its own power supply and it can be connected directly to mains. Its behavior, functionally and parameters are the same as those of the modular drive.

General characteristics

See table 18.

Derating of the compact drives

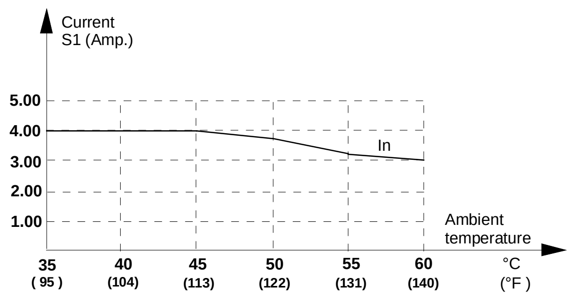
The following graphs show the maximum rms current in continuous duty cycle offered by the various compact drives depending on ambient temperature.

Fagor compact axis drives (synchronous motors) offer an rms current of up to 12.5 A on their "ACD 1.25" model and Fagor compact spindle drives (asynchronous motors) up to 17.75 A on their "SCD 1.25" model.

Note that the "ACD 2.xx and SCD 2.xx" models have been discontinued !

Axis compact drives:

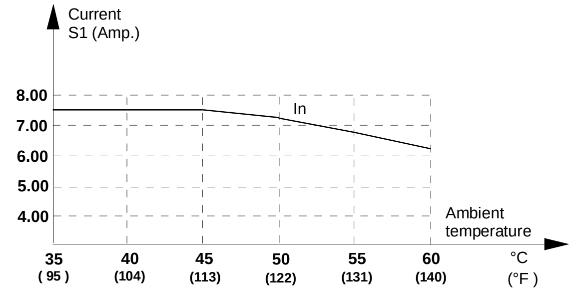
They can supply twice as much current for a maximum or 0.5 seconds, and always in cycles longer than 10 seconds.



ACD 1.08 & CMC 1.08

Tª amb		I_n
°C	°F	A_{rms}
35	95	4.00
40	104	4.00
45	113	4.00
50	122	3.75
55	131	3.25
60	140	3.00

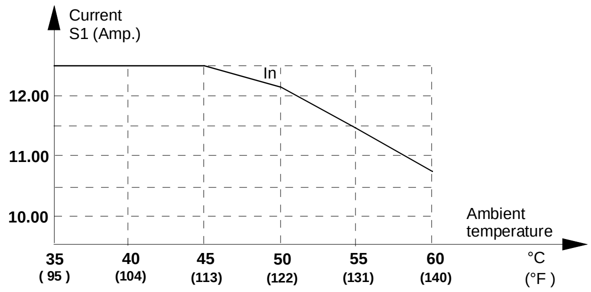
fig. 64 Derating graph of the compact drive: ACD - 1.08 & CMC 1.08



ACD 1.15 & CMC 1.15

Tª amb.		I_n
°C	°F	A_{rms}
35	95	7.50
40	104	7.50
45	113	7.50
50	122	7.25
55	131	6.75
60	140	6.25

fig. 65 Derating graph of the compact drive: ACD - 1.15 & CMC 1.15

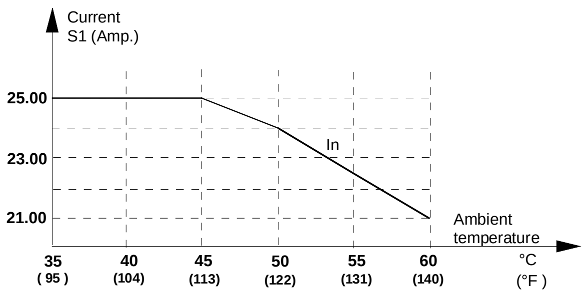


ACD 1.25 & CMC 1.15

Tª amb.		I_n
°C	°F	A_{rms}
35	95	12.50
40	104	12.50
45	113	12.50
50	122	12.20
55	131	11.50
60	140	10.75

fig. 66 Derating graph of the compact drive: ACD - 1.25 & CMC - 1.25

Discontinued

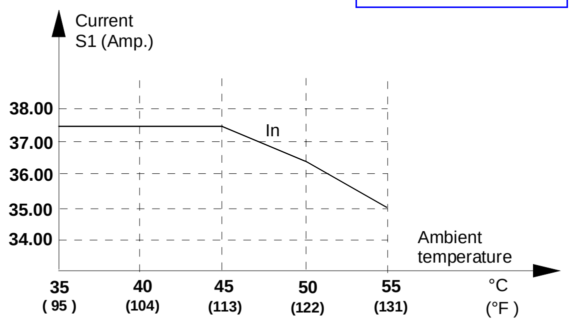


ACD 2.50 & CMC 2.50

Tª amb.		I_n
°C	°F	A_{rms}
35	95	25.00
40	104	25.00
45	113	25.00
50	122	24.00
55	131	22.50
60	140	21.00

fig. 67 Derating graph of the compact drive: ACD - 2.50 & CMC 2.50

Discontinued

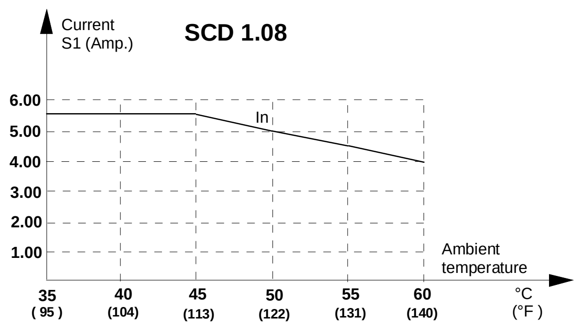


ACD 2.75 & CMC 2.75		
Tª amb.		I_n
°C	°F	A_{rms}
35	95	37.5
40	104	37.5
45	113	37.5
50	122	36.40
55	131	35.00

fig. 68 Derating graph of the compact drive: ACD - 2.75 & CMC 2.75

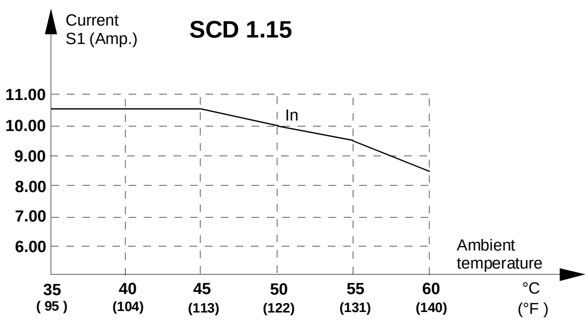
Spindle compact drives:

Compact models can provide the indicated rated current in any duty cycle.



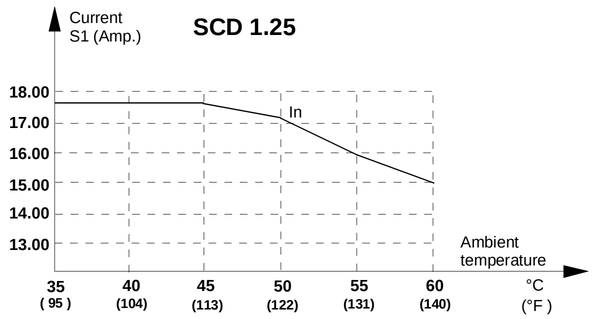
SCD 1.08		
Tª amb.		I_n
°C	°F	A_{rms}
35	95	5.60
40	104	5.60
45	113	5.60
50	122	5.00
55	131	4.50
60	140	4.00

fig. 69 Derating graph of the compact drive: SCD - 1.08



SCD 1.15		
Tª amb.		I_n
°C	°F	A_{rms}
35	95	10.60
40	104	10.60
45	113	10.60
50	122	10.00
55	131	9.50
60	140	8.50

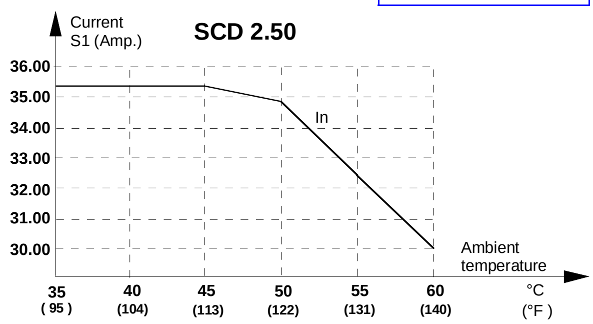
fig. 70 Derating graph of the compact drive: SCD - 1.15



SCD 1.25		
Tª amb.		I_n
°C	°F	A_{rms}
35	95	17.75
40	104	17.75
45	113	17.75
50	122	17.00
55	131	16.00
60	140	15.00

fig. 71 Derating graph of the compact drive: SCD - 1.25

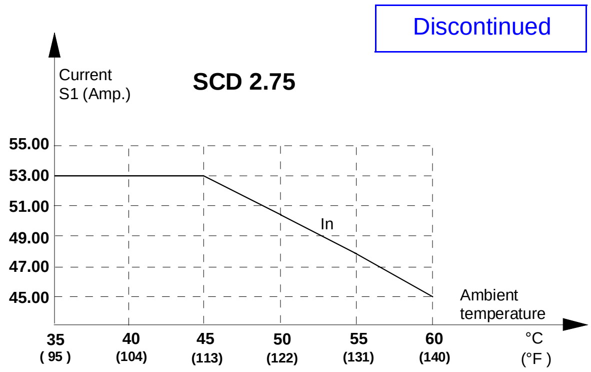
Discontinued



SCD 2.50		
Tª amb.		I_n
°C	°F	A_{rms}
35	95	35.40
40	104	35.40
45	113	35.40
50	122	35.00
55	131	32.50
60	140	30.00

fig. 72 Derating graph of the compact drive: SCD - 2.50

Discontinued

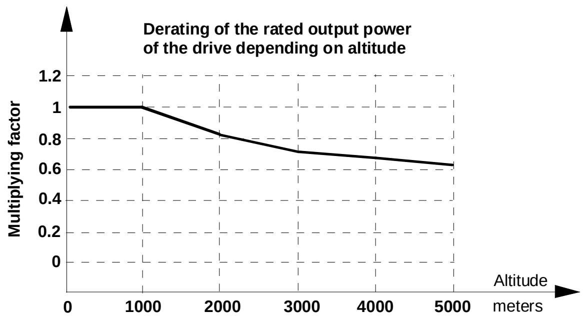


SCD 2.75		
Tª amb.		I_n
°C	°F	A_{rms}
35	95	53.00
40	104	53.00
45	113	53.00
50	122	50.40
55	131	47.90
60	140	45.00

fig. 73 Derating graph of the compact drive: SCD - 2.75

Power derating

The following graphs show the variation suffered by the output rated power of the compact drive (for all its models) depending on the installation altitude over sea level.



Output rated power radio	
Altitude (m)	**Multiplying factor (no units)**
0	1.00
1000	1.00
2000	0.82
3000	0.71
4000	0.65
5000	0.62

fig.74 Power derating depending on altitude.

	AXIS COMPACT DRIVE [note 1]		SPINDLE COMPACT DRIVE [note 2]	
	ACD / CMC 1.08	**ACD / CMC 1.15**	**SCD 1.08**	**SCD 1.15**
Rated current (A)	4	7.5		
Maximum peak current for 500 ms in cycles longer than 10 s	8	15		
Maximum current in any duty (note 3)			5.6	10.6
Power supply	Three - phase mains 50/60 Hz with a voltage range between 400 Vac -10% and 460 Vac +10%			
Internal power bus voltage	567.5 - 650 Vdc			
Filter capacity	330 µF - 900 Vdc			
Energy stored in the capacitors	$0.5\ C \cdot V^2$			
Internal Ballast resistor (.) **Power (W)**	75 (150)			
Energy pulse that can be dissipated (kWs) **Pulse duration (s)**	3.5 (0.40)			
Ballast circuit ON / OFF	768 Vdc / 760 Vdc			
Minimum external Ballast resistor [ohm]	75			
Feedback	Encoder / Resolver		Encoder	
Control method	PWM, AC Sinewave, Vector Control			
Communications	Serial line to connect to a PC or to the programming module			
Interface	Standard analog or digital via Sercos® (in all models) Serial line RS232/RS422 (only on CMC drives)			
Status display	7 - segments display			
Speed range with analog input	1 : 8192			

table 18 General characteristics of compact drives

Current bandwidth	800 Hz
Velocity bandwidth	100 Hz (depends on the motor / drive combination)
Protections	Overvoltage, overcurrent, overspeed, heat-sink temperature, ambient temperature, motor temperature, Ballast temperature, hardware error, overload. - See appendix E -

table 18 General characteristics of compact drives

	AXIS COMPACT DRIVE (note 1)		SPINDLE COMPACT DRIVE (note 2)	
	ACD / CMC 1.08	**ACD / CMC 1.15**	**SCD 1.08**	**SCD 1.15**
Power for internal circuits (24 Vdc)				
Input voltage (X1 connector)	Between 400 Vac -10% and 460 Vac +10% (50/60 Hz)			
Mains consumption	124.5 mA (400 Vac), 108 mA (460 Vac)			
Output voltage, maximum current	24 Vdc (5%), 100 mA (X2 connector , pins 1 and 2)			
Ambient conditions				
Ambient temperature	5 °C / 45 °C (41 °F / 113 °F)			
Storage temperature	- 20 °C / + 60°C (- 4°F / + 140°F)			
Maximum humidity	less than 95% non condensing at 45 °C (113°F)			
Vibration while running	0.5 G			
Vibration while shipping	2 G			
Sealing	IP 2 x			
Weigth kgr, (lb)	6.0 (13.2)			

table 19 General characteristics of compact drives

(Note 1) Drives for synchronous motors

(Note 2) Drives for asynchronous motors

(Note 3) This current must be equal to or greater than that of the corresponding spindle motor in S6

	AXIS COMPACT DRIVE (note 1)			SPINDLE COMPACT DRIVE (note 2)		
	ACD / CMC 1.25	**ACD/ CMC 2.50**	**ACD/ CMC 2.75**	**SCD 1.25**	**SCD 2.50**	**SCD 2.75**
Rated current (A)	12.5	25	37.5			
Maximum peak current for 500 ms in cycles longer than 10 s	25	50	75			
Maximum current in any duty (note 3)				19.6	35.4	53.0
Power supply	Three - phase mains 50/60 Hz with a voltage range between 400 Vac -10% and 460 Vac +10%					
Internal power bus voltage	567.5 - 650 Vdc					
Filter capacity	330 µF 800Vdc	705 µF 800 Vdc		330 µF 800Vdc	705 µF 800 Vdc	
Energy stored in the capacitors	0.5 $C \cdot V^2$					
Internal Ballast resistor (.) Power (W)	23 (210)	12 (240)	8.2 (240)	23 (210)	12 (240)	8.2 (240)
Energy pulse that can be dissipated (kWs) Pulse duration (s)	3.6 (0.45)	12 (0.70)	12 (0.50)	3.6 (0.45)	12 (0.70)	12 (0.50)
Ballast circuit ON / OFF	764 Vdc / 756 Vdc					
Minimum external Ballast resistor (.)	23	12	8.2	23	12	8.2
Feedback	Encoder / Resolver			Encoder		
Control method	PWM, AC Sinewave, Vector Control					
Communications	Serial line to connect to a PC or to the programming module					
Interface	Standard analog or digital via Sercos® (in all models) Serial line RS232/RS422 (only on CMC drives)					
Status display	7 - segments display					
Speed range with analog input	1 : 8192					
Current bandwidth	800 Hz					
Velocity bandwidth	100 Hz (depends on the motor / drive combination)					
Protections	Overvoltage, overcurrent, overspeed, heat-sink temperature, ambient temperature, motor temperature, Ballast temperature, hardware error, overload. - See appendix E -					

table 20 General characteristics of compact drives

	AXIS COMPACT DRIVE (note 1)			SPINDLE COMPACT DRIVE (note 2)		
	ACD/ CMC 1.25	ACD/ CMC 2.50	ACD/ CMC 2.75	SCD 1.25	SCD 2.50	SCD 2.75
Power for internal circuits (24 Vdc)						
Input voltage (X1 connector)	Between 400 Vac -10 % and 460 Vac +10 % (50/60 Hz)					
Mains consumption	124.5 mA (400 Vac), 108 mA (460 Vac)					
Maximum voltage at the bus	780 Vdc					
Output voltage, maximum current	24 Vdc (5%), 100 mA (X2 connector, pins 1 and 2)					
Ambient conditions						
Ambient temperature	5 °C / 45 °C (41 °F / 113 °F)					
Storage temperature	- 20 °C / + 60°C (- 4°F / + 140°F)					
Maximum humidity	less than 95% non condensing at 45°C (113 °F)					
Vibration while running	0.5 G					
Vibration while shipping	2 G					
Sealing	IP 2 x					
Weigth kgr, (lb)	8.3 (18.4)	13.2 (29.3)		8.3 (18.4)	13.2 (29.3)	

table 21 General characteristics of compact drives

Notes 1, 2 and 3 correspond to the ones shown earlier.

Connectors of the compact drive

The next diagram shows the elements appearing on the front plate of the compact drive:

1. Power connectors for motor and mains connection. Access to the power bus.

1a. Connector for the external Ballast resistor [crowbar connector].

2. Fuses to protect the internal control circuit. Two 1 A [T] / 500 V slow fuses on the power supply lines.

3. Sercos® interface connectors.

4. Status Display. Shows the status information of the drive itself or the corresponding error code.

5. Compact drive status leds. Activation of the Ballast circuit, presence of power at the Bus and 24 Vdc available.

X1. Connector for the internal 24 Vdc power supply (two phase: 400 - 460 Vac).

X2. Connector for the basic control signals.

X3. Connector with two possible uses:

- as output of the encoder simulator.
- as input of the second feedback for the position loop.

X4. Connector for the motor feedback. Encoder or resolver.

X5. RS232 serial line connector

X6. RS232/RS422 serial line connector

(only for CMC drives).

SL1. Slot for cards: A1, 16DI-8DO and 8DI-16DO.

SL2. Slot for cards: 16DI-8DO and 8DI-16DO.

DDS PROG MODULE. Accessory for adjusting and monitoring the system, it can be mounted into the compact drive. Available upon request.

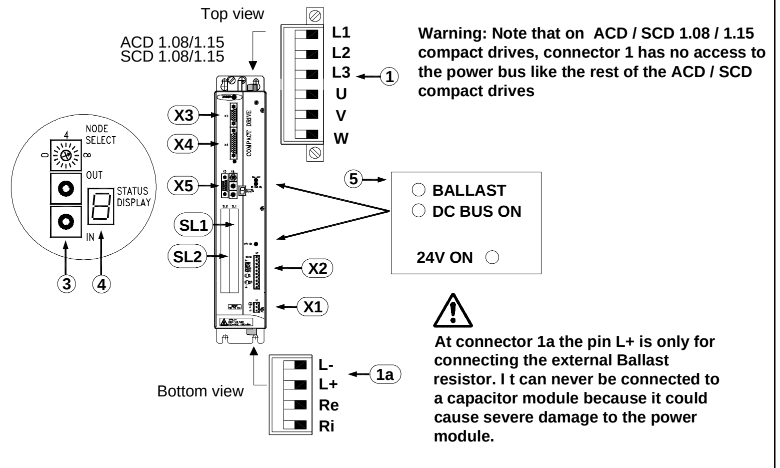


fig. 75 Connectors of the compact drive: ACD / SCD 1.08 / 1.15

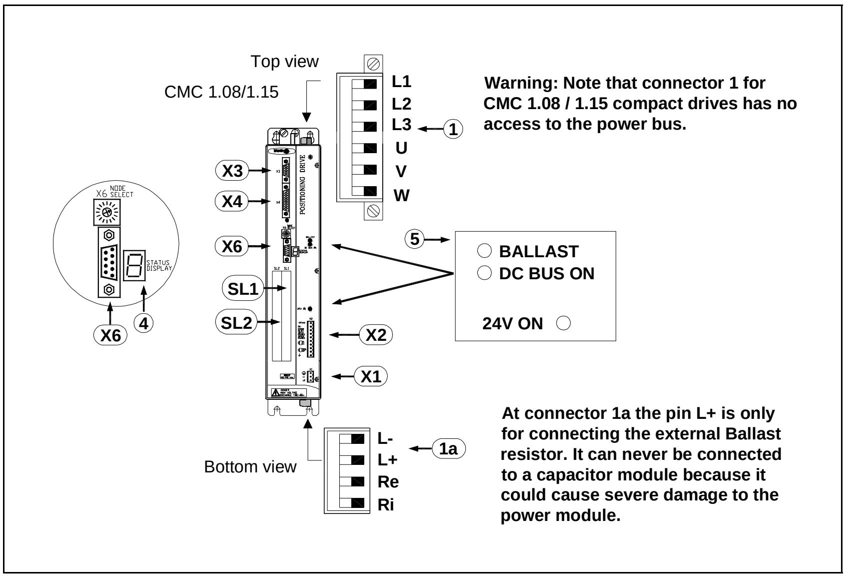


fig. 76 Connectors of the compact drive: CMC 1.08 / 1.15

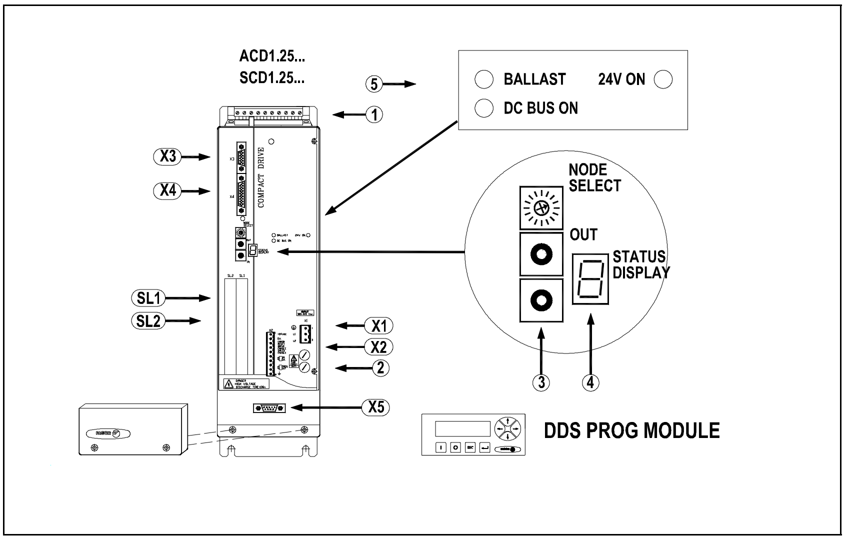


fig. 77 Connectors of the compact drive: ACD / SCD 1.25

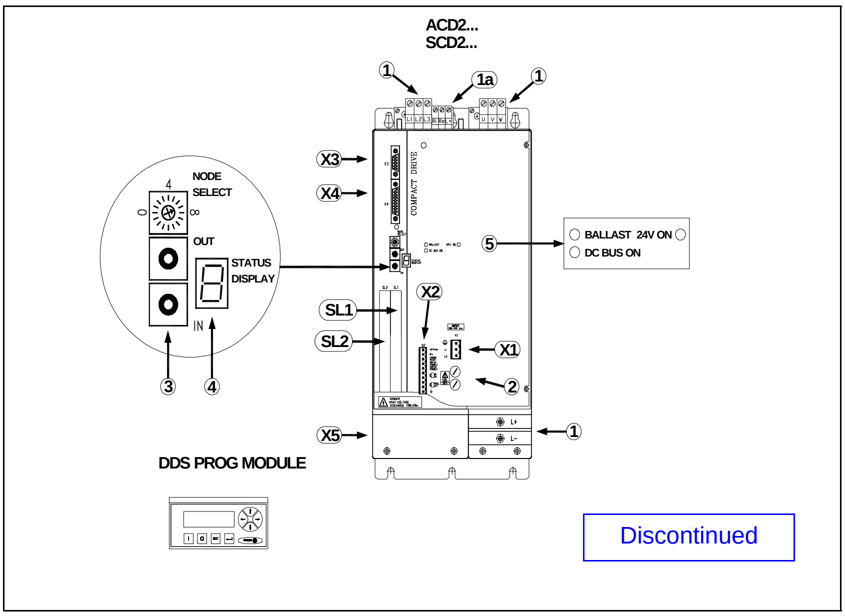


fig. 78 Connectors of the compact drive: ACD / SCD 2.xx

Power connectors

They are used for connecting the compact drive to mains (L1, L2, L3) and to the motor (U, V, W).

In the case of ACD /SC1.08 /1.15 drives only these connections are allowed through this connector. There is another connector at the bottom of the module to connect the external Ballast resistor.

Never use the L+ terminal to connect a capacitor module.

In the case of ACD / SCD 1.25 drives this top connector gives access to the power bus (L+, L-) and to the connection of the external ballast resistor. These terminals may also be connected to a capacitor module.

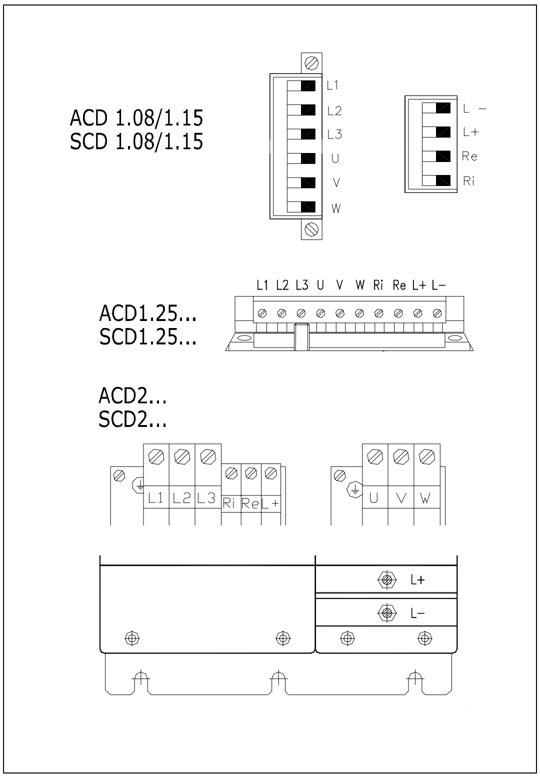


fig. 79 Power connectors

The ground connection of the cable shields is made from the vertical plate next to these connectors.

The ACD / SCD 2.xx drives provide the bus via the lower connector like modular drives.

2 plates are provided with each module to make this connection and another one for connecting the chassis to each other.

The following table shows the thread pitch and the fastening torque of the screws for both the power connector and the Ballast as well as the maximum section of their cables.

	ACD 1.08 / 1.15 SCD 1.08 / 1.15 POWER / BALLAST	ACD 1.25 SCD 1.25 POWER / BALLAST	ACD 2.xx SCD 2.xx POWER	ACD 2.xx SCD 2.xx BALLAST
Gap between terminals (mm)	7.62	8.1	12.1	10.16
Max. tightening torque (N·m)	0.6	1	2	1.6
Maximum section (mm^2)	2.5	4	16	10

table 22 Extra data of power and Ballast connectors

The equipment must be protected with fuses on the three-phase supply lines L1, L2 and L3.

Follow the instructions of the installation chapter 2.

When connecting an external Ballast resistor to the compact module, check that the ohmage of the resistor is equal to than of the internal Ballast resistor. See the characteristics table and the chapter 2 of the installation manual.

Therefore, the RM -15 must not be used with the compact drives.

When connecting the drive module with its corresponding motor, connect terminal U of the drive module with the corresponding U phase of the motor. same as terminals V-V , W-W and ground - ground. Otherwise, it will not run properly.

The cable hose must have a metallic shield which must be connected to the drive's ground terminal and not to that of the motor in order to comply with CE directives.

Before handling these terminals proceed as follows:

1. Disconnect the mains voltage at the electrical cabinet.
2. Wait before handling these terminals.

   The module needs time to bring the voltage at the power bus down to safe values (< 60 Vdc). The fact that the green **DC BUS ON** light is off does not mean that it is safe to handle the power bus. The discharge time depends on the number of elements connected to this Bus and it is approximately 4 minutes.

Terminals R_i, R_e y L+ are used for configuring the Ballast circuit which dissipated the energy generated when braking the motors.

By jumpering the terminals (R_i y L+), the system is configured so as to work with the internal resistor of the compact drive module.

Up to 45 °C (113°F), this internal resistor dissipated the power indicated in the previous characteristics table.

It also incorporates a protection against overtemperature which issues an error 301 when reaching 105 °C (221°F).

By removing this jumper (R_i y L+) an external resistor may be connected between R_e y L+ which will then dissipate the energy.

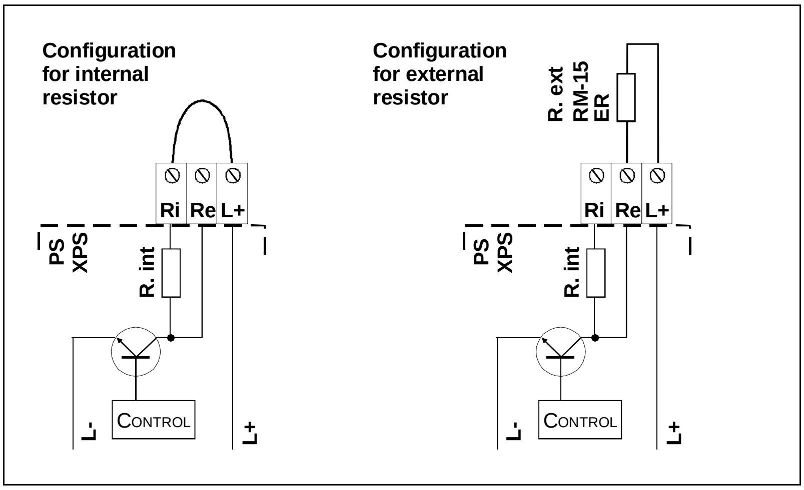


fig. 80 Ballast resistor configurations

The following graphs show the power derating of the compact drives:. On ACD / SCD 1.08 - 1.15 drives is 150 W for the full temperature range.

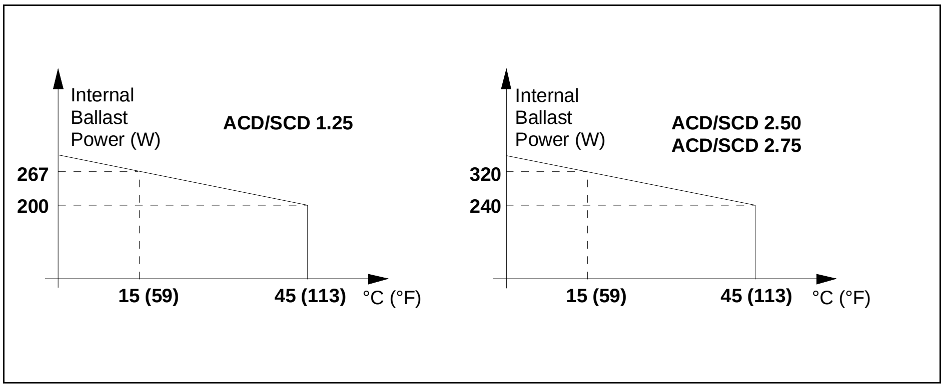


fig. 81 Power derating of compact drives

Connector X1

Compact drives internally generate the 24 Vdc necessary for the internal circuits. In regular operation, this voltage is obtained from the power bus and from mains when starting up the system.

The mains energy necessary for start - up is supplied via this three - prong Phoenix connector.

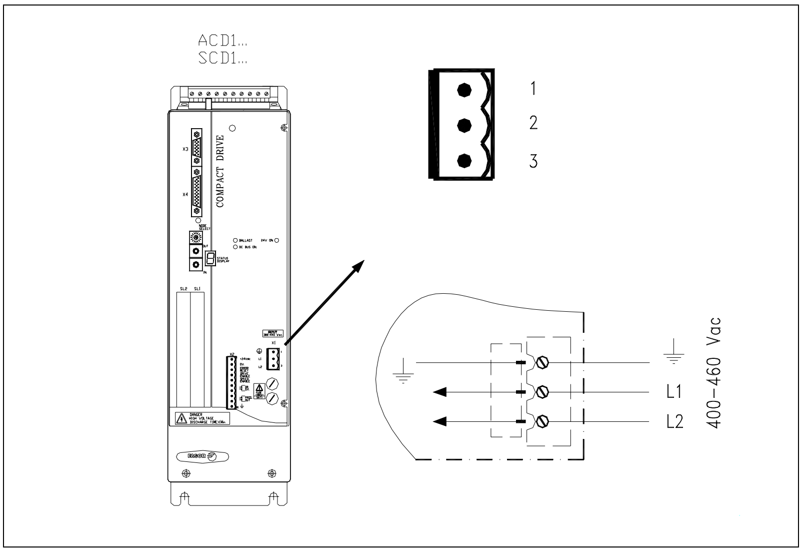


fig. 82 X1 connector

The start - up process needs an internal module test prior to supplying power to the upper terminals. Therefore, bear in mind the following warning:

Power from this internal power supply, through this connector X1, must be the very first thing to do before any other electrical maneuver.

Current from mains phases to these lines L1 and L2 must be obtained from a point before the contactor providing the three - phase power to the upper connectors of the compact drive. See sample schematic of an electrical cabinet on chapter 2.

The module is protected by 1 A fuses one per phase.

Status display

During the module start up, in order to check that all the display segments are operating correctly, this display shows the following information:

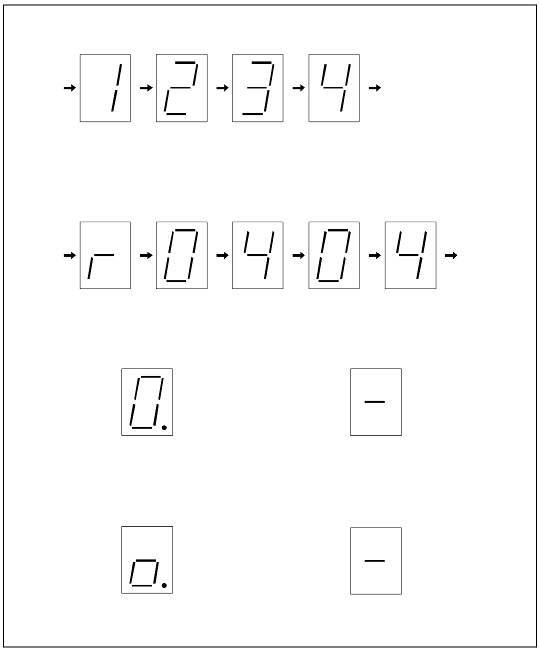


fig. 83 Status display

First, the display is seen completely off, and then it shows numbers 1, 2, 3 and 4 corresponding to the four initializing stages and, then, it will turn back off.

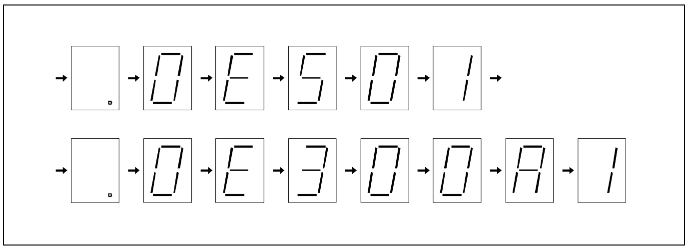
Then, the version of the software used by the modules is shown. First, the letter r (indicating the “release“ version), followed by the version number (digit by digit). When the drive is active and the axis is being governed, the display will show a zero with a blinking dot. While loading parameters, the display only shows the middle segment

From version 03.21 on: When a Sercos® drive is not in phase 4. In other words, that the CNC - drive communication has not fully initialized, the display shows a smaller 0.

If it is also blinking, it means that the light ring is not closed or there is too much distortion. This permits detecting which section of the optical fiber is causing the problem (or which drive is not sending light).

The drive displaying this blinking 0 is the one that is not receiving the light at its input. While loading parameters, the display only shows the middle segment.

Lastly, if there are any error messages or warnings, the display shows them as indicated by these two examples. The period resets the error and warning display.



Error 501 has occurred

Error 300 and warning 1

fig. 84 Error and warning sequences

See appendix B for the meanings of errors and warnings.

The system will not start running until all the errors detected at the drive have been eliminated. To eliminate these errors, their cause has to have disappeared and, then an " error reset " must be carried out. This reset may be carried out via X2 (1) of the power supply module, or pin X2 (3) of the compact drive.

There are errors indicated as non - resettable in appendix B and they cannot be removed by this method. Those non - resettable errors can only be removed by turning the unit off and back on provided their cause has been previously eliminated.

Sercos® connection

The IEC 1491 SERCOS® interface is an international standard for digital communications between CNC's and servo drives of CNC machines.

The Sercos® communications ring integrates several functions:

It carries the velocity command from the CNC to the drive in digital format with greater accuracy and immunity against outside disturbances.

It carries the feedback signal from the drive to the CNC.

It communicates the errors and manages the basic control signals of the drive (enables).

It allows setting, monitoring and diagnosis of the parameters from the CNC with simple and standard procedures.

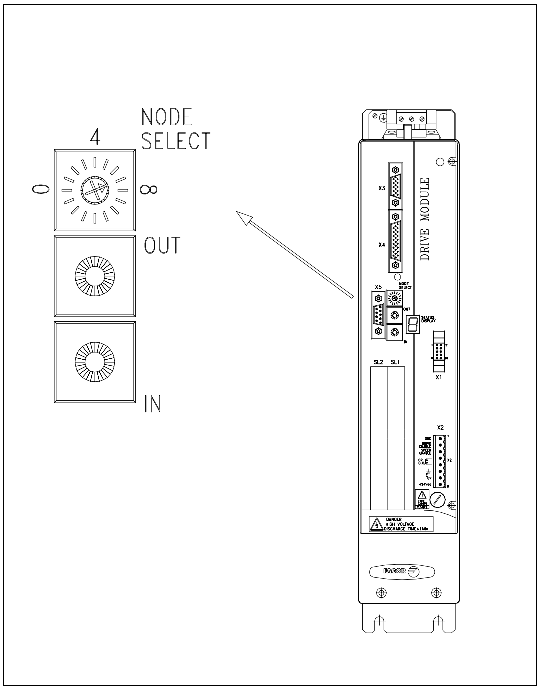


fig. 85 Sercos® connection

All this drastically reduces the hardware required at the drive, thus, making it more reliable.

Its open standard structure provides compatibility between CNCs and servo systems from different manufacturers on the same machine.

The bending radius oh the fiber optic cable must be more than 30 mm.

Connector X2, Control

Modular drive:

When the control circuit is supplied with 24 Vdc (pins 7 and 8) the drive runs an internal test.

If the system is ok, it closes the module status contacts (pins 4 and 5 " Drive Ok "). This contact stays closed while the drive is supplied with 24 Vdc and it runs properly.

To govern a motor, the drives also needs energy at the power bus.

The maximum internal consumption of the 24 Vdc supply input is 2 A for the bigger drives.

The internal circuits are protected by a 2.5 A fuse.

See the characteristics table of the previous sections.

With the "Drive Enable" and "Speed Enable" inputs (pins 2 and 3) together with the velocity command, it is possible to govern the motor. The consumption of these control signals is between 4.5 and 7 mA.

A later graph shows the behavior of the drive depending on the "Drive Enable" and "Speed Enable" inputs.

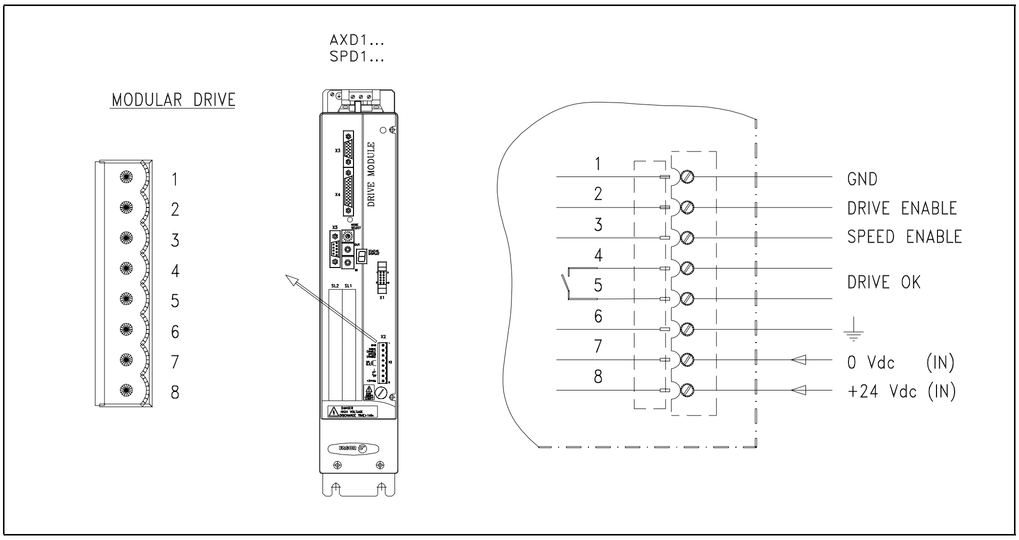


fig. 86 X2 connector of the modular drive

MODULAR DRIVE:			
1	GND	Control signals	Reference 0 V for control signals
2	DRIVE ENABLE		Through the motor current enable (24 Vdc)
3	SPEED ENABLE		Drive speed enable (24 Vdc)
4	DRIVE OK	Module status contact (it opens in case of failure). Limit: 1 A at 24 Vdc	
5	DRIVE OK		
6	CHASSIS	Chassis connection	
7	0 Vdc (IN)	Supply input for the control circuit	Reference 0 V
8	+ 24 Vdc (IN)		Positive voltage input (21 Vdc ... 28 Vdc)

table 23 Pinout of the X2 connector of the modular drive

Compact drive:

Integrates specific functions of the power supply and modular drives.

Specific of the power supply:

With the Error Reset input [pin 3], it possible to remove the errors at the compact drive. See appendix B, resettable errors.

When activated, (24 V) those errors are eliminated.

If the cause of the error persists, the status display will show the error again.

But if it is a major error, it can only be eliminated by powering the unit off and back on.

Pins 1 and 2 offer a 24 Vdc output for the user.

The maximum output current is 100 mA.

Specific of the modular drive:

Control signals. The "Drive Enable" and "Speed Enable" inputs (pins 4 and 5) together with the velocity command govern the motor. The consumption of these control signals is between 4.5 and 7 mA. The following page describes the behavior of the drive depending on these control signals.

The "Drive Ok" contact (pins 6 and 7) will stay closed as long as the compact drive runs properly.

Other functions:

The "Prog Out" contact (pins 8 and 9) is a user programmable output by means of the drive's internal parameter OP5 [F0144].

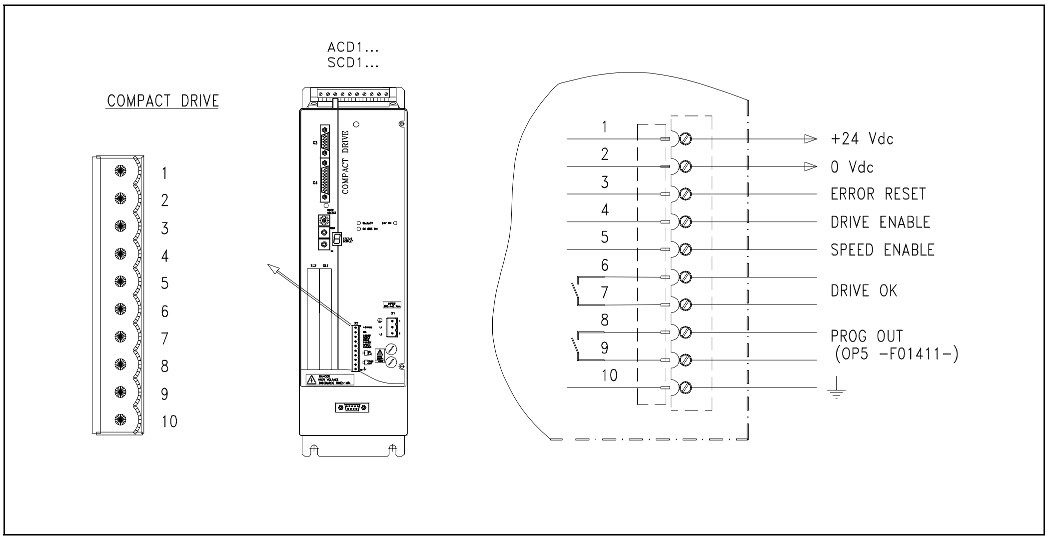


fig. 87 X2 connector of the compact drive

COMPACT DRIVE:			
1	+ 24 Vdc (OUT)	Internal power supply output	Positive voltage output (24 Vdc, 100mA)
2	0 Vdc (OUT)		0 V reference
3	ERROR RESET	System error reset input (24 Vdc) , (4.5 - 7 mA)	
4	DRIVE ENABLE	Control signals	Motor current enable (24 Vdc)
5	SPEED ENABLE		Drive speed enable (24 Vdc)
6	DRIVE OK	Module status contact (It opens in case of failure) Limit: 1 A at 24 Vdc	
7	DRIVE OK		
8	PROG OUR	Programmable internal contact Limit: 1 A at 24 Vdc	
9	PROG OUR		
10	CHASSIS	Chassis connection	

table 24 Pinout of the X2 connector of the compact drive

Speed Enable, Drive Enable

Normal operation mode:

1. Activate inputs Drive Enable and Speed Enable (24 Vdc). They may be activated in any order. Before doing go, the Soft Start process (smoothly reaching the power bus voltage) must be over. The torque at the motor will only be available when Drive_Enable is active and there is voltage at the power bus. The motor speed will be controlled by a velocity command when Speed_Enable function is active.

For activating the Drive_Enable function, the system must request it in three different ways: Electrical signal at connector X2, variable BV7 [F00203], and variable DRENA of the PLC when using the Sercos® interface. It could be deactivated through any of them.

2. The motor will respond to all analog command variations only while both inputs (Drive Enable and Speed Enable) are at 24 Vdc. If any of them is deactivated, the following will happen:

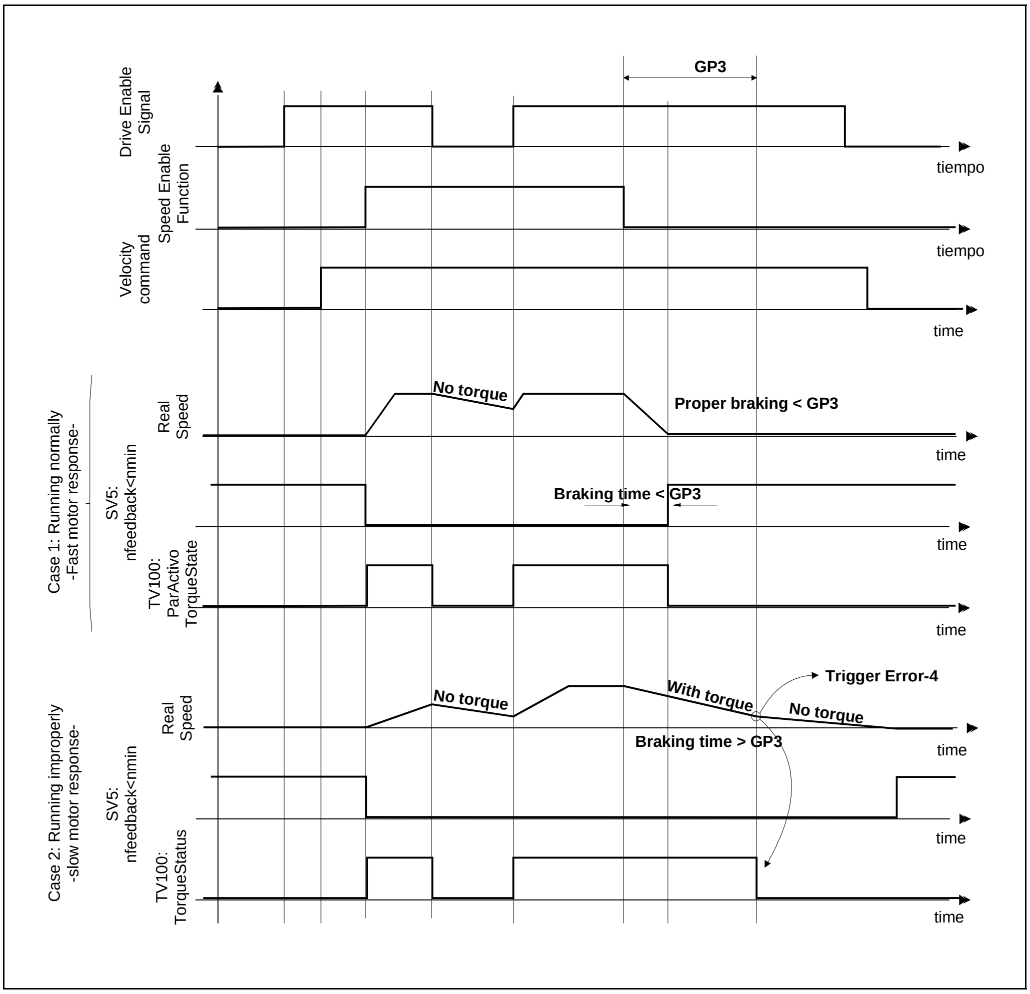


fig. 88 Operating modes

Deactivation of the Drive Enable input:

The Drive Enable input (pin 2) controls the current loop by hardware.

When it is powered with 24 Vdc the current loop is enabled and the drive can work.

If the Drive Enable input is set to 0 Vdc, the power circuit turns off and the motor loses its torque. In this situation the motor is no longer governed and will turn freely " stopping by friction ".

Deactivation of Speed Enable function:

When Speed Enable is set to 0 Vdc, lthe internal velocity command switches to 0 rpm and :

Case 1:

The torque is kept active by braking the motor.
When it stops, variable SV5 [S00331] is activated. The motor has stopped in a time period shorter than the one indicated by parameter GP3 [F00702]. The torque is canceled and the rotor is free.

Case 2:

The torque is kept active by braking the motor.
The motor does not stop in a time period shorter than the one indicated by parameter GP3 [F00702]. Error 4 is issued, the torque is canceled and the rotor is free. The motor stops when its inertia runs out (by friction).

GP3 [F00702] and SV5 [S00331] are internal parameters and may be consulted in appendix A of this manual.

Safety standards (EN-60204-1) require the drive module to have a software independent input in order to always assure that the motor will stop.

The Drive Enable input, using only hardware, can cancel the power circuit leaving it deactivated. This allows stopping even when the software fails.

In case of mains failure, the control circuit and its signals must maintain their 24 V_{dc} while the motors are braking.

On the modular drive 24 V_{dc} for supply and Drive_Enable activation must be provided by a power supply that can maintain it during that time. The power supplies PS-25B3 and PS-25B4, the auxiliary power supply APS 24 and the regenerative power supplies XPS meet this signals.

In the case of the compact drive, the 24 V_{dc} at pins 1 and 2 meets this requirement and are appropiate for managing the control signals.

Connector X3

This connector offers two possible configurations:

- encoder simulator
- direct feedback

X3. Encoder simulator

For the simulator, X3 is a high density 15 - pin sub - D type male connector whose pins are galvanically isolated from the rest of the drive.

It outputs square differential TTL pulses simulating those of an encoder that would be mounted on the motor shaft.

The number of pulses per turn and the position of the reference mark I_0 are programmable.

The parameter that set up the characteristics of this simulated encoder are:

EP1 [F00500], EP2 [F00501], EP3 [F00502] and EC1 [F00503].

The setting procedure is described in the chapter 4, and the parameters in appendix A of this manual.

The cable for connecting the encoder simulator to an 8055 CNC is supplied with the name of SEC and the one for connecting it to an 8040 CNC or an 8055i CNC with the name of SEC-HD and they are 25 meters long.

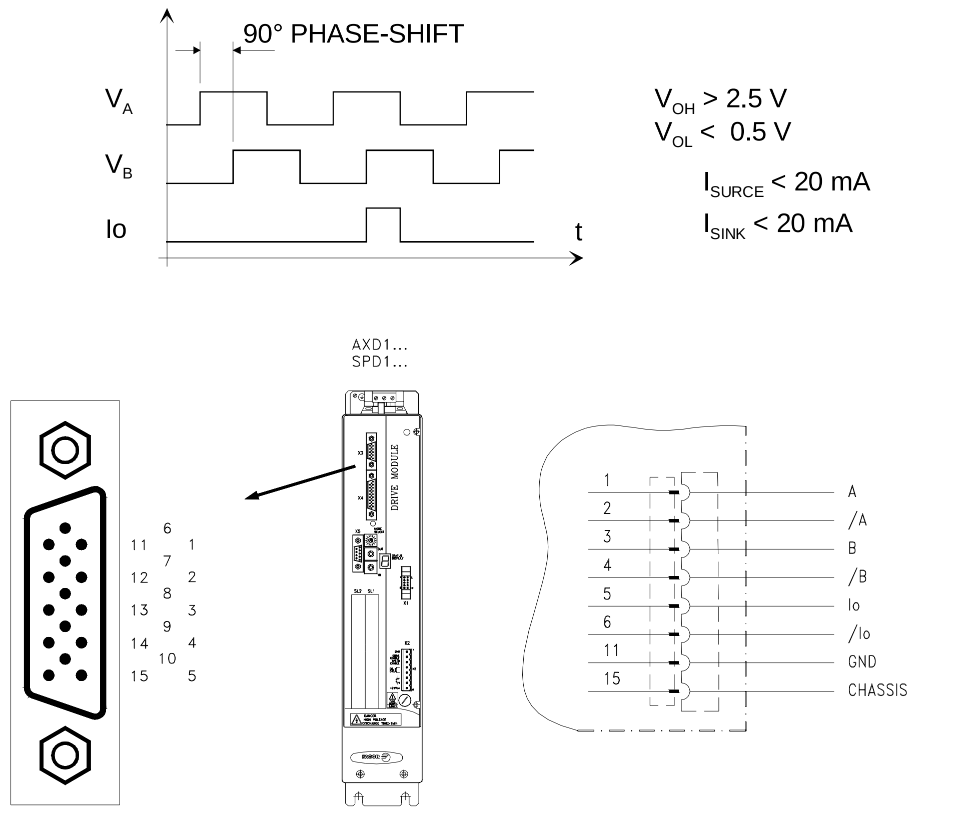


fig. 89 X3 connector, encoder simulator

X3. Direct feedback

For direct feedback, X3 is a high density 15 - pin sub - D type female connector.

This connector admits three different types of feedback signals:

- Square TTL signals
- Square differential TTL signals (double - ended)
- 1Vpp sinewave signals.

It admits the following frequencies:

- 1 MHz with square signals
- 500 KHz with sinewave signals

The input impedance for sinewave signals is 120 . .

◻ INCREMENTAL FEEDBACK:

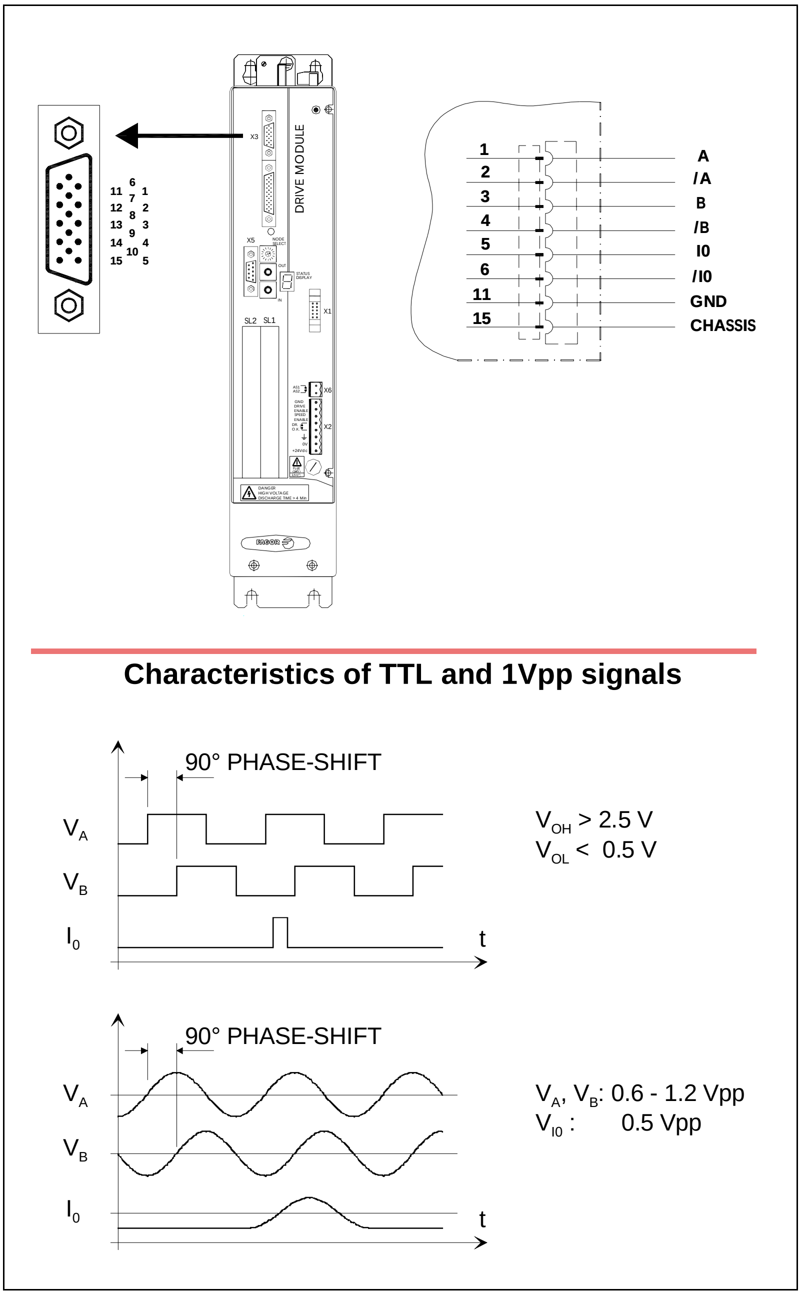
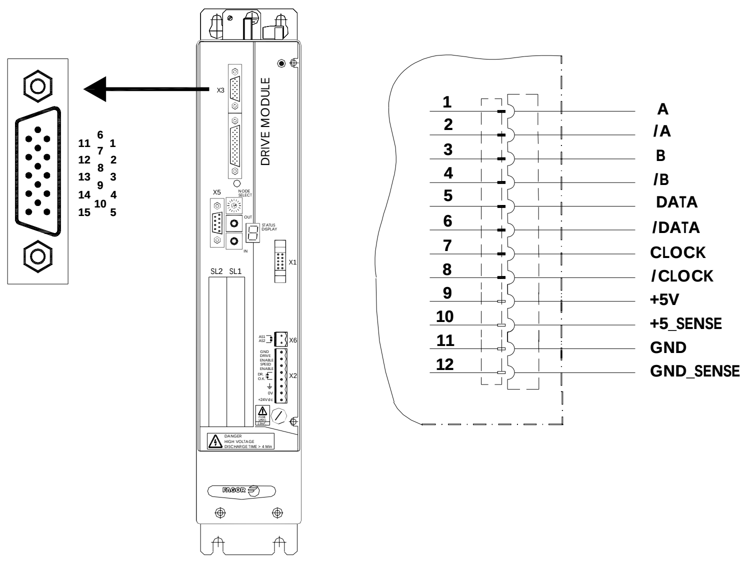
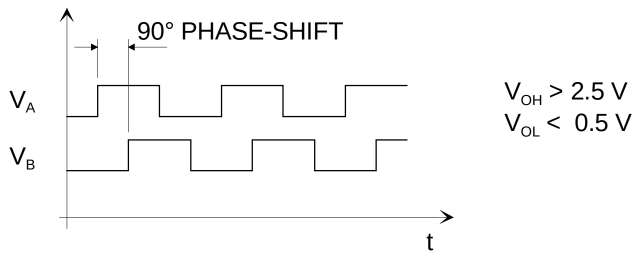


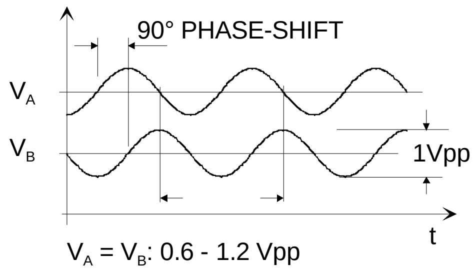
fig. 90 Connector X3. Incremental direct feedback.

☐ ABSOLUTE FEEDBACK: (SSI data interface).



Characteristics of TTL and 1Vpp signals



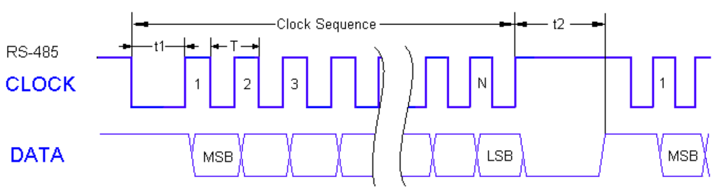


$V_A = V_B$: 0.6 - 1.2 Vpp

Centering < 6.5%

V_A / V_B ratio: 0.8 - 1.25 Vpp

Characteristics of the SSI signal



N = 32 bits

T = 1∝s = 10∝s

T1 > 1∝s

t2 = 20 - 35∝s

Logic levels, according to EIA RS-485

fig. 91 Connector X3. Absolute direct feedback.

Software involved:

Parameters:
AP1 [S32], GP10 [F719], PP115 [S115], NP117 [S117], NP118 [S118] indicate various aspects of the direct feedback.
If it is an absolute direct feedback with SSI interface (unidirectional), the following must also be considered:
RP60 [F2360], RP61 [F2361], RP62 [F2362] and RP63 [F2363].

The gear ratio between the motor and the ballscrew is indicated by: NP121 [S121], NP122 [S122] and NP123 [S123].

The transmission ratios between the direct feedback and the load movement are shown by parameters:
NP131 [F130], NP132 [F131] and NP133 [F132].

Connector X4, (motor feedback)

Connector X4 receives the signals coming from the feedback at the motor shaft.

The feedback on Fagor motors may be through a **sinusoidal encoder** or a **resolver**.

In either case, the signals must be taken to different pins using the connection cables EEC, EEC - SP and REC respectively.

Fagor supplies these cables with lengths of up to 50 meters.

X4 is high density 26 - pin sub-D type female connector.

General parameter GP2 [F00701] determines the type of sensor that the rotor has.

The parameter group R sets the features of the sensor.

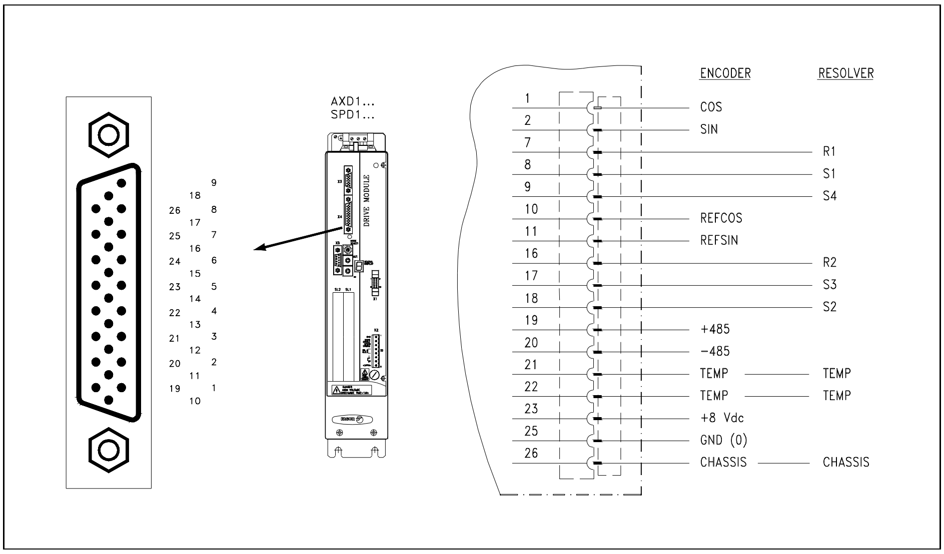
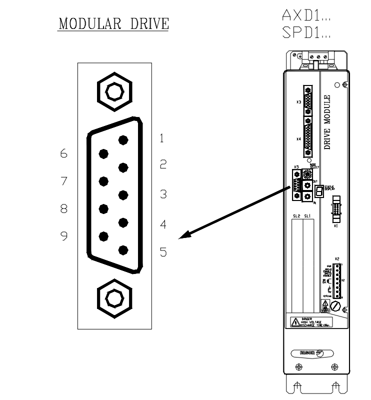


fig. 92 X4 connector, motor feedback

Connector X5, RS232 serial line

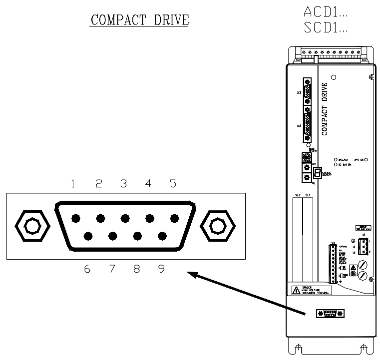
To set the configuration parameters and adjust the drive module, it may be connected to a PC, or the programming module DDS PROG MODULE. This conne X5.

It is a 9 - pin sub - D type male connector for serial line communications. It also offers the 5 Vdc supply for the programming module.



1		Not connected
2	R x D	Receive data
3	T x D	Transmit data
4	+ 5 V	Supply outputs
5	GND	Zero volts reference
6		Non connected
7		Reserved*
8		Non connected
9		Reserved*
chassis	chassis	Cable shield

* Reserved pins it be connected to anything



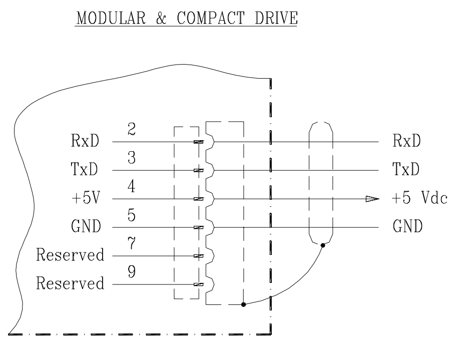


fig. 93 X5 connector, RS-232 serial line

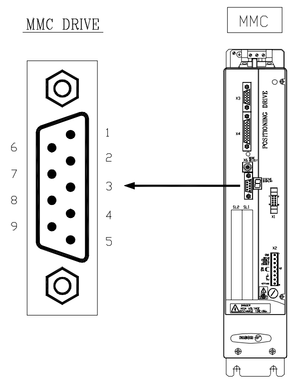
On positioning drives MMC and CMC, connector X5 is located in the same position as on the drives shown in the fig.93.

Connector X6, RS232 and RS422 serial line

Several CMC (Compact Motion Control) or MMC (Modular Motion Control) may be connected to each other through a device that will act as the master. This device is usually a PC or a video terminal ESA (VT).

Yhrough this 9 - pin male sub - D type X6 connector, the drive may establish communication with these devices.

See chapter 6 of this manual that describes the connection of this system in full detail.



1	-----------	Not connected
2	R x D 232	RS 232 line (receive data)
3	T x D 232	RS 232 line (send data)
4	+ 5 V ISO	Supply voltage output
5	GND ISO	0 V reference
6	T x D 422	RS 422 line (send data)
7	#T x D 422	
8	R x D 422	RS 422 line (receive data)
9	#R x D 422	
chassis	chassis	Cable shield

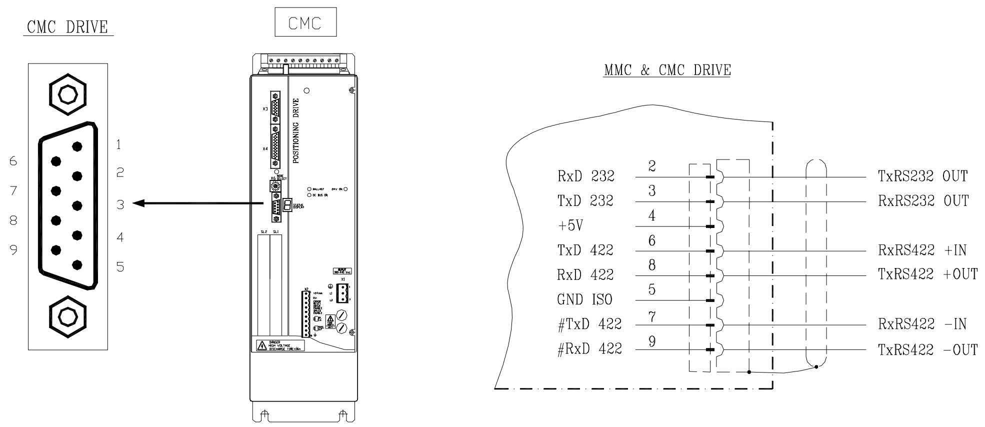


fig. 94 X5 serial line, RS-232 and RS-422 serial lines

Note that when there is a connector X6, there is no connector X5.

Conectors at SL1 and SL2

A1 card

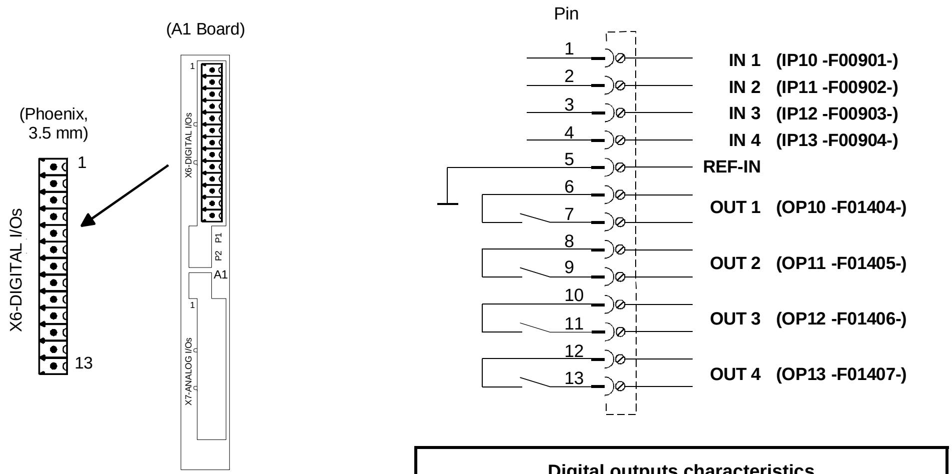
The A1 card must always be in SL1.

X6, digital inputs and outputs:

If offers 4 digital inputs and 4 digital outputs, all of them fully programmable. The digital inputs are optocoupled and referred to a common point (pin 5). The digital outputs are contact type and also optocoupled.

Wach input and output is associated with a parameter as shown in the fig.95.

The operator may assign internal boolean type variables to these parameters (for example: SV3 [S00332] , TV10 [S0333] , ...) in order to indicate the system status through electrical contacts. These variables are set by means of the monitoring program for PC through the DDS PROG MODULE.



Digital inputs characteristics	
Rated voltage [maximum]	24 Vdc [36 Vdc]
Turn on / off input voltage	18 Vdc [5 Vdc]
Typical consumption [max]	5 mA [7mA]

Digital outputs characteristics	
Maximum voltage	250 V
Maximum load current [peak]	150 mA [500 mA]
Maximum internal resistance	24 .
Galvanic isolation voltage	3750 V [1min]

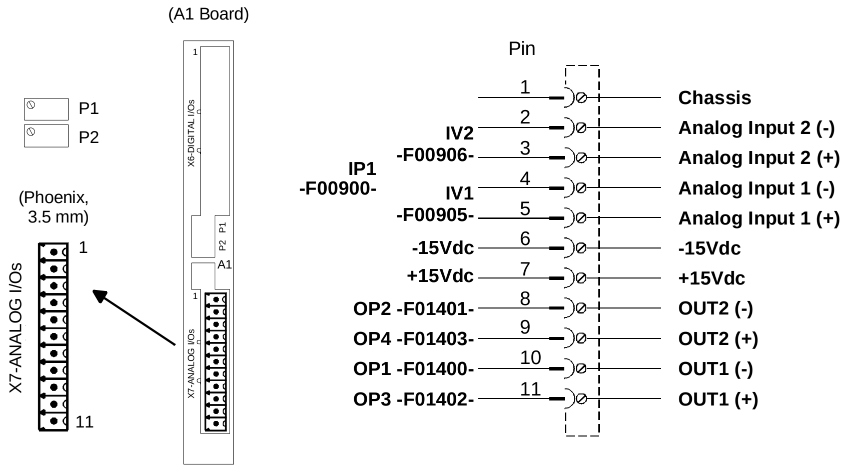
fig. 95 "A1: X6" card, digital inputs and outputs

X7, analog inputs and outputs:

It offers 2 inputs and 2 outputs , all of them fully programmable.

Each input and output is associated with certain parameters as indicated in the fig.96.

It offers a ±15V power supply for easily generating the command.



1	Chassis
2	Analog input 2 [-]
3	Analog input 2 [+]
4	Analog input 1 [-]
5	Analog input 1 [+]
6	- $15V_{dc}$ output for adjustment [user]

7	+ $15V_{dc}$ output for adjustment [user]
8	Reference for analog output 2 [-]
9	Analog output 2 [+]
10	Reference for analog output 1 [-]
11	Analog output 1 [+]

fig. 96 "A1: X7" card, analog inputs and outputs

Analog input 1 (pins 4 and 5):

It is the usual input for the velocity command (±10Vdc) generated by the CNC.

The initial offset adjustment is made through parameter SP30 [F01603].

Later adjustment may be made with potentiometer P1.

Analog input 2 (pins 2 and 3):

This is an input for an auxiliary command.

The initial offset adjustment is made through parameter SP31 [F01604].

Later adjustments nay be made with potentiometer P2.

Variables IV1 [F00905] - AnalogInput1 and IV2 [F00906] AnalogInput2 register the value of these analog inputs at all times. Parameter IP1 [F00900] selects which of these inputs is considered by the drive as its velocity command.

Parameter SP20 [F00031] and SP21 [F00081] set the relationship between the voltage applied at the input and the velocity command it corresponds to. See chapter 4.

Analog inputs characteristics		
Resolution		1.22 mV
Input voltage range		±10 Vdc
Input overvoltage	Continuous mode	80 Vdc
	Transients	250 Vdc
Input impedance	With respect toGND	40 K.
	Between both inputs	80 K.
Voltage in common mode		20 Vdc

table 25 Analog input characteristics

Dip - Switches:

The status of the Dip-Switch [DS1, DS2] must not be changed by the operator.

Adjustment outputs (pins 6 and 7):

With these outputs and a potentiometer, the user can obtain a variable analog voltage for adjusting the servo system during setup.

The voltage, with no load, at these pins is ±15 Vdc .

fig.97 shows the electrical circuit necessary to obtain the reference voltage.

The table next to it shows the resistor values recommended for a Vref voltage range of about ±10 Vdc .

±10 V range	
Rext.	R'
1 k.	0 .
5 k.	820 .
10 k.	1.8 k.
20 k.	3.3 k.

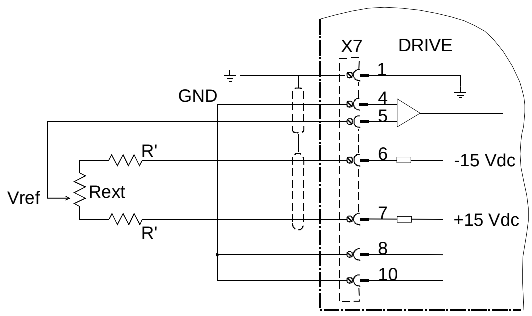


fig. 97 Adjustment outputs

Analog outputs (pins 8 -9 and 10 -11):

These outputs provide the status of the two internal system variables with an analog value. They are especially designed to continuously monitor those internal variables and to be connected to an oscilloscope thus facilitating system setup.

Note: if the output current is high, the voltage range may decrease.

The parameters controlling these analog outputs are OP1 [F01400], OP2 [F01401], OP3 [F01402] and OP4 [F01403]. The internal variables [speed reference, actual speed, torque,...] that can be associated with each one of the outputs are set by means of the monitor program for PC - Windows supplied by Fagor, DDSSetup. See chapter 4.

Analog outputs characteristics	
Resolution	4.88 mV
Voltage range	±10 Vdc
Maximum current	±15 mA
Impedance (respect to GND)	112 .

table 26 Analog output characteristics

Cards 8DI - 16DO and 16DI - 8DO

These cards may be located in SL1 and/or SL2.

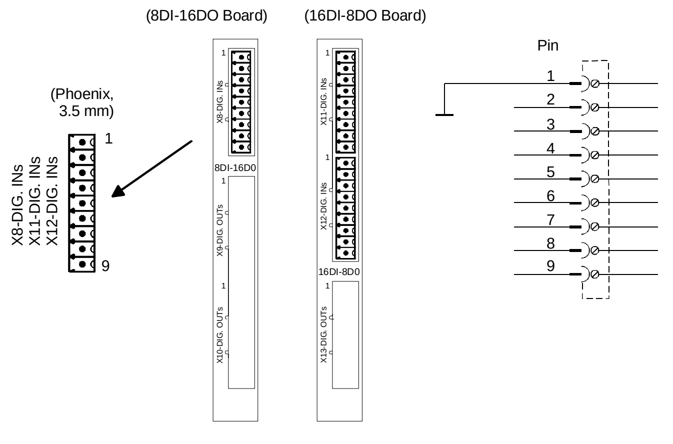
- 8DI-16DO offers to the user 8 digital inputs and 16 outputs
- 16DI-8DO offers to the user 16 digital inputs and 8 outputs

X8, X11, X12, digital inputs:

They offer 8 fully programmable digital inputs.

The digital inputs are optocoupled and referred to a common point (pin 1) and they admit digital signals at 24 Vdc. The four least significant bits of parameter IP5 [F00909] DigitalInputsVoltage determine this configuration for the input voltage.

Each input is associated with a PLC resource.



Characteristics of the digital inputs configured at 24 V	
Rated voltage (maximum)	24Vdc (40 Vdc)
Turn on / off input voltage	12 Vdc / 6 Vdc
Typical consumption (maximum)	5 mA (7 mA)

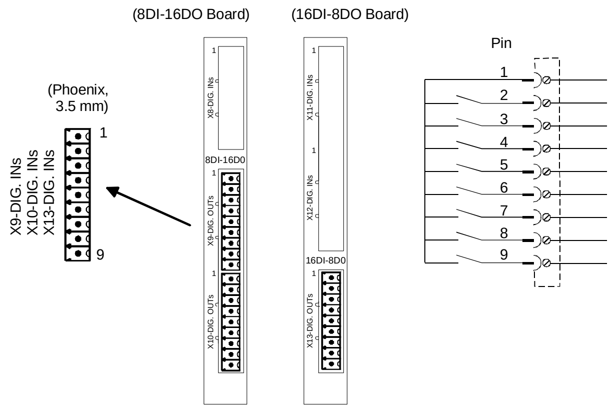
fig. 98 8DI -16DO and 16DI - 8DO: X8, X11, X12 cards, digital inputs

X9, X10, X13, digital outputs:

They offer 8 fully programmable digital outputs.

These outputs are optocoupled and of the contact type referred to a common point (pin 1).

Each output is associated with a PLC resource.



Digital outputs characteristics	
Maximum voltage	250 V
Maximum load current	150 mA
Current selflimitation	200 mA
Maximum internal resistance	20 .
Galvanic isolation voltage	3750 V (1 min)

fig. 99 8DI - 16DO and 16DI - 8DO: X9, X10, X13 cards, digital outputs

Numbering of the PLC resources on the cards

Inserting the cards in slots SL1 and SL2 permits all the possible combinations except for two A1 type cards.

At the PLC, the input / output resources can be named according to their location in SL1 and/or SL2:

- The card inserted in slot SL1 numbers the pins from I1 and O1 on.
- The card inserted in slot SL2 numbers the pins from I17 and O17 on.
- The resources are numbered from top to bottom.

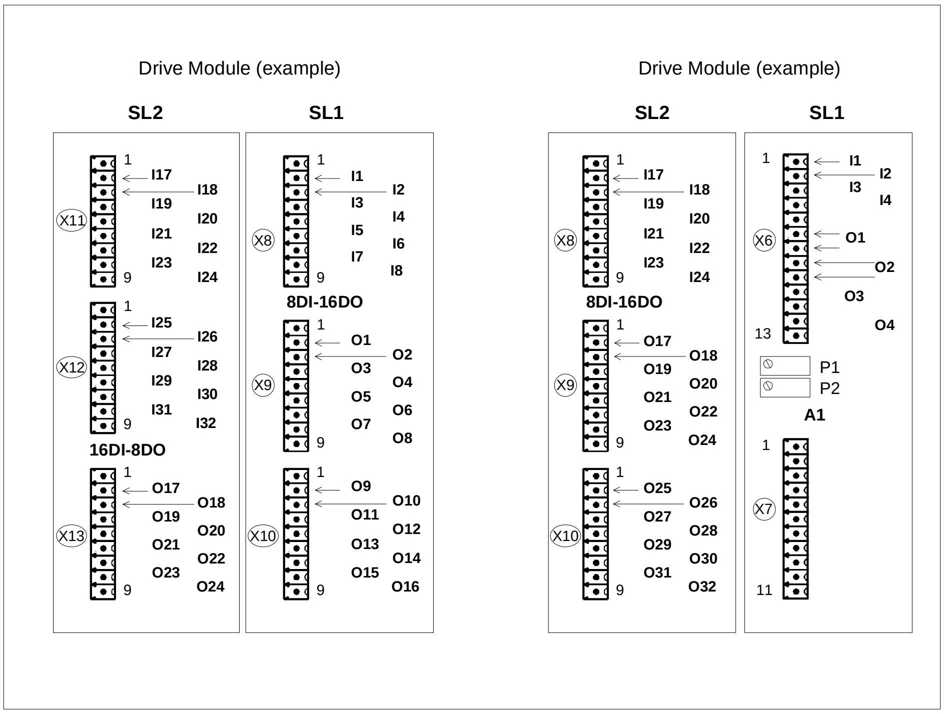


fig. 100 PLC resources on cards located in SL1 and SL2

Internal configuration

The following graphic is the internal diagram of the drive consisting of four basic blocks which are: position loop, velocity loop, current loop and rotor sensor loop.

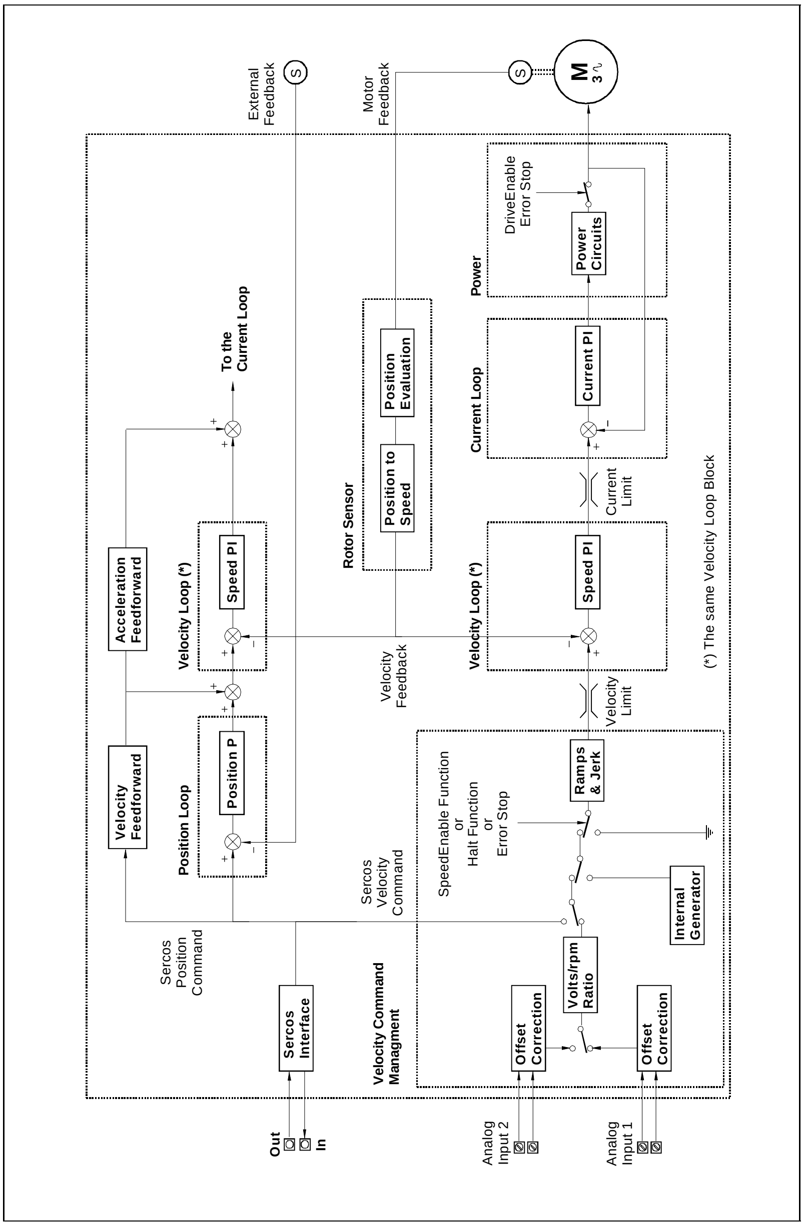


fig. 101 Internal drive configuration

FAGOR

DDS
Software
v.06.xx

SERVO DRIVE
SYSTEM MANUAL

ELECTRONIC MODULES

Aspects common to both modular and compact

Aspect common to AXD and ACD drives

All the considerations described in this chapter [electronic modules] up to this section for the AXD and ACD drives such as:

- Dimensions
- Overall characteristics
- Derating curves
- Cables and connectors
- Connections

correspond with their MMC (Modular Motion Control) and CMC (Compact Motion Control) equivalent .

Thus, for example, a modular AXD 1.08 drive has the same characteristics, derating curves, connectors, dimensions, connections,... as a modular MMC 1.08 drive.

Their differences are described in the next section.

Differentiating aspects of the AXD and ACD

Different characteristics:

- They are drives designed for Motion Control applications.
- They only work with software version 04.02 and later.
- They may have a connector X6 for RS-422 serial line communications from software version 4.02.

See section: X6 connector, RS232- RS422 serial line.

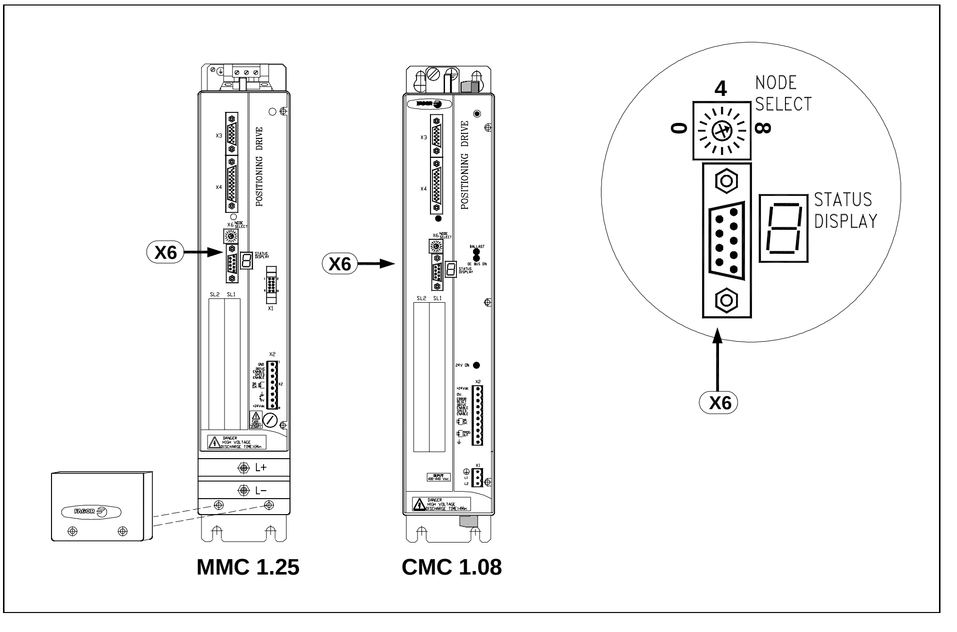
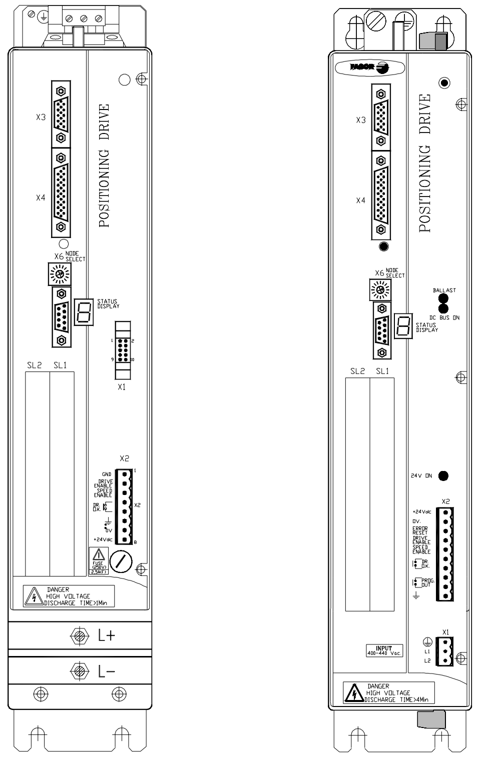


fig. 102 X6 connector - RS-422 serial line

• Their face plates indicate that they are positioning drive.



MMC 1.25 **CMC 1.08**

fig. 103 X6 connector - RS-422 serial line

Mains filter, DLC

In order to comply with European Directive 92/31/CE on electromagnetic compatibility, it is mandatory to insert a DLC mains filter (that replaces the previous EMK filter).

This filter must be connected between the mains and the servo drive system (modular or compact).

Its purpose is to reduce the conducted disturbances coming from the drive within the levels indicated by that directive and, at the same time, make it immune to transient burst type over-voltages or voltage pulses.

Technical characteristics:

	DLC 3042	DLC 3130
Rated voltage	3 phases: 380 - 480 Vac (50/60 Hz)	
Rated current	42 A	130 A
Approximate weight	2.8 kg (6.17 lb)	7.5 kg (16.53 lb)
Rated leak current	0.5 mA	0.75 mA
Maximum leak current	27 mA	130 mA
Power loss	19 W	40 W

table 27 DLC mains filters

¡ Discontinued !	EMK 3040	EMK 3120
Rated voltage	3 phases: 480 Vac (50/60 Hz)	
Rated current	40 A	120 A
Approximate weight	2.3 kg (5 lb)	11 kg (24.2 lb)
Rated leak current	0.5 mA	0.75 mA
Maximum leak current	27 mA	130 mA
Power loss	30 W	45 W

table 28 EMK mains filters (discontinued)

Characteristics of the connection terminals:

	DLC 3042	DLC 3130
Tightening torque (N·m)	1.5 | 1.8	6 | 8
Min / Maximum section (mm^2)	0.2 / 10 (rigid) 0.2 / 6 (flexible)	16 / 50 (rigid) 16 / 50 (flexible)

table 29 Technical data of the connection terminals of DLC mains filters

¡ Discontinued !	EMK 3040	EMK 3120
Pitch (mm)	10.1	15.1
Maximum tightening torque (N·m)	1.7	7
Maximum section (mm^2)	10	25

table 30 Technical data of the connection terminals of EMK mains filters.

The last section of this chapter shows its mechanical dimensions.

Note that this filter must be mounted near the drive.

Chapter 2 shows the installation rules that must be strictly followed.

Choke for an XPS power supply

When returning power to mains, the impedance of mains for the outgoing currents is very low. Thus, the up ramps of this current must be limited with a choke.

This choke is installed in the circuit in series with the returning line from the power bus to mains. To do this, it must be connected to the bottom power terminals of the XPS.

The internal switching mechanism of the XPS generates a regenerative current to mains which is filtered by this choke.

Fagor supplies the chokes that the XPS power supplies necessarily come with. The following table shows the characteristics of these chokes.

The last section of this chapter describes the mechanical dimensions.

	CHOKE XPS-25	CHOKE XPS-65
Inductance (10 KHz)	0.35 mH	0.35 mH
Rated current	50 A	120 A
Peak current	100 A	150 A
Max section cable	10 mm^2	50 mm^2
Operating ambient temperature	5°C to 45°C (41°F to 113°F)	
Storage temperature	- 20°C to 60°C (- 4°F to 140°F)	
Relative humidity	80% max.	
Operating vibration	0.5 G	
Shipping vibration	2G	
Sealing	IP20	
Weight	8 kg (17.6 lb)	23 kg (50.6 lb)

table 31 Chokes for XPS power supplies

The use of these chokes is a must for the proper operation of the XPS regenerative power supplies.

The length of the cable joining the choke with the power supply must never exceed 2 meters.

Resistor modules: RM -15, ER

These modules are designed for dissipating the energy excess at power bus when requiring a Ballast resistor with greater power than can be dissipated inside the power supply module. They do not need an external power supply.

Stackable module RM -15:

The module can be mounted on either side and it has a safety thermal switch. Next, the general characteristics of the module are described, its derating graph and the power connector data.

The last section of this chapter shows the module dimensions.

The PS-65A and XPS-65 must be connected to two RM-15 modules in parallel.

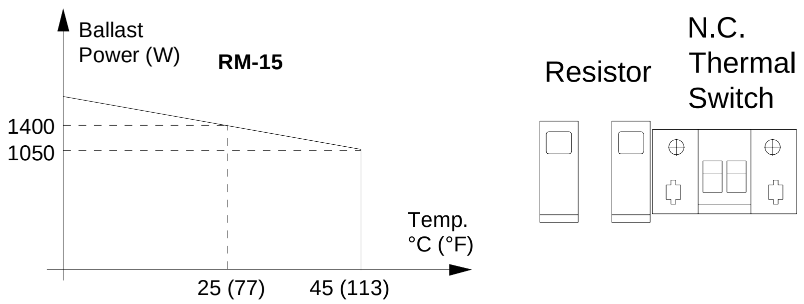
The PS-25A, PS-25B3, PS-25B4 and XPS-25 must be connected to a single RM-15 module.

The compact drives must never be connected to an only RM-15.

	RM -15
Resistance	18 .
RMS power	1480 W
Peak energy	72 kWs (1.2 s)
Operating ambient temperature	5°C to 45°C (41°F to 113°F) *
Storage temperature	- 20°C to 60°C (- 4°F to 140°F)
Thermal switch	Klixon NC, 140°C (284°F)
Relative humidity	< 90% non condensing at 45°C (113°F)
Operating vibration	0.5 G
Shipping vibration	2 G
Sealing	IP2x
Weight	4.6 kg (10.12 lb)

* It may reach 55°C (131°F) but with a 15 W/°C reduction in dissipated power

table 32 Characteristics of the resistor module: RM -15



	RM -15 power
Gap between terminals (mm)	8.1
Max tightening torque (N·m)	1
Maximum section (mm^2)	4

fig. 104 Derating and connection characteristics of the module: RM - 15

Independent resistors ER:

They are electrical resistors which may also be applied to the compact drives.

Here below may be found the general characteristics of these 5 models.

The last section of this chapter indicates their dimensions.

	ER-43/350	ER-24/750	ER-18/1100	ER-18/1800	ER-18/2200
Resistance	43 .	24 .	18 .	18 .	18 .
RMS power	300 W	650 W	950 W	1300 W	2000 W
Energy absorbed in overload	20 kJ	40 kJ	60 kJ	55 kJ	83 kJ
Operating ambient temperature	5°C to 45°C (41°F to 113°F)				
Storage temperature	- 20°C to 60°C (- 4°F to 140°F)				
Relative humidity	< 90% non condensing to 45°C (113°F)				
Operating vibration	0,5 G				
Shipping vibration	2 G				
Sealing	IP55			IP54	
Weigth	460 gr (1.01 lb)	920 gr (2.02 lb)	1250 gr (2.75 lb)	3000 gr (6.60 lb)	7000 gr (15.40 lb)

table 33 Characteristics of ER resistor modules

The rms power data is given for the following conditions: The resistor is mounted vertically, with the connection cables at the bottom and separated at least 10 cm from the closest surface.

The resistor surface may sometimes reach 375 °C [707 °F].

Ohmage:

The following table indicates how to combine resistors RM-15 and ER to obtain the Ohm value required for each power supply and compact module.

PS-25A **PS-25B4**	18 .	1.5 kW	RM-15
		950 W	ER-18/1100
		1.3 kW	ER-18/1800
		2.0 kW	ER-18/2200
XPS-25	18 .	1.5 kW	RM-15
		950 W	ER -18/1100
PS-65A	9 .	3 kW	RM-15 // RM-15
		1.9 kW	ER-18/1100 // ER-18/1100
		2.6 kW	ER-18/1800 // ER-18/1800
		4.0 kW	ER-18/2200 // ER-18/2200
XPS-65	9 .	3 kW	RM-15 // RM-15
		1.9 kW	ER-18/1100 // ER-18/1100
ACD 1.25 **SCD 1.25**	24 .	650 W	ER-24/750
ACD 2.50 **SCD 2.50**	12 .	1.3 kW	ER-24/750 // ER-24/750
ACD 2.75 **SCD 2.75**	9 .	3 kW	RM-15 // RM-15
		1.9 kW	ER-18/1100 // ER-18/1100

table 34 Required Ohm values

Capacitor module, CM 1.60

This module stores the energy returned while the motors are braking. Also, in systems sporadically demanding great peak currents from the power bus, it is recommended to install the capacitor module improving the capacity of the bus itself.

This module is connected in parallel to the power bus. Energy wise, it is more efficient than the resistor module.

Two plates are provided with each module for connecting it to the power bus.

The last section of this chapter shows the module dimensions.

	CM 1.60
Capacity	4 mF
Maximum bus voltage	797 Vdc
Operating ambient temperature	5°C to 45°C (41°F to 113 °F)
Storage temperature	- 20°C to 60°C (- 4°F to 140 °F)
Relative humidity	< 90% non condensing to 45°C (113°F)
Operating vibration	0.5 G
Shipping vibration	2 G
Sealing	IP2x
Weight	6.0 kg (13.23 lb)

table 35 Characteristics of the capacitor module: CM 1.60

Auxiliary power supply module, APS 24

The purpose of this module to generate the 24 Vdc needed by the power supply and drive modules to power the control circuits. This voltage is supplied through three identical connectors connected in parallel.

The APS 24 includes protections against overcurrent and overvoltage both at the input and at the output.

Using this power supply makes no sense in the case of compact drives or XPS power supplies, since they already offer these features.

The last section of this chapter shows the module dimensions.

	APS 24
Output voltage maximum current	24 Vdc (5%) , 10 A
Input voltage [single phase]	400 Vac (-10 %) - 460 Vac (+10 %) (50/60 Hz)
Mains consumption	0.72 A (400 Vac) 0.63 A (460 Vac)
Maximum inrush current	23.9 A (460 Vac)
Bus consumption	0.485 A (567.5 Vdc) 0.44 A (650 Vdc)
Maximum bus voltage	790 Vdc
Operating temperature	5°C to 45°C (41°F to 113°F)
Storage temperature	- 20°C to 60°C (- 4°F to 140°F)
Operating vibration	0.5 G
Shipping vibration	2 G
Sealing	IP2x
Weight	4.3 kg (9.46 lb)

table 36 Characteristics of auxiliary power supply module: APS-24

In case of microsurges or total mains power outage, this module guarantees the stability of the 24 Vdc for as the emergency stop of the motors lasts. This is an absolute must in order to comply with the CE requirement for the machine.

This auxiliary power supply has three LEDs to indicate the operating status.

- **RED LED 1:** Output OVER VOLTAGE. The power supply has exceeded 28 V_{dc} and it is not working.
- **RED LED 2:** Output OVER CURRENT. The power supply has exceeded 10 A and its output voltage is less than $24V_{dc}$.
- **GREEN LED :** Running ok. ON.

When the power supply quits working due to overvoltage, the module has push - button for system reset.

The last section of this chapter shows the module dimensions.

This APS 24 power supply is to be used to supply to the electrical control circuits and signals to run the drive.

It must never be used for the brake of a motor. The brake may generate voltage peaks that could damage the module.

Block diagram of the "APS 24" module

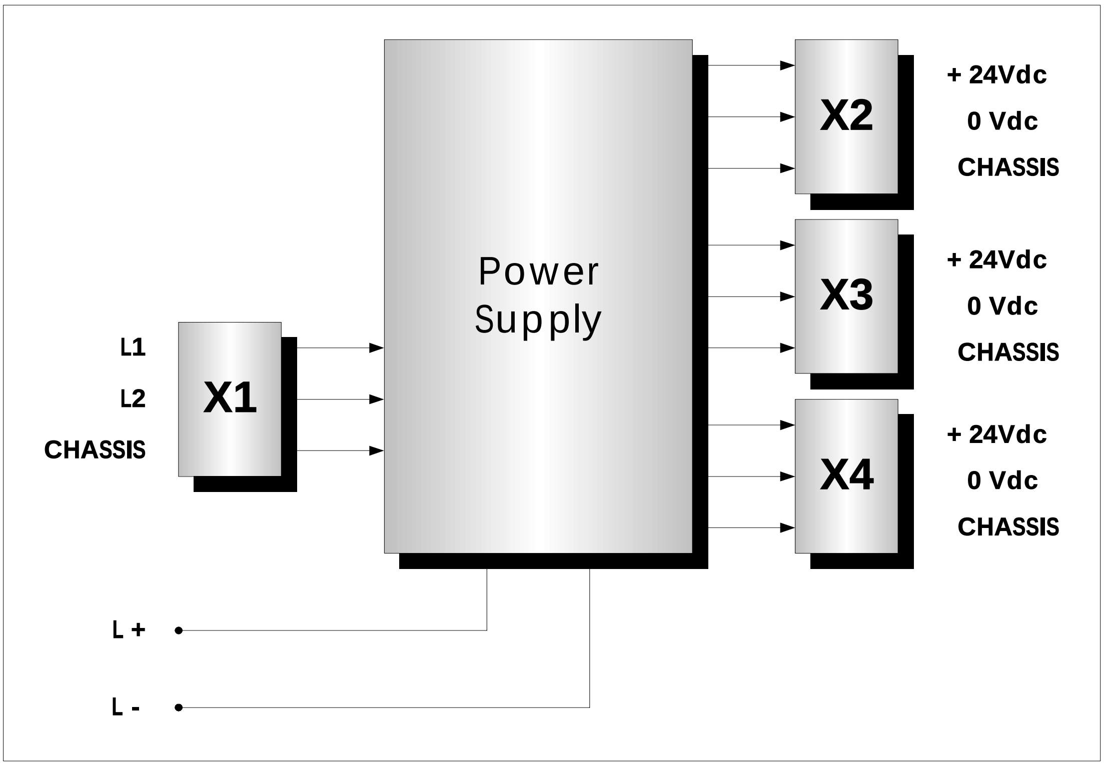


fig. 105 Block diagram of the "APS 24" module

APS 24 connectors

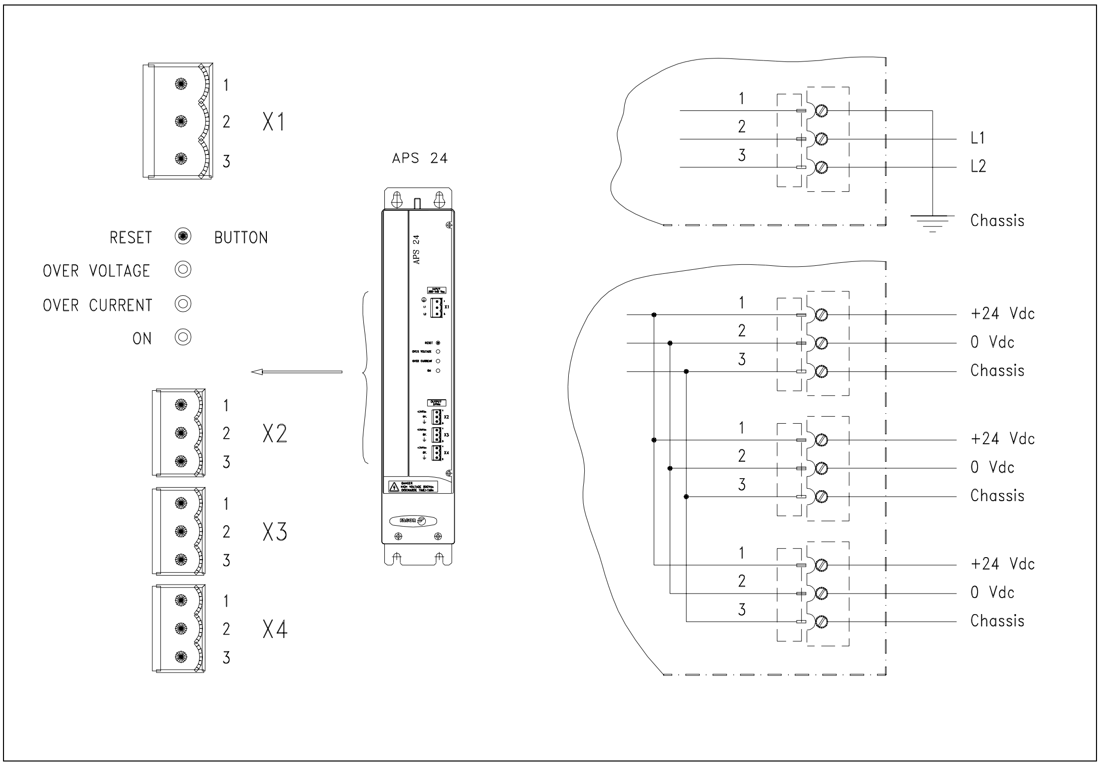


fig. 106 Connectors and LEDS of the "APS 24" module

Programming module, DDS PROG MODULE

The programming module is a small portable unit that could replace a PC for setting the parameters and monitoring the system.

It is connected to the drive module via the serial communications line. It can transfer parameters tables, edit them when setting them, execute commands, monitor internal variables and save that parameter table in its internal nonvolatile memory.

It can also be connected to a PC for transferring parameter tables.

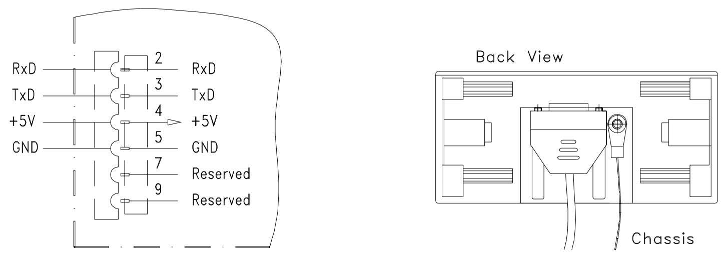
Its electrical installation is limited to the connection of that serial communications line since it receives the $+5V_{dc}$ supply through it.

It may be built into any of the compact modules ACD or SCD. It can be mounted inside the electrical cabinet onto (32 mm) or (35 mm) type metallic rails.

It can be shown on the outside of the enclosure using a front adapter supplied by Fagor and described in the last section of this chapter.

The last section of this chapter shows the module dimensions.

Electrical connections:



	DDS PROGRAM MOD
Operating ambient temperature	5°C to 45°C (41°F to 113°F)
Storage temperature	- 20°C to 60°C (- 4°F to 140°F)
Relative humidity	80% max
Operating vibration	0.5 G
Shipping vibration	2 G
Sealing	IP4x (IP5x front panel)
Weight	150 gr (0.330 lb)

fig. 107 Characteristics and connections of the DDS PROG MODULE

Power cables:

Fagor supplies the cables for transferring electrical power to the motors via three phases with a ground wire. Other cables include two thinner wires used to govern the brake on synchronous motors or for the connection of the thermal switch on the asynchronous motors.

The Fagor cables with their references and mechanical characteristics are:

Reference	Motor power cable section
MPC - 4 x 1.5	4 x 1.5 mm^2
MPC - 4 x 2.5	4 x 2.5 mm^2
MPC - 4 x 4	4 x 4 mm^2
MPC - 4 x 6	4 x 6 mm^2
MPC - 4 x 10	4 x 10 mm^2
MPC - 4 x 16	4 x 16 mm^2
MPC - 4 x 1.5 + [2 x 1]	4 x 1.5 mm^2 + [2 x 1 mm^2]
MPC - 4 x 2.5 + [2 x 1]	4 x 2.5 mm^2 + [2 x 1 mm^2]
MPC - 4 x 4 + [2 x 1]	4 x 4 mm^2 + [2 x 1 mm^2]
MPC - 4 x 6 + [2 x 1]	4 x 6 mm^2 + [2 x 1 mm^2]
MPC - 4 x 10 + [2 x 1]	4 x 10 mm^2 + [2 x 1 mm^2]
MPC - 4 x 16 + [2 x 1.5]	4 x 16 mm^2 + [2 x 1.5 mm^2]
MPC - 4 x 25 + [2 x 1]	4 x 25 mm^2 + [2 x 1 mm^2]
MPC - 4 x 35 + [2 x 1]	4 x 35 mm^2 + [2 x 1 mm^2]
MPC - 4 x 50 + [2 x 1.5]	4 x 50 mm^2 + [2 x 1.5 mm^2]

table 37 Motor power cables. References and sections

Type: Shielded (EMC compatible).

Flexibility: High. Special to be used in cable carrying chains with a bending radius of 10 times the Dmax under dynamic conditions and 6 times the Dmax under static conditions.

Covering: PUR. Polyurethane immune to the chemical agents used in machine tools.

Temperature: Working: - 20°C to +60°C (- 4°F to 140°F). Storage: - 50°C to +80°C (- 58°F to 176°F).

Work voltage: U_o / U: 600/1000 V.

Feedback cables:

Several cables are available to the user for connecting encoders, resolvers or encoder simulator boards. Their maximum length is 50 meters (164 ft). The attached table shows their names and availability:

Feedback cables						
Length		References				
		Encoder		Resolver	Encoder simulator	
1 m	(3.2 ft)				SEC-1	SEC-HD-1
1.25 m	(4.1 ft)	EEC-1A				
3 m	(9.8ft)	EEC-3			SEC-3	SEC-HD-3
5 m	(16.4 ft)	EEC-5	EEC-SP-5	REC-5	SEC-5	SEC-HD-5
7 m	(22.9 ft)	EEC-7				
10 m	(32.8 ft)	EEC-10	EEC-SP-10	REC-10	SEC-10	SEC-HD-10
15 m	(49.2 ft)	EEC-15	EEC-SP-15	REC-15	SEC-15	SEC-HD-15
20 m	(65.6 ft)	EEC-20	EEC-SP-20	REC-20	SEC-20	SEC-HD-20
25 m	(82 ft)	EEC-25	EEC-SP-25	REC-25	SEC-25	SEC-HD-25
30 m	(98.4 ft)	EEC-30	EEC-SP-30		SEC-30	SEC-HD-30
35 m	(114.8 ft)	EEC-35	EEC-SP-35		SEC-35	SEC-HD-35
40 m	(131.2 ft)	EEC-40	EEC-SP-40			
45 m	(147.6 ft)	EEC-45	EEC-SP-45			
50 m	(164 ft)	EEC-50	EEC-SP-50			

table 38 Feedback cables. References and lengths

For Sercos® connection:

Fagor Automation supplies the fiber optic cables for Sercos® communications between the group of drives and the CNC in lengths ranging from 1 to 25 meters. The cables between drives come with the connectors for each module.

OPTIC FIBER (SERCOS®)			
Length		References	
1 m	3.2 ft	SFO - 1	SFO - FLEX - 10
2 m	6.4 ft	SFO - 2	SFO - FLEX - 15
3 m	9.8 ft	SFO - 3	SFO - FLEX - 20
5 m	16.4 ft	SFO - 5	SFO - FLEX - 25
7 m	22.4 ft	SFO - 7	SFO - FLEX - 30
10 m	32.8 ft	SFO - 10	SFO - FLEX - 35
12 m	39.4 ft	SFO - 12	SFO - FLEX - 40
15 m	49.2 ft	SFO - 15	SFO - FLEX - 45
20 m	65.6 ft	SFO - 20	SFO - FLEX - 50
25 m	82.0 ft	SFO - 25	

table 39 Sercos® connection cables: References and lengths

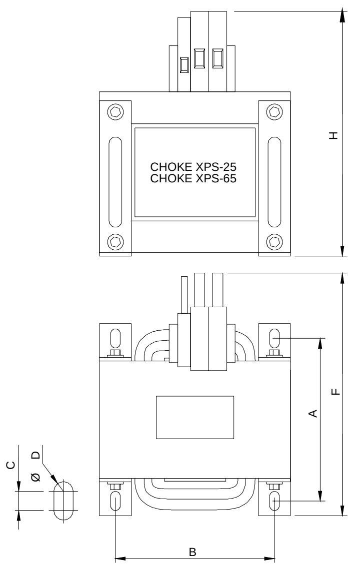
Note that on applications requiring certain flexibility (cable carrying chains), we recommend to use the SFO-FLEX-XX cables instead of the SFO-XX because the latter are more rigid.

Dimensions

When building an electrical cabinet, it must be borne in mind to leave enough room for cables and connectors.

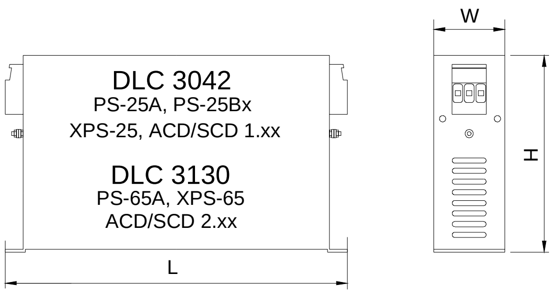
The upper power connectors may need up to 45 mm.

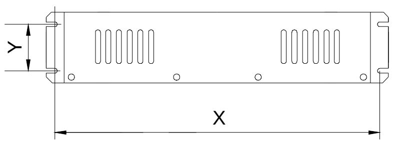
The units in the figure are in mm (inches).



	CHOKE XPS-25 mm	CHOKE XPS-25 pulg.	CHOKE XPS-65 mm	CHOKE XPS-65 pulg.
A	115	4.52	156	6.14
B	105	4.13	150	5.90
C	10	0.39	9	0.35
D	9	0.35	9	0.35
H	165	6.49	230	9.05
F	180	7.08	230	9.05

fig. 108 Dimensions of the XPS-xx chokes.

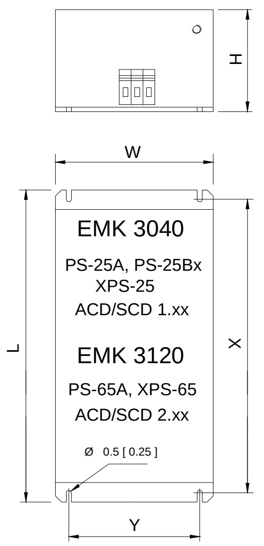




	"DLC 3042" FILTER mm	"DLC 3042" FILTER pulg.	"DLC 3130" FILTER mm	"DLC 3130" FILTER pulg.
L	330	12.99	440	17.32
W	70	2.75	110	4.33
H	185	7.28	240	9.44
X	314	12.36	414	16.30
Y	45	1.77	80	3.15

fig. 109 Dimensions of DLC mains filters.

Discontinued



	"EMK 3040" FILTER		"EMK 3120" FILTER	
	mm	pulg.	mm	pulg.
L	270	10.63	430	16.93
W	140	5.51	200	7.87
H	62	2.44	130	5.12
X	258	10.15	408	16.06
Y	106	4.17	166	6.53

fig. 110 Dimensions of EMK mains filters (discontinued).

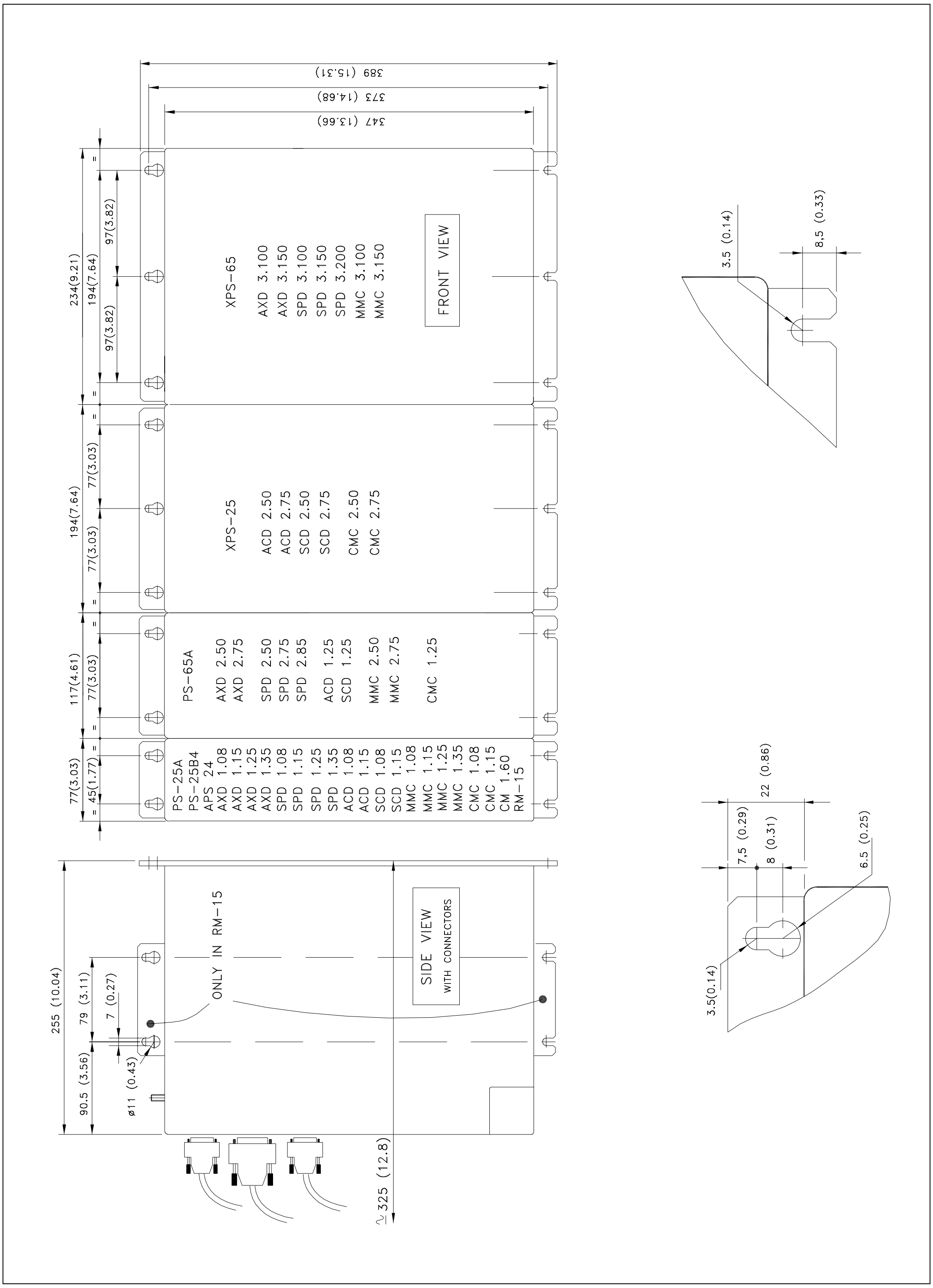
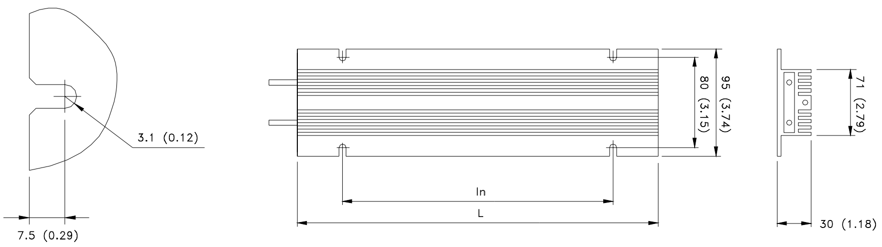


fig. 111 Dimensions of the power supplies, drive modules and other modules

	EXTERNAL RESISTOR "ER"		
	ER - 43 / 350	**ER - 24 / 750**	**ER - 18 / 1100**
In	60 (2.36)	140 (5.51)	240 (9.45)
L	110 (4.33)	220 (8.66)	320 (12.60)



	EXTERNAL RESISTOR "ER"	
	ER - 18 / 1800	**ER - 18 / 2200**
A	120 (4.72)	190 (7.47)
B	40 (1.57)	67 (2.63)
L	380 (14.94)	380 (14.94)
I	107 (4.21)	107 (4.21)
P	300 (11.80)	300 (11.8)

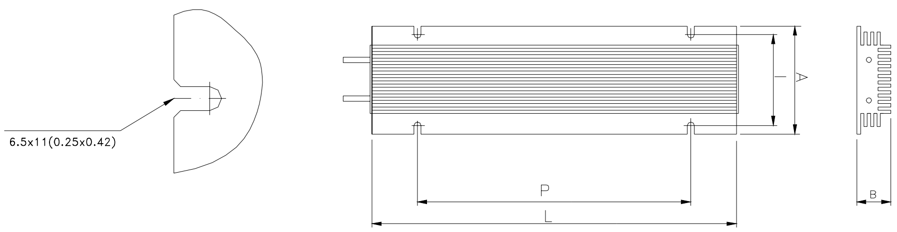


fig. 112 Dimensions of the external resistor "ER". Units in mm (inches).

Discontinued

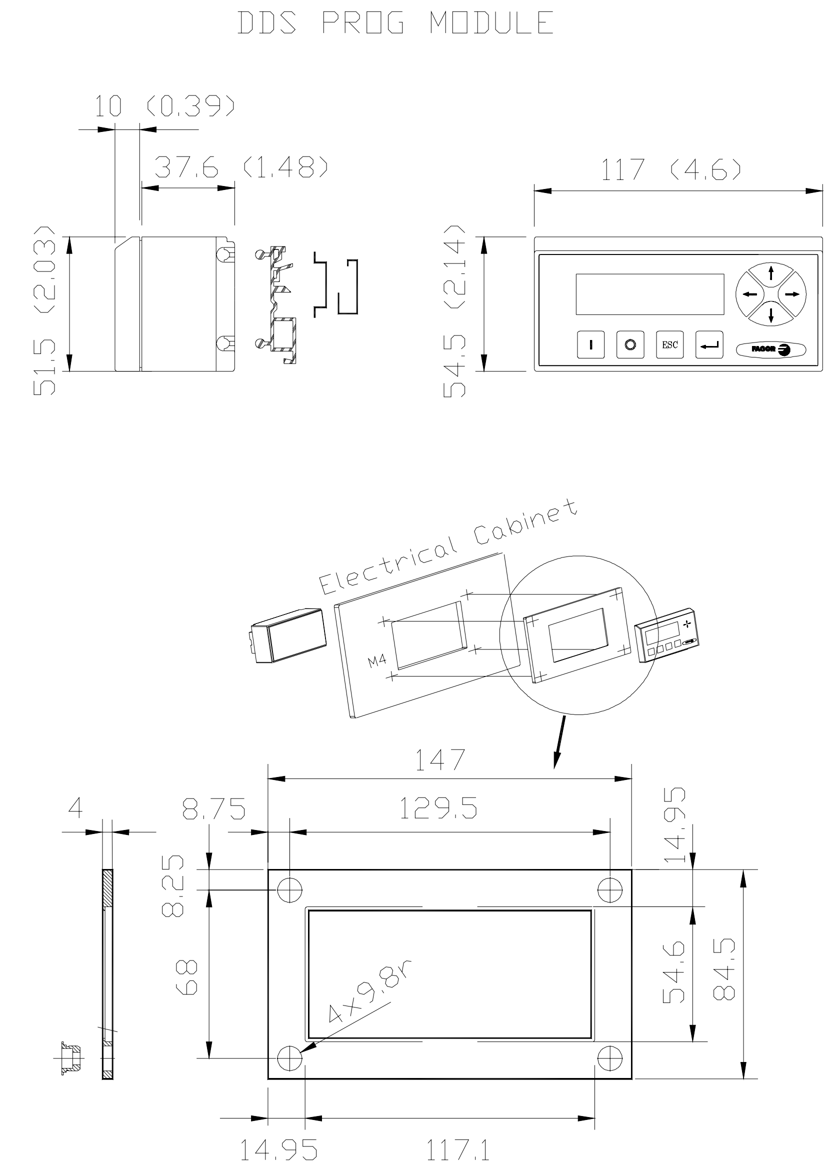


fig. 113 Dimensions of the "DDS PROG MODULE". Units in mm (inches).

Module identification

Each electronic module is identified by its characteristics plate. It indicates the model and its main technical characteristics.

WARNING: The user must make sure that the references indicated on the packing list of the order match those supplied by each module on its characteristics plate before making any connection to avoid any possible shipping errors !

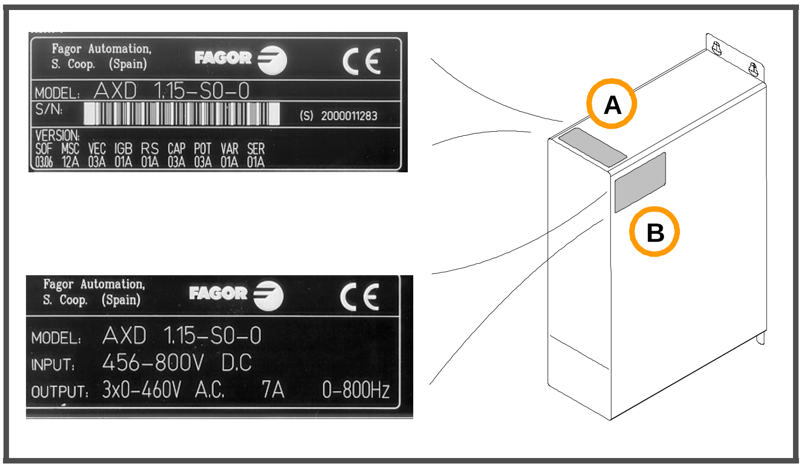


fig.114 Module identification plates.
A. Version label **B.** Characteristics plate.

The versions plate shows the hardware and software versions of the equipment. For example, the IGBT board mounted in this module has version 01A [IGB]; the software version is 03.06.

These two plates fully identify the module and must be referred to when repairing or replacing these units. They also help solve compatibility problems between versions.

The drive is also labeled on its package:

fig.115 Packaging label of the drive module.

User notes:

INSTALLATION

2

Introduction

Follow these steps for a complete system installation:

- Prepare the supports for the module in the electrical cabinet.
- Unpack and mount all the system modules in the electrical cabinet.
- Mount the mains filter in the cabinet.
- Electrical interconnection of the drive system.
    1. Power bus bars at the bottom of each module.
    2. Ground bars at the top and connection of the assembly to the ground connection.
    3. Internal bus between the modules powered by the same power supply and the power supply itself.
    4. Connection to the external Ballast resistor RM-15 or ER if applicable.
- Supply voltage. Connection with motors and the CNC.
    1. Cable hose from mains to the drive system through the filter.
    2. Power cable hose from each motor to each drive.
    3. Feedback cables from each motor to each drive.
    4. Circuit for the control of the brake.
    5. Power for the 24 Vdc auxiliary power supply from mains APS 24, XPS or PS-25Bx.
    6. Power the control circuits of each drive module with 24 V_{dc}.
- Control and communications signals.
    1. Encoder simulator cables from each drive to the CNC if applicable.
    2. Analog velocity command voltages from the (CNC) to each drive.
    3. Connection of the control signals of the modules, inputs and outputs.
    4. Sercos® connection.
    5. Identify each system drive with a rotary switch.
    6. Connect the modules and the CNC through the fiber optic.
- Adjust the modules through the serial line.

In order for the Fagor Servo System to meet the European Directive on Electromagnetic Compatibility 92/31/CE , the modules installation rules must be strictly followed regarding:

- The mounting of the filter to mains
- Electrical installation of the power stage
  - Wiring to mains
  - Power connection motor - drive

Securing all the elements

A. Prepare the fixtures in the electrical cabinet. See chapter 1, section on dimensions.

B. Unpack the system motors and modules.

C. Mount each of the motors on the machine.

D. Install all the modules making up the servo drive system in the electrical cabinet.

Placement of the servo drive system

Ambient conditions.

Never install the servo drive system in places where there are corrosive gases.

Always install it well away from areas with unfavorable atmospheric conditions, avoiding exposure to oil, water, air, high humidity, excessive dust or metal particles.

Especially:

When installing the RM-15 outside the electrical cabinet, it must be done away from water, coolant, chips,... since the module only guarantees a sealing protection of IP2x. The sealing degree of the ER resistor is IP55.

It is entirely up to the installer to take care of these matters.

Mechanical conditions.

The drive system must be mounted vertically in the electrical cabinet. To secure it, use the holes and slots made for that purpose.

Vibrations should be avoided. If necessary use securing means made of a material which absorbs or minimizes vibrations.

To facilitate heat removal, the equipment should be installed so as to leave at least 80 mm (3.15 in) above and below.

See fig. 1:

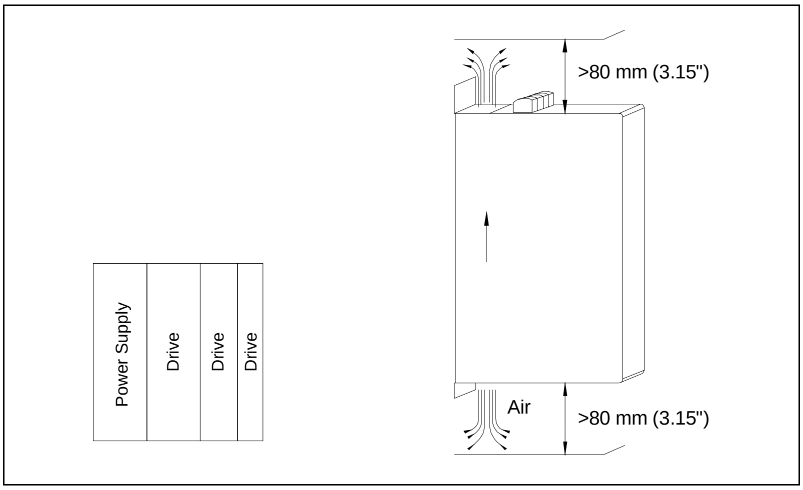


fig. 1 Location of the servo drive system

Mount the drive module of greater power next to the power supply module and use the same criteria for the rest of the drive modules.

Climate conditions.

Watch the temperature in the electrical cabinet is always kept under 55 °C (131°F). Never install the servo drive system beside a heat source.

The modules themselves generate heat. The following table shows the power dissipated by each one of them. These are data to be borne in mind when deciding whether the electrical cabinet needs external cooling or not.

External Ballast resistors RM-15 and ER should be mounted outside the electrical cabinet because they are power dissipating elements which generate a lot of heat. They must be installed away from splashes of water, coolant, metal chips,....

When applying external cooling to the system, make sure that water condensation does not fall on the equipment.

Module	Dissipated power
PS-25A	160 W
PS-65A	275 W
PS-25B3	180 W
PS-25B4	180 W
XPS-25	180 W
XPS-65	350 W

Module	Dissipated power
APS-24	60 W
CM 1.60	0 W
RM-15	(*)
ER	(*)

(*) Depends on the Ballast protection activation circuit

table 1 Power dissipated by the modules

Module	Dissipated power (W) at 4 / 8 kHz
AXD 1.08	33 / 44 W
AXD 1.15	69 / 89 W
AXD 1.25	115 / 148 W
AXD 1.35	156 / 195 W
AXD 2.50	295 / 305 W
AXD 2.75	285 / 395W
AXD 3.100	513 / 695 W
AXD 3.150	617 / 847 W
SPD 1.08	---------------
SPD 1.15	98 / 98 W
SPD 1.25	146 / 145 W
SPD 1.35	195 / 201 W
SPD 2.50	349 / 350 W
SPD 2.75	390 / 395 W
SPD 2.85	432 / 438 W
SPD 3.100	724 / 743 W
SPD 3.150	904 / 930 W
SPD 3.200	1163 / 1187 W

Module	Dissipated power (W) at 8 kHz
ACD 1.08	150 W
ACD 1.15	150 W
ACD 1.25	220 W
ACD 2.50	415 W
ACD 2.75	575 W

Module	Dissipated power (W) at 4 kHz
SCD 1.08	150 W
SCD 1.15	150 W
SCD 1.25	238 W
SCD 2.50	485 W
SCD 2.75	677 W

DLC 3042	19 W
DLC 3130	40 W
EMK 3040	30 W
EMK 3120	45 W

table 1 Power dissipated by the modules

Cooling of the electrical cabinet.

The following should be used to cool the electrical cabinet:

- **Heat exchangers**: They prevent contaminated air (mist, metallic dust in suspension, ...) from getting into the electrical cabinet thus eliminating the chances of accumulating particles, condensation, etc. in the cooling circuits of the DDS system modules.

If it is impossible to use heat exchangers:

- **Air extraction systems**, avoiding in any case blowing air into the electrical cabinet using fans.
  - Place the extractor fan at the top of the cabinet and the air intake at the bottom.
  - The air intake must have a filter and the fan should also have a filter.
  - The air intake must be greater than that of the fan to reduce the speed of the incoming air.
  - The required power and air flow depends on the power installed.
  - Install the DDS system as far away as possible from air inputs and outputs.

- Carry out periodic maintenance on air filters.

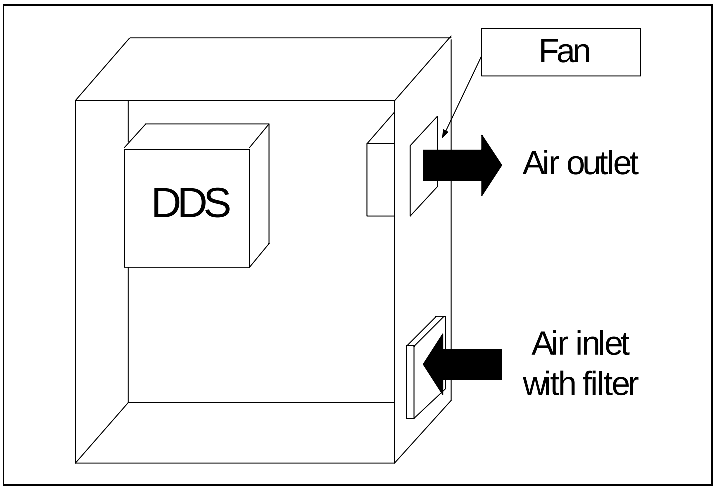


fig. 2 Air intake and output in the electrical cabinet

Use the following suggestions to minimize the maintenance of this type of cooling systems and the contamination of the electrical cabinet:

- Set the fan to work only when the inside temperature of the electrical cabinet exceeds the predetermined limit [for example 45°C]. This will decrease its running time and the flow of the incoming air while increasing the lifespan of the fan. The cost of this solution is minimal using a bimetal type thermostat or controlling it by using one of the outputs of the PLC or CNC.
- Install a fan whose speed varies depending on the air temperature. This type of fans have an NTC sensor either integrated into it or supplied as an accessory by the fan manufacturer.

Power bus connection

Connect the power bus located at the bottom of the module. Use 2 of the 3 plates and the washers and nuts supplied with each module to make the connection of the power bus (lower part of the module).

All the modules must be tightly joined to each other guaranteeing a good electrical contact.

The tightening torque must between 2.3 and 2.8 N·m.

The plates are identical and no particular order or direction has to be observed.

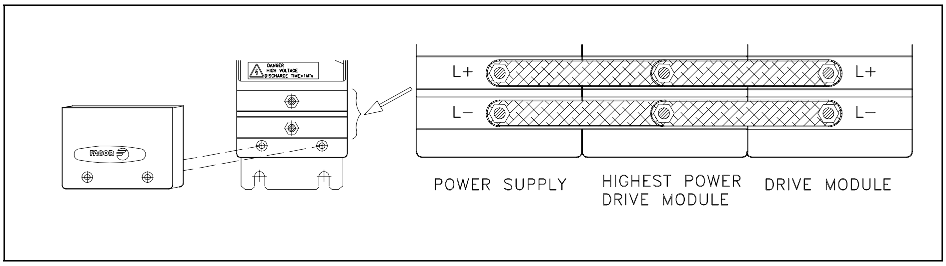


fig. 3 Power bus connection

The power supply module must provide the power needed by all the drives connected to it. If the power required by the group of motors exceeds the maximum that a single power supply can provide, two power supplies must be used assigning to each one the supply of a separate group of drives.

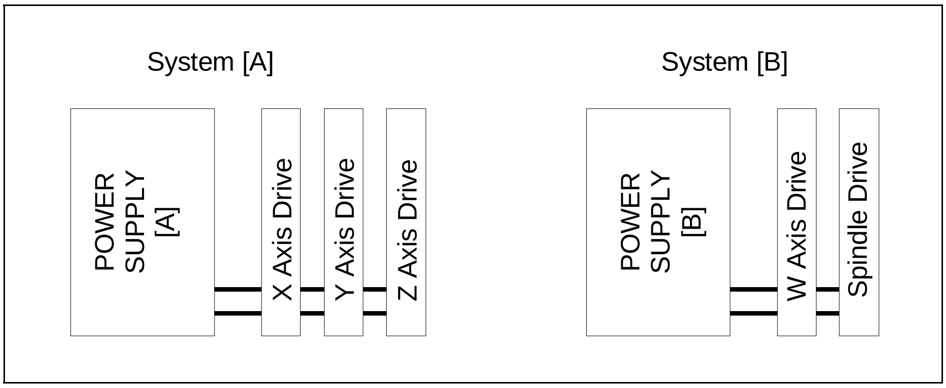


fig. 4 2 power supplies required, two separate groups

The power buses of different power supply modules must never be connected in parallel. Always make separate groups, connecting each power supply to a different group of drives.

Joining the chassis between modules

Use the 3rd plate and the washers and nuts supplied with each module to join the chassis between modules. The tightening torque must be between 2.3 and 2.8 N·m.

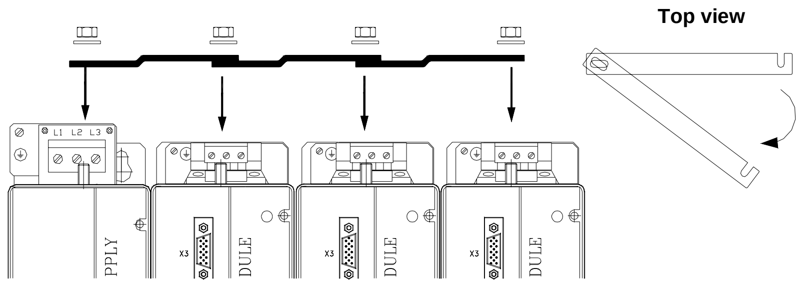


fig. 5 Joining the chassis between modules

Connecting these terminals by means of metal plates offers mechanical rigidity; but it does to guarantee proper ground connection of each module.

When a drive module fails, the following steps should be followed to free it from the fixtures securing it to the other drive modules:

1. **Loosen** the screw and the nut of the affected module.
2. **Loosen** the screws that secure it to other modules at both sides.
3. **Rotate** the plates of the affected drive module and that of the one to its as shown in fig. 5.

The drive module will be completely free from the adjacent drive modules.

Ground connection

The chassis of each module must be connected to the machine ground point. Use the washers and nuts supplied with each module to make the ground connection. The tightening torque must be between 2.3 and 2.8 N·m.

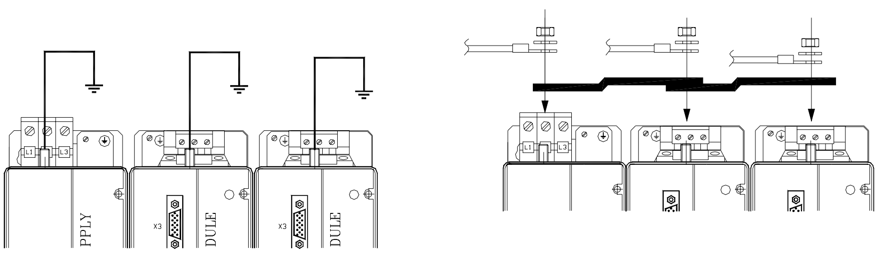


fig. 6 Ground connection

Take a ground cable (as short as possible) from each module to each main machine ground point. The cable section must be the same as that of the cables connected to the largest servomotor (at least 6 mm^2).

Internal bus connection

Connect connectors X1 using the cables supplied with each module as shown in fig. 7.

If the machine uses two separate servo drive systems (each one with its own power supply) they must have two separate internal buses.

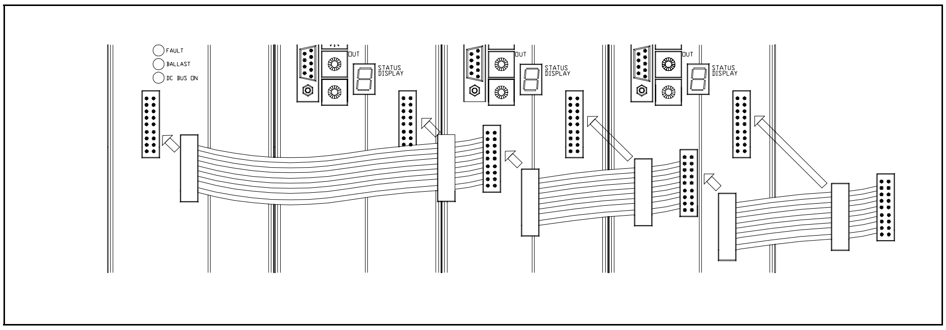


fig. 7 Internal bus connection

Connection to the external Ballast resistor

If the energy to be dissipated when braking the motors is too high, an external Ballast resistor.

The Fagor modules RM -15 and ER are designed for this purpose. See the section (resistor modules RM-15 and ER of chapter 1).

To know whether this module is necessary or not on your machine, see the relevant section of chapter 7.

Electrical configurations and ohm value.

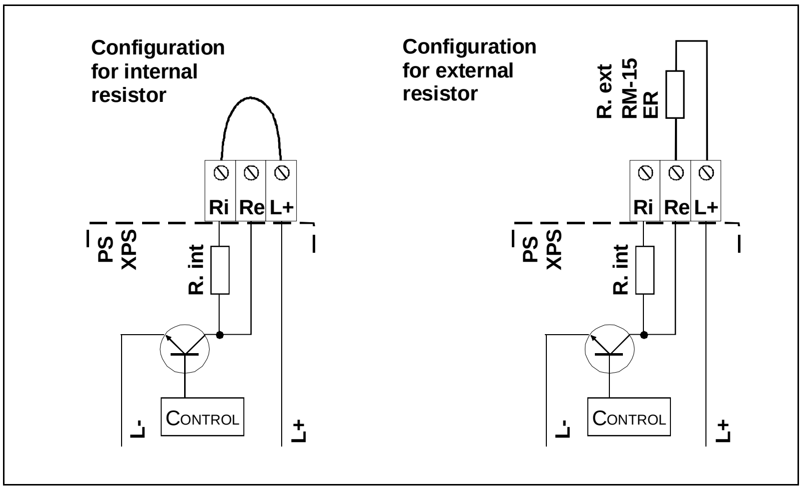


fig. 8 Ballast resistor configuration

The ohm value of the external Ballast resistor must be the same as that of the internal resistor of that module.

Never connect an external resistor in parallel with the internal Ballast resistor. It may cause severe damage to the system.

Compact drives must never be connected to the RM-15 module.

Ohm value.

PS - 25A **PS - 25Bx**	18 .	1.5 kW	RM -15
		950 W	ER-18/1100
		1.3 kW	ER-18/1800
		2.0 kW	ER-18/2200
XPS - 25	18 .	1.5 kW	RM -15
		950 W	ER-18/1100
PS - 65A	9 .	3 kW	RM -15 // RM -15
		1.9 kW	ER-18/1100 // ER-18/1100
		2.6 kW	ER-18/1800 // ER-18/1800
		4.0 kW	ER-18/2200 // ER-18/2200
XPS - 65	9 .	3 kW	RM -15 // RM -15
		1.9 kW	ER-18/1100 // ER-18/1100
ACD / SCD 1.25	24 .	650 W	ER-24/750
ACD / SCD 2.50	12 .	1.3 kW	ER-24/750 // ER-24/750
ACD / SCD 2.75	9 .	3 kW	RM -15 // RM -15
		1.9 kW	ER-18/1100 // ER-18/1100

table 2 Required Ohm values

Heat dissipation.

Ballast resistor can generate a great deal of heat. Optionally, a PAPST 614 type fan may also be installed for better dissipation.

The figure and table below show the temperatures reached in the gap above the module and the fan effect.

Dissipated power [W]	734	896	1042	1400	1400 [*]
Ambient temperature	25	22	24	24	24
T1	90	89	115	138	74
T2	157	170	185	217	113
T3	80	79	88	104	64
T4	60	68	72	82	46
T5	50	54	57	65	47
T6	40	40	44	45	44

[*] with PAPST 614 fan

Temperature in °C [°F = °C * 1.8 + 32]

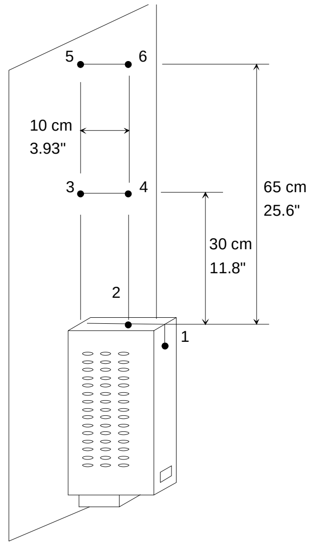


fig. 9 Heat dissipation

Above the RM-15 and ER the air temperature may reach 120 °C (248°F). Therefore, it should be mounted away from the rest of the modules or even outside the electrical cabinet, always vertically and away from cables and other temperature sensitive material.

Warining: the RM-15 module guarantees a sealing degree of IP2x . The ER guarantees a degree of IP55.

System cabling to mains

The DDS modular drive system has been designed to be connected to a three-phase mains between 400 Vac (-10 %) and 460 Vac (+10 %). To connect the system to other voltages, use transformers or auto-transformers.

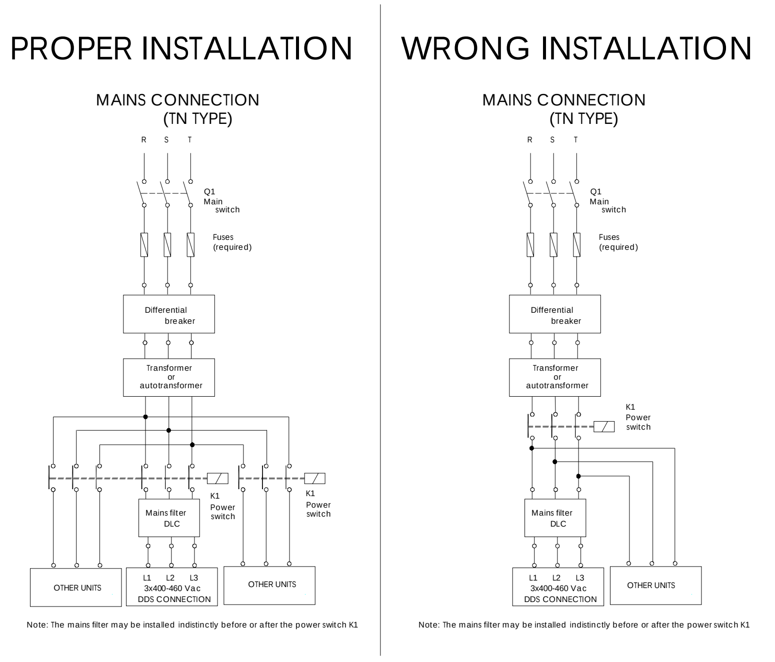
The connection may vary depending on the type of mains and electromagnetic compatibility required by the machine.

Certain mandatory protection devices must be added to the mains lines, others may be optional.

The diagram indicates the possibilities and how to make the connection.

After the main switch Q_1 place the protection fuses, the differential breaker, the 400 - 460 Vac transformer (if necessary), the power switch K_1 to turn on/off the DDS system and the filter for electromagnetic disturbances.

Some inductances in line may dampen the mains voltage fluctuations.



WARNING: The DLC mains filter (replacement for the discontinued EMK) may be installed **indistinctly** before or after the power switch K1.

fig. 10 DDS-to-mains connection diagram

WARNING: Never connect other components (motors, inductive components, etc.) in parallel with the drive system. They may cause the system to perform poorly when stopping the machine. The equipment to be connected together with the DDS system must be powered through a second contactor or through auxiliary contacts of the drive's contactor !

This chapter describes the characteristics, component requirements and connection diagrams of mains connection.

Mains filter DLC

In order for the Fagor servo drive system to meet the European Directive on Electromagnetic Compatibility 92/31/CE the DLC mains filter, must also be installed.

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This does not guarantee the compliance with such CE directive on electromagnetic compatibility regarding the machine because it may have other devices that could cause disturbances.

To install it, it must be properly connected to ground and the wires connecting to the power supply module must be as short as possible. See fig.6 for ground connections.

In the following table is shown the appropriate filter for each module.

Module	DLC filter	EMK filters (discontinued)
PS -25x, XPS -25	DLC 3042	EMK 3040
PS - 25B3, PS - 25B4	DLC 3042	EMK 3040
PS - 65A, XPS - 65	DLC 3130	EMK 3120
ACD / SCD 1.xx	DLC 3042	EMK 3040
ACD / SCD 2.xx	DLC 3130	EMK 3120

table 3 DLC mains filters. EMK filters have been discontinued

Fuses

*The protect the servo drive system **fuses must be included** on the lines coming from mains.*

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The DDS servo drive system does not include the fuses.

These fuses must be extremely fast to protect the semiconductors sized according to the type of power supply.

The fuses are selected according to the characteristics indicated in the table 4 and table 5. Tables 6, 7 and 8 show a group of fuses that may be used from different manufacturers. The fuse references given in these tables are the ones that may be installed to obtain the maximum power on each model. In those cases where the power supply is oversized, the fuse value should be adjusted to the actual requirements of the machine.

Fuse characteristics	Power supply module			
	PS - 25A PS - 25B3 PS - 25B4	PS - 65A	XPS - 25	XPS - 65
I_N	= 40 A	> 100 A	= 40 A	> 100 A
I_{surge}	> 115 A (1 s)	> 325 A (1 s)	> 115 A (1 s)	> 325 A (1 s)
Clearing I^2t [$A^2 s$]	< 500	< 15000	< 500	< 15000

table 4 Fuse characteristics depending on power supplies

Fuse characteristics	Compact drives				
	ACD 1.08	ACD 1.15	ACD 1.25	ACD 2.50	ACD 2.75
	SCD 1.08	SCD 1.15	SCD 1.25	SCD 2.50	SCD 2.75
I_N	> 5.6 A	> 10.6 A	> 17.7 A	> 35.4 A	> 53 A
I_{surge}	> 8 A (0.5 s)	> 15 A (0.5 s)	> 25 A (0.5 s)	> 50 A (0.5 s)	> 75 A (0.5 s)
I^2t [A^2s]	< 120	< 338	< 900	< 900	< 2000

table 5 Characteristics of the fuse for compact drive modules

Manufacturer	Power supply module			
	PS - 25A PS - 25B3 PS - 25B4	PS - 65A	XPS - 25	XPS - 65
BUSSMANN	FWH45B	RF00-125A	FWH45B	RF00-125A
	XL50F-45A	XL50F-125A	XL50F-45A	XL50F-125A
	RF000-40A	RF000-125A	RF000-40A	RF000-125A
	40FE	100FE	40FE	100FE
	170M2611	170M1318	170M2611	170M1318
	170M3009	170M3013	170M3009	170M3013

table 6 Bussmann fuses for power supplies

Manufact.	Power supply module			
	PS - 25A PS - 25B3 PS - 25B4	PS - 65A	XPS - 25	XPS - 65
GOULD	A00-66C5D8	A00-66C125D8	A00-66C5D8	A00-66C125D8
	A00-66C5D1	A00-66C125D1	A00-66C5D1	A00-66C125D1
FERRAZ	6.9 gRB 00 D08L 040	6.9 gRB 00 D08L 125	6.9 gRB 00 D08L 040	6.9 gRB 00 D08L 125
	6.6 gRB 000 D08/040	6.6 gRB 000 D08/100	6.6 gRB 000 D08/040	6.6 gRB 000 D08/100
SIBA	20 189 20- 50A	20 189 20- 125A	20 189 20- 50A	20 189 20- 125A
WICKMANN	45FEE	140FEE	45FEE	140FEE
LITTELFUSE	-------------	L70S125	-------------	L70S125
SIEMENS	3NE8 003	3NE8 021	3NE8 003	3NE8 021

table 7 Fuses from other manufacturers for power supplies

Manufacturer	Compact drives				
	ACD 1.08	ACD 1.15	ACD 1.25	ACD 2.50	ACD 2.75
	SCD 1.08	SCD 1.15	SCD 1.25	SCD 2.50	SCD 2.75
BUSSMANN	FC-6A	FC-12A	FC-20	FE-40	FE-63
	XL50 -10A	XL50 -15A	RF-000-25	RF-000-40	RF-000-63
	6CT	12CT			
	FWH - 6.30A6F				
GOULD	ST- 6 10x38	ST-12 10x38	ST- 20 10x38	ST- 40 14x51	000- 63
	000- 10	000- 16	A60x20	000- 40	000/80 - 63
	000/80 - 10	000/80 - 16		000/80 - 40	A70Q60
FERRAZ	6.600CP URC 14.51/6	6.600CP URC 14.51/12			
	6.621CP URC 14.51/6	6.621CP URC 14.51/12			
	6.6URE10/6	6.6URE10/12			
	A60Q6-2	A60Q12-2			
	A60X6-1	A60X12-1			
SIEMENS			3NE8015 3NE8003 3NE8017	3NE8017	3NE8018

table 8 Fuses from other manufacturers for compact drive modules

Using other protection devices instead of fuses (magneto-thermal switches, for example) does no guarantee proper protection of the equipment.

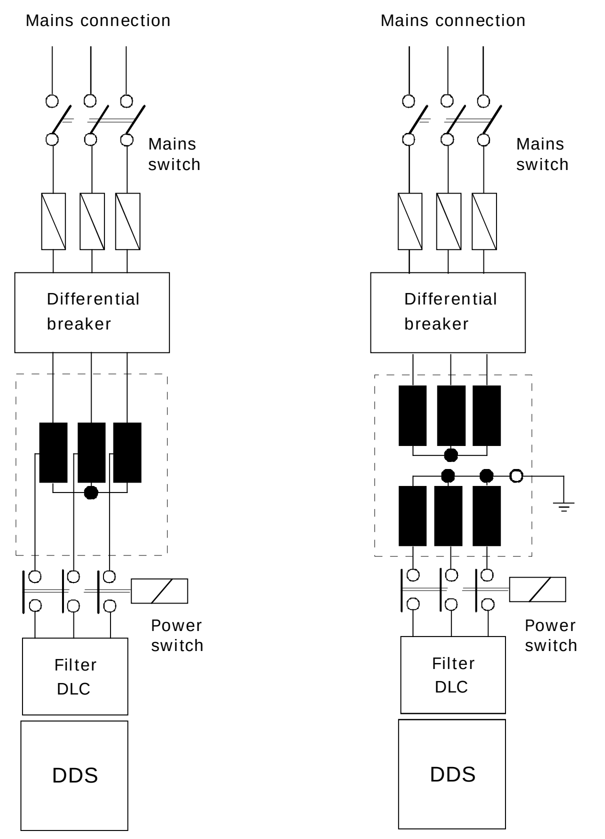
Autotransformer or transformer.

When the mains voltage must be isolated or adapted to the levels required by the DDS system, it may be connected through an isolating transformer or an auto-transformer. This element will also help reduce the amount of harmonics on the line although **it will not guarantee the compliance with the CE regulation.**

When having a mains perfectly referred to ground, autotransformers may be used to adapt the mains voltage.

However, if mains is not referred to ground, an isolating transformer must be used in order to avoid possible dangerous voltage surges on any phase with respect to ground that could damage the equipment. In this situation, the secondary must have a star configuration with access to the middle point. This middle point of the secondary must be connected to ground or the neuter of mains.

On systems with an XPS power supply, the inductance of the transformer must be very low and negligeable against the inductive value of the Choke XPS-xx.



WARNING: The DLC mains filter (replacement for the discontinued EMK) may be installed **indistinctly** before or after the power switch K1.

fig. 11 Position of the autotransformer or isolating transformer

When using transformers or autotransformers, the main contactor must be connected between them and the DDS system, never on the input line of the transformer or autotransformer.

For machines whose servo drive system includes XPS modules, the transformer or auto-transformer must be properly sized. The rated power of the auto-transformer must be the one resulting from applying the following formula: $\mathbf{P}_N = 570 \cdot IS6$, where IS6 is the current set for the S6 duty cycle of the spindle motor.

See chapter - Design.

This means oversizing the transformer or autotransformer considerably in relation to the power of the machine. Thus, individual transformers should not be used for each machine; instead, several machines should be connected to a single transformer. Thus it is possible to apply simultaneity factors and decrease the power required by the transformer or auto-transformer.

WARNING: Not complying with the given indications could cause the servo drive system to perform poorly !

Differential breaker

On a DDS system, fault DC current, practically flat, may come up besides the AC currents and pulsating DC currents. This forces the use of a differential circuit breaker that must be a universal B type with selective breaking.

It is not recommended to use differential breakers sensitive to pulsating currents and, overall, general purpose differential breakers. In this cases, undesired stops might occur due to the high sensitivity of those devices to pulsating currents.

When using this type of differential breakers, although not recommended, use the least sensitive ones (I_{leak} > = 500 mA).

Line inductance

Line inductance means including chokes on each of the three power lines. Its function is to reduce the harmonics generated in mains. The recommended value is given by the formula below.

$$L = \frac{V \cdot 0,04}{2\pi f \cdot I_{rms}}$$

To simplify the choice, we could consider optimum the values given in table 9.

	PS-25A PS-25Bx	PS-65A	ACD/SCD 1.08/1.15	ACD/SCD 1.25	ACD/SCD 2.50	ACD/SCD 2.75
L (mH)	1	0.4	5	3	1.5	1
Irms (A)	40	100	11	18	36	53

table 9 Line inductance

If the DLC filter has not been installed, the Line Inductance is recommended in order to minimize disturbances, although is warned that this **does not guarantee CE marking compliance**.

No line inductances must be installed in line with XPS power supplies since they would interfere with their regenerating function.

Types of mains

Depending on the diagram of the electric energy distribution circuit, there are three types of mains: TN, TT and IT.

Depending on the type of mains, the cabling in the electrical cabinet will vary considerably.

We here describe their characteristics and, later on, sample diagrams for a proper installation. Note that the diagrams do not show the main contactor that must be connected between the transformer or autotransformer and the DDS unit.

TN diagram

Distribution diagram that has a point directly connected to ground and the conductive parts of the installation are connected to this point through ground protection conductors.

There are three types of TN systems depending on the protection neuter and ground combination:

- **"TN - S" diagram :** where the neuter and the ground protection conductors are separated throughout the whole length of the system.
- **"TN - C - S" diagram :** where the neuter and the ground protection wire are combined in a single conductor somewhere in the system.
- **"TN - C" diagram :** where the neuter and the ground protection functions are combined in a single conductor throughout the system.

TN type mains are the only ones to which the DDS system can be connected either directly or through an auto-transformer.

fig.12 on the next page shows a diagram for the proper installation of the DDS system with a "TN - C" type mains distribution.

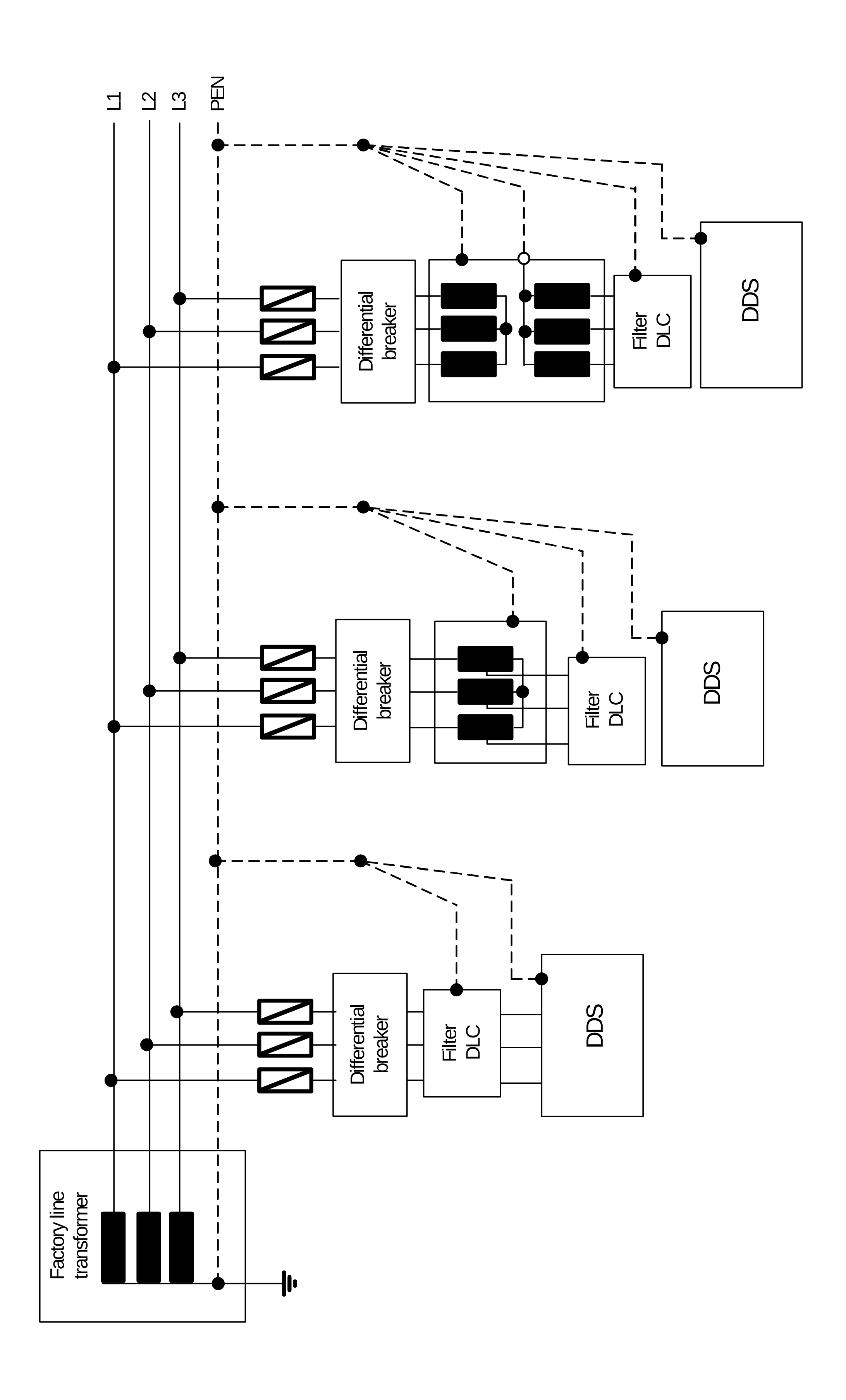


fig. 12 Installation diagram in TN - C type mains

TT diagram

Distribution diagram that has a point directly connected to ground and the conductive parts of the installation are connected to this ground point independently from the ground electrode of the power supply system.

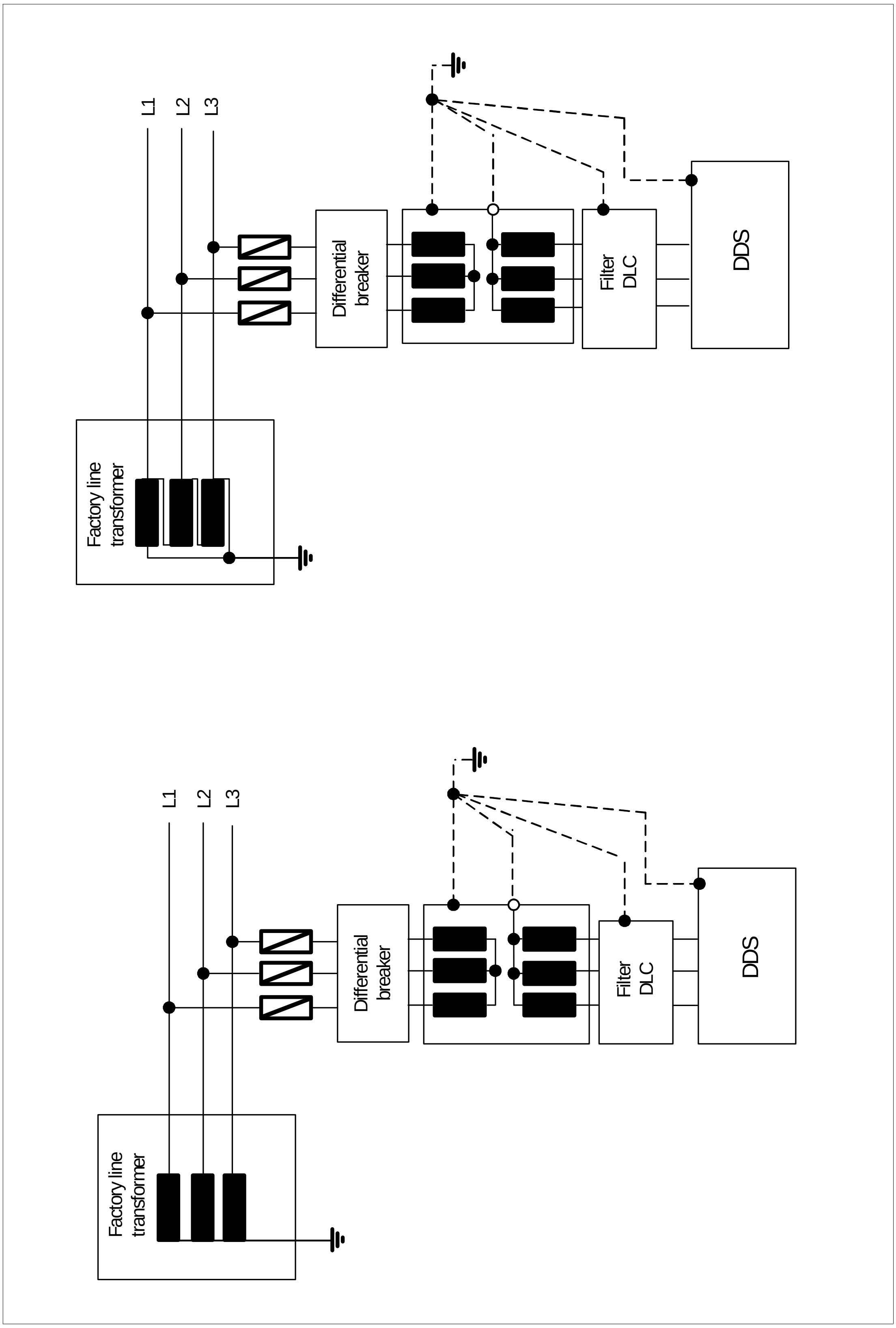


fig. 13 Installation diagram in a TT type mains

IT diagram

Distribution diagram that has no direct connection to ground and the conductive parts of the installation are connected to ground.

In this type of mains, the differential breaker is used assuming that the capacitance of mains with respect to ground is large enough to ensure that a minimum fault current flows with the same magnitude as that of the operating differential current assigned. Otherwise, its use is not necessary.

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Note that an IT type mains can also be controlled through an isolation watcher. Both protection measurements are compatible with each other.

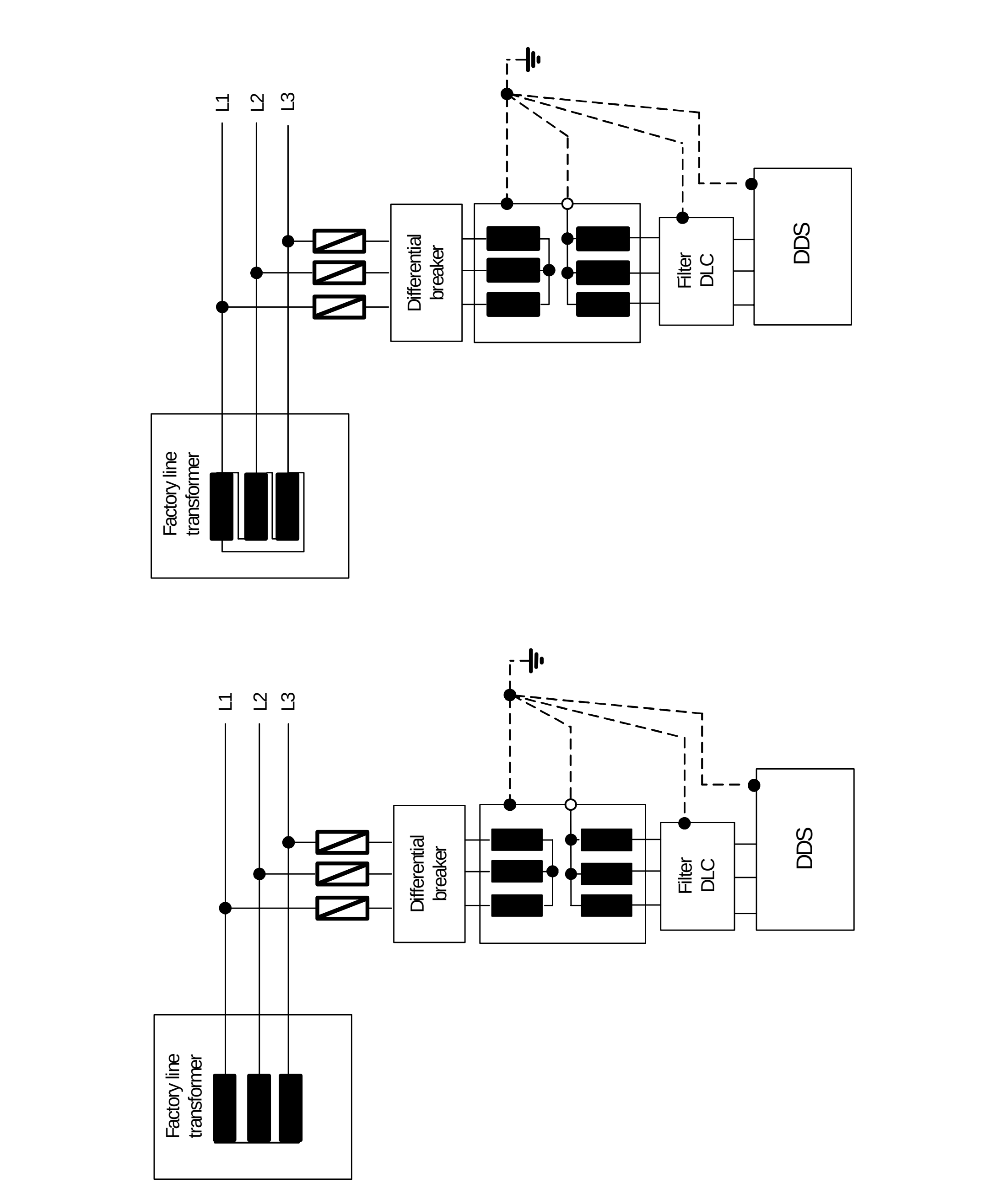

fig. 14 Installation diagram of an IT type mains

Cabling considerations

When designing the electrical cabinet where the DDS system will be installed, the following suggestions should be kept in mind in order to avoid operating problems, breakdown, disturbances, etc.

You should:

- Avoid running signal cables and power cables together. Try to run them as far away as possible form each other.
- Use shielded cables for the power cables.
- Lay out the modules and components of the system so the power cables are as short as possible, especially the general mains cables, the output cables to the motor and the connection to the choke for XPS regenerative power supplies.
- Use double-shielded cables for motor feedback. Although the system complies with the current regulation on immunity with single-shielded motor feedback cables; better results have been achieved with double-shielded cables considerably exceeding the requirements of such regulation.
- Connect the cable to the point of same potential or to ground as recommended in fig. 15.

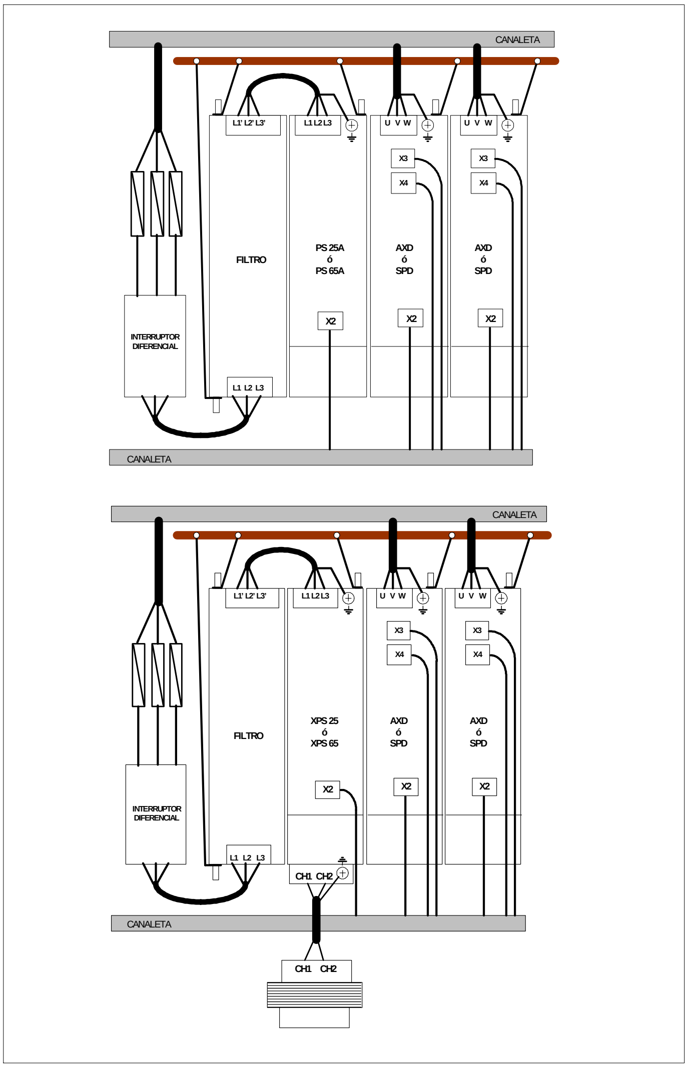

fig. 15 Cabling with power supplies: PS - xx & XPS - xx

Considerations to bear in mind to improve electromagnetic compatibility.

With shielded cables:

Usually, when connecting two units that are connected to ground, the cable shield must be connected at both ends.

When the connections include analog signals, it will only be connected at one end (usually the receiver).

If one of the units does not have a ground connection, the shield must be connected only at the end of the unit connected to ground.

Avoid interruptions in the shielded cable connections. If not possible, use shielded interconnection systems (for example, connectors with metal housing).

Without shielded connectors (without metal housing):

If it is not possible to use shielded connectors, make the cables as short as possible to ensure the best connection between the cable shields . See fig. 16.

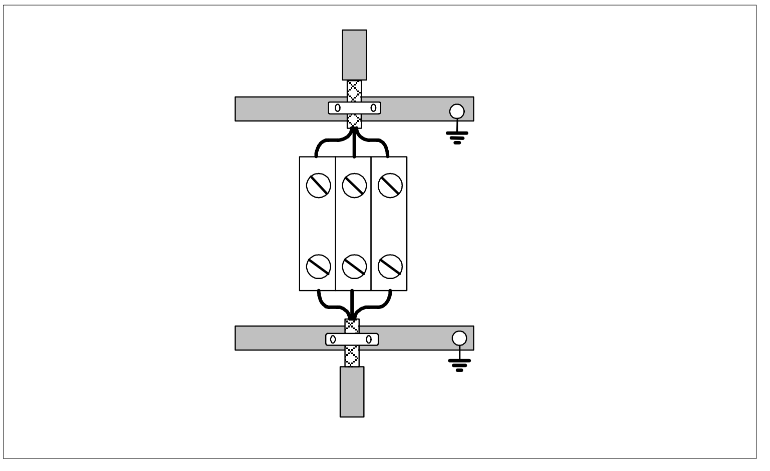

fig. 16 Make the shielded cables as short as possible when the connectors are not shielded.

When connecting power cables, connect their shields to a ground connection bar. See fig. 17.

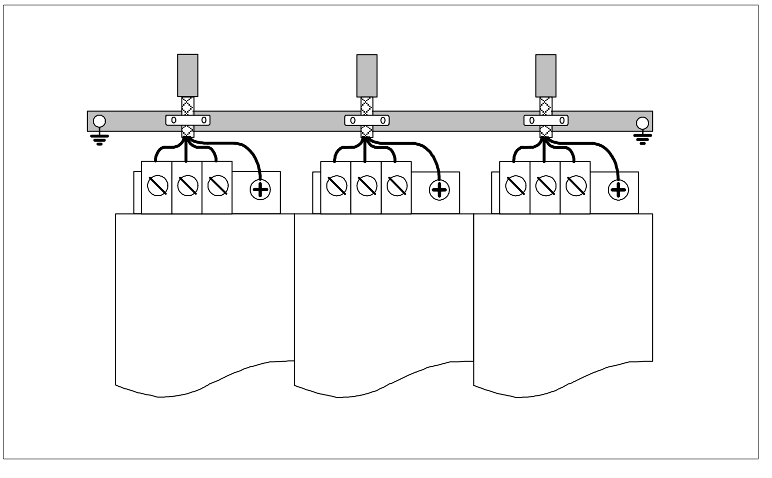

fig. 17 Shield connection to a ground bar

Inductive components

During installation, take the following precautions when cabling inductive components (contactors, relays, electrovalves, motor brakes or any types of coils).

Thus:

- All inductive circuits or components must have their own interference suppressor that must be installed as close as possible to the inductive component.
- Use RC circuits, varystors or suppressing diodes as interference suppressors.
- Do not use fly diodes as interference suppression elements for these components.

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Note that the fly diode could only serve as interference suppressor of the inductance due to the cabling itself.

- Try not installing through the same conduit the excitation cables of inductive components and the signal cables, and even more so if their cables are not shielded. A common case are inductive proximity sensors or alike that are usually installed with an unshielded cable.
- In extreme situations and if the sensors used on the machine are very sensitive to the interference conducted through the supply cables (24 Vdc), it may be necessary to isolate or decouple them from that of the supply of the system elements (inductive components, drives, ...).

Section of the cables for mains connection

Section [mm^2]	Imax [A_{rms}]
1.5	12.2
2.5	16.5
4	23
6	29
10	40
16	53
25	67
35	83

table 10 Section / Imax

The table on the right gathers the regulation applicable to typical installation of drive systems.

Determines the maximum current in continuous duty cycle, admitted by three - phase conductors in PVC hoses and installed on the machines through conduits and channels.

The ambient temperature considered is 40 °C [94 °F].

To determine the cables needed to connect the power supply to mains, proceed as indicated in chapter 7. This is the cable selection offered by Fagor:

MPC - 4 x 1.5	MPC - 4 x 1.5 + [2 x 1]	MPC - 4 x 25+ [2 x 1]
MPC - 4 x 2.5	MPC - 4 x 2.5 + [2 x 1]	MPC - 4 x 35 + [2 x 1]
MPC - 4 x 4	MPC - 4 x 4 + [2 x 1]	MPC - 4 x 50 + [2 x 1.5]
MPC - 4 x 6	MPC - 4 x 6 + [2 x 1]	
MPC - 4 x 10	MPC - 4 x 10 + [2 x 1]	
MPC - 4 x 16	MPC - 4 x 16 + [2 x 1.5]	

table 11 Fagor power cables: Nr of cables x section [mm^2].

Mechanical characteristics of the connectors

Module	Pitch (mm)	Max. tightng torque (Nm)	Max section. (mm^2)
AXD / SPD - 1.08 / 1.15	7.62	0.6	2.5
ACD / SCD - 1.08 / 1.15	7.62	0.6	2.5
AXD / SPD - 1.25 ACD / SCD - 1.25	7.5	0.6	4
PS-25A AXD / SPD 1.35	8.1	1	4
EMK 3040, DLC 3042 AXD 2.50, AXD 2.75 SPD 2.50, SPD 2.75, SPD 2.85 PS - 65A (ballast) XPS - 65 (ballast) ACD / SCD - 2.50 / 2.75 (ballast)	10.1	1.7	10
PS - 25B3, PS - 25B4	10.1	1.5	10
XPS - 25 ACD / SCD - 2.50 / 2.75 (power)	12.1	2	16
EMK 3120, DLC 3130 AXD / SPD - 3.100	15.1	7	25
AXD / SPD - 3.150 SPD - 3.200 PS - 65A (power) XPS - 65 (power)	18.8	7	50

table 12 Power cable connectors: mechanical characteristics.

Motor - drive connection

When connecting the drive module with its corresponding motor connect terminal U of the drive module with the terminal corresponding to the U phase of the motor. Same as terminals V - V, W - W and ground - ground.

In order for the system to comply with the European Directive on Electromagnetic Compatibility, the hose grouping all four cables U - V-W - ground must be shielded and must be connected only at the drive end as shown in fig. 18. These conditions are a must.

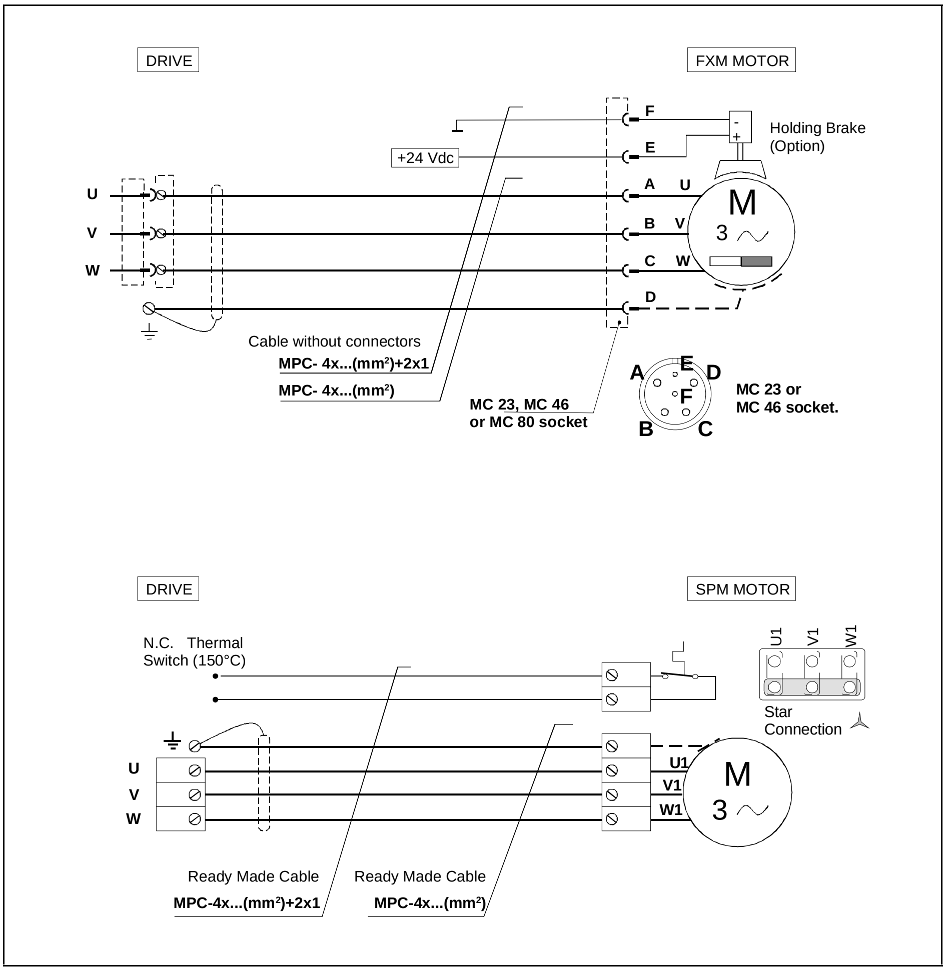

fig. 18 Motor - drive connection

Motor power cable selection

Use the following table to select the power cables for synchronous motors (FXM) and asynchronous motors (SPM & FM7) see the of the corresponding motor.

Ground connection

The ground connections of the drives (screwed on plates) must go to a single point and from there to the ground terminal of the electrical cabinet. When applying a 10 A current between this ground point and any of these points, the voltage drop must not exceed 1 V.

When not having a separate ground point, join the plates to the terminal of the power supply module which, in turn, will be connected to mains ground.

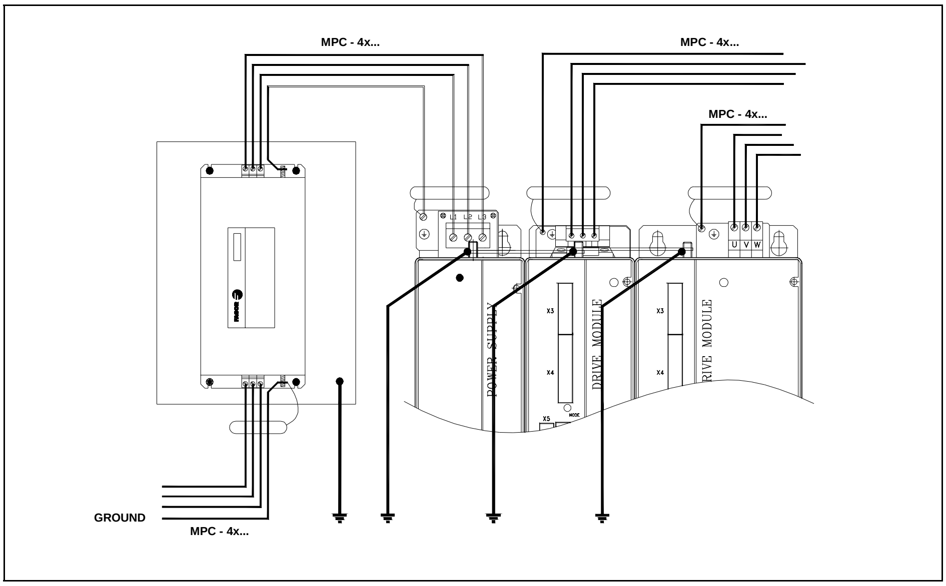

fig.19 Ground connection.

CE DIRECTIVE:

In order to ensure compliance with the European Directive on Electro-magnetic Compatibility 92/31/CE, it is a must to:

- Power the system through mains filter DLC
- Secure the filter onto a metallic support with a good contact on its whole base, good ground connection and as close to the power supply as possible.
- Make all the ground connections indicated in fig.19, with a cable having a section equal to or greater than the three - phase power supply and at least 6 mm^2.
- Always use shielded cables for three - phase motor connections.

Connecting the motor feedback to the driver

Use the cable with connectors supplied by Fagor to lead the motor feedback to connector X4 of the drive module. The motor feedback can be one of two types: encoder or resolver. **If the user has an FM7 spindle motor, refer to the connection diagrams in the motor manual.**

EEC encoder connection

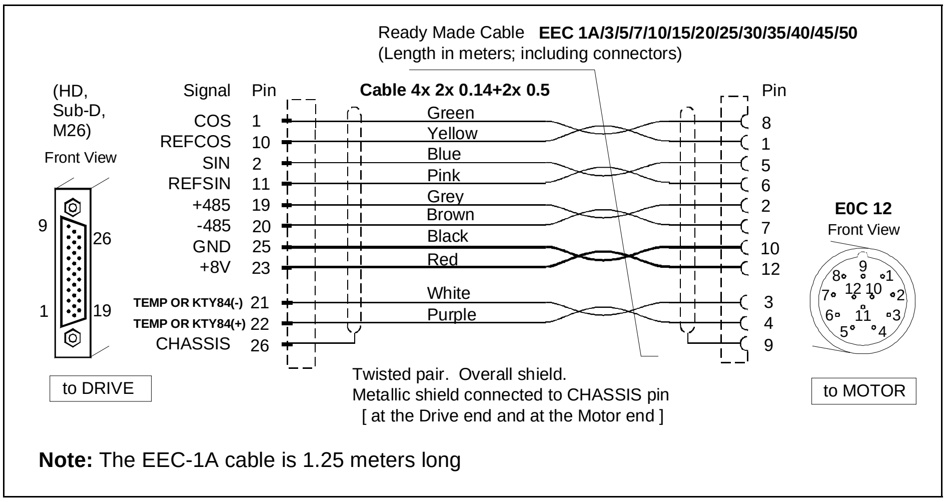

fig. 20 EEC cable to connect the encoder to the drive. Cable with overall shield

EEC - SP encoder connection

Note that both type I and II mentioned next are the same. Their only difference is the color of the wires because they are from different manufacturers. WHEN REFERRING TO THE CABLE HOSE, IT MEANS THE CABLE WITHOUT CONNECTOR SHOWN ON THE CONNECTION DIAGRAMS. The user must verify which one matches his cable by looking at these diagrams.

With I type cable:

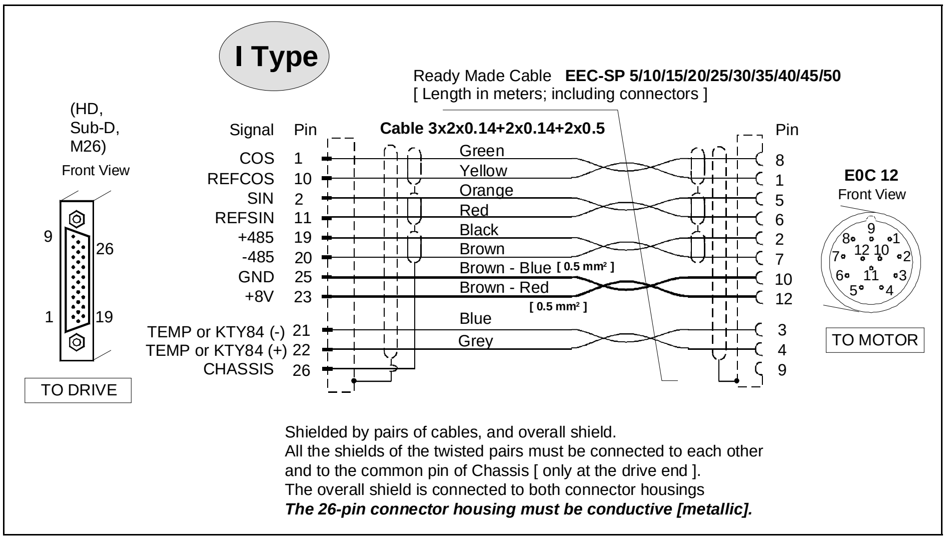

fig. 21 EEC - SP cable to connect the encoder to the drive. Twisted - pair cable with shielded pairs . " I " type cable

With II type cable:

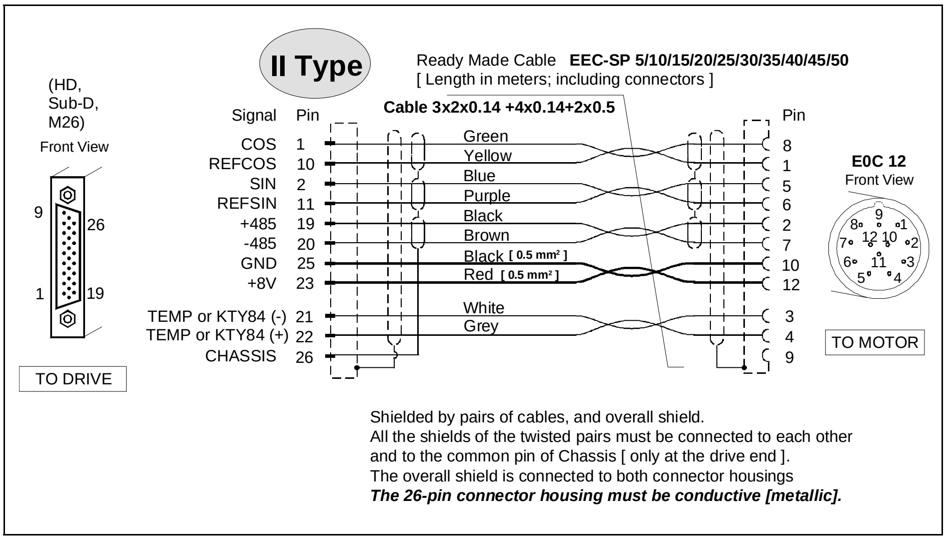

fig. 22 EEC - SP cable to connect the encoder to the drive. Twisted - pair cable with shielded pairs . " II " type cable

Observe that using an EEC - SP cable instead of an EEC cable to connect the encoder improves its flexibility and system immunity against disturbances.

REC resolver connection

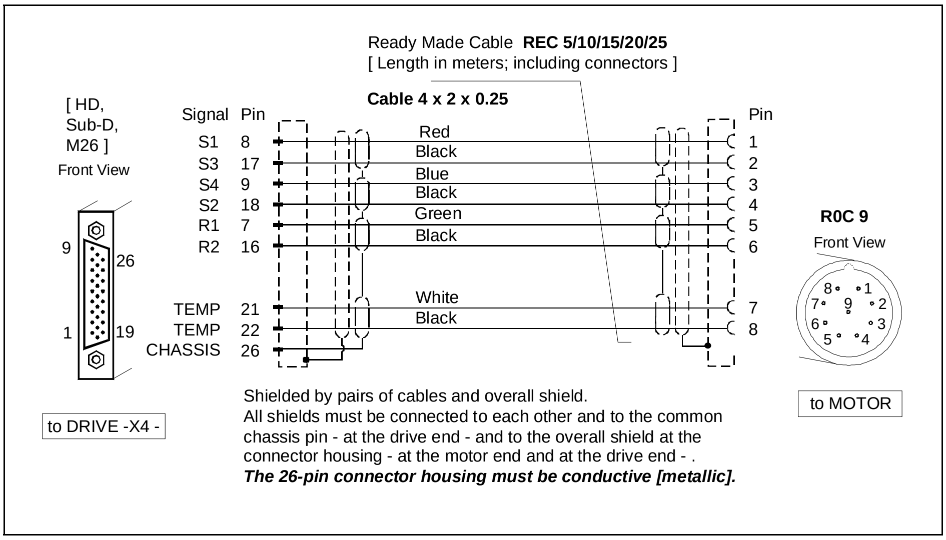

fig. 23 REC resolver connection. Overall shield and shielded twisted pairs.

Brake control

The mechanical brakes optionally available for **FXM** and **FKM** motors must be supplied with **24 V_{dc}**.

Their power consumption is shown in the manual for AC servo motors: FXM and FKM.

A transformer - rectifier circuit like the one in fig. 24 will be enough to power the brake of an FXM or FKM motor.

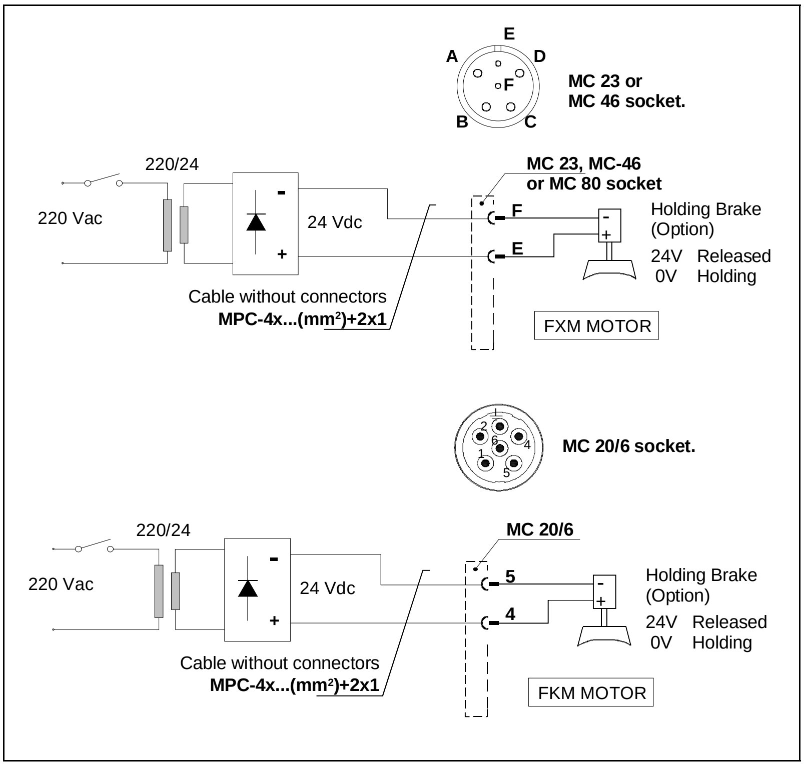

fig. 24 Brake control

Applying the indicated voltages releases the motor shaft.

When installing the motor, verify that the brake fully releases the shaft before turning it for the first time.

The 24 V_{dc} generated by modules like the PS-25Bx, APS 24 or XPS, or that being generated by another power supply handles the control signals of the drive must never be used to also control these brakes.

These brakes generate voltage peaks that can damage the driver.

On the FXM, watch that no voltage over 26 volts is applied which would prevent the shaft turning.

Control power supply for the modules

The internal circuits of all electronic modules need 24 Vdc.

The PS-25A and PS-65A power supply modules and modular drives must be supplied with this voltage through their X2 connector.

These modules have stabilizing system for the supplied voltage.

The maximum consumption of each module is:

- **PS power supply .... 1 Amp.**
- **Modular drive .... 2 Amp.**

The 24 V_{dc} voltage supply is essential for the system to run.

The APS 24 auxiliary power supply offers these 24 V_{dc} and 10 Amp. Regenerative power supplies XPS-25, XPS-65 and the PS-25Bx power supplies are self - supplies and they also offer 8 Amps of these 24 Vdc. Compact drives are self - supplied and offer up to 110 mA of these 24 Vdc.

These 24 Vdc can also be used in the circuit of the electrical cabinet, but never to activate the brake of a motor. **This is must for the EC seal of the machine.**

The 24 Vdc can also be used in the electrical cabinet circuit, but never to activate the motor brake.

Connection of the APS 24 power supply.

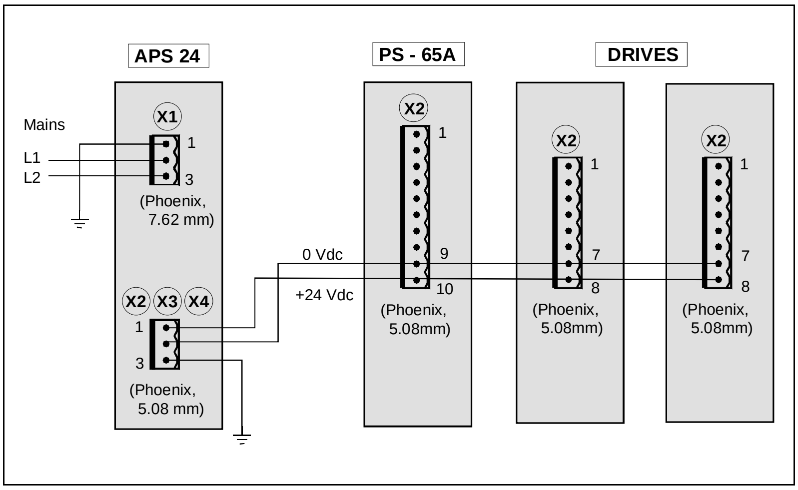

fig. 25 Connection of the APS 24 power supply

Connection of the PS-25Bx and XPS power supplies.

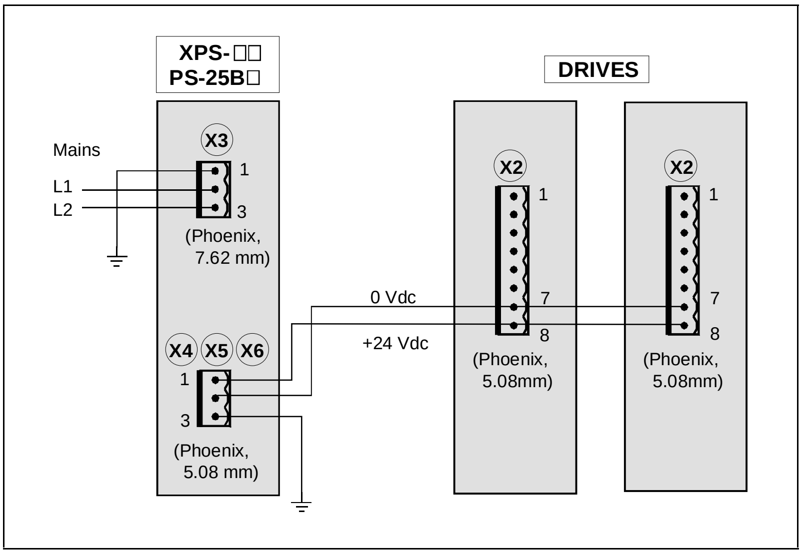

fig. 26 Connection of the PS-25Bx and XPS power supplies

Control and communication signals

Connect the encoder simulator to the CNC.

If the drive is going to work analog interface, take the ±10 V_{dc} velocity command from the CNC.

When working with Sercos® interface, identify the drives and connect them with each other.

SEC, encoder simulator connection

Depending of the type of motor feedback, the drive can generate a set of signals that simulate the TTL signals of an encoder mounted onto the rotor of the motor.

Take these signals from the drive to the 8055 CNC with the SEC cable.

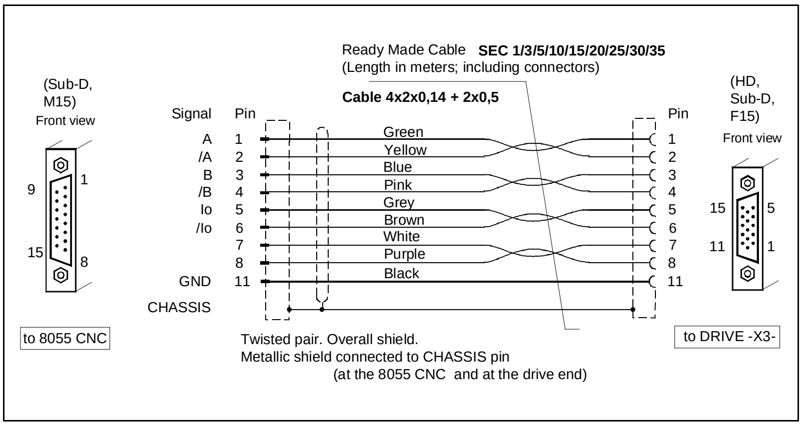

fig. 27 SEC encoder simulator connection with an 8055 CNC

"SEC - HD" encoder simulator connection

Take the signals that simulate those of a TTL encoder attached to the motor rotor from the drive to the 8055i CNC or 8040 CNC using the "SEC - HD" cable.

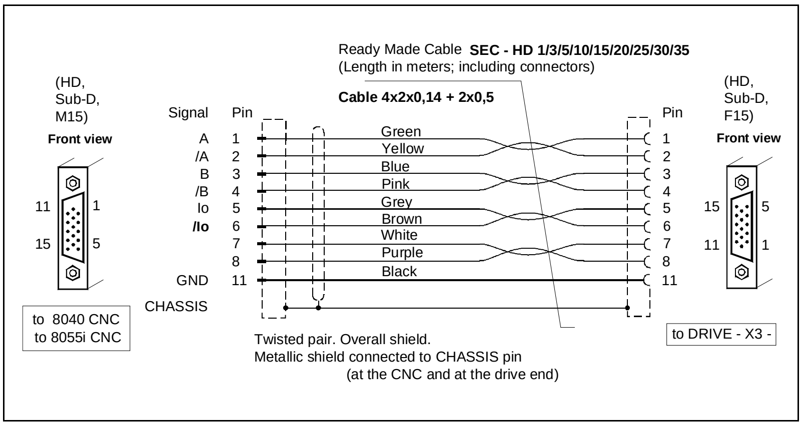

fig. 28 "SEC-HD" encoder simulator connection with an 8055i CNC or an 8040 CNC.

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The maximum length for SEC and SEC-HD cables for best performance is 50 meters.

Direct feedback connection

When using the drive as a positioning drive (with the 8070 CNC , or independently - Motion Control -) .

Take these signals from the incremental linear encoderto the drive using the cable EC-PD ☐ supplied by Fagor .

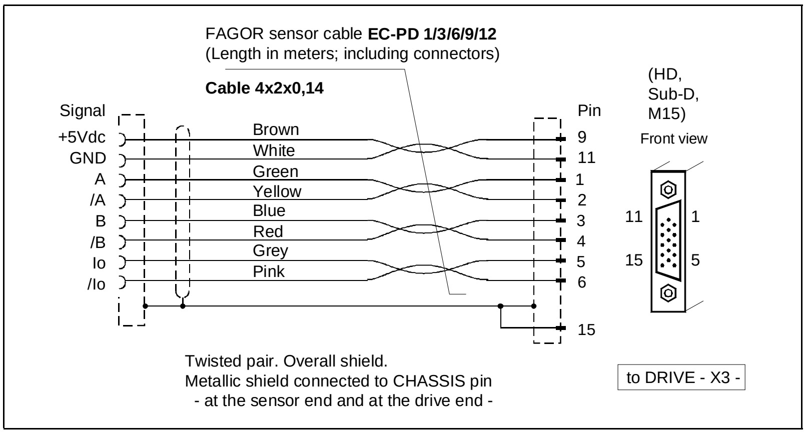


fig. 29 Direct feedback (incremental linear encoder) connection

If it is an absolute linear encoder, use the cable supplied by Fagor EC-☐ B-D:

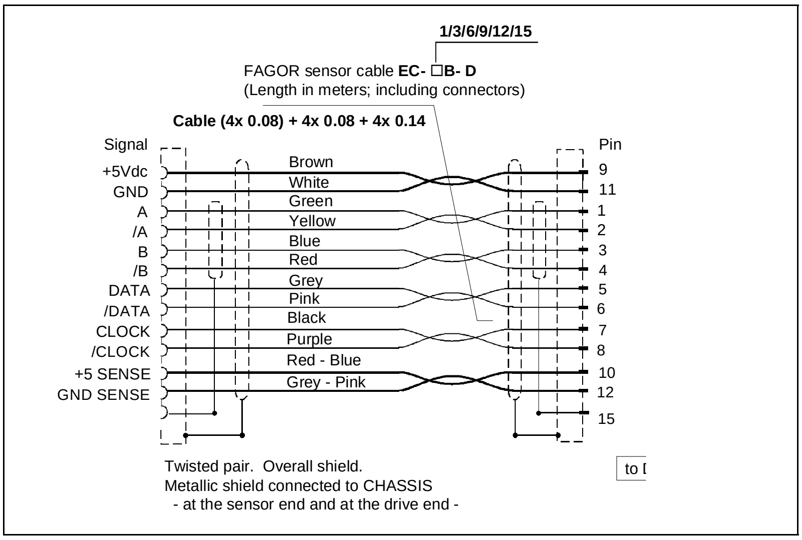


fig. 30 Direct feedback (absolute linear encoder) connection

If the direct feedback is a Stegmann sinusoidal encoder, the pin-out of X3 of the drive will be:

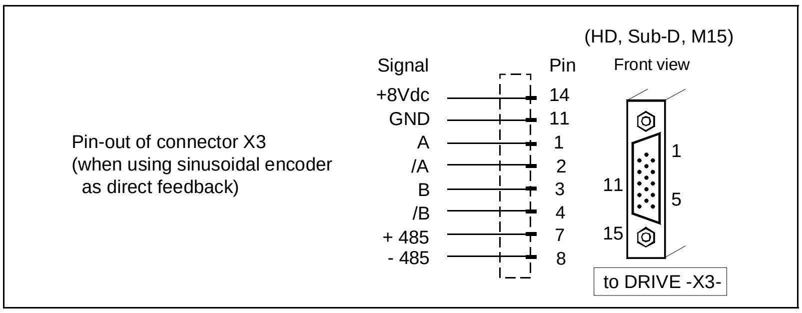


fig. 31 Direct feedback Stegmann sinusoidal encoder connection

Before connecting the encoder to the drive, find out the pin-out at the encoder side supplied by the manufacturer and connect it according to the previous pin-out.

Analog velocity command

Take the analog velocity command from the CNC to the drive.

Connector X7 of the drive has two analog inputs. By means of an internal parameter IP1 [F00900], it is possible to select which one the drive has to attend to.

F00900 = 1 Main input [Analog Input 1, pins 4/5 of X7]

F00900 = 2 Auxiliary input [Analog Input 2, pins 2/3 of X7]

The connectors offers ±15 V_{dc} to easily generate the velocity command with a potentiometer.

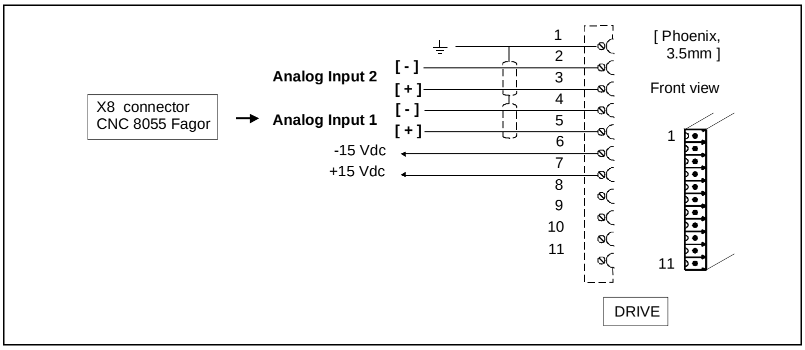


fig. 32 Analog command

Digital outputs

When the drive outputs are connected to inductive loads, we must protect the optocoupler with circuits such as the ones shown here:

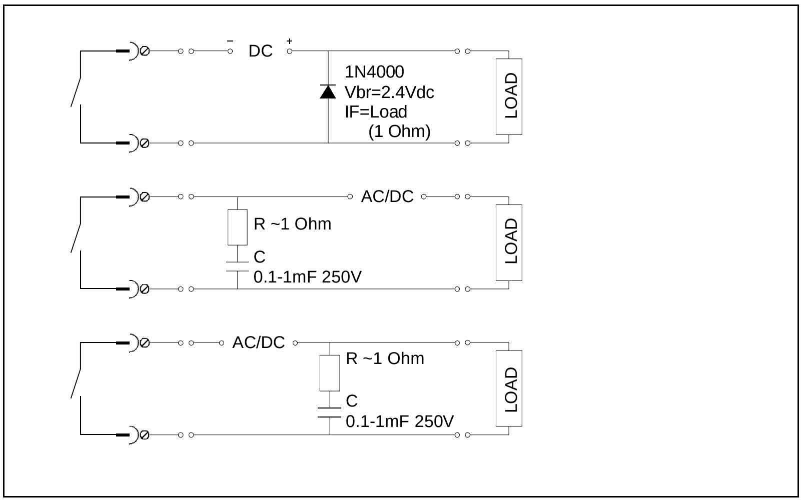


fig. 33 Digital outputs

Sercos® connection

Identification.

Distinguish each drive by means of the 16 position rotary switch [Node_Select] **with sequential numbers starting from 1**. After any change at the Node_Select switch, the module has to be reset for the change is assumed.

Given to the SERCOSID parameters of the CNC the same ID numbers as the ones assigned by means of the Node_Select switch. See fig. 34.

If the same motor is to be used as C axis and spindle, the two CNC tables must have the same value for the SERCOSID parameter.

If the zero identifier is assigned to a drive, that module will be ignored, even when the ring stays closed for all purpose for the rest of the elements. That drive may receive the velocity command in an analog way and can be adjusted through the serial line.

A system with four drives identified as 1, 2, 3 y 4. If we wish to ignore the second one, we must renumber some of the other ones so they are sequential. The easiest way would be: 1, 0, 3, 2.

Remember that the SERCOSID parameters of the CNC can also be modified the same way.

Interconnection.

Connect in the Sercos® ring all the drives that will be governed by the CNC. Connect, with each fiber optic line, an OUT terminal with another IN terminal. See fig. 34.

Each drive comes with a fiber optic line to connect it to the adjacent module. Fagor provides the other necessary fiber optic lines upon request.

The bending radius of the fiber optic cable must be more than 30 mm.

If the machine has two separate servo drive system (each with its own power supply) and a single CNC, the same ring must interconnected all the drives of the machine

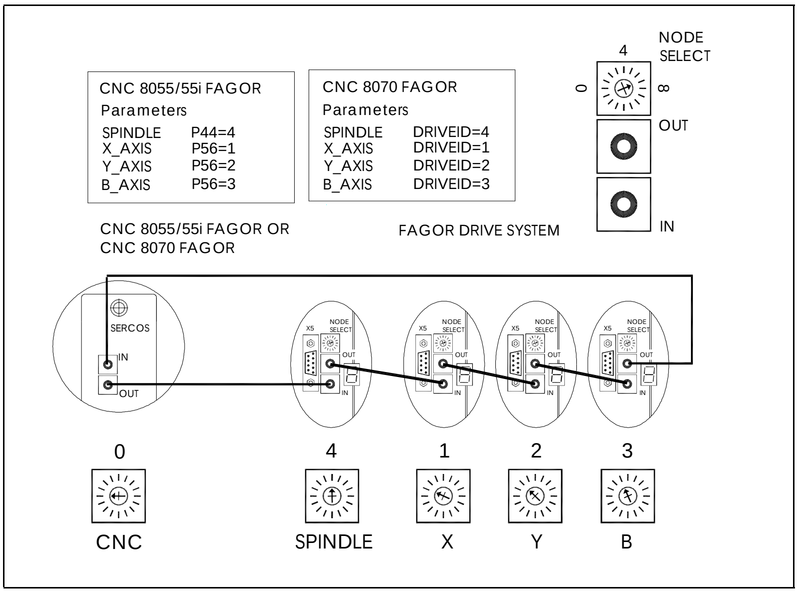


fig. 34 Sercos® connection

Baudrate selection.

From version v.06.05 on, the drive will have a Sercos® board capable of transmitting data at 2, 4, 8 or 16 Mbaud.

This board will not be compatible with software versions older than v.06.05 !
See the chapter on COMPATIBILITY.

In this data transmission, each drive may receive and send 8 IDns (Sercos®) or 16 Words through the fast channel.

The communication speed between the drives that will be governed by the CNC in the Sercos® ring is selected by hardware using the "boot" button located over the connector of the Sercos® board. See fig. 35.

Therefore, the serial connection will not be necessary for selecting the transmission speed.

QP11 is the parameter associated with the selection of the communication speed of the Sercos® ring in such a way that every time a speed value is selected, this parameter is assigned its corresponding associated value. **This parameter** is compatible with previous software versions. See tabla 13 and Appendix A.

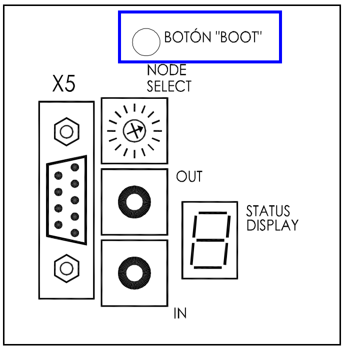


fig. 35 Location of the "boot" button on the drive.

Transmission rate changing process.

At the initial state (0 state), the display shows the information that it already showed in previous versions (errors, Sercos® phase, etc.). When holding the "boot" button pressed for over 3 seconds (long press) it goes to a new state (1 state) that lets you select the communication speed and shows the currently speed setting.

In this "1 state", every time the button is pressed for less than 0.8 seconds (short press), the display shows the next communication speed value that may be selected.

Thus, do short presses until it displays the desired speed.

Once the display shows the desired speed, do a long press so it assigns its associated value to QP11, it saves it in flash memory and it resets the drive.

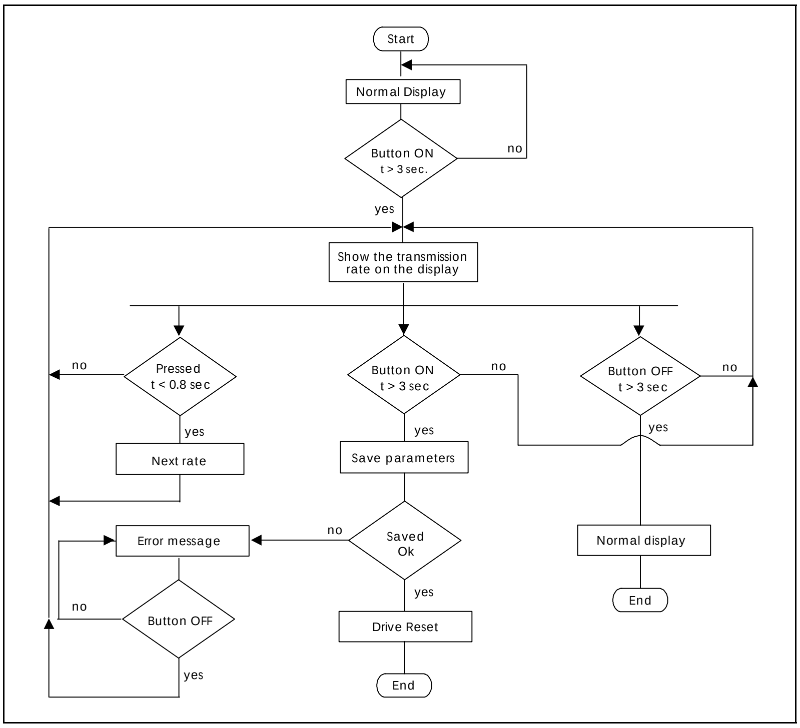


fig. 36 Diagram for selecting the transmission rate via Sercos®.

Possible anomalies during the process.

Any error that may come up when saving the parameters into flash memory will be displayed by an error message at the disply until the "boot" button is released, then returning to the "1 state" (velocity selection).

Any attempt to write into parameter QP11 a value other than those assigned to the possible transmission rates will generate an error and it will not modify the parameter value !

Any change of the communication rate is maintained after the drive is turned off if the parameters have been properly saved.

If by any chance, the drive is turned off or reset in any state of the process, on a new power-up, the value of the transmission rate given by QP11 will be the last one that was successfully assigned in previous changes.

It is possible to ignore the rate change (without having changed anything) at any time, if the command to save parameters has not been given.

While in the "1 state", if the "boot" button has not been pressed in more than 8 seconds, the drive goes to the "0 state" and the display shows the initial information !

Values that may be assigned to the transmission rate.

The possible values that may be selected to set the transmission rate supported by the hardware are:

Value	Rate	Shown on the display
QP11 = 0 *	4 MBaud	4
QP11 = 1 *	2 MBaud	2
QP11 = 2	2 MBaud	2
QP11 = 4	4 MBaud	4
QP11 = 8	8 MBaud	8
QP11 = 16	16 MBaud	1.

* for compatibility with previous versions of the Sercos® board.

tabla 13 Selection of the transmission rate in the Sercos® ring using the "boot" button.

Serial line connection

To transfer the parameter table and set up the system, the drive must be connected to a **PC-Compatible** computer or with the **programming module** "DDS PROG MODULE" through a serial line.

The metal shield must be soldered to the hood of the connector at the drive end. The pins labeled as "reserved" in the drawings must not be connected anywhere by the operator.

Serial line to a PC.

If the PC has more than one serial port, it must be selected by means of the setup window of the communication program WinDDSSetup. See chapter 5.

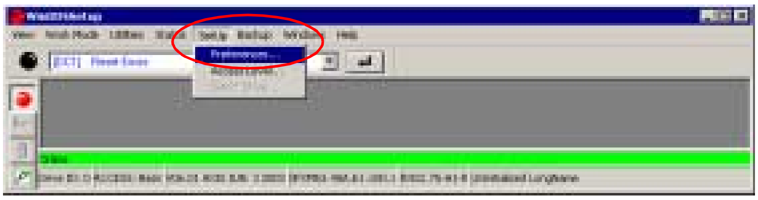


fig. 37 Serial communication port selection

The serial port of the PC may be accessible through either a 9 - pin or a 25 - pin SUB-D type connector.

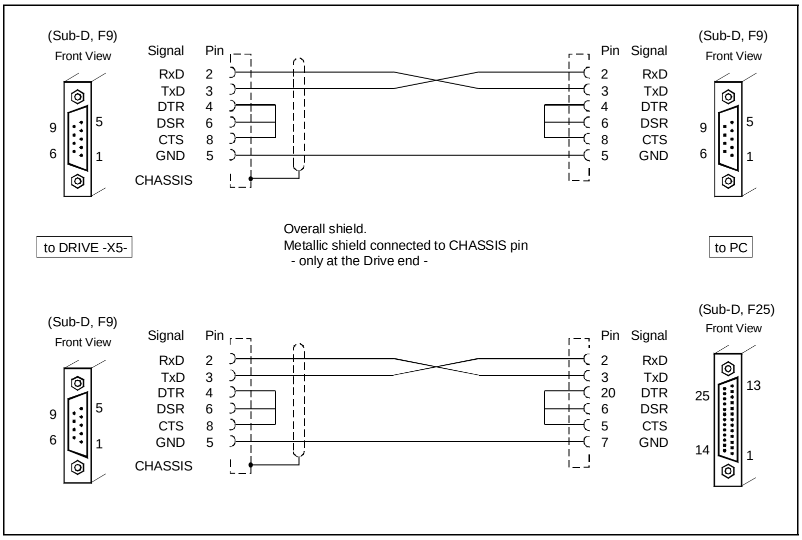


fig. 38 Serial line cable to a PC

Serial line to DDS PROG MODULE.

The line labeled as +5V is only required when using the programming module "DDS PROG MODULE".

When mounting the programming module away from the drive, the screw located next to the connector should be connected to a chassis pin.

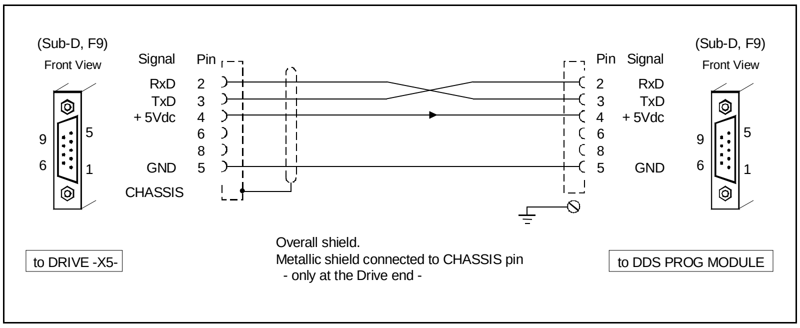


fig. 39 Serial line cable to the DDS PROG MODULE

Connection of an SPD module with an SPM spindle motor and encoder feedback.

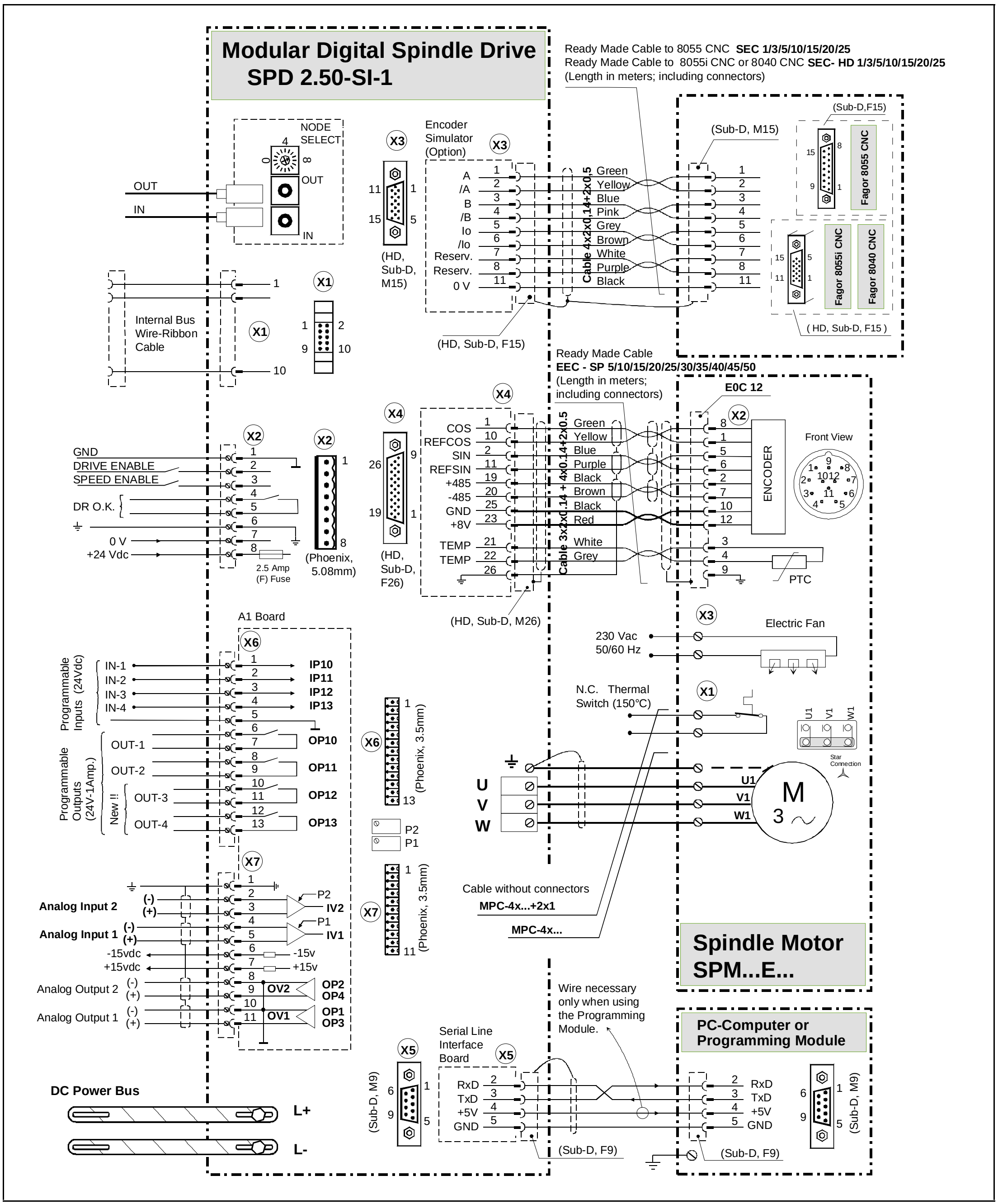


fig. 40 Connection of the SPD module with the SPM spindle motor

Connecting an AXD module with an FXM servomotor and resolver feedback.

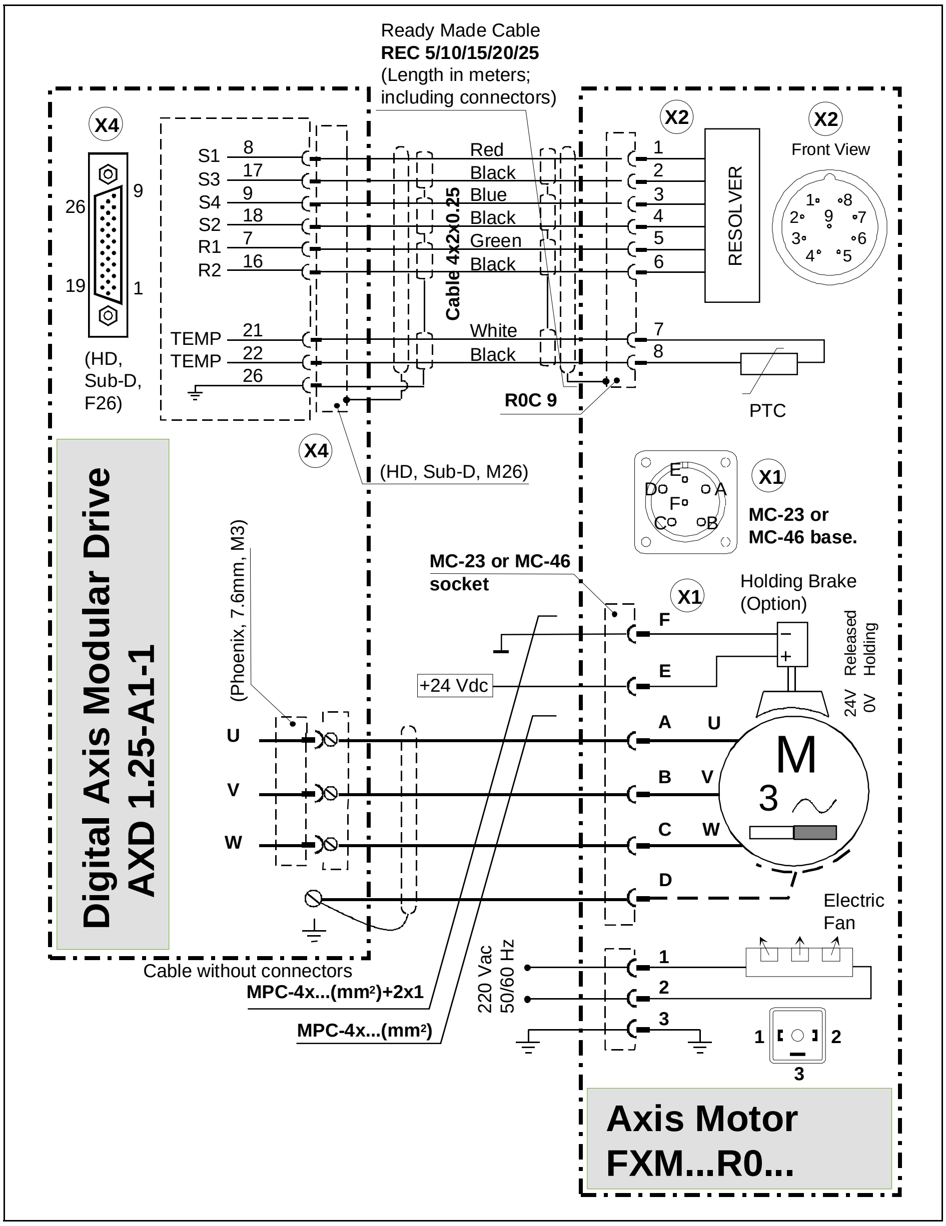


fig. 41 Connection of the AXD module with the FXM servo motor

Connection of an SCD module with a spindle motor SPM and encoder feedback.

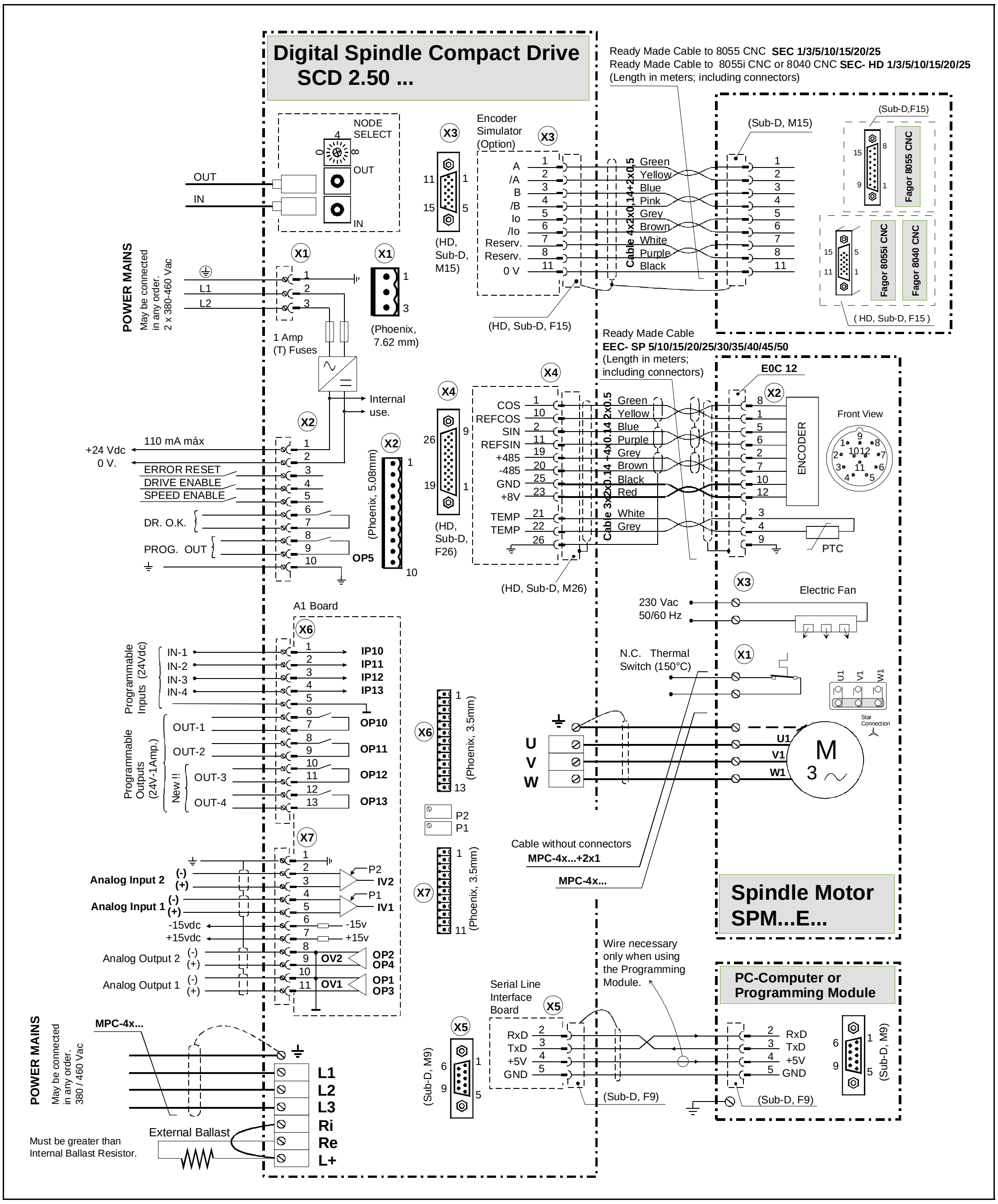


fig. 42 Connection of the SCD module with the SPD spindle motor

Let us see which is the system power - up procedure.

The internal control circuits of each power supply module, drive or compact drive must be supplied with 24 V_{dc}.

Compact modules, XPS power supplies and the PS-25Bx power supplies do not need an external 24 V_{dc} power supply. These modules need two - phase 380-460 V_{ac}.

Each module verifies its hardware and internal configuration.

If the status is correct, the DR.OK contacts are closed.

If all the drives are OK, the power supply closes its System OK contact.

We supply mains power to the power supply module.

The power supply " loads " the power bus with "Soft Start".

We activate the Drive_Enable control input of each drive.

We activate the Speed_Enable control input of each drive and the System_Speed_Enable input of the power supply.

The motor is now ready to follow the velocity command given by the CNC.

The following diagrams for power and control circuits in the electrical cabinet are **only orientative for the technician designing the machine and they may be further completed or simplified at will** according to each application.

Next, we offer a brief description of the function of each part of the circuit.

When turning the main switch on [Q1], the 24 V power supply powers the control circuit of each module. These circuits perform an internal test of the module. If there is no errors, the corresponding Drive_OK contact closes and this status is communicated to the power supply module via the internal bus. If all the modules associated with a power supply are "OK" and the latter does not detect any errors in its own module, it closes the System_OK contact.

In the case of the **compact modules** as well as the **XPS and PS-25Bx** power supplies, the closing of Q1 must take two phases to connector X1 without the need for external fuses.

Emergency line: The D1 relay confirms that the system is mechanically and electrically in working condition and it will be activated by the System_OK contact of the power supply. D1 will be deactivated if an emergency occurs at the CNC, if the operator presses the E - stop button [mushroom]. if the SPM motor overheats or if any axis of the machine hits the end - of - travel [limit] switch. A normally open push - button is included in parallel with the limit switches in order to be able to take apart the axes of the machine.

We are now ready to turn on the system by pushing the ON button which activates contactor K1. By pushing OFF power can be removed.

Error Reset. Should any module have errors, its Driver_OK and the System_OK would be open, D1 deactivated, and the power supply could not be powered up. Some of these errors may be eliminated by applying 24 V_{dc} to the Error_Reset pin of the power supply. The errors are reset by means of the contact associated with the ON button. This may cause the Driver_OK and System_OK contacts to close activating D1and, while ON is pressed, activate K1.

This circuit configuration joins the error reset and the system power - up in a single push - button.

Activating D2 activates the relay D3 which in turn confirms the Drive_Enables of all drive modules. The green and red lamps indicate that there is or not motor torque [Drive_Enable].

When activating the System_Speed_Enable signal of the power supply, the D2 contact is executed.

Now, the CNC may enable each axis [CNC_Enable] and confirm the Speed_Enable signal to each drive by means of D4, D5, D6 and D7. Remember that a drive will only respond to an external velocity command when the Drive_Enable, Speed_Enable and System_Speed_Enable signals are active [24 V_{dc}].

Stop. When D1 is deactivated on the emergency line or the OFF button is pressed, K1is deactivated and the power supply loses its three - phase power. The System_ Speed_Enable signal drops and, with zero velocity command, the motors try to stop.

To obtain a controlled stop, with torque:

- *the drives control circuits must be under power and*
- *the Drive_Enable signal must remain active while braking the motor.*

These two points are obtained:

- *using a 24 V_{dc} power supply that maintains those 24 Vdc by using the energy returned by the motor to the power bus. The auxiliary power supply APS 24, as well as the internal power supplies of the XPS, PS-25Bx and compact modules meet this condition, [24 V_{dc} [*] on the diagrams].*
- *delaying the canceling of D3 and using a maintained 24 V_{dc} voltage to activate the Drive_Enable pin shown with an asterisk [*] on the diagram.*

When opening Q1, the braking must also be controlled.

Controlling the brake. In some applications, the Z axis on a milling machine, a electromechanical brake is used over the rotor in order to lock it.

The brake holds the rotor when it loses voltage at its terminals. Therefore, when the machine is down, the brake locks the Z axis so it does not drop. The reaction time of a brake may be anywhere from 200 ms to several seconds.

While the brake is locking the motor, the motor must be kept with torque. To do this, the drive has parameter GP9 [S00207] DriveOffDelayTime. This GP9 indicates how long the drive will maintain its torque active after stopping the motor [speed ~ 0]. GP9 [S00207] is given in milliseconds. By assigning to GP9 a value slightly larger than the brake holding time, one assures that the axis does not drop in emergency stops.

When powering the machine up, the brake must not be released until the system assumes control of that axis. This can also be controlled by means of internal variable TV100 [F01702] TorqueStatus .

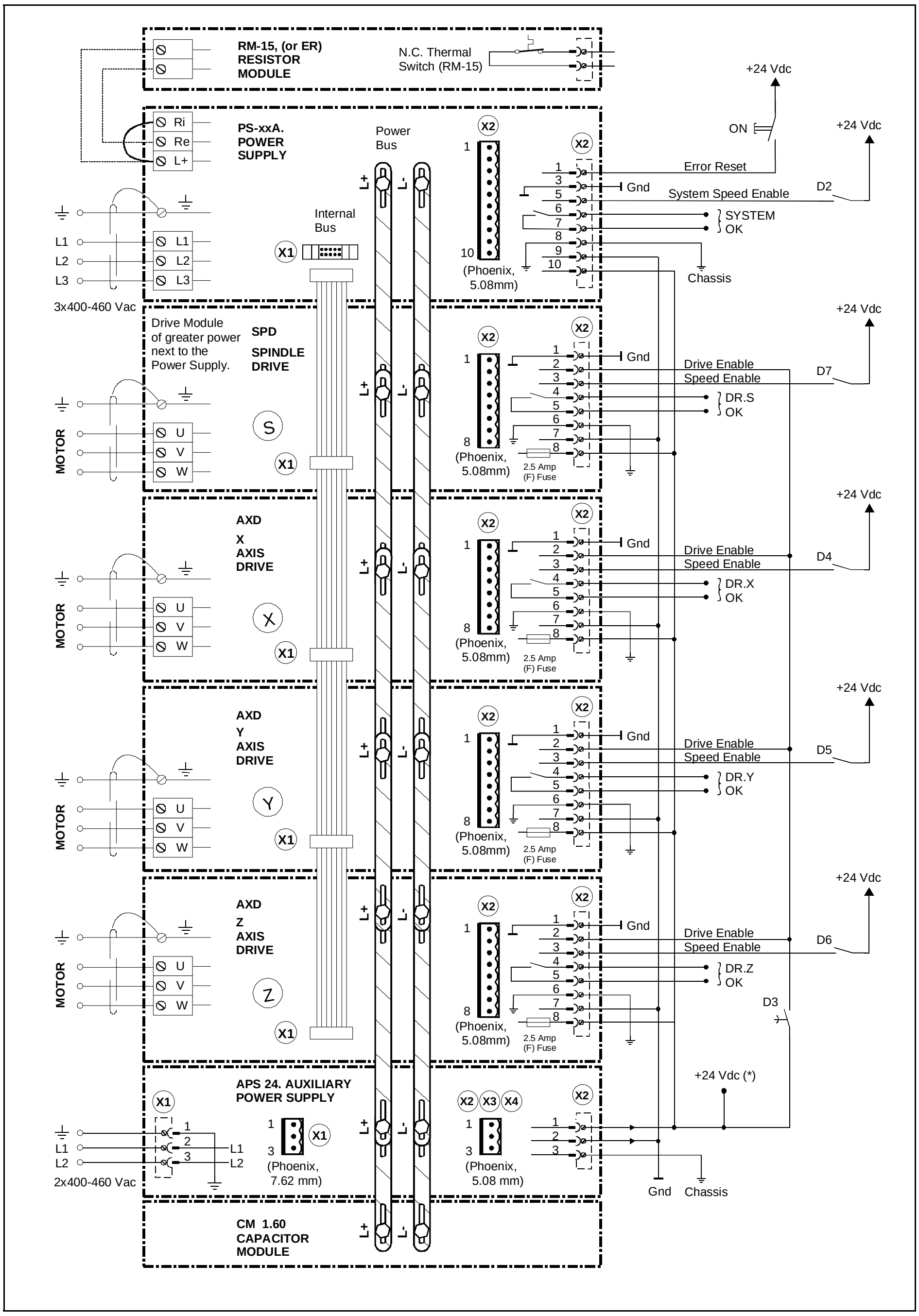


fig. 43   [A] - Modular system with PS-xxA

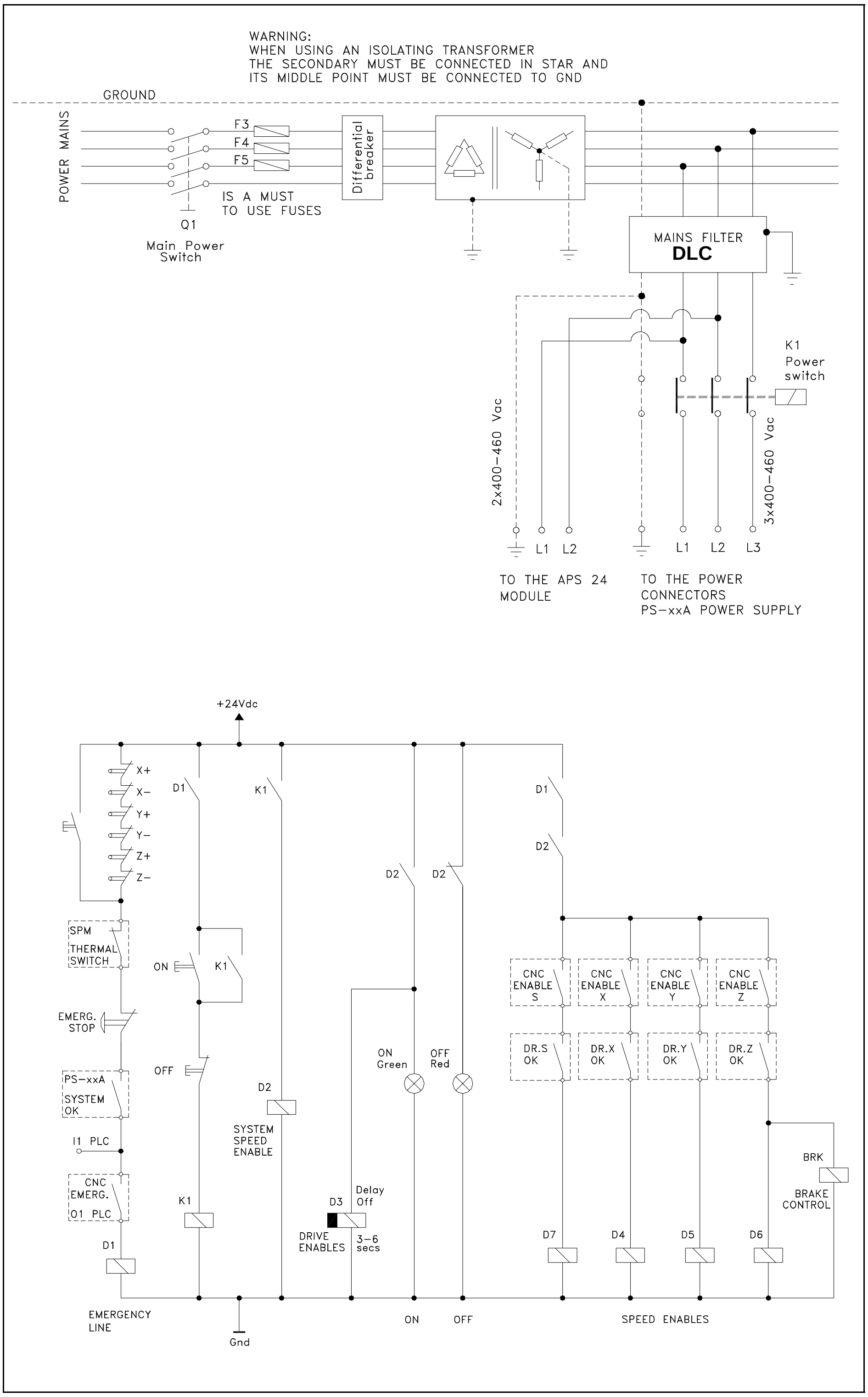


fig. 44 [B] - Modular system with PS-xxA

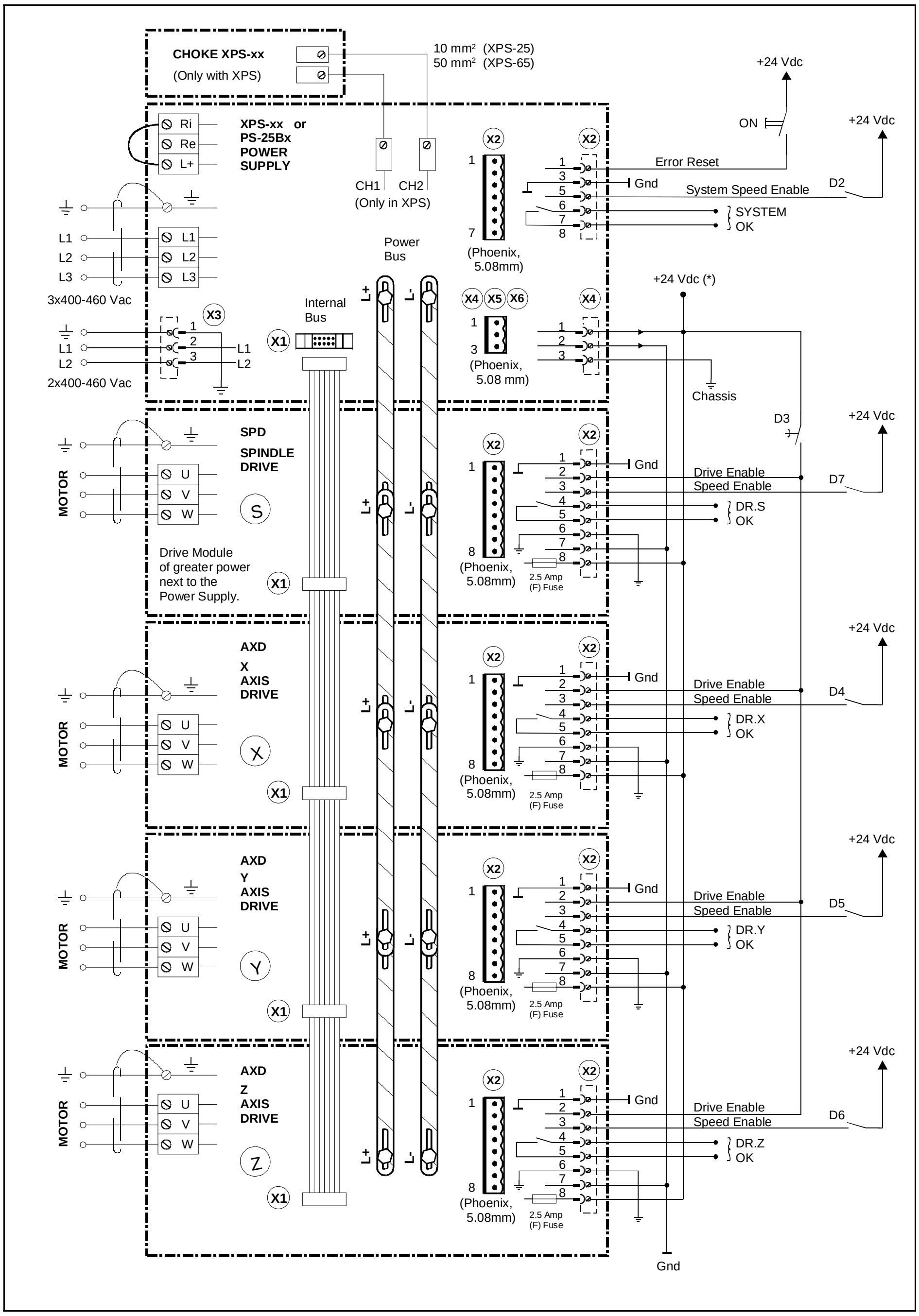


fig. 45 [A] - Modular system with XPS or PS-25Bx

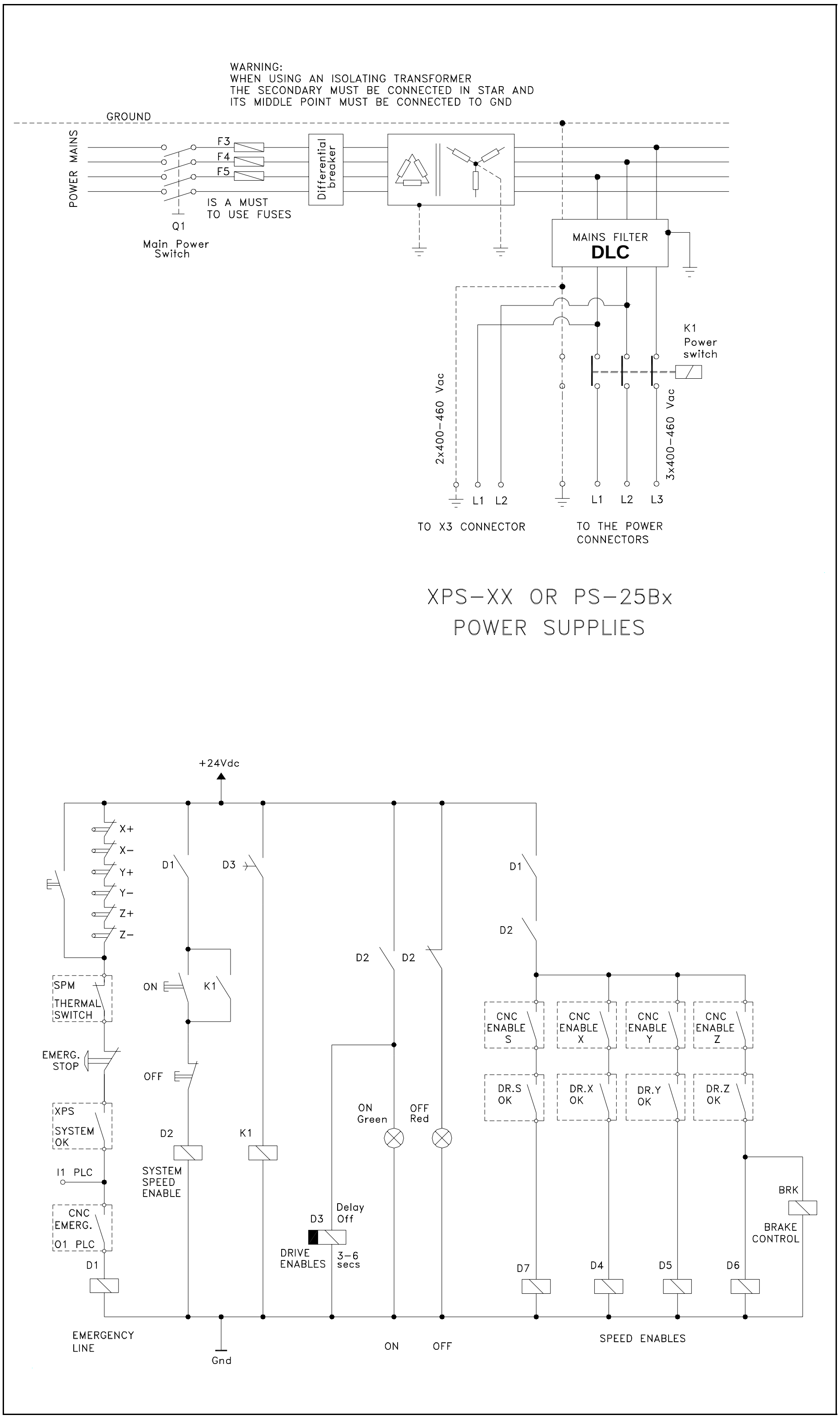


fig. 46 [B] - Modular system with XPS or PS-25Bx

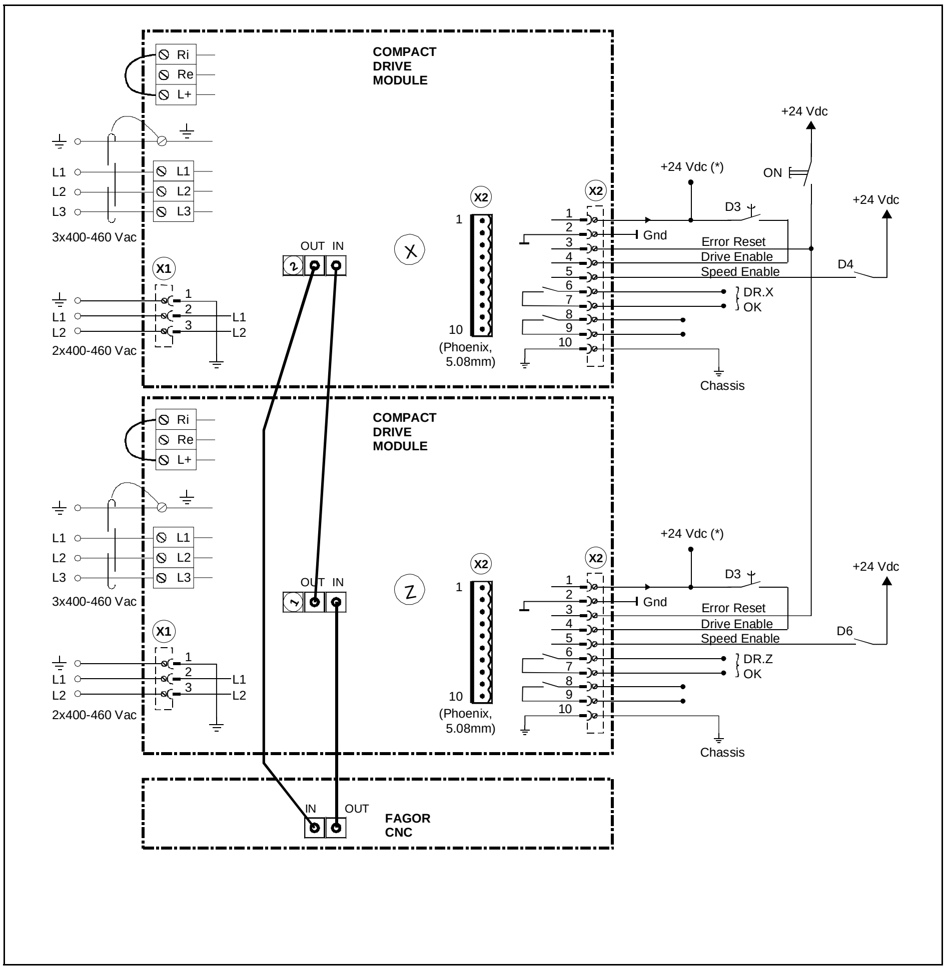


fig. 47 [A] - Compact system with Sercos®

Compact modules do not have the System_Speed_Enable signals.

In this schematics, in spite of having Sercos® interface, electrical signals are used to activate the enables.

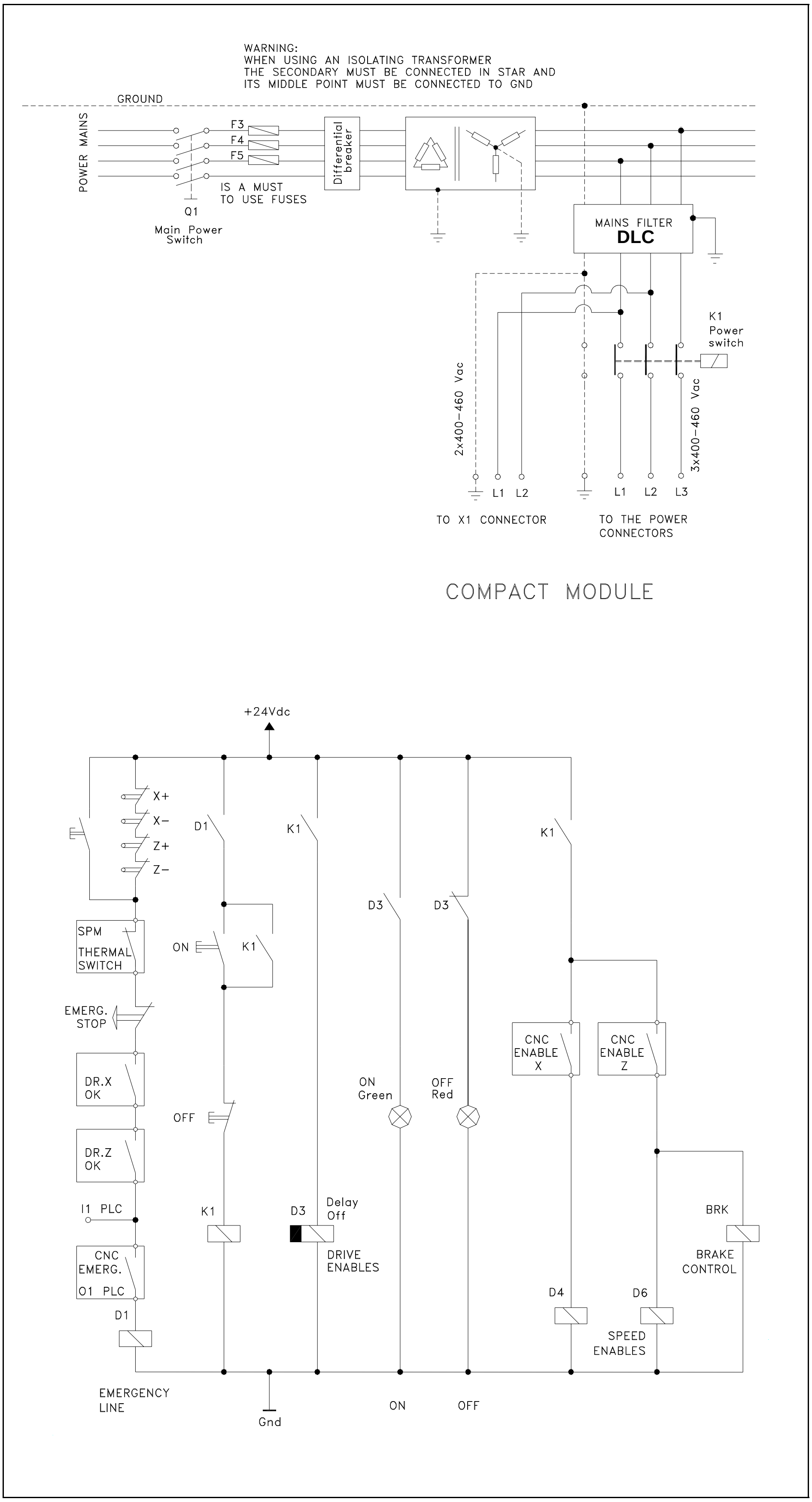


fig. 48 [B] - Compact system with Sercos®

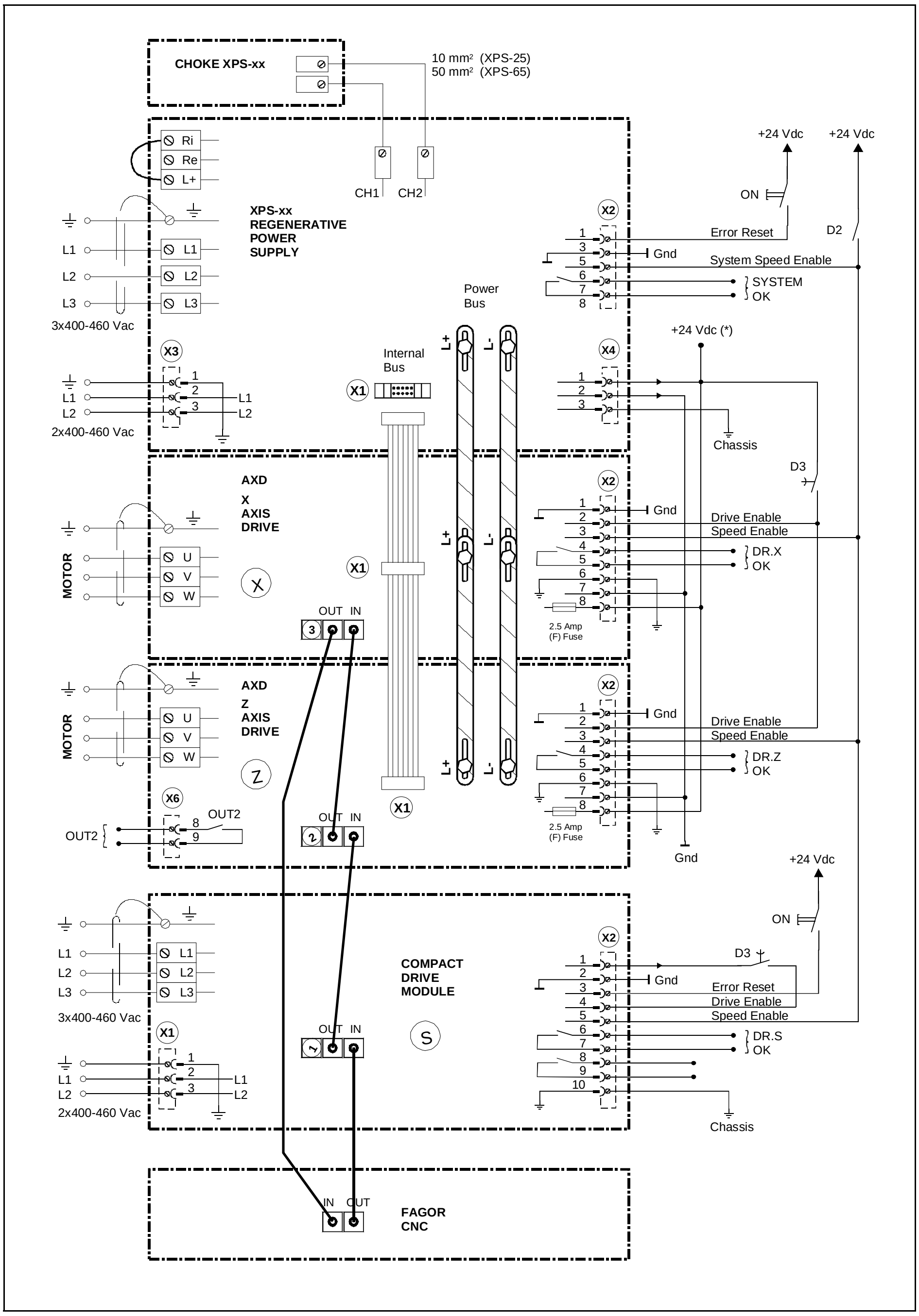


fig. 49 [A] - Mixed system with Sercos®

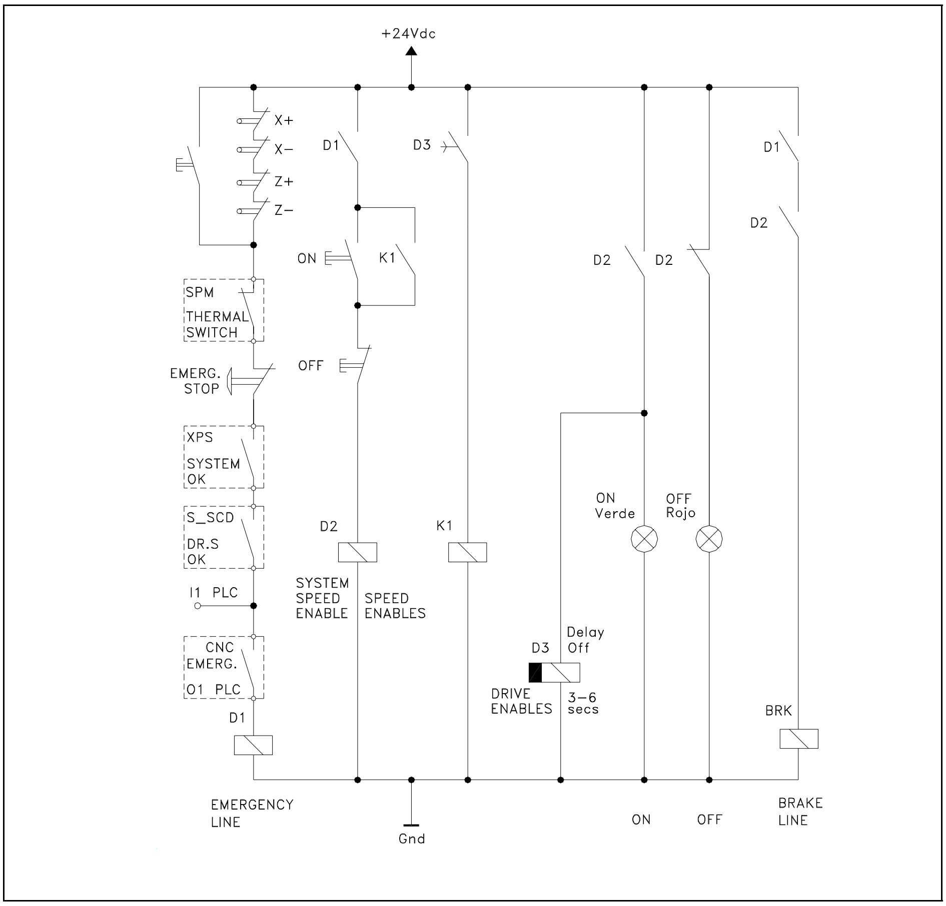


fig. 50 [B] - Mixed system with Sercos®

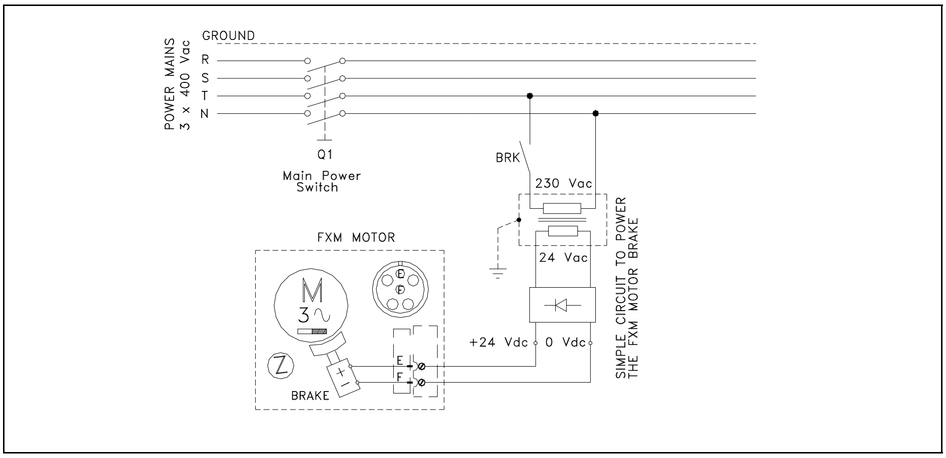


fig. 51 Brake connection

User notes:

COMMON SETUP

3

Introduction

This chapter describes some of the steps of the adjustment process for the drive module DDS. It only considers the ones that are common to the **velocity drive** and **position drive** applications. The specific steps of each application are described in the following chapters 4 and 5 .

Module power - up

When powering up the DDS module or doing a reset, various messages appear on the seven - segment display:

1. Initializing stages 1, 2, 3 and 4.
2. Software version, after the **r** with the identifying digits.
3. Error listing.
4. Warning listing.
5. Return to step 3.

Phases shown on the 7- segment display (04.01 version) DDS :

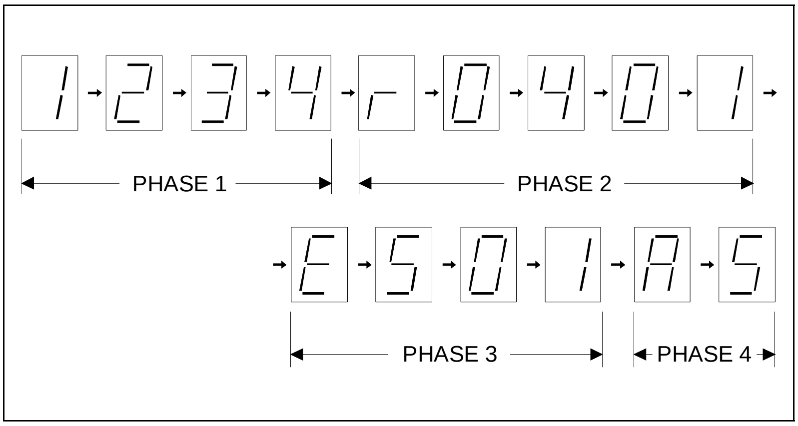


fig.1 Module startup stages.

Data storage structure

Both the PC and the programming module as well as the drive it self have nonvolatile memory. The **hard disk** and the **flash** memories respectively.

These systems keep the stored data even when power is removed. Also, the drive has another two memory areas used for its internal operation and communications: **internal memory** and **RAM memory**. fig.2 shows the interconnection between all of them.

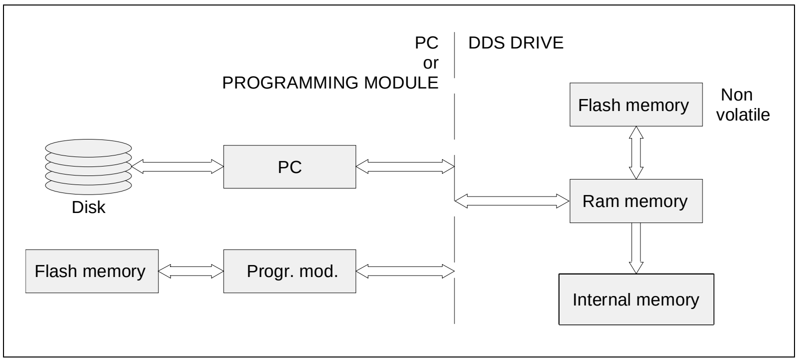


fig. 2 Data storage structure.

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

WinDDSSetup

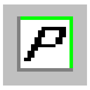
Fagor's own program, **WinDDSSetup** (running on Windows 95, 98, 2000, XP and NT) permits, through the **RS232 serial line**, to set up the drive.

To install the WinDDSSetup at the PC, insert the CD-Rom supplied by Fagor and follow the steps indicated to guide you through the whole procedure.

The minimum PC requirements for the WinDDSSetup are:
486 - 66 MHz microprocessor and 16 Mb RAM

It may also be adjusted from the portable Programming Module, **DDS PROG MODULE** although with fewer choices than those offered by the PC program.

Parameter and variable editing



Once the WinDDSSetup application is open, clicking this icon on the icon bar displayed in its window shows another window named parameter setting (editing mode) with a list of parameters, variables and command of the drive.

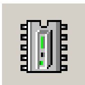
To edit one of them, it must be located and then selected. There are two ways to locate it:

1.- 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.

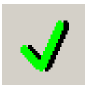
2.- Using the arrow to locate and selecting the specific **GROUP** the parameter or variable belongs to from the drop list. The list displayed on the screen displays will obviously be smaller.

Once locate, it is selecting by clicking on it. Key in the desired value in the **VALUE** drop list and pressing the **ENTER** key located to its right to validate it and click on the icon to validate what is described further below.

This value is stored in the drive's RAM memory and it may be displayed on the screen on the "**Value in RAM**" column**.**



The "SAVE INTO FLASH" icon may be used to save that value permanently in FLASH memory by clicking on the relevant button, displaying it on the "**VALUE IN FLASH**" column. It also carries out the function of the "VALIDATE" icon described next. The commands acting when activating this icon are GC1 and then GC4.



The **VALIDATE** icon may be used to validate the modification of a parameter regardless of whether it is off-line or on-line. This modification is stored in the FLASH memory; therefore, generating a RESET at the drive without previously saving the previous change will lose that change. Consequently, it must be saved permanently in FLASH memory using the previous icon. The commands that acts when activating this icon is GC4.

Observer that each parameter, variable or command has an access level assigned to it. Therefore, they can only be edited at those levels

The following illustration shows the parameter setting window (editing mode):

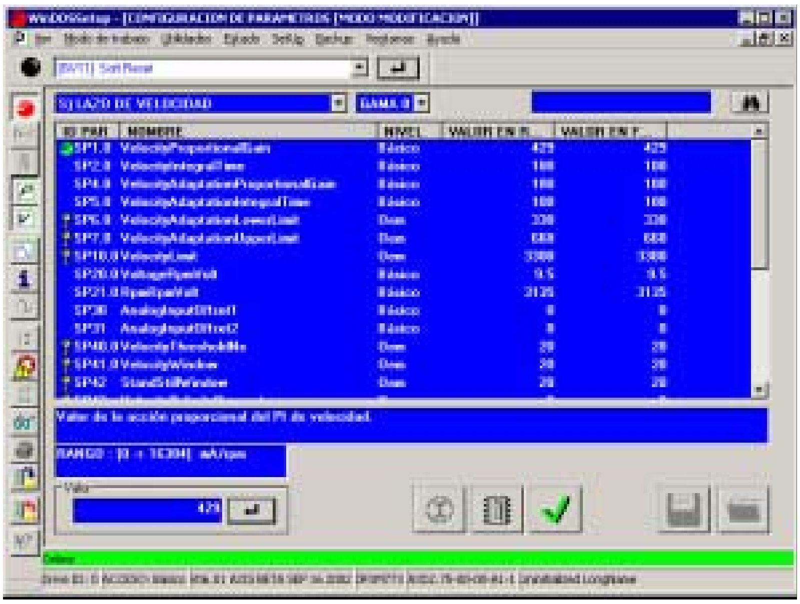
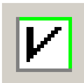


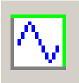
fig.3 Parameter setting window.



The variables are edited the same way by accessing the variables configuration window displayed when clicking the relevant icon of the icon bar of the WinDDSSetup.

fig.4 Variable setting window.

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:

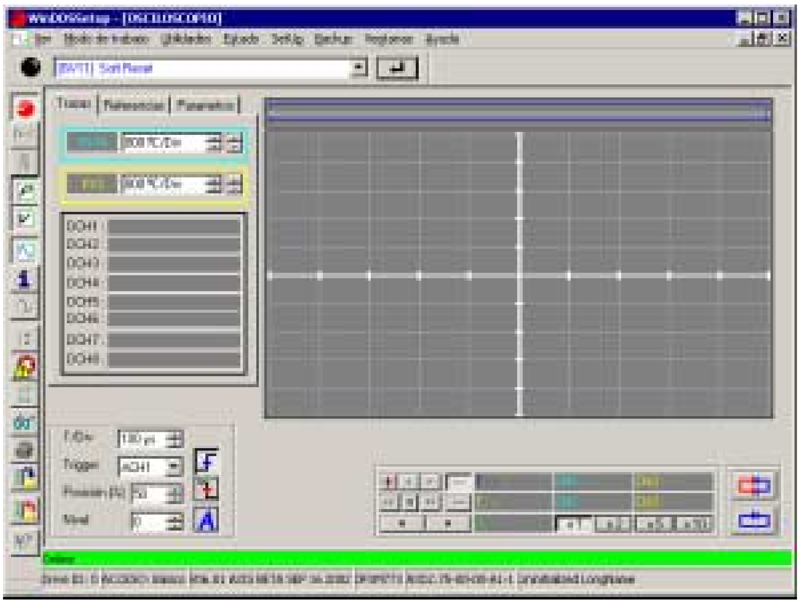
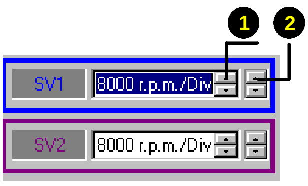


fig.5 Oscilloscope window.

This tool may be used to display on the oscillograph the behavior of two drive variables over time.

If 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:



1. The scale
2. The zero reference position for the variable. In other words, the vertical displacement with respect to the horizontal coordinate [abscissa] axis.

fig. 6 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 channel.

In this box, use the scroll bar to select the group the variable belongs to. Select the desired variable from the list of the group by simply clicking on it.

The dialog boxes look like this:

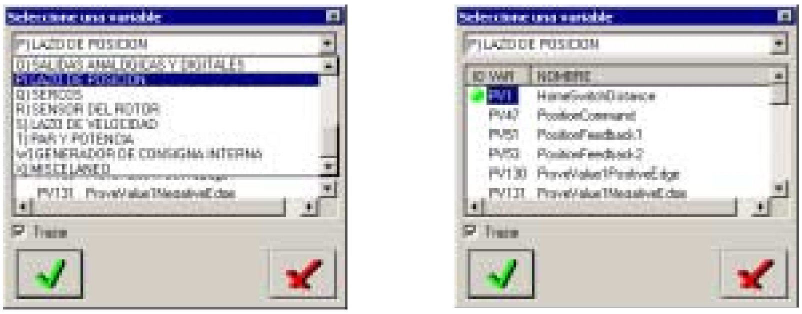


fig.7 Variable selecting boxes.

Activating or deactivating the **trace** means activating or deactivating the channels.

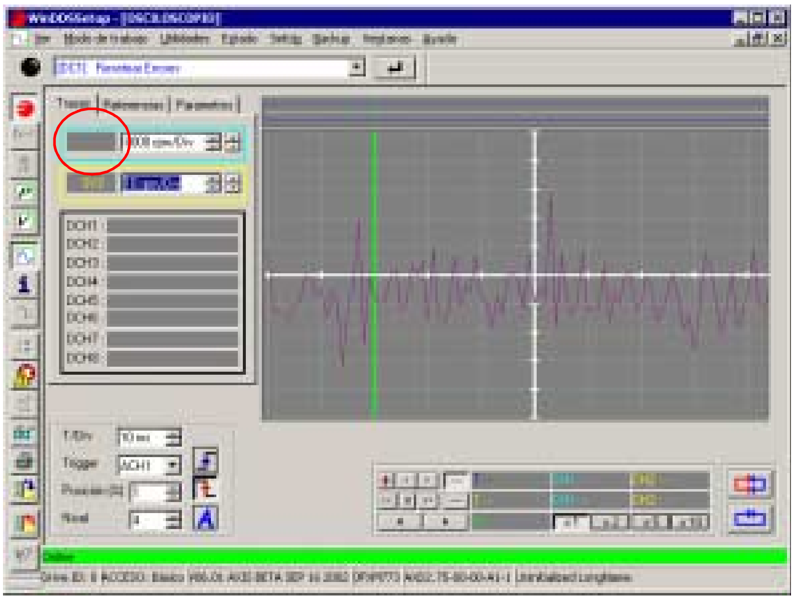
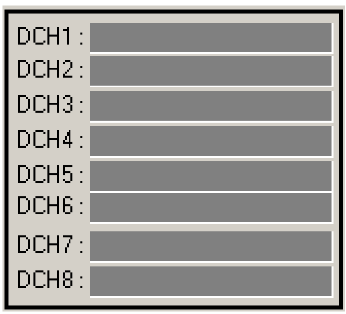


fig.8 Cancelling the TRACE option.

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.

fig.9 Digital channels.

The dialog box looks like this:

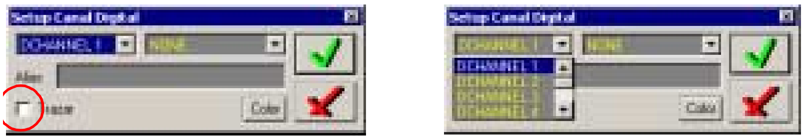


fig.10 Digital Channel Setup boxes.

It also 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.

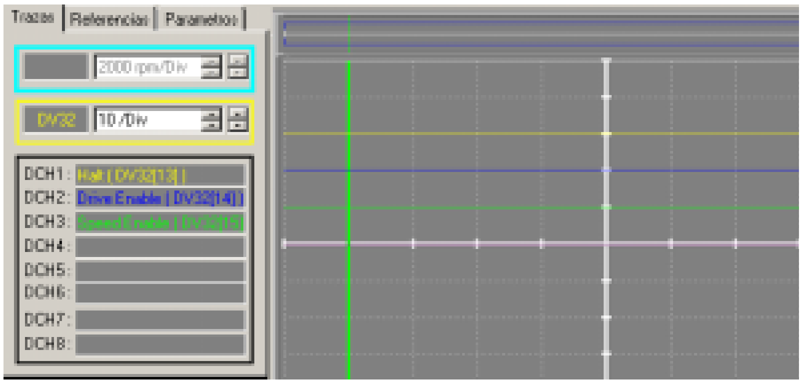
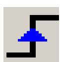
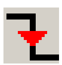


fig.11 ALIAS for channels with active TRACE.

Activating **Trace** permits displaying it on the oscillograph and the Alias - ID var (bit) in the selected digital channel.

It is also possible to set times / 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 with the fields of the following box of the oscilloscope window:


Sets the up - flank trigger


Sets the down - flank trigger

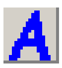

Sets the automatic trigger mode

fig.12 T/Div. trigger, position and level fields.

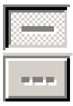
In order to obtain numerical data of the signals shown on the oscillograph, the oscilloscope window shows a box where one can:

- 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
- display the position where the trigger is activated.

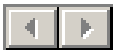
The dialog box that offers all these possibilities appears on the oscilloscope screen and looks like this:

fig. 13 Oscilloscope control panel

Activate/deactivate both cursors

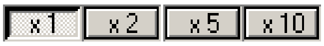


Cursor selection



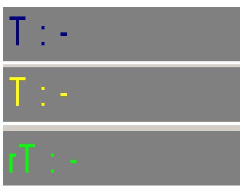
Left/right movement of the selected cursor

Leftmost / rightmost movement of the cursor



Time/division reduction in the indicated proportions

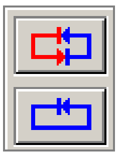
Displays for the values of the intersections between the signals shown on the oscillograph and the active cursors.



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, 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 **graphic setup.**

It is also possible to print and save data and other options shown in the figure below:

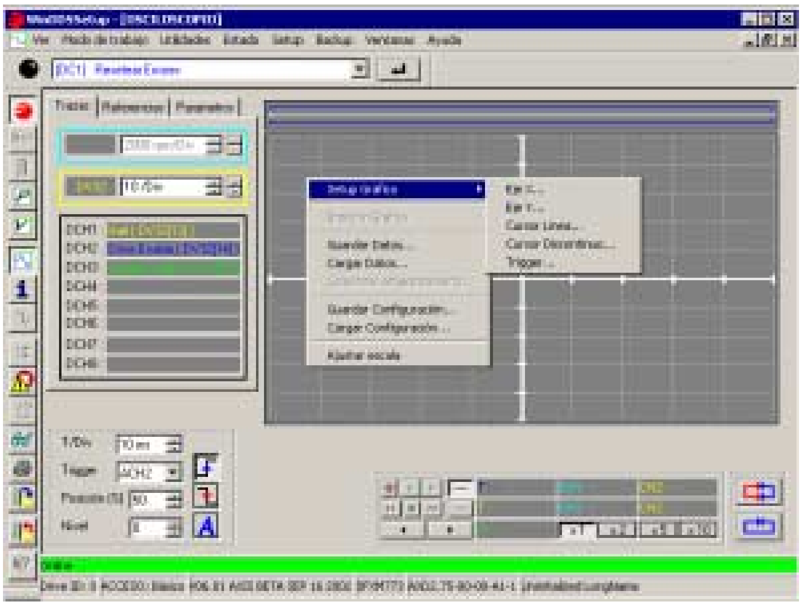


fig.14 Graphic Setup.

From these windows it is possible to configure the attributes of the horizontal and vertical axes such as grid dimensions, logarithmic scale, color, style, line width and many other attributes.

fig.15 Windows to define attributes of the axes, cursors and trigger.

It is also possible to set how to display the behavior of the variable assigned to each channel on the oscillograph by clicking the right button of the mouse on each channel of the oscilloscope and selecting **setup** at the window being displayed:

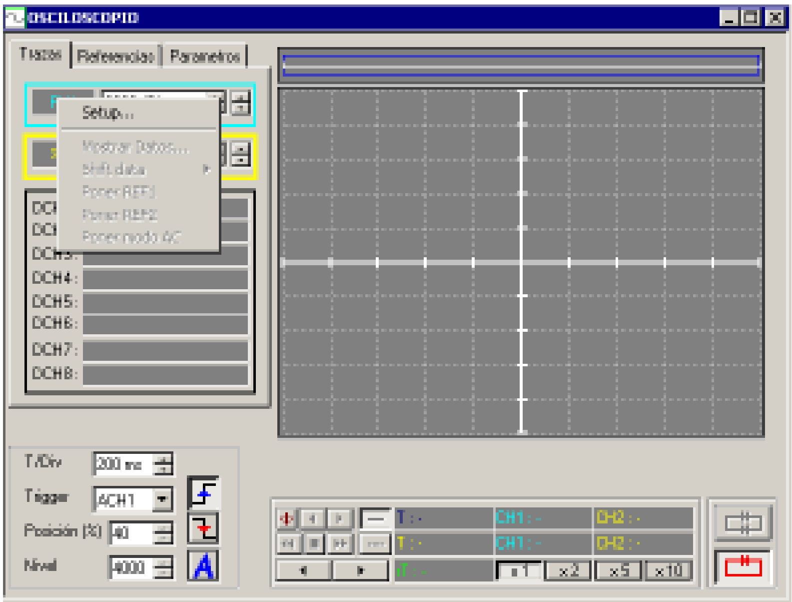


fig.16 Setup.

Depending on the what has been selected in the drop box, it will show one window or the other to set the different attributes for displaying the signal corresponding to that channel.

fig.17 Windows to define the Plot parameters and bar graphics.

Selecting **shift data** *with can only be 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. Thus, selecting 0 bits will display the first 16 and the bit string move as you select the number of bits.

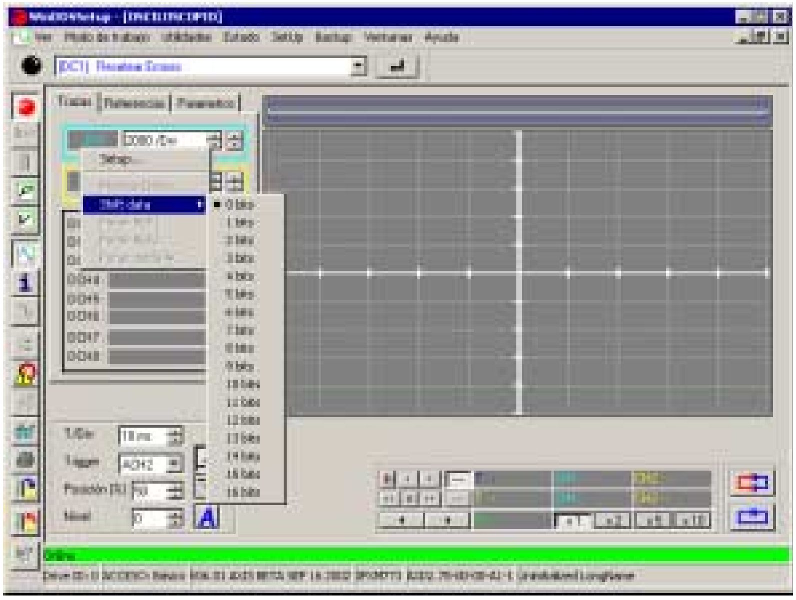


fig.18 Drop menu: shift data.

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 contains data [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 label** activated) expands a menu for selecting the destination reference channel for the captured trace (select REF1 or REF2).

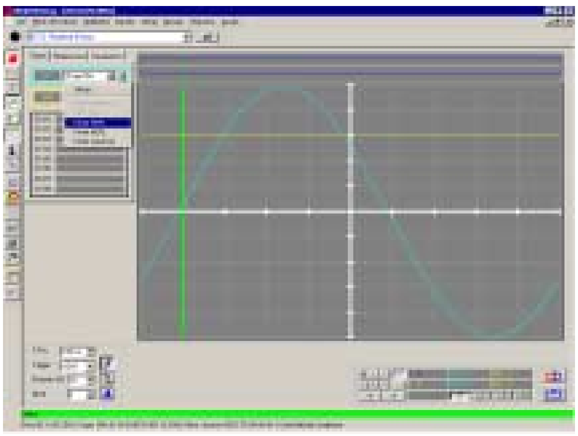


fig.19 Transfer menu with trace captured in channel 1 to reference channel 1 using REF1.

The traced captured in channel 1 is loaded as a reference trace 1 when activating REF 1 of the expanded menu. Activating the **reference label** it is possible to verify that the captured trace is located in the first reference channel.

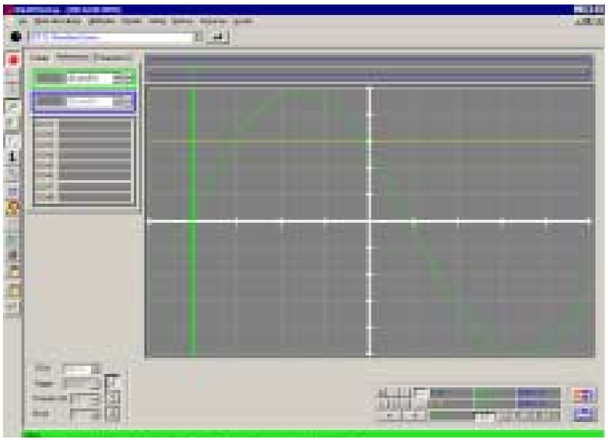


fig.20 Trace captured in the reference channel 1.

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.

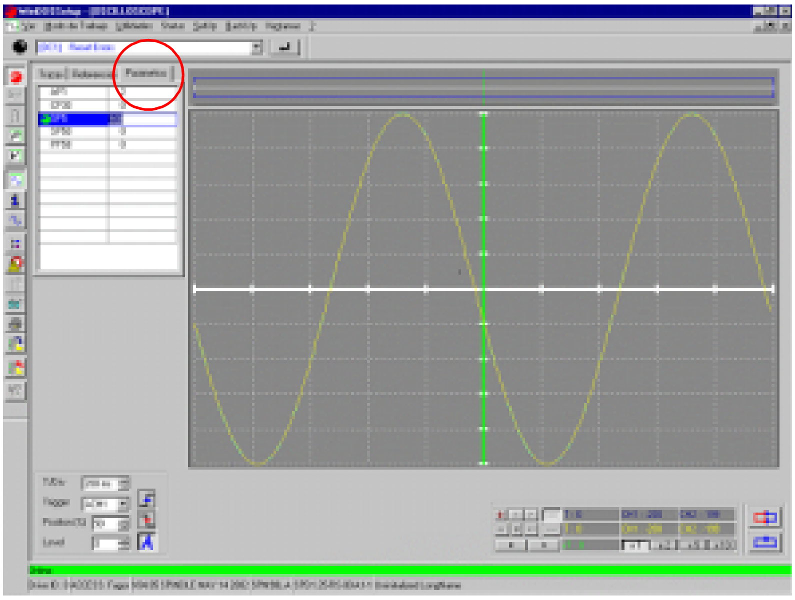


fig.21 Parameters tab. Configurable parameter list for adjustment.

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.

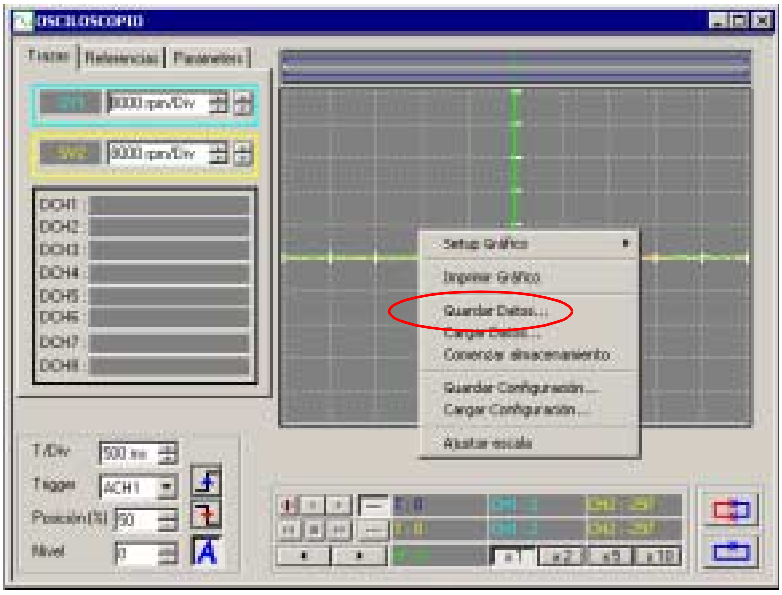


fig.22 Store the list of parameters in a file using the option to save data.

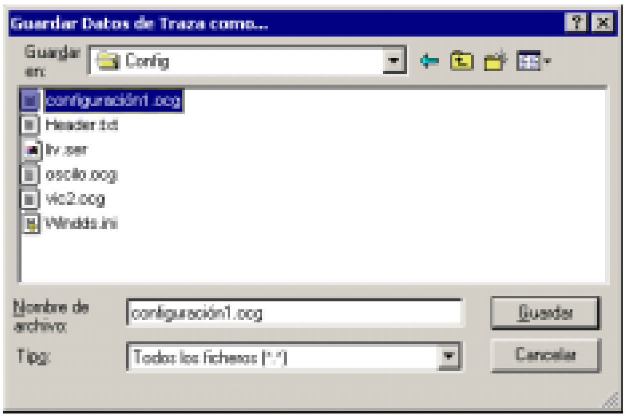


fig.23 Window < save trace data as ... >.

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**".

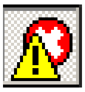
Either mode may be selected from the menu used to transfer a trace from a capture channel to a reference channel.

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.

fig.24
Drop Menu for selecting either the AC or DC mode.

Error display



From the WinDDSSetup application and by clicking this icon, the SPY window can display the list of errors occurred at the drive, in the order they came up which may sometimes facilitate the diagnosis.

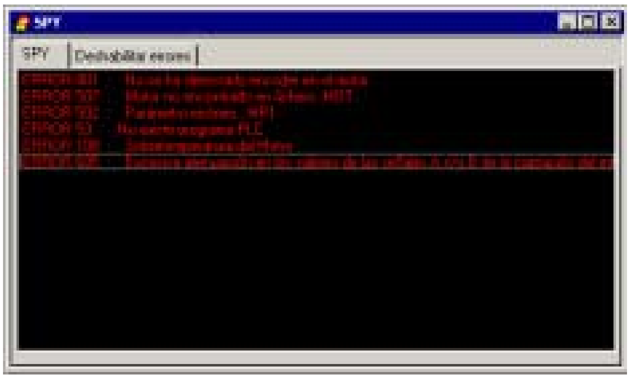


fig.25 SPY window. List of errors.

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.

fig.26 Spy window: Disable errors.

Select the error in the window expanded on the screen and confirm by clicking the  icon.

This option requires user, OEM or FAGOR access.

Then, execute the DC1 command (reset errors) to make error disabling effective.

fig.27 DC1: Reset errors.

Operation of the programming module

With the programming module **DDS PROGRAM MOD**, the same operations as from a PC may be carried out although with the limitations of a smaller screen and a smaller keyboard.

Its basic functions are:

Edit parameters. Individually or in sets.

Read, store and transmit parameter tables.

Execute drive commands.

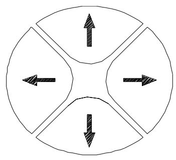
Dynamic display of internal variables.

From now on, the various keys of the module will be referred to by the numbers appearing in the figure: **UP**, **DOWN**, **LEFT**, **RIGHT**, **I**, **O**, **ESC** and **Enter.**

Menu structure

The menus are organized on different levels as indicated by the diagram of the figure below.

To move around between menus of the same level, use the keys:



To Enter into a submenu, press Enter and press ESC to exit from a submenu to a more generic one.

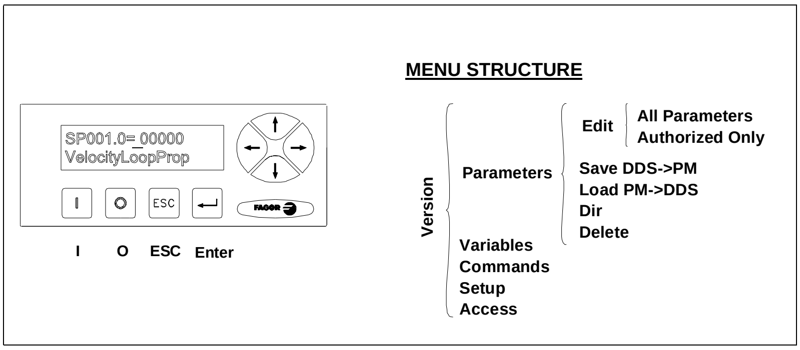


fig.28 DDS front panel. Menu structure.

Menu for editing parameters

The parameters may edited through two different menus, **Edit - All Parameters** and **Edit - Authorized Only**. The first option shows all the parameters and the second one only the ones which may be modified depending on the current access level.

The top line shows the parameter identifier and its current value in the drive's Ram memory. An asterisk (*) at the end of the first row indicates that the parameter cannot be modified from the current access level.

The bottom row shows the name of the parameter. If it does not fit in the 16 characters being displayed, their full name can be displayed by pressing **O**. By pressing **O** again, we return to the editing mode.

Function of each key of this menu:

O — Shows the full parameter name if longer than 16 characters.

ESC — Cancels the parameter editing mode and it steps back in the menu structure.

ENTER — Validates the new value and it is stored in the drive's RAM memory. It steps forth in the menu structure.

← → — Move the cursor on the row being edited.

↑ ↓ — Edit the parameter name and its value. By placing the cursor under the character to be changed, we could select the group, index and set the parameter belongs to and change its value. With the cursor under the equal sign will scroll the whole parameter list.

Notes:

The parameters are in alphabetical order and with their indexes in descending order.

When selecting the (*), on the identifying digit, we will be editing all eight parameter sets at the same time. There are parameters containing the identifier for another parameter or variable. With cursor placed on that identifier, we can scroll the whole set of parameters and variables with the keys ↑ ↓ .

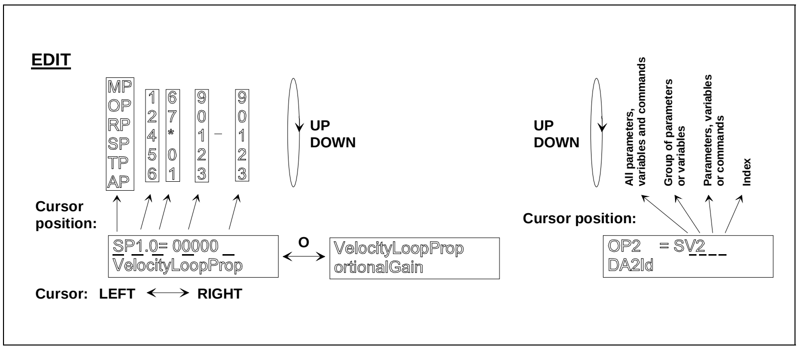


fig.29 Parameter editing.

Operation with parameter tables

This portable programming module offers the possibility to store a great number of parameter tables in its permanent memory without having to be under electrical power. One can rename them, read them from some drives and later transfer them into other drives, thus copyng their configurations.

Within the **Parameters** menu, there are four submenus to operate with parameter tables. They are: bidirectional table transfer, directory of tables stored in the programming module and deleting them: **save**, **load**, **dir** and **Delete**.

The function of each key on this menu is.

ESC Steps back in the menu structure cancelling the command in progress.

ENTER Loads, saves or deletes the table. Steps forth in the menu structure

← → Moves over the characters when editing the name of the table.

↑ ↓ Scroll the alphanumeric set when editing the name of the table.

Variables menu

his menu is used for monitoring the variables dynamically.

Some of these variables may be edited from the keyboard just like the parameters. When the cursor is placed under the value of a variable, monitoring is momentarily frozen. The ones showing an (*) on their right cannot be changed from the current access level. The bottom row shows the name of the variable.

Press **O** to display its full name.

Setup menu

This menu requires an OEM access level. The module itself will request the password when attempting to access it.

The SETUP menu permits generating an internal signal which we can use as a velocity command and adjust the parameters of the speed PI (SP1 and SP2), and the drive's offset (SP30 y SP31) on - line.

The menu offers three fields to define this internal velocity command signal. **Waveform**, **period** and **amplitude** (Wave, period, ampl.). We can choose from a squarewave or DC (Square, Dc).

The definition of the **amplitude** and **period** of this velocity command as well as the **modification of the adjustment parameters** have and **immediate effect** at the internal generator and on the drive's behavior.

The function of each key of this menu is:

I Turns on the internal signal generator.

O Turns off the internal signal generator

ENTER Accepts the selected waveform. It steps forth in the menu structure.

ESC Cancels the selection of the waveform. It steps back in the menu structure.

← → Move the cursor back and forth on the editing row.

↑ ↓ Edits the digits and toggles waveforms.

Notes:

When selecting the DC waveform, the period field disappears and the amplitude field may take a negative sign.

The period field can only take specific values.

Parameters SP1 and SP2 (speed PI) adjusted with this method correspond to the currently active parameter set. See (parameter set) on chapter 6.

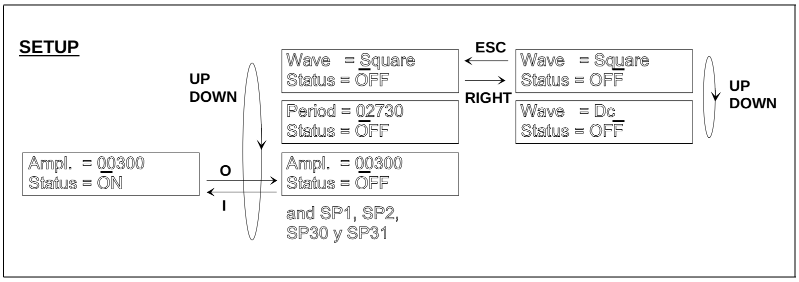


fig.30 Setup menu.

Commands menu

Depending on the access level, the COMMANDS menu lists a series of commands which may be executed by pressing the **Enter** key. Some of them are:

BackupWorkingMemoryProcedureCommand (GC1)

Transfers the parameter table from the drive's RAM memory into its permanent Flash memory and recommends to do a Reset.

SoftReset (GV11 = 3) Resets the drive.

ResetClass1Diagnostics (DC1)

Resets the errors shown at the display.

ResetClass1Diagnostics (DC1)

EncoderParameterStore (RC1)

Stores in the encoder memory the sales reference stored in MP1and the RV3 variable for correcting the phase shift between the encoder and the motor.

Access menu

This menu is used for charging the current access level.

The function of each key of this menu is:

I,O Not being used on this menu.

ESC Exits the access level.

ENTER Validates the level choice and the password just keyed in.

← → Moves over the characters when keying in the password.

↑ ↓ Selects the level to be accessed. It scroll the set of alphanumeric characters to edit the password.

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.

The access each parameter, the drive must be set up at the access level required by that parameter. See appendix A.

The access to each level required a password.

To change the access level from the WinDDSSetup, execute the **access level...** option on the **SetUp** menu .The bottom of the screen shows the currently active level.

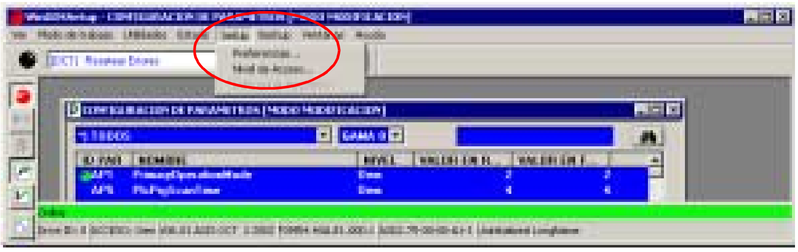


fig.31 Setup. Access level.

The **USER level** is the basic level. On power up, the drive access this level by default, thus 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. Appendix A describes 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).

Parameter editing

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

Important:

The editing of parameters with WinDDSSetup or with the portable programming module affects all the data stored in the drive's RAM memory.

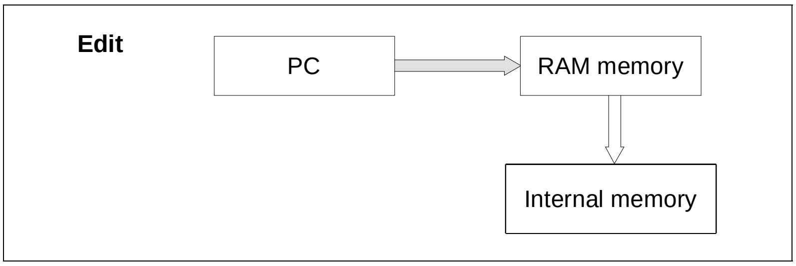


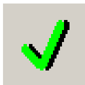
fig.32 RAM memory and INTERNAL memory.

Only the modification of certain parameters also affects the data stored in internal memory. These parameters are known as modifiable on-line. Appendix A shows them with an asterisk (*) after the parameter identifier.

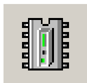
Example:

PP58 ***Os** [S58)] 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 directly 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**.**

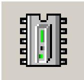


If the unit is turned off, the values of the on - line parameters assumed when turning the nit back on will be the last ones saved in the flash memory.

This way, the new permanent configuration will be saved.

See the following sections of this chapter.

Save into flash memory



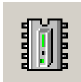
In order for the values given to the parameters during setup stay a permanent drive configuration, they must be transferred into the flash memory. **This is so for both on-line and off-line parameters.**

1. The drive must be connected to power

2. Save the parameters

To do this, execute the command to save into flash.

- At the WinDDSSetup (editing mode) press the button.



- With the command **ParametersToFlash** of the portable programming module.

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

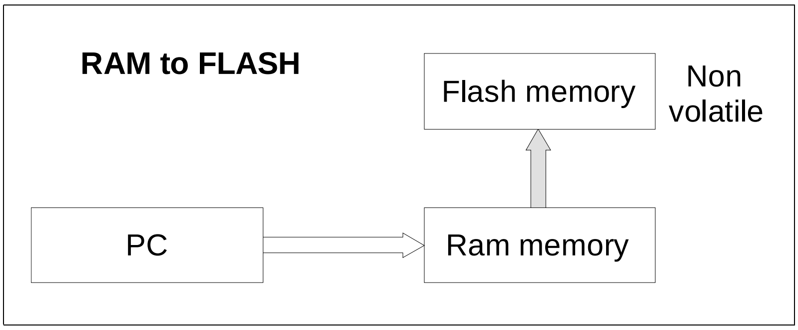
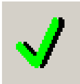


fig. 33 Save into flash memory.

3. The drive needs not to be reset in order for the changes to be effective as in versions older than v.06.xx.

Validating OFF - LINE parameters

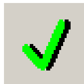


Validating off-line parameters makes it possible that any change on the value of this type of parameters be effective with a single mouse click on the "validate" icon (command GC4) appearing in the parameter configuration window [modify mode] of the WinDDSetup. This command **does not save** the new 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, thus speeding up the setup. To keep the drive configuration change permanent, **it must be saved into flash memory** using the relevant icon.

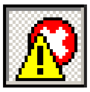
fig.34

Validate from this parameter configuration window.

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

- **Analog axes:** Clicking the **validate** icon 

  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 502.

  The list of errors may be displayed by clicking the  icon of the icon bar of the WinDDSSetup.

- **Sercos axes:** Clicking the **validate** icon, according to the validation of the Sercos Standard; in other words, when going from phase 2 to phase 4.

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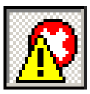
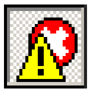
The current versions of the 8070 CNC and 8055 CNC are not ready for such validation and, consequently, the drive parameters must be validated using the method described in the previous section; in other words, saving the parameters in flash memory and then doing a reset at the drive.

This validation tests the following parameters. If there is any erroneous parameter, it will show error 502.

The list of errors may be displayed clicking the  icon of the icon bar of the WinDDSetup.

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 issue error 504.

The list of errors may be displayed by clicking the  icon of the icon bar of the WinDDSSetup.

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.

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.
- With the **SoftReset** command of the portable programmable module.
- At the WinDDSSetup program using the **[GV11] Soft Reset** command. See fig.35.

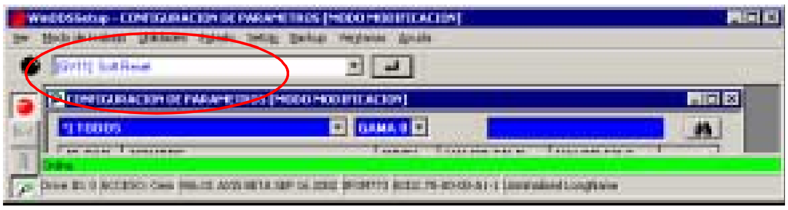


fig.35 GV11 - Soft reset.

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 X2 <1> of the power supply (pin X2 <3> at the compact).
- Executing the command **[DC1] Reset errors** at theWinDDS Setup program.

There are errors considered as **non resettable**, see appendix B.

These errors can only be eliminated by a reset of the drive.

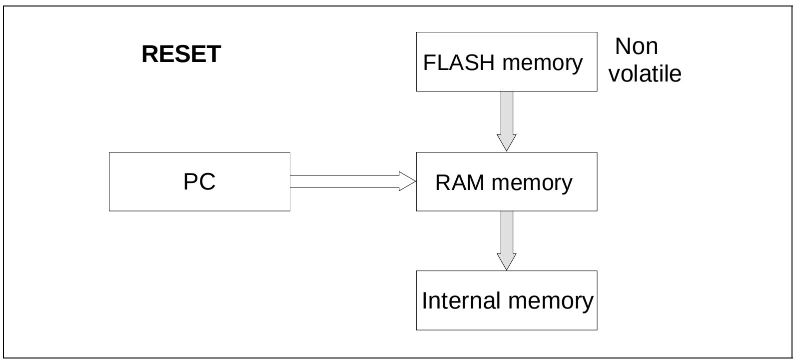
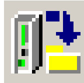


fig.36 Error reset.

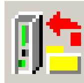
Transferring parameter tables

From the **Flash** of the drive to the hard disk of the **PC**:

- At the WinDDSSetup program, press 

It is used to save the configuration of the drive.

From the hard disk of the **PC** to the **Flash** of the drive:

- At the WinDDSSetup program, press 

it is used to load (copy) a known configuration into a new drive.

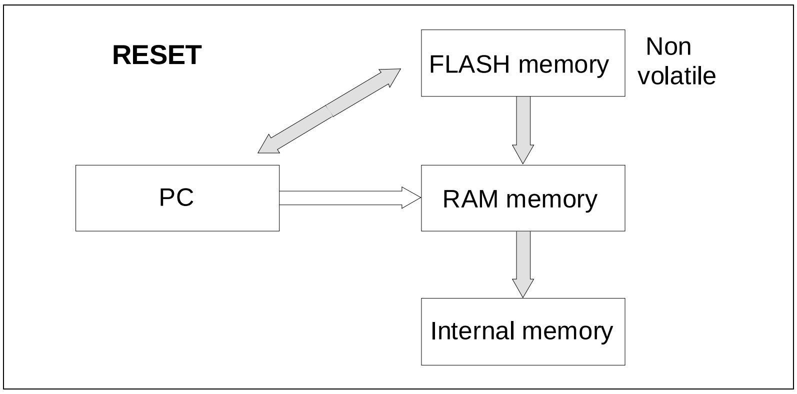
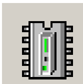


fig.37 Transferring parameter tables.

Observe that it is different from **saving parameters** where:

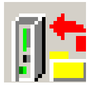
- At the WinDDSSetup, in the parameter setting window, pressing 

  the contents of the **RAM** memory of the drive is downloaded into **FLASH** memory thus saving the parameters.

- The same operation can also be carried out using the command GC1 [S264] Backup Working Memory Command .

(*.mot) file transfer

From the **PC's** hard disk to the drive's **flash** memory:

- At the tool bar of the WinDDSSetup, press 

It is also used to transfer a motor file (*.mot). Each FXM, FKM, SPM or FM7 motor requires a specific drive software configuration. This software contains its corresponding fxm_fkm_xx.mot, spm.mot or fm7.mot file with the initialized parameter data for each motor as well as the parameters for the adjustment of the current and flux loops.

To assign the proper values the motor related parameters, you must "tell" the drive which motor is to be governed. Before selecting the motor, its corresponding (*.mot) file must be transferred.

This way, clicking the icon mentioned earlier shows a window like this:

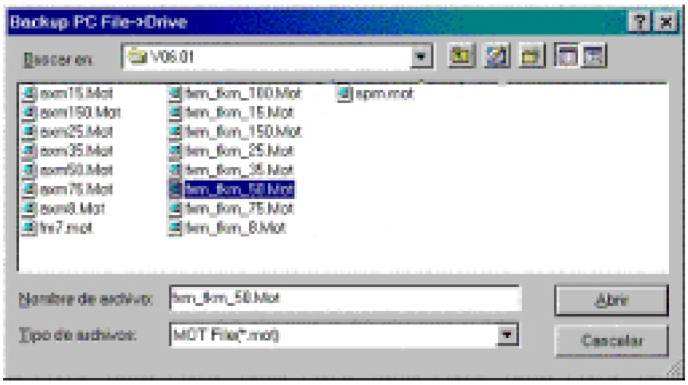


fig.38 Window for transferring [*.mot] files.

Note that "MOT File" (*.mot) must be selected in the "file type" box that shows all the *.mot files existing in the version folder (in this case v.06.01).

FM7 and SMP motors have a single file (fm7.mot and spm.mot, respectively) that contains all the valid motor-drive combinations and the parameters properly set.

FXM and FKM motors have a particular file depending on the drive they are associated with and it is reflected with the digits after fxm_fkm. These digits represents the drive's peak current. Therefore, if an FXM or FKM motor is associated with a 75Amp AXD axis drive, you must select the file: fxm_fkm_75.mot.

After selecting the file and clicking the "Open" button, it starts transferring the selected file to the drive.

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

fig.39 Notifications.

Motor identification

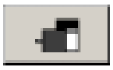
As mentioned in the previous chapter, each FXM, FKM, SPM or FM7 motor requires a specific drive software configuration. This software contains its corresponding fxm_fkm_xx.mot, spm.mot or fm7.mot file with the initialized data of the parameters for adjusting the current and flux loops. Appendix A shows 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 is the motor to be governed.

From the adjusting program WinDDSSetup select the M-motor group at the parameter setting window [modification mode].

fig.40 Parameter setting window.

At an OEM access level or higher and whenever MotorType [MP1] is selected,



it displays a window like the one shown below that displays an icon for selecting the motor.

Note that this icon is not shown in the window for a BASIC access level and therefore the selection is not possible.

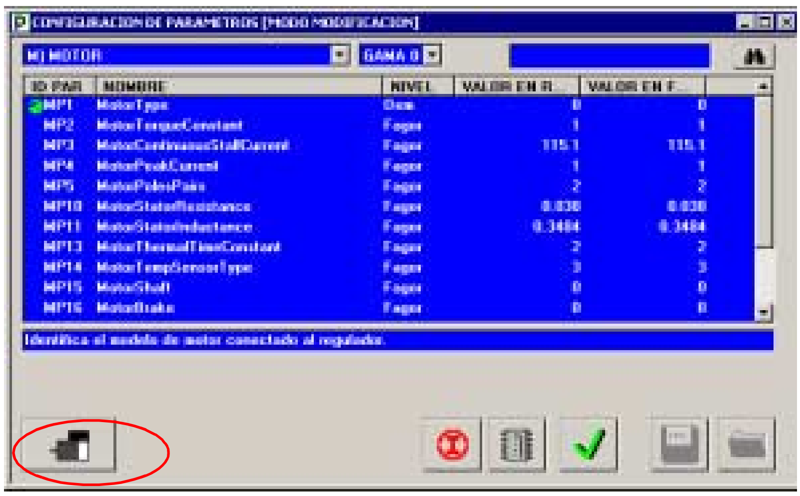


fig.41 Motor selecting icon.

The motor selection window will be similar to this one for an FXM with resolver (an fxm_fkm_xx.mot file must be previously loaded at the drive):

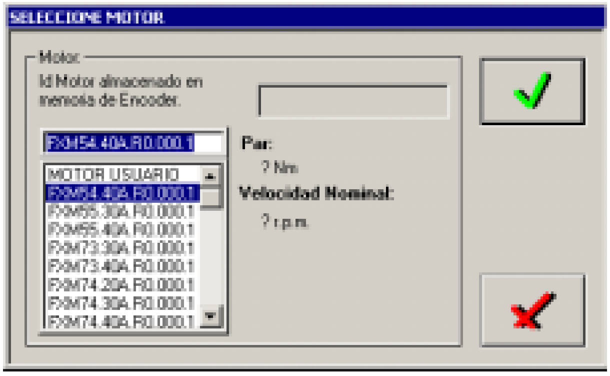


fig.42 Window for selecting an FXM motor with resolver.

This will be the window for an FM7 motor with TTL encoder (an fm7.mot file must be previously loaded at the drive):

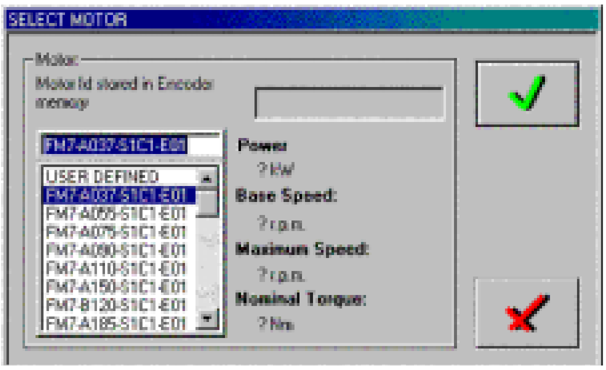


fig.43 Window for selecting an FM7 motor with TTL encoder.

Note that the list of errors appearing in this window depends on the *.mot file loaded at the drive. Thus, an fxm_fkm_xx.mot will be loaded for the first case and an fm7.mot for the second one.

When the motor uses encoder feedback:

The Fagor motors equipped with encoder feedback (ref. E0, E1, E2, E3, A0 or A1) store the motor sales reference in the encoder's permanent memory.

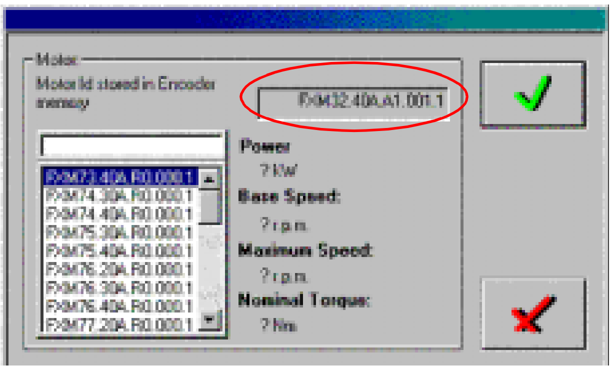


fig.44 Window showing the ID of the motor saved in the encoder memory.

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

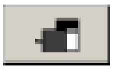
At the window of fig.44 , the motor ID appearing in the indicated field shows the type of feedback device connected. In this case, it is an A1 encoder.

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

From software version v06.08 on, the <motor selection> window shows the **DEFAULT** option. Thus, when selecting this option, MP1 is directly assigned the motor ID stored in the memory of the encoder integrated into the motor itself (see the RV7 variable in appendix A).

Remember that the DEFAULT option only works when the motor has an encoder !

Proceed this way:



With an OEM access level or higher, activate the motor selection icon.
From the <motor selection> window, select the <DEFAULT> option of the drop text list (expandable).

fig.45 Motor selection window : DEFAULT option.

The drive checks whether the ID stored in the encoder of the motor connected to it is correct or not; i.e. whether it matches any of the ID's stored in the (*.mot) file of the motor table.

If so, it automatically sets the parameters of the drive for that motor.

Otherwise, if there is no match, it issues error E505.

When the motor uses resolver feedback:

Fagor motors equipped with resolver feedback (ref. R0) do not have auto - identification.

The drive module must be "told" which motor has been connected to it. The selection window offers a range of motors included in the fxm_fkm_xx.mot file (for FXM and FKM motors) that has been loaded. If the connected motor is, for example, the 2000 rpm FXM32, select FXM32.20A.R0.000.1 at the window for a motor with resolver feedback.

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The selection of the motor using these selection window modifies the MP1 [S00141] MotorType. Assigning a particular reference to parameter MP1 means that all the motor parameters (shown in appendix A with an M) take a fixed value that cannot be changed.

Motor identification and initialization:

The motor may be identified through the initialization button.

Activating this icon displays the window **SELECT MOTOR FOR INITIALIZATION:**

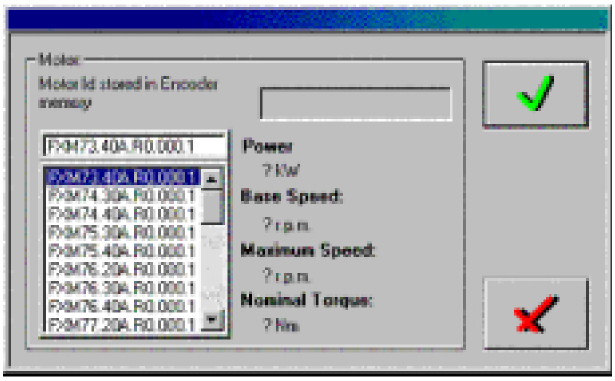


fig.46 Window for selecting an FXM motor to be initialized.

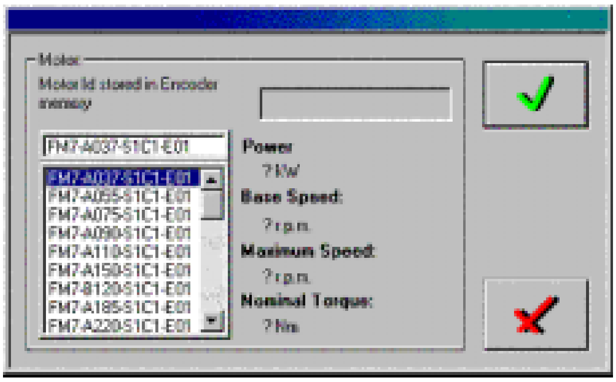


fig.47 Window for selecting an FM7 motor to be initialized.

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 affect those belonging to set and reduction zero. Set 0 and reduction 0 are left as the only useful ones.

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

Automatic identification process on motors with encoder feedback:

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 they are given a **user motor** value (a name starting with zero) its motor parameters may be changed.

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.

User motor:

When installing a non - Fagor motor (user motor) or to get access to certain **motor parameters**, MP1 [S00141] Motor Type must be loaded with a value starting with 0, for example: 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 previous section on transferring parameter tables.

Save to Flash.

Remember that 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:

> **After the adjustment by any of the previous methods, it is necessary to save the parameter table into Flash memory.**

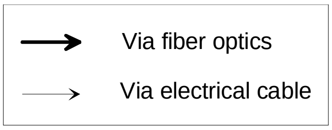
On power - up or after a reset, the system will check that the value given to MP1 [S00141] MotorType (manually or automatically) is correct. In other words, that the motor and the drive are compatible with each other. The error codes will identify the mistake made.

Position or velocity drive

After identifying the motor other adjustment are necessary.

The drive, with the CNC and the feedback, is ready to work with different configurations. Parameter AP1 [S32] configures the drive to work with each of these configurations.

Meaning of the arrows in the following diagrams:



Velocity drive. *(see chapter 4: Adjustment of the speed drive)*

Velocity drive with encoder simulator

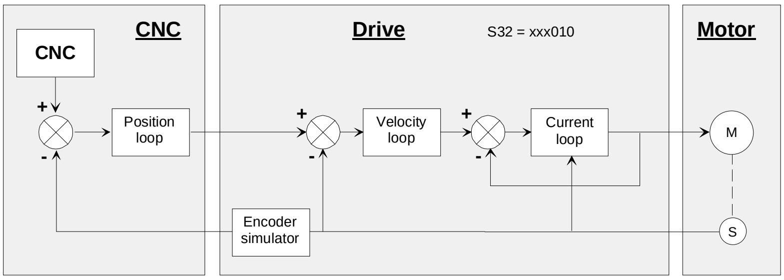


fig.48 Speed regulation with encoder simulator.

Velocity drive with motor feedback

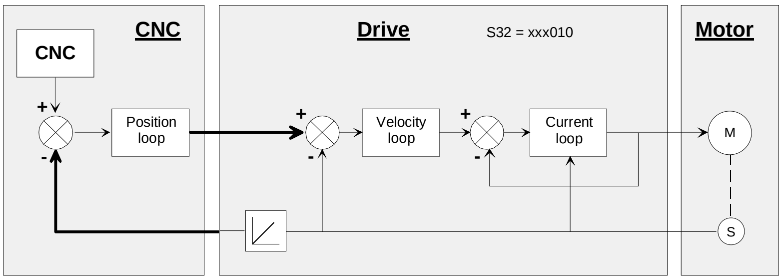


fig.49 Speed regulation with motor feedback.

Velocity drive with direct feedback

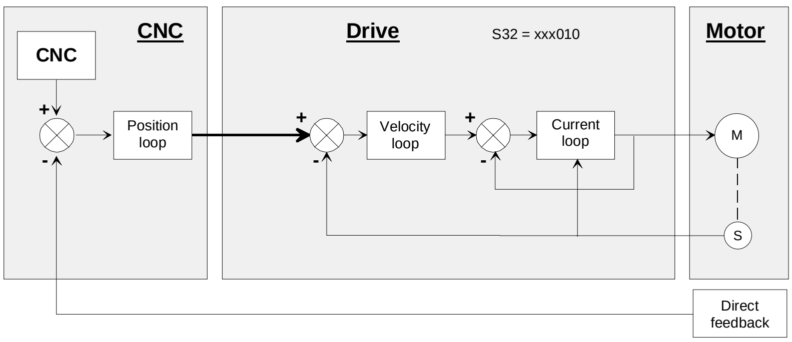


fig.50 Speed regulation with direct feedback (I).

Velocity drive with direct feedback

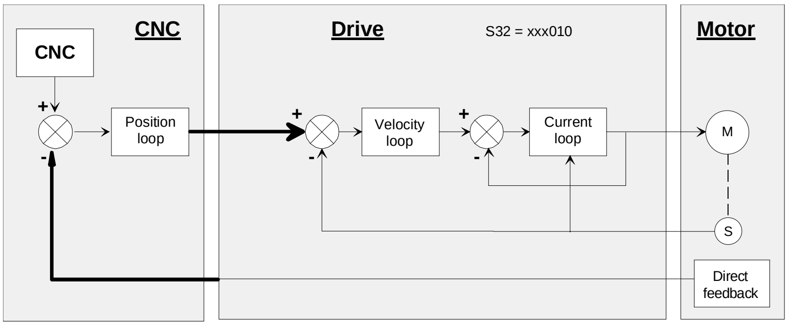


fig.51 Speed regulation with direct feedback (II).

Position drive. *(see chapter 5: Adjustment of the position drive)*

Position drive with motor feedback

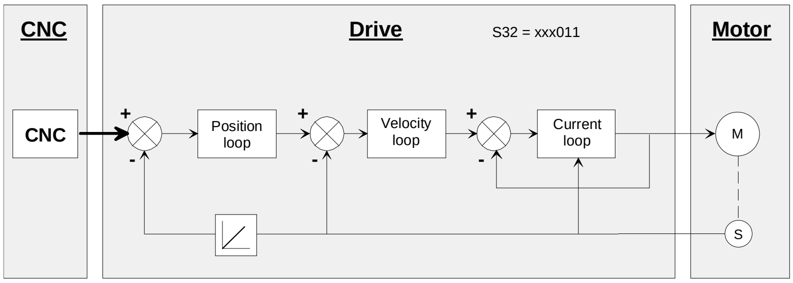


fig.52 Position regulation with motor feedback.

Position drive with direct feedback

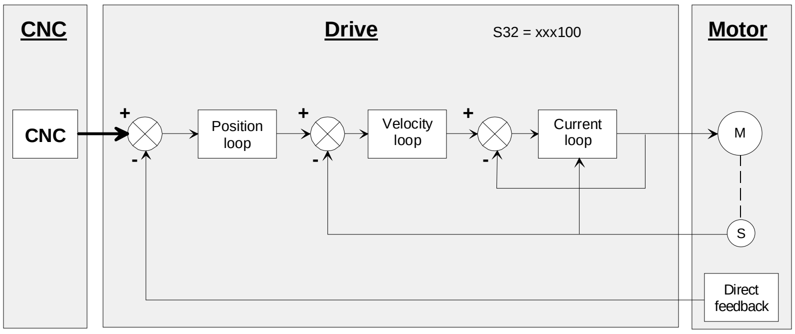


fig.53 Position regulation with direct feedback.

Continue with the setup as described in chapters 4 and 5 for speed regulation and position regulation respectively.

Adjustment of the encoder offset

After adjusting the control loops, the motor 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 (motor _ feedback, 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.

Circle adjustment.

It is the procedure to adjust the feedback signal treatment so the A and B (RV1 [F01506], RV2 [F01507]) approach the sin. and cos. functions. The **gain and offset** adjustments compensate both the amplitude and the offset of the A and B signals with respect to the sin. and cos. . The ideal values for the gain and the offset are 1 and 0 respectively.

Adjusting procedure:

- Turn the motor at a sinusoidal speed of 6 rpm and a period of 6 seconds (6000 ms) using the internal command generator of the drive.
- 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.

Modify the values of RP1 [F01500] ,RP2 [F01501], RP3 [F01502] and RP4 [F01503] eliminating the noise and improving the control of the motor.

When this process has ended, **Save into Flash** to store the 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. Rotary

Set an axis movement at constant speed [°/min] given by the formula:

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

2. Linear

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

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

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

Example:

... for NP121 = NP122 = 1

NP123 = 10 mm/rev.

... after replacing values and adjusting units:

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

$$Radius = 60\ (mm/min) * 6\ sec. * (1min/60\ sec) = 6\ (mm)$$

Note: To know the meaning of parameters NP121, NP122 and NP123 see appendix A - SERCOS GROUP - in this manual.

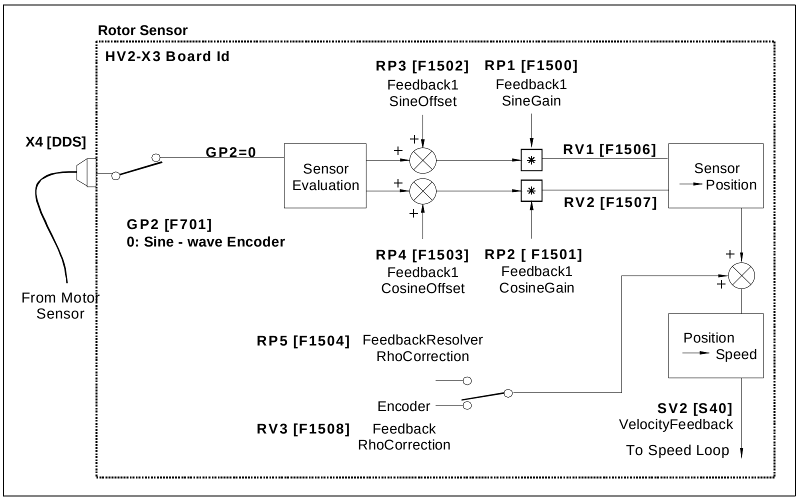


fig. 54 Schematics of the variables involved in the encoder offset adjusting procedure

Current loop

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 entered in MP1.

FOR USER MOTORS:

They can only be modified for user motor ID's. **User motor** means that it is not supplied by FAGOR and, therefore, the motor ID entered in 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 "1" and parameters MP10 and MP11 must be other than zero.

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 WinDDS or using the GC1 command and do a soft reset using the GV11 command.
3. When starting up again, the feature is activated and it calculates the proper values of CP1 and CP2.
4. Save the parameters again, save the calculated CP1 and CP2 values into flash memory and do a soft reset (GV11).

The current loop within the velocity loop helps stabilize the system even more and its diagram may be seen in the figure below:

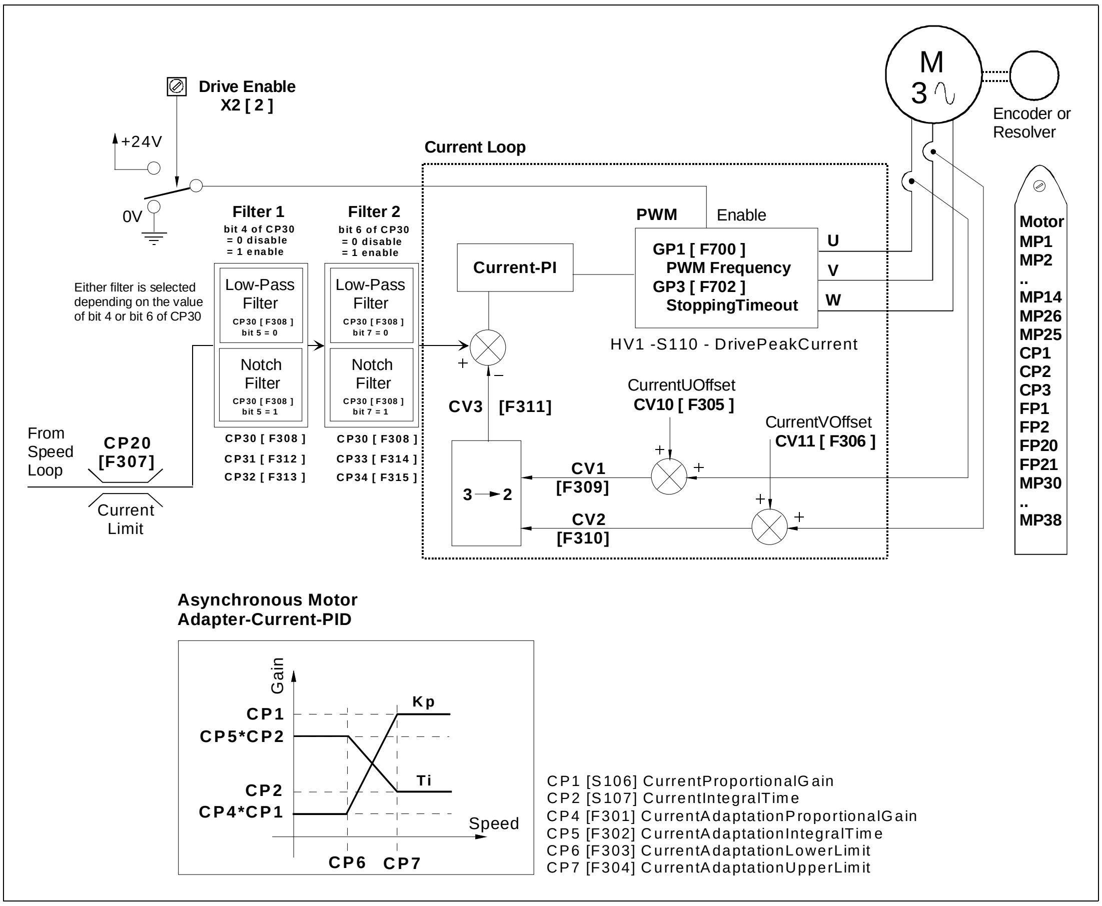


fig. 55 Current loop diagram.

Parameter CP20

The current command limit is set by the value of parameter CP20. This parameter is default set to overcurrent 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 may be modified at an OEM access level or greater.

Filter parameter setting

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 frequecy 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.

Low - passing filter:

The diagram of fig.56. shows the curves representing the frequency response of a 2nd order system in a Bode diagram for different damping factors . and a gain K=1 in the passing zone (condition absolutely necessary in machine-tool related servo drive systems)

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

- ***Resonance peak*** M_r , defined as the maximum value of the system's response amplitude. It only depends on the damping factor . . The lower . is, the higher M_r is,

- ***Bandwidth*** B_w , defined as the frequency range where the amplitude of the transfer function drops -3 dB. It depends on the damping factor . and it gets smaller as . increases. Once . has been set by the resonance peak, the bandwidth depends on the natural frequency w_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.

- ***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 log K [dB]. Since a gain of K = 1 has been considered, the graph will coincide with the ordinate axis. See fig.56.

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.

The phase diagram below shows the phase shift originated between the response and the input.

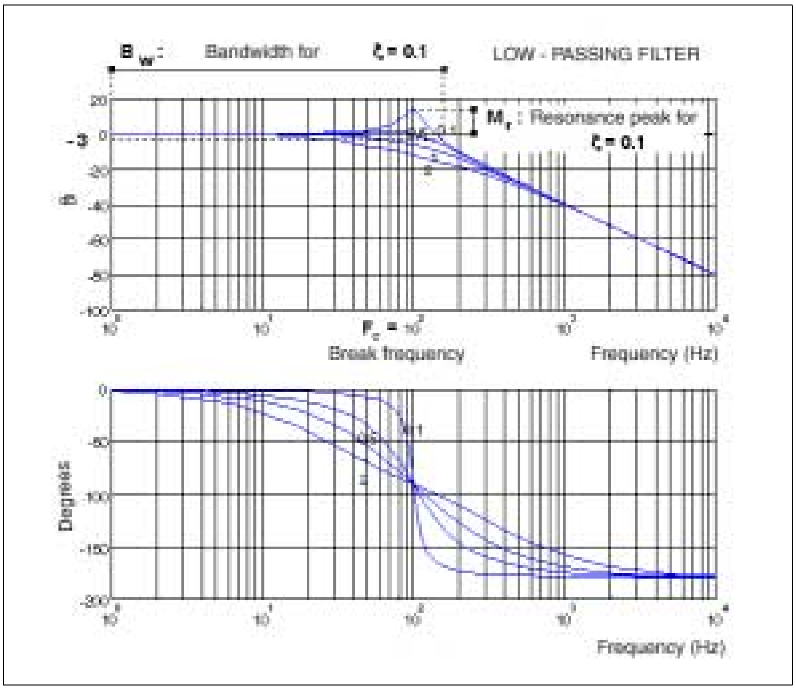


fig.56 Low-passing filter. Bode diagram for a break frequency Fc = 100 Hz and different values of the damping factor . .

Bandstop (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.

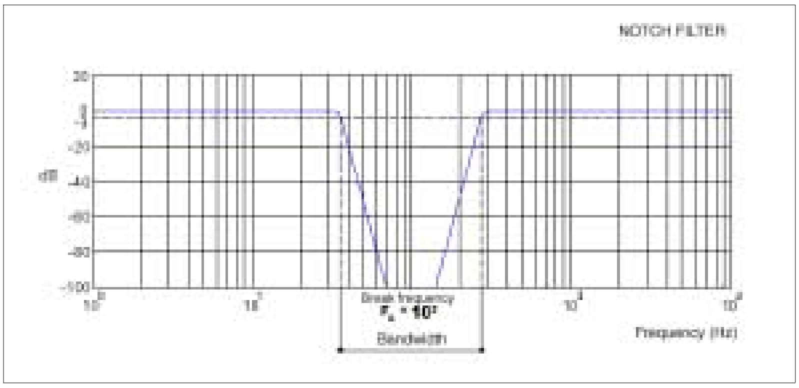


fig.57 Notch filter.

Parameter setting for current command filters:

The parameters involved in setting the filters are: CP30 [F00308], CP31 [F00312], CP32 [F00313], CP33 [F00314] and CP34 [F00315]. These parameters may be edited at OEM level or higher and they have an immediate effect (on-line).

These filters may be applied both to servo drive systems with synchronous and asynchronous machines.

Parameter CP30 [F00308] CurrentCommandFilterSelection:

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. Each filter may be set as low passing filter or as notch filter.

Parameter.Bit	Function
CP30.bit4	**Enable / disable filter 1** 0 - Filter 1 disabled (CP31 & CP32 not operational) 1 - Filter 1 enabled (CP31 & CP32 operational)
CP30.bit5	**Select type for filter 1** 0 - Filter 1 type: low passing 1 - Filter 1 type: notch
CP30.bit6	**Enable / disable filter 2** 0 - Filter 2 disabled (CP33 & CP34 not operational) 1 - Filter 2 enabled (CP33 & CP34 operational)
CP30.bit7	**Select type for filter 2** 0 - Filter 2 type: low passing 1 - Filter 2 type: notch

table 1. Parameter CP30: Filter selection and types of filters for the current command.

Remember that the Least Significant Bit is bit 0 !

Thus, all the possible values for parameter CP30 are:

CP30	Filter 1	Filter 2
0x00	Disabled	Disabled
0x10	low passing	Disabled
0x30	notch	Disabled
0x40	Disabled	low passing
0xC0	Disabled	notch
0x50	low passing	low passing
0x70	notch	low passing

table 2. Possible parameter combinations for both filters.

Parameter CP31 [F00312] CurrentCommandFilter1Frequency:

This parameter may be used to set the break 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 (CP31 other than "0").

Parameter CP32 [F00313] CurrentCommandFilter1Damping:

This parameter has two functions depending of 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.

If the selected filter type is **notch** (bit 5 of CP30 is 1) it reflects the bandwidth $\mathbf{B_w}$ or width of the filter's break frequency.

Parameter CP33 [F00313] CurrentCommandFilter2Frequency:

This parameter may be used to set the break 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 (CP33 other than "0").

Parameter CP34 [F00314] CurrentCommandFilter2Damping:

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

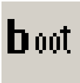
If the selected filter type is **low-passing** (bit 7 of CP30 is 0) this parameter reflects the filter's damping factor.

If the selected filter type is **notch** (bit 7 of CP30 is 1) it reflects the bandwidth $\mathbf{B_w}$ or width of the filter's break frequency.

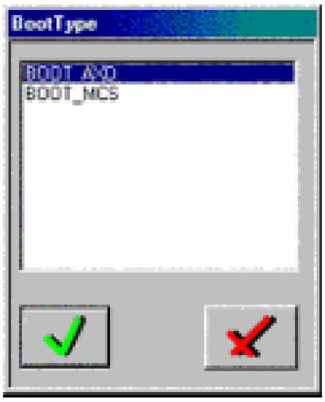
See appendix A in this manual for further information on these parameters.

Install or update a new software at the drive

After installing the WinDDSSetup application from the CD-ROM supplied by Fagor, and being the drive under power and connected with a PC through the serial line, the procedure to install or update a new software version at the drive is the following:



Activating this icon located on the icon bar shown in the main window of the WinDDS displays the **BootType** window.



In it, it is possible to select the drive model being used. This window is shown at the beginning by default.

Later on, using the "**preferences**" tab of the Win DDS, you can indicate the type of **boot** desired by default also canceling "ask for boot type".

After pressing OK, later installations of software will not show the **BootType** window and will directly take the default option defined in the "**Preferences**" window.

fig.58 " BootType " and " Preferences " windows.

Next, it will show the BootStrap window from which to execute the action to load or update the drive's software version.

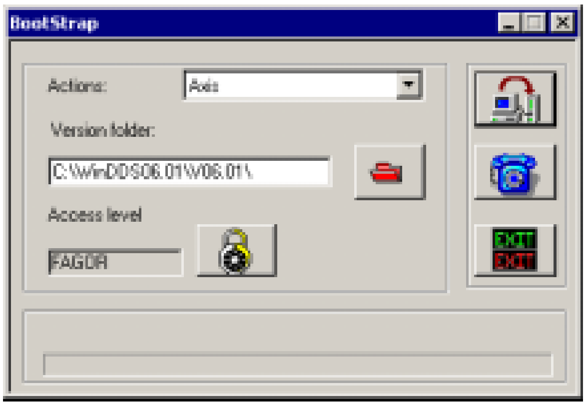
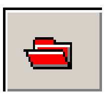


fig.59 "BootStrap " window.



Clicking this icon displays the "**version folder**" window.

In folder v06.xx, locate the file: **módulos.cfg**. Select this file and click **Open**.

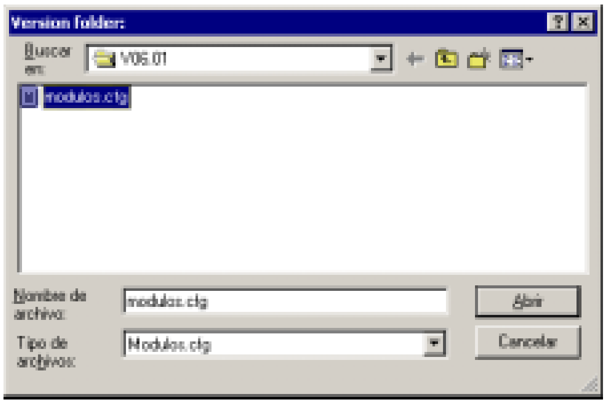
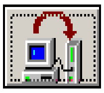


fig.60 " Version folder " window.



Clicking this icon displays the "**Instructions**" window. Follow its instructions. The two buttons it refers to are on the front panel of the drive.

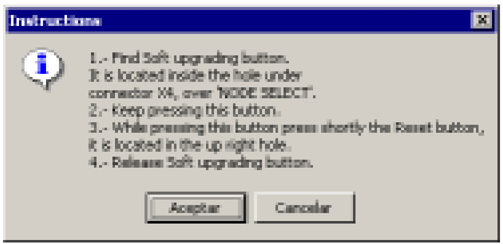
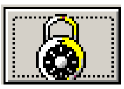


fig.61 " Instructions " window.

After accepting it, it will start executing the process of loading the software from the PC to the drive.

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:



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.

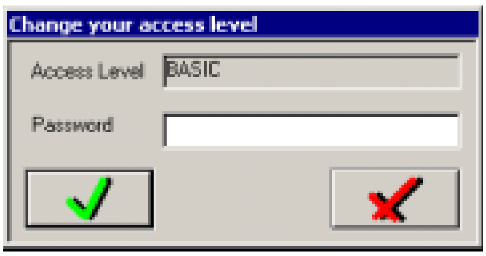


fig.62 " Password " window.

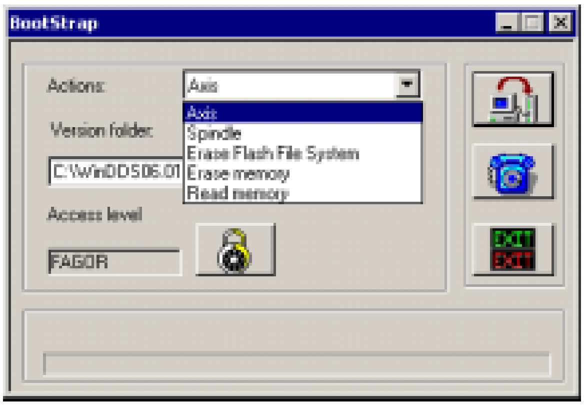
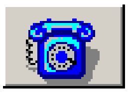


fig.63 " Actions " drop list.



Clicking this icon shows the "**configuration**" window to indicate certain aspects to be considered when loading the software version.

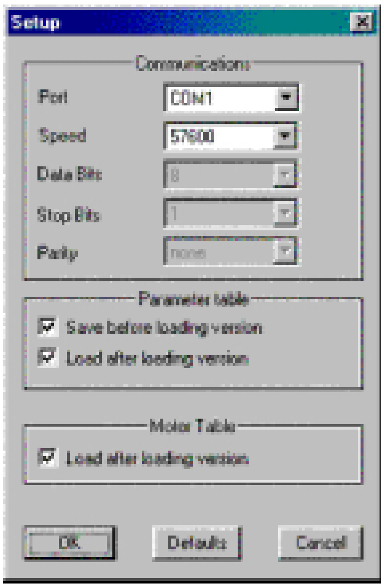


fig.64 " Communications " window.

- **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 the following option:

  - **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.mot for a spindle drive (SPD or SCD).

i

This option may be used to send new motor settings out to the field without having to change the software version.

VELOCITY DRIVE SETUP

4

Introduction

This chapter describes the setup procedure for DDS drive module when as **velocity drive**. The necessary steps for the application as **position drive** are described in the next chapter 5.

Adjustment of the offset of the analog signal

Power the drive on. The next step is to eliminate the possible offset of the analog command. When using Sercos® interface, this section is not applicable.

Send 0 volts command to the drive. Monitor the motor speed at the CNC or by **watching** the SV2 [S00040]. Assign values to the offset parameter **SP30 [F01603],** [with the opposite sign of SV2 [S00040]] until the motor stops completely. But, careful, this way, only the drive's offset is eliminated, the CNC may have another offset. Now adjust the CNC offset.

To adjust the offset of the whole control loop, get the CNC in dro mode but with the **Drive_Enable** and **Speed_Enable** active. Give values to SP30 [F01603] until the motor stops. Another procedure may be to set a position for the axis with the CNC and adjust SP30 [F01603] until the following error is symmetrical (same in both directions).

After determining the correct value for SP30 [F01603], it is necessary **to save it permanently into Flash** memory. Procedure explained in the chapter 3.

Apart from this adjustment mechanism, there is a potentiometer (see fig.1 and P1) designed so the user can correct the slight drifts suffered by electrical components with time.

Same for analog input 2 with SP31 [F01604] and potentiometer P2.

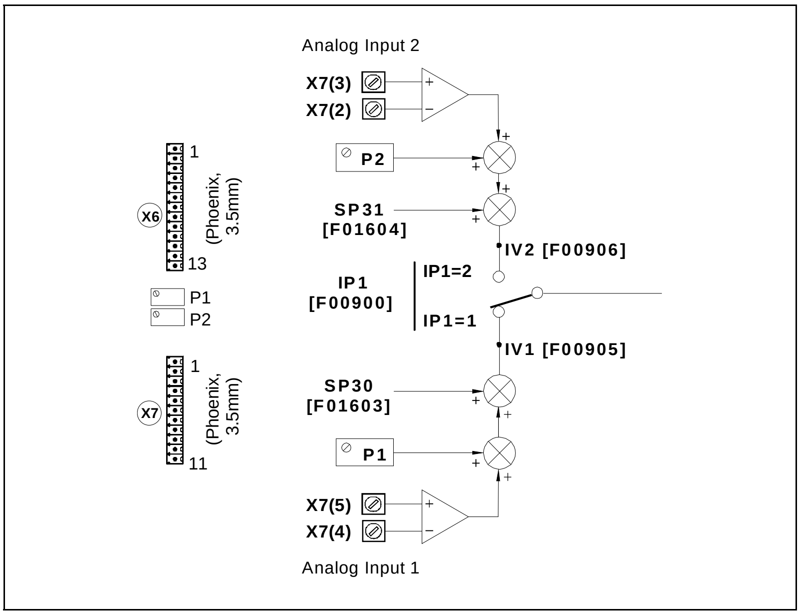


fig.1 Analog command offset adjustment.

Volts - speed of the analog voltage

On equipment having an analog interface and on spindle drives with Sercos® interface, one must indicate the relationship between the analog voltage and the velocity command.

There are three parameters to set this voltage - speed relationship.

SP20 [F00031] and **SP21 [F00081]** establish the **voltage / speed ratio of the velocity command**.

SP21 [F00081] is allocated the maximum speed to be supplied by the motor in our application. And SP20 [F00031] is allocated the analog voltage to be applied for that maximum speed. The hardware limits SP20 [F00031] to 10000 millivolts (10 V).

SP10 [S0091] sets the **maximum velocity command effective** at the drive. Its value is given by the characteristics of the motor and those of the machine. The drive's software does not allow SP10 [S0091] values greater than 10% over the rated (nominal) motor speed. If the instantaneous speed of the motor exceeds the SP10 [S0091] value over 12% overspeed error 200 will be issued. See fig.2.

Example:

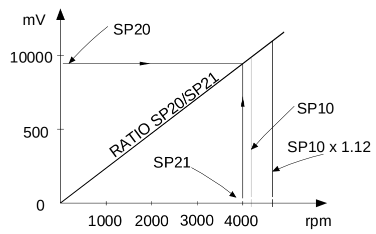
If the application requires a speed of 4000 rpm when applying an analog voltage of 9.5 V, and the motor has a nominal speed of 4000 rpm, the values for these parameters could be:

SP20 = 9500 mV

SP21 = 4000 rpm

SP10 = 4200 rpm

SP10, SP20, SP21:



Avoid setting parameters SP21 [F00081] and SP10 [S0091] to similar values in order to allow instantaneous speed values greater than the SP21 [F00081] values.

Modifying these parameter has no on-line effect. They are stored in the drive's RAM memory and they must be saved in Flash memory **in order to make them effective**.

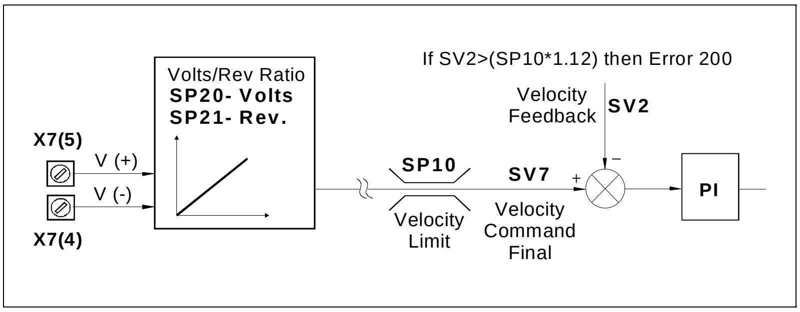


fig.2 Parameters SP10, SP20 and SP21.

Parameters for the 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 Io and /Io.

This is an optional feature.

The encoder simulator is programmable by means of the following parameters:

EP1 [F00500] Number of pulses per turn

EP2 [F00501] The point where the reference marker pulse is generated I_0

EP3 [F00502] Counting direction

Number of pulses

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

With squarewave motor feedback, this parameter EP1 must be set to the number of pulses of that feedback.Otherwise, error E502 will be issue in versions v.05.xx and v.06.xx.

Marker pulse (home I_0) position

It is the location of the reference mark. The inverted marker pulse signal (/Io) is also available.

The home position may be set by following any of these two different procedures:

1. Orient the rotor shaft to the desired home position. Then, execute the command **EC1 [F00503].**
2. Move the marker pulse point by means of parameter **EP2 [F00501]**.

For example, if EP1 [F00500] is 1250 and we wish to move the current marker pulse position 58°, we must load parameter EP2 [F00501] with a value of 1250*58/360 which is approximately equal to 200.

The range for this parameter varies from 1 to the value assigned to parameter EP1 [F00500] although it is recommended to reset it to 1. If a home value greater the number of pulses defined by EP1 [F00500] is indicated, the initialization process will generate error 500.

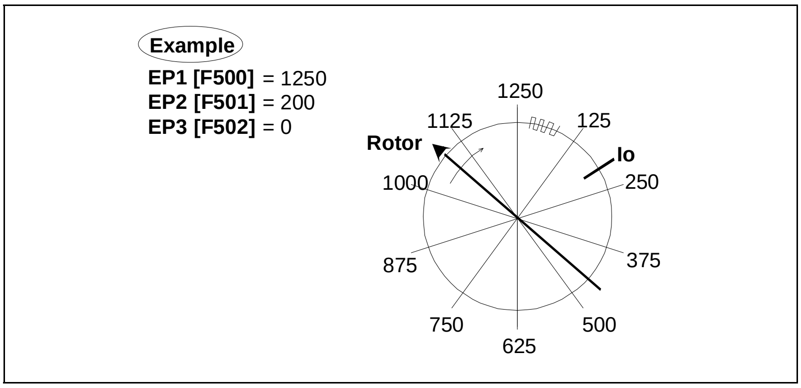


fig.3 Home (I_0) point adjustment example.

Counting direction

For the turning direction of the diagram below (clockwise), the encoder simulator generates the A signal 90° ahead of the B signal when parameter **EP3 [F00502]** has its default value EP3 = 0.

If EP3 [F00502] = 1, the simulator will generate the B signal 90° ahead of the A signal for the same turning direction of the motor.

Obviously, the opposite turning direction (counterclockwise) inverts the order of the signals:

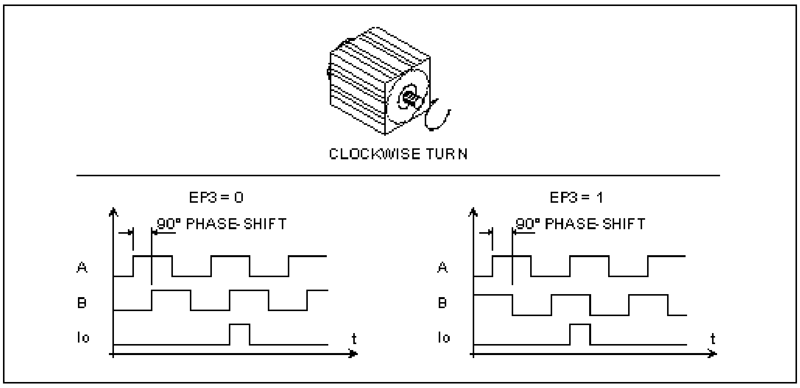


fig.4 Counting direction.

PinOut of the encoder simulator connector

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

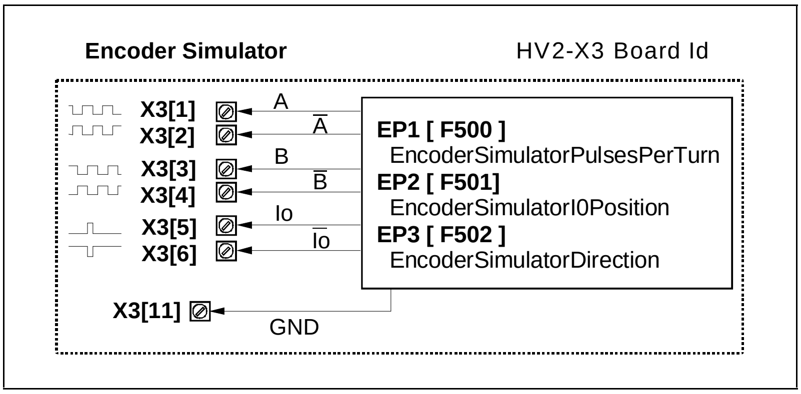


fig.5 X3 connector pinout (encoder simulator).

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 displaying the various internal variable of the drive. Anyway, the most common ones are:

SV1 VelocityCommand

SV2 VelocityFeedback

SV7 VelocityCommandFinal

CV3 CurrentFeedback

TV1 TorqueCommand

TV2 TorqueFeedback

TV3 TorqueFeedbackPorcentage

The variables are selected by means of parameters OP1 [F01400] and OP2 [F01401].

OP3 [F01402] and OP4 [F01403] set the values of these variables corresponding to an analog output voltage of 10 Vdc. The modification of these variables has an immediate effect (on- line). To keep the values of these parameters, they have to be saved into Flash memory.

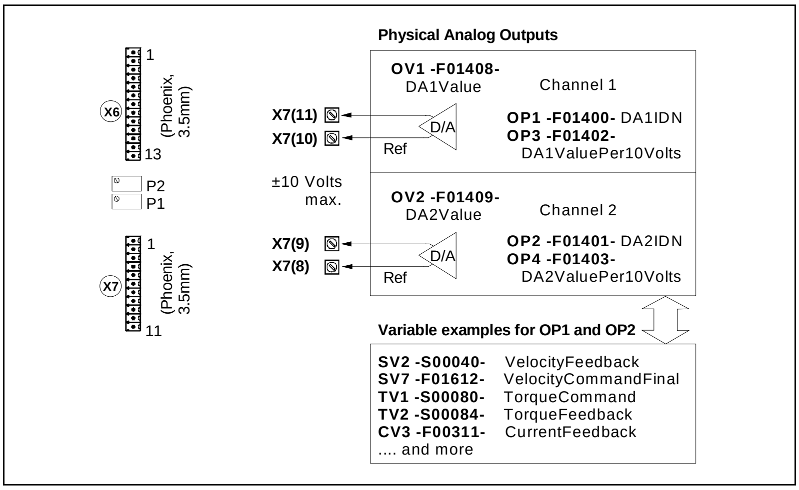


fig.6 Analog outputs.

Analog outputs as adjustment tools.

With an oscilloscope connected to these analog outputs, it is possible to monitor those internal variables of the drive and check overshooting, stabilizing times, accelerations, system stability ...

During the setup process, it is common practice to monitor the velocity command (SV1 [S00036]) and the actual speed (SV2 [S00040]).

Example:

To display the torque and instant speed signals:

OP1 = SV2	Actual velocity via channel 1, pins 10/11 of connector X7.
OP2 = TV2	Actual torque via channel 2, pins 8/9 of connector X7.
OP3 = 1000	(1000 rpm / 10 V)
OP4 = 600	(600 dN·m / 10 V)

fig.7 shows a possible look of the oscilloscope screen and its interpretation depending on the gains set.

CALCULATION OF VALUES

Speed = 1000rpm/10 V * 2 V/division * 2.5 divisions = 500 rpm
Torque = 600 dN·m/10 V * 2 V/division * 3 divisions = 360dN·m = 36 N·m
speed = 500 rpm

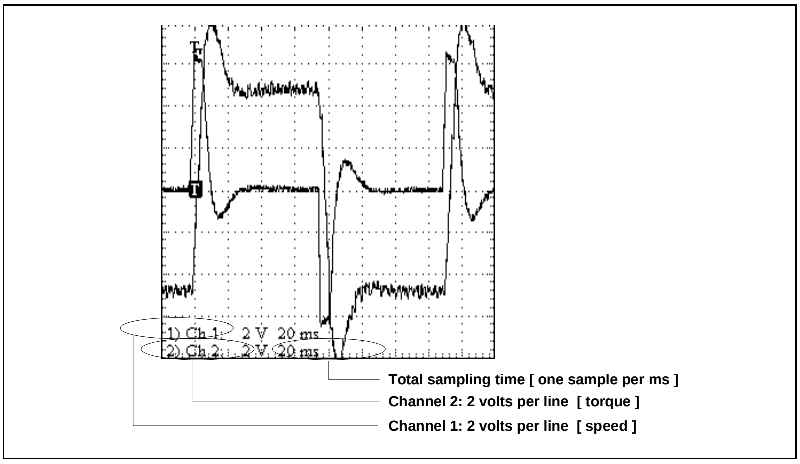


fig.7 Oscillograph obtained with a conventional oscilloscope.

Warning :

Give to OP3 [F01402] and OP4 [F01403] values that cannot be reached by the chosen internal variables. This way, the output will never exceed the ±10 V range.

For example, if the speed is not expected to ever exceed 2500 rpm, the gain may be set in 2500 rpm/10 V or greater.

If the values given to OP3 [F01402] and OP4 [F01403] are too small, the electrical signal will be saturated when reaching ±10 V.

The **WinDDSSetup** program for setting the drive up from a PC includes an oscilloscope. This way, the setup is much easier.

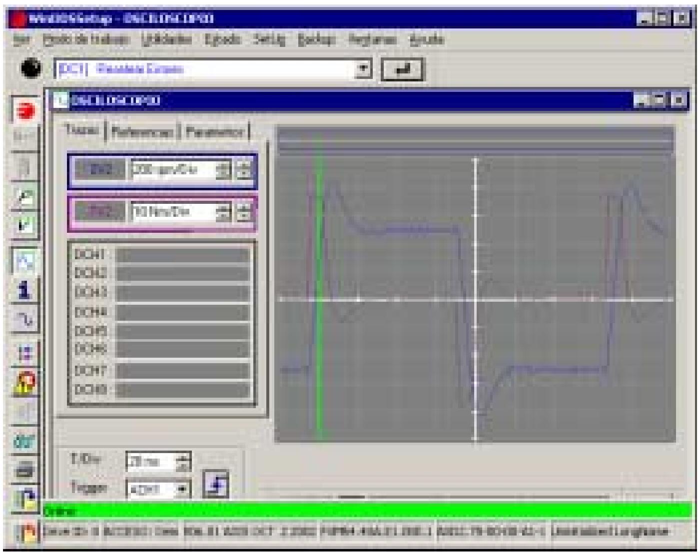


fig.8 Oscillograph obtained with the WinDDS oscilloscope.

It is same oscilloscope graph seen under the oscilloscope incorporated by the WinDDSSetup.

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

By calculating the values, we observe that:

Speed = 200 rpm/div * 2.5 div = 500 rpm
Torque = 10 N·m/div * 3.6 div = 36 N·m

Adjustment of the velocity loop

The next step is to adjust the velocity loop. This is achieved by:

- Using the internal velocity command generator of the drive itself.
- Adjusting the PI of the velocity loop.
- Filtering, if so desired, the velocity command by limiting the acceleration and / or choke and the velocity reference filter [SP51].
- Adjust the speed feedback filter if necessary using parameter SP50.

The following sections describe these steps in further detail.

Velocity command generator

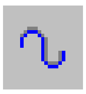
This function generates velocity commands internally. When activated, the drive ignores the velocity command coming from the outside. This function may be used to move the system with known commands and then observe its behavior with them.

It can generate four types of (signal) waveforms; square, sinusoidal, triangular and continuous.

The following aspects may be programmed: amplitude, period. offset, number of waves and duty cycles.

The squarewave is usually utilized in order to analyze the system's behavior towards a sudden step (shoulder).

For example, we want to display a graph on the oscilloscope 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, thus setting a value of 2 for parameter AP1 [S32] Primary Operation Mode.



Use this icon to generate velocity commands internally. They can only be activated at OEM or Fagor access levels, not at the basic level. When clicking this button, the screen shows dialog box that looks like this:

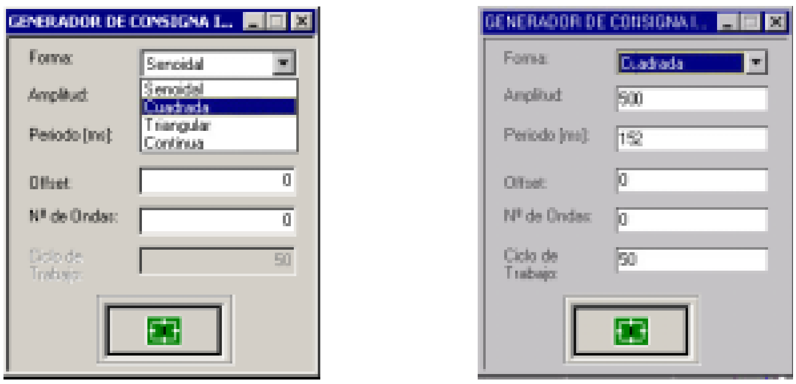
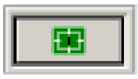


fig.9 Windows of the internal command signal generator.

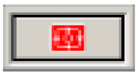
It is possible to set the signal waveform, amplitude, period and other aspects appearing in the dialog box.

The range for each field are:

Amplitude:	[-32768, 32767]
Period:	[1,32764]
Offset:	[-32768,32767]
Number of waves:	[0,65535]
Duty cycle:	[1,99]



It activate the command generator



It deactivate the command generator

Thus, 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):

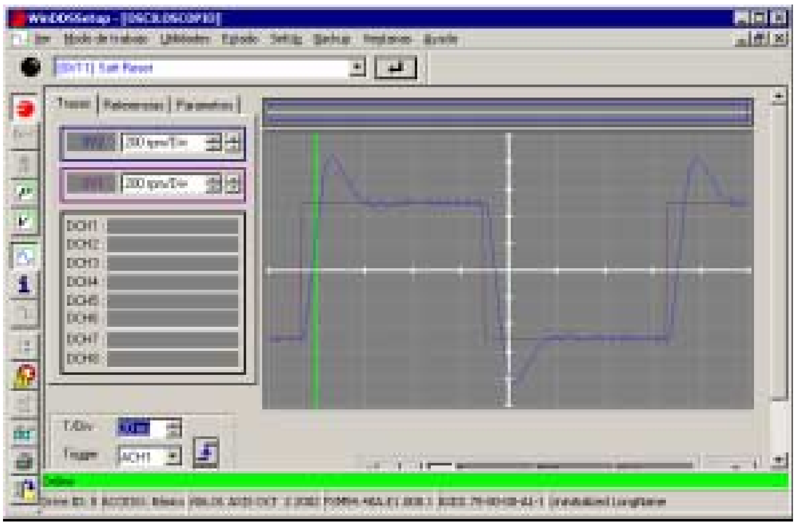


fig.10 Oscillograph obtained according to set data.

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

Speed PI adjustment

The velocity loop basically consists of a proportional - integral (PI) controller shown in the fig.11. The operation of this PI is determined by two constants, The operation of this PI is determined by two constants, **Kp** given by parameter **[SP1]** and **Ti** given by parameter **[SP2]**.

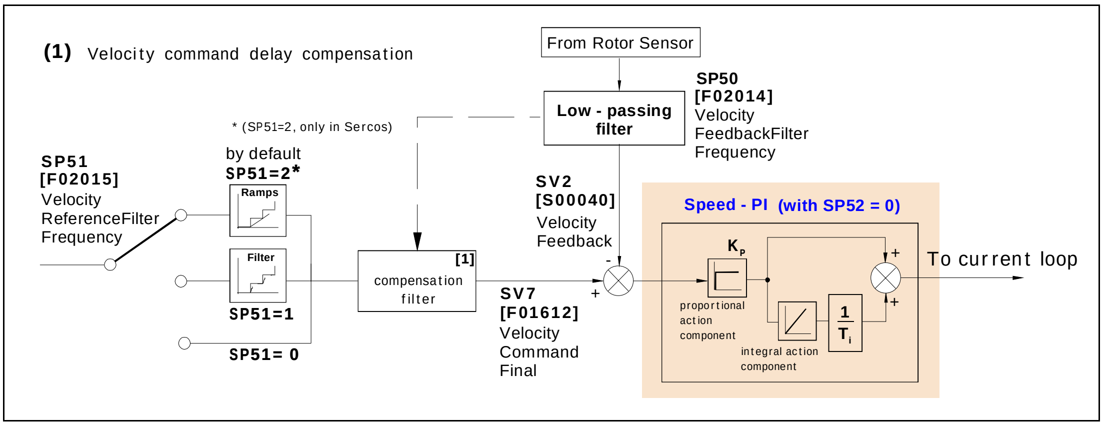


fig.11 Speed PI.

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 fig.12.

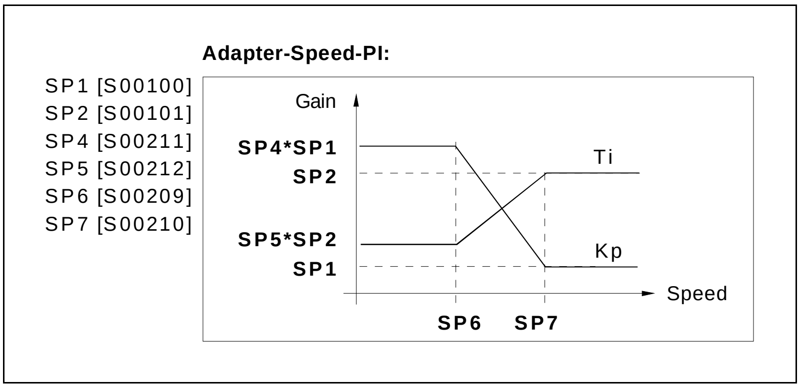


fig.12 Kp and Ti values depending on speed.

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

Is very 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).

The following parameters are available for the adjustment:

SP1 [S00100] Value of the proportional action (Kp) of the speed PI.

SP2 [S00101] Value of the integral action (Ti) of the speed PI.

A lower value of the integral time Ti means an increase of the integral effect of the PI.

SP4 [S00211] Adaptation of the value of the proportional action at low speed.

SP5 [S00212] Adaptation of the value of the integral action at low speed.

SP6 [S00209] Adaptation limit of the velocity loop at low speed.

Lower speed at which the PI toggles from being constant to being variable and vice versa.

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 %) and SP1 = 30 (0.030 Arms/rpm), the value for the proportional action Kp at low speeds will be the 150 % of SP1, that is, 0.045 Arms/rpm.

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

fig.14 shows the complete internal structure of the velocity loop of the DDS.

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

The modifications to these parameters are immediately effective (SP1, SP2, SP4 and SP5). When reaching the desired performance level, these values must be **saved into the drive's flash** memory.

To do this, follow the same instructions as those in section (save into Flash memory) of the previous chapter.

The operation of the PI is now determined with three constants, **Kp** given by parameter **[SP1]**, **Ti** given by parameter **[SP2]** and the time constant **T1** of the P-T1 element given by parameter **[SP52]**. See fig.13 and appendix A for further details.

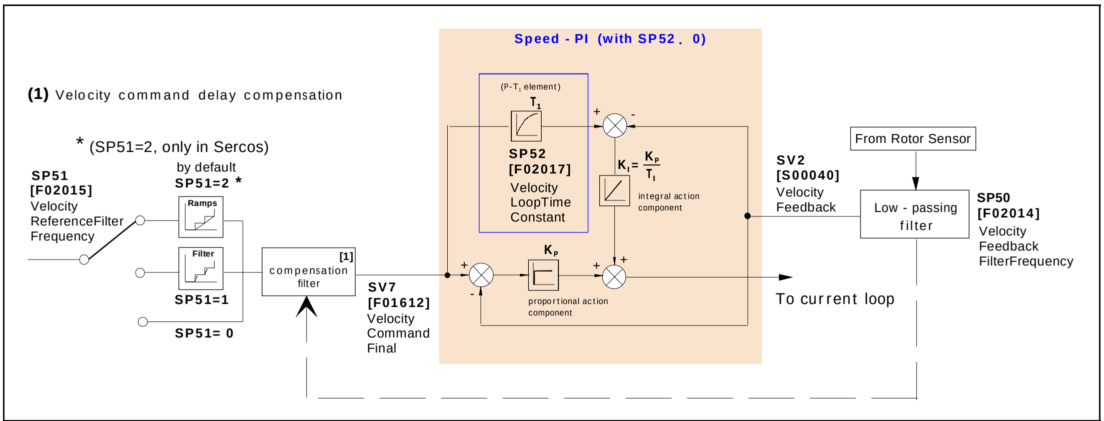


fig.13 Velocity PI with delay element P-T1. SP52 . 0.

WARNING: With SP52 = 0, the velocity loop is the same as that of software versions older than v.06.08 !

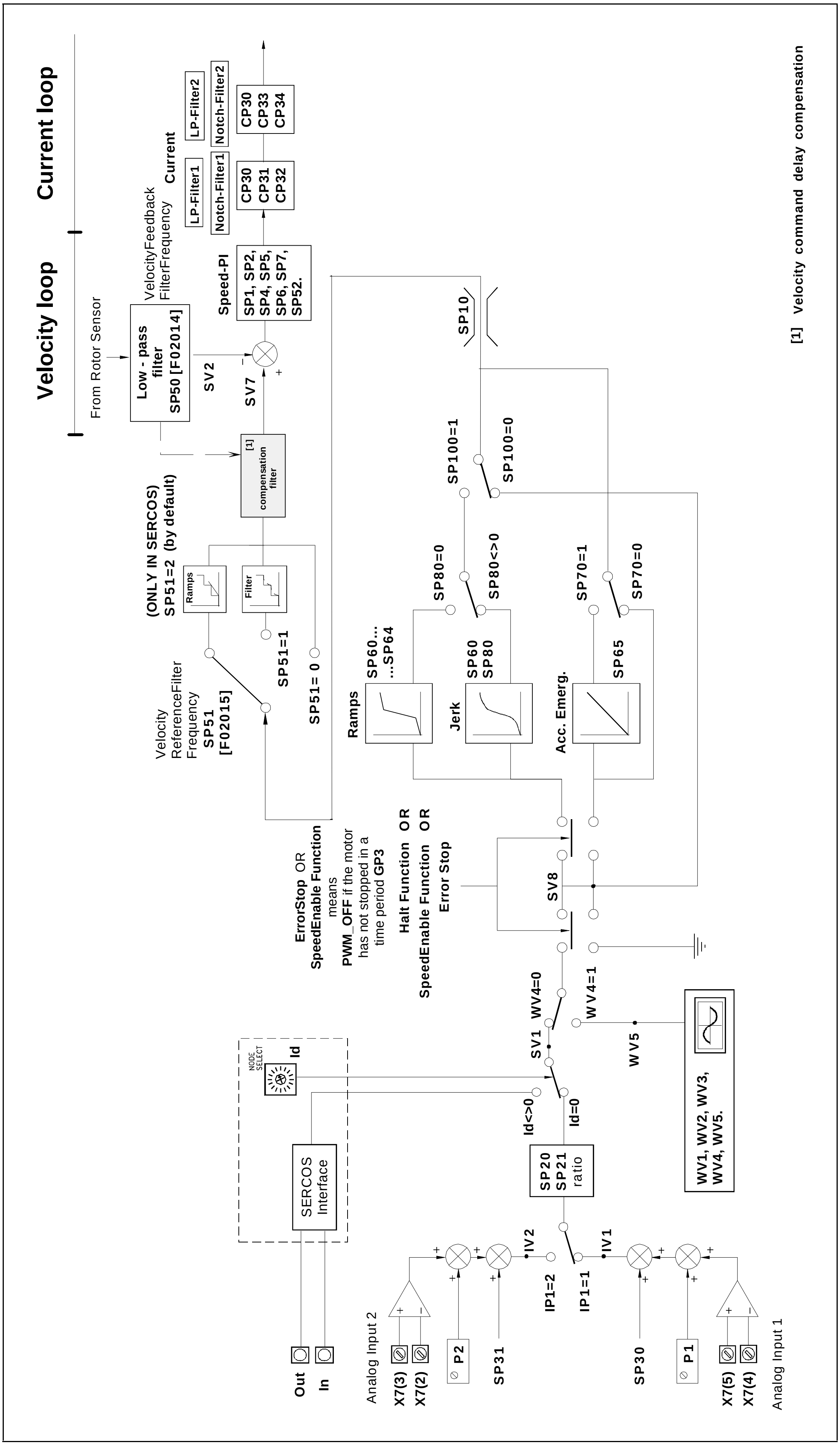


fig.14 Command signal management.

Velocity command filters

The smooth motor movement, the velocity command can be **filtered** in two ways described in the following sections. The first one is converting the command into velocity ramps limiting the acceleration **ramp generation**. The second one is limiting the acceleration and the jerk of the command, **jerk limit**.

These command filters can be eliminated permanently by setting **SP100 [F01611]** to **0**.

In an emergency stop (Halt function, SpeedEnable or Error) the braking deceleration can be limited to a safe value. **It is the emergency acceleration limit**.

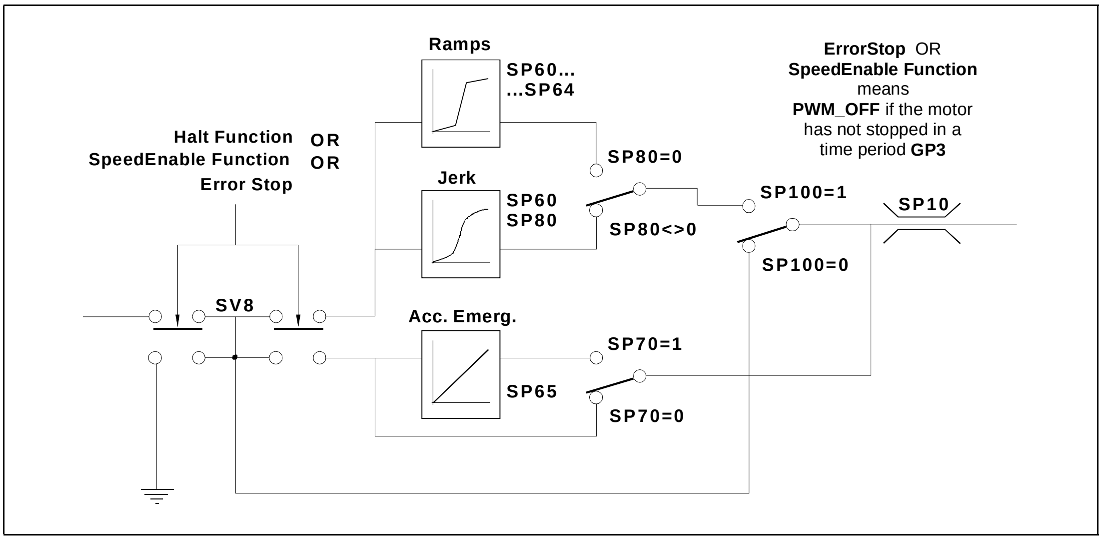


fig.15 Command signal filters.

Emergency acceleration limit

To filter the velocity command in an emergency stop, set **SP70 [F01610]** to 1.

An emergency stop is the one requested by activating the Halt function, by deactivating the Speed_Enable, or the one due a drive malfunction.

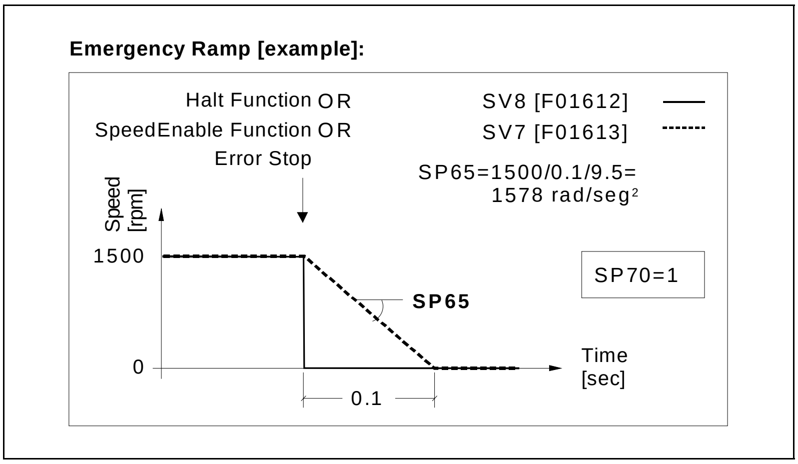


fig.16 Emergency acceleration limit.

Ramp generation

For this type of velocity command filter, set **SP80 [S00349]** = 0 and **SP100 [F01611]** = 1.

The action of this ramp generator is divided into three velocity sections.

In each one of them, the acceleration can 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**.

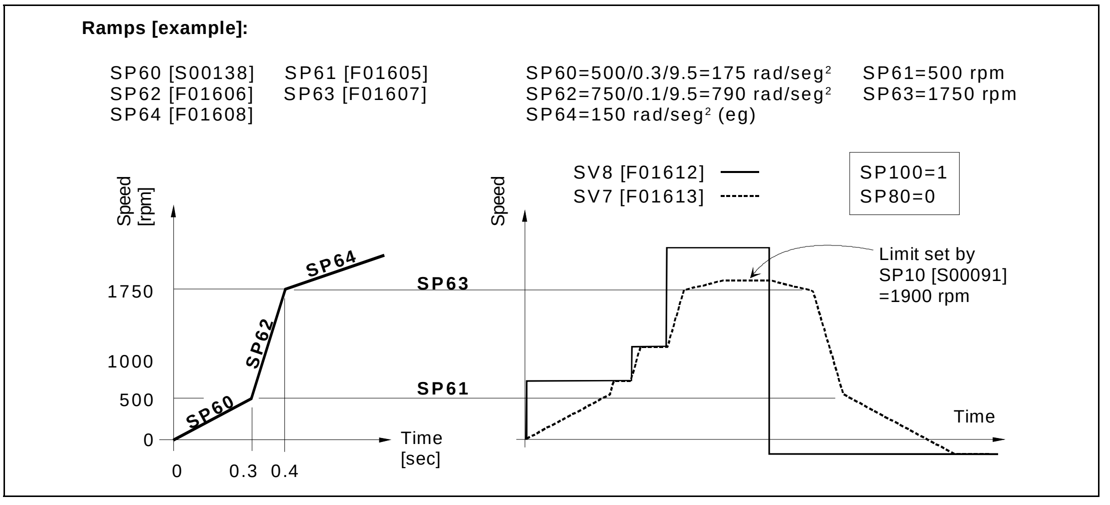


fig.17 Ramp generation.

Jerk limit

For this velocity command filter, set **SP80 [S00349]** other than 0 & **SP100 [F01611]** = 1.

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

SP80 [S00349] sets the jerk limit. The smaller this parameter is, the more smoothly the motor will run.

SP60 [S00138] sets the maximum acceleration in this operating mode.

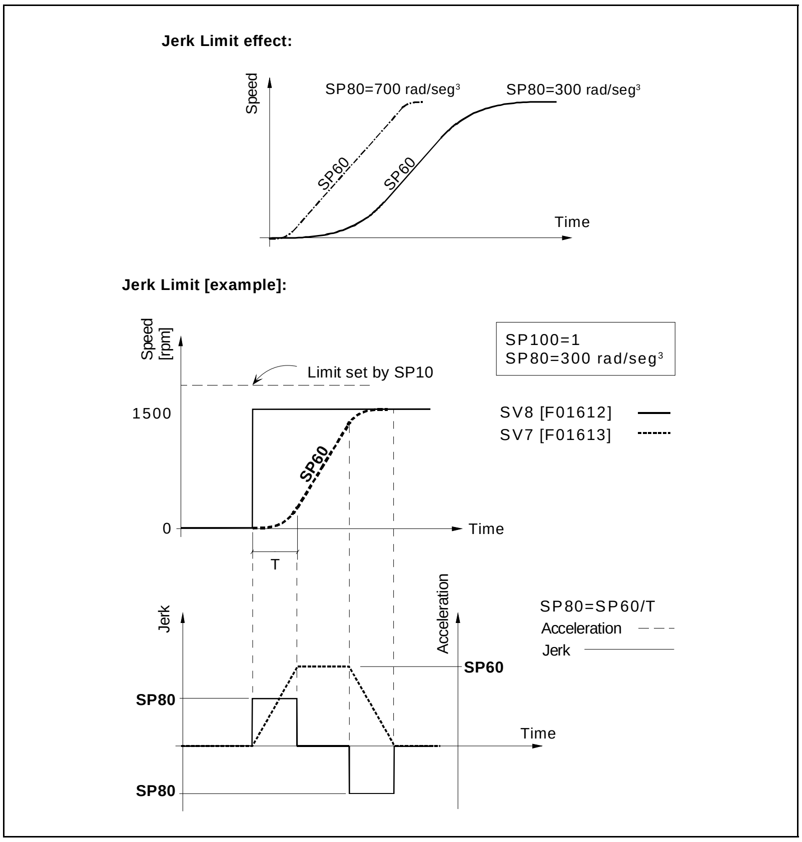


fig.18 Choke limit.

Velocity reference filter

When the drive is working in velocity mode (e.g: with the 8055 CNC) this parameter smoothes the velocity command by generating intermediate commands between those sent out by the CNC. This effect may be created by applying either a 1st order filter on the velocity command (SP51=1) or velocity ramps (SP51= 2 <only in Sercos®>).

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

WARNING: Remember that if parameter SP80 = 0 & SP100 = 1, then SP51 = 2 will have no effect !

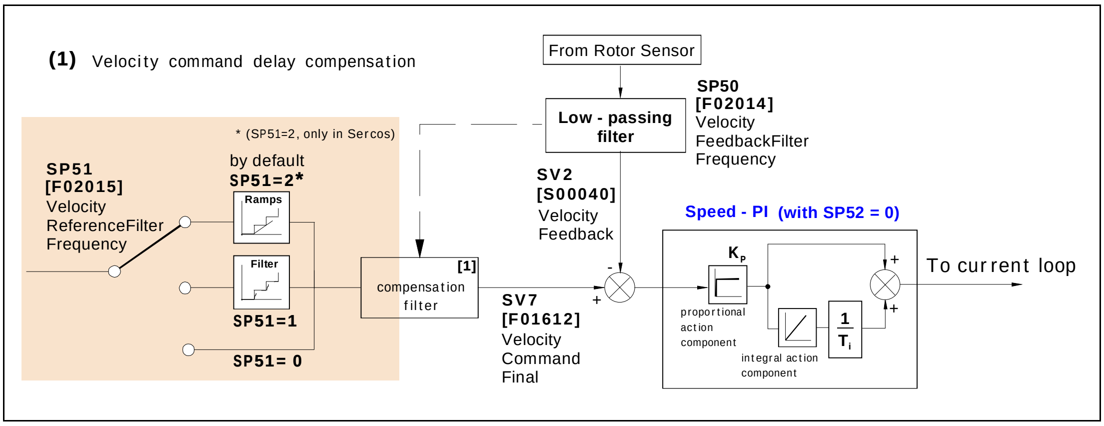


fig.19 Location of the velocity reference filter: SP51.

Velocity feedback filter

It is a first order low-passing filter that may be set with parameter **SP50 [F2014] VelocityFeedbackFilterFrequency**.

Its function is to filter the actual speed coming from the velocity feedback making it smoother thus reducing the amount of current noise at the motor. It can also, sometimes, eliminate resonance. This value of the velocity feedback already filter may be displayed in the variable: **SV2 [S40] VelocityFeedback.**

This filter may be disabled by setting **SP50 = 0** and it admits values between 1 and 4000 Hz.

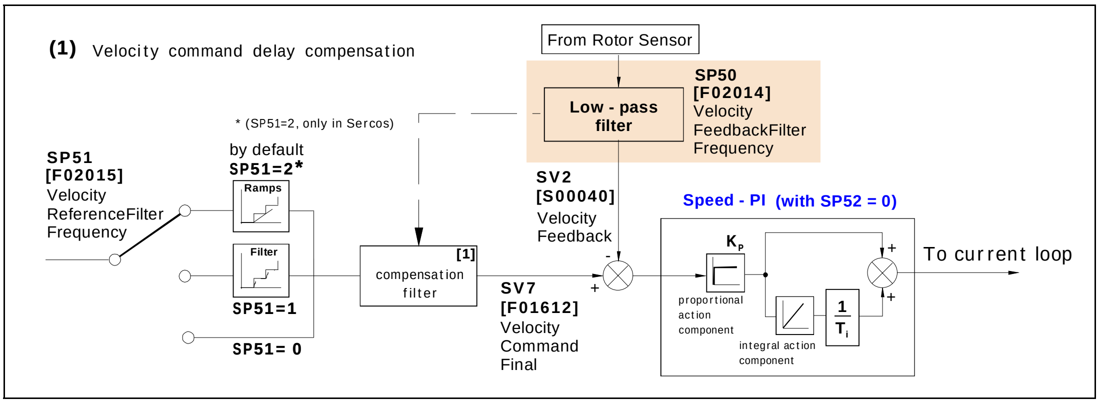


fig.20 Location of the velocity feedback filter: SP50.

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.

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

Considerations when adjusting this filter

- Enter its maximum value (4000) in SP50, because its default value is 0 (not activated).
- Observe its effect on the velocity noise (display SV2).
- Decrease its value 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 CNC.

Removal of the internal command

When done adjusting it, **save the parameters permanently** into the drive's Flash memory.

To merely deactivate the generator, it can be done using the relevant icon at the WinDDSSetup or by resetting the drive.

User notes:

User notes:

POSITION DRIVE SETUP

5

Introduction

This chapter describes some characteristic aspects of the setup of DDS drive modules when used to regulate position. chapter 4 describes the necessary steps for the application as velocity regulation.

Position 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 fig.1.

The position feedback may be taken from the (motor feedback) or from a feedback located on the load (direct feedback).

First of all, the operating mode of the drive must be determined with parameter **AP1 [S32]**.

This parameter determines:

- whether the position feedback is on the motor or on the load.
  - the motor feedback will be connected to connector X4 of the drive.
  - the feedback signal on the load (direct feedback) will go to connector X3 of the drive.
- whether feed-forward will be applied in the position loop or not.

The position loop also offers a parameter for controlling the ballscrew backlash and, in rotary movement, it can handle the command in module format.

From software version 04.02 on, it is possible to regulate in position by changing the feedback on-line and setting the corresponding operation mode through parameter AP1 [S32].

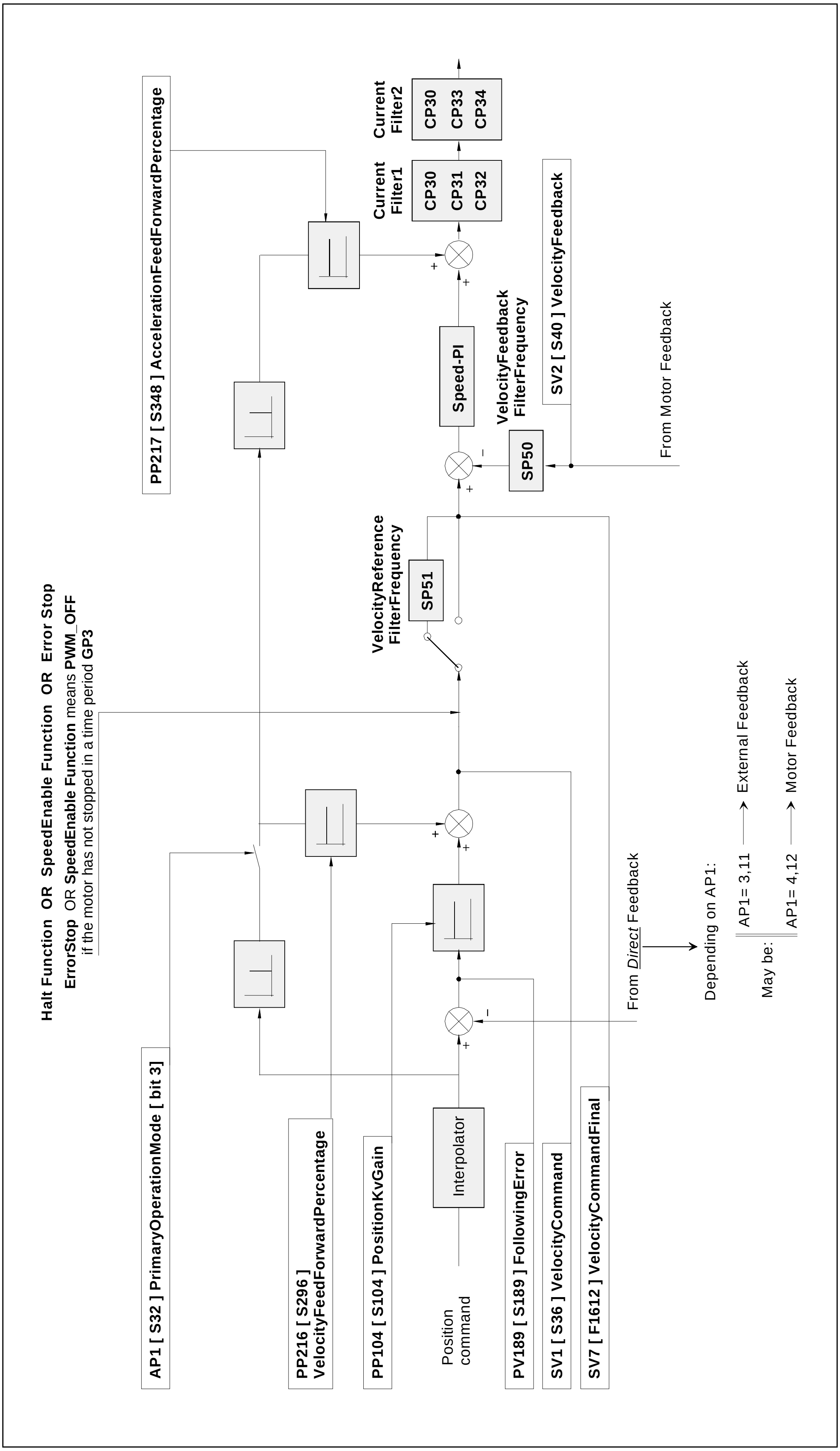


fig. 1 Loop diagram including the position loop

FAGOR

DDS
Software
v.06.xx

SERVO DRIVE
SYSTEM MANUAL

POSITION DRIVE SETUP

Position loop

Direct feedback

The position feedback may be mounted directly on the moving load. From now on, this will be referred to as **direct feedback**.

To work with direct feedback:

- take the signal to connector X3 of the drive.
- activate bit 2 of parameter **AP1 [S32]**.
- indicate to the drive the type of feedback device and the type of signal using these parameters:

GP10	**[F719]**	Feedback2Type
NP117	**[S117]**	ResolutionOfFeedback2
NP118	**[S118]**	ResolutionOfLinearFeedback
PP115	**[S115]**	PositionFeedback2Type

From version v.06.02 on, it is possible to have absolute direct feedback using Stegmann encoder so as to read the absolute position on power-up without having to search home. This is configured by setting GP10 = 3. The relevant version of the direct feedback board will be required.

From version V.06.08 on, it is possible to have absolute direct feedback using a Fagor linear encoder so as to read the absolute position on power-up without having to search home. Its parameters are set GP10=4 or GP10=5 depending on whether the signal is square or 1 Vpp, in either case with SSI communication. The relevant version of the direct feedback board will be required.

The following parameters must also be taken into account:

RP60	**[F2360]**	SSIClockFrequency
RP61	**[F2361]**	SSIDataLength
RP62	**[F2362]**	SSIDataFormat
RP63	**[F2363]**	SSIFeedbackResolution.

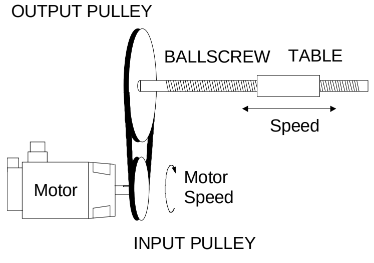
Remember to do the following when using motor feedback:

- take the signal to connector X4 of the drive.
- deactivate bit 2 of parameter **AP1 [S32]**.
- indicate to the drive the type of feedback device and the type of signal using these:

GP2	**[F701]**	Feedback1Type

In order for the drive to know the mechanical radio between the motor movement and the direct position feedback, set the following parameters:

NP121	**[S121]**	InputRevolutions
NP122	**[S122]**	OutputRevolutions
NP123	**[S123]**	FeedConstant



Example:
Diameter of the output pulley = 25.75 mm
Diameter of the input pulley = 15.3 mm

NP121 = 2575
NP122 = 1530

Gear ratio =2575/1530 =1.683

Ballscrew pitch = 5 mm

NP123 = 5 milimeters

fig. 2 Gear ratio

Interpolator

The CNC generates the position commands with a frequency indicated by parameter QP1 [S1] ControlUnitCycleTime. Depending of these CNC commands, the interpolator generates internal commands with a period of 250us [cubic interpolation]. This treatment of the position commands make the system behavior more linear.

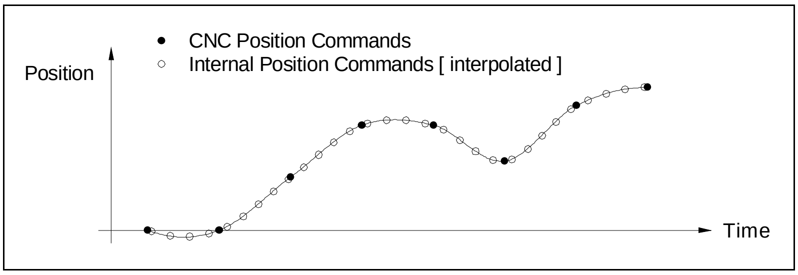


fig. 3 Interpolator

Proportional control

It is the basic of the position loop. Its function at the drive is the same as that of CNC parameter **PROGAIN [P23]**.

Proportional gain setting.

The gain is given at the drive by parameter:

PP104 [S104] PositionKvGain

For **linear axes**, it is given in m/min of programmed velocity command per thousandth of a degree 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:

S104 = 1 means that to a programmed feedrate of 1000 mm/min (F1000 at the CNC) corresponds a following error of 1 mm.

S104 = 2 at F1000, the following error will be 0.5 mm.

For a following error of 5 microns at F2000, Kv will be 2/0.005, that is: S104 = 400.

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

Velocity feed-forward

It is added 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. This decreases 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.

This is achieved with parameter:

PP216 [S296] VelocityFeedForwardPercentage

It indicates the percentage of the final velocity command that does not depend on following error (open loop). The rest of the final velocity command will be due to the proportional gain. See block diagram in fig.1.

Example:

S296 = 80 80% of the velocity command comes from feed-forward.

20% of the velocity command comes from the proportional gain.

Feed-forward acceleration

It is an addition 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.

Feed-forward allows reducing the amount of following error on accelerations without increasing the gain, thus maintaining system stability.

Acceleration feed-forward gain setting.

Set the effect of acceleration feed-forward using the following parameter:

PP217 [S348] AccelerationFeedForwardPercentage

It indicates the portion of the final acceleration command being forwarded. See the previous block diagram in fig.1.

Example:

S348 = 80 80% of the acceleration command is due to feed-forward

20% of the acceleration command comes from the proportional control and the velocity feed-forward.

Home search

The **position drive** is capable of carrying out an automatic home searching process. This feature is not required in the case of motors with an absolute encoder (ref. A0 and A1).

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 searching procedure.

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

⓪ It is a random point on machine power-up. Initially, the position feedback PV51 [S51] PositionFeedback1 takes that point as coordinate 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:

① With the home-switch released PV200 [S400]=0. Solid line.

② With the home-switch pressed PV200 [S400]=1. Dashed line.

Parameters PP41 [S41] Homing Velocity Fast and PP1 [F1300] Homing VelocitySlow set the homing feedrate in each phase of the process.

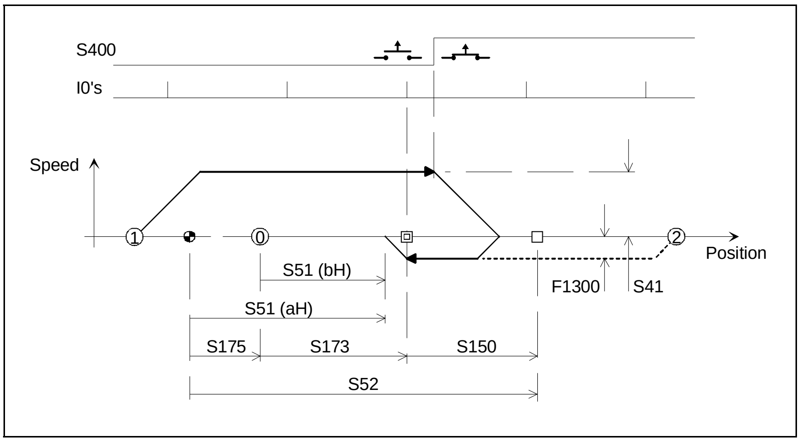


fig. 4 Incremental feedback. Automatic home search

□ Is the point with the searched marker pulse. When going over that point, which is always done feedrate PP1 [F1300] HomingVelocitySlow, the system registers the value of the position feedback in parameter PV173 [S173] MarkerPosition A.

PV208 [S408] ReferenceMarkerPulseRegistered is activated.

The motor stops.

Is the machine zero point for the absolute references. To set the new PV51 [S51] PositionFeedback1 set PV175 [S175] DisplacementParameter1 by means of the formula:

S175 = S52 - S150 - S173.

PV203 [S403] PositionFeedbackStatus is activated.

The internal position command PV47 [S47] PositionCommand is given the value of the new position feedback PV51 [S51] PositionFeedback1.

Finally, the **position drive** remains ready to execute absolute movements.

i

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 always been found correctly.

Change of the location of point □.

Replacing the feedback device or the motor may change the location of the marker pulse. To keep the same home location, set the offset parameter PP150 [S150] ReferenceOffset1. Determine this offset based on a known position in the previous reference system.

Note:

Direct feedback.

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

Attending to the motor's own feedback:

PP52	[S52]	ReferenceDistance1
PP150	[S150]	ReferenceOffset1
PV51	[S51]	PositionFeedback1
PV175	[S175]	DisplacementParameter1

Attending to the direct feedback:

PP54	[S54]	ReferenceDistance2
PP151	[S15]	ReferenceOffset2
PV53	[S53]	PositionFeedback2
PV176	[S176]	DisplacementParameter2

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

Home search setting.

It is possible to set the home searching direction and the boolean logic of the home-switch.

Bits 1 and 2 of parameter PP147 [S147] set the positive home searching direction and whether the home switch closes its contacts or opens them when activated.

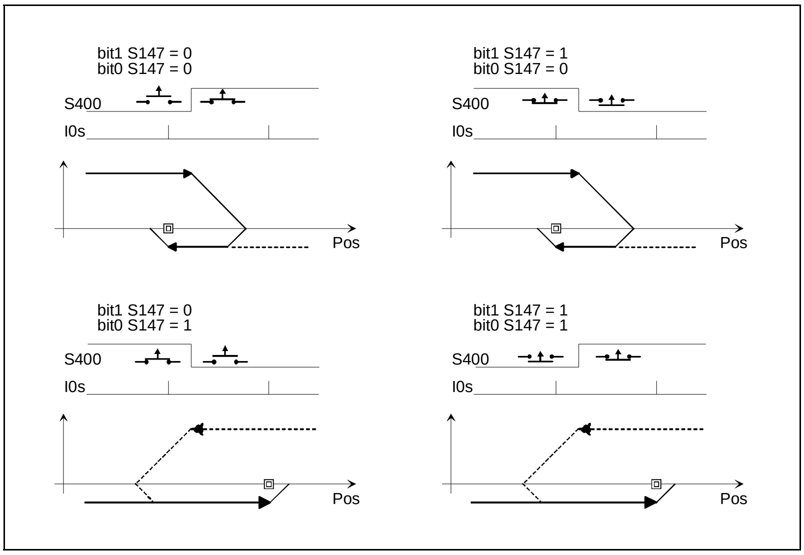


fig. 5 Home search configuration

Electrical connection of the home-switch and parameter setting.

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

If no PLC is used, assign variable PV200 [S400] to one of parameters IP10 ... IP13 (in the Sercos® nomenclature, F901 ... F904). 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 zero of parameter S400 must take the value of one of the digital inputs [for example I1]. The instruction would be: I1 = B0S400.

When the electrical contact is taken to one of the digital inputs of the CNC 8070.

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 marker pulses (reference marks) [E0, E2, E3, R0 on the Fagor motor reference].

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

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

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

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

Feedback with marker pulses [E1, I0 on the Fagor motor reference].

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. Thus, 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, 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 fig.6-a and fig.6-b to confirm this fact.

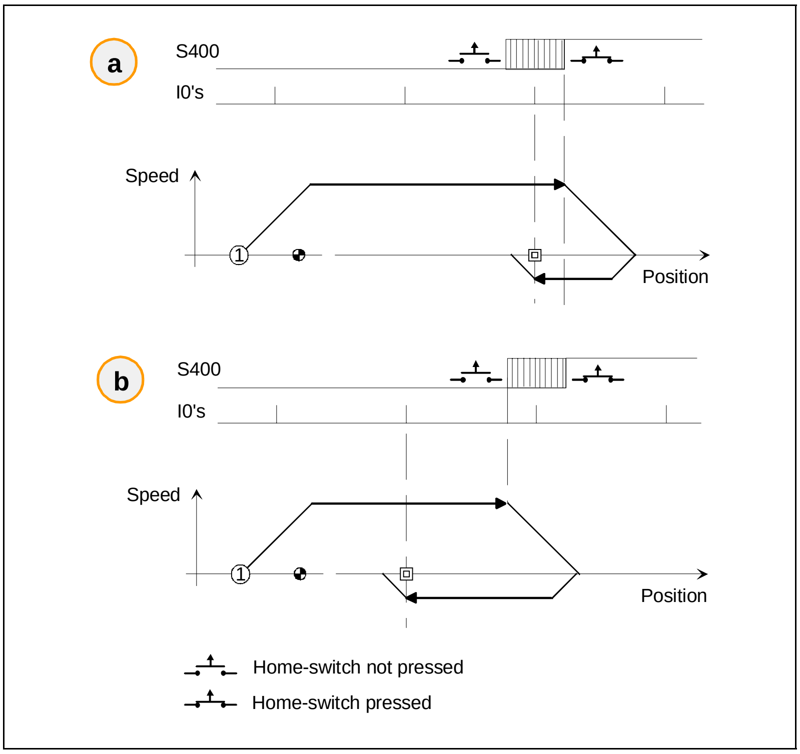


fig. 6 Repeatability problem when searching home.

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 [S298] HomeSwitchDistance

after carrying out a home search.

- **Moving the home switch through software:**

Shift the home switch by executing the command:

GC6 [F615] HomeSwitchAutoCalibration

where the parameters to be considered are:

PP4 [S299] HomeSwitchOffset
PV1 [S298] HomeSwitchDistance

See appendix A.

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.

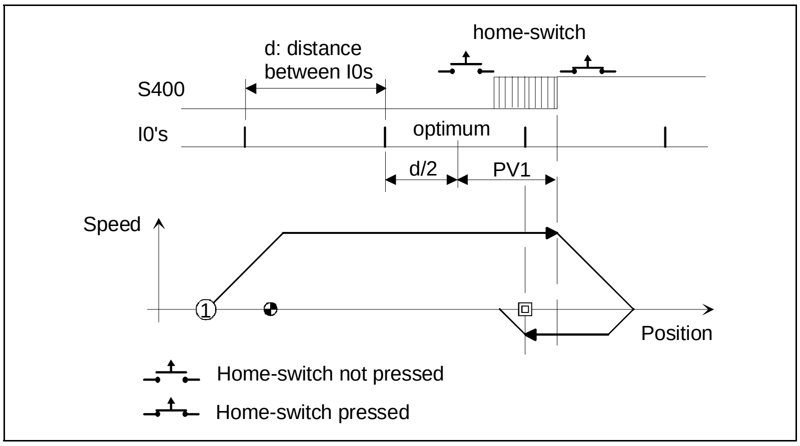


fig. 7 First home search. Meaning of variable PV1.

- **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.

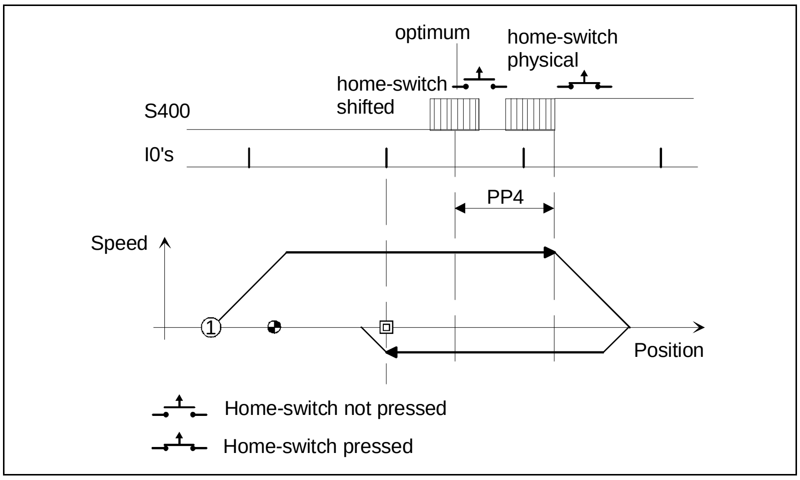


fig. 8 How to get the valid reference mark (I0).

Warning: From software version v.06.03 on, it checks the coordinates obtained after a home search. If the coordinate obtained (PV53 or PV51as the case may be) is out of limits and these limits are enabled (PP55.4=1), it will issue error E150 (OverTravelLimitIsExceeded). This will only be tested at the end of the home search and it is carried out both in position control and velocity control.

With spindle home and gear ratio other than 1:1

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

Restrictions of the application:

It can only be applied to:

- To toothed belt transmissions.
- Rotary axes (or spindles).

Note that it makes no sense for 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 ration 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 marks 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 ration 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 (home-switch) in a home search could not repeat the reference mark and consequently could set a different machine zero point.

Remember that with gear ratios that may be simplified mathematically, **the simplification must be exact**. Thus, for a 32/24 ratio, the result of the simplification is 4/3 and, consequently, NP121 must be set to 4 and NP122 to 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.

Feedback with distance-coded reference marks

A short 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.

NP117	**[S117]**	ResolutionOfFeedback2	
NP118	**[S118]**	ResolutionOfLinearFeedback	**(only linear)**
NP165	**[S165]**	DistanceCodedReferenceMarksA	
NP166	**[S166]**	DistanceCodedReferenceMarksB	
PP115.0	**[S115]**	PositionFeedback2Type	**(bit 0)**

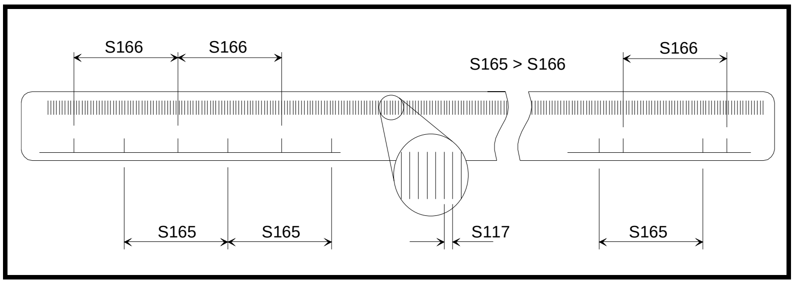
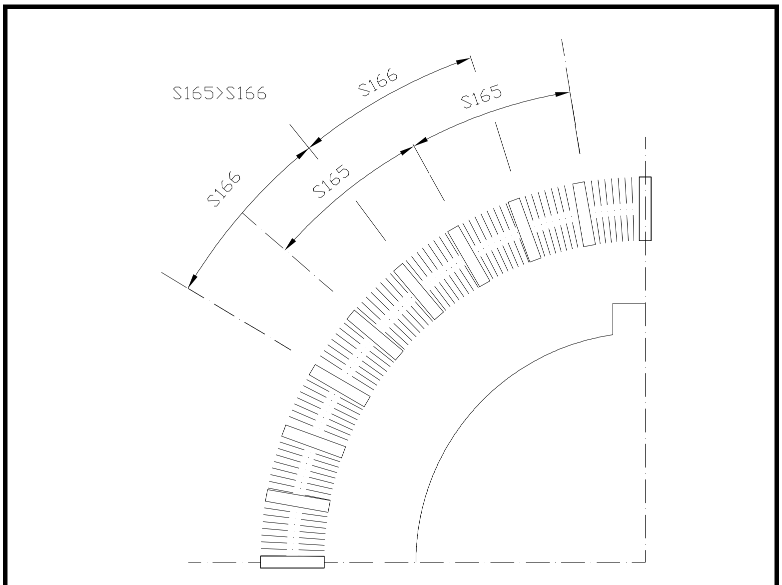


fig. 9 Illustration of the linear encoder parameters



S117: Number of pulses per turn.

fig. 10 Meaning of the parameters of an encoder

Example 1:

Fagor MOVP model glass scales have several reference marks separates 100 signal cycles, the group of marks alternating with the previous ones are separated 100.1 signal cycles and their pitch is 20 microns.

Let us suppose that in this particular scale model and using a multiplying factor of **x10**, and accuracy of 2 microns is obtained. The values to be assigned to these parameters are:

S117 = 20 microns S118 = 2 microns

S165 = 1001 S166 = 1000

To operate with this type of feedback, set the following bits:

5, 3, 1 and 0 of PP115.

Proceed as follows.

- bit 0 = 1 (linear)
- bit 1 = 1 (I0s distance-coded)
- bit 3 counting direction should be already set
- bit 5 Do a home search, move the axis in the positive direction and do a home search again, if the coordinate given after the second home search is smaller than the one given in the first one, invert the value of PP115 (bit 5).

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:

- Do a home search.
- Move the axis to the point selected as zero.
- Reed the PV53 [S53] PositionFeedback2 variable.
- Set parameter PP178 [S178] AbsoluteDistance2 to the value read in PV53 with reversed sign.

Example 2:

Fagor encoder models SOP and HOP have a set of reference marks (I0) 100 signal cycles apart from each other, another set of marks that alternate with the previous ones 100.1 signal cycles apart from each other. Their resolution is 18,000 pulses per turn.

The values to be assigned to these parameters are:

S117 = 18000 S165 = 1001 S166 = 1000

Set the following bits when using this type of feedback devices:

5, 3, 1 and 0 of PP115.

Follow these steps:

- bit 0 = 0 (rotary)
- bit 1 = 1 (distance-coded)
- bit 3 The pulse counting direction should've been adjusted already
- bit 5 Search home, move the axis in the positive direction and search home again; if the coordinate given after the second home search is smaller than the one given by the first search, complement the value of PP115 (bit 5).

Follow these steps to shift the encoder "0":

- Search home.
- Move the axis to the point chosen as machine zero.
- Read the "PV53 [S53] PositionFeedback2" variable.

Assign to parameter "PP178 [S178] AbsoluteDistance2 " the value read in PV53 with the opposite sign.

Fagor scales have the following characteristics:

Tipe	Feedback signal period [NP117]	Distance between I0s	Incremental distance between I0s
COC	20 microns	10 mm	20 microns
COVC	20 microns	10 mm	20 microns
COVP	20 microns	10 mm	20 microns
COVS	20 microns	10 mm	20 microns
COVX	4 microns	10 mm	20 microns
COX	4 microns	10 mm	20 microns
FOC	100 microns	50 mm	100 microns
FOP	100 microns	50 mm	100 microns
FOS	100 microns	50 mm	100 microns
FOT	20 microns	50 mm	100 microns
FOX	4 microns	50 mm	100 microns
MOVC	20 microns	10 mm	20 microns
MOVP	20 microns	10 mm	20 microns
MOVS	20 microns	10 mm	20 microns
MOVX	4 microns	10 mm	20 microns
MOVY	2 microns	10 mm	20 microns

table 1   Characteristics of Fagor linear encoders

To calculate the values to be given to the parameters:

$$NP166 = \frac{[\text{Distance between I0s}] \times 2}{[\text{Increment distance between I0s}]}$$

$$NP165 = \frac{[\text{Distance between I0s}] \times 2 + [\text{Incremental distance between I0s}]}{[\text{Incremental distance between I0s}]}$$

Thus, for example: Fagor FOP feedback:

$$NP166 = \frac{50 \cdot 2}{0.1} = 1000 \qquad NP117 = 100 \text{ microns}$$

$$NP165 = \frac{50 \cdot 2 + 0.1}{0.1} = 1001$$

In fact all Fagor scales appearing in this table are adjusted with NP166 = 1000 and NP165 = 1001.

Absolute feedback

The absolute feedback device on Fagor FXM motors registers the value of its angular position throughout ± 2048 revolutions (4096 revolutions) and **does not lose it when turning the machine off** (see variable RV5 [F1515] StegmannType). Thus, the drive knows from the very first instant the absolute position of that 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 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 [S51] PositionFeedback1"
- Assign to parameter "PP177 [S177] AbsoluteDistance1" the value read in PV51.

If the absolute feedback device is a direct feedback, follow the same procedure by taking into account PV53 [S53] PositionFeedback2 and PP178 [S178] AbsoluteDistance2.

Backlash compensation

When the position feedback is obtained on the motor shaft, the ballscrew backlash must be compensated for.

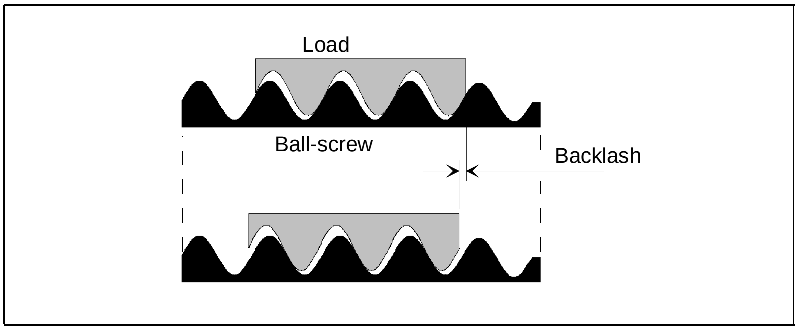


fig. 11 Backlash between the load and the ballscrew

Feedback on the motor.

The drive can compensate for any backlash between the load and the ballscrew by internally acting upon the position command. Thus correcting the movement ***hysteresis*** originated when reversing the direction of the axis.

Set this parameter:

PP58 [S58] Backlash

This ballscrew backlash compensation only takes place if:

- the drive is in position control mode and.

- there is no feedback on the load.

Both the drive and the CNC offer parameters setting the value of ballscrew backlash. This value must only be registered at one of them. The other parameter must be set to 0.

Direct feedback.

The drive, acting internally on the velocity command, is able to compensate for backlash between the load and the ballscrew. This corrects the following error originated when reversing the axis moving direction.

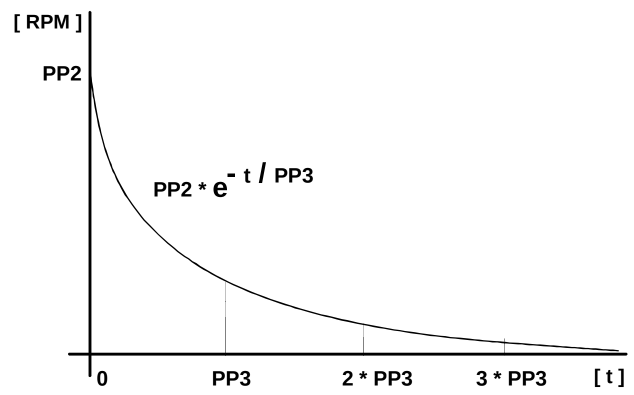
The following on-line parameters are involved in the adjustment:

PP2 [F1301] BacklashPeakAmplitude

PP3 [F1302] BacklashPeakTime

This **reversal peak** compensation is carried out by increasing the motor speed [PP2] for a time period [PP3] so their product **approximately** matches the amount of backlash.

The **reversal peak** compensation is given by an exponential function like the one shown in fig.11:



The area under the graph down to the horizontal axis between limits [0, h] represents *approximately* the compensate backlash

fig. 12 Reversal peak compensation with an exponential shape

where:

PP2: Initial amplitude in (rpm)

PP3: Time constant in (ms)

The whole area under the curve between [0, h] that is equivalent to the integral of the exponential function between those limits **approximately** represents the backlash compensation:

Atotal Z PP2 * PP3 Z backlash compensation.

Between:

0 and PP3 ms, it compensates 63% of backlash.

0 and 2* PP3 ms, it compensates 87% of backlash.

0 and 3* PP3 ms, it compensates 95% of backlash.

This ballscrew backlash compensation is only applied if:

- the drive in position control mode
- there is feedback on the load.

When adjusting it, manipulate both parameters until minimizing the amount of following error.

Both the drive and the CNC have parameters to determine the value of the ballscrew backlash. This value must only be set in one of them, The other parameter must be set to "0".

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 [F1902] ConstantPositiveTorqueCompensation
TP11 [F1903] ConstantNegativeTorqueCompensation
TP12 [F1904] DynamicPositiveTorqueCompensation
TP13 [F1905] DynamicNegativeTorqueCompensation

Inertia related:

NP1 [F2200] ReducedActuatedMomentumOfInertiaPercentage

All these parameters are on-line, that is, immediate effect, and consequently after executing the feature using the command: **GC5 [F0615] AutoCalculate** recalculates all of them overwriting 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 slow constant speed (eg. 50 rpm).
2. movement at fast constant speed (i.e. half the motor rated speed).
3. noticeable acceleration between both movements (eg. 2000 mm/s^2).
4. duration of the movement at constant speed (eg. between 1 and 5 s).

i

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 s.

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 with to keep this parameter setting, save them into Flash using the relevant icon or the GC1 command.

The minimum requirements of the programmed movement needed for auto-adjustment of the inertia may be seen in the following figure:

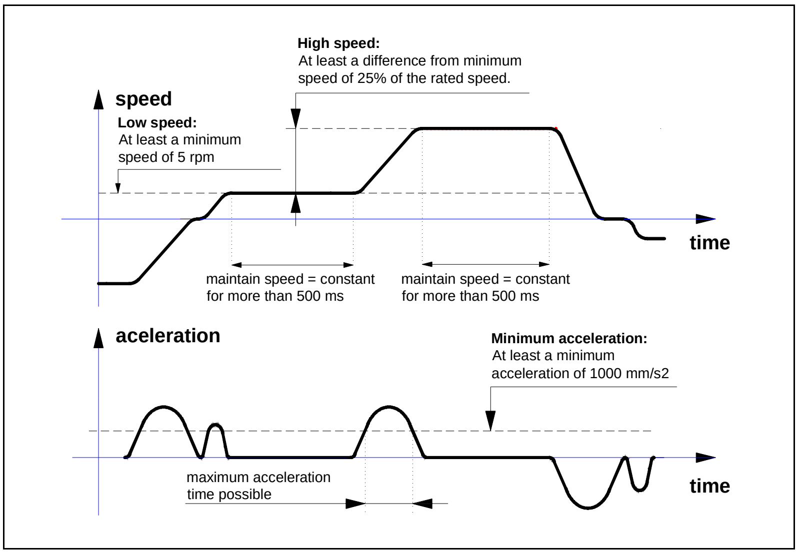


fig. 13 Movement programmed to auto-adjust the inertia

Following error monitoring

The monitoring of following error prevents the axes from running away. The drive compares these parameters:

PV189 [S189] FollowingError

PP159 [S159] MonitoringWindow

If FollowingError > MonitoringWindow means that the servo system follows the command with an excessive delay and it triggers the error message:

Error 156 ExcessiveFollowingError (DV1 [S11], bit 11)

This monitoring if the **following error** is only done if:

- the drive is in position control mode, (see AP1 [S32])
- parameter MonitoringWindow is other than zero, PP159 > 0 and
- there is motor torque, TV100 [F1702] = 1.

If parameter PP159 [S159] 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.

The CNC also monitors the maximum amount of following error allowed by indicating in its relevant parameter in the parameter table for each axis at the CNC.

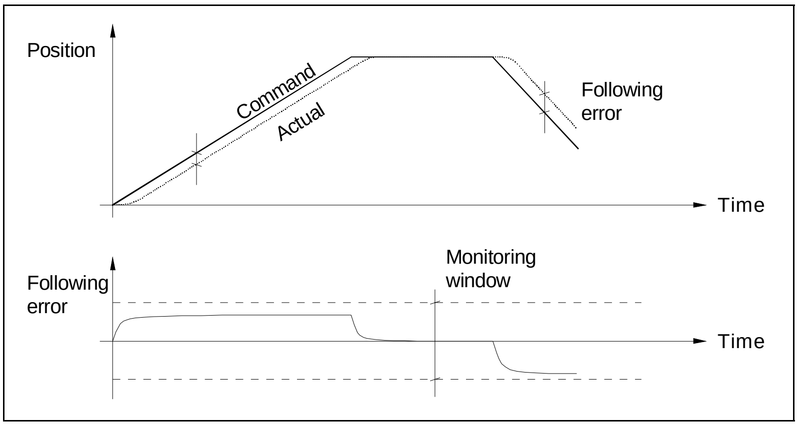


fig. 14 Monitoring of following error

Module format

The drive can work in module format.

This is format 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 [S103] ModuloValue

Bit 7 of the following parameter:

PP76 [S76] PositionDataScalingType

determines the drive configuration in either **module** or **absolute** format.

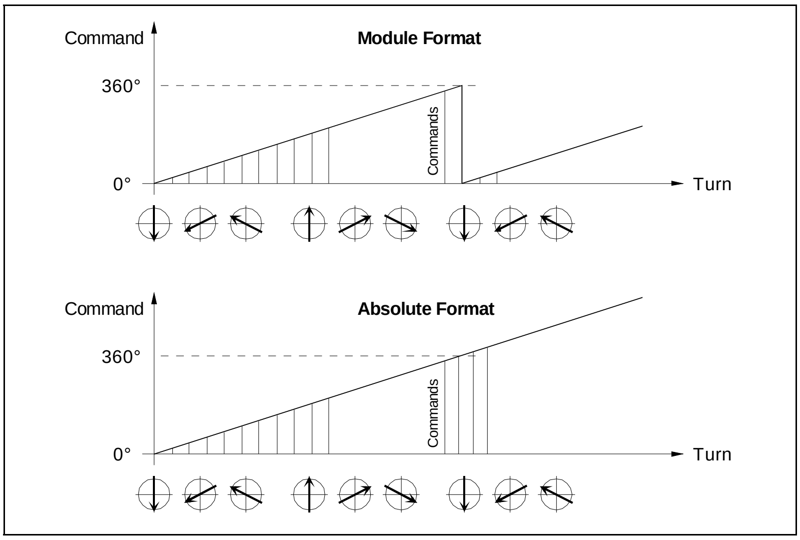


fig. 15 Module format

Working in module format, the drive does not admit:

- commands in absolute value greater than PP103.

Verify that the CNC defines that axis the same way (module or linear format).

Position limits

Parameters PP49 [S49] PositivePositionLimit and PP50 [S50] NegativePositionLimit set the travel limits. This establishes a permitted zone and a forbidden zone for axis movement. Any position command PV47 [S47] PositionCommand that would force the axis into the forbidden zone will cause error 150.

See parameters PP49 [S49] PositivePositionLimit and PP50 [S50] NegativePositionLimit in appendix A of this manual and the definition of error 150 in appendix B.

The position limits may be canceled by setting bit 4 of PP115 to "0" or leaving parameters PP49 and PP50 at "0". It is not necessary to meet both conditions, it is enough to meet either one to cancel them without issuing error 150.

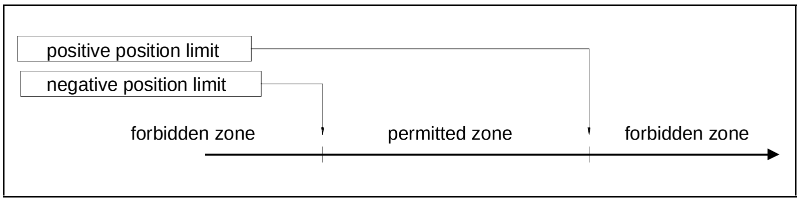


fig. 16 Position limits

On line change of feedback

Introduction

With version 04.01, it could only regulated with the feedback chosen in the initial parameter setting. If a given point, you wanted to switch from regulating with an external feedback to doing it with the motor feedback or viceversa, the system had to be turned off and the relevant parameters had to be changed.

However, many Motion Control applications require an on - line feedback change without having to turn the system off, set the new parameters and reset the drive. This is possible with v.04.02.

Mode of operation and parameter setting

Introduction

With version 04.01 there were two modes of operation to regulate in position with each of the two feedbacks (motor or external).

Parameter AP1 established the mode of operation:

With AP1=	3	position and motor feedback
	11	position and motor feedback with feed-forward
	4	position and direct feedback
	12	position and direct feedback with feed-forward

From version 04.02 on, there are two modes of operation:

With AP1=	5	position and both feedbacks
	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.

Feedback changing command

The command that makes the feedback change is the PC150 [F2003] ChangePosFB12.

It operates as follows:

- Enter the value 3 to execute it.
- It return the value of 7 if everything is working fine.
- It return the value of 15 (error) if the command is not executed properly.

When executed correctly, is switches to a regulation with direct feedback. Enter a 0 to switch back to regulating with motor feedback.

Every time this command is executed, the direct feedback will be equaled to the motor feedback one thus preventing an error between feedbacks.

i By default, the feedback that will be used to close the position loop will be the 1st one unless the CNC or Motion Control program selects the direct feedback on start - up.

Parameters, variables and commands

Refer to appendix A in this manual to see the new parameters, variables and commands included in this on - line feedback changing feature.

Home search with any of the two feedbacks

With version 04.01 according to parameter AP1 that sets the operating mode, home search could be carried out either the motor or on the direct feedback. With version 04.02, home search may be operating modes set by AP1 with the values of 5 and 13.

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 setting parameter 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 operation mode is the same as setting parameter 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, home search is carried out on the direct feedback.

Since both feedbacks must have same coordinate, it calculates PV173 [S173] MarkerPositionA as PV53 [S53] 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 on the direct feedback:

- The command PC150 = 3
- Bit 3 of parameter PP147 = 0

With this setting, home search is carried out on the motor feedback.

The offset is calculated with the motor feedback, in other words, PV173 [S173] MarkerPositionA is the same as PV51 [S51] PositionFeedback1 plus the home offsets of the motor feedback. This calculated distance is applied to PV47, PV51 and PV53.

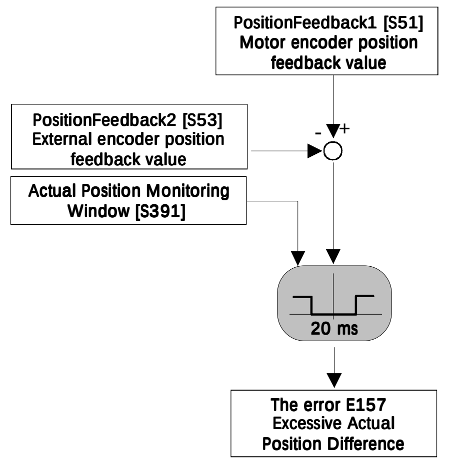
The feedback cannot be changed on line while moving. The motor must be stopped. On the other hand, before switching feedbacks, it must be verifier that their parameters are set properly. To do that, either check that the value of PV190 (that indicates the error between both feedbacks) is not too high or use parameter PP5.

Maximum error allowed between feedbacks

Parameter:

PP5 [S391] ActualPositionMonitoringWindow

It 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 157 ExcessiveActualPosition Difference (DV11 [S11], bit 11).



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 !

Version V.06.09 permits setting PP5 = -1 thus making the feedbacks fully independent.

REMEMBER THAT: If PP5 = -1, 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.

General parameters:

AP1: Selects how the drive will operate.

= 3 : position loop with motor feedback without feedforward.

= 4 : position loop with direct feedback without feedforward.

= 5 : position loop with motor or direct feedback without feedforward.

= 11 : position loop with motor feedback and feedforward. [PP216, PP217]

= 12: position loop with direct feedback and feedforward. [PP216, PP217]

= 13: position loop with motor or direct feedback and feedforward. [PP216, PP217]

GP10 : Direct feedback signal type.

= 0 There is no direct feedback.

= 1 Square TTL signal.

= 2 1Vpp sinewave signal.

= 3 Signal from a Stegmann feedback device

= 4 TTL square signal with SSI communication

= 5 1Vpp sinusoidal signal with SSI communication

Check the value taken by the parameter:

GP2 : Motor feedback type.

= 0 Sinewave encoder

= 1 Resolver.

= 2 Square TTL encoder.

= 5 Heidenhain encoder [ERN 1387] for Siemens motors, 1FT6 family.

When using motor feedback (AP1=3 or AP1=11)

The following parameters are ignored:

PP54: Refvalue with direct feedback.

PP115: Direct feedback parameter setting.

NP117: Pitch/pulses setting for direct feedback.

When using direct feedback (AP1=4 or AP1=12)

The following parameters are ignored:

PP150: Refshift for motor feedback.

PP52: Refvalue with motor feedback.

Resolution related parameters:

PP115: Direct feedback parameter setting.

Bit 5: structure of distance coded feedback

= 0 counting positive with positive direction

= 1 counting negative with positive direction

Bit 3: Direction polarity

= 0 not inverted

= 1 inverted

Bit 1: Feedback type.

= 0 without distance - coded reference marks.

= 1 with distance - coded reference marks. NP165 and NP166

Bit 0: Direct feedback type:

= 0 Rotary [encoder], [NP117 will give pulses per turn].

= 1 Linear [scale], [NP118 will give the period of the scales feedback signal].

NP117: Resolution of the rotary direct feedback in pulses per turn.

NP118: Resolution of the linear direct feedback.

- period of the scale signal. 20 microns for Fagor scales [graduated glass] , S118 = 20 microns.

NP121, NP122: The **NP121/NP122** ratio indicates the gear ratio between the motor and the ballscrew..

They only admit integer values up to 32767.

NP123: Ballscrew pitch. If it is a rotary axis, set NP123 = 360000.

NP131, NP132: 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.

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 both encoders).

Parameters to identify a linear feedback with distance coded reference marks:

NP165: Distance between reference marks.

NP166: Distance between **coded** reference marks.

Home switch parameters.

PP147: Setting of the home search.

Bit 5:	= 0	The home-switch is monitored (by default)
	= 1	The home-switch is ignored
Bit 3:	= 0	Motor feedback (see PP52, PP150)
	= 1	Direct feedback (see PP54, PP151)
Bit 1:	= 0	Home-switch normally open
	= 1	Home-switch normally closed.
Bit 0:	= 0	The motor shaft turns clockwise when searching home.
	= 1	The motor shaft turns counterclockwise when searching home.

Bit 3 of parameter PP147 indicates which feedback will be used for homing regardless of which feedback is used for regulation. Therefore, **Bit 3** of parameter **PP147:**

bit 3 = 0 with motor feedback

bit 3 = 1 with direct feedback

With the 8070 CNC take the electrical contact **home -switch** to one of its digital inputs.

PP1: Slow motor speed when the electrical contact **home - switch** to one of its digital inputs.

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 paramenters **REFVALUE** [P53] of the axis 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 8050/55 CNC except that the drive does not move to return to the **REFVALUE** [P53] position.

Horning method. The home switch may be connected directly to the PLC or to the drive, this is now irrelevant.

Gain related parameters.

PP104: Proportional gain in the position loop. It is similar to axis parameter **PROGAIN** [P23] of the 8050/55 CNC. PP104 =1, means a following error of 1mm at F1000 mm/min.

PP216.#: % of velocity feed-forward [0 to 100%]. It is similar to axis parameter **FFGAIN** [P25] of the 8050/55 CNC.

PP159: Maximum amount of following error permitted. If this parameter is set to 0, the following error is not monitored. It is very important to set it to a value other than 0 to prevent the axes from running away out of relevant parameter in the parameter table for each axis at the CNC.

PV 189: Monitoring of the following error.

Various parameters for the position loop.

PP49, PP50: 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. That is, bit 0 of PV203 [S403] Position FeedbackStatus is set to 1.

If the variable PV58 [S258] TargetPosition exceeds the position limits, the drive will activate bit 13 of DV9 [S12] Class2 Diagnostics [Warnings] TargetPositionOutsideTheTravelZone.

The CNC also observes the travel limits defined in its axis parameter tables.

PP55: Controls the polarity of various position data.

Bit 4: Position limits

= 0 cancels the position limits.

= 1 active (by default). See PP49 and PP50.

Bit 3: Direct position feedback value.

= 0 non inverted.

= 1 inverted (by default).

Bit 2: Motor position feedback value.

= 0 non inverted.

= 1 inverted (by default).

Bit 0: Position command value.

= 0 non inverted.

= 1 inverted (by default).

PP58: Ballscrew error. With motor feedback, the drive compensates for the backlash in changing direction. Both the drive and the CNC offer parameters to set the value of the ballscrew backlash; but this value must only be registered in either one of them. The other parameter must be set to 0.

PP2, PP3 : Leadscrew backlash. With direct feedback, the drive compensates for backlash when reversing the moving direction.

Both the drive and the CNC offer parameters that set the amount of leadscrew backlash. This value must only be set on one of the units, the other parameter must be set to 0.

PP76: Command application in module format. Verify that the CNC defines that axis the same way [module or absolute format].

Bit 7: = 0 The module format is not applied.

= 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 motor and direct feedbacks. Being PP5= -1, independent feedbacks.

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 [S258] TargetPosition for considering that the axis is in position.

Parameters related to the SSI communication of the Fagor absolute linear encoder:

With GP10 = 4 or GP10 = 5:

RP60: Frequency of the SSI communication clock.

RP61: SSI data size in bits.

RP62: SSI data format.

RP63: Units of the coordinate read by SSI.

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 appendix A: Parameters, variables and commands. Should you have any doubts on how any of them works, refer to this appendix.

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.

fig.17 Toolbar of the WinDDSSetup.

CONFIGURING THE APPLICATION:

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.

General description of the screen

The data of the screen for **<configuring the application>** is laid out as follows:

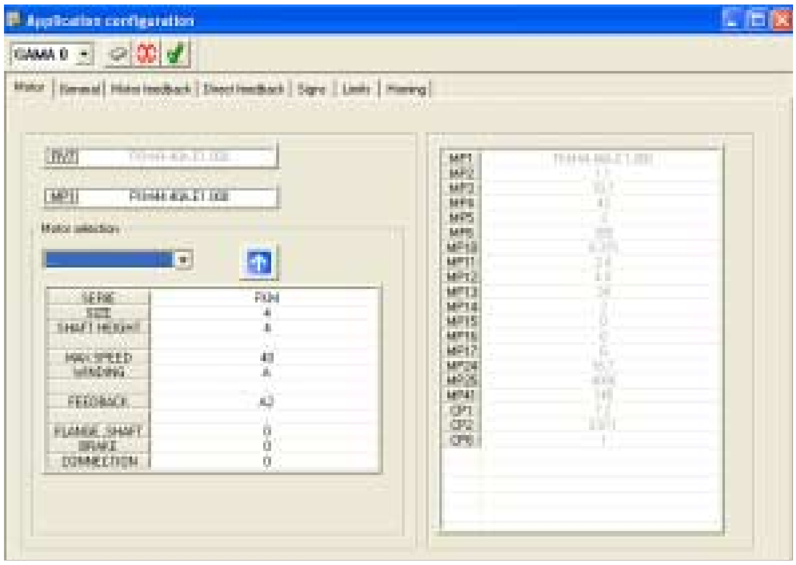


fig.18 Configuring the application from the WinDDSSetup.

Execute the following from the icon bar located at the top of the window:

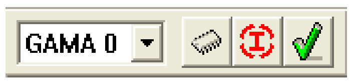
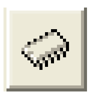


fig.19 Icon bar.

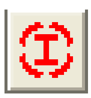
GEAR SELECTION:

From the drop list, select the gear (bear in mind that it corresponds to a purely mechanical gear ratio)
Possible gears to be selected: gear 0 (no gear ratio or out of range), gear 1 (higher speed gear ratio) ... gear 7 (lower speed gear ratio).



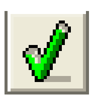
PARAMETERS TO FLASH:

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.

<Configuring the application> with the **<motor>** label active:

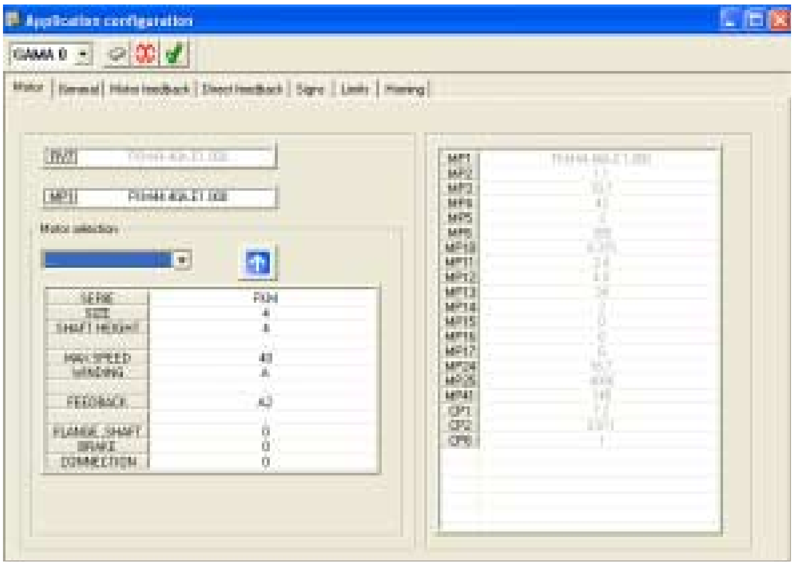
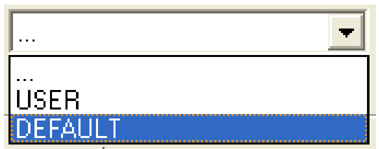


fig. 20 Configuring the application from the WinDDSSetup with the **<motor>** label active:

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.

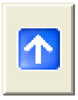
C. Field <RV7>: This field shows the ID recorded in the encoder that is integrated into the motor. If it does not detect any, the text field will appear empty.

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>**.

<Configuring the application> with the **<General>** label active:

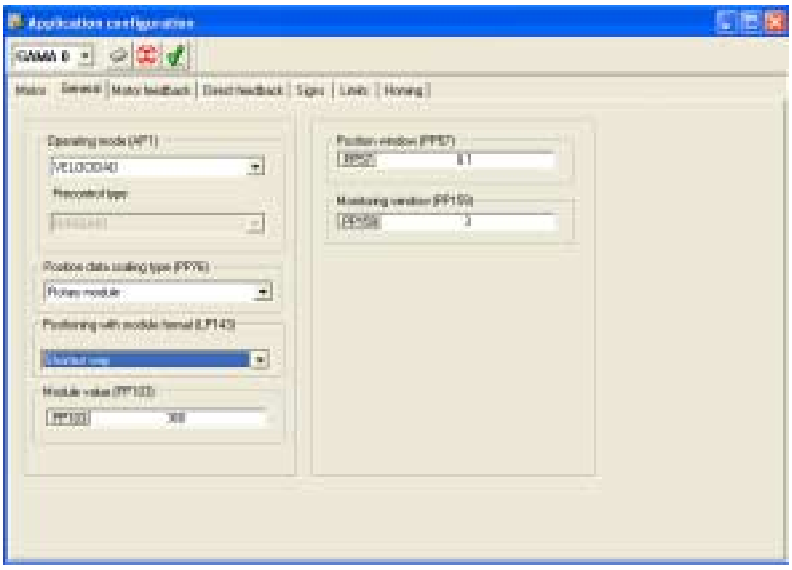


fig. 21 Configuring the application from the WinDDSSetup with the **<General>** label active:

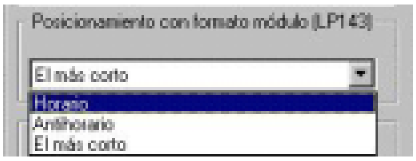
The fields shown in this window are:

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 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.

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:

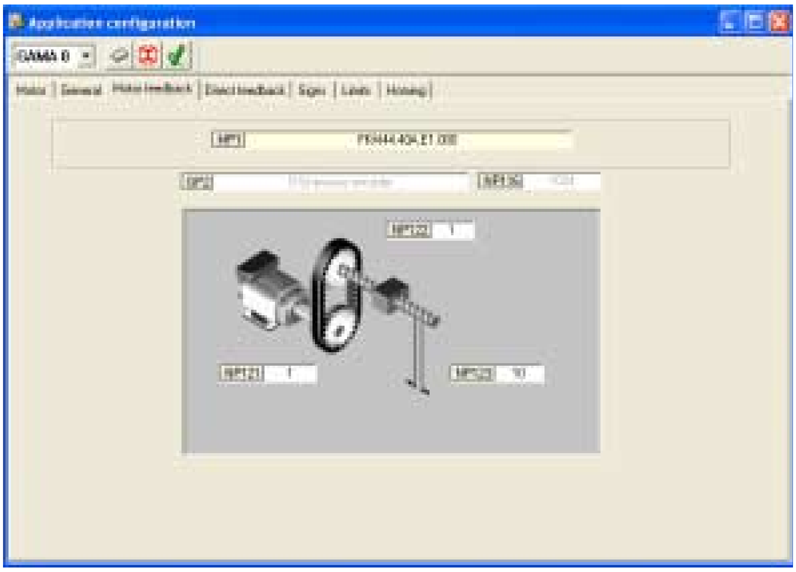


fig. 22 Configuring the application from the WinDDSSetup with the **<Motor feedback>** label active:

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
- (10) Motor simulator

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:

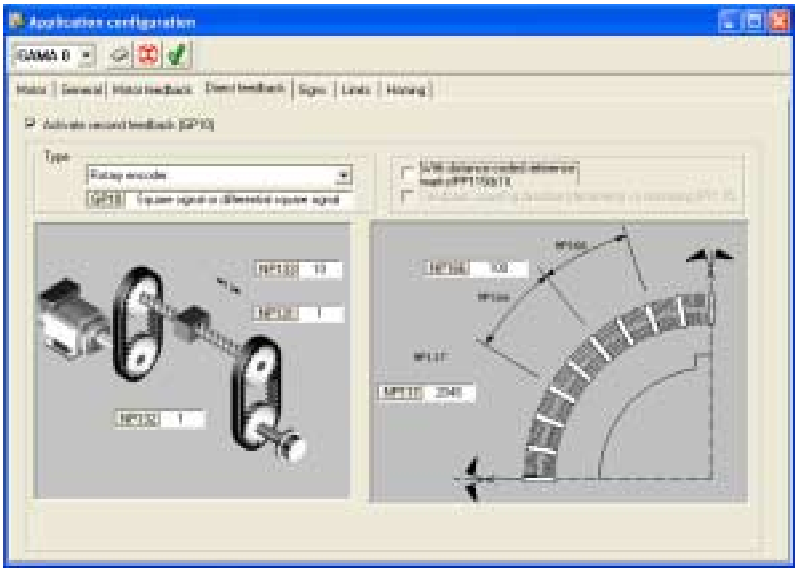


fig. 23 Configuring the application from the WinDDSSetup with the **<Direct feedback>** label active:

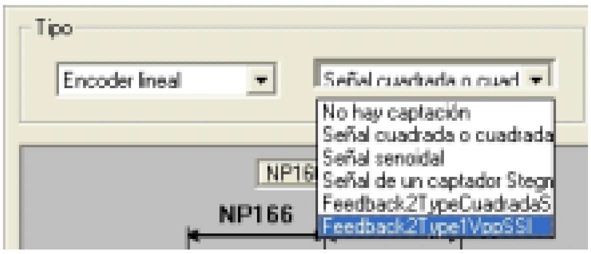
The fields shown in this window are:

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)
- Feedback2TypeCuadradaSSI
- Feedback2Type1VppSSI

See figure:



When selecting in this field the **<linear encoder>** option with the **<distance-coded I0's>** option off, the window and the fields that will be displayed are:

fig. 24 Configuring the application from the WinDDSSetup with the **<Direct feedback>** label active: Linear direct feedback without distance-coded I0'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.

If the option **<With distance-coded I0's>** that appears in this window is activated, the following fields are also displayed:

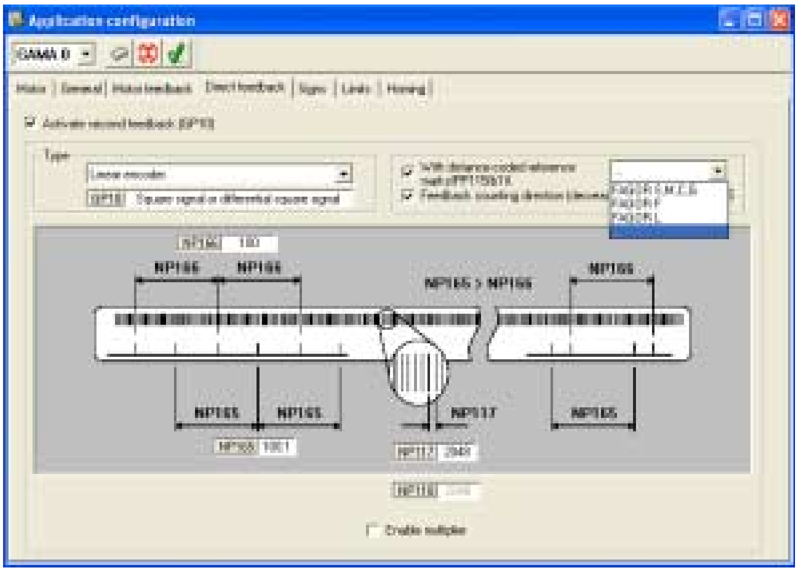


fig. 25 Configuring the application from the WinDDSSetup with the **<Direct feedback>** label active: Linear direct feedback with distance-coded I0's.

D. Field <NP165> : This field is used to define the gap between **two consecutive distance-coded I0's**. The **<With distance-coded I0'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 I0's**. The **<With distance-coded I0's> option must be selected previously.** To change this value, type the new value in this field.

Being the **<With distance-coded I0'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 I0's> option, the window and the fields that will be displayed are:**

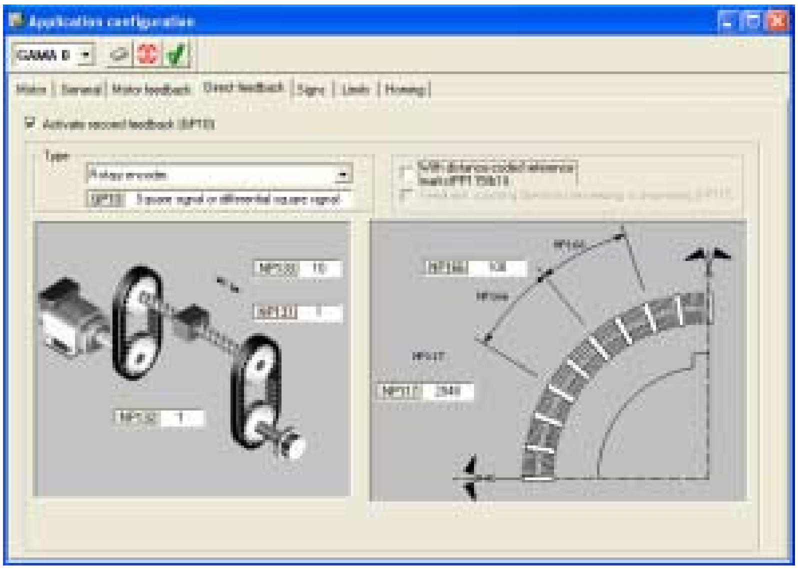


fig. 26 Configuring the application from the WinDDSSetup with the **<Direct feedback>** label active: Rotary direct feedback without distance-coded I0's.

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 I0's>** option, the following window and fields are displayed:

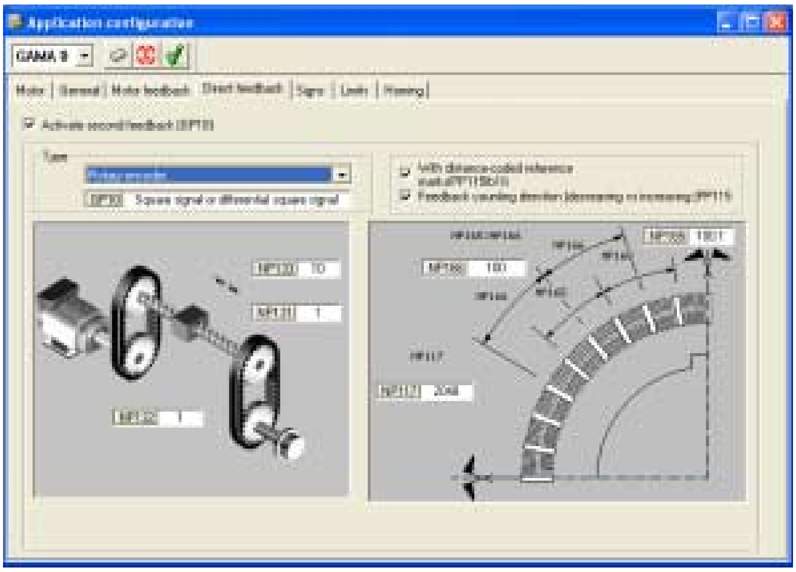


fig. 27 Configuring the application from the WinDDSSetup with the **<Direct feedback>** label active: Rotary direct feedback with distance-coded I0's.

J. Field <NP165>: This field is used to define the gap between **two consecutive distance-coded I0's**, when using distance-coded I0's. The **<With distance-coded I0'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 I0's**, when using distance-coded I0's. The **<With distance-coded I0's> option must be selected previously.** To change this value, type the new value in this field.

Being the **<With distance-coded I0'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:

- If in the AP1 operating mode, the <velocity> option 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), thus changing the sign of the data it represents.

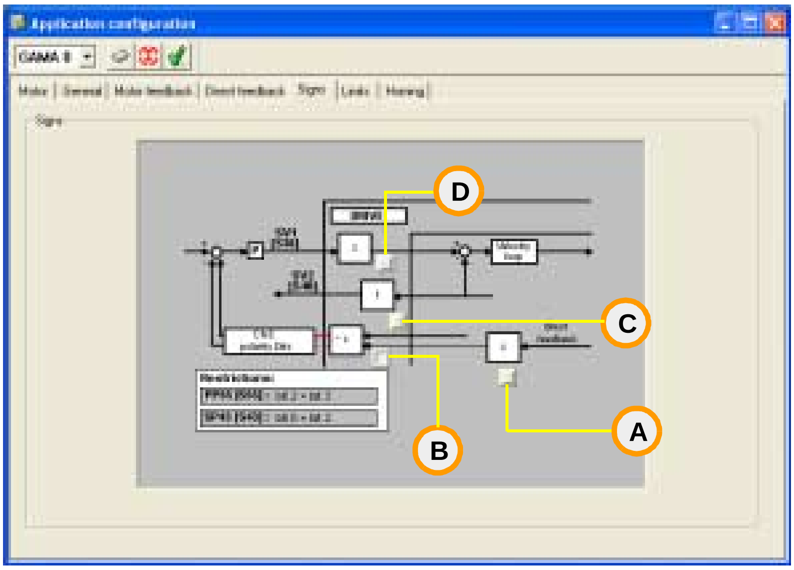


fig. 28 Configuring the application from the WinDDSSetup with the **<Signs>** label active: Reverse the sign of the various velocity and position data when the CNC closes the position loop.

Thus activating the **<activate>** button implies:

A. Change the counting direction of the direct feedback represented by parameter (PP115. bit 3).

B. Change the sign of the position command value (PP55. bit 0), of the motor position feedback value (PP55. bit 2) and of the motor direct feedback (PP55. bit 3). They affect the operation of the loop and may be used to solve a positive feedback (axis runaway) problem.

C. Change the sign of the velocity feedback value represented by parameter (SP43. bit 2).

D. 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), thus changing the sign of the data it represents:

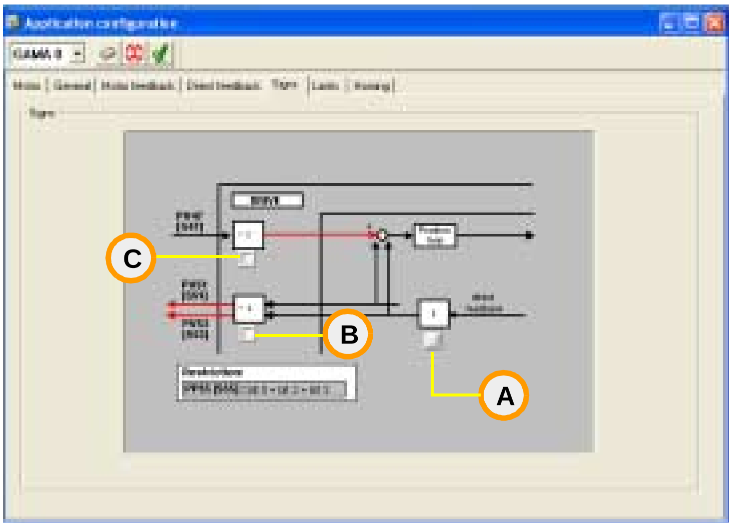


fig. 29 Configuring the application from the WinDDSSetup with the **<Signs>** label active: Reverse the sign of the various position data when the drive closes the position loop.

Thus activating the **<activate>** button implies:

A. Change the counting direction of the direct feedback represented by parameter (PP115. bit 3).

B. 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.

C. Change the sign of the position command value represented by parameter (PP55. bit 0).

The window **<Configuring the application>** with the **<Limits>** label active is:

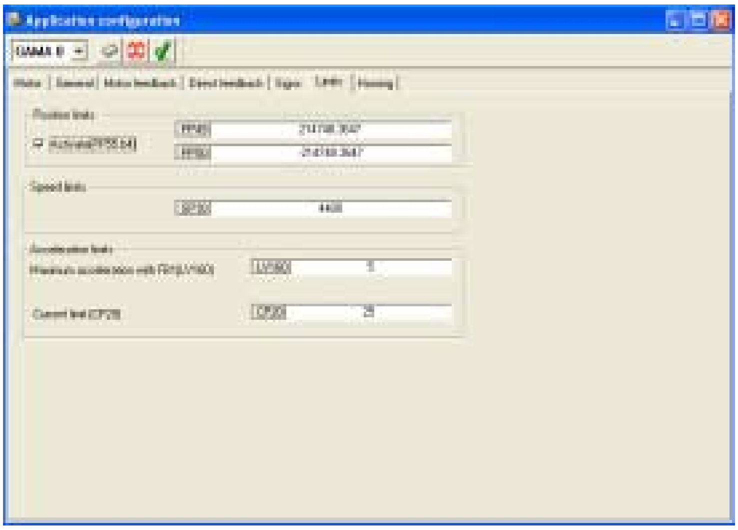


fig. 30 Configuring the application from the WinDDSSetup with the **<Limits>** label active:

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 by this field:

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.

The acceleration limit is set by this field:

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 this window also shows the field < Maximum acceleration with FB1 [LV160] > if the drive communicating with the WinDDSSetup is an MMC or an CMC (modules for MC applications) !

E. Field <LV160>: This field is used to set the maximum acceleration applied to all the positioning blocks (in module).

Véase figura.

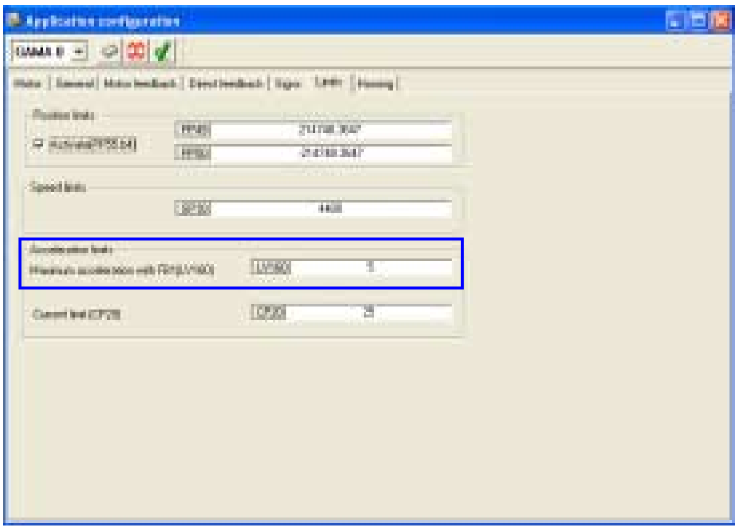


fig. 31 Configuring the application from the WinDDSSetup with the **<Limits>** label active, if the connected drive is an MMC or a CMC and the **<FB1 position>** option has been selected in the **<AP1 operating mode>**.

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 active label **<Home search>** is:

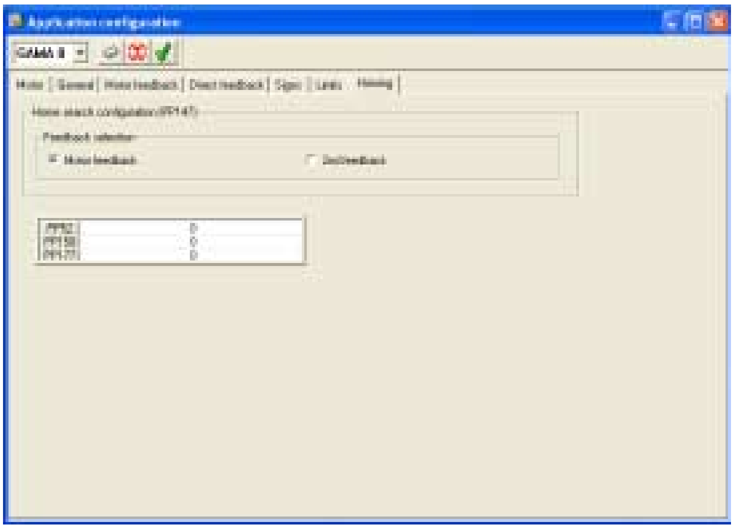
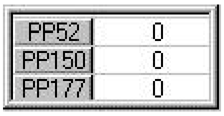


fig. 32 Configuring the application from the WinDDSSetup with the **<Home search>** label active:

This window may be used to configure the home search, it lets you select:

- **Motor feedback:**

  The fields shown in this window are:

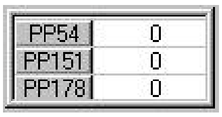


where:

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:



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.

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:

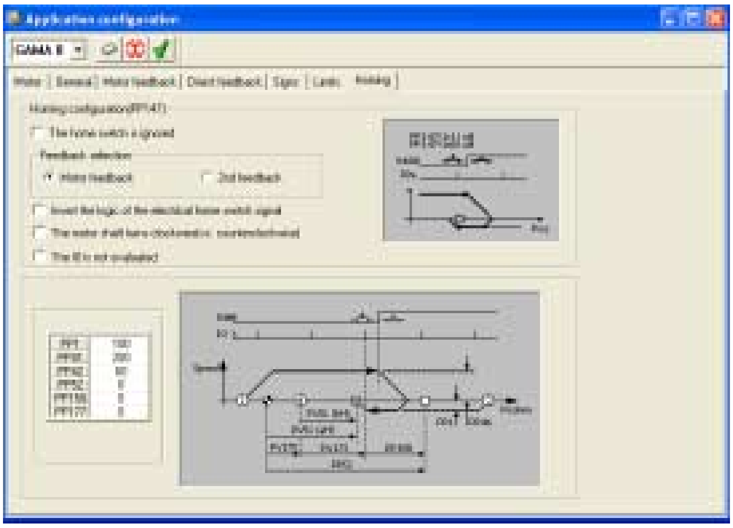


fig. 33 Configuring the application from the WinDDSSetup with the **<Home search>** label active:

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 is ignored:

If this option is activated:

Option	
The HS is ignored	PP147. bit5 = 1

Feedback selection:

The feedback used is:

Option	
Motor feedback	PP147.bit3 = 0
Direct feedback	PP147.bit3 = 1

Inverted Home Switch signal:

Pressing the home switch sets the PLC input.

Option	
(1) Positive logic	PP147.bit1 = 0
(0) Negative logic	PP147.bit1 = 1

Home search direction:

Motor shaft turning direction:

Option	
Positive. Clockwise	PP147.bit0 = 0
Negative. Counterclockwise	PP147.bit0 = 1

Evaluate Home switch:

Evaluation of the reference mark (I0):

Option	
Reference mark (I0) evaluated	PP147.bit6 = 0
Reference mark (I0) not evaluated	PP147.bit6 = 1

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 **<2nd 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.

User notes:

User notes:

APPLICATIONS

6

Introduction

This chapter describes some particularities of the servo drive system:

- Considerations for the system start - up with Sercos® interface.
- Adjustment of the motors for spindle at low rpm
- Motor locking function, Halt.
- Monitoring the drive's internal variables
- Set of parameters and gear ratios
- Spindle overload detection
- Considerations for loading and debugging MC and PLC programs.

The features documented in this chapter need the following software versions: 8055/55i CNC versions 01.01 (mill) and 02.01 (lathe) and later. Drive versions 03.01 and later.

Sercos connection with the 8055/55i CNC

Sercos® is a communications standard designed especially for the machine - tool industry and simplifies the connection between CNCs 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).

The drives with Sercos® interface carry special connections for the fiber optic lines with the display and their sales reference is **SI** and **S0**, for example, AXD1.25.SI.0, SPD2.75.S0.0

The Sercos® interface reduces considerable the needed hardware and simplifies the cabling making the system more robust since it improves its immunity to electrical noise. See chapter 2 in this manual.

Sequence of start - up operations.

- Connection of the fiber optic lines and identification of the drives.
- Parameter setting at the 55/55i CNC.
- Description of the maneuver at the PLC 55/55i.
- Parameter setting at the drives.
- Powering the machine up again.
- Troubleshooting.

Considerations at the 8055/55i CNC

When using the Sercos® interface, the drives must be identifier in the ring and determine the operation mode.

Certain 55/55i CNC and drive parameters must also be set.

Identification and operation mode

The following CNC parameters must be set for each servo drive.

DRIBUSID [Parameters: P056 for the axes, P044 for the spindles, P044 for the auxiliary spindle].

Function: Identifies each drive in the Sercos® ring. Its value must match the selection at the Node_Select switch.

Valid values:

- 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.

Example: See fig.1.

Note that parameter DRIBUSID was called SERCOSID in versions older than V.09.11 (mill) and V.10.11 (lathe) It has a new name from these versions on !

DRIBUSLE [Parameters: P063 for the axes, P051 for the spindles]

Function: Determines the feedback source at this servo drive system through its connector at the axes module of through the Sercos® interface. In either case, the velocity command is sent out to the drives via Sercos®.

Valid values:

- **0** **(Mode 0)**. The servo system has an encoder or scale outside the motor and the 8055/55i CNC receives the signals **through the corresponding connector** at its axes module.
- **1** **(Mode 1)**. The 8055/55i CNC receives the feedback position from the drive **through the Sercos® ring.** This drive has generated that signal based on the **motor feedback** itself.
- **2** **(Mode 2)**. The 8055/55i CNC receives the feedback position from the drive **through the Sercos® ring.** This drive has generated that signal based on the **direct feedback** itself.

Note that parameter DRIBUSLE was called SERCOSLE in versions older than V.09.11 (mill) and V.10.11 (lathe) It has a new name from these versions on !

The value of the SERCOSID parameter must match the address selected with the Node Select switch at the drive module. Remember that the numbers must be correlative and starting from 1. If the same motor is to be used as **C axis** and as **spindle** , the SERCOSID parameter of both 8055/55i CNC tables must have the same value.

The servo drive identified as number 1 (for example) does not have to correspond to the X axis, the Y axis to another and so on. However, it would be much simpler to make the axes of the machine X, Y, Z, U, V, W, A, B and C follow a sequential numbering system. fig.1 is an example.

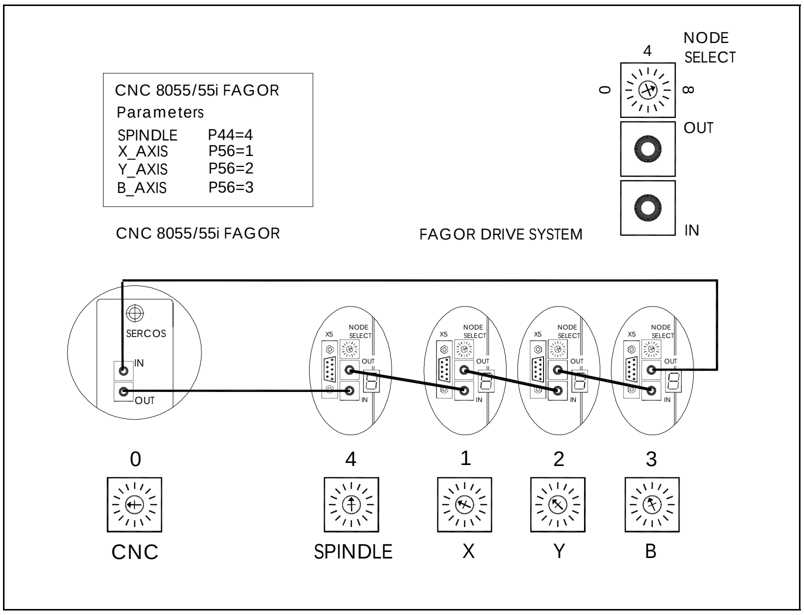


fig.1 Sercos® connection between drives and the CNC.

Use parameter **DRIBUSLE** to select which will be the mans of communication of the signal and the type of feedback. This creates **three work modes** that are described in the following section.

8055/55i CNC in 0 mode (external feedback)

The CNC receives the position feedback through its connector at the axes module. The velocity command sent out by the CNC to the drive through the optical fiber is given in rpm referred to the motor.

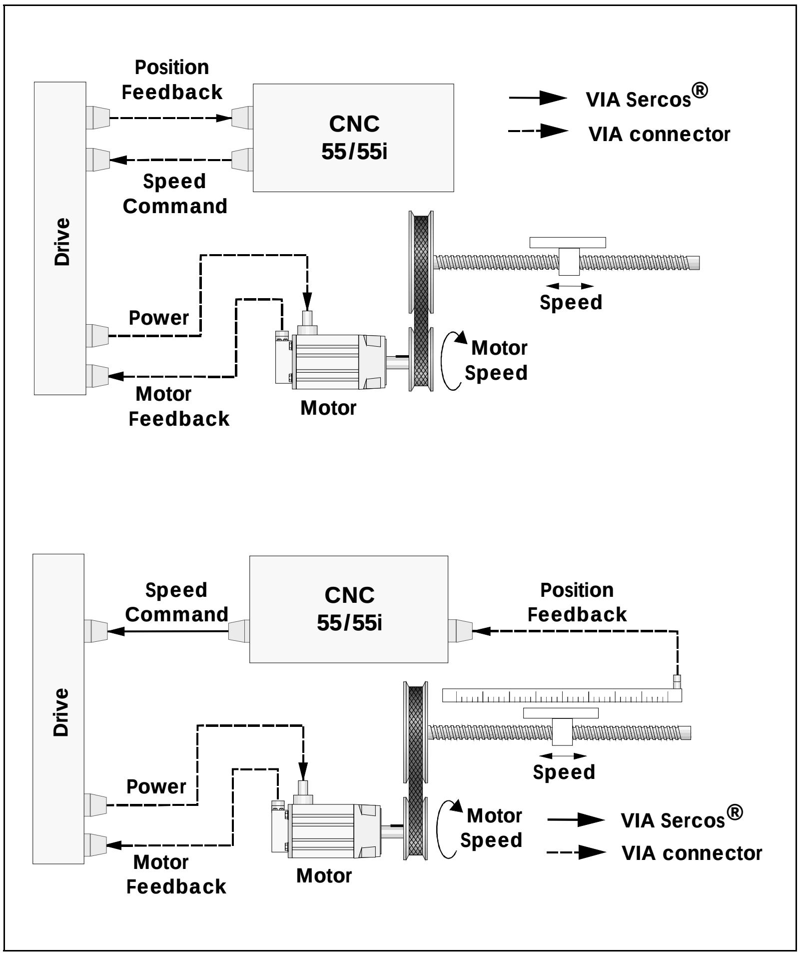


fig.2 8055/55i CNC in mode "0".

8055/55i CNC in 1 mode (motor feedback)

The CNC receives the position feedback through the fiber optic lines of the Sercos® ring. This feedback is generated by the drive based on the feedback of the motor itself. It gives the position feedback through its connector at the axes module. The velocity command sent out by the CNC to the drive through the optical fiber is given in rpm referred to the motor.

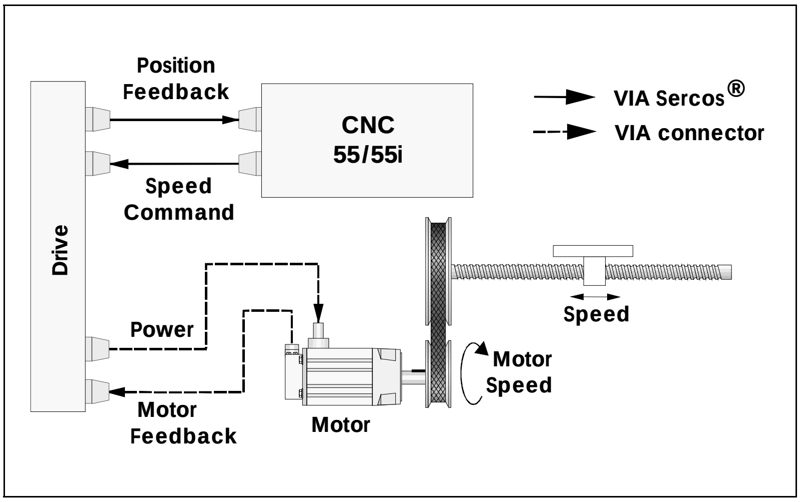


fig.3 8055/55i CNC in mode 1.

8055/55i CNC in 2 mode (direct feedback)

The CNC receives the position feedback through the fiber optic lines 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.

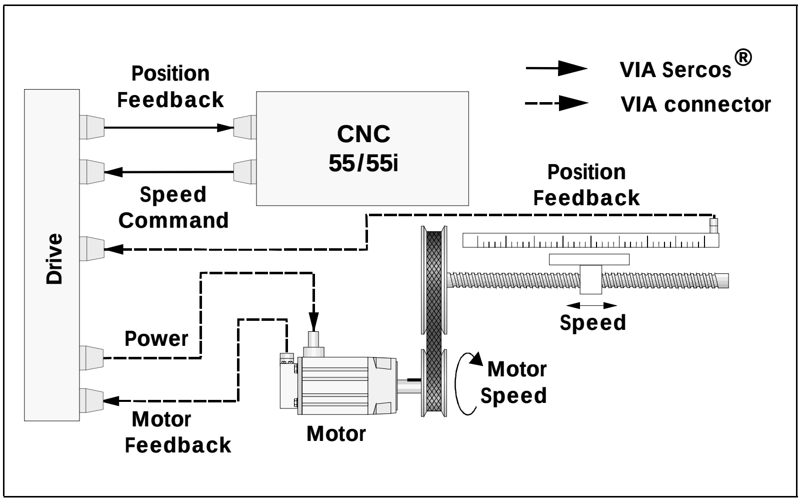


fig.4 8055/55i CNC in mode 2.

Other 8055/55i CNC parameters

The analog velocity command at the 8055/55i CNC is adjusted by means of parameters PROGAIN, FFGAIN, DERGAIN, ACFGAIN, MAXVOLT, MAXVOLT1...4.

PROGAIN [PROportional GAIN] [Parameters: P023 for axes and spindles]

Function: 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.

Axes: PROGAIN indicates the mV of velocity command desired for a following error of 1 mm.

Spindle: PROGAIN indicates the mV of velocity command for a following error of 1°. Only when the spindle is working in M19 mode or rigid tapping.

Valid values: 0..65535 mV/mm (1000 mV/mm, by default), or in mV/degree for the spindle.

DERGAIN [DERivative GAIN] [Parameters: P024 for the axes and spindles]

Function: Derivative gain. It gives an additional component to the velocity command.

Its function depends on the value of another parameter ACFGAIN:

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:

Axes: DERGAIN indicates the mV of command corresponding to a variation of following error of 1 mm in 10 ms.

Spindle: DERGAIN indicates the mV of command for a change of 1° of following error in 10 msec. Only when the spindle is working in M19 mode or rigid tapping.

Valid values: 0..65535 mV/ (mm/10 ms)

0 mV/ (mm/10 ms), by default.

FFGAIN [Feed Forward GAIN] [Parameters: P025 for axes and spindles]

Function: **Axes:** defines the percentage of additional command due to the programmed feedrate.

Spindles: defines the percentage of additional command due to the programmed speed. Only when the spindle is working in M19 mode or rigid tapping.

Valid values: 0..100 (0, by default).

ACFGAIN [AC-Forward GAIN] [Parameters: P046 for the axes, P042 for the spindles]

Function: Determines whether the axis machine parameter DERGAIN is applied to the variations in following error or to the variations of the programmed feedrate. See DERGAIN function.

Valid values: No: on following error

Yes: on variation of programmed speed.

MAXVOLT [MAXimum VOLTage][Parameter: P037 for the axes]

Function: Indicates the value of analog voltage of velocity command for G00FEED.

Possible values: 0...9999 mV (9500 mV, by default)

On axis drives when working with Sercos® interface, this parameter must always be set to 9500.

MAXVOLTn [MAXimum VOLTage gear n] [Parameters:P037...P040 for n = 1...4 at the spindles]

Function: Indicates the value of the analog voltage of velocity command for the maximum speed of the gear n.

Possible values: 0...9999 mV (9500 mV, by default).

These parameters are described in chapters 3 and 4 of the installation manual of the 8055/55i CNC .

These parameters and the way 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 55/55i CNC as well as at the drive. The following sections show how to see them.

On axis drives

The CNC communicates to the drive and through the Sercos® ring the desired motor speed in rpm (MS) calculated as follows:

$$MS = \underbrace{\boxed{f\,[\,\text{PROGAIN, FFGAIN...}]}}_{mV} \times \frac{\text{G00FEED}}{\text{MAXVOLT}} \times \frac{1}{\text{NP123}} \times \frac{\text{NP121}}{\text{NP122}} \;[\text{ rpm motor }]$$

NP121 [S0012], NP122 [S00122] and NP123 [S00123] are parameters of the drive.

Thus, for a proper setup of the system, proceed as follows:

At the drive:

- Set parameters **NP121, NP122 and NP123** according the gear ratios installed.
- **SP20 [F00031]** and **SP21 [F00081]** are ignored.

At the CNC:

- Set **MAXVOLT = 9500** that is: 9.5 V.
- Calculate the **PROGAIN** constant based on a command of 9500 mV. Thus:

:

$$\text{PROGAIN} = \frac{9500}{\text{EdS}} = \frac{9500\ K_v\ 1000}{\text{G00FEED}} \quad [\text{ mV/mm }]$$

where:

EdS [mm] = following error at G00FEED.

Kv is a constant indicating the ratio between G00FEED and the EdS. Thus:

for Kv=1 the EdS will be 1 mm for a feedrate of 1 m/min.

for Kv=2 the EdS will be 0.5 mm for a feedrate of 1 m/min.

Feedback parameter setting at the axis drive:

With DRIBUSLE = 0

Using external feedback requires that all the feedback parameters to be set at the CNC: **PITCH [P007], NPULSES [P008], DIFFBACK [P009], SINMAGNI [P010], FBACKAL [P011], REFPULSE [P032], IOTYPE [P052], ABSOFF [P053]** and **EXTMULT [P057].** They are located in the parameter table for each axis a the 8055/55i CNC.

With DRIBUSLE = 1

The drive indicates the motor speed to the 8055/55i CNC by means of digital commands through Sercos®. Therefore, the feedback characteristics will be set by the parameters of the drive. At the 8055/55i CNC, the parameters mentioned earlier are ignored.

With DRIBUSLE = 2

The drive indicates the motor speed to the 8055/55i CNC through Sercos® using digital commands. Therefore, the feedback characteristics will be defined by the parameters of the drive. At the 8055/55i CNC, the parameters mentioned earlier are ignored.

On spindle drives in open loop

The 8055/55i CNC indicates to the spindle drive, through the Sercos® ring, the desired motor speed in rpm (MS) which is calculated as follows:

$$\text{MS} = \text{Programmed Speed}\ \frac{\text{MAXVOLTn}}{\text{MAXGEARn}} \times \frac{\text{SP21}}{\text{SP20}} \quad [\text{ rpm motor }]$$

mV

To properly setup the drive, proceed as follows:

At the drive:

- Set parameters SP20 [F00031] and SP21 [F00081] with the maximum motor speed for this application and 9500 millivolts respectively.
- Set NP121 [S00121], NP122 [S00122] and NP123 [S00123] when wishing to display the tool speed on the screen while working with DRIBUSLE = 1.

At the 8055/55i CNC:

- Set the 8055/55i CNC **MAXGEARn** parameters with the maximum tool speed for that gear n.
- Set the **MAXVOLTn** parameters according the following equation:

$$\text{MAXVOLTn} = \underbrace{\boxed{\text{MAXGEARn} \cdot \text{Red}}}_{[\text{ rpms motor }]} \cdot \frac{\text{SP21}}{\text{SP20}} \ [\text{ mV }]$$

$$\text{Ratio} = \text{Gear ratio} = \frac{\text{N motor}}{\text{N tool}}$$

Example of open loop spindle:

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.

Therefore, proceeding as indicated earlier:

SP21 [F00081] = 4000

SP20 [F00031] = 9500

MAXGEAR1 = 1000 rpm,

MAXGEAR2 = 2000 rpm

MAXGEAR3 = 3800 rpm.

The MAXVOLTn parameters will be:

$$\text{MAXVOLT1} = 1000 \cdot \frac{4}{1} \cdot \frac{9500}{4000} [\text{ mV }] = 9500 [\text{ mV }]$$

$$\text{MAXVOLT2} = 2000 \cdot \frac{2}{1} \cdot \frac{9500}{4000} [\text{ mV }] = 9500 [\text{ mV }]$$

$$\text{MAXVOLT3} = 3800 \cdot \frac{1}{1} \cdot \frac{9500}{4000} [\text{ mV }] = 9025 [\text{ mV }]$$

Feedback parameter setting at the spindle drive in open loop:

With DRIBUSLE = 0

Using external feedback requires all the feedback parameters to be set at the 8055/55i CNC: **NPULSES [P013], DIFFBACK [P014], FBACKAL [P015]** and **REFPULSE [P032].**

With DRIBUSLE = 1

The drive indicates the motor speed to the 8055/55i CNC by means of digital commands through Sercos®. Therefore, the feedback characteristics will be set by the parameters of the drive. At the 80 55/55i CNC, the parameters mentioned earlier are ignored.

With DRIBUSLE = 2

The drive indicates the motor speed to the 8055/55i CNC by means of digital commands through Sercos®. Therefore, the feedback characteristics will be set by the parameters of the drive. At the 8055/55i CNC, the parameters mentioned earlier are ignored.

On spindle drives in closed loop, M19 or rigid tapping

The CNC indicates to the drive, through the Sercos® ring, the desired motor speed [MS] which is calculated in a way similar to that of the axis drive.

$$MS = \underbrace{\boxed{f\,[\,PROGAIN,\ FFGAIN...]}}_{mV} \times \frac{SP21}{SP20} \quad [\text{ rpm motor }]$$

To properly set the drive, proceed as follows:

At the drive:

- Set parameters SP20 [F00031] and SP21 [F00081] with the maximum motor speed value for this application and 9500 millivolts 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 gear n.
- Set the **MAXVOLTn** parameters according to the equation shown in the previous section.

And:

At the 8055/55i CNC:

- The constants PROGAIN, DERGAIN,... must also be set. For example:

  Two 8055/55i CNC parameters:

  REFEED1 [P034] = Maximum angular speed in M19 [°/min].

  REFEED2 [P035] = Maximum 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].

Hence, PROGAIN is calculated as follows:

$$PROGAIN = \frac{MV\_M19}{EdS} = \frac{MV\_M19\ K_v\ 1000}{REFEED1} \quad [\text{ mV / ° }]$$

where:

$$MV\_M19 = \frac{MAXVOLT1}{MAXGEAR1} = \frac{REFEED1}{360} \quad [\text{ mV }]$$

and

$$REFEED1 = MG\_M19 * 360 \quad [\text{ °/min }]$$

and where:

EdS [mm] = following error at a speed of REFEED1.

Kv is a constant indicating the ratio between REFEED1 and the EdS. Thus:

for Kv=1 the EdS will be 1° for a speed of 1000 °/min.

for Kv=2 the EdS will be 0.5° for a speed of 1000 °/min.

Example for a spindle in closed loop:

Using the example for a spindle in open loop, we have :

The machine has three gear ratios: 4/1, 2/1 and 1/1.

Maximum motor speed for this application: 4000 rpm.

SP21 [F00081] = 4000

SP20 [F00031] = 9500.

MAXGEAR1 = 1000 rpm

MAXGEAR2 = 2000 rpm

MAXGEAR3 = 3800 rpm.

MAXVOLT1 = 9500 mV

MAXVOLT2 = 9500 mV

MAXVOLT3 = 9025 mV

And:

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. [Kv=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:

REFEED1 = 100 * 360 = 36000 [°/min]

REFEED2 = 50 * 360 = 18000 [°/min]

$$\mathbf{MV\_M19} = \frac{9500}{1000}\ \frac{36000}{360} = 950\ [\ mV\ ]$$

EdS = 36 ° para los 36000 ° / min de REFEED1

$$\mathbf{PROGAIN} = \frac{950 * 1 * 1000}{36000} = \frac{950}{36} = 26.38\ [\ mV/°\ ]$$

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] is equal to 0, we will set PROGAIN = 26

When GAINUNIT [P041] is equal to 1, we will set PROGAIN = 2638

These can be found in the spindle parameter table of the 8055/55i CNC

Feedback parameter setting at the spindle drive in closed loop:

With DRIBUSLE = 0

Using external feedback requires all the feedback parameters to be set at the 8055/55i CNC: **NPULSES [P013], DIFFBACK [P014], FBACKAL [P015]** and **REFPULSE [P032].**

With DRIBUSLE = 1

When not using an external encoder, the motor encoder may be used by setting SERCOSLE=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 mark of the spindle [Io] is that of the motor feedback.

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 ration meets one of these two conditions:

- The gear ratio is 1/1. The reference mark of the spindle (I0) is that 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 among the n signals generated by the motor encoder per spindle turn.

With 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.

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. (See PP5: ActualPositionMonitoringWindow).

Considerations at the drives

When using the Sercos® interface, certain drive parameters are no longer needed.

If neither the encoder simulation nor the I/O boards are installed, their associated parameters are not needed either.

Parameters **NP121 [S00121], NP122 [S00122]** and **NP123 [S00123]**, must be properly set in the following cases:

- at the spindle drives, always.
- at the spindle drives, when wishing to display tool speed or to work in closed loop (M19 or rigid tappin) while working with motor feedback (DRIBUSLE = 1).

At the spindle drives with external feedback (DRIBUSLE = 0) the NP parameters need not be set.

SP20 [F00031] and **SP21 [F00081]**:

- At the spindle drives, always. Set them with the maximum motor speed values for the application and 9500 millivolts respectively.
- The need not be set at the axis drives.

Example for setting parameters NP121, NP122 and NP123:

If for every 5 turns of the motor shaft, the ballscrew turns 3 times. The parameters must be set as follows:

NP121 = 5   NP122 = 3

If it is a linear axis where for each ballscrew turn, the table moves 4 mm:

NP123 = 40000 tenths of a micron

If it is a rotary axis where each turn of the output pulley means a 360° turn:

NP123 = 3600000 ten - thousandths of a degree.

For example:

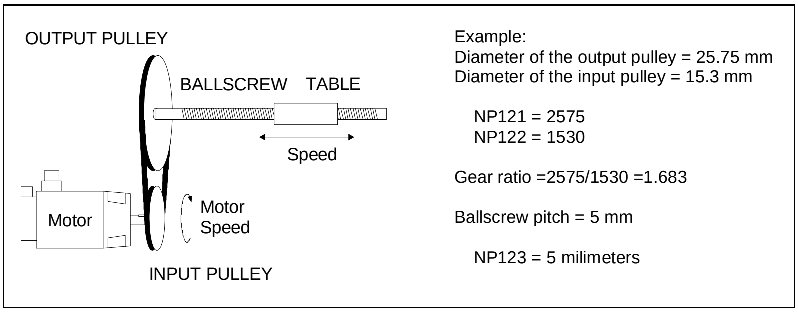


fig.5 Setting of parameters NP121, NP122 and NP123.

Control signals PLC 8055/55i - drive

Signals from the PLC 8055/55i 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 50/55 now offers two new 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 drive. The motor has no torque.
- 1 Enables the drive.

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 M5448]

Function: Identifies the electrical signal Drive Enable of connector X2 of the drive.

Valid values:
- 0 Disables the drive. The motor has no torque.
- 1 Enable the drive.

The **Speed Enable** function at the drive will be activated when the SPENA variable is activated and the electric signal Speed_Enable is activated the pins of connector X2. The **Drive Enable** function will be activated when the DRENA variable is activated and the electrical signal- Drive_Enable is activated at the pins of connector X2.
See fig.6.

Safety regulations (EN-60204-1) demand the drive module to have an input non - software related to guarantee that the motor will stop:

The hardware control over the electrical signal Drive_Enable must not be removed even when using the Sercos® interface.

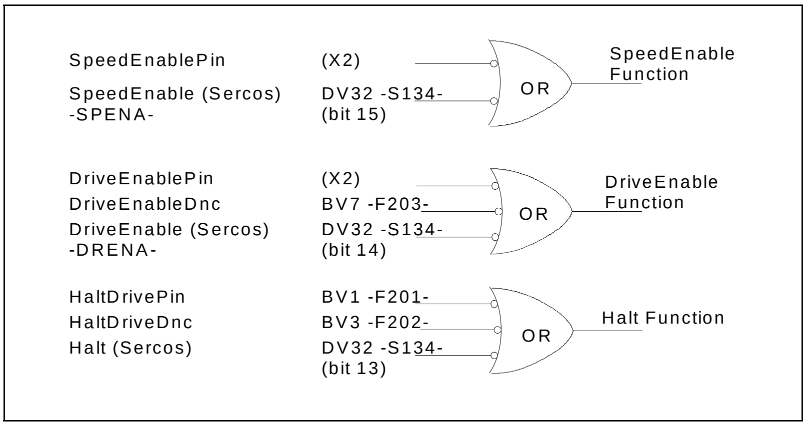


fig.6 Control signals 8055/55i PLC - drive.

Signals from the drive to the PLC 8055/55i .

The drive offers two bits to the PLC 8055/55i to indicate the operating status.

There are: **DRSTAFn** and **DRSTASn**. The table below shows the meaning of these signals.

DRSTAFn [DRive STAtus First n] [n=1..7,S,S2,AS] [M5603, M5653, M5703, M5753, M5803, M5853 and M5903 at the axes. M5953, M5978 and M5557 at the spindles].

DRSTASn [DRive STAtus Second n] [n=1..7,S,S2,A] [M5604, M5654, M5704, M5754, M5804, M5854 and M5904 at the axes. M5954, M5979 and M5556 at 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:	0,1 with the meaning explained on the table 1.

As a general rule, the PLC assign 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.

Thus:

if the machine has three axes (for example 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.

Those 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.

DRSTAFn	DRSTASn	Status	Action
0	0	The drive is not ready. Do not apply mains power to the power supply.	Check the 24 Vdc 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 with Drive_Enable and Speed_Enable.
1	1	The Drive_Enable and Speed _Enable functions activated. The motor follows the command	Govern the motor with the command.

table 1 Signals from the drive to the PLC of the 8055/55i.

This is an example of how to program a Fagor PLC 8055/55i.

If handles the drive's control signals depending on its status and other variables.

;-- This 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 output.

;----- 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 axis 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 outputs
```

;----- MANAGING AXES ENABLES -----

```
CPS R101 GE 2 = M111             ; the X axis has power
CPS R102 GE 2 = M112             ; the Z axis has power
M111 AND M112 = M133
                ; all the axis drives ok and with power

M111 AND NOT LOPEN AND O1        ; X axis enable
AND [others] = SERVO1ON = SPENA1 ; Speed Enable for the X ;axis
= TG3 1 300
T1 = DRENA1        ; Drive Enable with a 300 ms delayed
                   ; deactivation for 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
                         ; deactivation to prevent axis sag.
```

;----- MANAGING SPINDLE ENABLES -----

```
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
                                          ; cancel 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                              ; 4sec delayed deactivation
                                     ; for emergency stops.
SPENAS AND [M119 OR RIGID] AND NOT LOPEN = SERVOSON
                                  ; M19 or rigid tapping , close the loop.
```

; ----- MANAGING FEED HOLD AND STOP -----

```
M133 AND [others] = / FEEDHOL
```

Connection with the Fagor 8070 CNC

The Fagor 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.

The are:

OPMODEP Similar to parameter AP1 [S32] PrimaryOperationMode.

Give this parameter a value consistent with that of AP1 at the drive.

LOOPTIME Similar to parameter QP1 [S1] ControlUnitCycle Time of the drive.

Same.

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 Telegram type used in the Sercos® ring.

Set TELEGRAMTYPE = 4.

DRIVEID Identifies the drive in the Sercos® ring.

Set this parameter with the same value as the one selected at the drive's thumbwheel.

NPULSES

PITCH Parameters that determine feedback resolution.

The 8070 can work with a resolution of a tenth of a micron.

Thus, the relationship between these two parameters must be:

$$\frac{\text{PITCH}}{\text{NPULSES} * 4} = 0.1\ \mu$$

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.

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)		External	B1=0 B5=0; If normal I0. B1=1 B5=0; If increasing distance-coded I0. B1=1 B5=1; If decreasing distance-coded I0.
NPULSES2	PP115 (bit 0)		External	B0=0; External rotary feedback (NPULSES<>0). B0=1; External linear feedback (NPULSES==0).
AXISCH + LOOPCH	PP115 (bit 3)	pos	External	B3=0; External feedback reading AXISCH==LOOPCH. B3=1; External 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. B0=5; There is a home switch. B5=1; There is no home switch. B0=3; Internal feedback. B5=3; External feedback. B1=0; The DECEL signal of the CNC always uses positive logic.
REFEED1	PP41			
REFEED2	PP1			
REFVALUE	PP52 PP54	pos pos	Internal External	
REFSHIFT	PP150 PP151	pos pos	Internal External	It always writes PP150=0 at the drive. It always writes PP150=0 at the drive.

Note that when mentioning internal feedback, it means motor feedback and external feedback means direct feedback.

CNC	DRIVE	pos/vel	Feedback	Remarks
ABSOFF	PP177 PP178		Internal External	Only when using distance-coded I0's. Only when using distance-coded I0's.
I0CODDI1 I0CODDI2	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		External	It affects all the gears. Only when using rotary feedback (NPULSES2<>0).
OUTPUTREV2	NP132.x		External	It affects all the gears. Only when using rotary feedback (NPULSES2<>0).
PITCH2	NP133		External	Only when using rotary feedback (NPULSES2<>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)
MODULO (360)	PP103			PP103 = 360; 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.

Note that when mentioning internal feedback, it means motor feedback and external feedback means direct feedback.

CNC	DRIVE	pos/vel	Feedback	Remarks
Type of 2nd feedback	GP10			GP10=0; Second feedback is not being used. GP10=1; TTL signal (SINMAGNI==0). GP10=2; Vpp signal (SINMAGNI<>0).
NPULSES PITCH2 Resolution of the second feedback.	NP117 NP117		External External	Only if it is rotary encoder (NPULSES<>0). Only if it is a linear encoder (NPULSES==0).
PITCH2 Resolution of linear second feedback.	NP118		External	Only if it is a linear encoder (NPULSES==0).

Note that when mentioning internal feedback, it means motor feedback and external feedback means direct feedback.

Parameter set and gear ratio

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 ending going 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**. fig.7 shows the organization of the table.

Terminology:

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.

For 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.

The parameter set up for a **C axis** must be made using the 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 (in neutral).

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.

For example , gear ratio **2** 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 radio active at the time. All set - gear ratio combinations are possible.

Important parameters:

GP4: number o useful sets

GP6: number of useful gear ratios

GV21: set active

GV25: active gear ratio

fig.7 shows an example:

Parameters GP4 and GP6 limit the number of sets and gear ratios that can be activated.

For 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, thus 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.

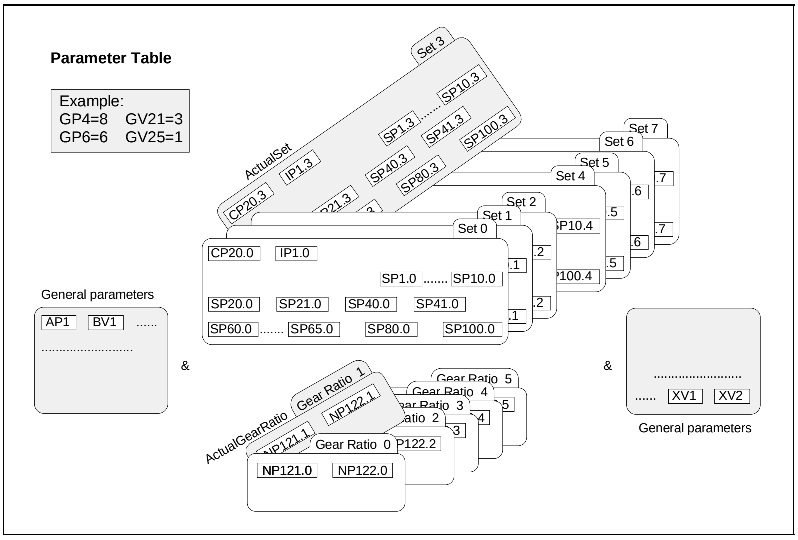


fig.7 Set of parameters and gear ratios.

Parameter set

The active set may be changed by means of external digital signals or through the Sercos® interface.

Set change through digital inputs

Running status:

Parameter **GP4** sets the number of useful sets (1 = GP4 = 8).

Variable **GV21** informs of which is the currently active set (0 = GV21 = GP4).

Boolean variables to change the active set:

GV32, **GV31** and **GV30** are used to preselect the new active set.

GV22 registers this preset.

GV24 - Strobe - 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)

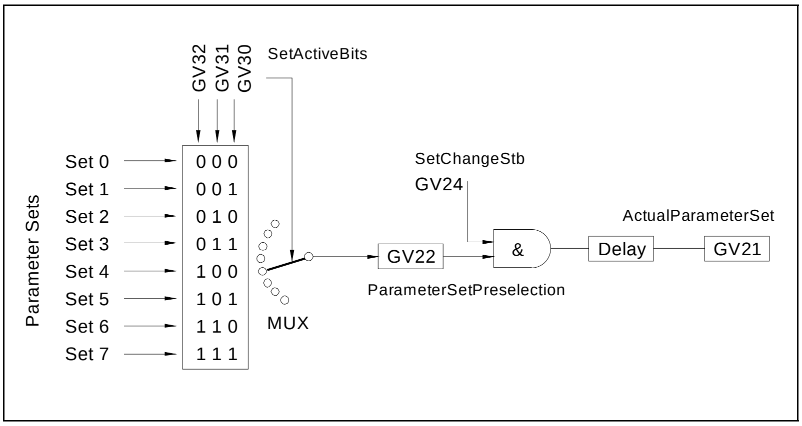


fig.8 Set change via digital inputs.

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.

fig.9 shows an example of this..

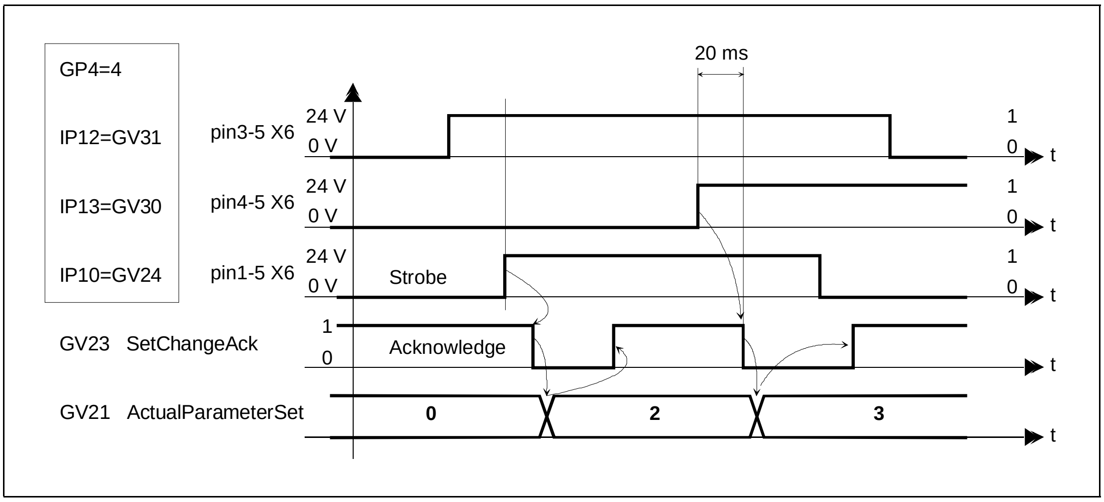


fig.9 Set changing procedure.

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 milliseconds.

fig.10 shows an example of this.

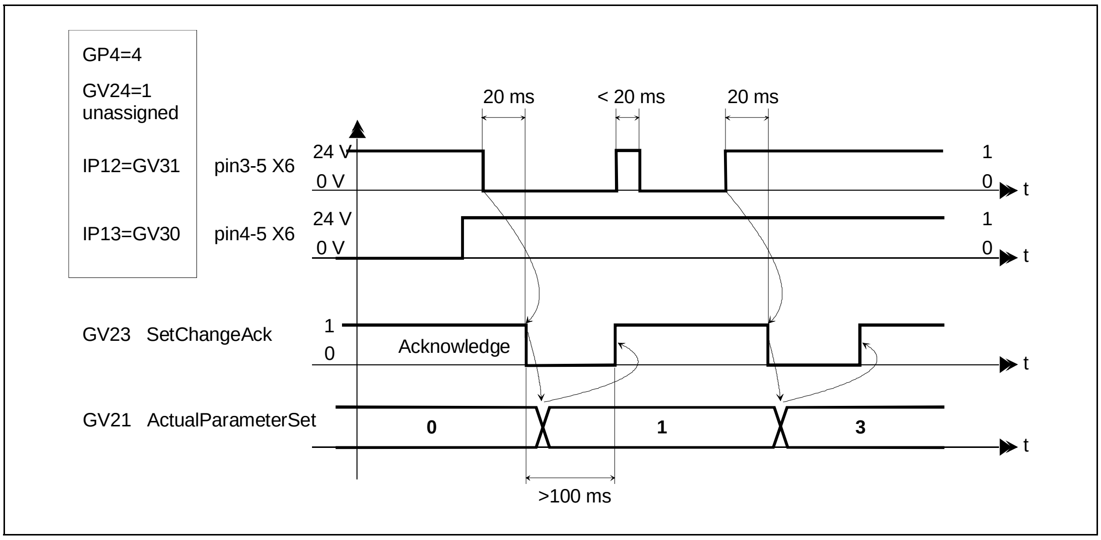


fig.10 Operation with the strobe always active.

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 milliseconds.

See fig.11.

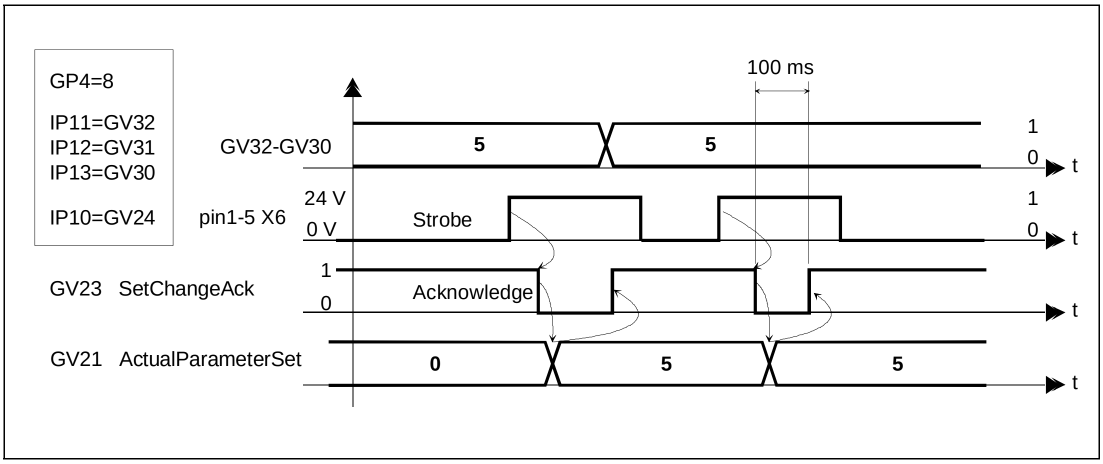


fig.11 Set change acknowledge signal.

Set change through Sercos® interface

The procedure is identical and parallel ti the change of gear ratio.

See the section on " change of gear ratio through Sercos® interface ".

There is a very important aspect to be considered when changing sets through Sercos® interface:

To change a parameter set through Sercos® interface, the variables GV24, GV30, GV31 and GV32 must not be assigned to a digital input.

Gear ratio

The gear ratios consist of parameters NP121, NP122 and NP123 only.

These parameters indicate the mechanical transmission ratio between the motor and the axis ballscrew or between the motor and the tool in the spindle. NP123 indicates the pitch of the ballscrew.

Axes:

These parameters must be set for each gear ratio and change the active ratio with each gear change.

Spindle:

These NP parameters must be updated for each change of gear only when working in DRIBUSLE = 1 mode and if we want to display the spindle speed on the CNC screen or work in M19 or in rigid tapping.

In those cases, the mechanical maneuver in the machine gear box will be accompanied by a change of active gear ratio.

The command to change gears is given through the Sercos® interface. This change cannot be handled through digital inputs.

Operation status:

Parameter **GP6** sets the number of useful gear ratios

(1 = GP6 = 8).

Variable **GV25** informs which is the current (actual)

(0 = GV25 = GP6).

Variable **GV26** registers the preselected gear ratio.

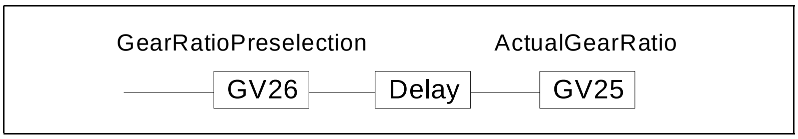


fig.12 Variables GV25 and GV26.

Change of gear ratio 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 variables:

GP4	33471	[F00703]	SetNumber
GP6	33485	[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
SSETGS ....for 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
...		...	

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.

A nex 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 these 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 on the next pages.

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.

(DRIBUSID = 3 in the parameter table of the main spindle S).

Therefore, one must set the 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 "ActualGearRatio" [GV25] and "ActualParameterSet" [GV21].

At the CNC, the spindle table must be defined.

Spindle in open loop with three ranges.

The feedback is defined DRIBUSLE =1

DRIBUSID = 3

At the drive two gear ratios an a single parameter set must be defined:

Gear ratio 0	Gear 1	Parameter set 0
Gear ratio 1	Gear 2	

GP4 = 1

GP6 = 2

; -- EXAMPLE OF A PLC PROGRAM FOR A GEAR CHANGE AT THE MAIN SPINDLE --

;

; Information on resources in use:

;

; 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

; the Sercos® identifier

; 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 minimum N [SP40].

;

CY1

;

END

;

PRG

REA

;

;---------- DRIVE STATUS ---------

;

DRSTAFS = B1R104

DRSTASS = B0R104 ;reading of the spindle drive running status

;

CPS R104 GE 1 = M104 ; spindle drive 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 R700 $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 for 1st gear
I42 AND NOT I41 = TG2 42 200
                             ; confirmation delay for 2nd gear
;
T41 = GEAR1   ; confirmation of 1st gear at 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
RESETOUT 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 during 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
                ; 1st gear does not match drive's 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
                ; 2nd gear does not match drive's gear ratio
AND NOT SERPLC
= SET M342
;
M242 OR M342 = M147
DFU M147= MOV $01 R41
           = CNCWR[R41,SETGES,M1000]
                  ; request for drive's second 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
                  ; cancel request for a gear change
= RES M141= RES M142 = RES M241
= RES M242= RES M341 = RES M342
;
M241 AND O1 AND M156 = O141
          ; activate servo valve to change into first gear
M242 AND O1 AND M156 = O142
          ; activate servo valve to change into second 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 PLCCNTL ]
AND M114                            ; drives under power
AND [closed door conditions]        ; closed door
= 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 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
```

Ex. of a PLC program for a parameter set change

This 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 identified as number 3 in the Sercos® ring.

At the drive:

A different parameter set must be defined (it must be the last set 7 for the C axis) In the C axis mode, the machine must be forced to work in the lowest range (greater gear) and indicate it to the drive (gear ratio 0).

Set:

GP4 = 8 (to make it possible to activate set 7).

GP6 = 1 (to only work with gear ratio 0, in this example).

Two tables must be defined at the CNC :

spindle table. DRIBUSID = 3
C axis table. spindle in closed loop working as a regular axis.

Set the external feedback (DRIBUSLE = 0) with all the necessary parameters.

DRIBUSID = 3

When using the same motor as C axis or as a spindle, both CNC tables must have the same DRIBUSID parameter value.

Set PLC P28[SRR700] = 3.33172.

(the number 33172 is the Sercos® identifier of variable DV11 [F00404]).

This way, register R700 (associated with parameter P28) will contain the DV11 "FagorDiagnostics" variable of the main spindle making it possible to know variables "ActualParameterSet" [GV21] and "ActualGearRatio" [GV25] through it.

; -- EXAMPLE OF A PLC PROGRAM FOR A SET CHANGE AT THE MAIN SPINDLE [C AXIS] --

```
;
; Information of the resources being used:
;
; I79 = "Drive OK" spindle drive [ C axis ]
;
; PLC parameter P28 [R700] = 3.33172, set Sercos®
; identifier 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
          ; write permission for parameter table at the drive
;
DFU M252 = MOV $77 R41
    = CNCWR[R41,SETGES,M1000]
                    ; selects 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
= SET M262
          ; write permission for parameter table a the drive
;
DFU M262
= MOV $00 R41
= CNCWR[R41,SETGES,M1000]
                 ; selects parameter table 0 at the drive
M252 AND CPS R45 EQ $77
                 ; select C axis parameter table
    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
;
```

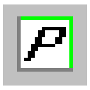
;---------- ENABLING THE DRIVE ----------

```
;
CAXSEROK                                ; C axis active
AND M115                    ; drivers under power
AND [closed door conditions]            ; closed door
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]          ; closed door
= 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                    ; STROBES confirmation
;
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
```

Sets in WinDDSSetup



This section describes how the sets are treated from WinDDSSetup. Activating this icon gives access to the parameter configuration window [modification mode].

The parameter configuration window [modification mode] displays a drop list giving access to a particular group of parameters if the drive or even to a list of all of them.

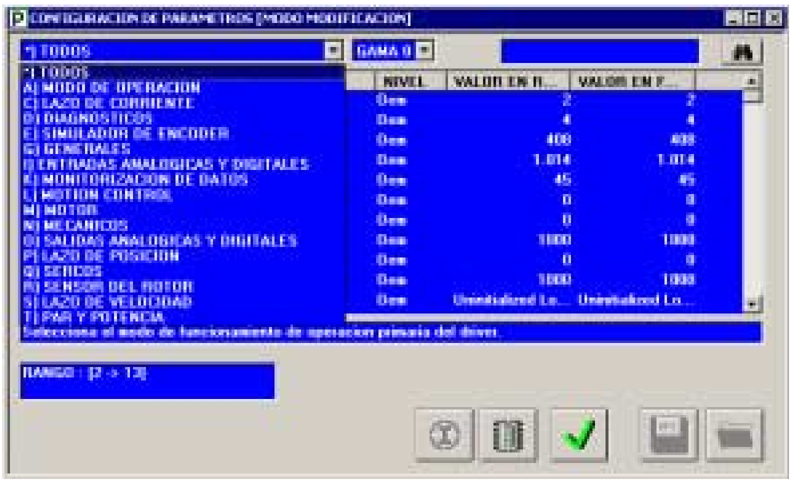


fig.13 Parameters setting window.

Another drop list appears to its right showing the existing sets. The desired set may be selected from this drop list. It also shows the parameters that belong to the selected set. The set identifying digit accompanies the parameter ID .

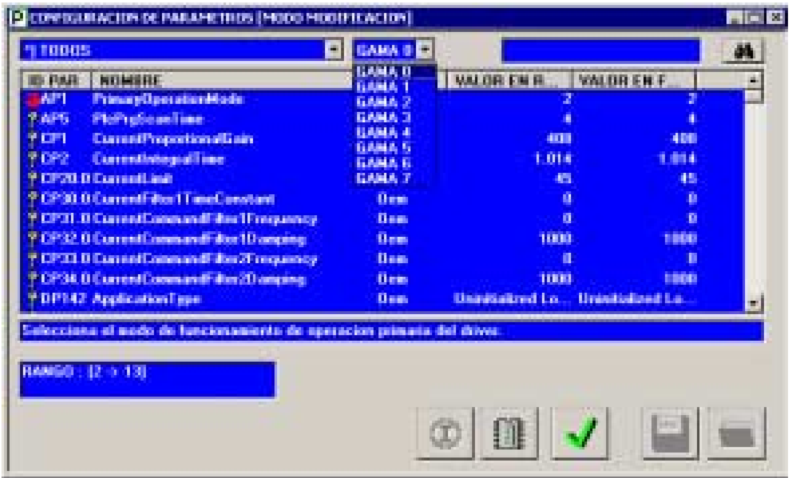


fig.14 Drop box with the gears.

To edit or modify its value, select the parameter from the list by clicking on it, enter the value on the **value** drop list and validate it by pressing **enter** located to its right.

The next figure shows what it look like:

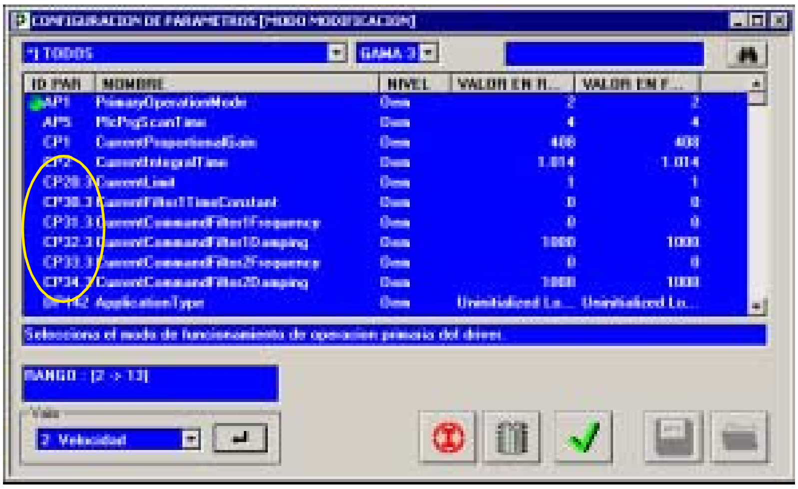


fig.15 Parameters with the gear identifying digit next to its ID.

Any parameter editing without indicating the set will affect the parameter corresponding to set zero.

Variable monitoring

The continuous monitoring of internal variables of the drive module may be carried out in two ways. By electrical signals through the digital and analog outputs or by showing their values on the display of the programming module.

For example, to monitor the power of the asynchronous motors [TV50] and the motor torque on the synchronous ones [TV2] through the analog outputs and to see if the motor is stopped [SV5] through a digital output:

OP1 = TV50	power variable through channel 1, pins 10/11 of X7.
OP3 = 10000	Ten kilowatts per volt.
OP2 = TV2	torque variable through channel 2, pins 8/9 of X7.
OP4 = 1000	A thousand deciNm per 10 volts.
OP10 = SV5	closed contact between pins 6/7 of X6 is the motor is stopped.

Programming module as monitor

Internal drive variables may be monitored permanently on the screen of the programming module.

Select the digital or analog variable from the VARIABLES menu.

Bear in mind that their units are the ones appearing in the appendix A and when the cursor is located under the value of a variable, the monitoring is temporarily frozen.

The bottom line shows the name of the variable. Its full name can be displayed by pressing the **O** key. Example:

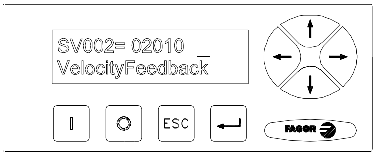


fig. 16 Programming module as monitor

Digital electrical signals for PLC or maneuver

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 variable chosen most often are:

- speed lower than Nx
  - SV3 = nFeedbackMinorNx. (See SP40)
- command speed reached
  - SV4 = nFeedbackEqualNCommand. (See SP41)
- motor stopped
  - SV5 = nFeedbackEqual0. (See SP42)
- torque smaller than Tx
  - TV10 = TGreaterTx. (See TP1)

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 will be closed if the motor is sttoped.

Check the chapter 1 of this manual in order not to exceed the electrical limitations for these electrical contacts.

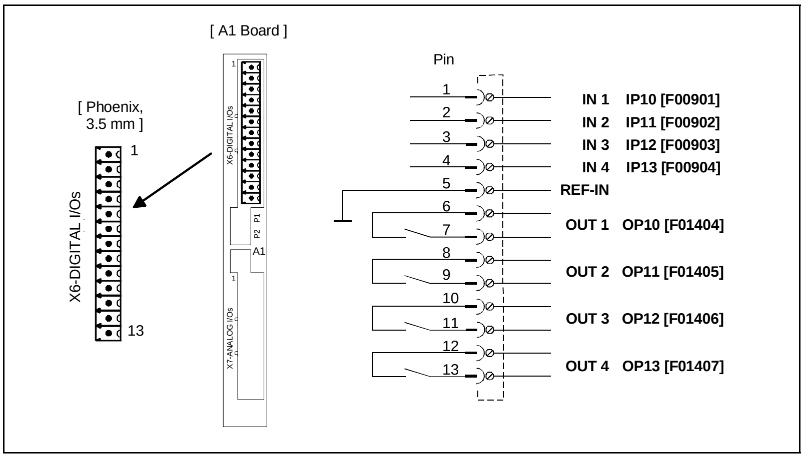


fig.17 Digital signals for PLC or maneuver.

Analog outputs for the < dial >

Two internal variables of the drive can be represented permanently on the machine's operator panel by means of volt - meters.

The most often monitored variables are:

on spindle drives:	power in use, TV50.
on axis drives:	motor torque, TV2.
on both:	TV3, portion of available power being developed by the motor. This variable is given in a 0/00 and is valid for synchronous and asynchronous motors in any duty cycle.

Example I:

Let us suppose that we have a volt - meter with a measuring range of +5 Vdc, corresponding to a range from 0% to 100%. We wish to use it to represent the percentage of power being used with respect to the one available. The setting must be as follows:

OP2 = TV3 — Percentage of power used with respect to the maximum power available, channel 2, pins 8/9 of connector X7.

OP4 = 2000 — 2000 Deci% / 10 V = 1000 Deci% / 5 V

(TV3 in Deci%)

Example II:

We installed a volt - meter with a measuring range +12 Vdc corresponding to a range between 0 % and 200 %. We wish to use it to represent the percentage of rated power (S1) being developed. This spindle motor has a rated power (S1) = 11 kW. The setting must be as follows:

OP1 = TV50	power feedback, channel 1, pins 10/11 of connector X7.
OP3 = 1833	1833 daW / 10 v
	(TV50 comes in daW) according to:

$$11\ \mathbf{kW} \cdot 2 \cdot \frac{10}{12} = 18.33\ \mathbf{kW} = 1833\ \mathbf{daW}$$

Ever if the needle never reaches the top of the scale because the maximum output voltage will be 10 V. At its maximum power in S6 (16kW) 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.

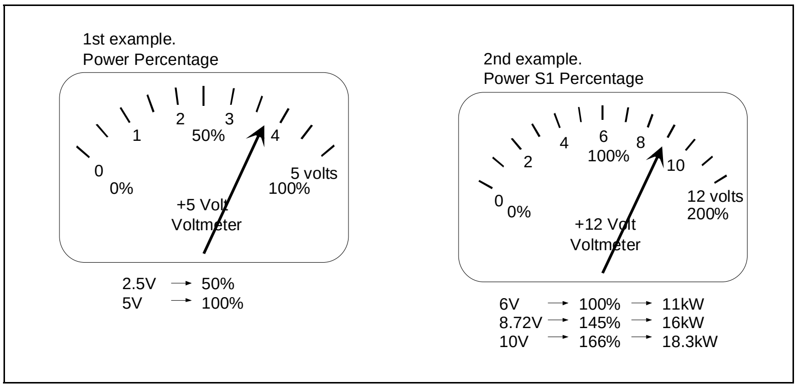


fig.18 Volt-meter measurements for examples I and II.

The features documented in this chapter need the following software versions: 8055/55i CNC versions 01.01 (mill) and 02.01 (lathe) and later. Drive versions 03.01 and later.

The data transmitted through the Sercos® ring is classified in two groups:

Cyclic channel (fast):

It is updated at every position loop. It contains the velocity commands, feedback,... Each variable read or written at the drive is included in this information package. In order not to overload the interface, one must limit the number of affected variables of the drive to a minimum.

Service channel (slow):

Data transmitted at every certain number of position loops, (monitoring, ...). This channel is accessed through part - program instructions, from the PLC channel or from the user channel.

Cyclic channel. Variables of the drive to be read from the PLC.

These variables are: (see appendix A of this manual).

Variable	Sercos ®	ID	Name
DV9	00012	S12	Class2Diagnostics (Warnings)
DV10	00013	S13	Class3Diagnostics (OperationStatus)
SV2	00040	S40	VelocityFeedback
PV51	00051	S51	PositionFeedback1
TV2	00084	S84	TorqueFeedback
CV3	33079	F311	CurrentFeedback
DV11	33172	F404	FagorDiagnostics
IV1	33673	F905	AnalogInput1
IV2	33674	F906	AnalogInput2
IV10	33675	F907	DigitalInputs
TV50	34468	F1700	PowerFeedback
TV3	34469	F1701	PowerFeedbackPercentage

Identify the drive 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.

See the next example.

These 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 which belongs to the drive identifier with the Sercos® number 4.

Cyclic channel. Drive variables to be written from the PLC.

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: (see appendix A of this manual).

Variable	Sercos ®	ID	Name
OV1	34176	F1408	DA1Value
OV2	34177	F1409	DA2Value
OV10	34178	F1410	DigitalOutputs
SV1	00036	S36	VelocityCommand

(This variable SV1 [S36] can only be written for axes set as DRO axes (DRO mode)).

Reading example:

Set P69 =1.34176 in CNC machine parameters.

This way, the value of OV1 of the drive identified as Sercos® number 1 may be assigned to PLC register R801.

If we now write... = MOV 8000 R801

the analog output of channel 1 (pins 11/10 of connector X7) will output 2441 mV.

Voltage = Register · 0.3 V

Service channel. Drive variables to be read or written.

This service channel can only be accessed through a high - level block of the part - program, PLC channel or user channel. Use CNC machine global parameters P100-P299.

All " non - string " type variables can be accessed.

(see appendix A of this manual)

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: VelocityFeedback [00040].

If, for example, the speed were 200 rpm, P100 would assume a value of 200000.

Writing example: (SVARZ 36 = P110)

It will assign the value of parameter P110 to the Z axis VelocityCommand [00036].

If, P110 were 3500000, the velocity command would be forced to 350 rpm.

Parameter = Velocity [rpm] · 10000

From the PLC channel:

Reading example: ... = CNCEX [[P100 = SVARX 40],M1]

Reading example: .. .= CNCEX [[SVARZ 36 = P110],M1]

Cyclic channel (fast). Drive variables to be read from the CNC.

The drive variables that may be read from the CNC are:
(see appendix A in this manual).

Variable	Sercos ®	ID	Name
CV3	33079	F311	CurrentFeedback
DV9	12	S12	Class2Diagnostics (Warnings)
DV10	13	S13	Class3Diagnostics (OperationStatus)
DV11	33172	F404	FagorDiagnostics
IV1	33673	F905	AnalogInput1
IV2	33674	F906	AnalogInput2
IV10	33675	F907	DigitalInputs
IV11	33676	F908	DigitalInputsCh2
PV51	51	S51	PositionFeedback1
PV53	53	S53	PositionFeedback2
PV130	130	S130	ProbeValue1PositiveEdge
PV131	131	S131	ProbeValue1NegativeEdge
PV189	189	S189	FollowingError
PV190	34773	F2005	PosErrorBetweenFeedbacks
QV30	33495	F727	FiberDistErrCounter
SV2	40	S40	VelocityFeedback
SV10	34383	F1615	PositionFeedback1Delta
SV11	34384	F1616	PositionFeedback2Delta
TV2	84	S84	TorqueFeedback
TV3	34469	F1701	PowerFeedbackPercentage
TV4	34680	F1912	VelocityIntegralAction
TV50	34468	F1700	PowerFeedback
TV92	92	S92	BipolarTorqueForceLimit
XV10	34800	F2032	GeneralVariable32A
XV11	34801	F2033	GeneralVariable32B
XV12	34802	F2034	ReadPLCMarksGroup
XV13	34803	F2035	WritePLCMarksGroup

Cyclic channel (fast). Drive variables to be written from the CNC.

The variables that may be written from the CNC are:
(see appendix A in this manual).

Variable	Sercos ®	ID	Nombre
OV1	34176	F1408	DA1Value
OV2	34177	F1409	DA2Value
OV10	34178	F1410	DigitalOutputs
OV11	34181	F1413	DigitalOutputsCh2
PV47	47	S47	PositionCommand
PV136	336	S336	InPosition
PV200	400	S400	HomeSwitch
PV201	401	S401	Probe1
PV205	405	S405	Probe1Enable
QV30	33495	F727	FiberDistErrCounter
SV1	36	S36	VelocityCommand
TV92	92	S92	BipolarTorqueForceLimit
XV10	34800	F2032	GeneralVariable32A
XV11	34801	F2033	GeneralVariable32B
XV12	34802	F2034	ReadPLCMarksGroup
XV13	34803	F2035	WritePLCMarksGroup

Motor power reduction

This feature is aimed at asynchronous motors **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. See the next example for further detail.

When applying the reduction, the required constant power may be obtained from a lower speed to a higher one. In other words, it increases the speed range where the motor provides the power required by the application.

The parameter used to obtain this reduction is:

TP22 [F1914] MotorPowerReduction.

See appendix A.

Remember that in drive version older than v06.01 this parameter TP22 was known as MP22.

Here is an application example:

The motor provides 5 kW in S1 from 500 rpm up.

Solution:

The SPM132L motor's rated power in S1 is 15 kW and 22 kW in S6-40%. Its base speed (from which it actually outputs all that power) is 1500 rpm.

By limiting its maximum power to a third of its capacity, the effective base speed is also reduced to one third, 500 rpm. This effect is controlled with parameter **TP22** (Fagor access level).

Limiting the power at the motor does not mean that it can be controlled with a smaller drive. However, the power required for the power supply will be lower.

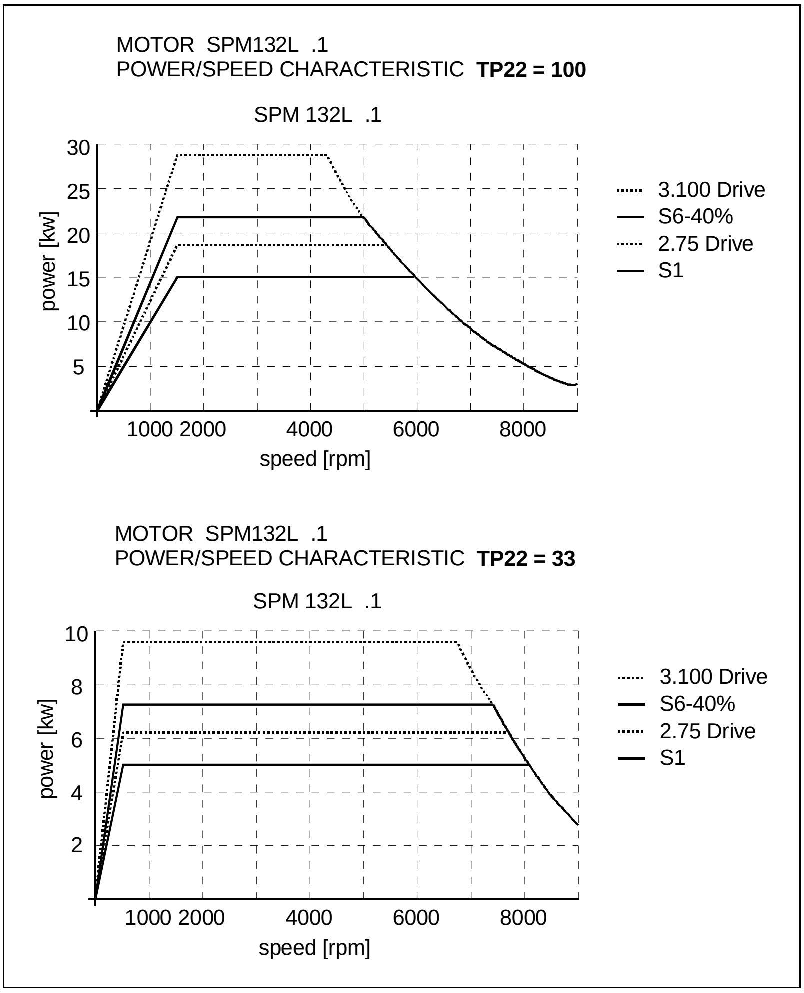


fig.19 Power limit. Parameter TP22.

Bear in mind that if there are several motor options to choose from, select one that requires a smaller drive.

Value to be assigned to parameter TP22 in order to apply the reduction:

$$TP22 = [\, P_{ap} / P_{CP20} \,] * 100$$

where:

P_{ap} :	Power required by the application
P_{CP20} :	Power corresponding to the current value given to CP20.

By default: CP20 = 1.5 In.

Note the In value of the motor is given by parameter MP3.

If the rated current of the motor is greater than the maximum current of the drive in any duty cycle, the CP20 value will be, by default, the maximum current that the drive can supply.

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 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:

- 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 DV32 [S00134] is set to 0).

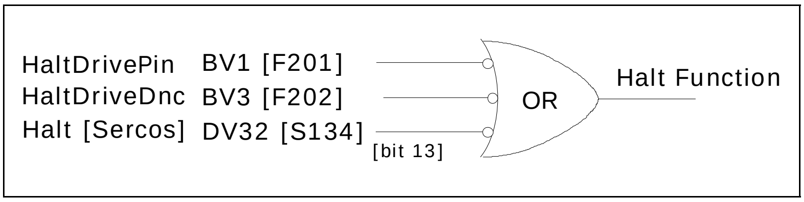


fig.20 Halt function.

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 (SP70 = 1, SP100 = 1).

Next, a programming example and a graphic to show how it works.

IP10	[F0090]	= 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 deceleration of 500 rd/s^2 and will stay locked. With 24 volts at that pin, the servo drive will continue to follow the velocity command.

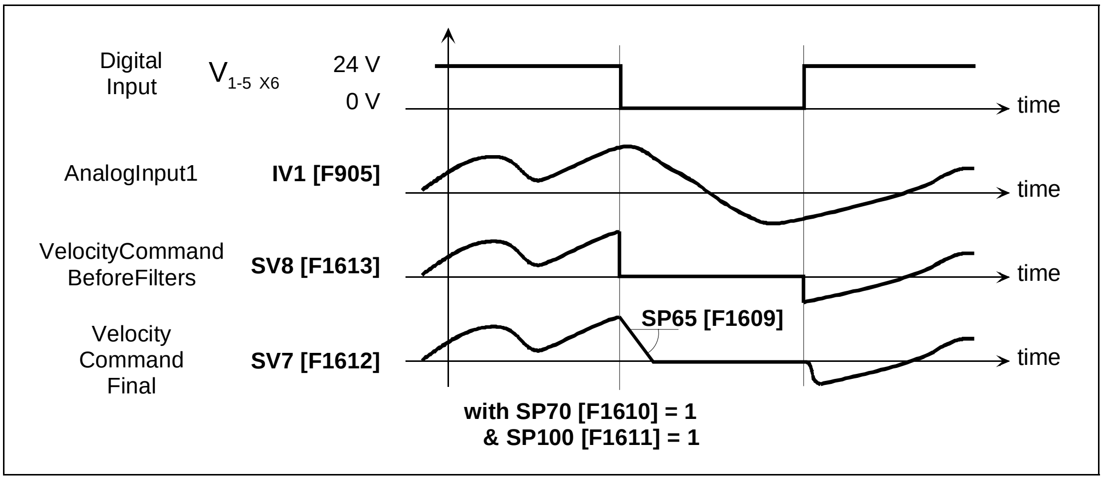


fig.21 Explanatory diagram of the example.

Motor stop due to torque overload

From software version 02.04 on, includes a new feature especially designed for spindle drives although it is also available for axes.

Ii offers the possibility to detect that the motor has stopped when, for instance, the tool gets stuck.

This detection triggers an error message and it is handled by means of two new parameters.

Operation:

When the drive detects that:

the motor speed is below the threshold set by GP8 [F0236] and the internal current command is near its maximum value (CP20 [F0307]), an internal timer starts running.

If the time elapsed under these conditions [torque overload condition] exceeds the time value set by GP7 [F0235], error 203 is issued.

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 [F235] OverloadTimeLimit

Function:	When the overload conditions exceeds this time period, the error is issued.
Valid values:	0..10000 ms. With GP7 = 0 this protection is disabled.
Default value:	200

GP8 O [F236] OverloadVelocityThreshold

Function:	Sets the speed threshold under which the motor is considered to be stopped in terms of overload detection.
Valid values:	0..1000 rpm
Default value:	100 (asynchronous motors). Rated current (synchronous motors).

Generated error message:

203 Torque overload error

The servo drive is locked up and it cannot turn freely. Due to too high a torque, the turning speed has not exceeded the GP8 value for a time period greater than the GP7 [F0235] value.

Free the motor. If the error comes up for no apparent reason, increase the GP7 [F0235] and / or GP8 [F0236] values. If GP7 is set to 0, the error message is never issued.

Flux reduction without load

Software version 03.06 includes a new feature for asynchronous motors.

While the motor is turning without a load, this feature makes it possible to momentarily decrease the magnetizing current. This considerably decreases the noise generated by the motor and its heating.

This reduction does not affect the power output, since the magnetizing current increases automatically when motor torque is needed.

The parameter used for this is:

FP40.# [F622.#] FluxReduction

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.

Control of high speed spindles

From version v.06.01 on, there is software capable of controlling a high speed asynchronous motor (high speed spindle) of up to 18000 rpm (with GP1= 4000 Hz) and up to 42000 rpm (with GP1 = 8000 Hz).

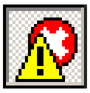
Remember that GP1 is the parameter that indicates the switching frequency of the IGBT's !

The way the parameters of an asynchronous motor are set will depend on whether it is a Fagor motor or a user motor.

After initializing, in order for the drive that governs it to start up correctly, none of the parameters listed in the user motor (type I) column of table 2. must be zero.

On Fagor motors, this condition will always be checked, but on user motors, any of them may take a zero value. The drive display will show error 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. To eliminate the error, they must be initialized.



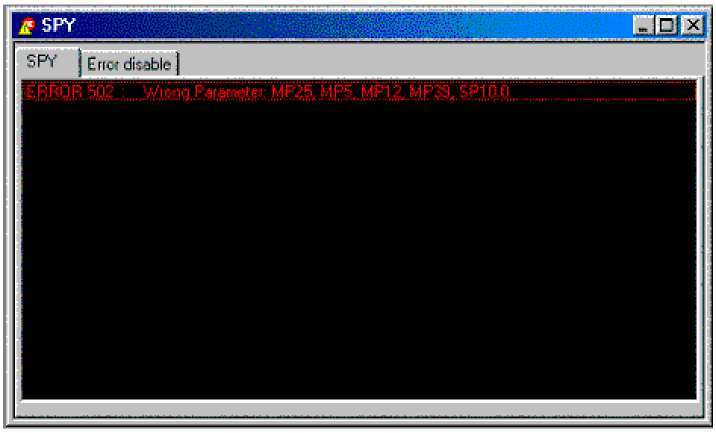


fig.22 Display of the uninitialized parameters. E502.

Parameter setting for a Fagor motor (FM7, SPM)

Use the WinDDSSetup to load a <*.mot > file (e.g. fm7.mot or spm.mot) that contains a parameter table for each motor.

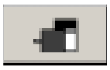
Once these files are loaded, write in MP1 the ID of the motor whose parameters are to be set by modifying the necessary parameters.

See sections: transferring <*.mot > files and motor identification in chapter 3 of this manual.

Parameter setting for a user motor (not Fagor)

It is a parameter setting process that must be carried out manually entering the known motor parameters one by one. Depending on the type of application, these parameters might not be the same ones that is why there are 4 different ways to manually set the parameters of an asynchronous motor depending on the parameters available.

The process is initiated by selecting the M group (motor) at the WinDDSSetup program for PC in the parameters setting window (modification mode).



Using an OEM access level or higher, a window is displayed showing the motor selection icon as long as the Motor Type (MP1) has been previously selected.

Note that for a BASIC access level, the window does not show this icon, therefore, it will not be possible to make this selection !

Pressing this button displays a **MOTOR SELECTION** window. Use the vertical scroll bar to find the **CLEAR MOTOR PARAMETERS** field (located in the last field) and validate it.

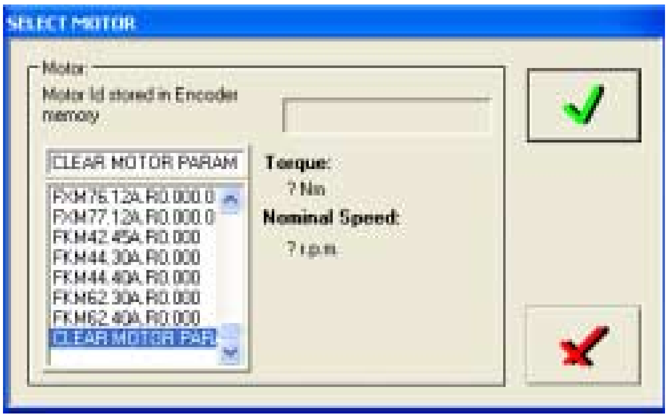


fig.23 Selection of **CLEAR MOTOR PARAMETERS** for MP1.

Doing this **initializes** the following parameters **to zero**:

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

table 1. Parameters initialized to zero after entering **CLEAR MOTOR PARAMETERS** in MP1.

Depending on the data known (available on the motor specs plate) there are 4 different types of parameter setting. Thus:

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**	**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**		
MotorNoLoadVoltage		**MP40**		

table 2. Different types of parameter settings depending on the known data of the user motor.

The motor whose parameters are to be set must be classified in one of the these types according to available data. After entering the values one by one, save them permanently into Flash memory.

The parameters of asynchronous FM7 motors may be set either as Fagor motors or as user motors (motor 0).

In this situation and before carrying out the auto-adjustment of the asynchronous user motor described next:

Remember that parameters CP20 and SP10 must be set with the proper values !

Auto-adjustment of an asynchronous user motor

From version v.06.08 on, there is a software capable of obtaining an initial parameter setting when adjusting a high speed spindle or spindle motor supplied by the OEM, once the motor

WARNING: This feature is only applicable to asynchronous motors classified as type IV in the previous table 2.. When knowing the data of another type of motor, it must be adjusted manually.

This feature is useful when using **non-Fagor** asynchronous motors

The characteristic plate of all asynchronous motors classified as type IV 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	**[F1238]**	**MotorElectricalParametersIdentification**

Note that:

- After entering the user motor parameters (type IV 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	**[F701]**	**Feedback1Type**
NP116	**[S116]**	**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 fig.23.

  Enter, one by one, the values of all the parameters indicated in table 2. for a **type IV** asynchronous motor. These values are given on the characteristics plate of the motor and they're all known.

WARNING: Error 508 will be issued if the MC1 command is executed without having carried these two steps out.

- **Other parameters:**

  The following must also be set:

MP14	**[F1210]**	**MotorTempSensorType**
MP21	**[F1217]**	**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 section: < Calculation of the serial inductance > in this chapter !

WARNING: Error 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 GC1 command.**

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 rpm and at 1500 rpm !

Identification

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 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

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	[S106]	CurrentProportionalGain
CP2	[S107]	CurrentIntegralTime
CP3	[F300]	CurrentFeedbackDerivativeGain
CP4	[F301]	CurrentAdaptationProportionalGain
CP5	[F302]	CurrentAdaptationIntegralTime

... of the flux loop:

FP1	[F600]	MotorFluxProportionalGain
FP2	[F601]	MotorFluxIntegralTime

... of the back electromotive force (bemf):

FP20	[F602]	MotorBEMFProportionalGain
FP21	[F603]	MotorBEMFIntegralTime

Recommendations

We recommend:

- Executing the MC1 command twice.
- Perform a second identification when the motor is at working temperature, if it does not have a temperature sensor.

The greater the current supplied by the drive, the more accurate will the identification be !

Calculation of the serial inductance

When using high speed spindles, the value of the leak inductance of the motor is low. In order for the sindle servo system to perform properly, this leak inductance value must be greater than the minimum value. Otherwise, a **three-phase inductance** must be installed in series between the motor and the drive.

Then, you first have to check if the motor's leak inductance exceeds the minimum value according to the formula:

$$0.005182 \cdot \frac{V_0}{I_0} \cdot \frac{Nmáx^2}{Fpwm^2} \cdot \frac{P}{N_{base}} \cdot \cdot {}_{Lh} - (L_1 + L_2) > 100 \propto H$$

If this formula is not met, it will not be necessary to install the inductance in series. However, it it is met, it will be required and its value will be given by:

$$L_{series} = 0.005182 \cdot \frac{V_0}{I_0} \cdot \frac{Nmáx^2}{Fpwm^2} \cdot \frac{P}{N_{base}} \cdot \cdot {}_{Lh} - (L_1 + L_2)$$

where:

Term	Description	Units	Parameter
V_0	Voltage w/o 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 pole pairs	-----	MP5
N_{base}	Base speed	rpm	MP25
$\cdot \; {}_{Lh}$	Gain of mutual inductance	-----	MP30 / MP37
$L_1 + L_2$	Sum of leak inductance (phase-neuter) of stator and rotor	H	MP11 + MP28
L_{series}	Serial inductancia	H	CP16

WARNING: It is recommended to use a PWM frequency of 8 kHz (instead of 4 kHz) so as not to have use a three-phase coil. However, this could require installing a larger drive due to the current derating and, consequently to the lower power that the drive will be able to provide.

The characteristics of the inductance to be supplied to the manufacturer to get it are the following:

Inductance value	L_{series}	H
Pulsating frequency used to calculate L_{series}	F_{pwm}	kHz
Rated current (in S1) of the motor	I_{S1}	A

Auto-adjustment of the rotor resistance value:

From version v.06.01 there is a software capable of improving the behavior of an asynchronous motor regardless of the variations of the rotor resistance value depending on temperature and 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 [F612] RotorEstimation.

FP31 [F613] RotorFixedTemperature.

See appendix A.

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 (Estimation on)
  FP30 = 0 (Estimation off)

- **Determine whether the motor has a temperature sensor or not:**

  MP14 = 2 (for a KTY84 sensor)
  MP14 = 3 (for an FM7 sensor)
  MP14 = a value other than the previous ones (without sensor)

- **Determine the value of FP31:**

  It does have a sensor: FP31 = 0
  It has no sensor: FP31 = fixed temperature (eg. 75 °C).

Loading and debugging of PLC and MC programs

Introduction

This section defines the characteristics required by the user interface to use and set up the MC software and its applications.

The user will have to edit application programs in a specific MC language and compile them; load them at the drive and debug them in order to fine tune the system. The following tools may be used for this purpose:

Tools to generate MC application programs. They consist of an MC language editor for those applications and a compiler to convert those source files into application files that may be executed by the MC software of the drive.

A tool to load those applications into the drive, because they are edited and compiled at a PC.

A tool to debug those applications. It has to do with the system setup and it must offer the user the possibility to check the performance of the applications in the system itself.

These tools should be interrelated and it should be easy to switch from one to another. However, it is not possible to have several applications activated at the same time if they control and access the same communications line. That is why these tools are grouped in two separate work environment depending to their need to communicate with the drive.

These two work environments are:

Editing for creating applications and compiling them. These tasks do not require a direct communication with the drive.

Loading and debugging MC programs. Tasks that require communication with the drive. This environment is part of the WinDDSSetup that is an application that establishes and controls the communication with the drive.

This section describes in detail the loading and debugging environment, but not the one for editing because it is described in the DDS-MC system manual.

However, remember that the WinDDS icon must be activated to switch from editing to loading / debugging by displaying the WinDDS window. Browse for the WinDDSSetup.exe. When activated, it will show the window with its tool bar to access the icons for loading and debugging programs.

The figure below shows the WinDDS window:

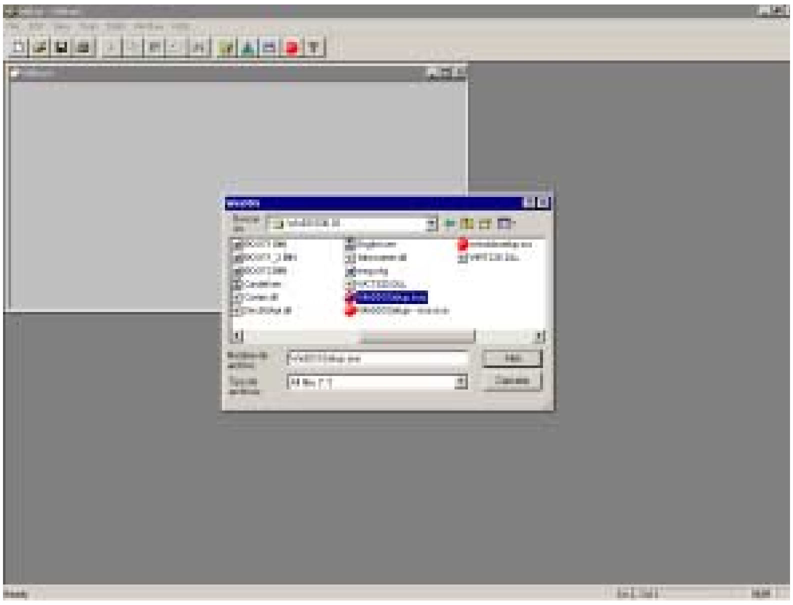
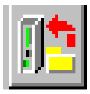


fig.24 Going from the editor to the WinDDSSetup through the WinDDS window.

Loading the program



Activating this icon from the icon bar of the WinDDSSetup window allows displaying a new window **Backup file → drive** where the operator may select the type and name of the file to be loaded from the PC to the drive.

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.

The following types of files may be sent using this function:

EXTENSION	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 the MC application
CFG files (*. cfg)	Configuration files
MOT files (*. mot)	Motor parameter table
CAM files (*. cam)	Cam profile tables

This function sends the MC or PLC application file, or from the parameters table in the same way as the drive parameters are sent. This application is stored in drive's **flash memory**.

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:

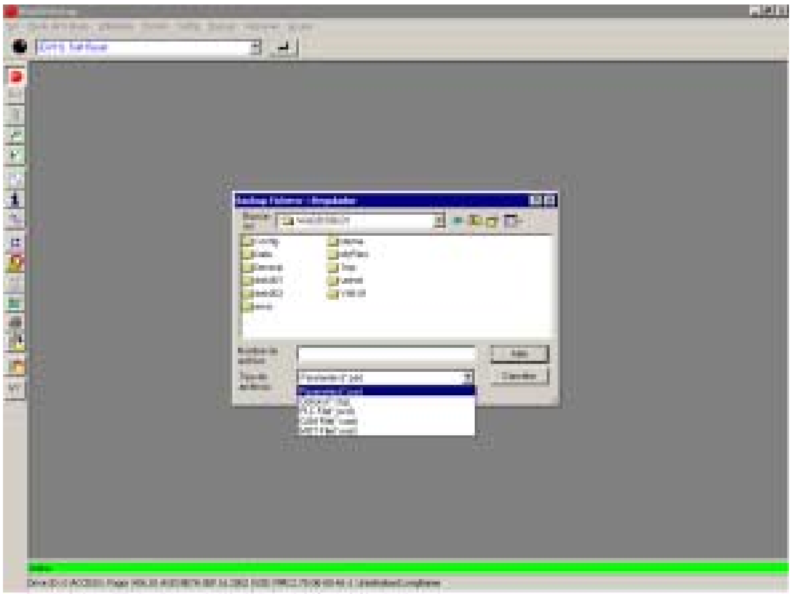
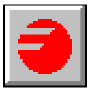


fig.25 < File ➔ drive backup > window.

Once the desired file type and name has been selected, it is loaded into the drive by clicking on **Open.**

MC program debugging



After editing and compiling MC and PLC applications, access the WinDDS window from the editor by clicking this icon. This will display the WinDDSSetup and its loading and debugging tools.

The debugging tool must permit looking at the source files but not modifying them as well as loading the MC application to be debugged, sending commands to the drive, set execution break points, variable watches, ...

Therefore, this debugging tool must be associated with the WinDDSSetup application.

The main debugging functions it must offer the operator are:

1. load the application file into the drive.
2. open a window displaying the source file to be debugged.
3. activate debugging control commands that lets you control the execution: start, stop, resume, ...
4. access application variables in read mode and in write mode (watch).

With the WinDDSSetup application, it is possible to send parameter files from the PC to the drive and to load or send MC or PLC application files out to the drive.

On the other hand, there are specific functions to establish watches for variables and parameters of the drive. This application also display the user variables of the MC or PLC applications.

It also offers a debugging tool for MC applications that includes the rest of the functions such as debugging, displaying MC application files, ...

The window shows what the WinDDSSetup looks like and it indicates the function icons corresponding to these tools.

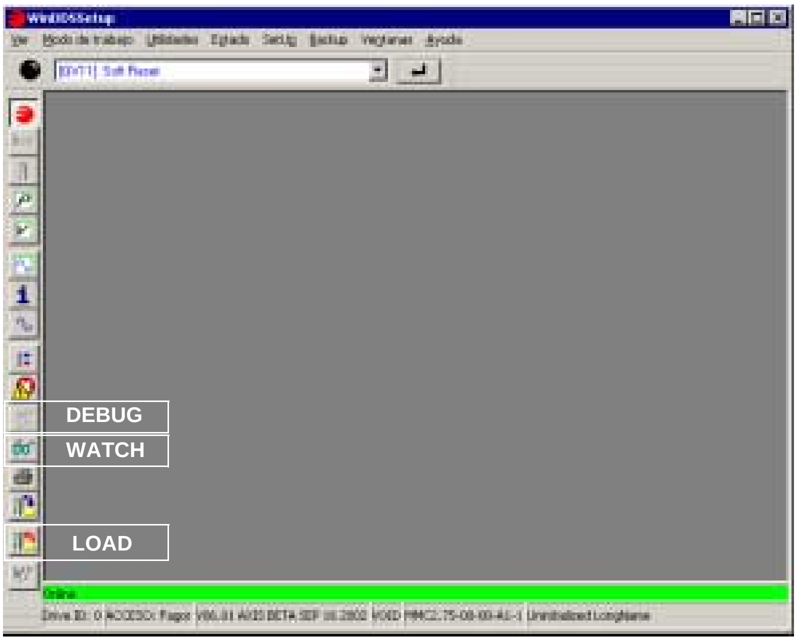


fig.26 Layout of the < debug, watch and load > icons on the tool bar of the WinDDSSetup.

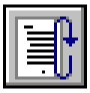
This debugging tool for MC/PLC applications will only be enabled for those drives having the MC/PLC software loaded or active because not all of them satisfy this requirement. This way, when launching WinDDSSetup, it obtains this information from the drive and either enables or disables he functions of the debugging tool.

The debugging tool will be able to detect whether the MC/PLC application to be displayed and debugged matches the one loaded into the drive (if any). Also, if the application loaded into the drive and the one opened for debugging do not match, an error message is issued because the symbols and data of the debugging environment do not correspond with the data loaded into the drive (variable names, code lines, ...).

It that case, the user may:

1. Look for the source code corresponding to the application loaded into the drive.
2. Load into the drive the application to be debugged overwriting the one it had before.

Debugging of applications



Activating this icon at the WinDDSSetup window permits displaying the **debug** window used to debug MC applications. It offers functions to display the files to be debugged, to activate application executing commands and to set execution break points.

After activating this icon, the debugging tool looks like this:

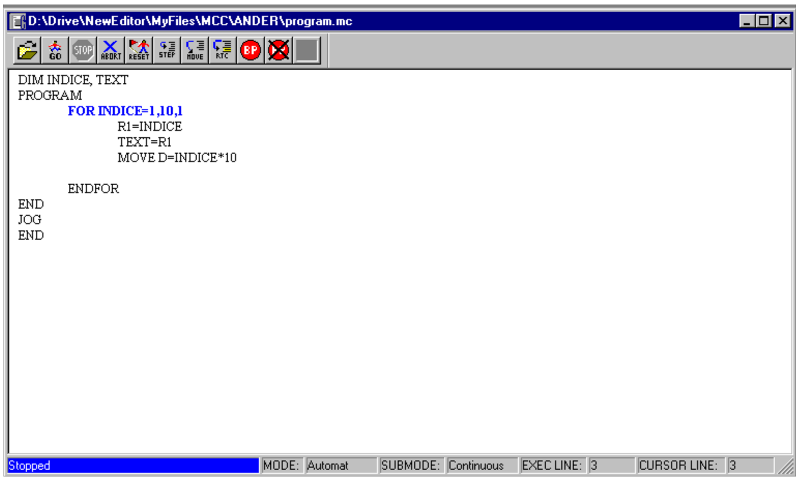
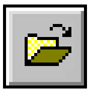


fig.27 Debug window.

Displaying the source code

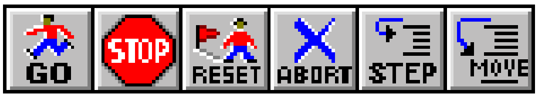


Activating this icon at the **debug** window lets the operator open a window to display the source code of the application to be debugged and set break points. When the execution stops at those break points, it displays the code line where it stopped.

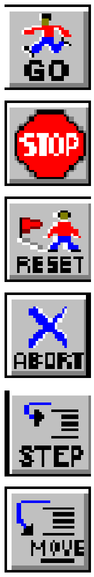
The source code is debugged at high level, not at pseudocode level. The display window shows the status of the application on the **status bar** indicating whether it is running or not and on which it has stopped [if it has]. The debugging software obtains this data by accessing two MC software variables that indicate on one hand the execution status LV30 [F2330] KernelExecutionState and on the other the execution point where it was interrupted LV31 [F0233] KernelExecutionPoint.

The status bar looks this:

Debugging commands



This group of icons appearing at the tool bar of the **debug** window offers the operator a number of debugging commands for a controlled execution of the application. Each icon determines how each command is executed.



To start the execution of the application

To stop the execution immediately

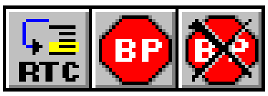
To stop the execution immediately and reset the application positioning at the beginning

To interrupt and finish the positioning block at any time without waiting for the target position to be reached

To execute the application step by step where the high level statements may be executed one by one

To execute positioning blocks one at a time

Break points



This group of icons appearing at the tool bar of the **debug** window offers the operator two MC application debugging mechanism. Each icon determines how a particular mechanism is executed.

RTC sets the application interruption point defined by the cursor

BP activates and deactivates the break points on the current application line

Removes all the break points of the application

The MC software implements two mechanisms of this sort for debugging MC applications: **BP break point** and the execution up to the cursor point **RTC (Run To 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.

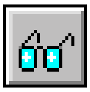
The RTC also sets an application interruption point so the execution stops when reaching this point for the first time and it is then deactivated. Only one element of this type may be set every time the execution is started.

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 icon.

If the operator wants **to quickly remove all the BP's** activate the icon of the tool bar that shows the letters BP crossed out.

To **set a RTC again**, place the cursor on the program line and activate the RTC icon of the tool bar.

Displaying variables



Activating this icon at the WinDDSSetup window displays the **watch** window where the operator may access the read and write application variables during debugging. This window offers the possibility to select and display the desired variables.

The window displayed after clicking on this icon looks like this:

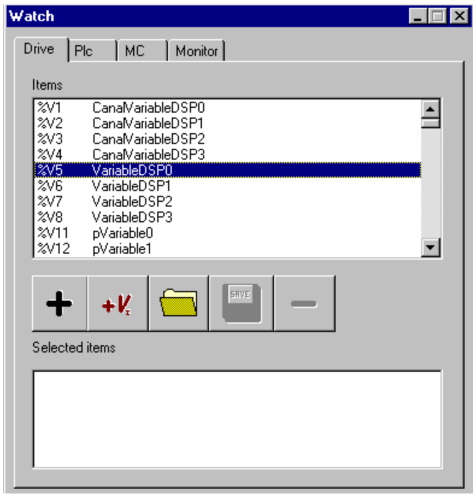


fig. 28 Watch window.

As can be seen on the image, besides selecting parameters and variables of the drive. It is possible to select and monitoring PLC and MC variables together if so desired.

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.

For example:

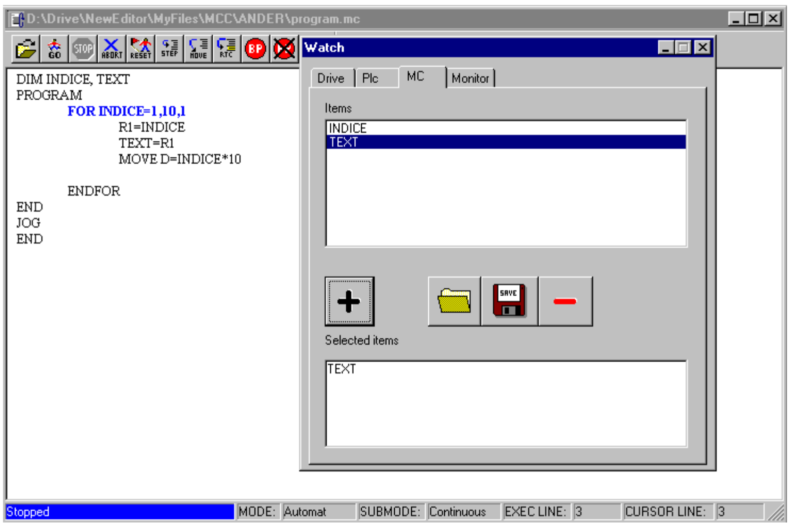


fig.29 Recognizing the names of user assigned variables.

The watch window offers the **monitor** tab that when activated shows a set of filed 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 field box corresponds to each selected variable or command and it shows the current values they have at the drive. All this will be executed when clicking the monitoring button.

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 ENTER.

This is an example of this window:

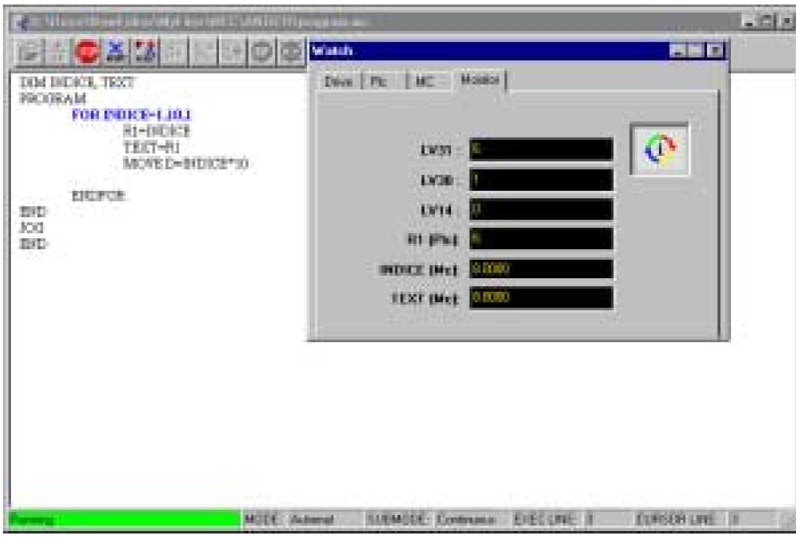


fig.30 Watch window. Monitoring label.

To load a new configuration of the variables to be displayed and save the modifications done to them from the monitoring window, click the right button of the mouse at the monitoring tab which will show:

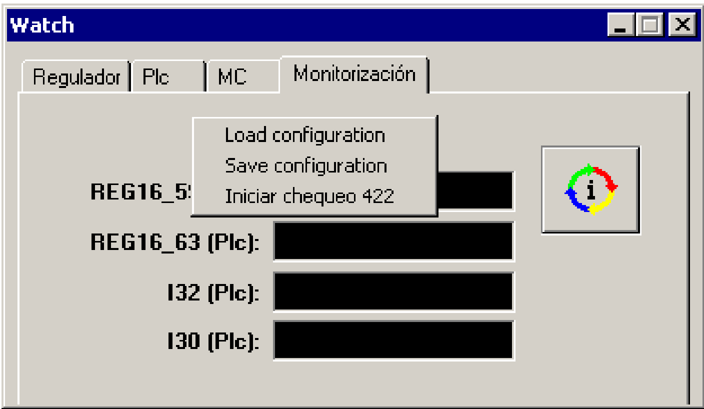


fig.31 Load and save new configurations.

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.

ESA video terminal

Description

An ESA video terminal (VT) is a device that may be used to control or monitor a system. The VT may send commands using keys or on-screen touch buttons configured by the user.

It can also send data to determine the procedure and display the data coming originated by it.

There are two main groups of video terminals:

1. Those with a keypad.

2. Those with a touch screen.

In order for the VT work, a project must be created and loaded onto the terminal. A project is a **set of screens** of the same size as the VT screen being used. The user is free to configure each one of them so as to contain texts, display and define project variables or both types at the same time.

These screens, configured like this, may be interconnected for easier user browsing.

In each project it will also be possible to generate diagnostic signals and warnings informing the user of any process malfunctions at all times.

Therefore, the project is a system of screens more or less complicated for the user in order to provide the management and display of a process.

Communications

All the VTs communicate with other devices through serial and / or parallel communications ports.

Serial communications are particularly sensitive to external disturbances. Use shielded cables to minimize them.

Hence, the serial communications cable should have the following specifications:

SERIAL CABLE CHARACTERISTICS	
Resistance in DC	$[R/L]_{max}$ = 151 . /km
Capacitance coupling	$[C/L]_{max}$ = 29 Pf/m
Shielding	> 80 %

table 3. Selection of the external resistor.

Take special care when choosing and handling the interfaces cables and especially the serial cable connecting the VT with the device. Always select the shortest cable possible and run it as far away as possible from cables generating any disturbance.

Drive's RS 232 / 422 serial port

RS232 - RS422 CONNECTOR	
PIN	**SIGNAL**
1	N.C.
2	R X D 232
3	T X D 232
4	+ 5 V ISO
5	GND ISO
6	T X D 422
7	# T X D 422
8	R X D 422
9	# R X D 422
N.C.: Not connected	

The connection to the drive is carried out through this port.

It has a 9-pin male Sub-D type connector.

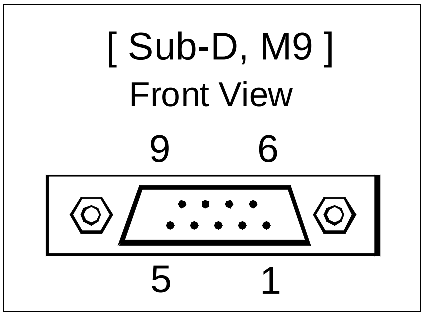


table 4. RS 232 - RS 422 serial line connector.

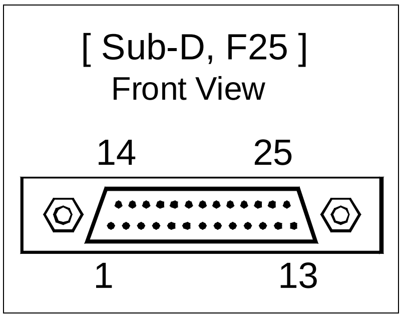
MSP serial port of the video terminal VT

MSP CONNECTOR	
PIN	**SIGNAL**
1	N.C.
2	T X RS 232 OUT
3	R X RS 232 IN
4	RTS RS 232 OUT
5	CTS RS 232 IN
6	N.C.
7	GND
8	N.C.
9	* T x C.L. +OUT
10	T x R x 485 - IN / OUT
11	* T x C.L. - OUT
12	T X RS 422 - OUT
13	R X RS 422 + IN
14	IKT OUT
15	IKR OUT
16	+ 5 Vdc (reserved)
17	N.C.
18	* R x C.L. +IN
19	N.C.
20	N.C.
21	N.C.
22	T x R x 485 + IN / OUT
23	T x RS 422 + OUT
24	R x RS 422 - IN
25	* R x C.L. - IN
* C.L. : Current loop	
N.C. : Not connected	

table 5. MSP serial connector of the VT from ESA.

The MSP serial port (Multi Serial Port) is a part of all the VTs and is used to connect it with other devices. Thus, the project is transferred from the PC to the ESA VT through this port.

It has a 25- pin Sub - D type connector and may communicate with other devices using RS 232, RS 422, RS 485 and C.L. (TTY - 20 mA).



Note that pin 16 cannot communicate with any type of load. Any disturbance at pin 16 may damage the VT and the process.

Strong disturbances at pin 16 could damage the VT.

Connections

The following sections describe the possible connections from the PC to the VT and from the VT to a drive or several drives so they can communicate with each other.

Some connections will mention the adapter "RS232/RS422 BE", thus being necessary to describe it and its pinout at both ends.

Remember that the user is free to use it or not. However, using it would make the connection a lot easier !

See figure:

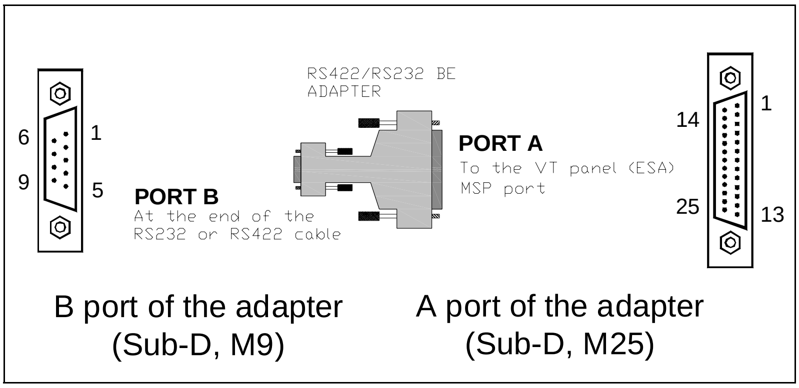


fig.32 RS422/RS232 BE adapter.

The following table shows the pinout of the B port connector:

B PORT PINOUT	
1	Not connected
2	T x RS232 0UT
3	R x RS232 IN
4	Not connected
5	RS232 GND
6	R x RS422 + IN
7	R x RS422 - IN
8	T x RS422 + OUT
9	T x RS422 - OUT

The pinout for port A is the same as for the MSP port of the VT panel from ESA described in the previous section !

PC-VT connection via RS232 serial line

This VT - PC connection is essential for transferring the communication driver and the project.

The connection cable to use will depend on whether the adapter RS232/RS422 BE is used or not.

☐ PC-VT connection using an RS232 cable (without adapter).

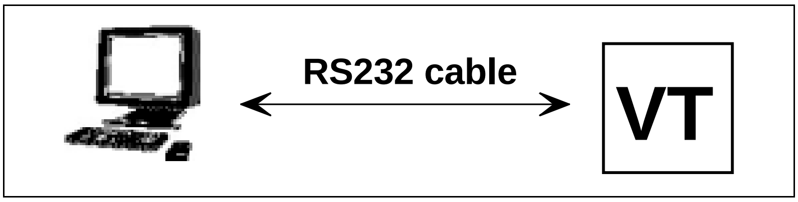
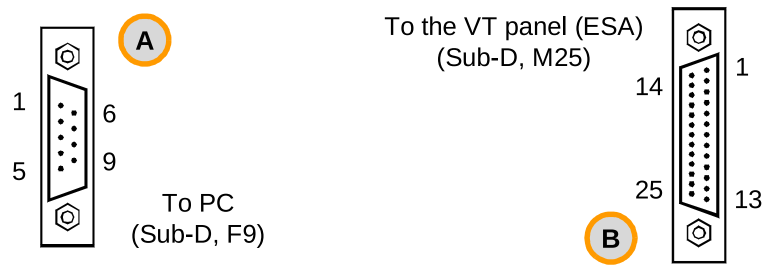


fig.33 PC-VT connection without adapter.

The connection cable when not using the adapter RS232/RS422 BE will have the following connectors at its ends:



These two connectors are located at both ends of the RS232 cable when connecting without the adapter.

fig.34 **A.** Connector **of the RS232 cable** for direct connection to the PC.
B. Connector **of the RS232 cable** for direct connection to the VT.

The connection is:

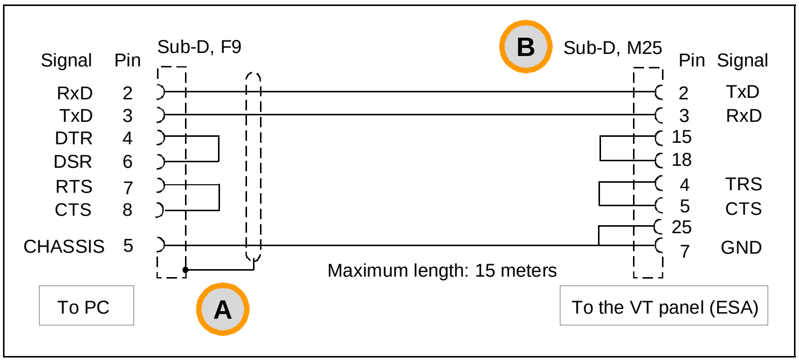


fig.35 RS232 connection between PC and VT without adapter.

See the previous section for further information on the pinout of the 25 - pin connector of the MSP port of the VT panel from ESA !

PC-VT connection using an RS232 cable (with adapter).

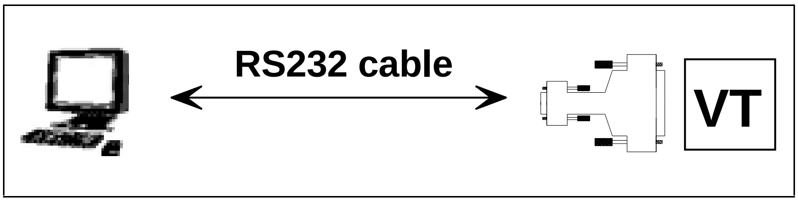


fig.36 PC-VT connection with adapter.

The adapter RS232/RS422 BE has the following connectors at its ends:

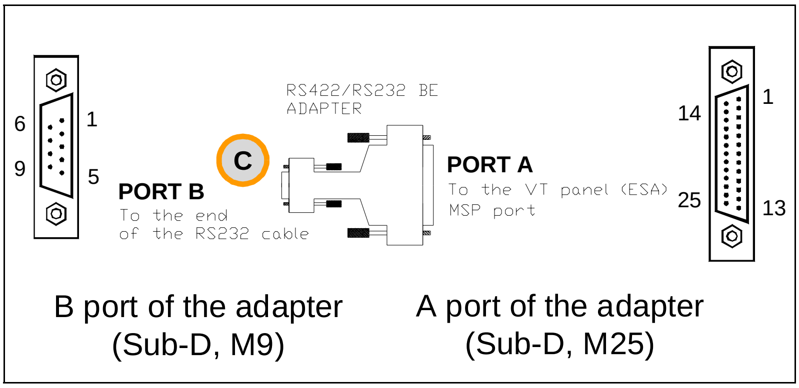
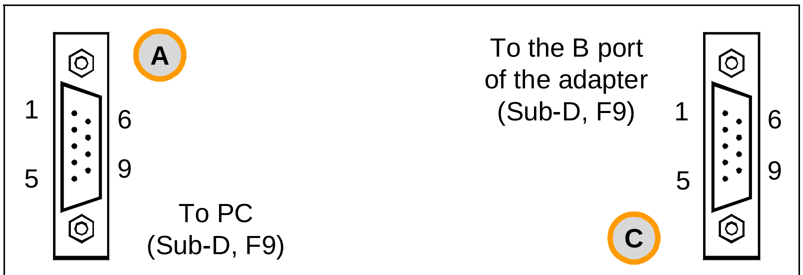


fig.37 RS422/RS232 BE adapter

The connection cable when using the adapter RS232/RS422 BE will have the following connectors at its ends:



These two connectors are located at both ends of the RS232 cable when connecting with the adapter.

fig.38 **A.** Connector **of the RS232 cable** for direct connection to the PC.
C. Connector **of the RS232 cable** to connect to the B port of the adapter.

The connection is:

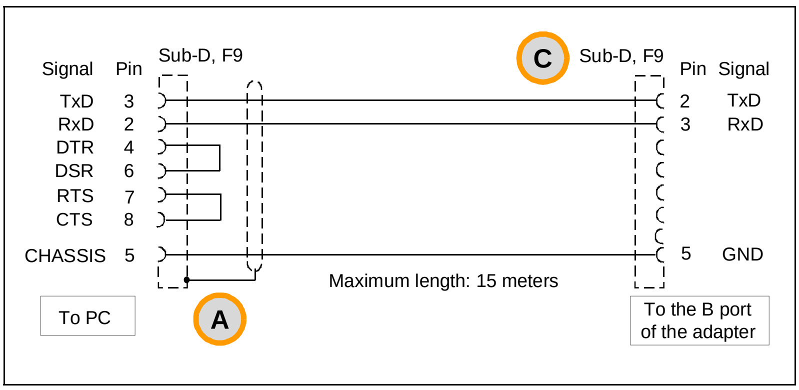
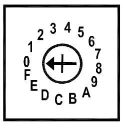


fig.39 RS232 connection between PC and VT with adapter.

VT-DRIVE connection via RS232 serial line

Once the project has been transferred from the PC to the VT (ESA), an ESA video terminal may be connected to **a single drive**, thus establishing communication via the MSP serial port of the VT and the drive's RS232 serial port.

When mentioning a drive, it means any model of the Fagor catalog, i.e. AXD, SPD, ACD, SCD, MMC and CMC models !



WARNING: The RS232 serial line can only be used between the ESA VT and a single drive. The arrow of the drive's node selecting rotary switch (Node_Select) must be pointing at 0.

It is now possible to handle and control from the Video Terminal the process application by communicating with the connected drive.

The connection cable to be used is described next.

The adapter RS232/RS422 BE is not required in any case !

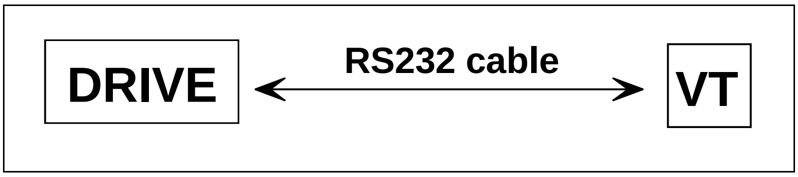


fig.40 VT- drive connection.

The connection cable must have the following connectors at its ends:

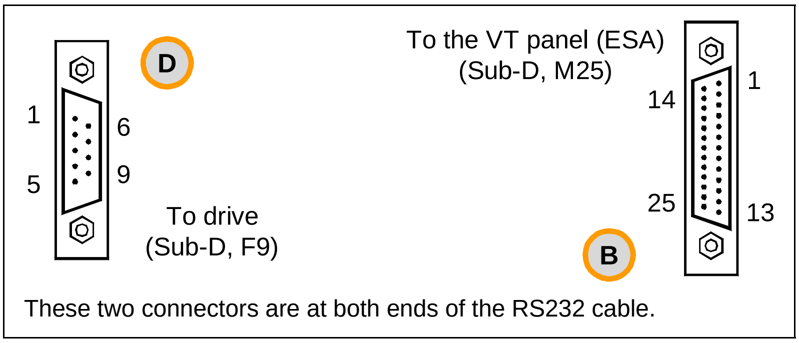


fig.41 **D.** Connector **of the RS232 cable** for direct connection to the drive.
B. Connector **of the RS232 cable** for direct connection to the VT.

The connection is:

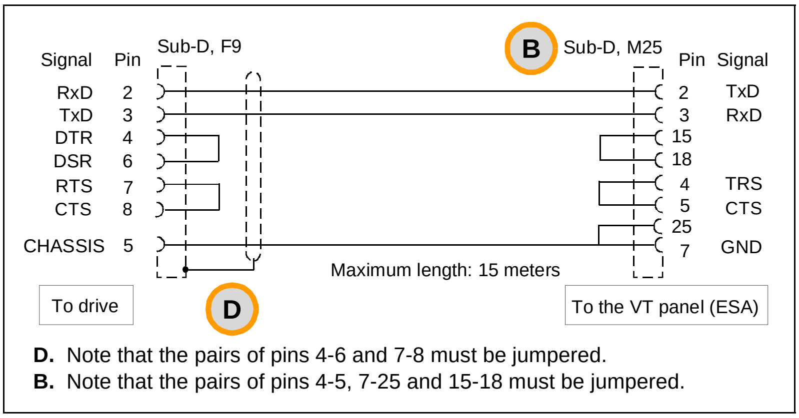
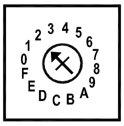


fig.42 RS232 connection between the VT and the drive.

VT -DRIVES connection via RS422 serial line

In this section, when mentioning drives, it means **only** the MMC and CMC models of the Fagor catalog. This connection must be used when using ModBus communications protocol between an ESA VT panel and several MMC or CMC modules !

Once the project has been transferred from the PC to the VT, the VT may now be connected with several drives. This connection may be made either by connecting directly as described next or through the adapter RS232/RS422BE that will make the connection a lot easier for the user. In either case, communication must be established through the MSP serial port of the VT (port A when using the adapter) and the RS232/RS422 serial port (B port when using the adapter) of each drive.



WARNING: The RS422 serial line can only be used between the ESA VT and several drives. The arrow of the node selecting rotary switch (Node_Select) of each drive making up the system must necessarily be pointing at a position other than 0. The position selected at the rotary switch of each drive assigns a node number to it that identifies it within the system; therefore, each drive must be assigned a different node number. In other words, two drives cannot have the same node number.
For a node number change to become effective, first do a reset at the drive affected by the change.

◻ VT - MMC or CMC connection through RS422 cable (without adapter).

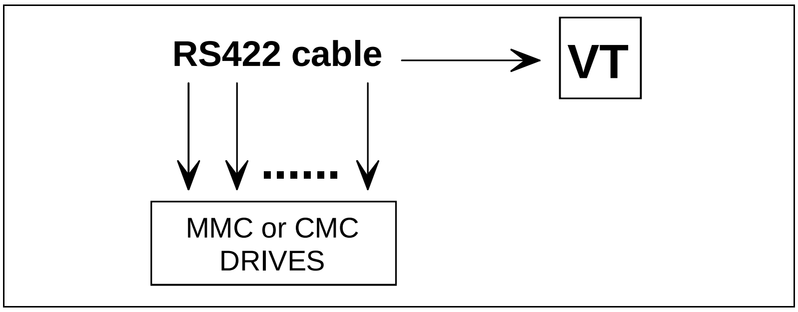


fig.43 Connection of a VT with MMC or CMC drives without adapter.

Follow the diagram of the next figure to make this type of connection (without adapter).

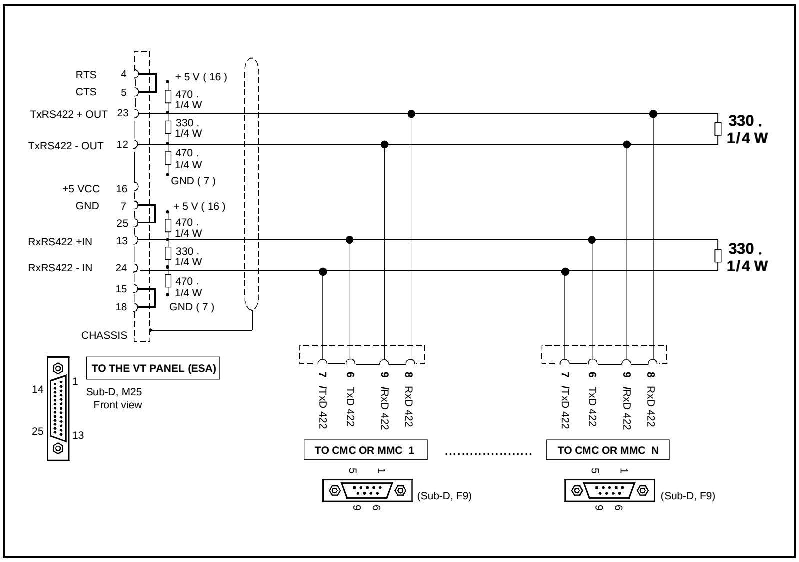
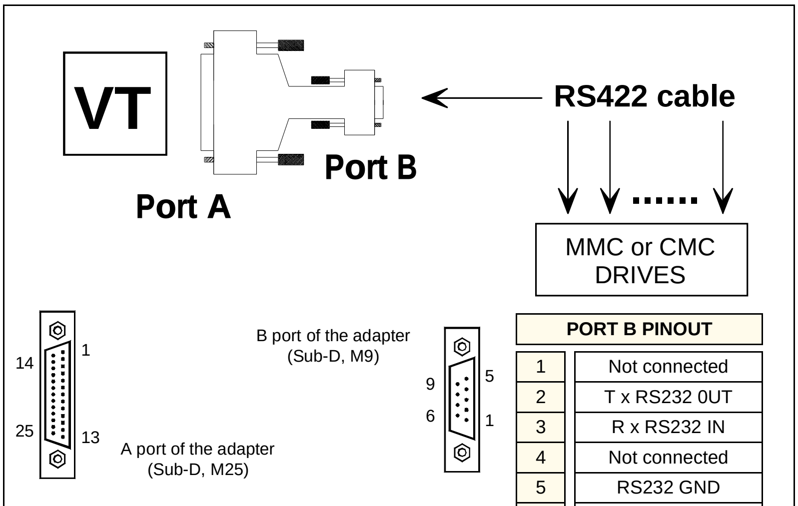


fig.44 Connection between ESA VT and MMC or CMC drives without adapter.

◻ VT - MMC or CMC connection through RS422 cable (with adapter).



PORT B PINOUT	
1	Not connected
2	T x RS232 0UT
3	R x RS232 IN
4	Not connected
5	RS232 GND
6	R x RS422 + IN
7	R x RS422 - IN
8	T x RS422 + OUT
9	T x RS422 - OUT

For further detail on the pinout of port A of the adapter, see the section regarding the MSP serial port of the ESA VT panel already described earlier.

fig.45 Connection of a VT with MMC or CMC drives with adapter.

Follow the diagram of the next figure to make this type of connection (with adapter).

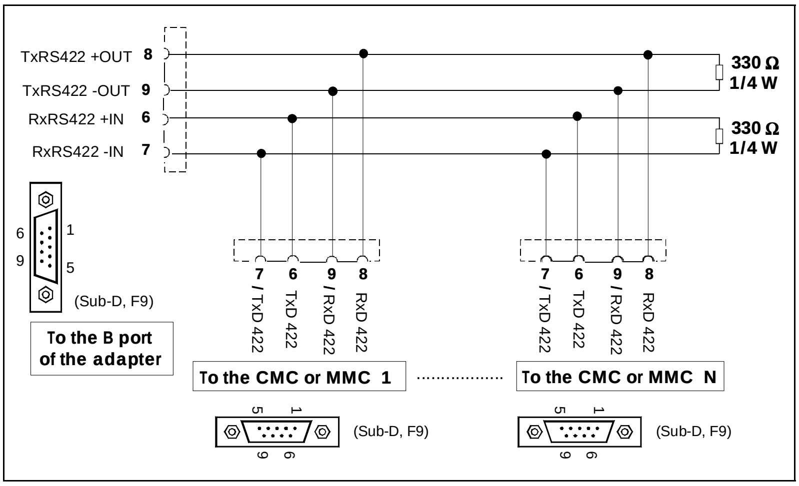


fig.46 Connection between ESA VT and MMC or CMC drives with adapter.

Protocol and communication mode from the WinDDSSetup

On MMC drives and CMC drives:

From the WinDDSSetup window, activate the **SetUp** menu bar and the screen shows the **PREFERENCES** screen.

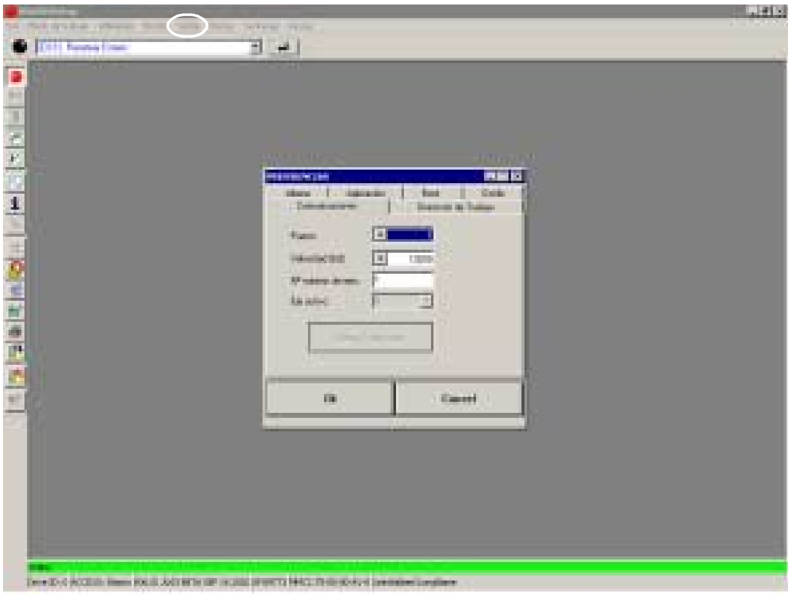


fig.47 PREFERENCES window.

Activating the **communications** tab determine all the communications characteristics through the following fields:

Port: Selects the port to communicate with the PC.

Baudrate (bd): Sets the communication speed (baudrate).

Max Nr of axis: n This field indicates the number of drives connected to a PC or to a VT.

Active axis: This field is used to select the drive that all the parameters, variables, commands, ... refer to and may be displayed and modified from WinDDSSetup. The entered value selects the drive whose node number matches this value.

All the applications that may be executed from WinDDSSetup (oscilloscope, wave generator,...) will refer to the drive specified in this field, 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 RS422 or an RS232 connection at each drive and the node assigned to each drive using the rotary switch.

Cases where a transmission will be established:

RS422; **n>1:** **communication with several drives in RS422 mode:**

The communication protocol for **several axes** in RS422 mode will be the DNC50. The node number assigned to each drive with its rotary switch identifies it with that number and it must be other than 0.

RS422; **n=1 :** **communication with a single drive in RS422 mode:**

The communication protocol for **several axes** in RS422 mode will be the DNC50. The node number assigned to the drive must be other than 0.

i

To establish communication with a single drive in RS422, it must be done using the DNC50 protocol for several axes. Write a value greater than 1 in the maximum number of axes field. Since it tries to establish communication with 1 drive and the maximum number of axes field indicates a value > 1, the WinDDSSetup will run a test and will recognize that there is only one axis.

RS232; **n=1 :** **communication with a single drive in RS232 mode:**

The communication protocol for a **single axis** in RS232 mode will be the DNC50. The node number assigned to the drive must be 0.

For the rest of the possible combinations, WinDDSSetup will detect some sort of transmission error.

Note that the status bar of the WinDDSSetup window will show which axis is active that will match the one set in the **active axis** field of the **preferences** window.

Its location on the status bar is shown below:

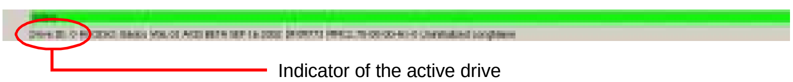


fig.48 Status-bar location.

On AXD,SPD, ACD and SCD drives:

These drives do not offer RS422 communication. Therefore, the RS232 serial line may be used with a DNC50 protocol for a single axis.

The <maximum number of axes> field of the **PREFERENCE communications** window described earlier must be set to 1.

The rest of the fields of the window operate in the same way as for the MMC and CMC drives.

User notes:

DESIGN

7

Axis motor and servo drive selection

First motor pre - selection

The motor must meet the specifications on torque (N·m), speed, duty cycles or other kind of requirements of the axis to be moved.

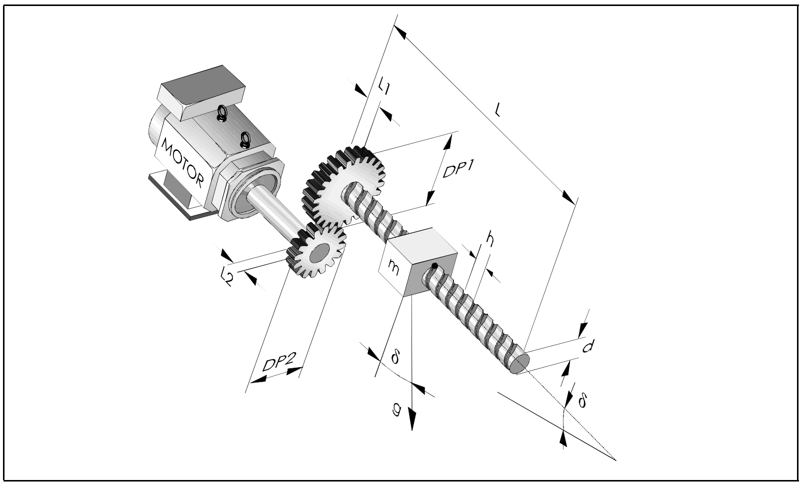


fig. 1 Axis

The shape of an axis may be like the one in fig.1.

Calculation of the necessary motor torque [M]

The total motor torque M_T has two components:

- The continuous torque M_S (to maintain the table at a constant speed or fixed in a position).
- The acceleration torque M_A (to changes its speed).

The reduction in the motor ballscrew transmission [***i***] is a factor to be considered in many of the following calculations:

$$M_T = M_S + M_A \qquad i = \frac{DP1}{DP2}$$

$$M_{TOTAL} = M_{CONTINUOUS} + M_{ACCELERATION}$$

The continuous torque M_S

$$M_S = M_F + M_W + M_C$$

$$M_{CONTINUOUS} = M_{FRICTION} + M_{WEIGHT} + M_{CUTTING}$$

is due to:

- the friction between table with its ways and with the ballscrew M_F,
- the weight of the table when not moving horizontally M_W,
- the cutting force of the tool M_C.

Friction torque M_F:

$$M_F = [M_{F-table} + M_{F-ballscrew}] \bullet \frac{1}{i} = \left[\frac{m \bullet g \bullet \propto \bullet h}{2\pi} + \frac{d}{10}\right] \bullet \frac{1}{i}$$

where:

M_F The torque due to friction and is given in N·m.

m The table mass in kg.

d The diameter of the ballscrew in mm.

g The gravitational acceleration, 9.81 m/s^2

h The ballscrew pitch in meters per turn.

$\propto$ The friction coefficient between the table and the ways it moves on:

typical $\propto$ values depending on material:

Iron	0.1 ÷ 0.2
Turcite	0.05
Roller bearings	0.01 ÷ 0.02

Torque due to weight of the table M_W:

When the move does not move horizontally, but at an angle δ like in the previous fig.1 the torque due to the weight of the table must also be considered:

$$M_W = \left[\frac{m \bullet g \bullet sen\delta \bullet h}{2\pi}\right] \bullet \frac{\%}{i}$$

M_W is the torque due to table weight and is given in N·m.

δ is the incline angle of the ballscrew with respect to the horizontal axis.

% is a mass compensation factor that can vary between 0 and 1.

If the total table weight is compensated for by means of some sort of hydraulic system or counterweights so the motor makes the same effort to move the table up as to move it down, the *%* factor will be 0. At the other end, if no compensation is applied, *%* will be 1.

Torque to the needed cutting force M_C:

There is a cutting force between the tool and the part and this means a hindrance for moving the table. The torque necessary at the motor to make this movement is calculated as follows:

$$M_C = \left[\frac{F \bullet g \bullet h}{2\pi}\right] \bullet \frac{1}{i}$$

M_C Torque due to the cutting force of the tool in [N·m].

F Cutting force of the tool in [kg-force].

g Gravitational acceleration 9.81 m/s^2.

Motor speed calculation [motor rpm]

The machine will need a maximum speed **(motor rpm)** in a linear movement of the table. Therefore, the motor must have a maximum speed of:

$$RPM_{motor} = \left[\frac{V_{max}}{h}\right] \bullet i$$

Vmax is the maximum linear speed the table needs.

In the characteristics table for Fagor synchronous motors (see synchronous motor manual), select a motor that has:

- **A stall torque equal to or greater than the calculated continuous torque M_S.**
- **A maximum turning speed equal to or greater than the calculated value motor RPM.**

Second motor pre - selection

Calculation of inertia [J]

The next step is to calculate the load that the motor has to move when accelerating; that is the moment of inertia of all the elements it moves.

The total inertia J_{TOTAL} is due to the load J_{LOAD} and to the rotor of the motor itself J_{MOTOR}.

$$J_{TOTAL} = J_{LOAD} + J_{MOTOR}$$

The inertia due to load may be divided into that of the table + that of the ballscrew + that of the system used to compensate for non - horizontal axes + that of the pulley or gear used for transmission and which turns with the ballscrew **[pulley 1]**. All these elements are affected by the reduction factor **i** as shown by the following equation.

The inertia due to the pulley that turns with the motor **[pulley 2]** is not affected by the **i** factor.

$$J_{LOAD} = \frac{J_{table} + J_{ballscrew} + J_{pulley1} + J_{compensation}}{i^2} + J_{pulley2}$$

The inertia of each element is:

$$J_{table} = m \bullet \left[\frac{h}{2\pi}\right]^2 \qquad J_{ballscrew} = \frac{d^4 \bullet L \bullet \pi \bullet \alpha}{32}$$

$$J_{pulley1} = \frac{D_{p1}^4 \bullet L_1 \bullet \pi \bullet \alpha}{32} \qquad J_{pulley2} = \frac{D_{p2}^4 \bullet L_2 \bullet \pi \bullet \alpha}{32}$$

The resulting inertia are in $[kg \cdot m^2]$

L is the ballscrew length [m].

L_1 is the width of pulley 1 [m].

L_2 is the width of pulley 2 [m].

D_{p1} is the diameter of pulley 1 [m].

D_{p2} is the diameter of pulley 2 [m].

α is the material density:

7700 $[kg/m^3]$ for iron/steel

2700 $[kg/m^3]$ for aluminum

i, $\propto$**, h,** δ are data used earlier.

The inertia of the motor J_{MOTOR} is:

$$J_{MOTOR} = J_{ROTOR} + J_{BRAKE}$$

This data may be obtained from the characteristics table of the: AC servo motor manual: FXM and FKM.

Verify that in the characteristics table the rotor of the motor chosen in the 1st selection has an inertia which meets the following condition:

$$J_{MOTOR} = [J_{LOAD} / K]$$

where **K** is a factor whose value depends on the application given to the motor.

The ideal will be to obtain a $J_{MOTOR} = J_{LOAD}$.

For a positioning axis, the typical value of K will be between 1 and 3.

If this requisite is not met, a new motor must be selected which meets the conditions of the 1st selection and the 2nd one.

Third motor pre - selection

Calculation of the acceleration torque and time

The required acceleration torque is determined by the total inertia to be moved and the needed acceleration.

The required acceleration is determined by the acceleration time t_{ac} which is the time estimated for the motor to reach its rated speed from zero rpm.

$$M_{ACCELERATION} = J_{TOTAL} \bullet \frac{2\pi \bullet n_N}{60 \bullet t_{AC}}$$

n_N is the rated [nominal] motor speed.

t_{AC} is the time it takes the motor to go from 0 rpm to the rated speed.

From the same equation:

$$t_{AC} = J_{TOTAL} \bullet \frac{2\pi \bullet n_N}{60 \bullet M_{ACCELERATION}}$$

Calculation of the needed rms torque [M_{rms}]

The third and last motor selection requires a new data the RMS torque.

$$M_{RMS} = \sqrt{(M_F + M_W + M_{AC})^2 \bullet \frac{t_{AC}}{T} + (M_F + M_W)^2 \bullet \frac{t_p}{T} + (M_F + M_W + M_C)^2 \bullet \frac{t_C}{T}}$$

where:

t_{AC} is the acceleration time mentioned earlier.

t_p is the tool positioning time.

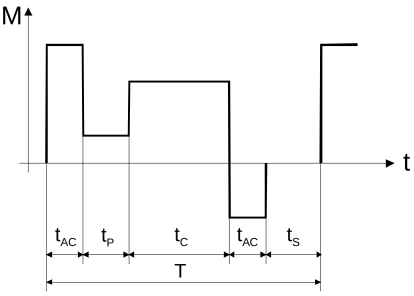
t_c is the cutting time in a typical machining cycle.

The typical values for t_{AC}, t_p and t_C in machine tool cycle are:

$$\frac{t_C}{T} = 0.6$$

$$\frac{t_P}{T} = 0.4$$

$$\frac{t_{AC}}{T} . 0$$



Calculation of the motor peak torque [M_{peak}]

The required maximum torque is the sum of the friction, weight and acceleration torque.

$$M_{MAX} = M_F + M_W + M_{AC}$$

For a given acceleration time, we will need specific acceleration torque and maximum torque. The motor must be able to provide a peak torque equal to or greater than the calculated maximum torque.

Verify that the motor chosen in previous selections meets the following condition:

Peak torque equal to or greater than the calculated maximum torque: $M_{PEAK} = M_{MAX}$

Rated torque equal to or greater than the calculated RMS value: $M_{RATED} = M_{RMS}$

Summary of the three pre - selection:

- Maximum speed equal to or greater than calculated value (rpm de motor)
- Stall torque equal to or greater than calculate continuous value ($M_{continuous}$)
- Motor inertia equal to or greater than inertia (J_{load}/k)
- Peak torque equal to or greater than calculated value (M_{max})
- Rated torque equal to or greater than calculated RMS value (M_{rms})

Drive selection

Once the motor has been selected, check the electrical characteristics table in the Manual for synchronous motors.

There are several drives available for each motor and the peak torque obtained with each one of them will be different.

A drive has to be chosen whose peak current is greater than the one calculated for the application.

Spindle motor and servo drive

On the spindles of machine tools, it is important to maintain a constant turning speed of the spindle. To control this speed, the drive applies torque to the load according to the characteristics of this load as well as to the adjusted accelerations and decelerations.

Procedure to calculated the needed motor power:

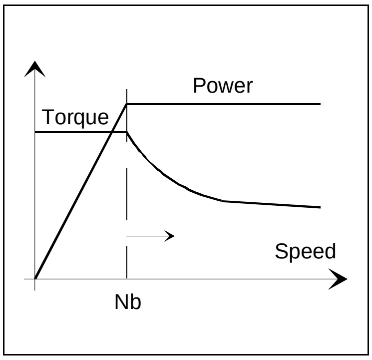
1. Depending on the characteristics of the load, determine the rated values of the needed power (in continuous cycle, instantly and periodically).
2. Increase the value of that needed power, considering the efficiency of the power transmission and load dispersion.
3. Select the drive that offers the current needed to govern the motor in all duty cycles for that machine.

Power demanded from a motor for a particular load.

To determine the needed motor power, use the following formula:

$$P_{MOTOR} > P_{LOAD} + P_{ACCEL/DECEL}$$

The power of the motor must be greater than the sum of the power required by the load and the power required by the machine's accelerations and decelerations.



Constant motor power	
Load type	Constant power, regardless of speed
Examples	Constant tension coils, Mill spindle Lathe spindle
Torque / speed characteristics	The torque decreases from base speed on
Motor power	Rated drive power will be the one demanded by the load

fig. 2 Constant motor power demanded by a load.

Power required by the load.

The power demanded from a spindle motor in a turning or machining center is determined by the cutting power.

A good cutting process required the spindle motor to be working at constant power and with a power range between 1:3 and 1:5.

The power values used for a cutting operation on a lathe, mill or machining center with a drill are calculated using the following formulas.

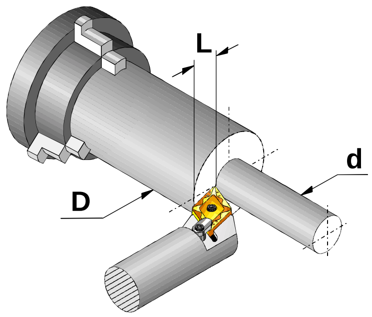
For a more accurate calculation of the power required, one must bear in mind different factors such as cutting oil, material, shape of the tools, hardness of the material machined,...

For lathe work, a cutting blade forces against the part to be machined, while this turns as shown in the fig.3.

The power required, P_c is calculated as follows:

$$Pc = \frac{K_S\, d\, L\, V}{60 \bullet 1000 \bullet \cdot_C} = \frac{d\, L\, V}{S_C \cdot_C} \ (kW)$$

$$V = \frac{\pi \bullet D N_S}{1000} \quad (m/(min))$$



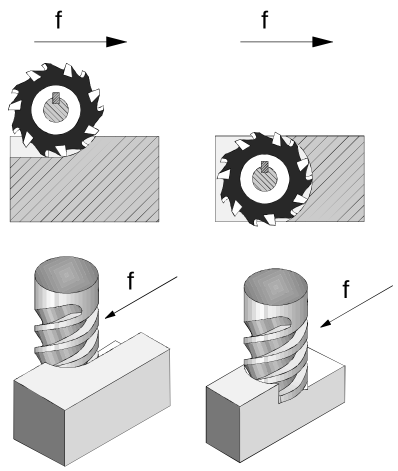
K_S : is the relative cutting resistance in [N/mm^2]
d : is the depth of the cut in [mm]
L : is the length of the blade, or feedrate per full turn in [mm]
D : is the diameter of the part machined in [mm]
N_S : is the turning speed of the spindle in [rpm]
$\cdot_c$: in the mechanical efficiency [varies from 0.7 to 0.85]
S_c : is the cutting efficiency, that is, cut volume per kilowatt each minute in [cm^3/kW] / min

fig. 3 Cutting power for turning operations

In the case of a milling machine, the cutter is mounted on the spindle itself and turns with this to cut the material. See fig. 4.

The power required in this case P_f is calculated as follows:

$$Pf = \frac{K_S\, d\, W\, f}{60 \bullet 1000^2 \bullet \cdot_f} = \frac{d\, W\, f}{1000^2 \bullet S_f \cdot_f} \ (kW)$$



K_S : is the relative cutting resistance in [N/mm^2]
d : in the depth of the cut in [mm]
W : is the width of the cut in [mm]
f : is the feedrate in [mm/min]
$\cdot_f$: is the mechanical efficiency [varies from 0.7 to 0.8]
S_f : is the cutting efficiency, that is, cut volume per kilowatt each minute in [cm^3/kW] / min

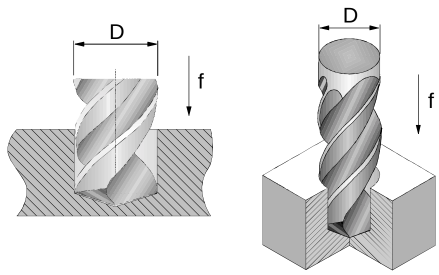
fig. 4 Cutting power for milling operations

In the case of a drill, the bit is mounted on the spindle itself and turns with this to drill the material.

See fig. 5.

Te power required in this case P_d is calculated as below:

$$P_d = \frac{M \bullet 2\pi n}{60 \bullet 100 \bullet 1000 \bullet \cdot_d} = \frac{\pi D^2 f}{4 \bullet 1000 \bullet S_d \cdot_d} \quad (kW)$$



M : is the drill load torque in [N· cm]

n : is the spindle turning speed in [rpm]

D : is the diameter of the hole in [mm]

f : is the feedrate in [mm/min]

· d : is the mechanical efficiency [varies from 0.7 to 0.85]

S_d : is the cutting efficiency, that is, cut volume per kilowatt each minute in [cm^3 / kW] / min

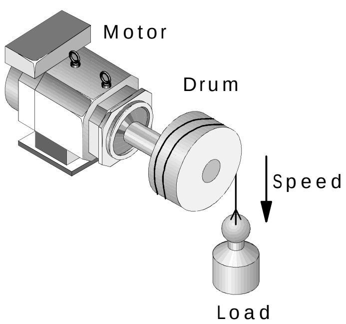
fig. 5 Required drilling power

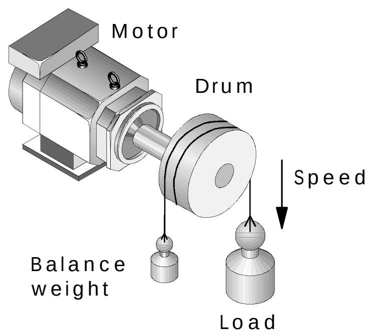
In the event of governing a **gravitational load**, the power required depends very much on the presence on absence of balance weights. (crane or elevator). See fig. 6.

The power required in this case, P_{GL} and P_{GLC} is calculated in the following way:

$$P_{GL} = \frac{m_L \bullet V}{6120 \bullet .} \quad (kW)$$

$$P_{GLC} = \frac{(m_L - m_C) \bullet V}{6120 \bullet .} \quad (kW)$$





V : is the linear speed in [m/min]

m_L : is the load mass in [kg]

. : is the mechanical efficiency

m_C : is the balance weight mass in [kg]

fig. 6 Power required with gravitational load

Governing a **frictional load**. This is the case of horizontal movements such as a conveyor belt or a movable table. For a friction coefficient ∝ , the power required in this case P_F , is calculated as follows. See fig.7.

$$P_F = \frac{\propto \bullet m_L \bullet V}{6120 \bullet .} \quad (kW)$$

∝ : is the friction coefficient
m_L : is the load mass in [kg]
. : is the mechanical efficiency
V : is the linear speed in [m/min]

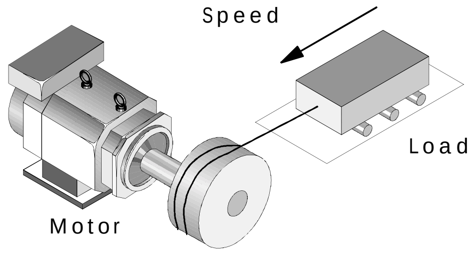
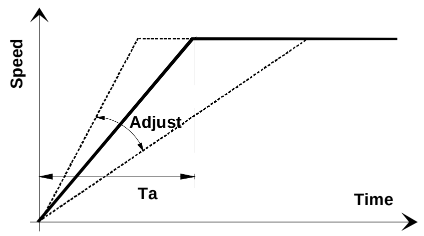


fig. 7 Power required with frictional load

Power needed for the acc/dec of the spindle motor.

There are three methods to control the acceleration and deceleration process of the machine spindle:

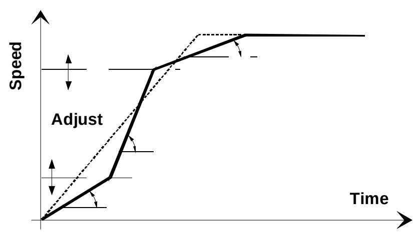
- Acceleration limited by time.



Method	Acceleration limited by time.
Control	Speed increases linearly in time until the command speed is reached.
Comments	The acceleration torque is constant.

fig. 8 Acceleration limited by time

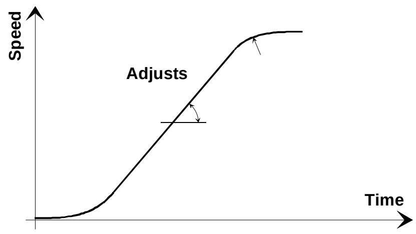
- Different acceleration ramps depending on the speed reached.



Method	Different accelerations depending on speed.
Control	Linear acceleration avoiding abrupt variations in transmitted torque.
Comments	Emulation of the square sine function for speed by using ramps.

fig. 9 Different accelerations depending on speed

- Limited acceleration and choke. Choke = variation of acceleration.



Method	Acceleration and choke limit.
Control	Progressive acceleration, avoiding abrupt variations of transmitted torque.
Comments	Approach square sine function (bell shape) for the speed.

fig. 10 Choke and acceleration limit

The capability demanded from the motor is determined by the following formulas:

Capacity required by the motor in the constant torque area ($0 < N_M < N_B$):

$$P_N = \left(\frac{2\pi}{60}\right)^2 \bullet \frac{J_M \bullet N_M^2}{1000 \bullet t} \quad (kW)$$

Capacity required by the motor in the constant torque and constant power area ($0 < N_M < N_{max}$):

$$P_N = \left(\frac{2\pi}{60}\right)^2 \bullet \frac{J_M \bullet (N_M^2 + N_B^2)}{2000 \bullet t} \quad (kW)$$

J_M : is the inertia of the load in [kg· m²] as viewed from the motor shaft

P_N : is the rated power at the base speed in [kW]

Nmax : is the maximum motor speed in [rpm]

N_B : is the base motor speed in [rpm]

N_M : is the motor speed in [rpm] reached after a time period t

t : is the acceleration time in seconds until the N_M [s] is reached

We will now give several examples of calculations using a mechanical specifications and for a standard motor. The results could vary from real ones through mechanical losses, fluctuations in mains voltage, or inaccuracies of mechanical data.

Example:

Data:

Acceleration time:

From 0 to 1500 rpm. in 0.5 s. [1]

From 0 to 6000 rpm in 2.5 s. [2]

Motor inertia: $J_{motor} = 0.13\ kg{\cdot}m^2$

Motor base speed: $N_B = 1500$ rpm

Calculations:

1. When the speed ranges from 0 to 1500 rpm

$$P_N = \left[\frac{2\pi}{60}\right]^2 \bullet \frac{J_M \bullet N_M^2}{1000t}\ [kW] = \left[\frac{2\pi}{60}\right]^2 \bullet \frac{0.13 \bullet 1500^2}{1000 \bullet 0.5} = 6.41\ [kW] \qquad [1]$$

2. When the speed ranges from 0 to 6000 rpm

$$P_N = \left[\frac{2\pi}{60}\right]^2 \bullet \frac{J_M[N_M^2 + N_B^2]}{2000t}\ [kW] = \left[\frac{2\pi}{60}\right]^2 \bullet \frac{0.13[6000^2 + 1500^2]}{2000 \bullet 2.5} = 10.89\ [kW] \quad [2]$$

Calculation of acceleration and braking time.

After selecting the mechanical characteristics and the power of the drive, the acceleration and braking time is calculated as follows:

Constant torque area:

$(0 < N_M < N_B)$:

$$t_1 = \frac{2\pi \bullet J_M \bullet N_M}{60 \bullet T_M} \quad (s)$$

Constant power area:

$(N_B < N_M < N_{max})$:

$$t_2 = \frac{2\pi \bullet J_M \bullet (N_M^2 - N_B^2)}{120 \bullet T_M \bullet N_B} \quad (s)$$

Constant torque and constant power area:

$(N_B < N_M < N_{max})$:

$$t_3 = (t_1 + t_2) = \frac{2\pi \bullet J_M \bullet (N_M^2 + N_B^2)}{120 \bullet T_M \bullet N_B} \quad (s)$$

J_M : is the inertia of the load in $[kg \cdot m^2]$ as viewed from the motor shaft

T_M : is the rated torque in [kW] at the base speed

$N_{máx}$: is the maximum motor speed in [rpm]

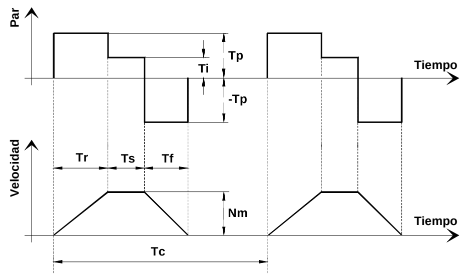
N_B : is the base motor speed in [rpm]

N_M : is the motor speed in [rpm] after the acceleration time

Calculation of power with intermittent load.

Forming the drive to the right dimensions has to be done with the greatest care when the application involves a periodical starting and stopping operation, frequently repeated as in the case of threading with a miller.

For a cycle like the one shown in the fig.11 which includes acceleration and stopping, the equivalent effective torque T_R of equation must be within the S1 dimension given for the drive torque. The maximum T_P value is 120% of dimension S2 30 minutes of the motor.



$$T_R = \sqrt{\frac{T_P^2 \bullet (t_r + t_f) + T_L^2 \bullet t_s}{t_c}} \quad (Nm)$$

fig. 11 Periodic start-stop operation

Drive selection.

If an SPM motor has been selected, check the characteristics graphs in the manual for the AC spindle motor SPM. These graphs indicate the power that the drives may obtain from this motor.

If an FM7 motor has been selected, check the manual for the AC spindle motor FM7. Its chapter 6: Selection indicates the drive associated with the selected motor.

Power supply selection

Calculate the power demanded to the power supply for servo systems with a synchronous motor [axis].

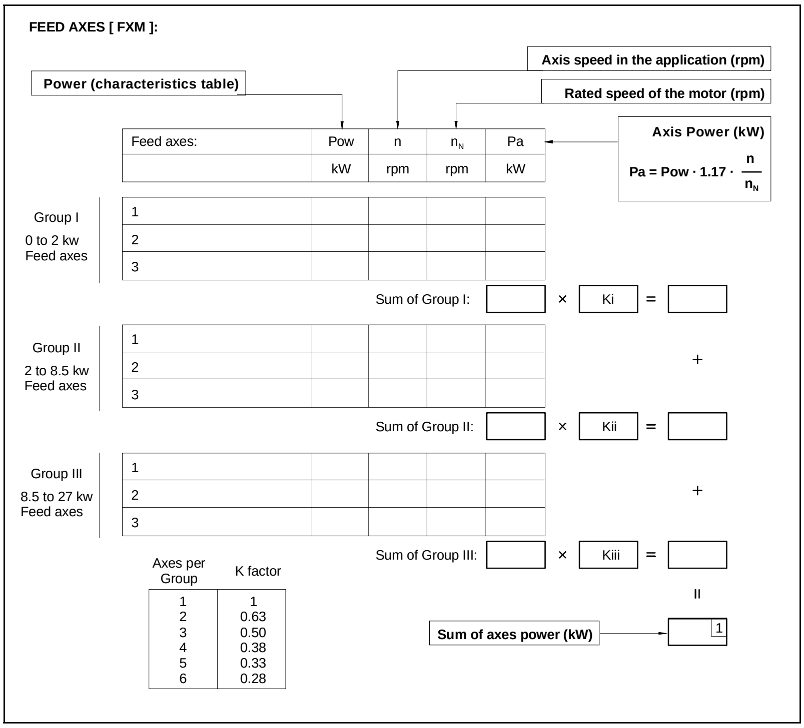


fig. 12 Power supply selection depending on the power output of the motor

where:

p_{ow} motor power [kW], according to the characteristics tables of the FXM.

1.17 coefficient combining the performance of the motor [0.9] and that of the drive [0.95].

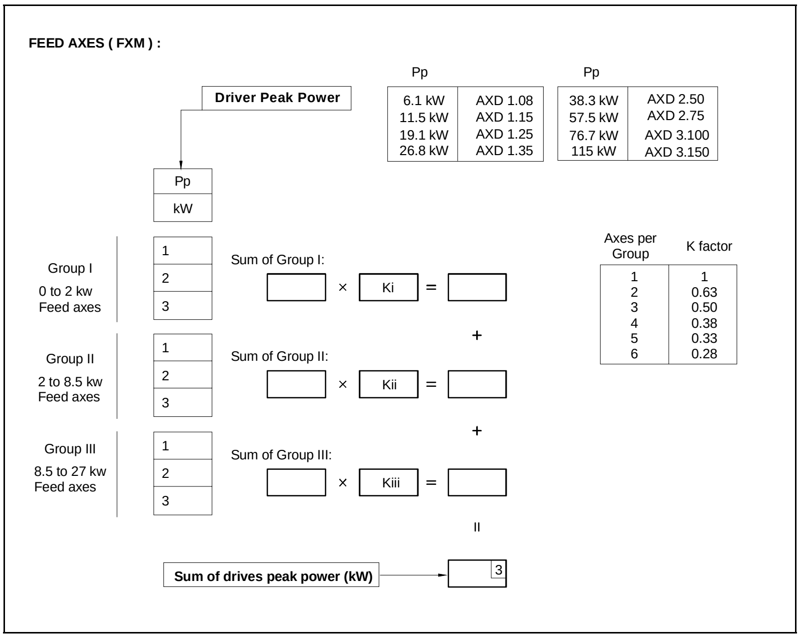
n maximum work speed of the motor in that application [rpm]

n_N nominal motor speed [rpm].

The set of drives and motors has been divided into groups according to their power and a simultaneity factor has been applied to each group.

Ki, **Kii** and **Kiii** are the simultaneity factors applicable to each power group.

Then, depending on the peak power that could be requested by the drives at any time:



Pp	
6.1 kW	AXD 1.08
11.5 kW	AXD 1.15
19.1 kW	AXD 1.25
26.8 kW	AXD 1.35

Pp	
38.3 kW	AXD 2.50
57.5 kW	AXD 2.75
76.7 kW	AXD 3.100
115 kW	AXD 3.150

Axes per Group	K factor
1	1
2	0.63
3	0.50
4	0.38
5	0.33
6	0.28

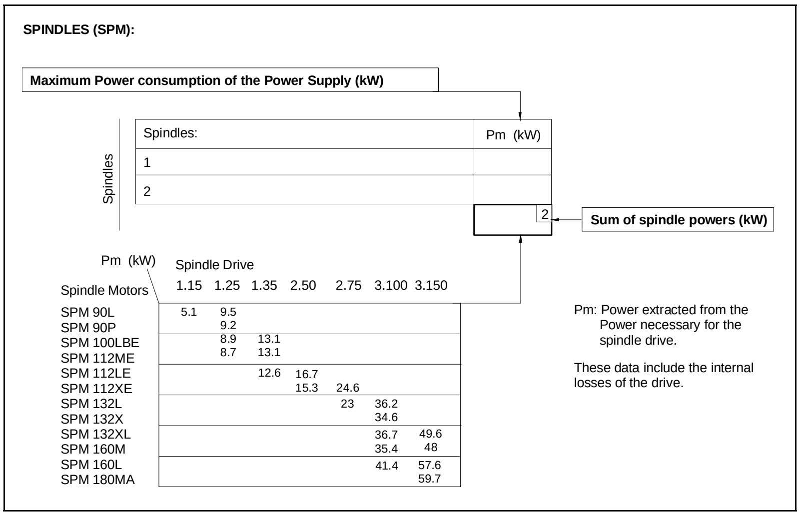
fig. 13 Power supply selection depending on the peak power provided by the drive

where:

p_p peak power requested by the drive [kW].

Calculate the power required from the power supply by the asynchronous motors.

1. Spindle motor SPM



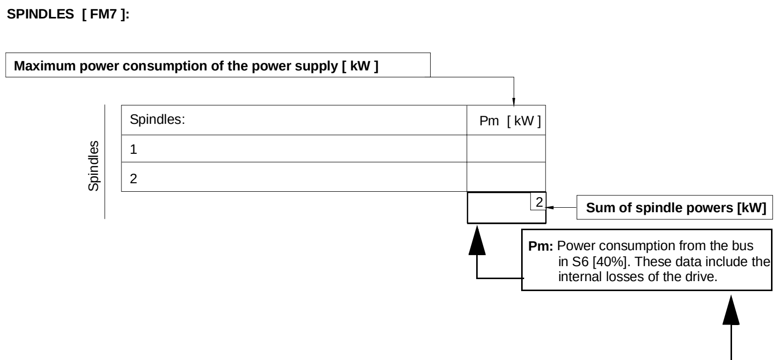
Spindle Motors \ Pm (kW) Spindle Drive	1.15	1.25	1.35	2.50	2.75	3.100	3.150
SPM 90L	5.1	9.5					
SPM 90P		9.2					
SPM 100LBE		8.9	13.1				
SPM 112ME		8.7	13.1				
SPM 112LE			12.6	16.7			
SPM 112XE				15.3	24.6		
SPM 132L					23	36.2	
SPM 132X						34.6	
SPM 132XL						36.7	49.6
SPM 160M						35.4	48
SPM 160L						41.4	57.6
SPM 180MA							59.7

fig. 14 Select the power supply according to the power required by asynchronous motors SPM

where:

p_m maximum power that the drive may demand from the power supply in each motor-drive combination. It includes the power dissipated by the drive itself.

2. Spindle motor FM7



Spindle Motors	power [kw] S1	power [kw] S6 [40%]	efficiency [%] S1	efficiency [%] S6 [40%]	driver power [kw]	spindle driver	driver eff. [%]	Pm [kw]
FM7 - A037	3.7	5.5	83.5	83.0	6.6	SPD 1.25	90	7.7
FM7 - A055	5.5	7.7	86.0	84.5	9.1	SPD 1.25	90	10.1
FM7 - A075	7.5	11	86.5	84.6	13.0	SPD 1.35	90	14.4
FM7 - A090	9	13	87.3	85.7	15.2	SPD 2.50	90	15.2
FM7 - A110	11	15.5	90.2	89.2	17.4	SPD 2.50	90	17.4
FM7 - A 150	15	22	90.4	89.3	24.6	SPD 2.75	90	24.6
FM7 - B120	12	18.5	91.0	90.4	20.5	SPD 2.75	90	20.5
FM7 - A185	18.5	26	91.8	91.5	28.4	SPD 2.85	90	28.4
FM7 - A220	22	33	89.2	88.1	37.5	SPD 3.100	90	37.5
FM7 - B170	17	25	89.1	87.7	28.5	SPD 2.85	90	28.5
FM7 - A300	30	45	92.1	91.6	49.1	SPD 3.150	90	49.1
FM7 - A370	37	56	92.5	91.7	61.1	SPD 3.200	90	61.1
FM7 - B220	22	33	91.3	90.5	36.5	SPD 3.100	90	36.5
FM7 - B280	28	42	91.1	90.0	46.7	SPD 3.150	90	46.7
FM7 - A510	51	71	92.8	92.2	77.0	SPD 3.200	90	77.0
FM7 - C215	21.5	29	85.4	82.7	35.1	SPD 3.150	90	35.1
FM7 - C270	27	37	86.6	83.9	44.1	SPD 3.200	90	44.1

fig. 15 Select the power supply according to the power required by asynchronous motors FM7

Where:

p_m : maximum power that the drive system can demand from the power supply in each motor-drive combination. It includes the power dissipated by the drive itself.

3. Non-Fagor spindle motor

For non-Fagor spindle motors (e.g.: an high speed spindle) the previous tables for standard Fagor motors are not available.

To properly calculate the power demanded by the non-Fagor spindle from the power supply, it is necessary:

- To know the maximum power to be provided at the drive. Use the power in S1 or S6, never use the PEAK value.
- Obtain the power at the motor terminals by dividing the previous value by the efficiency of the motor.

  If the value of the motor efficiency (eff) is unknown, apply the following rule:

  for:

  P < 22kW eff_{motor} = 85% (. = 0.85)

  P > 22kW eff_{motor} = 90% (. = 0.90)

- Divide by the efficiency of the drive.

  eff_{drive} = 90% (. = 0.90)

Selection criteria.

1. The power supply module must be capable of supplying the power required by the set of motors and drives connected to it.

First Criterion.

The "Power Supply" module must be capable of supplying the power required by all the Drive + Motor combinations connected to it.

Power Supply needed: (1 + 2) = [ ] **(kW)** →

Rated Power (S1)	Power Supply Module
kW	Reference
< 25	**PS-25x, XPS-25**
< 65	**PS-65 A, XPS-65**
> 65	**(*)**

(*) Until reaching the needed power from the Power Supply
Very important: When using two Power supplies on the same machine, they have to form two separate groups with their respective drives. Only the Sercos ring, if there is one, may be common to both groups.

fig. 16 First selection criteria

[*] If the power required by the set is greater than 65 kw, the set of motors and drives must be divided into groups and powered by different power supplies. **Never connect the power supplies in parallel.**

2. The power supply module must be capable of supplying the peak power required by the set of motors and drives connected to it.

Second Criterion.

The "Power Supply" module must be capable of supplying the peak power required by all the Drive + Motor combinations connected to it.

Peak Power Supply needed: (3 + 2) = [ ] **(kW)** →

Peak Power	Power Supply Module
kW	Reference
< 75	**PS-25A, PS-25B3, PS-25B4**
< 195	**PS-65A**
> 195	**(*)**

Regenerative →

kW	Reference
< 55	**XPS-25**
< 108	**XPS-65**
> 108	**(*)**

(*) Until reaching the needed peak power from the Power Supply
Very important: When using two Power supplies on the same machine, they have to form two separate groups with their respective drives. Only the Sercos ring, if there is one, may be common to both groups.

fig. 17 Second selection criteria

(*) If the peak power required by the set is greater than 108 kW , the set of motors and drives must be divided into groups and powered by different power supplies. **Never connect the power supplies in parallel.**

3. The table below shows the range of the Fagor power supplies that may be selected.

It shows their rated (nominal) power, the mains voltage and whether the power supply has a built - in 24 Vdc power supply or not.

FAGOR POWER SUPPLY RANGE:

	Model	Output power	Input voltage	Built-in 24 Vdc power supply
Non Regenerative	**PS-25**	**25 kw**	**400**	**No**
	PS-25A		**400-460**	**No**
	PS-25B3		**400**	**Yes**
	PS-25B4		**400-460**	**Yes**
	PS-65	**65 kw**	**400**	**No**
	PS-65A		**400-460**	**No**
Regenerative	**XPS-25**	**25 kw**	**400-460**	**Yes**
	XPS-65	**65 kw**	**400-460**	**Yes**

fig. 18 Fagor power supplies

4. Use the following sheet to calculate the input transformer, and the section of the mains cable.

Mains voltage

The Fagor Servo Drive system requires **400 - 460 Vac.**

Transformer:

The transformer or autotransformer being used must be of the power:

([1] + [2]) x 1.05 [kVA] = [4] [kVA]

Very important: when using an isolation transformer, the secondary must be of the star type its mid point being accessible so it can be connected to ground.
This mean that the output voltage of the autotransformer / transformer is maintained for the specified apparent power.

Power cables for mains connection

Vmains = From **400** to **460 Vac.**

Rated current through the mains cable:

Power Supply

$[4]\ [kW] \times \frac{1000}{Vmains\ \sqrt{3}} = \square\ [Amp] \rightarrow$

Axis Compact Module [ACD]:

FXM Motor Rated Current = ☐ [Amp] →

Spindle Compact Module [SCD]:

Maximum SPM Motor Current
Maximum FM7 Motor Current = ☐ [Amp] →

	Power Cable
Amp	Reference
< 12.2	**MPC-4x1.5**
< 16.5	**MPC-4x2.5**
< 23	**MPC-4x4**
< 29	**MPC-4x6**
< 40	**MPC-4x10**
< 53	**MPC-4x16**
< 67	**25** [MPC -4x25 + [2x1]]
< 83	**35 mm²** [MPC-4x35 + [2x1]]

The length of these power cables must be specifically ordered [in meters].

fig.19 Power of the input transformer.
Selection of the mains connection cable.

Very important: When using an isolating transformer, the secondary must have a star connection and its mid point must be accessible so it can be connected to ground. This means that the output voltage of the transformer/autotransformer is maintained for the indicated apparent power. **Note that** if the system has an **XPS power supply**, the rated power Pm of cell (2) of the previous expression corresponds to the sum of the Pm's of all the spindles of the system, whose value is the result of applying the expression **Pm = 570 · IS6** for each of them and then adding them all. **If it is a PS power supply**, cell (2) will register the value obtained from the figure 14 or figure 15 accordingly.

CM 1. 60 selection guide

The CM 1.60 is a module that increases the electrical capacitance of the power bus in 4 mF. It should be installed on machines with very short duty cycles (very repetitive accelerations and deceleration) and with low braking energy. Punch presses are a typical example of this.

The following table indicates how much energy can be stored in [watts seg] when the bus voltage increases from the nominal value (Vbus) to the Ballast circuit activating value (V ballast on).

Considering the different combinations of power supplies + CM1.60 modules and different mains voltage.

$$W = \frac{1}{2} \bullet C \left[Vballast_{ON}^{2} - V_{BUS}^{2} \right] \; [kW]$$

where:

C comes in (F).

V in (V_{DC})

W in (W·s → J).

Vmains	400 Vac	460 Vac
PS-25x	65	59
PS-65A	69	63
XPS-25	34	96
XPS-65	61	172
CM 1.60 + PS-25x	435	394
CM 1.60 + PS-65A	439	397
CM 1.60 + XPS-25	149	421
CM 1.60 + XPS-65	176	498

[Ws]

table 1 Extra energy that can be stored

Ballast resistor selection guide

Calculate the value of:

Wm is the energy generated by the braking of each system motor.

Pe is the rms power generated by all braking of all the motors throughout a complete duty cycle.

Based on the following formulae:

$$W_m = W_p + \frac{1}{2} \bullet J_t \left[\frac{2\pi \bullet n}{60}\right]^2 \quad [\,Ws\,]$$

$$W_p = m \bullet g \bullet . h$$

$$P_e = \sqrt{\frac{\sum_i \frac{W_{mi}^2}{t_i}}{T}} \quad [\,w\,]$$

where:

J_t is the total inertia of the servo drive system (motor+ mechanics) ($kg \cdot m^2$)

n is the turning speed of the motor when the braking starts (rpm).

W_{mi} is the energy of each braking during a cycle of time T [Ws].

W_p is the potential energy **lost** by the mass of the machine for as long as the braking lasts. Only on axes not compensated (Ws).

t_i is the braking time where the W_{mi} energy is generated (s).

T is the time of full cycle (s).

. **h** is the height **lost** when braking (m).

W_{mx} will be the maximum of all the W_m.

Once the values of W_{mx} and P_e are calculated, follow these flow charts:

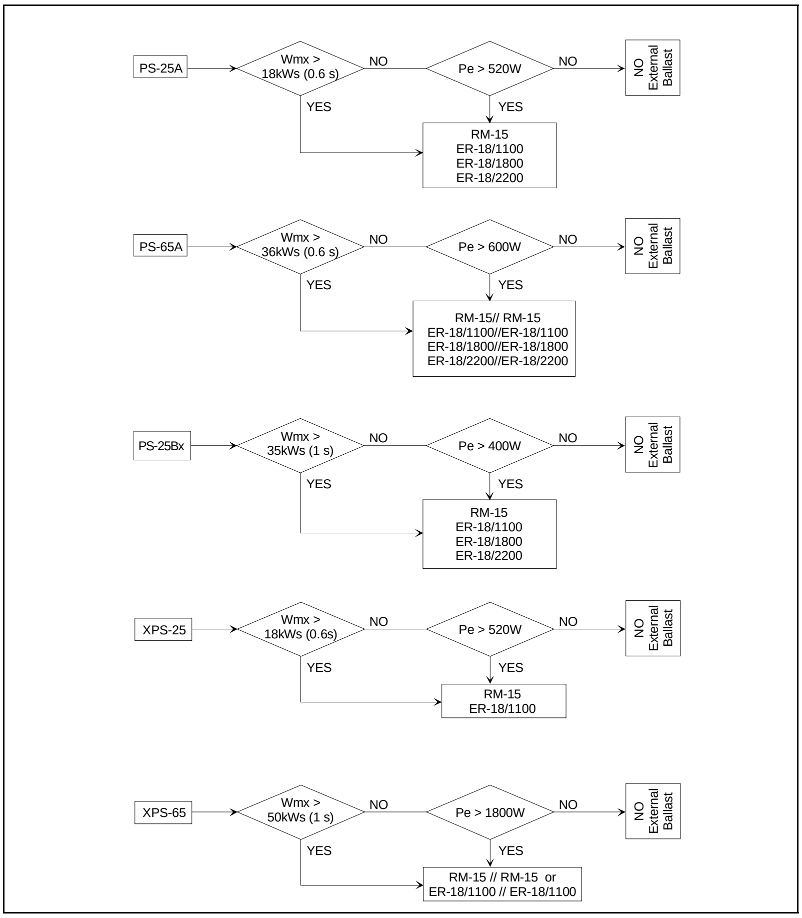


fig. 20 Power supplies for modular drives

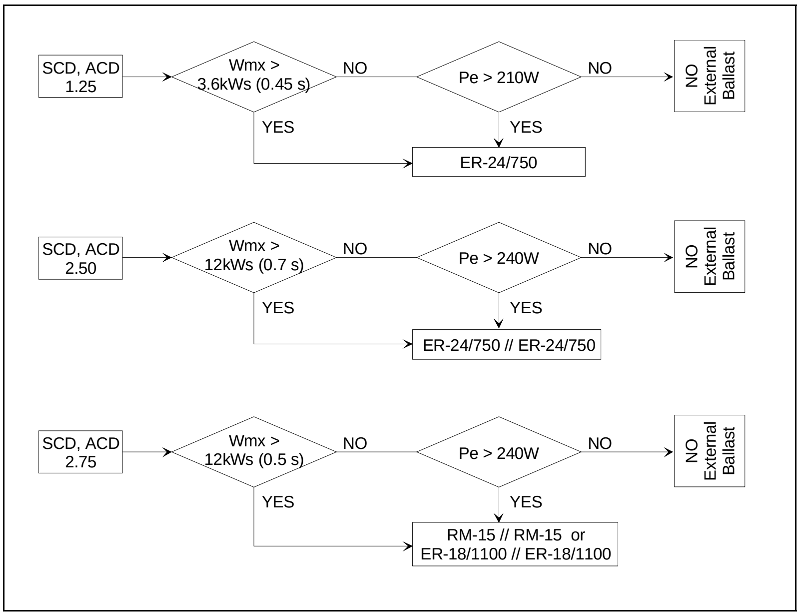


fig. 21 Power supplies for compact drives

User notes:

PARAMETERS, VARIABLES & COMMANDS

A

Notations

Notations used.

[Group] [Type] [Index] [.Set] where:

Group: Identifying character of the logic group to which the parameter or variable belongs.

There are the following groups of parameters:

GROUPS OF PARAMETERS, VARIABLES & 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	System's mechanics	Mechanic	N
14	Analog and digital outputs	Outputs	O
15	Position loop	Position	P
16	System communication	Sercos Communic.®	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

table 1 Groups of parameters, variables and commands

Type: Character identifying de type of data which the information corresponds to.

May be:

Parameter: It defines the operation of the system: (P).

Variable: can be read and it is modified dynamically: (V).

Command: It carries out a specific action: (C).

The difference between parameter and variable is that the parameter has a programmable initial value and, except on exceptions, a change in its value will be effective only after saving the parameters and resetting the drive.

Index: Character identifying the parameter or the variable within the group to which this belongs.

Set: Many of the parameters are subdivided into **sets**. Each set is a group of parameters that can configure the system differently. The "sets" only apply to parameters, not to variables.

See section: set of parameters and gear ratios of chapter 6.

Definition examples:

SP10.4:	S group	(P) Parameter	(Nº 10) Set 4
CV21:	C group	(V) Variable	(Nº 21)
GC1:	G group	(C) Command	(Nº 1)

Parameter identification:

The following characteristics are described after the name:

Parameter set	**#**	Parameter extended in sets
Immediate effect	*****	Parameter that may be modified on line
Modifiable variable	**W**	Modifiable variable (from any level)
Access level	**F**	Fagor
	O	OEM
		User
Sign	**s**	Signed
Related to the motor	**M**	Value determined by MotorType (MP1)
Motor type	**S**	Synchronous only
	A	Asynchronous only

Note that the WinDDSSetup application may be used to display the value of any parameter or variable regardless of the available access level !

Any parameter may be modified when having the relevant access level. Its access level is given by the label F (Fagor), O (OEM) or blank (basic), next to the parameter name !

Any variable may be modified when having the relevant access level. Its access level to be modified is given by the label F (Fagor), O (OEM) or W (basic), next to the variable name !

Note that a variable may be modified from the basic level if it is labeled with a W. If the access level is more restrictive (OEM or Fagor), it must be labeled with either an <O> or <F>, respectively in order to be able to modify it.

The name between brackets corresponds to the Sercos® interface itself.

Those starting with **S** belong to the standard Sercos® and those starting with **F** to Fagor. The Sercos® standard number for the Fagor parameters is obtained by adding 32768 to its numeric index, for example:

The F24 is referred to in Sercos® as S [24+32768]; i.e.: S 32792

The Sercos® numbers for the parameters extended in sets are obtained by adding 4096 to each set, e.g. the SP1:

The Sercos® number for SP1.0 is S 100, for SP1.1 is S4196, for SP1.2 is S 8292, ...

The Fagor parameters extended in sets are affected by both considerations.

Examples:

MP4 FMS [S109] MotorPeakCurrent

It means that it is a parameter of the **motor** group, that cannot be extended in sets, cannot be modified on line and it can only be modified from the Fagor access level, unsigned, defined by the Motor Id and that only applies to synchronous motors. It id number in the Sercos® interface is 109.

SV7 s [F1612] VelocityCommandFinal

It means that it is a variable (r**ead-only, does not have a W nor a label with higher access level <O> or <F>**) and it has a sign (s). Its Sercos® identifier is 1612+32768 = 34380.

Note that the physical units and ranges used for the parameters and variables in this appendix are the ones used by the WinDDSSetup for PC under Windows and also by the programming module.

A group: Application

AP1 O [S32] PrimaryOperationMode

Function: It sets the operating mode regarding the configuration of the system.

Bit	Name
Nr	**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

See chapters 3, 4 and 5 of this manual for further detail on these concepts.

Default value: 000011 binary (= 3 decimal), position command with motor feedback and feed-forward OFF.

AP5 O [F2001] 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).

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 is the same as setting a zero velocity command while keeping the rotor locked (with torque). It may be **activated** by an electrical signal at one of the digital inputs of the drive, by means of the WinDDSSetup 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 BVC3 = 0) or when requesting from the PLC of the CNC via Sercos® (bit 13 of DV32 is set to 0).

BV1 O [F201] 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 (with no effect).

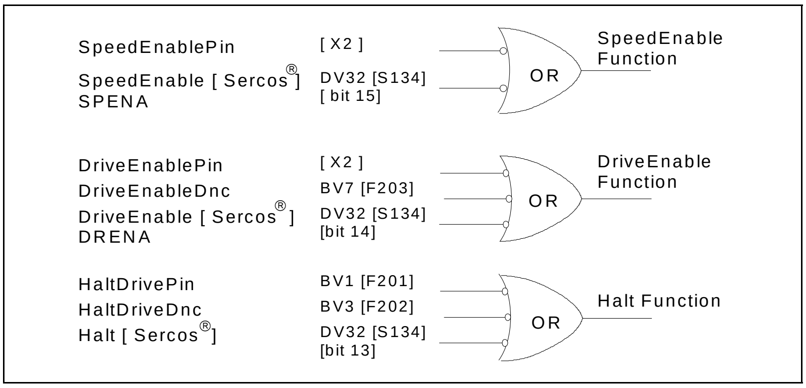
Example: IP11 = BV1 (digital input 2 carries out the Halt function; i.e. applying 0V at pin 2 with respect to pin 5, activates the Halt function and the motor stops).

BV3 O [F202] HaltDriveDnc

Function: It controls the Halt function through the serial line.

Default value: 1 (with no effect).

Example: BV3 = 0 (activates the Halt function).



Activating the DriveEnable function lets the current circulate through the motor.

It may be **deactivated** by an electrical signal at the control connector X2 of the drive, by means of the WinDDSSetup program through the serial line or through the Sercos® interface.

The DriveEnable function is deactivated (cancels motor torque) when applying zero volts at that electrical input when requested from the WinDDSSetup (variable BV7 = 0) or when requested from the PLC of the CNC via Sercos® (bit 14 of DV32 - DRENA variable at the PLC - is set to 0).

BV7 O [F203] DriveEnableDnc

Function: It controls the DriveEnable function through the serial line.

Default value: 1 (with no effect).

Example: BV7=0 (cancels the DriveEnable function, cancels motor torque).

BV14 [F204] NotProgrammableIOs

Function: Indicates the logic values of the **electrical control signals** of the drive.

24 V at the electrical input mean a logic 1 at the bits of this variable.

Bit	Name
Nr	**FUNCTION**
4 [MSB]	Lsc_Status (at the inter-modular bus X1)
3	Error_Reset
2	DR_OK (at the microprocessor, at the pins of X2)
1	Speed_Enable & Syst. Speed_Enable (drive and power supply)
0 [LSB]	Drive_Enable

Example: BV14 = 18 (10010 in binary).

This means that Lsc_Status and SpeedEnable & System are active. Speed_Enable.

C group: Current

CP1 *OM [S106] CurrentProportionalGain

Function: Value of the proportional gain of the current loop.

Valid values: 0 ... 327 (V/A).

CP2 *OM [S107] CurrentIntegralTime

Function: Value of the integral gain of the current loop.

Valid values: 0 ... 32 (ms).

CP3 *FMA [F300] CurrentFeedbackDerivativeGain

Function: Value of the derivative gain of the current loop.

Valid values: 0 ... 300 (µs).

CP4 *FMA [F301] CurrentAdaptationProportionalGain
CP5 *FMA [F302] CurrentAdaptationIntegralTime

Function: Adaptation of the value of the proportional /integral action of the current PI.

Valid values: 10% ... 1000%, i.e. the PI action at low speed may go from **1/10** up to **ten times** the action at high speed.

CP4·CP1/1000 must be smaller than the maximum value that CP1 can take.

CP5·CP2/1000 must be smaller than the maximum value that CP2 can take.

Default value: 50%
(constant proportional action at any speed).

100%
(constant integral action at any speed).

CP6 FMA [F303] CurrentAdaptationLowerLimit

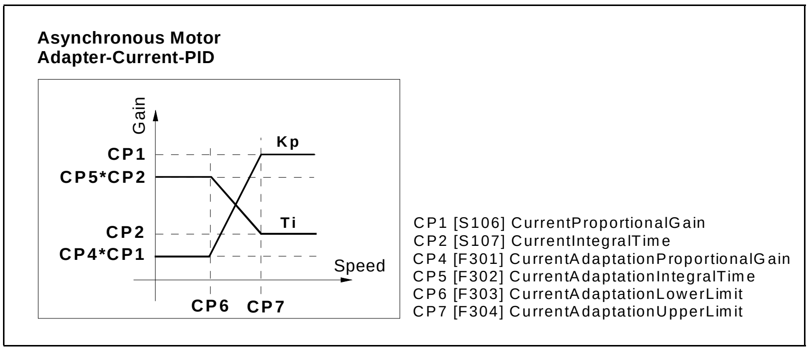
Function: It is the upper limit of the speeds considered **low** given in (rpm).

Valid values: It must be smaller thanCP7

CP7 FMA [F304] CurrentAdaptationUpperLimit

Function: It is the lower limit of the speeds considered **high** given in (rpm).

Valid values: It must be smaller thanSP10 and greater than CP6



CP8 F [F317] CurrentLoopGainsCalculation

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 v.06.01 on.
Expanded in version v.0607.

CP16 FA [F316] SeriesInductance

Function: This parameter only makes sense when using high speed spindles (very low leak inductance). In order to properly control the current loop, it may be necessary to insert a thre-phase inductance between the drive and motor in series with the one of the motor itself to increase the leak inductance. The minimum value of the motor's leak inductance must be 100 µH. The value of CP16 will be Lseries.
To calculate this value, see section: Calculation of the serial inductance.

Valid values: 0 ... 10000 (mH).

Default value: 0.

Version: Operative from version 06.01 on.

CP20.# O [F307.#] CurrentLimit

Function: Limit of the current command that reaches the system's current loop. See internal configuration diagram. This value is forced by the user.

Valid values: 0...300 (Arms)
it depends on the drive being connected.

Default value: On servo drive systems with an FXM motor, parameter CP20 takes the lowest value of the ones given by the motor and drive peak currents.

If the motor is an SPM or an FM7, it takes the value of the drive's maximum current. In applications requiring a lot of power (threading), the value of CP20 may be up to 15% higher than the maximum current of the drive.

CP30.# *O [F308.#] CurrentCommandFiltersType

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.

Thus, considering bits 4, 5, 6 and 7 of this parameter:

Bit	Name
Nr	**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.

Remember that the Least Significant Bit is bit 0 !

To know all the possible configurations, see section: Parameter setting of the current command filters in chapter 3.

Valid values: 0 ... 240.

Default value: 0.

Version: Modified in version 06.01

CP31.# *O [F312.#] CurrentCommandFilter1Frequency

Function: Break frequency of current command filter 1.

Valid values: 0 ... 4000 (Hz)

Default value: 0.

CP32.# *O [F313.#] CurrentCommandFilter1Damping

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 ... 8000 (non-dimensional)

Default value: 1000.

CP33.# *O [F314.#] CurrentCommandFilter2Frequency

Function: Break frequency of current command filter 2.

Valid values: 0 ... 4000 (Hz)

Default value: 0.

Version: Operative from version 06.01 on.

CP34.# *O [F315.#] CurrentCommandFilter2Damping

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 ... 8000 (non-dimensional).

Default value: 1000.

Version: Operative from version 06.01 on.

CV1 s [F309] CurrentUFeedback
CV2 s [F310] CurrentVFeedback

Function: Display the value of the feedback of the current going through phases U / V.

Valid values: -200 ... 200 A (instant values).

CV3 [F311] CurrentFeedback

Function: Display the rms current circulating through the motor.

Valid values: 0 ... 200 (Arms: rms value).

CV10 Fs [F305] CurrentUOffset
CV11 Fs [F306] CurrentVOffset

Function: Compensation of the current feedback offset of phase U / V.

Valid values: -5000 ... 5000
(depends on the drive connected).

Default value: 0. This values is factory measured and set.

DP142 O [S142] ApplicationType

Function: Informative parameter. It contains the type of application the drive is dedicated to (e.g.: spindle or rotary axis).

DV1 [S11] 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.

Bit	Name	Error
15 [MSB]	ManufacturerSpecificError	Rest.
14	Class1Reversed	
13	TravelLimit	
12	ComunicationError	400 → 499
11	ExcessiveFollowingError	156
10	PowerSupplyPhaseError	
9	UnderVoltageError	307
8	OverVoltageError	304, 306
7	OverCurrentError	212
6	ErrorInElectronicCommutationSystem	213 → 214
5	FeedbackError	600 → 699
4	ControlVoltageError	100 →105
3	CoolingErrorShutdown	106
2	MotorOvertempShutdown	108
1	AmplifierOvertempShutdown	107
0 [LSB]	OverloadShutdown	201, 202, 203

Bit = 0 ---> no error
Bit = 1 ---> error

Example: DV1=32804 which is equal to 1000000000 100100 in binary. Therefore, there is one FeedbackError, one MotorOvertemp Shutdown and one ManufacturerSpecific Error.

DV9 [S12] 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).

Bit	Name	Warning
15, 14	Reserved	
13	TargetPositionOutsideTheTravelZone	(warning 13)
12, 11, 10	Reserved	
9, 8	Reserved	
3	CoolingErrorShutdown	(warning 3)
2	MotorOvertempShutdown	(warning 2)
1	AmplifierOvertempShutdown	(warning 1)
0 [LSB]	OverloadShutdown	(warning 0)
Bit a 0	No warning	
Bit a 1	Warning	

Example: DV9 = 8 which is equal to 0000000000001000 in binary. Therefore, there is a CoolingError Shutdown warning.

DV10 [S13] 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).

Bit	Mark	Meaning
15, 14, 13, 12	Reserved	
11, 10, 9, 8	Reserved	
7	TV60 [S337]	$\lvert TV50 \rvert > TP2$
6	PV136	$\lvert PV189 \rvert > PP57$
5	Reserved	
4	Reserved	
3	TV10 [S333]	$\lvert TV2 \rvert > TP1$
2	SV3 [S332]	$\lvert SV2 \rvert < SP40$
1	SV5 [S331]	$\lvert SV2 \rvert < SP42$
0 [LSB]	SV4 [S330]	SV2 = SV1

Example: DV10 = 14 which is equal to 0000000000001 110 in binary. Therefore SV5, SV3 and TV10 have been activated.

DV11 **[F404]** **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).

Bit	Variable	Meaning
15, 14, 13	Reserved	
12	TV60 [S337]	PGreaterPx
11	TV10 [S333]	TGreaterTx
10	SV3 [S332]	NFeedbackMinorNx
9	SV5 [S331]	NFeedbackEqual0
8	SV4 [S330]	NFeedbackEqualNCommand
7, 6, 5, 4	GV21 [S254]	ParameterSetActual
3, 2, 1, 0	GV25 [S255]	GearRatioActual

Example: DV11 = 1280 which is equal to 0000010100 000000 in binary. Therefore, it is working with set 0, set 0 follows the command properly, it is not stopped, it is below the thresholds N_x, T_x y P_x.

DV14 **[F405]** **ErrorsInDncFormat**

Function: It permits reading all the errors active at the time. See appendix B on errors.

DV31 [S135] 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. Bit (from the most to the least significant). This variable is communicated to the via the Sercos® interface. Bits 15 and 14 are assigned to PLC variables DRSTAF and DRSTAS respectively.

Bit	Meaning	Possible values	
15, 14	PowerAndTorqueStatus	Bits [15, 14]	Meaning
		[0, 0]	DoingInternalTest
		[0, 1]	ReadyForPower
		[1, 0]	PowerOn
		[1, 1]	TorqueOn
	Indicate at which point of the start-up sequence the drive is.		
13	error		
12	WarningChangeBit		
11	OperationStatusChangeBit.		
9, 8	ActualOperationMode	Bits [9, 8]	Meaning
		[0, 0]	InPrimaryMode
		[0, 1]	InSecondary1Mode
		[1, 0]	InSecondary2Mode
		[1, 1]	InSecondary3Mode
7	Real Time StatusBit1		
6	Real Time StatusBit0		
5	ChangeBitCommands		
4, 3, 2, 1, 0	Reserved		

Example: DV31 = 11479 which is the same as 0010110011010 110 in binary and means that it is running an internal test (DoingInternal Tests), has an error, ...

DV32 **[S134] 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 the 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.

Bit	Name
15	SpeedEnable [SPENA]
14	DriveEnable [DRENA]
13	Halt
12, 11, 10	Reserved
9, 8, 7, 6, 5	Reserved
4, 3, 2, 1, 0	Reserved

Example: DV32 = 1110000000000000 in binary. The CNC enables the drive so the motor turns according to the velocity command.

DV95 **[S95] DiagnosticMessage**

Function: Not operational yet

DC1 **[S99] ResetClass1Diagnostics**

Function: Reset of the errors shown on the display. Available on the command menu of the programming module DDS PROG MODULE as ResetClass1Diagnostics.

E group: Encoder simulator

EP1 O [F500] EncoderSimulatorPulsesPerTurn

Function: Number of pulses generated by the encoder simulator per rotor revolution.

Valid values: 1 ... 16360 pulses per turn (integer number).

Default value: 1250 pulses per turn.

Note that when using square motor feedback (TTL), EP1 must be equal to NP116; otherwise, it will issue error 502 !

EP2 O [F501] 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 WinDDSSetup.

Valid values: 1 ... EP1 (integer number).

Default value: 1

EP3 O [F502] EncoderSimulatorDirection

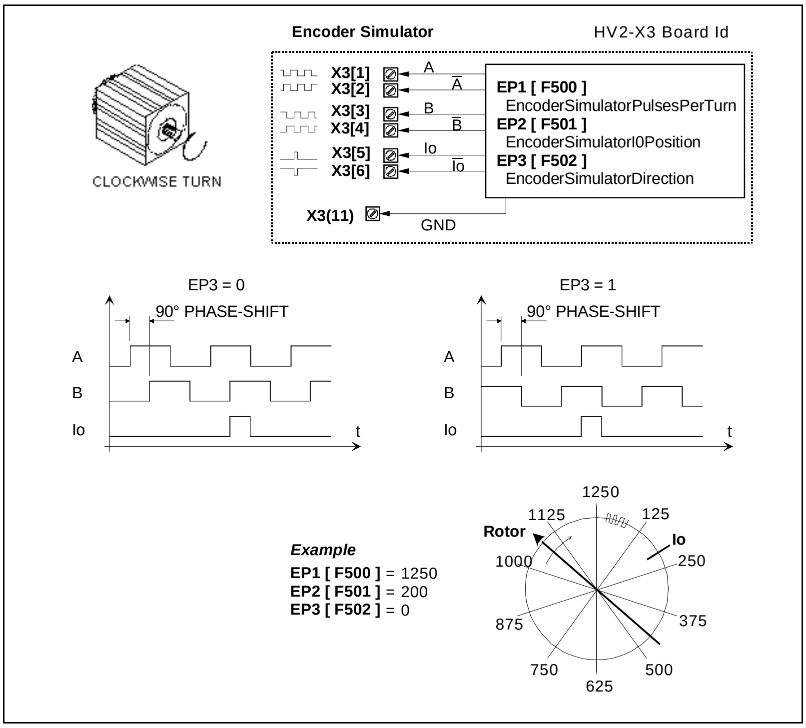
Function: This parameter is used to select the turning direction of the simulated encoder.

Valid values: 0 and 1, clockwise and counter-clockwise, respectively.

Default value: 0. (clockwise).

EC1 O [F503] EncoderSimulatorSetI0

Function: Executing this command sets the I0 signal position at the current rotor position. Available in the command menu of the programming module DDS PROG MODULE as EncoderSimulator FixI0 command.



F group: Flux

FP1 *OMA [F600] MotorFluxProportionalGain

Function: Value of the proportional gain of the flux loop.

Valid values: 0 ... 3200 (A/Wb).

Default value: It depends on the motor connected.

FP2 *OMA [F601] MotorFluxIntegralTime

Function: Value of the integral time of the flux loop.

Valid values: 0 ... 3200 (ms).

Default value: It depends on the motor connected.

FP20 *OMA [F602] MotorBEMFProportionalGain

Function: Value of the proportional gain of the BEMF.

Valid values: 0 ... 32 (mWb/V).

Default value: It depends on the motor connected.

FP21 *OMA [F603] MotorBEMFIntegralTime

Function: Value of the integral time of the BEMF.

Valid values: 0 ... 3200 (ms)

Default value: It depends on the motor connected.

FP30 FA [F612] 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

Version: Operative from version 06.01 on.

FP31 FA [F613] RotorFixedTemperature

Function: Fixed temperature of the rotor. The value of the rotor resistance will be the one corresponding to the temperature indicated in this parameter. This parameter is only taken into account if the estimation is not activated or there is no temperature sensor (MP14 K 2 or 3).

Valid values: 0 ... 150 ° C

Default value: 0 °C.

Version: Operative from version 06.01 on.

FP40.# FA [F622.#] 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 1000 % to cancel the effect of this parameter.

Valid values: 1 ... 1000 %.

Default value: 1000 %.

FV1 [F623] BEMF

Function: Value of the Back Electro-Motive Force.

Units: In volts.

G group: General

GP1 O [F700] 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. This parameter may be modified at OEM level.

Valid values: 4000 Hz.

8000 Hz.

Default value: 4000 Hz.
(for synchronous and asynchronous).

GP2 O [F701] Feedback1Type

Function: Type of motor feedback.

Valid values: 0 -. Stegmann sinusoidal encoder

1 -. Resolver

2 -. Square-wave TTL encoder

5 -. Heidenhain encoder (ERN 1387])
for Siemens motors, 1FT6 family.

Default value: 0 -. Sinusoidal encoder

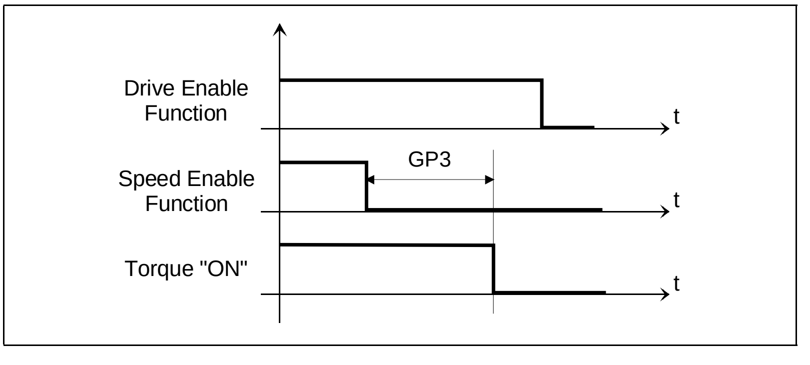
GP3 O [F702] StoppingTimeout

Function: After Speed_Enable has been canceled and the GP3 time has elapsed, if the motor has not stopped yet, the torque is canceled automatically and error 4 comes up. If the motor stops before the GP3 time has elapsed, the torque is also canceled but error 4 does not come up.

Valid values: 0 ... 65535 (ms). Depends on the motor.

Default value: 500 (ms) on axes.

5000 (ms) on spindles.



GP4 O [F703] 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 [F704] ParameterVersion

Function: It stores the version of the motor parameter table. It is a read-only parameter.

GP6 O [F717] GearRatioNumber

Function: Number of useful gear ratios. The useful gear ratios must be numbered 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 gear ratio).

GP7 O [F720] OverloadTimeLimit

Function: When the overload conditions exceed this time, the error comes up. See parameter GP8.

Valid values: 0 ... 10000 (ms).
Setting GP7 = 0 disables the detection.

Default value: 200 (ms).

GP8 O [F721] OverloadVelocityThreshold

Function: It sets the velocity threshold under which the motor is considered to be stopped in terms of overload detection. See parameter GP7.

Valid values: 0 ... 24000 (rpm).

Default value: 100 (rpm) for asynchronous motors.

rated speed (rpm) for asynchronous motors.

GP9 O [S207] DriveOffDelayTime

Function: After the motor has stopped because the SpeedEnable function has been disabled or because an error has come up, the cancellation of the DriveEnable function (that implies PWM-OFF) is delayed by a time period indicated by GP9. It is very useful when the axes are not compensated with holding brake. See the electrical diagrams of chapter 2.

Valid values: 0 ... 6553 (ms).

Default value: 0 (after motor stopped by SpeedEnable or ErrorStop, motor torque is canceled).

GP10 O [F719] Feedback2Type

Function: It sets the type of electrical signal received from the direct feedback through X3.

Valid values:

0 ➔ There is no feedback
1 ➔ Square TTL signal
2 ➔ 1Vpp sinusoidal signal
3 ➔ Signal from a Stegmann feedback device
4 ➔ Feedback2TypeCuadradaSSI
5 ➔ Feedback2Type1VppSSI

The options GP10 0 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 feedback.

Version: Modified from version 06.08 on.

GV2 [S30] ManufacturerVersion

Function: Display of the current version and the type of drive (axis or spindle).

GV3 [F705] FlashParameterChecksum

Function: It informs on the parameter checksum.

GV4 [S380] DCBusVoltage

Function: It informs about the voltage of the power bus in (V).

GV5 [F706] CodeChecksum

Function: It informs on the software checksum.

GV6 [F723] RamParameterChecksum

Function: It informs on the checksum of the parameters contained in RAM memory.

GV8 [F707] AcessLevel

Function: It informs about the current access level of the user

Valid values: 1 -. Basic (user)

2 -. OEM

3 -. Fagor

GV9 [S140] DriveType

Function: It informs about the drive's sales reference.

Valid values: All the possible ones according to the coding data shown in appendix C.

GV10 O [S262] LoadDefaultsCommand

Function: motor identification and initialization. Assigning an identifying reference of a particular motor to this variable (see appendix C) sets the parameters **related to the motor**to govern it and the rest of the parameters to their default values. See section **motor identification** in chapter 3.

Valid values: The references specified in appendix C for motors.

GV11 W [F708] SoftReset

Function: Variable for executing a software reset. See section **initializing process, reset** in chapter 3.

GV13 [F709] PowerBusStatus

Function: It indicates whether there is voltage or not at the power bus.

Valid values: 0 -. There is no voltage

1 -. There is voltage

GV14 F [F710] PowerVoltageMinimum

Function: While there is torque, if the bus voltage is lower than GV14, it activates error 307 or error 3.

Valid values: 0 ... 880 V.

GV21 [S254] 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 [S217] 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 [F711] ParameterSetAck
GV24 W [F712] 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, GV32. When the set change is effective, the drive shows it through the GV23 variable. If GV24 is not assigned to any digital input, it keeps the value of 1 [active] and, therefore, the changes in GV30 - 32 have an immediate effect in the active set.

Valid values: 0 -. Inactive

1 -. Active

GV25 [S255] 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 [S218] 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 [F713] ParameterSetBit0
GV31 W [F714] ParameterSetBit1
GV32 W [F715] 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 Vdc), respectively).

Example: GV32 = 1, GV33 = 1 and GV30 = 0, represent set 6.

GC1 [S264] BackupWorkingMemoryCommand

Function: Execution of the parameter transfer from RAM to FLASH. Available on the command menu of the programming module DDS PROG MODULE as BackupWorkMemoryProcedureCommand.

GC4 **[S220]** **OfflineParameterValidation**

Function: Command that validates any modification of an off-line parameter without having to save it. Therefore, 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 **[F614]** **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.

GC6 **[F615]** **HomeSwitchAutoCalibration**

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.

HV1 S [S110] 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 tables 12 and 13 of chapter 1: Electronic modules.

Version: Modified from version 06.03 on.

HV2 A [F804] S6LoadCurrent

Function: It identifies the current of a spindle drive module (current for an asynchronous motor in duty cycle S6 with a running factor of 15% and a cycle time of 1 minute).

Valid values: See tables 14 and 15 of chapter 1: Electronic modules.

Version: Operative from version 06.03 on.

HV9 [F806] ModularOrCompact

Function: It indicates whether the drive is modular or compact.

Valid values: 0 -. Modular

1 -. Compact

HV10 [F290] VsMSC

Function: It informs of the different hardware possibilities.

HV11 [F291] FlashManufacturerCode

Function: It indicates the code of the manufacturer of the Flash memory used in the drive.

HV13 [F293] Sercos® RS422Id

Function: This variable presents the identifier number of the switch on the Sercos board or on the RS422 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 [F800] MotorVoltage

Function: Rms voltage on the line or between motor phases.

Valid values: 0 ... 1000 V

Version: Operative from version 06.01 on

I group: Inputs

IP1.# O [F900.#] 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 [F909] 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 Vdc.

The card with connectors X6 and X7 cannot be configured by this parameter.

Bits 0 (LSB) and 1 configure the inputs of SL1.

Bit 0 configures the input group I1 - I8.

Bit 1 configures the input group I9 - I16.

Bits 2 and 3 configure the inputs of slot SL1.

Bit 2 configures the input group I17 - I24.

Bit 3 configures the input group I25 - I32.

Valid values: 0 -. Inputs configured for 24 Vdc (by default in all 4 bits).

IP10 O [F901] I1IDN
IP11 O [F902] I2IDN
IP12 O [F903] I3IDN
IP13 O [F904] 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) for IP10

Pin 2 (referred to pin 5) for IP11

Pin 3 (referred to pin 5) for IP12

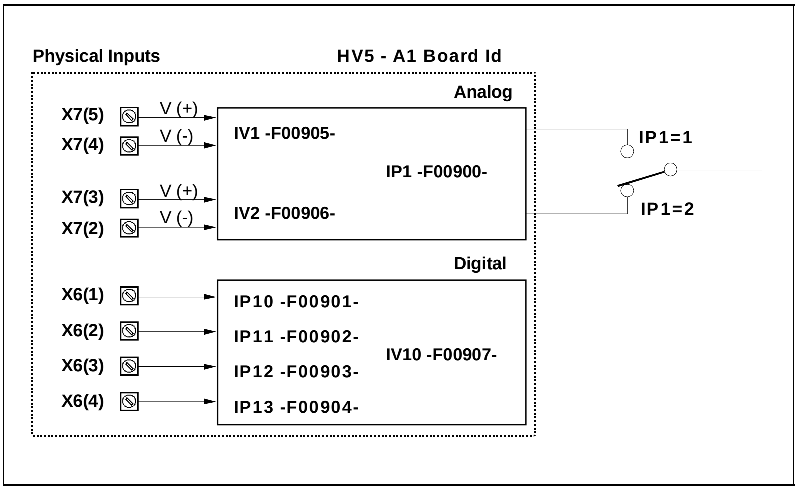
Pin 4 (referred to pin 5) for IP13

Default value: 0 (not assigned to any variable).

Example: IP10 = GV24 (pin 1 referred to 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).



IV1 s [F905] AnalogInput1
IV2 s [F906] 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 ... 10 (V).

IV10 O [F907] 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.

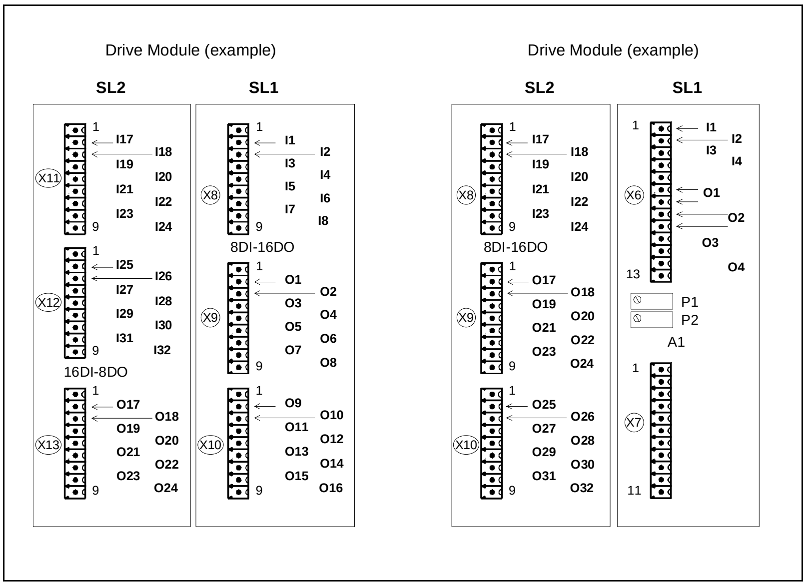
Example: Reading IV10 = 3 which in binary is 0011. This means that inputs 1 and 2 of connector X6 are active (receive 24 Vdc) and inputs 3 and 4 are inactive (0 Vdc).

IV11 O [F908] 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 IV11 = 30 which in binary is 00011110. This means that inputs I18, I19, I20 are active and the rest of the inputs are inactive (0 Vdc).



KP1 F [F1112] DriveI2tErrorEfect

Function: It determines whether the I^2t 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 [F1113] ExtBallastResistance

Function: It contains the Ohm value of the external Ballast resistor of a compact drive. It is useful for the I^2t protection of that resistor.

Valid values: 0 ... 6553.5 (.).

Default value: 0.

KP3 O [F1114] ExtBallastPower

Function: It contains the power value of the external Ballast resistor of a compact drive. It is useful for the I^2t protection of that resistor.

Valid values: 0 ... 65535 (W).

Default value: 0.

KP4 O [F1116] 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 I^2t protection of that resistor.

Valid values: 0 ... 400000 (J).

Default value: 0.

KV2 [F1100] DriveTemperature
KV4 W [F1101] DriveTemperatureErrorLimit

Function: Read/Write the limits set by the user for the warning and error of the drive's temperature.

Valid values: 5 ... 100 (°C).

KV5 **W** **[S201]** **MotorTemperatureWarningLimit**
KV6 **[S383]** **MotorTemperature**
KV8 **W** **[S204]** **MotorTemperatureErrorLimit**

Function: Read/Write the limits set by the user for the warning and error of the motor's temperature. Note that KV6 can only be applied to AXM motors.

Valid values: for KV5 and KV8: 0 ...150 (°C).

for KV6 : 5 ...150 (°C).

KV9 **W** **[S202]** **CoolingTemperatureWarningLimit**
KV12 **W** **[S205]** **CoolingTemperatureErrorLimit**

Function: Same for the heatsink and its temperature.

Valid values: 0 ...110 (°C).

KV10 **[F1102]** **CoolingTemperature**
KV20 **s** **[F1103]** **SupplyPlus5V**
KV21 **s** **[F1104]** **SupplyPlus8V**
KV22 **s** **[F1105]** **SupplyPlus18V**
KV23 **s** **[F1106]** **SupplyMinus5V**
KV24 **s** **[F1107]** **SupplyMinus8V**
KV25 **s** **[F1108]** **SupplyMinus18V**

Function: Monitoring of heatsink temperature (°C) and power supply voltages present at the module.

KV32 **[F1109]** **I2tDrive**

Function: Variable used internally by the system. It measures the internal load levels of the calculation of the I^2t at the drive in **percentage used over the maximum**. A value greater than 100% in this variable causes error E202.

KV36 **FS** **[F1111]** **I2tMotor**

Function: Variable used internally by the system. It measures the internal load levels of the calculation of the I^2t at the motor in **percentage used over the maximum**. A value greater than 100% in this variable causes error E201.

KV40 **F** **[F1115]** **I2tCrowbar**

Function: Shows the load percentage on the external Ballast resistor of a compact drive. It is useful for the I^2t protection of that resistor. A value greater than 100% in this variable causes error E301.

LP1 O [F2301] SecondCamSwitchStart

Function: This parameter determines which is the first cam that belongs to the second CamSwitch. Thus:

LP1= 0	It indicates that there is only the first CamSwitch and therefore all 8 cams will belong to it.
LP1=1	It indicates that there is only the second CamSwitch and therefore all 8 cams will belong to it.
LP1=2...8	It defines the first cam that will be part of the second CamSwitch, thus setting the cam distribution between the two CamSwitches.

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 * [F2310] 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 * [F2311] FeedrateOverrideLimit

Function: It sets the maximum value for the feedrate multiplier registered in variables LV108 [S108] FeedrateOverride.

Valid values: 0 ... 250 (%).

Default value: 250 (%).

LP12 *s [F2312] 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: - 214000 ... 214000 (m/min).

Default value: 10 (m/min).

LP22 *s [F2322] 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: -214000 ... 214000 (m/min).

Default value: 5 (m/min).

LP23 *s [F2323] 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: - 214000 ... 214000 (mm).

Default value: 1 (mm).

LP25 * [F2325] InPositionTime

Function: Parameter related to 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 ... 65535 (ms).

Default value: 10 (ms).

LP40 * [F2340] 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 * [F2341] 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 ... 200 (m/s^2).

Default value: 2 (m/s^2).

LP42 * [F2342] SynchronizationVelocity

Function: This parameter defines the synchronization speed and sets the maximum velocity for the position adaptation in position synchronization.

Valid values: 0 ... 214748 (m/min).

Default value: 15 (m/min).

LP47 * [F2347] 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 E919 of Kernel execution.

Remember that to disable the synchronization timeout, parameter "LP47 [F2347] SynchronizationTimeout" must be set to the proper maximum value (2147483647) !

Valid values: 0 ... 2147483647 (ms).

Default value: 10000 (ms).

LP59 [F2359] SynchronizationMasterSource

Function: This parameter may be used to select the source for the master axis position.

Valid values: 0 - PV53 [S53] PositionFeedback2.

1- LV245 [S245] LeadDrive1AngularPosition

Default value: 0.

LP60 Os [S60] PosSwitch1On
LP61 Os [S61] PosSwitch1Off

Function: When the axis is positioned within the range defined by these two parameters, output Nr 1 of the CamSwitch will be active.

Valid values: -214 ... 214 (m).

Default value: 0 (m).

LP62 Os [S62] PosSwitch2On
LP63 Os [S63] PosSwitch2Off
LP64 Os [S64] PosSwitch3On
LP65 Os [S65] PosSwitch3Off
LP66 Os [S66] PosSwitch4On
LP67 Os [S67] PosSwitch4Off
LP68 Os [S68] PosSwitch5On
LP69 Os [S69] PosSwitch5Off
LP70 Os [S70] PosSwitch6On
LP71 Os [S71] PosSwitch6Off
LP72 Os [S72] PosSwitch7On
LP73 Os [S73] PosSwitch7Off
LP74 Os [S74] PosSwitch8On
LP75 Os [S75] PosSwitch8Off

Function: Same for outputs Nr 2, 3, 4, 5, 6, 7, 8 of the Cam-Switch.

LP143.# *O [S393.#] 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.

LP183 * [S183] SynchronizationVelocityWindow

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 [F2346] will be activated indicating that synchronization has been reached.

Valid values: 0 ... 214748 (m/min).

Default value: 0.3 (m/min).

LP228 * [S228] SynchronizationPositionWindow

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 [F2346] will be activated indicating that synchronization has been reached.

Valid values: 0 ... 214748 (mm) for linear axes & (°) for rotary axes.

Default value: 1 (mm).

LP236 * [S236] LeadDrive1Revolutions

Function: This parameter defines the number of revolutions of the master axis needed to set the transmission ratio.

Valid values: 1 ... 2147483647.

Default value: 1.

LP237 * [S237] SlaveDriveRevolutions1

Function: This parameter defines the number of revolutions of the slave axis needed to set the transmission ratio.

Valid values: 1 ... 2147483647.

Default value: 1.

LV2 O [F2302] CamSwitchCompile

Function: If the ON/OFF points of any of the cams of any CamSwitch 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, 1.

Default value: 0.

LV13 W [F2313] 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.

LV14 W [F2314] 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 [F2315] 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. It is necessary to begin the execution through this **Start** signal always 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 [F2316] 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 [F2315] KernelStartSignal is activated again, it goes on with the remaining portion of the block.

LV17 W [F2317] 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 [F2315] KernelStartSignal.

LV18 W [F2318] 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 [F2319] KernelManMode

Function: It indicates which is the operating submode within the jog mode (LV13 = 1).

Valid values: 0 -. Continuous submode (by default).

1 -. Incremental submode.

LV20 W [F2320] 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 [F2321] JogNegativeSignal

Function: Digital signal used in the JOG module of the Motion Control application (*.mc) to activate the jog movement in the negative direction.

LV24 [F2324] FeedrateOverrideEqualCero

Function: Digital signal that indicates that the FeedrateOverride value on the machine is zero and, therefore, the motor could not be moved at all.

LV26 Ws [F2326] 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: - 214748 ... 214748 (mm).

Default value: 0 (mm).

LV27 [F2327] KernelInitError

Function: Index that indicates the exact meaning of error 900. This error comes up when initializing the Motion Control program and is communicated through the status display of the drive. It cancels the system initialization process and does not allow to run the MC software.

Valid values:

0 If there are no initialization errors.

1 *.MCC application not loaded into memory.

2 Wrong *.MCC application file.

3 *.MCC application file too large (8 Kbytes maximum).

4 Using a nonexistent drive variable

5 Too many drive variable

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 [F2328] KernelExecError

Function: Variable that groups the execution errors of the Motion Control program (901-922). 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, thus being possible to check values of variables and parameters.

Valid values:

0	If there are no errors.
1	Division by zero (error 901 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	Battery underflow
10	Overflow when calculating a position
11	Absolute positioning without homing
12	An attempt has been made to write in a PLC counter
13	Unknown Pccode
14	TargetPosition exceeds ModuleValue
15	The distance programmed for the block has exceeded the maximum value allowed.
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

LV30 [F2330] 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	When the execution is interrupted
1	When the execution is running

LV31 **[F2331] 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 **[F2332] 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 **[F2333] KernelApplicationPars**

Function: Variable that returns the names and indexes for each **user parameter** used in the motion control application 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 **[F2334] 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.

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 **[F2335] 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 a new positioning block is launched.

Valid values: - 214748 ... 214748.

Default value: 0.

Units: For rotary axes (°).
For linear axes (mm).

LV36 Ws [F2336] BlockCoveredDistance

Function: Variable that returns for a 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: -214748 ... 214748 (mm) for linear axes and (°) for rotary axes.

Default value: 0 (mm).

LV43 W [F2343] GearRatioAdjustment

Function: The transmission ratio is given by dividing parameter SlaveDriveRevolutions1 [S237] by LeadDrive1 Revolutions [S236] 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 ... 214748

Default value: 0.

LV44 Ws [F2344] 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: -214748 ... 214748 (m/min).

LV45 Ws [F2345] 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: - 214748 ... 214748 (mm).

LV46 [F2346] InSynchronization

Function: Mark that indicates whether synchronization has been reached or not. When synchronization is reached, a logic 1 is activated.

Valid values: 0, 1.

LV48 Ws [F2348] MasterOffset1

Function: Postion offset (in position - position cams) or time offset (in position-time cams) of the master axis. Value that is subtracted from the master axis position or time to calculate the entry position of table 1 of the electronic cam.

Valid values: - 214748 ... 214748.

Default value: 0.

Units: for the position - position (mm or °) type cam.

for the position - time (ms) type cam.

Version: Operative from version 06.01on. Expanded in version v.06.03

LV49 W [F2349] 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.

Valid values: 0 ... 214748.

Default value: 360.

Units: for a position - position (mm or °) type cam .

For a position - time (ms) type cam.

Version: Operative from version 06.01 on.

LV50 Ws [F2350] SlaveOffset1

Function: Slave axis position offset according to table 1 of the electronic cam.

Valid values: - 214748 ... 214748.

Default value: 0.

Units: For rotary axes (°).
For linear axes (mm).

Version: Operative from version 06.01 on.

LV51 W [F2351] SlaveScale1

Function: Slave axis position range according to table 1 of the electronic cam.

Valid values: 0 ... 214748.

Default value: 360.

Units: For rotary axes (degrees).
For linear axes (mm).

Version: Operative from version 06.01 on.

LV52 Ws [F2352] MasterOffset2

Function: Postion offset (in position - position cams) or time offset (in position-time cams) of the master axis. Value that is subtracted from the master axis position or time to calculate the entry position of table 2 of the electronic cam.

Valid values: - 214748 ... 214748.

Default value: 0.

Units: for the position - position (mm or °) type cam.

for the position - time (ms) type cam.

Version: Operative from version 06.01on. Expanded in version v.06.03

LV53 W [F2353] 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.

Valid values: 0 ... 214748.

Default value: 360.

Units: for the position - position (mm or °) type cam .

For the position - time (ms) type cam.

Version: Operative from version 06.01 on.

LV54 Ws [F2354] SlaveOffset2

Function: Slave axis position offset according to table 2 of the electronic cam.

Valid values: - 214748 ... 214748.

Default value: 0.

Units: For rotary axes (°). For linear axes (mm).

Version: Operative from version 06.01 on.

LV55 W [F2355] SlaveScale2

Function: Slave axis position range according to table 2 of the electronic cam.

Valid values: 0 ... 214748.

Default value: 360.

Units: For rotary axes (°). For linear axes (mm).

Version: Operative from version 06.01 on.

LV108 W [S108] 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 [F2311] FeedrateOverride Limit. In any case, the velocity will be limited to the value given by SP10 [S91] VelocityLimit.

Valid values: It varies between 0 % and the value indicated by LP11 [S91] VelocityLimit.

LV158 Ws [S258] 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 [S258] TargetPosition.

Valid values: - 214748 ... 214748.

Units: For rotary axes (°).
For linear axes (mm).

LV159 W [S259] 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 [S259] PositioningVelocity. variable.

Valid values: 0 ... 214748 (m/min).

LV160 W [S260] PositioningAcceleration

Function: Maximum acceleration applied to all the positioning blocks (in module).

Valid values: 0.1 ... 200 (m/s^2).

LV193 O [S193] PositioningJerk

Function: Maximum jerk limit for all the positioning blocks (in module).

Valid values: 0.3 ... 1000 (m/s^3).

Default value: 0 (jerk cancellation) (m/s^3).

LV215 [S315] PositioningVelocityGreaterLimit

Function: Mark that activates when the positioning speed programmed for the current positioning block exceeds the limit given by SP10 [S91] VelocityLimit.

Valid values: 0 and 1.

LV223 **[S323]** **TargetPositionOutsideOfTravelRange**

Function: Mark that activates when the target position indicated in the current positioning block is off the position limits given by parameter PP49 [S49] PositivePositionLimit or PP50 [S50] NegativePositionLimit.

Valid values: 0 and 1.

LV242 **[S342]** **TargetPositionAttained**

Function: Mark indicating that the interpolator has reached the target position; in other words, it is activated when the position command PV47 [S47] PositionCommand reaches LV158 [S258] TargetPosition.

Valid values: 0 and 1.

LV243 **[S343]** **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 **[S245]** **LeadDrive1AngularPosition**

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 ... 214748.

Units: For rotary axes (°).
For linear axes (mm).

LC1 **[F2300]** **BackupMCPar**

Function: Motion control parameter backup. Available on the command menu of the programming module DDS PROG MODULE as **Save MC Parameters**.

MP1 O [S141] MotorType

Function: motor identification and initialization. Assigning to this parameter a reference indicating a particular motor (see appendix C) sets the **motor governing parameters**.

See the section on Motor Identification in chapter 3.

To govern a user motor (non-Fagor) or to modify one of these M parameters, set MP1 to a value that begins with a "0", e.g. MP1 =0supermotor.

Valid values: The references specified in appendix C for motors.

MP2 FMS [F1200] MotorTorqueConstant

Function: Torque constant of the synchronous motor, (motor torque according to the rms current).

Valid values: 0.1 ... 1000 N·m/Arms.

MP3 FM [S111] MotorContinuousStallCurrent

Function. Motor rated current.

Valid values: 0 ... 200 (Arms).
Depends on the motor connected.

MP4 FMS [S109] MotorPeakCurrent

Function. Peak current of the synchronous motor. This current must NEVER be exceeded in the motor.

Valid values: 0.1 ... 300 (Arms).
Depends on the motor connected.

MP5 FM [F1201] MotorPolesPairs

Function: Number of pairs of poles.

Valid values: 0 ... 40 (integer number).

MP6 FM [F1202] MotorRatedSupplyVoltage

Function. Rated voltage of the asynchronous motor.

Valid values: 0 ... 460 (V).

MP7 FMA [F1203] MotorPowerFactor

Function. Power factor of the asynchronous motor.

Valid values: 0 ... 0.999.

MP9 FMA [F1205] MotorSlip

Function. Slippage of the asynchronous motor.

Valid values: 0 ... 1000 (rpm).

MP10 FM [F1206] MotorStatorResistance

Function: Phase-neuter resistance of the stator at 20°C.

Valid values: 0 ... 10000 (.).

MP11 FM [F1207] MotorStatorLeakageInductance

Function: Phase-neuter leak inductance of the stator.

Valid values: 0 ... 10000 (mH).

MP12 FMA [F1208] MotorNominalPower

Function: Rated power.

Valid values: 0 ... 200 (kW).

MP13 FM [F1209] MotorThermalTimeConstant

Function: Thermal time constant of the motor.

Valid values: 1 ... 200 (min).

MP14 FM [F1210] MotorTempSensorType

Function: it identifies the sensor of a Fagor motor.

Valid values:

0.- SPM and FXM: Triple, sensitive between 130°C and 160°C.

1.- AXM: Simple, sensitive between 0 and 155 degrees

2.- KTY84

3.- FM7

MP15 FM [F1211] MotorShaft

Function: It offers information on the type of axis installed at the motor.

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 shielded 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.

MP16 FM [F1212] MotorBrake

Function: This parameter determines whether the motor has a brake (MP16 = 1) or not (MP16 = 0).

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 [F1213] MotorFan

Function: This parameter determines whether the motor has a fan MP17 = 1) or not (MP17 = 0).

This parameter only applies to FXM and FKM motors because all SPM and FM7 motors have a fan.

This parameter is set during the motor identification process.

MP18 FMA [F1214] MotorMounting

Function: This parameter indicates how the motor is mounted. The bearings of this motor are designed for this type of mounting.

On SPM motors:

MP18 = 0	Horizontal mounting B3/B5.
MP18 = 1	Vertical mounting with shaft facing down V1/V5.
MP18 = 2	Vertical mounting with shaft facing up V3/V6.

On FM7 motors:

MP18 = 3	Regardless of the mounting method.

This parameter is set during the motor identification process.

MP19 FMA [F1215] MotorBalancing

Function: This parameter indicates the balancing degree of the motor.

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 [F1216] MotorBearings

Function: This parameter indicates the type of bearings.

On SPM motors:

MP20 = 0 Normal bearings.
MP20 = 1 High speed bearings.

On FM7 motors:

MP20 = 1 Always.

This parameter is set during the motor identification process.

MP21 FMA [F1217] MotorPhasesOrder

Function: Phase inversion

On SPM motors:

MP21 = 0 Always.

On FM7 motors:

MP21 = 1 It inverts the phases.

This parameter is set during the motor identification process.

Default value: 0.

Version: Operative from version 06.01 on.

MP24 FM [F1220] MotorMomentumOfInertia

Function: Motor inertia.

Valid values: 0.1 ... 100000 (kgr/cm^2).

Default value: 1 (kgr/cm^2).

MP25 FM [F1221] MotorRatedSpeed

Function: Synchronous: Rated speed.

Asynchronous: Base speed. Over this speed, it is in the constant power zone.

Valid values: Synchronous: MP25 must be < SP10, otherwise, error 500 will come up. DV15 = 3.

Asynchronous: MP25 must be < MP26.

MP26 FMA [F1222] MotorMaximumSpeed

Function: Maximum speed attainable by the asynchronous motor.

Valid values: MP26 must be equal to or greater than SP10, otherwise, error 500 will come up. DV15 = 3.

Version: Operative from version 06.01 on.

MP27 FMA [F1223] MotorRotorResistance

Function: Phase-neuter resistance of the rotor at 20°C.

Valid values: 0 ... 10000 (.).

Default value: 0 (.).

Version: Operative from version 06.01 on.

MP28 FMA [F1224] MotorRotorLeakageInductance

Function: Phase-neuter leak inductance of the rotor.

Valid values: 0 ... 10000 (mH).

Default value: 0 (mH).

Version: Operative from version 06.01 on.

MP29 FMA [F1225] MotorMagnetizingInductance

Function: Magnetizing inductance.

Valid values: 0 ... 10000 (mH).

Default value: 0 (mH).

Version: Operative from version 06.01 on.

MP30 FMA [F1226] MotorInductanceFactor1
MP31 FMA [F1227] MotorInductanceFactor2
MP32 FMA [F1228] MotorInductanceFactor3
MP33 FMA [F1229] MotorInductanceFactor4
MP34 FMA [F1230] MotorInductanceFactor5
MP35 FMA [F1231] MotorInductanceFactor6
MP36 FMA [F1232] MotorInductanceFactor7
MP37 FMA [F1233] MotorInductanceFactor8
MP38 FMA [F1234] MotorInductanceFactor9

Function: Values of the magnetic saturation curve of the stator iron.

Valid values: 0.1 ... 100 (%).

Default value: 1 (%).

Version: Operative from version 06.01 on.

MP39 FM [F1235] MotorNoLoadCurrent

Function: Motor rms current without load.

Valid values: 0 ... 200 (Arms).

Default value: 0 (Arms).

Version: Operative from version 06.01 on.

MP40 FMA [F1236] 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.

MP41 FM [F1237] MotorMaximumTemperature

Function: It may be used to set the maximum temperature for the motor. A zero value in this parameter means that the temperature limit will be ignored.

Valid values: 0 ... 500 (°C).

Default value: 145 °C (for user motors).

Value given by its corresponding motor table (for FXM, FKM, AXM, SPM and FM7 motors).

Note: **Do not modify the value given by the FXM and SPM motor tables !**

Version: Modified from version 06.03 on.

MC1 O [F1238] **MotorElectricalParametersIdentification**

Function: After its execution, 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

Note: See section: < Auto-adjustment of an asynchronous user motor > in chapter 6. Applications in this manual!

Version: Operative from version 06.08 on.

NP1 *FM [F2200] ReducedActuatedMomentumOfInertiaPercentage

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 feedforward in the position loop.

Valid values: 0 ... 1000 (%).

Default value: 0 (%).

NP116 O [S116] ResolutionOfFeedback1

Function: It indicates the resolution of the motor feedback device X4.

If the motor feedback is a resolver with a pair of poles, after setting GP2=1, automatically, by default, NP116 is set to 1.

If the number of pairs of poles of the resolver is other than 1 (e.g. 3), MP1 is set as a user motor, GP2=1 and NP116 = 3.

Valid values: 1 ... 131072.

Default value: 1024 pulses per turn.

Version: Operative from version 06.01 on.
Expanded in version 06.05

NP117 O [S117] ResolutionOfFeedback2

Function: It indicates the resolution of the direct feedback device X3.

Units: If it is a linear encoder, the feedback period signal is given in microns. In the case of Fagor linear encoders (graduated glass) the resolution is 20 microns; i.e. S117 = 20. If it is a rotary encoder, the resolution of the feedback signal is given in pulses per turn.

Valid values: 1 ... 2147483647.

Default value: 2048 pulses per turn of the rotary encoder.

NP118 O [S118] ResolutionOfLinearFeedback

Function: It indicates the resolution of the linear encoder used as direct feedback. This parameter is ignored for a rotary feedback device. If the feedback signal is modified by an external multiplier, the value of this parameter must reflect the effect of this multiplier.

Units: The period of the feedback signal is given in microns. In the case of Fagor linear encoders (graduated glass) the resolution is 20 microns; i.e. S118 = 20. In the case of Fagor steel-tape-based linear encoders, the resolution is 100 microns; thus S118 = 100.

If a x5 multiplying factor is applied to a Fagor linear encoder COVX (20 microns), then S118 = 4.

Valid values: 0.1 ... 50000.

Default value: 20.

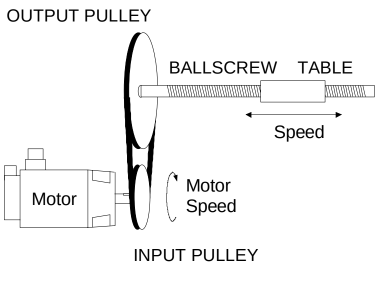
NP121.# O [S121.#] InputRevolutions
NP122.# O [S122.#] OutputRevolutions

Function: They define the gear ratio between the motor shaft and the final axis moved by the machine. For example, if 5 turns of the motor shaft mean 3 turns of the machine leadscrew, the value of these parameters is:

S121 = 5; S122 = 3

Valid values: 1 ... 32767 turns.

Default value: 1 turn in both parameters (direct coupling).



Example:
Diameter of the output pulley = 25.75 mm
Diameter of the input pulley = 15.3 mm

NP121 = 2575 turns
NP122 = 1530 turns

Gear ratio =2575/1530 =1.683

Ballscrew pitch = 5 mm

NP123 = 5 milimeters

NP123 O [S123] FeedConstant

Function: They define the gear ratio between the linear movement of the machine and the axis moving it.
For example, if the table moves 4 mm per turn of the leadscrew, parameter NP123 = 4. For a rotary axis, NP123 = 360, i.e. 360 degrees per turn.

Valid values: 0.0001 ... 214748.

Units: For rotary axes (°).
For linear axes (mm).

Default value: 10 mm per turn or 10 ° per turn.

NP131.# O [F130.#] InputRevolutions2
NP132.# O [F131.#] OutputRevolutions2

Function: They define the gear ratio between the direct feedback and the movement of the load. If 5 turns of the encoder shaft of the direct feedback are due to 3 turns of the machine leadscrew, the value of these parameters must be:

F130 = 5; F131 = 3

Valid values: 1 ... 32767 turns.

Default value: 1 turn in both parameters (direct coupling).

NP133 O [F132] FeedConstant2

Function: It defines the lineal displacement per each turn of the direct feedback encoder. Thus, for:

Rotary machines: this parameter is not applicable.

Linear machines with:

Direct feedback (GP10 . 0), rotary (PP115, bit0 = 0) and linear scaling (PP76, bits 1,0 = 01)

Yes:

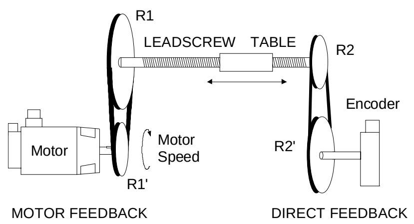
R1= R2: The linear movement per encoder turn is the same and parameter NP133 **must be set** with the value of the mechanical leadscrew pitch.

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 ... 214748.

Default value: 10.

Units: For rotary axes (°).
For linear axes (mm).



Example:

Rotary axis with 40 gear reduction and external encoder through a toothed belt 2:1

NP121 = 40
NP122 = 1
NP123 = 360 degrees per turn

NP131 = 2
NP132 = 1
NP133 = 360 degrees per turn

NP123 and NP133 do not require values when the axes are rotary.
Internally, it will assume a value of 360 degrees per turn.

Version: Modified from version 06.02 on.

Examples:

1.- Motor drive with toothed belt and external encoder attached to the leadscrew. 2:1 ratio; Leadscrew pitch: 10 mm.

Parameter setting: NP121 = 2, NP122 = 1, NP123 = 10 mm

NP131 = 1, NP132 = 1, **NP133 = 10 mm**

2.- In a MC application (cylindrical rollers) with measuring wheel.

Parameter setting:

Moving distance for the rollers:
NP121 = 5, NP122 = 2, NP123 =100 mm

Moving distance for the wheel:
NP131 = 1, NP132 = 1, **NP133 = 314.15 mm**

i

When updating the version, NP133 will assume the value that NP123 had before the update.
When setting machine up, set NP133 with the pitch value of the mechanical leadscrew

NP165 *O [S165] DistanceCodedReferenceDimension1

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 on linear feedback with distance-coded I0s.

Valid values: 0.1 ... 214748364.

Default value: 100.1.

NP166 *O [S166] DistanceCodedReferenceDimension2

Function: When the linear feedback device has distance-coded reference marks (I0), this parameter indicates the gap between two consecutive reference marks (I0). See chapter 5,, section on linear feedback with distance-coded I0s.

Valid values: 0.1 ... 214748364.

Default value: 100.0.

O group: Analog and digital outputs

OP1 *O [F1400] DA1IDN
OP2 *O [F1401] 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 [F1402] DA1ValuePer10Volt
OP4 *Os [F1403] 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: Theose of the variable being displayed.

Valid values: - 32767 ... 32767.

Default value: 1000.

Example:

If OP1 = SV2 (VelocityFeedback given in rpm) and OP3 = 3000. This means that when SV2 is 3000 rpm, the analog output will be at 10V (pins 10-11 of X7). It will keep this rpm/V ratio for the whole ±10V range.

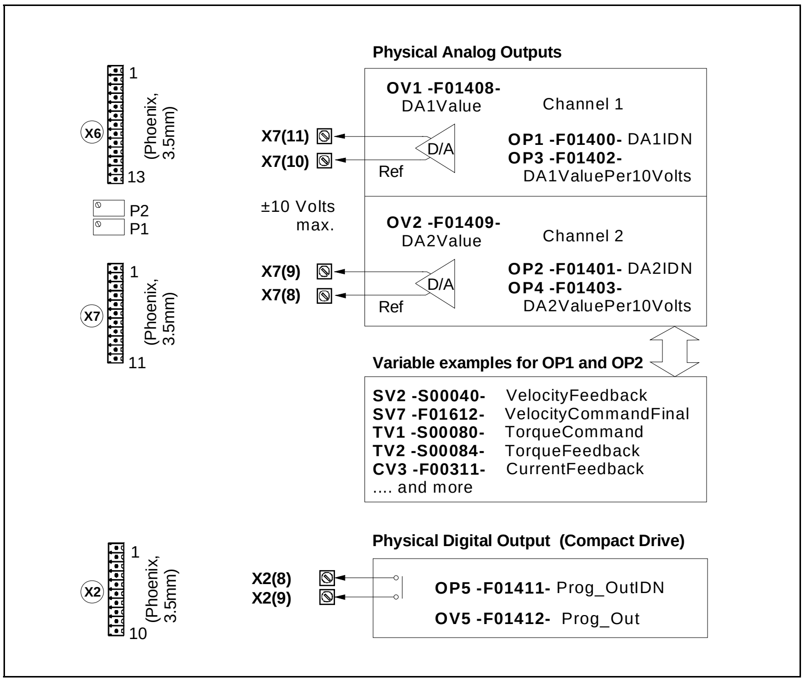
OP5 O [F1411] Prog_OutIDN

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).



OP10 O [F1404] O1IDN
OP11 O [F1405] O2IDN
OP11 O [F1406] O2IDN
OP13 O [F1407] 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) & (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 [F1408] DA1Value
OV2 Os [F1409] 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 ... 10 (V).

Example: Being OP1 = 0, set OV1 = 2 and there will be 2 volts between pins 11 and 10 of X7.

Note: Reading these variables makes no sense.

OV5 O [F1412] Prog_Out

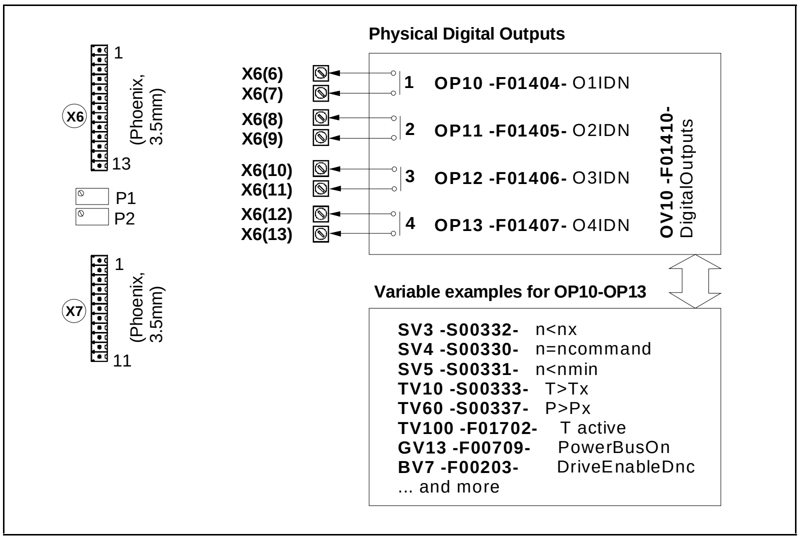
Function: The OV5 variable contains the binary data that represents the output status Prog_OUT of the compact drive. With operating modes:

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: reading OV5 = 1, while OP5 = TV100, means that there is torque. Writing OV5 = 1 while OP5 = 0 closes the Prog_OUT contact.



OV10 O [F1410] 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 ouputs.

In write mode: Values use to force the digital outputs that do not functions associated by the parameters OP10 - OP13.

Valid values: 0 ... 65535 ($FFFF).

Default value: 0 [unassigned].

Example: OV10 = 11 which is equal to 1011 in binary. This means that outputs 1, 2 and 4 of connector X6 are active and output 3 inactive; i.e. contacts (6, 7), (8, 9) and (12, 13) are closed and (10, 11) open.

Writing this same data, forces these positions to the contacts if nothing has been assigned to OP10 - OP13.

OV11 O [F1413] 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 ouptuts.

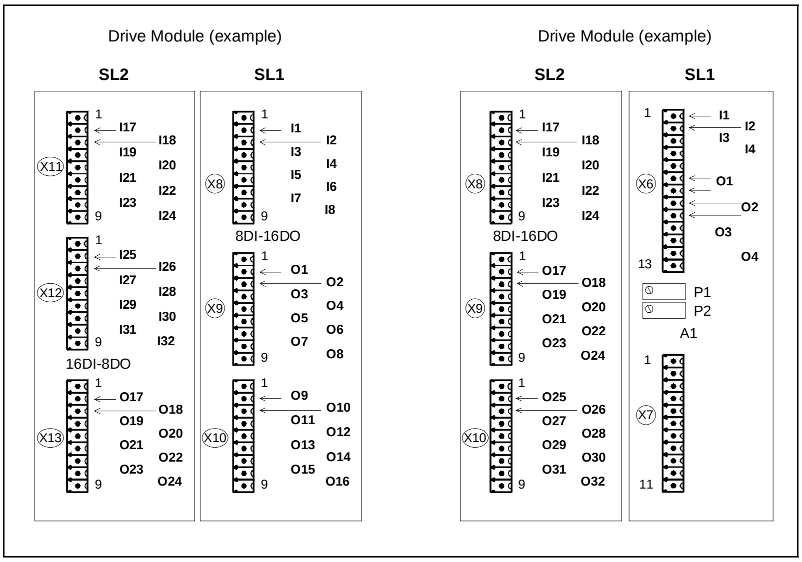
In write mode: Values that the digital outputs are forced to.

Valid values: 0 ... 65535 ($FFFF).

Default value: 0 (unassigned).

Example: Reading OV11 = 35 which is equal to 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.



PP1.# O [F1300.#]HomingVelocitySlow

Function: It is the slow speed of the homing process controlled from the drive itself. This parameter is necessary when the **home search** is controlled from the drive: PC148 [S148] DriveControlledHoming active.

Valid values: 0 ... 214748 (rpm) of the motor.

Default value: 100 (rpm) of the motor.

PP2 *Os [F1301] BacklashPeakAmplitude

Function: Additional analog pulse to recover possible leadscrew backlash in movement reversals.

Valid values: -1000 ... 1000 (rpm) of the motor.

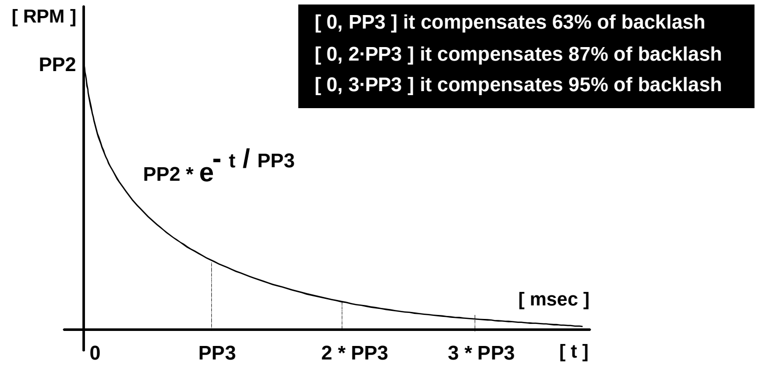
Default value: 0 (rpm) of the motor.

PP3 *O [F1302] BacklashPeakTime

Function: Duration of the additional analog pulse to recover the backlash in movement reversals.

Valid values: 0 ... 100 (ms).

Default value: 0 (ms).



The area between the curve and the horizontal axis between the [0, h] limits represents *approximately* the compensated backlash

PP4 * [S299] HomeSwitchOffset

Function: This parameter reflects the 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 ... 214748 (mm). For linear axes

0 ... 214748 (°). For rotary axes

Default value: 0.

Version: Operative from version 06.02 on.

PP5 O [S391] ActualPositionMonitoringWindow

Function: This parameter 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 157 ExcessiveActualPosition Difference (DV11 [S11], bit 11).

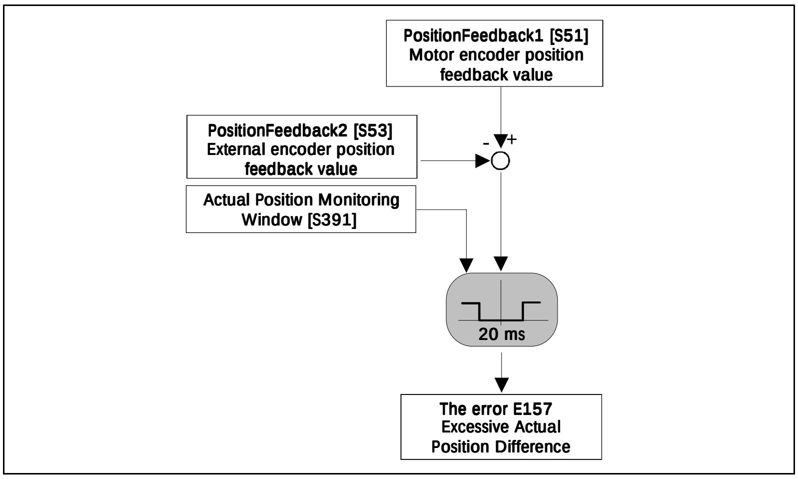
Considering that the purpose of this parameter is to offer an additional safety margin in applications that use an external measuring system, it should be set to a value other than zero for external square-wave feedback because there are no other monitoring systems for this case.

If this parameter is set to "0", the following error will not be monitored.

Valid values: -1 ... 214 · 10^3 (mm). For linear axes

-1 ... 214 · 10^3 (°). For rotary axes

Default value: 0. (there is no error monitoring).



Being PP5= -1, the motor feedback and the direct feedback become independent. Thus, 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 !

Versión: Modified in version 06.09.

PP41.# O [S41.#] HomingVelocityFast

Function: It is the fast speed of the homing process controlled from the drive itself. This parameter is necessary when the **home search** is controlled from the drive: PC148 [S148] DriveControlledHoming active.

Valid values: 0 ... 214748 (rpm) of the motor.

Default value: 200 (rpm) of the motor.

PP42.# O [S42.#] HomingAcceleration

Function: It is the acceleration applied in the homing process controlled from the drive itself. This parameter is necessary when the **home search** is controlled from the drive: PC148 [S148] DriveControlledHoming active.

Valid values: 0 ... 2147484 (rad/s^2).

Default value: 60 (rad/s^2).

PP49 *Os [S49] PositivePositionLimit
PP50 *Os [S50] NegativePositionLimit

Function: They delimit the area permitted for the movements of the axis. These limits are taken into consideration only if a home search has been carried out previously, i.e. bit 0 of PV203 [S403] PositionFeedbackStatus =1 (the Drive Contro-lledHoming command has been executed]. If the "PV47 [S47] Position Command" variable generates a movement of the axis that sends it beyond the permitted zone, it will issue error 150.

If the "LV158 [S258] TargetPosition" variable exceeds the position limits, the drive activates bit 13 of "DV9 [S12] Class2 Diagnostics [Warnings] Target Position Outside The Travel Zone".

Valid values: - 214748 ... 214748 (mm).

Default value: for linear axes:

PP49 = 214748 (mm)
PP49 = - 214748 (mm)

For rotary axes:

PP49 = 214748 (°)
PP50 = - 214748 (°).

PP52 Os [S52] 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: -214748 ... 214748 (mm).

Default value: 0.

PP54 Os [S54] 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: -214748 ... 214748 (mm).

Default value: 0.

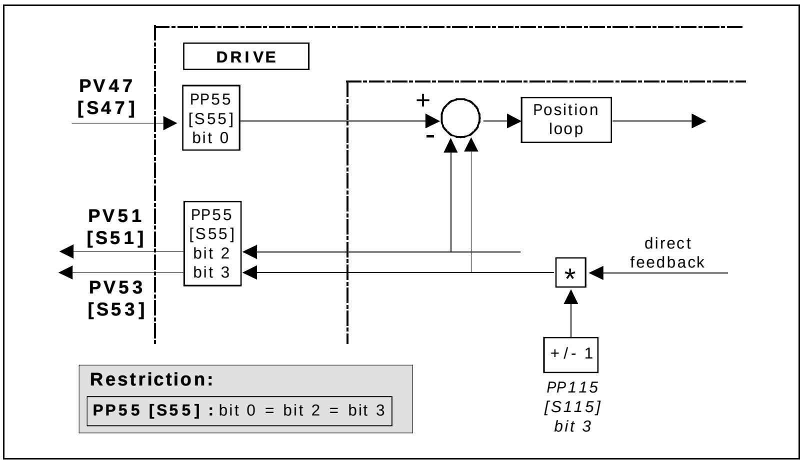
PP55 *O [S55] PositionPolarityParameters

Function: 16-bit register that may be used to invert the sign of the various position data.

When the drive closes the position loop:

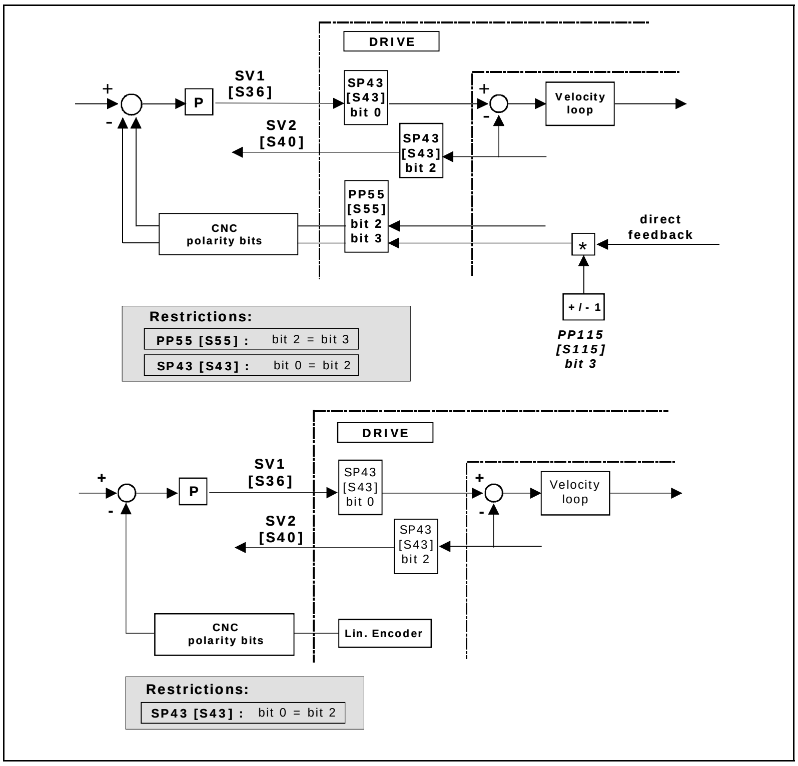
Bits 2 and 3 modify the sign of the monitored position feedback, but it does not affect the operation of the loop. These bits cannot be used to solve a positive feedback problem (axis runaway).

This case is solved by using bit 3 of "PP115 [S115] Position Feedback2Type" See figure.



When the CNC closes the position loop:

Bits 2 and 3 modify the sign of the monitored position feedback and it affects the operation of the loop. These bits may be used to solve a positive feedback problem (runaway) besides bit 3 of "PP115 [S115] Position Feedback2 Type". See figure.



Bear in mind that on rotary axes if the sign of the position command variations is positive, the motor will turn clockwise.

Bit	Meaning		
15 [MSB], 14, 13, 12, 11, 10, 9, 8, 7, 6, 5 (reserved)]			
4	Position limits		
		= 0	Cancels the position limits.
		= 1	Active (by default). See 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	Sign of the position command value		
		= 0	Not inverted
		= 1	Inverted (by default)

PP57 O [S57] PositionWindow

Function: It indicates the difference allowed between the actual position and the target position "LV158 [S258] TargetPosition" so the motor-drive system may be considered to be in position. The drive will than activate parameter PV136 [S336] InPosition during the execution of the command.

Valid values: 0 ... 214748 (mm) for linear movements.

0...214748 (°) for rotary movements.

Default value: 0.1 (mm) in linear movements.

0.1 (°) in rotary movements over 360°.

PP58 *Os [S58] Backlash

Function: leadscrew backlash. It only applies to motor feedback. It may be used for the position drive to compensate for the backlash when the axis reverses its moving direction. Both the drive and the CNC offer parameters to set the value of the leadscrew backlash. This value must only be entered in one of them, the value of the other one must be zero.

Valid values: -3.2 ... 3.2 (mm) for linear movements.

-3.2..3.2 (°) for rotary movements over 360°.

Default value: 0.

PP76 * [S76] 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 or not of the module format in the commands received.

Bit	Meaning
15 [MSB], 14, 13, 12, 11, 10, 9, 8	(reserved) = 0
7	Format = 0 Absolute format = 1 Module format. See PP103 Make sure that the CNC defines that axis in the same way (module or linear
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 [S103] ModuloValue

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 ... 214748 (°).

Default value: 360 (°). Normally used on rotary axes.

PP104.# * [S104.#] PositionKvGain

Function: It sets the value of the proportionality constant K_V 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 ... 32767 [(m/min)/mm].

Example: S104 =1 means that a following error of 1 mm is obtained with a programmed feedrate of 1000 mm/min (F1000 at the CNC).

S104=2 at F1000 the following error will be 0.5 mm.

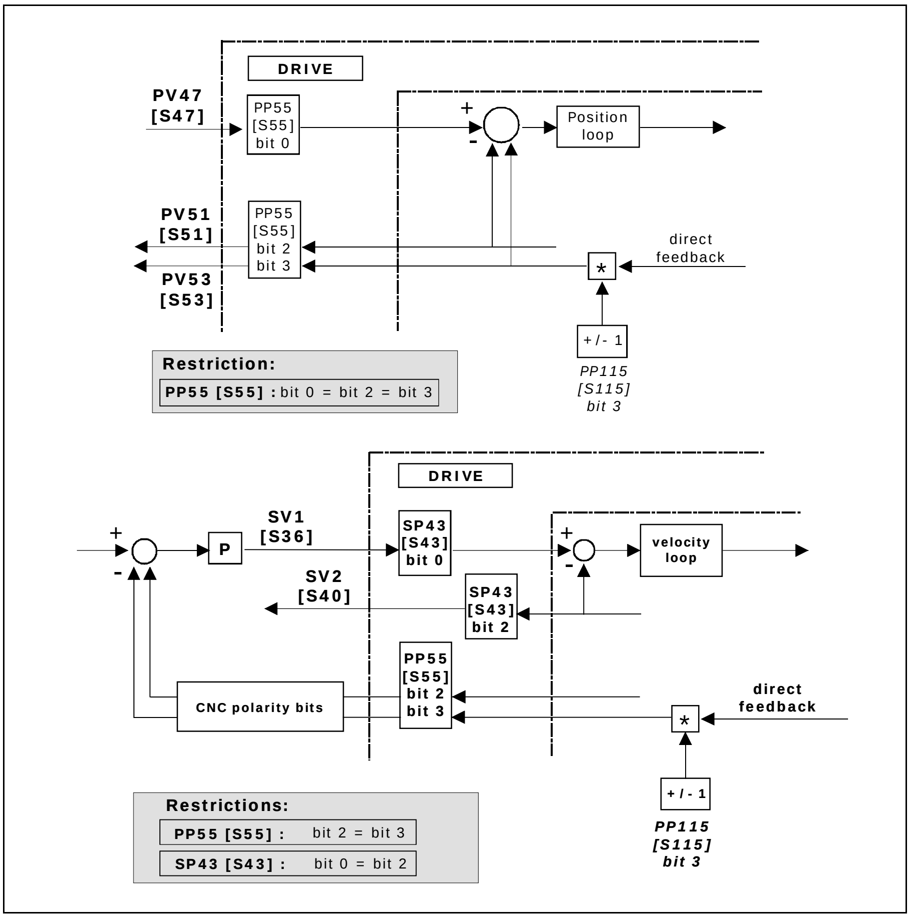
To obtain a following error of 500 microns, for a F2500, the Kv will be 2500/500, i.e. SP104 = 5.

Default value: 1
(following error of 1 mm for a feedrate of F1000).

PP115 O [S115] PositionFeedback2Type

Function: It indicates the various aspects of direct 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.

Bit	Meaning
15 [MSB], 14, 13, 12, 11, 10, 9, 8 (reserved)	
7, 4, 2 (reserved)	
6	It indicates the type of feedback: = 0 Incremental feedback device = 1 Absolute feedback device
5	Structure of distance-coded reference marks (I0's) = 0 Positive count in positive direction = 1 Negative count in positive direction
3	Feedback direction = 0 Not inverted = 1 Inverted
1	It indicates whether the feedback device has distance-coded I0's or not = 0 No distance-coded I0's = 1 With distance-coded I0's See NP165 and
0 [LSB]	It indicates the type of feedback = 0 Rotary encoder See NP117 = 1 Linear encoder. See NP118



PP147 * [S147] 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.

Bit	Meaning
15 [MSB], 14, 13, 12, 11, 10, 9, 8, 7	(reserved)
6	Evaluation of the reference mark (I0) = 0 The (I0) 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	Logic of the electrical signal of the home switch = 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.

PP150 *Os [S150] ReferenceOffset1

Function: Parameter that gives the position of the machine reference point with respect to the reference mark (I0), depending on the feedback of the motor. It is the same as parameter **REFSHIFT** [P47] of the axes of the 8055/55i CNC.

Valid values: -214748 ... 214748 (mm) in linear movements.

-214748 ... 214748 (°) for rotary movements.

Default value: 0.

PP151 *Os [S151] 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: -214748 ... 214748 (mm) in linear movements.

-214748 ... 214748 (°) for rotary movements.

Default value: 0.

PP159 O [S159] MonitoringWindow

Function: It sets the permissible following error range. If this is greater than the value given by PP159, the drive issues error 156 [too much following error] (DV1 [S11], 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 ... 214748 (mm) in linear movements.

0 ... 214748 (°) for rotary movements.

If PP159 = 0, The following error will not be monitored.

Default value: 3 (mm) in linear movements.

3 (°) for rotary movements.

PP169 O [S169] ProbeControlParameter

Funtion: This is the control parameter of the probe. It determines which probes and which flanks are activated by the procedure command of the probing cycle.

Its structure is:

Bit	Meaning		
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 selected for Probe 1
5	Probe 1 physical input selection		
		= 0	X4, pins 12 (+) and 3 (-)
		= 1	X3, pins 5 (+) and 6 (-)

The rest of the bits are reserved.

Valid values: 0 ... 63.

Default value: 0.

PP177 *Os [S177] 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.

Valid values: - 214748 ... 214748 (mm) for linear movements.

- 214748 ... 214748 (°) for rotary movements.

(See chapter 5, section: absolute feedback)

Default value: 0.

PP178 *Os [S178] 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.

Valid values: - 214748 ... 214748 (mm) for linear movements.

- 214748 ... 214748 (°) for rotary movements.

(See chapter 5, section: absolute feedback)

Default value: 0.

PP216.# **[S296.#] VelocityFeedForwardPercentage**

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 ... 120 (%).

Default value: 0 (%). The feedforward effect is not applied.

PP217.# **[S348.#] AccelerationFeedForwardPercentage**

Function: It sets the how much acceleration feed-forward is applied.

Valid values: 0 ... 120 (%).

Default value: 0 (%). The feedforward effect is not applied.

PV1 *s [S298] 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: -214748 ... 214748 (mm) on linear axes.
-214748 ... 214748 (°) on rotary axes.

Version: Operative from version 06.02 on.

PV47 Ws [S47] 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: -214748 ... 214748 (mm) on linear axes.

-214748 ... 214748 (°) on rotary axes.

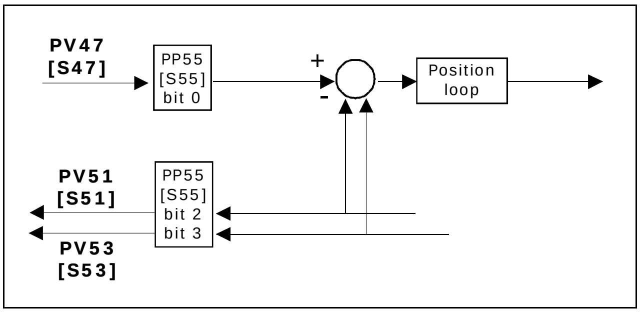
PV51 s [S51] PositionFeedback1

PV53 s [S53] 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.

Valid values: -214748 ... 214748 (mm) on linear axes.

-214748 ... 214748 (°) on rotary axes.



PV130 s [S130] 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: -214748 ... 214748 (mm) for linear movements.

-214748 ... 214748 (°) for rotary movements.

Default value: 0.

PV131 s [S131] 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: -214748 ... 214748 (mm) for linear movements.

-214748 ... 214748 (°) for rotary movements.

Default value: 0.

PV136 [S336] InPosition

Function: It is a mark that activates when the axis has reached the target position "LV148 [S258] TargetPosition". This positioning allows a margin given by parameter "PP57 [S57] Position Window".

Valid values: 0 (by default) and 1.

PV173 s [S173] 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: -214748 ... 214748 (mm) for linear movements.

-214748 ... 214748 (°) for rotary movements.

Default value: 0.

PV174 s [S174] 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: -214748 ... 214748 (mm) for linear movements.

-214748 ... 214748 (°) for rotary movements.

Default value: 0.

PV175 Ws [S175] DisplacementParameter1

Function: It indicates the offset of the coordinate system due to and after the home search carried out by the drive (with motor feedback).

Valid values: -214748 ... 214748 (mm) for linear movements.

-214748 ... 214748 (°) for rotary movements.

Default value: 0.

PV176 Ws [S176] DisplacementParameter2

Function: It indicates the offset of the coordinate system due to and after the home search carried out by the drive (with direct feedback).

Valid values: -214748 ... 214748 (mm) for linear movements.

-214748 ... 214748 (°) for rotary movements.

Default value: 0.

PV179 [S179] ProbeStatus

Function: If the drive stores one or more measurement values while the procedure command "PC170 [S170] Probing CycleProcedureCommand" is activated, it automatically sets the bit assigned in ProbeStatus.

If the CNC resets "PV205 [S405] Probe1 Enable", 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:

Bit	Meaning
0	Probe1PositiveLatched = 0 Not captured = 1 Captured
1	Probe1NegativeLatched = 0 Not captured = 1 Captured

The rest of the bits are reserved.

Valid values: 0 ... 3.

Default value: 0.

PV189 s [S189] 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 [F2005] PosErrorBetweenFeedbacks

Function: This variable may be used to display the error (difference) between the motor feedback and the direct feedback. 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.

PV200 O [S400] 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= B0S400.

Valid values:

0. Switch inactive.
1. Switch active (the axis is positioned on the switch).

PV201 O [S401] 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 1 = 1 INDEX active

Valid values: 0 and 1.

PV203 [S403] 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 [S148] DriveControlledHoming

and reactivates when it is executed successfully.

Also, the variable deactivates when the drive loses its reference to **machine zero**.

Valid values: 0 (position data referred to any point).

1 (position data referred to machine reference zero).

PV204 W [S404] PositionCommandStatus

Function: Variable internally useful to 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 reference zero).

Default value: 0.

PV205 O [S405] 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 1 = 0 Probe1 enabled

Valid values: 0 and 1.

PV207 O [S407] 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 [S146] NCControlledHoming

Valid values: 0 (home search disabled).

1 (home search enabled).

PV208 **[S408]** **ReferenceMarkerPulseRegistered**

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 Marker PositionA.

Valid values: 0 and 1.

PV209 **[S409]** **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 1 = 1 Probe1 positive captured

Valid values: 0 and 1.

PV210 **[S410]** **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 1 = 1 Probe1 negative captured

Valid values: 0 and 1.

PC150 W [F2003] 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.

Q group: Sercos® communication

QP1 * [S1] ControlUnitCycleTime

Function: Read parameter that indicates every how long the drives close the loop.

Valid values: 1 ... 8 (ms).

Default value: 4 (ms).

QP11 [F2000] Sercos®Mbaud

Function: It sets the transmission speed through the Sercos® ring. The CNC has a similar parameter. Both speeds must be the same in order to es Baudtablish communication.

Valid values:

1	2 MBaud
0	4 MBaud

With the Sercos® board (16 MBaud)	
0	4 MBaud *
1	2 MBaud *
2	2 MBaud
4	4 MBaud
8	8 MBaud
16	16 MBaud

*** for compatibility with previous Sercos® board versions.**

Default value:

0	4 MBaud

With the Sercos® board (16 MBaud)	
16	16 MBaud

Every time the transmission rate is selected with the "boot" button, the selected value is assigned to parameter QP11 !

Version: Modified from version 06.05.
Expanded in version 06.08.

QP12 *O [F2002] Sercos®TransmisionPower

Function: It defines the Sercos® power, i.e. the light power transmitted through the optical fiber.

Value of QP12	Cable length L (m)
2	L < 7
4	7 = L < 15
6	L = 15

Valid values: 1 ... 6.

Default value: 2.

When using the new Sercos® board (16 MBaud), the values of the previous table are no longer valid and those given in the following table must be considered instead !

Value of QP12	Cable length L (m)
1	L < 15
2	15 = L < 30
3	30 = L < 45
4	L = 45

Valid values: 1... 4.

Default value: 1.

Version: Operative from version 06.08 on.

QP13 **[F2004] IdOffset**

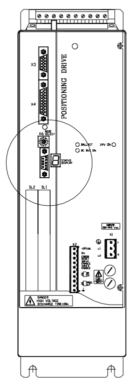
Function: This parameter may be used to direct more axes from the RS422 serial line. The real identifier is the number read on the rotary switch of the drive + (QP13 ·15). Regardless of the value of QP13, when the rotary switch is in position 0, the operation is set through serial line RS232.

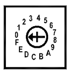
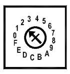
Valid values: 0 ... 8.

Default value: 0.

QP15 **[F2008] SerialProtocol**

Function: This parameter may be used to select the type of communications protocol with the position of the rotary switch of the RS422 board.



Rotary switch position	Value of parameter 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 (RTU mode) [RS - 422]
 position other than 0	**QP15 = 2**	ModBus (ASCII mode) [RS - 422]

RTU mode : binary data coding according to standard RTU (Remote Transmission Unit).
ASCII mode: ASCII data coding.

FAGOR

DDS Software v.06.xx

SERVO DRIVE SYSTEM MANUAL

PARAMETERS, VARIABLES & COMMANDS

Groups of parameters, variables and commands

QV1 F [F716] TMODE_Select

Function: This variable is useful to test the Sercos® ring hardware.

Valid values:

0	Normal operating mode
1	Zero Bit String
2	Continuous light output

QV30 F [F727] FiberDistErrCounter

Function: This variable may be used to diagnose Sercos® problems. 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 ... 65535.

R group: Rotor sensor

RP1 *O [F1500] Feedback1SineGain

RP2 *O [F1501] 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: 1500 ... 3070.

Default value: 2032.

RP3 *Os [F1502] Feedback1SineOffset

RP4 *Os [F1503] Feedback1CosineOffset

Function: Compensation (offset mode) of the sine/cosine signal that goes from the motor feedback to the drive.

Valid values: - 2000 ... 2000.

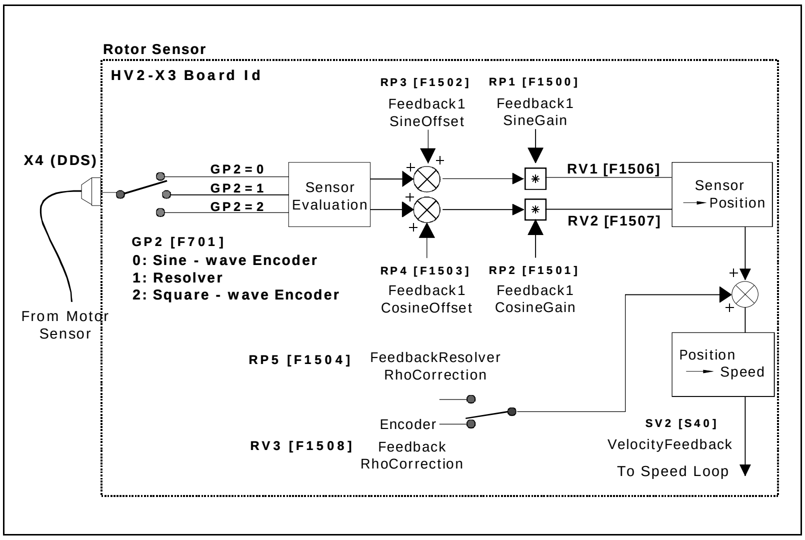
Default value: 0.

RP5 O [F1504] FeedbackResolverRhoCorrection

Function: Corrects the phase shift between the resolver's magnetic shaft and the motor shaft. The motors are shipped out mechanically adjusted from the factory and, usually, it is not necessary to manipulate RP5.

Valid values: 0 ... 65535.

Default value: 0.



RP6.# O [F1505.#]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 occur are not communicated).

Default value: 0.

RP51 O [F1550] Feedback2SineGain

RP52 O [F1551] 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: 1500 ... 3070.

Default value: 2032.

RP53 Os [F1552] Feedback2SineOffset

RP54 Os [F1553] Feedback2CosineOffset

Function: Compensation (offset mode) of the sine/cosine signal that goes from the motor feedback to the drive.

Valid values: - 2000 ... 2000.

Default value: 0.

RP60 O [F2360] SSIClockFrequency

Function: Frequency of the SSI communication clock.

Valid values: 59 ... 7500 (kHz).

Default value: 75 (kHz).

Version: Operative from version 06.08 on.

RP61 O [F2361] SSIDataLength

Function: SSI data size in bits.

Valid values: 8 ... 32.

Default value: 32.

Version: Operative from version 06.08 on.

RP62 O [F2362] SSIDataFormat

Function: SSI data format.

bit 0 = 0 ➔ Binary code

bit 0 = 1 ➔ Gray code

The rest of the bits are reserved.

Valid values: 0 and 1.

Default value: 0.

Version: Operative from version 06.08 on.

RP63 O [F2363] SSIFeedbackResolution

Function: Resolution value of the absolute linear feedback device (in dµm) with SSI digital communication protocol.Thus, if the resolution is 1 µm, RP63 will be 10, not 1.

WARNING: Its parameters will not be set with any value when using an absolute rotary encoder **!**

Valid values: 1... 2147483647 dµm

Default value: 1 dµm.

Version: Operative from version 06.08 on.

RV1 s [F1506] FeedbackSine

RV2 s [F1507] FeedbackCosine

Function: Sine and cosine of the feedback that goes from the motor to the drive as internal system variables.

Valid values: - 32768 ... 32767.

Note: From version v.06.03 on, when using square-wave motor feedback, these two variables may have incremental square-wave signals for display and diagnostics !

RV3 F [F1508] FeedbackRhoCorrection

Function: Corrects the phase shift between the encoder shaft and the motor 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 ... 65535.

RV4 [F1509] FeedbackRadius

Function: It may be used to display the radius formed by the RV1 and RV2 signals.

Valid values: 0 ... 32767.

RV5 [F1515] StegmannType

Function: The RV5 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:

Bits	Values	Meaning
7 - 0	02H	Sincos encoder
	07H	Multi-turn Sincos encoder
	12H	Sincoder encoder
	27H	Multi-turn Sincoder encoder
15 - 8		Reserved

RV6 **[F1510] EncoderError**

Function: The RV6 variable contains a list of feedback errors for the exclusive use of Fagor technicians.

RV7 **[F1511] 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 sales references in appendix C. RV7 will keep that value as long as the motor is not changed.

Valid values: The sales references of the motors indicated in appendix C.

RV8 F **[F1512] 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 3.

Valid values:

0 Adjustment in progress

1 Adjustment completed

RV9 W **[F1514] 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.: due to noise). See error E605 from the error listing of appendix B.

Valid values: 0 ... 4294967295.

Version: Operative from version 06.02 on.

RV10 s **[F1517] FeedbackRhoDisplacement**

Function: Variable useful for adjusting the Rho when using a resolver or an incremental encoder feedback. It displays the 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: -32768 ... 32767.

Default value: 0 (rho adjusted).

Version: Operative from version 06.03 on.

RV51 s [F1556] Feedback2Sine

RV52 s [F1557] Feedback2Cosine

Function: Sine and cosine of the feedback that goes from the direct feedback to the drive as internal system variables.

Valid values: -32768 ... 32767.

RV54 [F1559] Feedback2Radius

Function: It may be used to display the radius formed by the RV51 and RV52 signals.

Valid values: 0 ... 32767.

RV59 W [F1516] Feedback2ErrCounter

Function: This variable may be used to count the failures (they do not have to be consecutive) that occur on incremental signals with direct feedback (e.g.: due to noise). See error E608 from the error listing of appendix B.

Valid values: 0 ... 4294967295.

Version: Operative from version 06.02 on.

RC1 O [F1513] EncoderParameterStoreCommand

Function: It has many functions:

- If Sincos, 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).

S group: Speed

SP1.# * [S100.#] VelocityProportionalGain

SP2.# * [S101.#] VelocityIntegralTime

Function: Value of the proportional / integral action of the velocity PI.

Valid values: SP1: 0 ... 16384 (mArms/rpm).

SP2: 0 ... 1638.4 (ms).

Note: The value of the integral action SP2 has been reduced in a factor of x16 as compared to previous versions.

SP4.# * [S211.#] VelocityAdaptationProportionalGain

SP5.# * [S212.#] VelocityAdaptationIntegralTime

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 ... 400 (%). The action of the PI at low speeds may go from 25 % to 400 % of the action at high speeds.

(SP4·SP1)/1000 must be smaller than the maximum value that SP1can take.

(SP5·SP2)/1000 must be smaller than the maximum value that SP2 can take.

Default value: 100 (%). Constant proportional / integral action at any speed.

SP6.# O [S209.#] VelocityAdaptationLowerLimit

Function: It is the upper limit of the speeds considered **low**

Valid values: It must be smaller than SP7 (rpm).

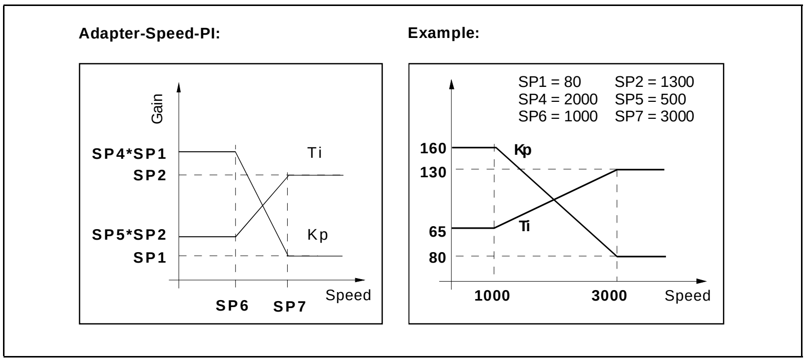
Default value: 10 % of SP10 (rpm).

SP7.# O [S210.#] VelocityAdaptationUpperLimit

Function: It is the lower limit of the speeds considered **high**

Valid values: It must be smaller than SP10 (rpm).
It must be greater than SP6 (rpm).

Default value: 80% of SP10 (rpm).



SP10.# O [S91.#] VelocityLimit

Function: Maximum value that "SV7 (Velocity Command Final)" can take.

If SV2 (VelocityFeedback) is greater than this parameter in a 12%, it issues error 200 (overspeed).

Valid values: 1 ... 24000 (rpm).
Depends on the motor connected.

Default value: Synchronous: 110% of MP25 (MotorRatedSpeed).

Asynchronous: 110% of MP26 (MotorMaximumSpeed).

SP13.# *O [F1601.#] VelocityIntegralResetThreshold

Function: Parameter that disables the integral action of the velocity PI for motors with **square-wave feedback.**

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 ... 1000 (rpm).

Default value: 0 (rpm).

SP20.# [F31.#] VoltageRpmVolt

Function: Parameter [SP20] & [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 ... 10 (V).

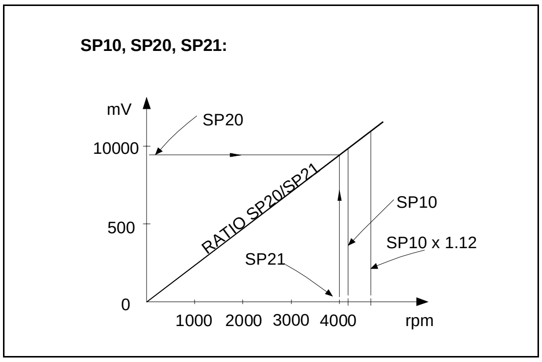
Default value: 9.5 V.

SP21.# [F81.#] RpmRpmVolt

Function: See SP20.

Valid values: 10 ... 24000 (rpm). It depends on the motor it connects to.

Default value: Synchronous: MP25 MotorRatedSpeed (rpm).
Asynchronous: MP26 MotorMaximumSpeed (rpm).



SP30 *s [F1603] AnalogInputOffset1

SP31 *s [F1604] AnalogInputOffset2

Function: Compensation of the offset of analog inputs 1 and 2 respectively.

Valid values: - 8190 ... 8190 (mV).

Default value: 0.

SP40.# O [S125.#] VelocityThresholdNx

Function: Velocity level under which logic mark nfeedback < 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 $n_{min.}$

Usage example:

In a particular application, we would like to know when the motor exceeds 400 rpm. This parameter SP40 is loaded with the value of 400. When the motor exceeds this speed, the mark associated with SV3 is deactivated to 0.

Valid values: 0 ... SP10 (rpm).

Default value: 20 (rpm).

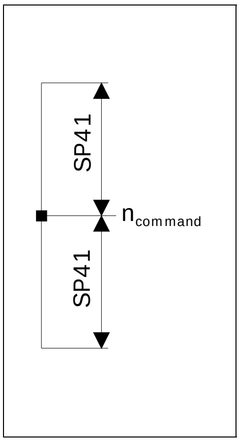
SP41.# O [S157.#] VelocityWindow

Function:

Velocity window assigned to logic mark nfeedback = ncommand.

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 (nfeedback) has reached the supplied command (ncommand) within the margins of that window SP41.



Valid values: 0 ... 12 % of parameter SP10 (rpm).

Default value: 20 (rpm).

SP42 O [S124] StandStillWindow

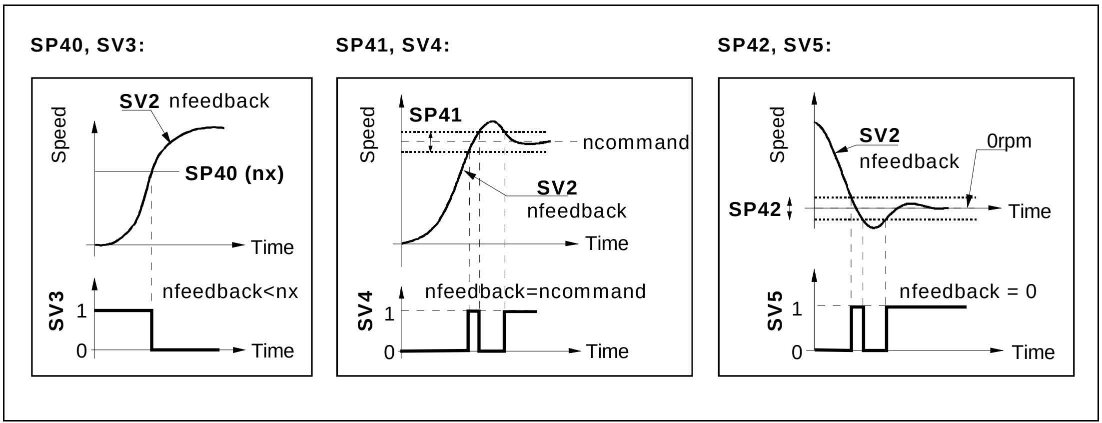
Function: the velocity window for logic mark $n_{feedback} = 0$. The logic mark is the SV5 variable.

Usage example:

In a particular application, we would like to know when the speed of the motor is lower than 10 rpm. This parameter SP42 is loaded with the value of 10 and when the motor speed is lower than 10 rpm, it activates the mark associated with SV5.

Valid values: 0 ... SP10 (rpm).

Default value: 20 (rpm).



SP43 O [S43] VelocityPolarityParameters

Function: This parameter is used, while in speed control, to change the sign of the velocity command both internally and for display. But not to change 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.

While in position control, it will change neither the sign of the command nor that of the feedback internally, it will change it for display only.

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 [S115] Position Feedback 2Type.

Bit	Meaning		
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 [S44] VelocityDataScalingType

Funtion: Parameter that has to do with the type of scaling.

Bit	Meaning
15 [MSB] -2	(reserved)
1, 0 [LSB]	Scaling method 10 Rotary

Valid values: 2.

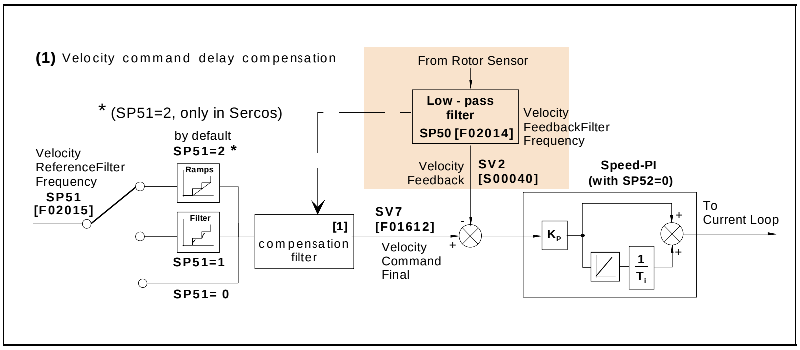
SP50 *O [F2014] VelocityFeedbackFilterFrequency

Function: This parameter sets the break 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: 0. (filter disabled).



SP51 *O [F2015] VelocityReferenceFilterFrequency

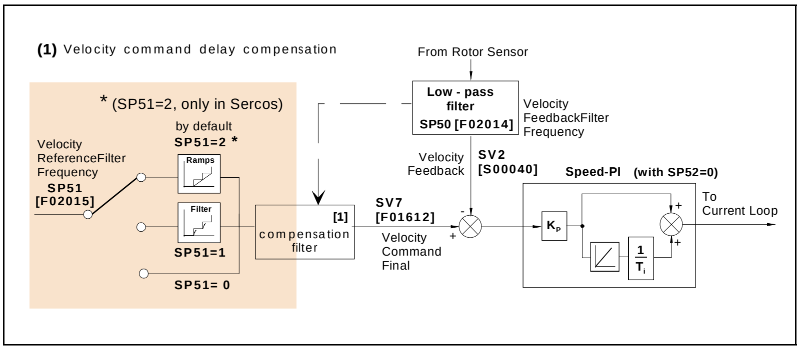
Function: With the drive working in velocity mode (e.g.: with the 8055 CNC), this parameter damps the velocity command and generates intermediate commands between those sent out by the CNC.

Valid values:
0 deactivated.
1 Activate a first order filter of the velocity command.
2 activate velocity ramps. (Only in Sercos®).

Default values: 2 (with velocity ramps).

WARNING: Remember that if parameter SP80 = 0 & SP100 = 1, then SP51 = 2 will have no effect !

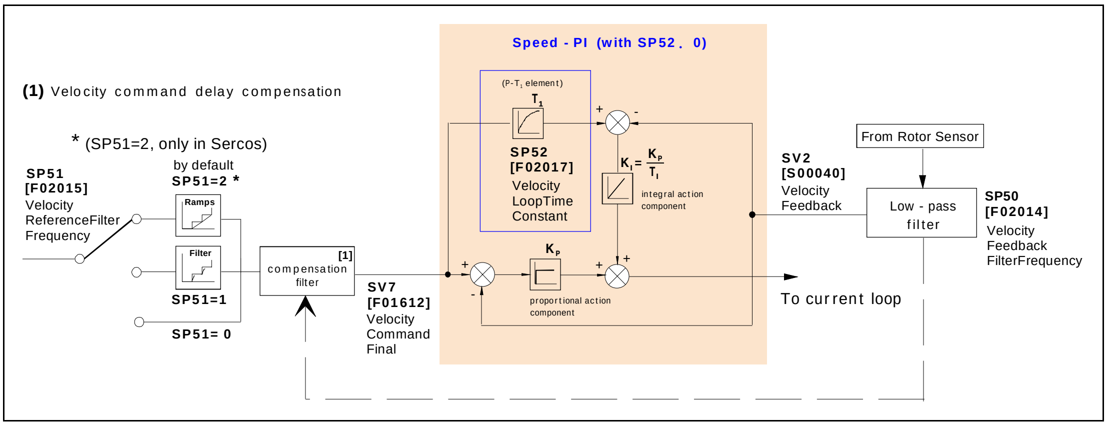
Version: Modified in version 06.02.



SP52 *O [F2017] VelocityLoopTimeConstant

Function: Parameter that may be used to **model** the velocity loop with a 1^{st} 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 given in ms. The right value makes the system more stable and it dampens its response.

Thus, it modifies the velocity loop with respect to software versions older than v.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).

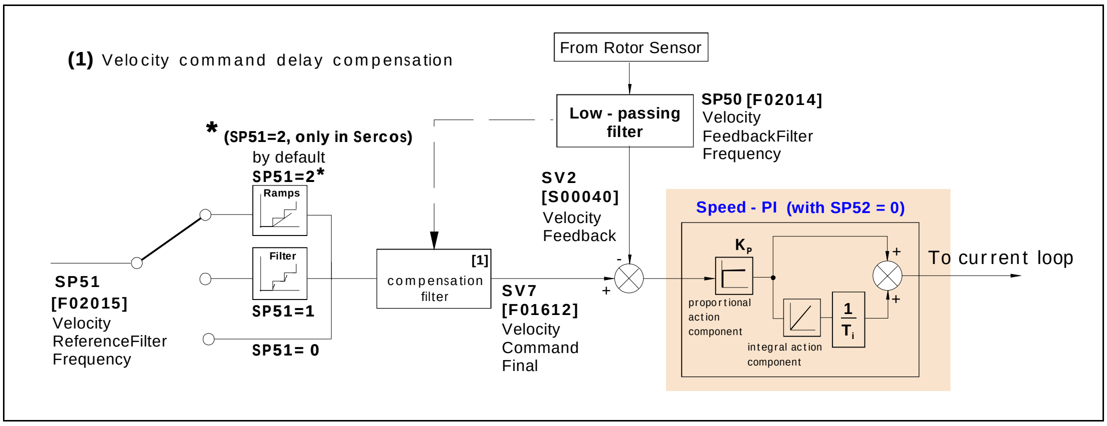


Note that a poor adjustment of SP52 may make the loop unstable !

Valid values: 0, ...,100 (ms).

Default value: 0.

With SP52 = 0, the velocity loop is the same as that of software versions older than v.06.08. See figure.



Version: Modified in version 06.08.

FAGOR

DDS Software v.06.xx

SERVO DRIVE SYSTEM MANUAL

PARAMETERS, VARIABLES & COMMANDS

Groups of parameters, variables and commands

SP60.# O [S138.#] AccelerationLimit

SP62.# O [F1606.#]AccelerationLimit2

SP64.# O [F1608.#]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/s^2).

The conversion is 1 rad/s^2 = 9.5492 rpm/s = 0.009545 rpm/ms

Valid values: 0 ... 32767.

Default value: 1000.

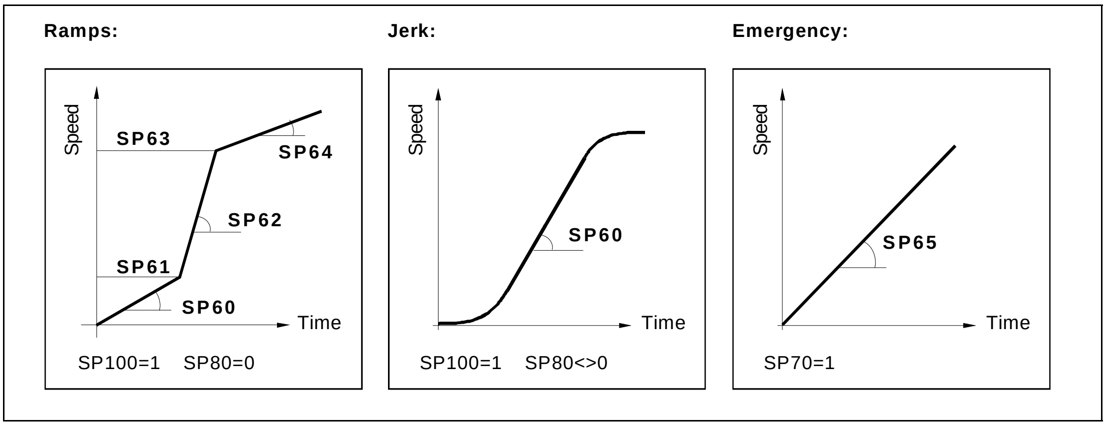
SP61.# O [F1605.#]AccelerationLimitVelocity2

SP63.# O [F1607.#]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 ... 24000 (rpm).

Default value: 1000 (rpm).



SP65.# O [F1609.#] EmergencyAcceleration

Function: It is an emergency stop and 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 an emergency stop.

Default value: **For asynchronous motors**:

SP65 = 1000 (rad/s^2)

For asynchronous motors, the user will calculate SP65 **(with K = 0.8 as recommended value)** as per the formula:

SP65 = K · (CP20 · MP2) / [MP24 · (1 + 0.01 · 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 = K = 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 formula.

Units: (rad/s^2).

The conversion is 1 rad/s^2 = 9.5492 rpm/s = 0.009545 rpm/ms

Valid values: 1 ... 2147484 (rad/s^2).

Version: Modified in version 06.01

SP70 O [F1610] AccelerationOnEmergency

Function: It determines whether the acceleration limit given by SP65 is applied or not in case of an emergency stop coming from Speed_Enable, Halt function or stop by error.

Valid values: 0 (ramps are not applied).

1 (ramps are applied)

Default values: 0 (ramps are not applied).

SP80.# O [S349.#] JerkLimit

Function: It limits the command **jerk**, i.e. how quickly the acceleration changes. It acts in conjunction with the acceleration limit SP60. SP80 must be 0 to cancel the effect of this limitation.

Units: (rad/s^3).

The conversion is 1 rad/s^3 = 9.5492 rpm/sec^2

Valid values: 0 ... 2147484647 (rad/s^3).

Default value: 10000 (rad/s^3).

SP100.# O [F1611.#]AccelerationLimitOn

Function: It activates or cancels the set of limitations and command filters (ramps, jerk). It does not affect the limitation of the emergency acceleration.

Valid values: 0 (off).

1 (on).

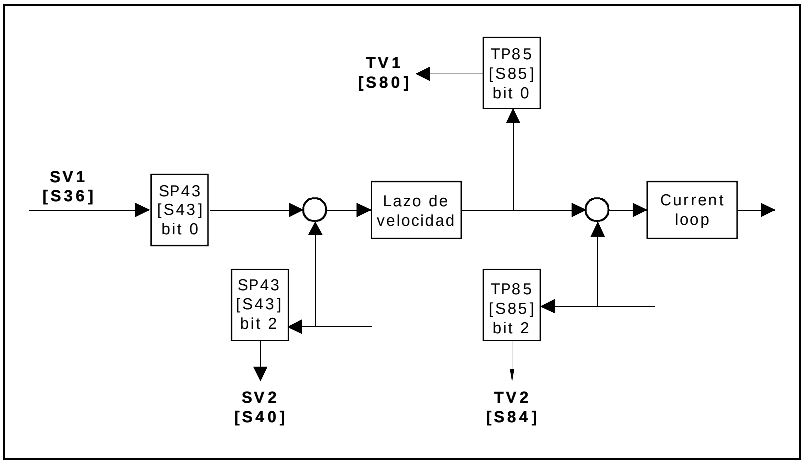
Default value: 0 (limits off).

SV1 Ws [S36] VelocityCommand

SV2 s [S40] VelocityFeedback

Function: The drive transfer this data to the CNC to display the value of the velocity command and feedback.

Valid values: -24000 ... 24000 (rpm).



SV3 [S332] nFeedbackMinorNx

Function: Boolean logic mark associated with: nfeedback < n_x.

See parameter SP40.

Valid values: 0/ 1, (no / yes).

SV4 [S330] nFeedbackEqualNCommand

Function: In speed regulation, it is the Boolean logic mark associated with: nfeedback = ncommand.

See parameter SP41.

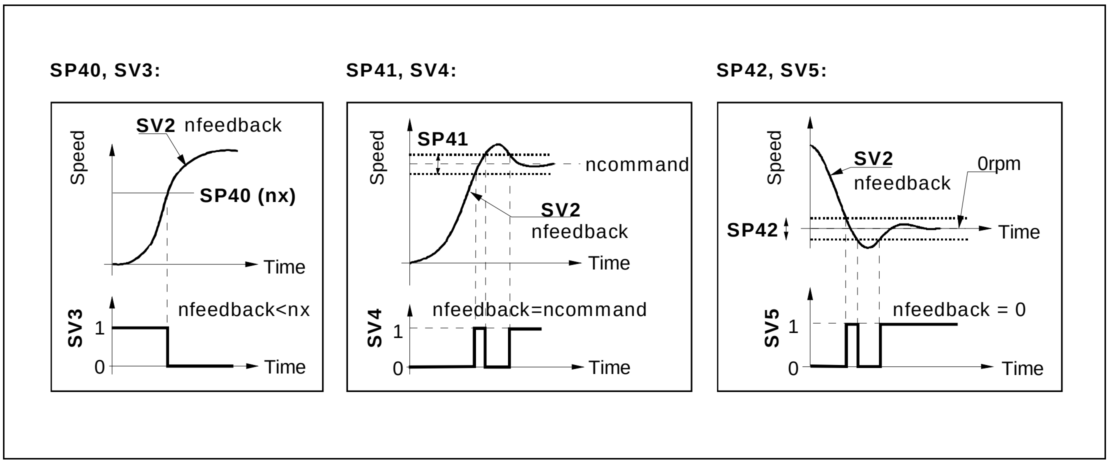
Valid values: 0/ 1, (no / yes).

SV5 [S331] nFeedbackEqual0

Function: Boolean logic mark associated with: nfeedback = 0.

See parameter SP42.

Valid values: 0/ 1, (no / yes).



SV7 s [F1612] VelocityCommandFinal

Function: It reflects the value of the velocity command after limitations, ramps, etc.

Units: (rpm).

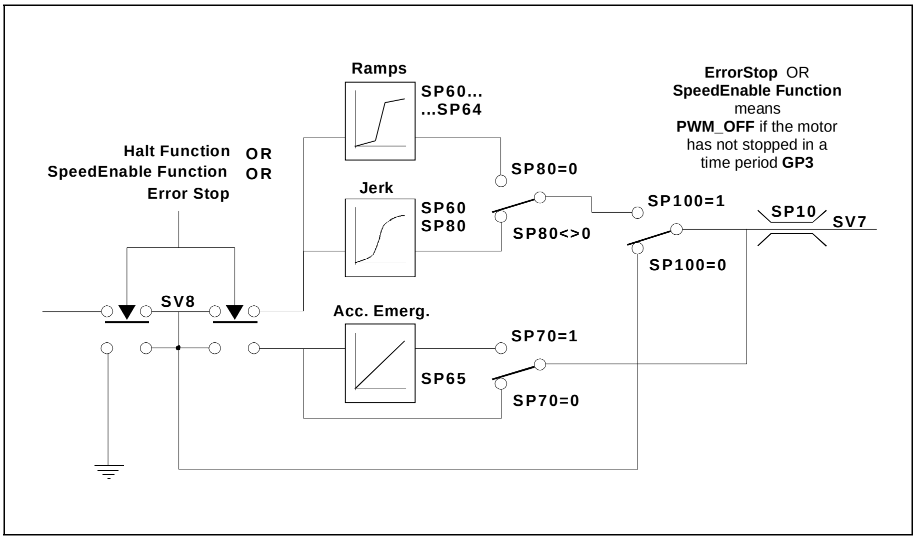
Valid values: -24000 ... 24000 (rpm).

SV8 s [F1613] VelocityCommandBeforeFilters

Function: It reflects the value of the velocity command before limitations, ramps, etc.

Units: (rpm).

Valid values: -24000 ... 24000 (rpm).



SV9 s [F1614] PositionCommandDelta

Function: It may be used to display the position increments (position delta) of the command per cycle time.

Valid values: -2147484647 ... 2147484647 (mm) linear.

-2147484647... 2147484647 (°) rotary

Default value: 0.

SV10 s [F1615] PositionFeedback1Delta
SV11 s [F1616] PositionFeedback2Delta

Function: Load velocity measured with motor feedback or with direct feedback respectively.

Valid values: - 2147484 ... 2147484 (mm/min).

Version: Operative from version 06.01 on.

T group: Torque and power

TP1 Os [S126] 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 ... 100 (%). Depends on the drive connected.

Default value: 5 (%).

TP2 Os [S158] 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 an FXM synchronous motor = product of 3 elements:

- MP2 [F1200] MotorTorqueConstant
- MP3 [S111] MotorContinuousStall Current
- MP25 [F1221] MotorRatedSpeed

In an SPM asynchronous motor =

- MP12 [F1208] MotorNominalPower

Units: Fraction of the rated value of the motor power.

Valid values: 0 ... 100 (%).

Default value: 5 (%).

TP10 *O [F1902] ConstantPositiveTorqueCompensation

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 ... 100 (N·m).

Default value: 0 (N·m).

TP11 *O [F1903] ConstantNegativeTorqueCompensation

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 ... 100 (N·m).

Default value: 0 (N·m).

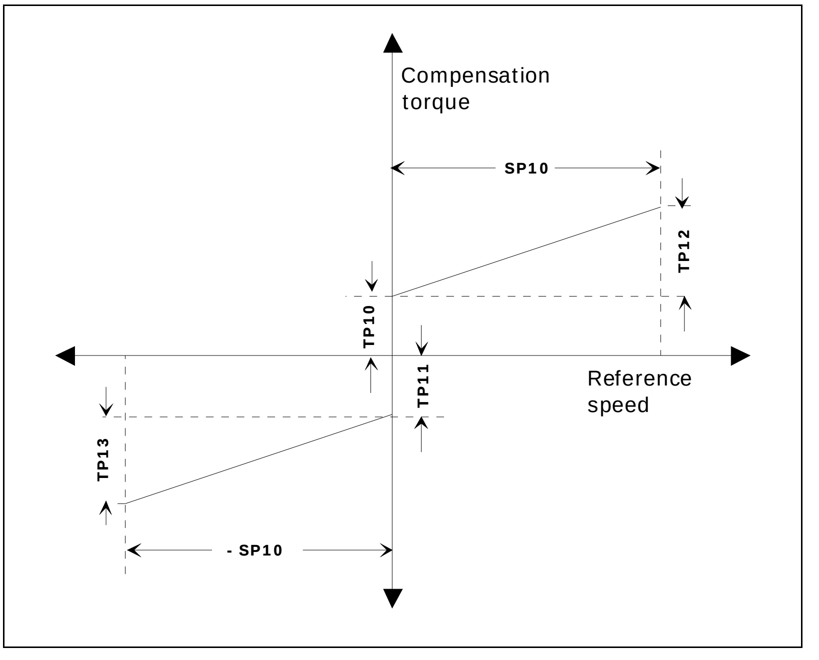
TP12 *O [F1904] **DynamicPositiveTorqueCompensation**

Function: Dynamic friction compensation 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.

Units: (N·m).

Valid values: 0 ... 100 (N·m).

Default value: 0 (N·m).



TP13 *O [F1905] **DynamicNegativeTorqueCompensation**

Function: Dynamic friction compensation 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 ... 100 (N·m).

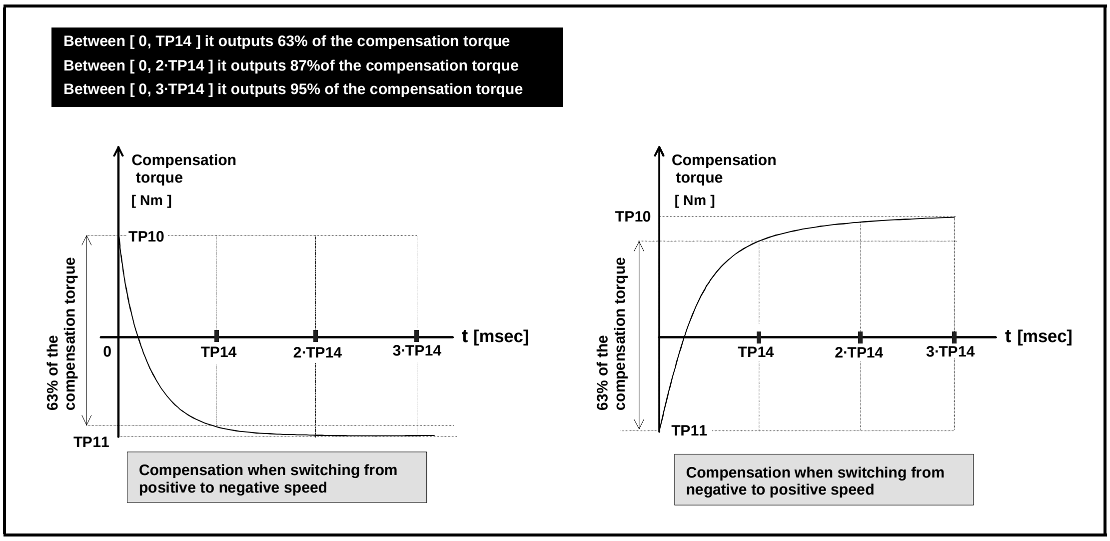
Default value: 0 (N·m).

TP14 *O [F1906] TorqueCompensationTimeConstant

Function: Time constant of the torque compensation. Before applying the torque compensation, it goes through a low-passing filter. This filter helps better represent 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 ... 100 (ms).

Default value: 0 (ms).



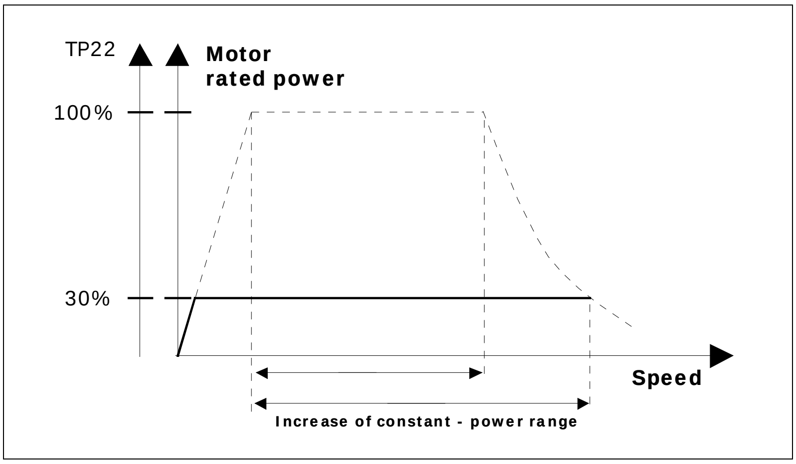
TP22 *FA [F1914] MotorPowerReduction

Function: Percentage reduction of the power level. It is used to reduce power when requiring a wide range of speeds at constant power. A motor must be used whose rated power is greater than what the application requires, providing 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 ... 100 (%).

Default value: 100 (%).

Version: Operative from version 06.01 on.



TP85 O [S85] 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 [S115] PositionFeedback2Type.

Bit	Meaning
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

TP86 [S86] TorqueScalingParameters

Function: **It is a read-only parameter**. It indicates, among other things, the units to write and read the torque. It is initialized with the value indicating that the torque is referred to the motor. The units are given in % of the rated motor torque. See TV1 and TV2.

Bit	Meaning
6	Torque reference = 0 at the motor shaft (by default) = 1 at the load
5	Reserved
4	Units for torque = 0 in (N·m) (by default) = 1 in (in·lbf)
3	= 0 Preferred scaling (by default) = 1 Parameter scaling
2 - 0 (LSB)	Scaling method = 000 Percentage scaling (by default) = 001 Linear scaling (force) = 010 Rotational scaling (torque)

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 !
The previous table shows the meaning of each bit.

Valid values: 0.

Version: Operative from version 06.01 on.

TV1 s [S80] TorqueCommand
TV2 s [S84] TorqueFeedback

Function: The drive transfer this data to the CNC to display the value of the torque command and feedback.

Valid values: -1000 ... 1000 (%).

Units: They are read and/or written as % of the rated torque according to TP86.

The rated torque is obtained:

Motor type	Obtaining the rated torque (N·m)
Synchronous	[MP2 (N·m/Arms) · MP3 (Arms)]
Asynchronous	[MP12 (kW) · 1000 · 60] / [MP25 (rpm) · 2π]

TV3 s [F1701] 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.

TV4 s [F1912] VelocityIntegralAction

Function: It is the output of the velocity PI. 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.

TV10 [S333] TGreaterTx

Function: Logic mark indicating that the torque (TV2) is greater than a threshold value (TP1). See TP1.

Valid values: 0 (TV2 < TP1).

1 (TV2 > TP1).

TV50 s [F1700] PowerFeedback

Function: Display of the real power value

Valid values: -100 ... 100 (kW).

TV60 [S337] PGreaterPx

Function: Logic mark indicating that the power (TV50) is greater than a threshold value (TP2). See TP2.

Valid values: 0 (TV50 < TP2).

1 (TV50 > TP2).

TV92 O [S92] 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 ... 1000.

Default value: 1000.

TV100 [F1702] 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 (there is no torque).

Default value: 1 (there is torque).

X group: Miscellaneous

XV1 **[F1900] One**
XV2 **[F1901] 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 (sets the digital output to 1).

IP12 = 0
(removes the digital input from any function).

XV10 Ws [F2032] GeneralVariable32A
XV11 Ws [F2033] 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 [F2034] ReadPlcMarksGroup
XV13 W [F2035] WritePlcMarksGroup

Function: Variables that may be used to share information in real time between the PLC of the 8055 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'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.

S -1	Q P1	ControlUnitCycleTime
S -11	D V1	Class1Diagnostics (Errors)
S -12	D V9	Class2Diagnostics (Warnings)
S -13	D V10	Class3Diagnostics (OperationStatus)
S -30	G V2	ManufacturerVersion
S -32	A P1	PrimaryOperationMode
S -36	S V1	VelocityCommand
S -40	S V2	VelocityFeedback
S -41	P P41	HomingVelocityFast
S -42	P P42	HomingAceleration
S -43	S P43	VelocityPolarityParameters
S -44	S P44	VelocityDataScalingType
S -47	P V47	PositionCommand
S -49	P P49	PositivePositionLimit
S -50	P P50	NegativePositionLimit
S -51	P V51	PositionFeedback1
S -52	P P52	ReferenceDistance1
S -53	P V53	PositionFeedback2
S -54	P P54	ReferenceDistance2
S -55	P P55	PositionPolarityParameters
S -57	P P57	PositionWindow
S -58	P P58	Backlash
S -60	L P60	PosSwitch1On
S -61	L P61	PosSwitch1Off
S -62	L P62	PosSwitch2On
S -63	L P63	PosSwitch2Off
S -64	L P64	PosSwitch3On
S -65	L P65	PosSwitch3Off
S -66	L P66	PosSwitch4On
S -67	L P67	PosSwitch4Off
S -68	L P68	PosSwitch5On
S -69	L P69	PosSwitch5Off
S -70	L P70	PosSwitch6On
S -71	L P71	PosSwitch6Off
S -72	L P72	PosSwitch7On
S -73	L P73	PosSwitch7Off
S -74	L P74	PosSwitch8On
S -75	L P75	PosSwitch8Off
S -76	P P76	PositionDataScalingType
S -80	T V1	TorqueCommand
S -84	T V2	TorqueFeedback

S -85	T P85	TorquePolarityParameters
S -86	T P86	TorqueScalingParameters
S -91	S P10	VelocityLimit
S -92	T V92	BipolarTorqueForceLimit
S -95	D V95	DiagnosticMessage
S -99	D C1	ResetClass1Diagnostics
S -100	S P1	VelocityProportionalGain
S -101	S P2	VelocityIntegralTime
S -103	P P103	Value module
S -104	P P104	PositionKvGain
S -106	C P1	CurrentProportionalGain
S -107	C P2	CurrentIntegralTime
S -108	L V108	FeedrateOverride
S -109	M P4	MotorPeakCurrent
S -110	H V1	S3LoadCurrent
S -111	M P3	MotorContinuousStallCurrent
S -115	P P115	PositionFeedback2Type
S -116	N P116	ResolutionOfFeedback1
S -117	N P117	ResolutionOfFeedback2
S -118	N P118	ResolutionOfLinearFeedback
S -121	N P121	InputRevolutions
S -122	N P122	OutputRevolutions
S -123	N P123	FeedConstant
S -124	S P42	StandStillWindow
S -125	S P40	VelocityThresholdNx
S -126	T P1	TorqueThresholdTx
S -130	P V130	ProbeValue1PositiveEdge
S -131	P V131	ProbeValue1NegativeEdge
S -134	D V32	MasterControlWord
S -135	D V31	DriveStatusWord
S -138	S P60	AccelerationLimit
S -140	G V9	DriveType
S -141	M P1	MotorType
S -142	D P142	ApplicationType
S -147	P P147	HomingParameter
S -150	P P150	ReferenceOffset1
S -151	P P151	ReferenceOffset2
S -157	S P41	VelocityWindow
S -158	T P2	PowerThresholdPx
S -159	P P159	MonitoringWindow
S -165	N P165	DistanceCodedReferenceDimension1
S -166	N P166	DistanceCodedReferenceDimension2

S -169	P P169	ProbeControlParameter
S -173	P V173	MarkerPositionA
S -174	P V174	MarkerPositionB
S -175	P V175	DisplacementParameter1
S -176	P V176	DisplacementParameter2
S -177	P P177	AbsoluteDistance1
S - 178	P P178	AbsoluteDistance2
S - 179	P V179	ProbeStatus
S - 183	L P183	SynchronizationVelocityWindow
S - 189	P V189	FollowingError
S - 193	L V193	PositioningJerk
S - 201	K V5	MotorTemperatureWarningLimit
S - 202	K V9	CoolingTemperatureWarningLimit
S - 204	K V8	MotorTemperatureErrorLimit
S - 205	K V12	CoolingTemperatureErrorLimit
S - 207	G P9	DriveOffDelayTime
S - 209	S P6	VelocityAdaptationLowerLimit
S - 210	S P7	VelocityAdaptationUpperLimit
S - 211	S P4	VelocityAdaptationProportionalGain
S - 212	S P5	VelocityAdaptationIntegralTime
S - 217	G V22	ParameterSetPreselection
S - 218	G V26	GearRatioPreselection
S - 220	G C4	OfflineParameterValidation
S - 228	L P228	SynchronizationPositionWindow
S - 236	L P236	LeadDrive1Revolutions
S - 237	L P237	SlaveDriveRevolutions1
S - 245	L V245	LeadDrive1AngularPosition
S - 254	G V21	ParameterSetActual
S - 255	G V25	GearRatioActual
S - 258	L V158	TargetPosition
S - 259	L V159	PositioningVelocity
S - 260	L V160	PositioningAcceleration
S - 262	G V10	LoadDefaultsCommand
S - 264	G C1	BackupWorkingMemoryCommand
S - 296	P P216	VelocityFeedFordwardPercentage
S - 298	P V1	HomeSwitchDistance
S - 299	P P4	HomeSwitchOffset
S - 315	L V215	PositioningVelocityGreaterLimit
S - 323	L V223	TargetPositionOutsideOfTravelRange
S - 330	S V4	nFeedbackEqualNCommand
S - 331	S V5	nFeedbackEqual0
S - 332	S V3	nFeedbackMinorNx

S - 333	T V10	TGreaterTx
S - 336	P V136	InPosition
S - 337	T V60	PGreaterPx
S - 342	L V242	TargetPositionAttained
S - 343	L V243	InterpolatorHalted
S - 348	P P217	AccelerationFeedForwardPercentage
S - 349	S P80	JerkLimit
S - 380	G V4	DCBusVoltage
S - 383	K V6	MotorTemperature
S - 391	P P5	ActualPositionMonitoringWindow
S - 393	L P143	ModuloCommandMode
S - 400	P V200	HomeSwitch
S - 401	P V201	Probe1
S - 403	P V203	PositionFeedbackStatus
S - 404	P V204	PositionCommandStatus
S - 405	P V205	Probe1Enable
S - 407	P V207	HomingEnable
S - 408	P V208	ReferenceMarkerPulseRegistered
S - 409	P V209	Probe1PositiveLatched
S - 410	P V210	Probe1NegativeLatched
F - 31	S P20	VoltageRpmVolt
F - 81	S P21	RpmRpmVolt
F - 130	N P131	InputRevolutions2
F - 131	N P132	OutputRevolutions2
F - 132	N P133	FeedConstant2
F - 201	B V1	HaltDrivePin
F - 202	B V3	HaltDriveDnc
F - 203	B V7	DriveEnableDnc
F - 204	B V14	NotProgrammableIOs
F - 290	H V10	VsMSC
F - 291	H V11	FlashManufacturerCode
F - 293	H V13	Sercos®RS422Id
F - 300	C P3	CurrentFeedbackDerivativeGain
F - 301	C P4	CurrentAdaptationProportionalGain
F - 302	C P5	CurrentAdaptationIntegralTime
F - 303	C P6	CurrentAdaptationLowerLimit
F - 304	C P7	CurrentAdaptationUpperLimit
F - 305	C V10	CurrentUOffset
F - 306	C V11	CurrentVOffset
F - 307	C P20	CurrentLimit
F - 308	C P30	CurrentCommandFiltersType
F - 309	C V1	CurrentUFeedback

F - 310	C V2	CurrentVFeedback
F - 311	C V3	CurrentFeedback
F - 312	C P31	CurrentCommandFilter1Frequency
F - 313	C P32	CurrentCommandFilter1Damping
F - 314	C P33	CurrentCommandFilter2Frequency
F - 315	C P34	CurrentCommandFilter2Damping
F - 316	C P16	SeriesInductance
F - 317	C P8	CurrentLoopGainsCalculation
F - 404	D V11	FagorDiagnostics
F - 405	D V14	ErrorsInDncFormat
F - 500	E P1	EncoderSimulatorPulsesPerTurn
F - 501	E P2	EncoderSimulatorI0Position
F - 502	E P3	EncoderSimulatorDirection
F - 503	E C1	EncoderSimulatorSetI0
F - 600	F P1	MotorFluxProportionalGain
F - 601	F P2	MotorFluxIntegralTime
F - 602	F P20	MotorBEMFProportionalGain
F - 603	F P21	MotorBEMFPIntegralTime
F - 612	F P30	RotorResistanceEstimationActive
F - 613	F P31	RotorFixedTemperature
F - 614	G C5	AutoCalculate
F - 615	G C6	HomeSwitchAutoCalibration
F - 622	F P40	FluxReduction
F - 623	F V1	BEMF
F - 700	G P1	PwmFrequency
F - 701	G P2	Feedback1Type
F - 702	G P3	StoppingTimeout
F - 703	G P4	SetNumber
F - 704	G P5	ParameterVersion
F - 705	G V3	FlashParameterChecksum
F - 706	G V5	CodeChecksum
F - 707	G V8	AccessLevel
F - 708	G V11	SoftReset
F - 709	G V13	PowerBusStatus
F - 710	G V14	PowerVoltageMinimum
F - 711	G V23	ParameterSetAck
F - 712	G V24	ParameterSetStb
F - 713	G V30	ParameterSetBit0
F - 714	G V31	ParameterSetBit1
F - 715	G V32	ParameterSetBit2
F - 717	G P6	GearRatioNumber
F - 719	G P10	Feedback2Type

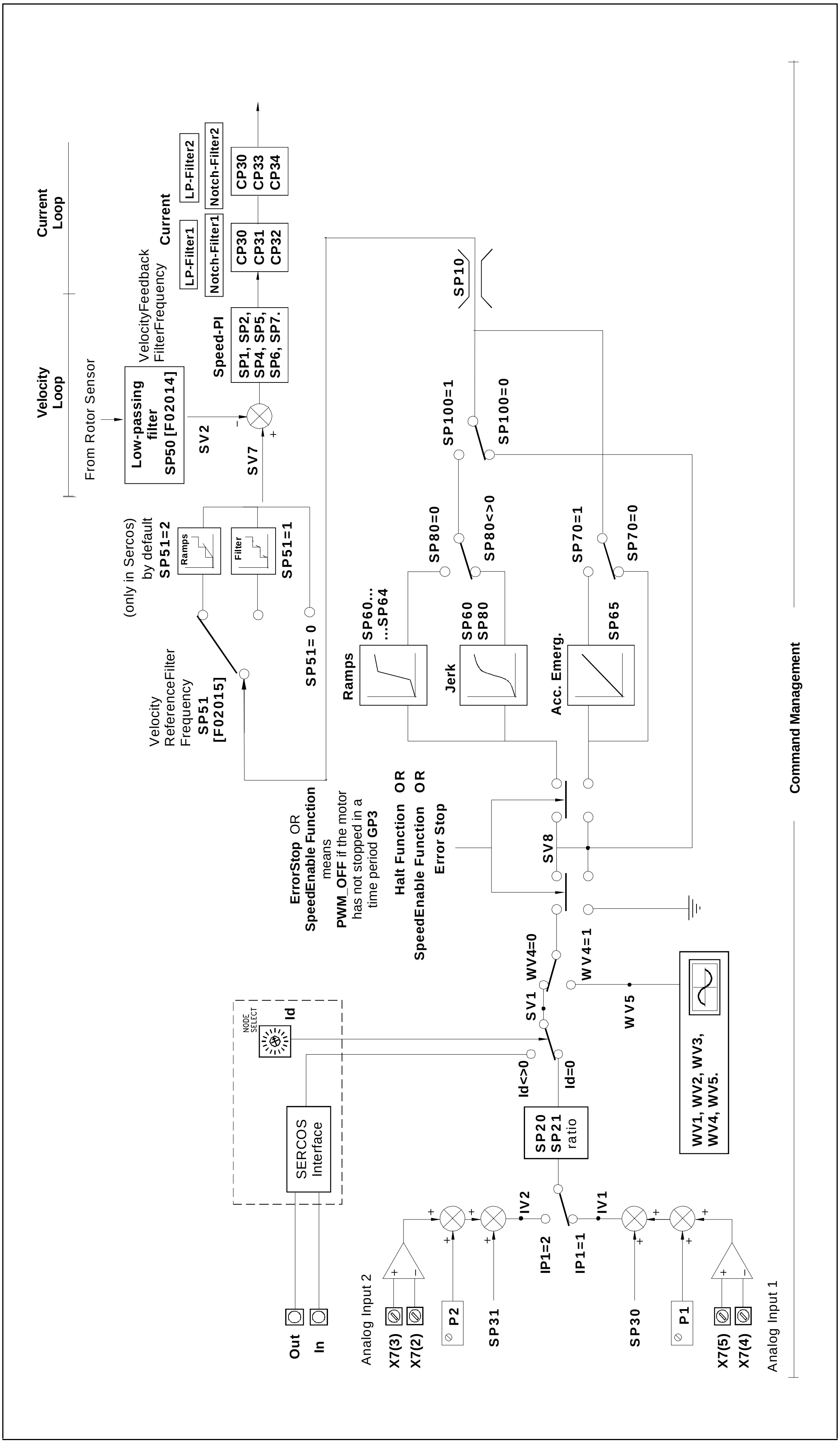
F - 720	G P7	OverLoadTimeLimit
F - 721	G P8	OverLoadVelocityThreshold
F - 723	G V6	RamParameterChecksum
F - 724	G V12	FFParameterChecksum
F - 727	Q V30	FiberDistErrCounter
F - 800	H V21	MotorVoltage
F - 804	H V2	S6LoadCurrent
F - 806	H V9	ModularOrCompact
F - 900	I P1	AnalogReferenceSelect
F - 901	I P10	I1IDN
F - 902	I P11	I2IDN
F - 903	I P12	I3IDN
F - 904	I P13	I4IDN
F - 905	I V1	AnalogInput1
F - 906	I V2	AnalogInput2
F - 907	I V10	DigitalInputs
F - 908	I V11	DigitalInputsCh2
F - 909	I P5	DigitalInputVoltage
F - 1100	K V2	DriveTemperature
F - 1101	K V4	DriveTemperatureErrorLimit
F - 1102	K V10	CoolingTemperature
F - 1103	K V20	SupplyPlus5V
F - 1104	K V21	SupplyPlus8V
F - 1105	K V22	SupplyPlus18V
F - 1106	K V23	SupplyMinus5V
F - 1107	K V24	SupplyMinus8V
F - 1108	K V25	SupplyMinus18V
F - 1109	K V32	I2tDrive
F - 1111	K V36	I2tMotor
F - 1112	K P1	DriveI2tErrorEfect
F - 1113	K P2	ExtBallastResistance
F - 1114	K P3	ExtBallastPower
F - 1115	K V40	I2tCrowbar
F - 1116	K P4	ExtBallastEnergyPulse
F - 1200	M P2	MotorTorqueConstant
F - 1201	M P5	MotorPolesPairs
F - 1202	M P6	MotorRatedSupplyVoltage
F - 1203	M P7	MotorPowerFactor
F - 1205	M P9	MotorSlip
F - 1206	M P10	MotorStatorResistance
F - 1207	M P11	MotorStatorLeakageInductance
F - 1208	M P12	MotorNominalPower

F - 1209	M P13	MotorThermalTimeConstant
F - 1210	M P14	MotorTempSensorType
F - 1211	M P15	MotorShaft
F - 1212	M P16	MotorBrake
F - 1213	M P17	MotorFan
F - 1214	M P18	MotorMounting
F - 1215	M P19	MotorBalancing
F - 1216	M P20	MotorBearings
F - 1217	M P21	MotorPhasesOrder
F - 1220	M P24	MotorMomentumOfInertia
F - 1221	M P25	MotorRatedSpeed
F - 1222	M P26	MotorMaximumSpeed
F - 1223	M P27	MotorRotorResistance
F - 1224	M P28	MotorRotorLeakageInductance
F - 1225	M P29	MotorMagnetizingInductance
F - 1226	M P30	MotorInductanceFactor1
F - 1227	M P31	MotorInductanceFactor2
F - 1228	M P32	MotorInductanceFactor3
F - 1229	M P33	MotorInductanceFactor4
F - 1230	M P34	MotorInductanceFactor5
F - 1231	M P35	MotorInductanceFactor6
F - 1232	M P36	MotorInductanceFactor7
F - 1233	M P37	MotorInductanceFactor8
F - 1234	M P38	MotorInductanceFactor9
F - 1235	M P39	MotorNoLoadCurrent
F - 1236	M P40	MotorNoLoadVoltage
F - 1237	M P41	MotorMaximumTemperature
F - 1238	M C1	MotorElectricalParametersIdentification
F - 1300	P P1	HomingVelocitySlow
F - 1301	P P2	BacklashPeakAmplitude
F - 1302	P P3	BacklashPeakTime
F - 1400	O P1	DA1IDN
F - 1401	O P2	DA2IDN
F - 1402	O P3	DA1ValuePer10Volt
F - 1403	O P4	DA2ValuePer10Volt
F - 1404	O P10	O1IDN
F - 1405	O P11	O2IDN
F - 1406	O P12	O3IDN
F - 1407	O P13	O4IDN
F - 1408	O V1	DA1Value
F - 1409	O V2	DA2Value
F - 1410	O V10	DigitalOutputs

F - 1411	O P5	Prog_OutIDN
F - 1412	O V5	Prog_Out
F - 1413	O V11	DigitalOutputsCh2
F - 1500	R P1	Feedback1SineGain
F - 1501	R P2	Feedback1CosineGain
F - 1502	R P3	Feedback1SineOffset
F - 1503	R P4	Feedback1CosineOffset
F - 1504	R P5	FeedbackResolverRhoCorrection
F - 1505	R P6	FeedbackErrorDisable
F - 1506	R V1	FeedbackSine
F - 1507	R V2	FeedbackCosine
F - 1508	R V3	FeedbackRhoCorrection
F - 1509	R V4	FeedbackRadius
F - 1510	R V6	EncoderError
F - 1511	R V7	StegmannMotorType
F - 1512	R V8	CircleAdjust
F - 1513	R C1	EncoderParameterStoreCommand
F - 1514	R V9	Feedback1ErrCounter
F - 1515	R V5	StegmannType
F - 1516	R V59	Feedback2ErrCounter
F - 1517	R V10	FeedbackRhoDisplacement
F - 1523	G C3	AutoPhasing
F - 1550	R P51	Feedback2SineGain
F - 1551	R P52	Feedback2CosineGain
F - 1552	R P53	Feedback2SineOffset
F - 1553	R P54	Feedback2CosineOffset
F - 1556	R V51	Feedback2Sine
F - 1557	R V52	Feedback2Cosine
F - 1559	R V54	Feedback2Radius
F - 1601	S P13	VelocityIntegralResetThreshold
F - 1603	S P30	AnalogInputOffset1
F - 1604	S P31	AnalogInputOffset2
F - 1605	S P61	AccelerationLimitVelocity2
F - 1606	S P62	AccelerationLimit2
F - 1607	S P63	AccelerationLimitVelocity3
F - 1608	S P64	AccelerationLimit3
F - 1609	S P65	EmergencyAcceleration
F - 1610	S P70	AccelerationOnEmergency
F - 1611	S P100	AccelerationLimitOn
F - 1612	S V7	VelocityCommandFinal
F - 1613	S V8	VelocityCommandBeforeFilters
F - 1614	S V9	PositionCommandDelta

F - 1615	S V10	PositionFeedback1Delta
F - 1616	S V11	PositionFeedback2Delta
F - 1700	T V50	PowerFeedback
F - 1701	T V3	PowerFeedbackPercentage
F - 1702	T V100	TorqueStatus
F - 1900	X V1	One
F - 1901	X V2	Zero
F - 1902	T P10	ConstantPositiveTorqueCompensation
F - 1903	T P11	ConstantNegativeTorqueCompensation
F - 1904	T P12	DinamicPositiveTorqueCompensation
F - 1905	T P13	DinamicNegativeTorqueCompensation
F - 1906	T P14	TorqueCompensationTimeConstant
F - 1914	T P22	MotorPowerReduction
F - 2000	Q P11	Sercos®MBaud
F - 2001	A P5	PlcPrgScanTime
F - 2002	Q P12	Sercos®TransmisionPower
F - 2003	P C150	ChangePostFB12
F - 2004	Q P13	IdOffset
F - 2005	P V190	PostErrorBetweenFeedbacks
F - 2008	Q P15	SerialProtocol
F - 2014	S P50	VelocityFeedbackFilterFrequency
F - 2015	S P51	VelocityReferenceFilterFrequency
F - 2017	S P52	VelocityLoopTimeConstant
F - 2032	X V10	GeneralVariable32A
F - 2033	X V11	GeneralVariable32B
F - 2034	X V12	ReadPlcMarksGroup
F - 2035	X V13	WritePlcMarksGroup
F - 2200	N P1	ReducedActuatedMomentumOfInertiaPercentage
F - 2300	L C1	BackupMCPar
F - 2301	L P1	SecondCamSwitchStart
F - 2302	L V2	CamSwitchCompile
F - 2310	L P10	ProcessBlockMode
F - 2311	L P11	FeedrateOverrideLimit
F - 2312	L P12	PositioningVelocityDefault
F - 2313	L V13	KernelOperationMode
F - 2314	L V14	KernelAutoMode
F - 2315	L V15	KernelStartSignal
F - 2316	L V16	KernelStopSignal
F - 2317	L V17	KernelResetSignal
F - 2318	L V18	KernelAbortSignal
F - 2319	L V19	KernelManModel
F - 2320	L V20	JogPositiveSignal

F - 2321	L V21	JogNegativeSignal
F - 2322	L P22	JogVelocity
F - 2323	L P23	JogIncrementalPosition
F - 2324	L V24	FeedrateOverrideEqualCero
F - 2325	L P25	InPositionTime
F - 2326	L V26	ProgramPositionOffset
F - 2327	L V27	KernelInitError
F - 2328	L V28	KernelExecError
F - 2330	L V30	KernelExecutionState
F - 2331	L V31	KernelExecutionPoint
F - 2332	L V32	KernelExecutionPcode
F - 2333	L V33	KernelApplicationPars
F - 2334	L V34	KernelApplicationVars
F - 2335	L V35	BlockTravelDistance
F - 2336	L V36	BlockCoveredDistance
F - 2340	L P40	SynchronizationMode
F - 2341	L P41	SynchronizationAcceleration
F - 2342	L P42	SynchronizationVelocity
F - 2343	L V43	GearRatioAdjustment
F - 2344	L V44	SynchronizationVelocityOffset
F - 2345	L V45	SynchronizationPositionOffset
F - 2346	L V46	InSynchronization
F - 2347	L P47	SynchronizationTimeout
F - 2348	L V48	MasterOffset1
F - 2349	L V49	MasterScale1
F - 2350	L V50	SlaveOffset1
F - 2351	L V51	SlaveScale1
F - 2352	L V52	MasterOffset2
F - 2353	L V53	MasterScale2
F - 2354	L V54	SlaveOffset2
F - 2355	L V55	SlaveScale2
F - 2359	L P59	SynchronizationMasterSource
F - 2360	R P60	SSIClockFrequency
F - 2361	R P61	SSIDataLength
F - 2362	R P62	SSIDataFormat
F - 2363	R P63	SSIFeedbackResolution



FAGOR

DDS
Software
v.06.xx

SERVO DRIVE
SYSTEM MANUAL

PARAMETERS, VARIABLES & COMMANDS

Groups of parameters, variables and commands

User notes:

User notes:

LISTING OF ERROR MESSAGES, WARNINGS AND SOLUTIONS

B

Effect of the errors on the system

Activating any of the errors listed in this appendix causes some effects on the system that depend on the type of interface being used.

Analog interface:

The activated error is shown on the drive's display.

Sercos®: interface

The activated error is shown on the drive's display.

The CNC screens displays this error.

The CNC may display the errors listed in this appendix as well as the errors of the Sercos® communication itself.

The drive activates bit 13 of the variable DV31 [S135].

The drive activates the bit corresponding to the error in the variable DV31 [S135].

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.

Error reset

The system will not resume operation until all the errors detected by the drive have been eliminated. To eliminate these errors, their causes must disappear and the errors must be reset.

This reset may be done through pin X2 <1> of the power supply module or pin X2 <3> if it is a compact drive.

The errors are reset through the Sercos® interface like any other CNC error.

Some errors cannot be reset and cannot be eliminated with this procedure. These errors can only be eliminated by powering the unit back up and only if the cause of the error has disappeared. These errors are:

ERRORS THAT CANNOT BE RESET									
1	2	5	6	7	8	9	10	31	50
51	52	53	54	55	100	101	102	103	104
105	109	211	305	410	501	502	503	504	505
506	507	508	604	605	606	607	608	610	611
700	701	702	703	704	705	706	707	800	801
802	803	804	805	807	808	809	810	811	812
900									

Motor stop

Activating some errors eliminates the current circulating through the motor. These errors are:

ERRORS THAT CUT OFF CURRENT									
2	4	5	6	7	109	200	202	203	205
211	212	213	214	215	302	303	304	306	314
315	410	500	501	502	503	504	506	507	508
604	605	606	607	608	609	610	611	700	701
702	703	704	705	706	707	801	802	803	804
806	807	808	809	810	811				

1 **Internal.**

Contact Fagor Automation.

2 **Internal.**

Contact Fagor Automation.

3 **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.

4 **Emergency stop exceeding the established time limit GP3.**

An attempt has been made to stop the motor by disabling the Speed_Enable. The system tries to stop the motor at maximum torque, but it cannot do it in a time period lower than the value given to GP3 (Pulse elimination delay = maximum time allowed to brake, before considering the error for being unable to stop the motor in the established time) or parameter [SP42] that determines when the motor is stopped is too small [bear in mind that zero speed or the total absence of speed does not exist; there is always a small velocity noise due to feedback.

May be:

The load is large to be stopped by the motor in the time period set by GP3 (increase the value of this parameter).

The threshold or velocity window considered zero [SP42] is too small (increase the value of this parameter).

The module is performing poorly or is incapable of stopping the motor (failure at the drive module).

5 **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.

6 **Error on the Sercos® board .**

Replace the Sercos® board .

If the error persists, replace the VeCon® board.

7 **Failure of the clock of the SerCon® board.**

8 **"SerCon® memory corrupted" failure.**

9 **Non-volatile data loss.**

10 **Damaged non-volatile data**

31 **Internal error**

Contact Fagor Automation.

50 - 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.

66 - 69 PLC execution error.

Refer to the chapters about the PLC in the DDS - MC manual that describe the meaning of this error.

100 Internal +5V out of range.

101 Internal -5V out of range.

102 Internal +8V out of range.

103 Internal -8V out of range.

104 Internal +18V out of range.

105 Internal -18V out of range.

Contact Fagor Automation.

106 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.

107 Drive overheated (CPU board).

The temperature of the drive enclosure is too high.

Decrease ambient temperature.

108 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.

109 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.

110 **Low "IGBT heatsink" temperature.**

The drive is under temperatures equal to or lower than 0ºC, in other words, too low.

Bring the temperature down.

Maybe the sensor or the cable is defective.

150 **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.

Check the limit values and the programming of movements so it does not happen again.

From version v.06.03 version 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).

152 **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.

153 **Too much difference in the position command.**

The path required by the position command causes a velocity command that is too high.

Decrease the demands on the path in terms of required speed.

154 **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.

155 **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.

156 **Too much following error (axis lag).**

The servo system follows the position command with a "PV189 [S189] FollowingError" greater than what is allowed by the "PP159 [S159] MonitoringWindow"

Check the settings of all the aspects affecting the following error as well as the value given to parameter PP159.

157 **Too much difference in actual (real) position.**

The difference between the values of the motor feedback position and direct feedback exceeds, for at least 20 ms, the maximum permissible error set by parameter "PP5 [S391] ActualPositionMonitoringWindow".

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.

200 **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.

201 **Motor overload.**

202 **Drive overload.**

The I^2t protection of the motor or drive went off.

The duty cycle is greater than the system can provide.

203 **Torque overload error.**

The motor has locked up and it could not turn freely. With very high torque, the turning speed has not exceeded GP8 for a longer period of time than GP7.

Free the motor and if the error comes up again for no reason, increase the values of GP7 and/or GP8. To prevent this error from ever coming up, set GP7 = 0.

Verify that two phases are not swapped.

Check that the power cables make good contact at their terminals.

Verify that the feedback cable is not defective and the pin-to-pin connection is correct (especially if the user has made the cable).

205 **The motor has no voltage for the demanded work conditions.**

If it happens while the motor is stopped, verify that there is no loose phase.

If it happens at near-rated speeds, see the torque-speed graph of the relevant motor in the motor manual and observe that it happens (i.e. that the motor loses its voltage) for the required torque and speed conditions.

Increase the value of the mains voltage if you don't wish to change these work conditions.

Decrease the maximum speed or acceleration value.

206 **Velocity command too high.**

The velocity command received (in velocity loop) exceeds the maximum command of the SP10 motor.

211 **Internal.**

Contact Fagor Automation.

212 **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.

213 **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.

214 **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.

215 **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 power 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 304 and 306.

250 **Home search error.**

Contact Fagor Automation.

251 **DriveControlledHoming command error**

Contact Fagor Automation.

253 **I0 not found in two turns.**

Contact Fagor Automation.

254 **Distance-coded I0's read wrong.**

Check the installation of the linear encoder and reader head of the direct feedback.

255 **Error when changing the feedback after executing the PC150 command (feedback change).**

Check that parameter AP1 is set to 5 or 13.

300 **Over-temperature at the heatsink of the power supply or of the compact module.**

301 **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.

302 **Short-circuit at the ballast of the power supply module.**

Contact Fagor Automation.

303 **Supply voltage of the ballast circuit driver out of range.**

Contact Fagor Automation.

304 **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 215 and 306.

305 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.

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.

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)

PSxxA			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 Crowbat IGBT
ON	OFF	OFF	Short-circuit at the Crowbar IGBT
ON	OFF	OFF	Crowbar resistor overheated (temperature of the exit air)
ON	OFF	OFF	Over-temperature at the heatsink
ON	OFF	OFF	Crowbar resistor overload

[I] Intermittent (flashing)

306 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 215 and 304.

307 Power bus voltage too low (software).

The mains voltage is lower than the permissible value (rated voltage < 380 Vac).

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.

308 Over-current in the regeneration circuit.

Contact Fagor Automation.

309 Short-circuit on the high side IGBT.

Contact Fagor Automation.

310 Low voltage at the driver of the high side IGBT.

Contact Fagor Automation.

311 Short-circuit on the low side IGBT.

Contact Fagor Automation.

312 Low voltage at the driver of the low side IGBT.

Contact Fagor Automation.

313 Consumption over-current.

The current required from the power supply is too high.

Decrease the demands of the work cycle.

314 ErrCrowbarROverLoad.

I^2t protection of the Crowbar resistor.

315 ErrLscBadStart.

Failed startup. 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.

403 MSTfault.

404 MDTfault.

405 Err_InvalidPhase.

406 Err_PhaseUpshift.

407 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.

410 Err_RuidoEntraAlSerconReset.

Noise gets in through the internal bus connection cable that reset the Sercon® but not the Vecon2®.

411 Error indicating that a wrong telegram has been received.

500 Incoherent parameters.

See error 502.

501 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:

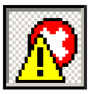
Validate the default values; to do this, simply save the parameters again.

Restore the previous values; to do this, load the parameters into RAM memory and check them out with the PC.

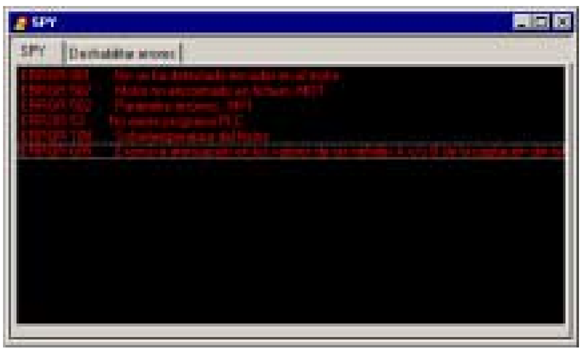
If the user considers them to be valid, he can validate them by saving them.

502 Wrong parameter.

A parameter has the wrong value.



Activating this icon of the WinDDSSetup bar opens a window on the screen like the one shown in the figure for displaying all the parameters whose values are wrong.



This error may come up when, regulating with square-wave motor feedback (1st feedback), the value of parameter EP1 does not coincide with the number of pulses of that feedback. (versions v.05.xx and v.06.xx).

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.

503 **The default motor values table is wrong**

This error does not come up in software versions 03.01 or newer.

This table has not been saved. The table must be saved.

504 **Wrong parameter in Sercos® phase two.**

Only in the case of Sercos® interface and from software version 03.01 on, parameter QV21 [S21] contains the list of the wrong parameters in phase 2 of the Sercos® protocol.

This variable can only be seen using the WinDDSSetup.

Correct these parameters.

505 **Connected motor different from the one adjusted in Flash memory.**

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.

This error does not interrupt the normal operation of the drive.

Save the parameters in Flash to work with the connected motor.

506 ***.mot file not found.**

507 **Motor not found in the *.mot file.**

508 **Listing of wrong parameters in phase 4.**

604 **Saturation in A and/or B signals of the motor feedback.**

607 **Saturation in A and/or B signals of the direct feedback.**

- Only with incremental 1Vpp signals -

The cables, the feedback or the feedback board (connector X3 or X4) are defective.

Parameters RP1, RP2, RP3 or RP4 are too high.

Check the condition of the cable, feedback device, cards or decrease the value of these parameters.

605 **Alarm in the feedback signals. Too much damping in A and/or B signals of the motor feedback.**

608 **Alarm in the feedback signals. Too much damping in A and/or B signals of the direct feedback.**

The cables, the feedback or the feedback board (connector X3 or X4) are defective.

Parameters RP1, RP2, RP3 or RP4 are too small.

Verify that four consecutive errors have not occurred in the signals of the feedback device being used. See the RV9 variables (with motor feedback) or RV59 (with direct feedback).

Check the condition of the cable, feedback device, X4 card or increase the value of the said parameters.

606 Excessive dispersion in the rotor sensor signals.

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.

609 Damaged temperature cable.

610 ErrWrongAbsSignals

Wrong absolute signals. Strange data has been read in the absolute position. This error may be disabled.
Check the feedback cable.

Contact Fagor Automation.

611 ErrUnstableAbsSignals

The axis is moving while starting the drive up and the absolte position cannot be read correctly.

700 Error identifying the RS-232 board.
701 Error identifying the VeCon® board.
702 There is not Sercos® board. There is no I/O board.

Check whether the node selector is at "0" or in an intermediate position that does not correspond to any node.

703 Wrong I/O board version.
704 The AD has been selected wrong on the I/O board.
705 Error identifying the power board.
706 Error identifying the motor feedback board.
707 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.

801 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.

802 Communication error with the encoder (with motor feedback).
803 Encoder not initialized (with motor feedback).
804 Defective encoder (with motor feedback).

Contact Fagor Automation.

805 **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.

806 **Home search error with sincoder.**

Contact Fagor Automation.

807 **Defective C and D signals.**

Contact Fagor Automation.

808 **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.

809 **Communication error with the encoder (with direct feedback).**

The cable is damaged or not connected.

810 **Encoder not initialized (with direct feedback).**
811 **Defective encoder (with direct feedback).**

The linear encoder is damaged or is faulty.

Contact Fagor Automation.

812 **Encoder detected (with direct feedback).**

Make the GP10 value coherent with the type of feedback installed.

Contact Fagor Automation.

900 **Initialization error in the motion control program.**
9xx **Execution error in the motion control program.**

Check the meaning of these errors in the DDS - MC manual.

Listing of warnings

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.

1. **Inside temperature**: (prior to error 107).
2. **Motor temperature**: (prior to error 108).
   ¡ Only on FM7 motors**!**
3. **Extreme temperature at the heatsink**: (prior to error 106).

   The warning temperature KV1, KV5 or KV9 respectively has been exceeded.
5. **Velocity limit overrun**: (prior to error 917).
13. **Position limit overrun**: (prior to error 918).

Version v.06.05 offers the warnings listed next:

182. WarSinchronizationT3in165

183. WarSinchronizationT3inDSP

184. WarSinchronizationT4in165

185. WarSinchronizationCubicInterp

186. WarSinchronizationDeltaIniError

Contact Fagor Automation when any of these warnings come up !

Troubleshooting

The purpose of this section is to help solve certain typical problems that might come up when installing the servo drive system.

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 and 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 desired motor cannot be selected; it doesn't seem to be on the list of motors.

The loaded drive software is older than version v.01.04 and data D01.06. These versions did not have all the available motors.

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.

User notes:

User notes:

FAGOR PRODUCT REFERENCES

C

References of synchronous servo motors.

FXM □□.□□□.□□.□□□- X□□

Field	Code	Meaning
MOTOR SERIES		
SIZE	1, 3, 5, 7	
LENGTH	1, 2, 3, 4, 5, 6, 7, 8	
RATED SPEED	**12**	**12**00 rpm
	20	**20**00 rpm
	30	**30**00 rpm
	40	**40**00 rpm
WINDING	**A**	400 Vac
	F	220 Vac
FEEDBACK TYPE	**E1**	Sinusoidal Sincoder
	R0	Resolver
	A1	Absolute multi-turn Sincos
	I0	Incremental TTL
FLANGE AND SHAFT	**0**	With standard keyway
	1	Without keyway
BRAKE OPTION	**0**	Without brake
	1	With standard brake (24 Vdc)
	9	With special brake
VENTILATION	**0**	Without fan
	1	With fan
SPECIAL CONFIGURATION	**X**	
SPECIFICATION OF THE SPECIAL CONFIGURATION	**01 → ZZ**	

A1 Sincos Stegmann™ SRM 50, 1,024 pulses/turn
E1 Sincoder Stegmann™ SNS 50, 1,024 pulses/turn
R0 Tamagawa™ resolver
I0 Tamagawa™ encoder OIH48 TS5214N510, 2500 pulses/turn

NO LONGER SOLD
S0 Sincoder Stegmann™ SNS 60
A0 Sincos Stegmann™ SCM 70
E0 Sincos Stegmann™ SCS 70

fig. 1 FXM motor sales reference

FKM □□.□□□.□□.□□□- K□□

Field	Code	Meaning
MOTOR SERIES		
SIZE	2, 4, 6	
LENGTH	1, 2, 4	
RATED SPEED	**60**	6000 rpm
	50	5000 rpm
	45	4500 rpm
	40	4000 rpm
	30	3000 rpm
WINDING	**A**	400 Vac
	F	220 Vac
FEEDBACK TYPE	**E3**	Sinusoidal Sincos
	R0	Resolver
	A3	Absolute multi-turn Sincos
	I0	Incremental TTL
FLANGE AND SHAFT	**0**	With keyway
	1	Cilyndrical (with no keyway)
BRAKE OPTION	**0**	Without brake
	1	With standard brake (24Vdc)
CONNECTION	**0**	Rotating angled connectors
	1	Cable exit without connectors
SPECIAL CONFIGURATION	**K**	
SPECIFICATION OF THE SPECIAL CONFIGURATION	**01 → ZZ**	

A3 Sincos Stegmann™ SRM (multi-turn) (with taper shaft), 1024 pulses/turn
E3 Sincos Stegmann™ SRS 50 (taper, sheet metal), 1024 pulses/turn
R0 Tamagawa™ resólver
I0 Tamagawa™ encóder OIH48 TS5214N510, 2500 pulses/turn

NO LONGER SOLD
A1 Sincos Stegmann™ (multi-turn) SRM, 1024 pulses/turn
E3 Sincos Stegmann™ SRS (taper, rubber flange), 1024 pulses/turn

fig. 2 FKM motor sales reference

SPINDLE MOTORS, SPM xx.1

Example: SPM 100LBE . E 1 . 0 0 0 0 0 . 1

SPINDLE **M**OTOR		
MOTOR MODEL [rated power in S1/S6 - 40%] [kW]	**90L** 2.2/3.3 **100LBE** 4/6 **112LE** 7.5/11 **132L** 15/22 **132XL** 22/28 **160L** 30/45	**90P** 3/4 **112ME** 5.5/8 **112XE** 11/16 **132X** 18.5/26 **160M** 22/33 **180MA** 37/55
FEEDBACK	**E0** Encoder Sincos™ **E1** Encoder Sincoder™	
MOUNTING	**0** B3/B5 Horizontal [standard] **1** V1/V5 Vertical downward **2** V3/V6 Vertical upward	
FLANGE AND SHAFT	**0** Standard **1** Protection Seal **2** Flange for mounting on ZF boxes **3** Without keyway **4..9** Special flange or shaft	
BALANCING GRADE	**0** S, standard balancing grade **1** SR, balancing grade	
BRAKE OPTION	**0** Without brake	
BEARINGS	**0** Standard **1** Special, high speed	
WINDING VOLTAGE *	**0** [330 Vac] **1** [270 Vac]	

* Only motor models 160L and 180MA have a 330Vac winding the rest have a 270 Vac winding

fig. 3 SPM motor sales reference

FM7 - □ □□□ - □□□□ - E0□

FAGOR M7 MOTOR	
BASE SPEED	1500 rpm - single winding A 1000 rpm - single winding B 500 rpm - single winding C
POWER (S1 cycle) [Kw]	A: 037, 055, 090, 110, 150, 185, 220, 300, 370, 510 B: 120, 170, 220, 280 C: 215, 270
ENCODER	**S** Standard **C** C axis
MOUNTING	**1** flange **3** foot **5** flange & foot *****
BALANCING GRADE	**B** V10 **C** V5 **D** V3
FLANGE & SHAFT	**0** plaint shaft (no keyway) **1** keyway (half keyway balancing)
WINDING	**E**
VERSION **	**01** **02**

** Flange & foot mounting is valid for all models except A037, A055, A075 and A090.*
*** Models A110, A300, A370, B220 and B280 do not have version E 02.*

fig. 4 FM7 motor sales reference

References of modular drives

AXIS DRIVE, AXD — Example: AXD 1 . 25 - A1 - 1

AXIS **D**RIVE		
SIZE	**1**	Width 77mm (08, 15, 25, 35)
	2	Width 117mm (50, 75)
	3	Width 234mm (100, 150)
CURRENT [IS1, IS3-5%] ... for IGBT switching frequencies of 4 kHz and 8 kHz.	**08**	[4 Amp, 8 Amp]
	15	[7.5 Amp, 15 Amp]
	25	[12.5 Amp, 25 Amp]
	35	[17.5 Amp, 35 Amp]
	50	[23.5 Amp, 47 Amp]
	75	[31.5 Amp, 63 Amp]
	100	[50 Amp, 100 Amp]
	150	[62 Amp, 124 Amp]
INTERFACE	**A1**	Analogic
	S0	Sercos
	SI	Sercos & Analogic
ADDITIONAL FEEDBACK FEATURES	**0**	None
	1	Encoder simulator
	2	Direct feedback

fig. 5 Sales reference of the AXD axis drive

SPINDLE DRIVE, SPD — Example: SPD 2 . 50 - S0 - 0

SPINDLE **D**RIVE				
SIZE	**1**	Width 77 mm (08, 15, 25, 35)		
	2	Width 117 mm (50, 75, 85)		
	3	Width 234 mm (100, 150, 200)		
CURRENT [IS1, IS6-15%] ... for IGBT switching frequency of 4 kHz.	**25**	[16 Amp, 22 Amp]	**85**	[50 Amp, 72.5 Amp]
	35	[23.1 Amp, 32 Amp]	**100**	[70 Amp, 91 Amp]
	50	[31 Amp, 45 Amp]	**150**	[90 Amp, 140 Amp]
	75	[42 Amp, 65 Amp]	**200**	[121 Amp, 170 Amp]
... for IGBT switching frequency of 8 kHz.	**25**	[13 Amp, 17.8 Amp]	**85**	[37 Amp, 53.6 Amp]
	35	[18 Amp, 24.9 Amp]	**100**	[56 Amp, 72.8 Amp]
	50	[27 Amp, 39.1 Amp]	**150**	[71 Amp, 110.4 Amp]
	75	[32 Amp, 65 Amp]	**200**	[97 Amp, 136.5 Amp]
INTERFACE	**A1**	Analogic		
	S0	Sercos		
	SI	Sercos & analogic		
ADDITIONAL FEEDBACK FEATURES	**0**	None		
	1	Encoder simulator		
	2	Direct feedback		

fig. 6 Sales reference of the SPD spindle drive

References of compact drives

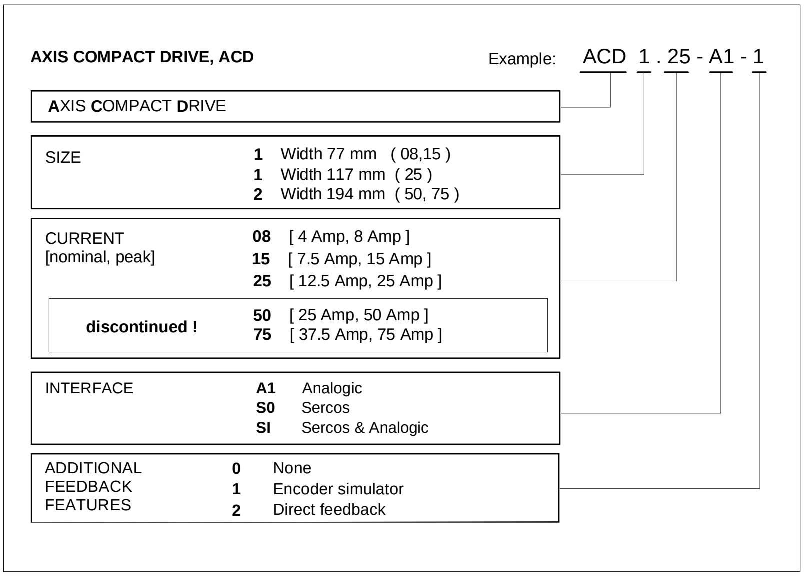


fig. 7 Sales reference of the ACD axis drive

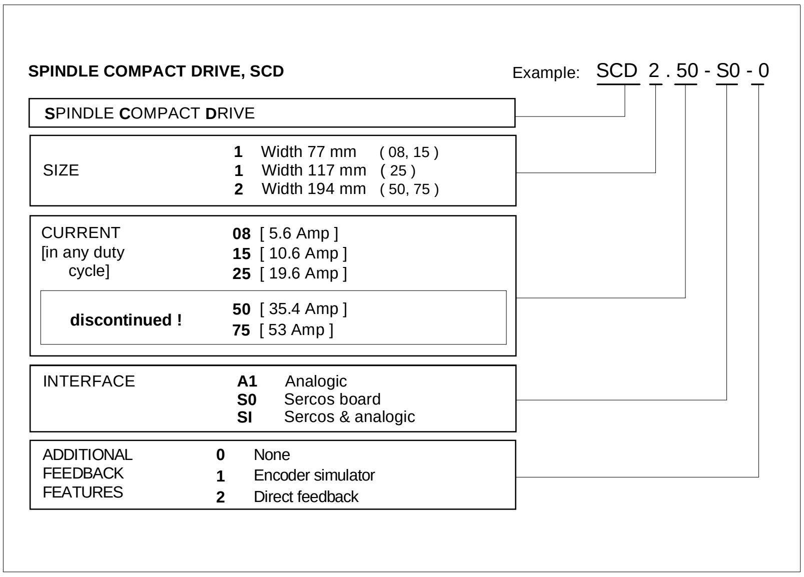


fig. 8 Sales reference of the SCD spindle drive

References of MMC drives

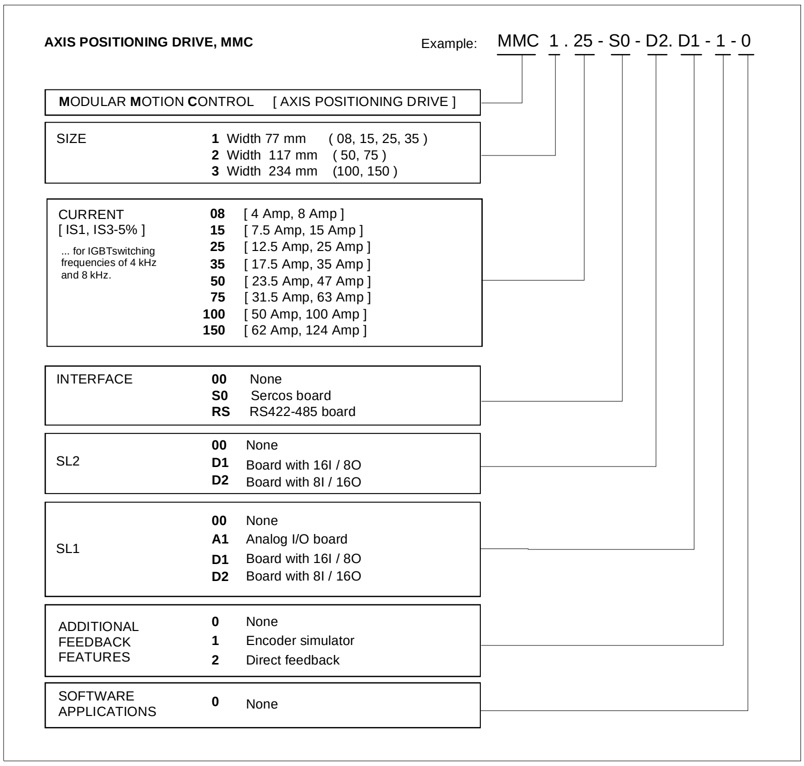


fig. 9 Sales reference of the MMC modular axis drive

Reference of CMC drives

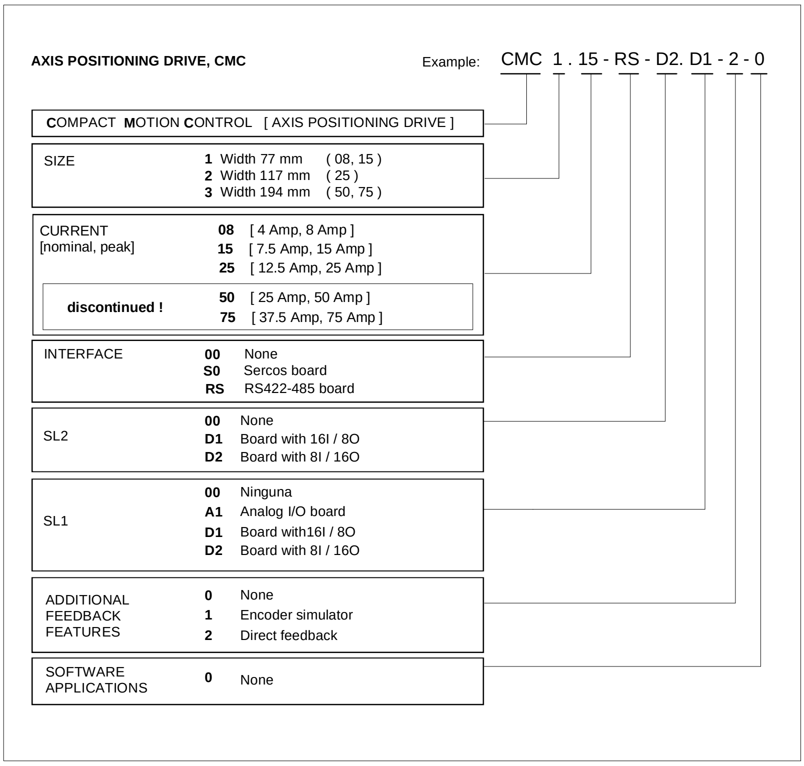


fig. 10 Sales reference of the CMC compact axis drive

Power supply references

POWER SUPPLY, PS

Example: PS - 25A

POWER **S**UPPLY [Mains voltage of 400 - 460 Vac]	
POWER [power, rated current]	**25A** [25 kw, 45 Amp] **65A** [65 kw, 120 Amp]

The old PS-xx admitted a mains voltage of 380 Vac.

fig. 11 Sales reference of the PS power supply

PS POWER SUPPLY
WITH INTEGRATED AUXILIARY 24 V POWER SUPPLY

Example: PS - 25B3

POWER **S**UPPLY [Mains voltage of 400 Vac]		
POWER [power, rated current]	**25B3**	[25 kw, 45 Amp] [24 Vdc, 8 Amp]

Discontinued

fig. 12 Sales reference of the PS power supply with integrated auxiliary 24V power supply.

PS POWER SUPPLY
WITH INTEGRATED AUXILIARY 24 V POWER SUPPLY

Example: PS - 25B4

POWER **S**UPPLY [Mains voltage of 400 - 460 Vac]		
POWER [power, rated current]	**25B4**	[25 kw, 45 Amp] [24 Vdc, 8 Amp]

fig. 13 Sales reference of the PS power supply with integrated auxiliary 24V power supply.

REGENERATIVE
POWER SUPPLY, XPS

Example: XPS - 25

X-circuit **P**OWER **S**UPPLY [Mains voltage of 400 - 460 Vac]	
POWER [power, rated current]	**25** [25 kw, 45 Amp] **65** [65 kw, 120 Amp]

fig. 14 Sales reference of the XPS regenerative power supply

References of other elements

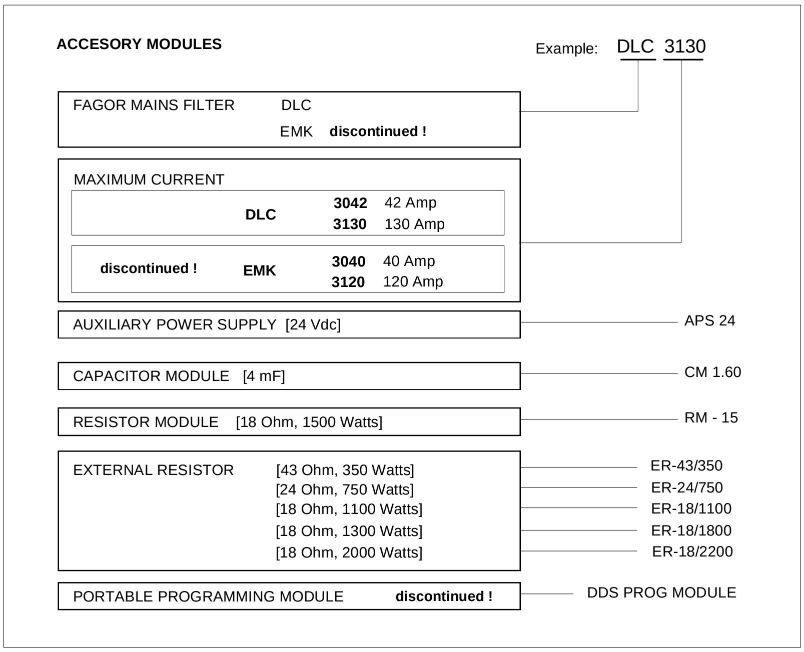


fig. 15 Sales reference of accessory modules

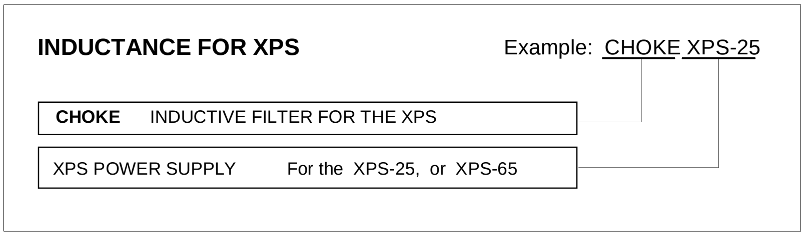


fig. 16 Inductance for XPS

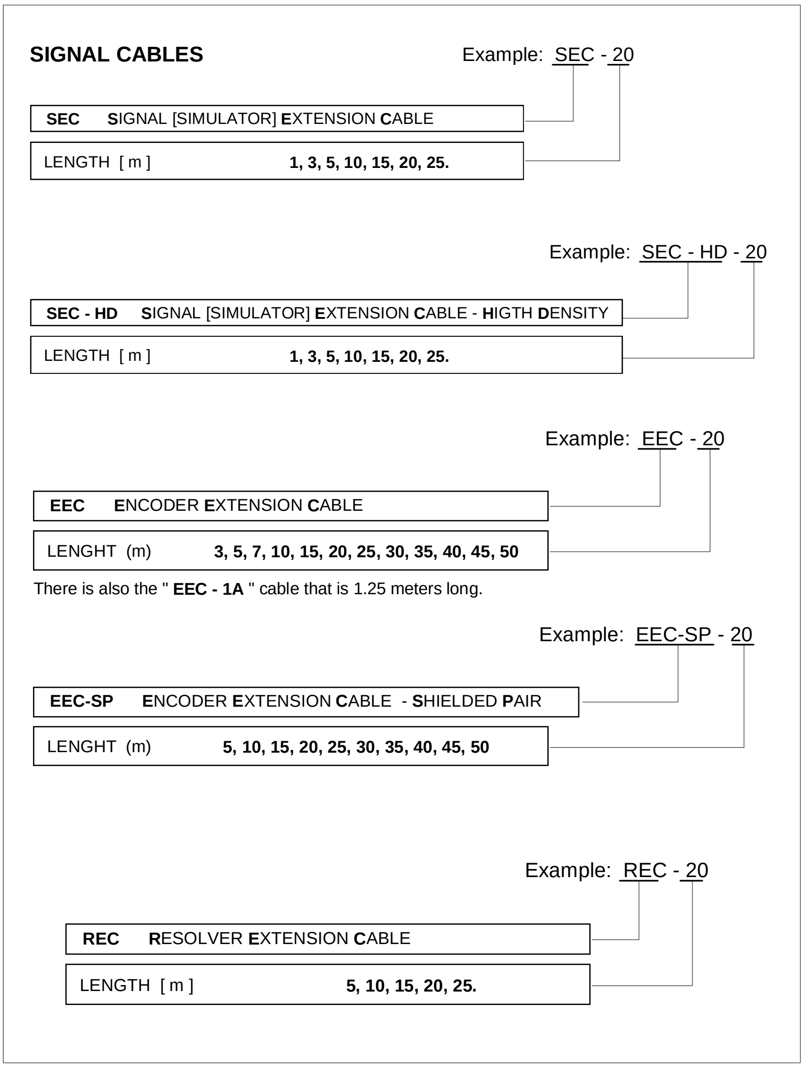


fig. 17 Sales reference of the signal cables

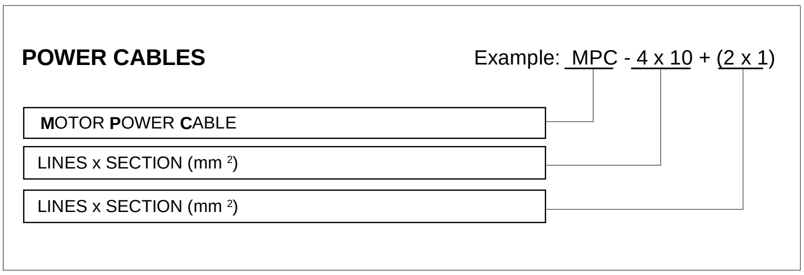


fig. 18 Sales reference of the power cables

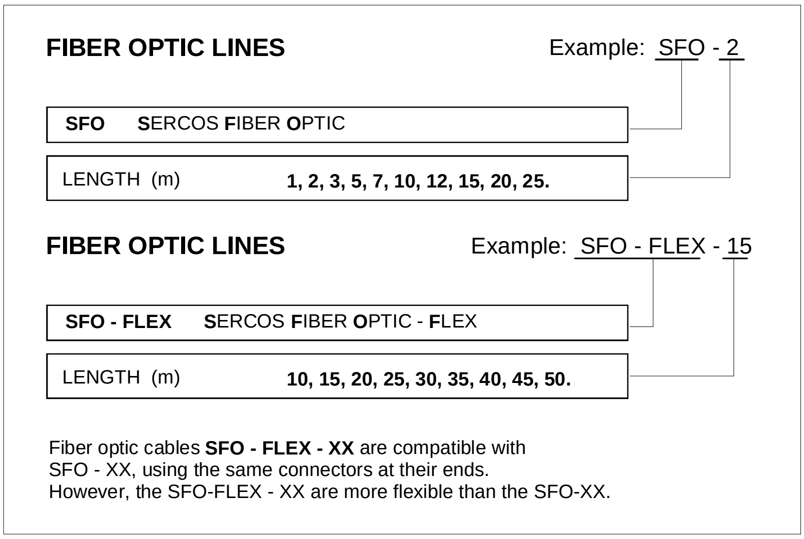


fig. 19 Sales reference of fiber optic lines

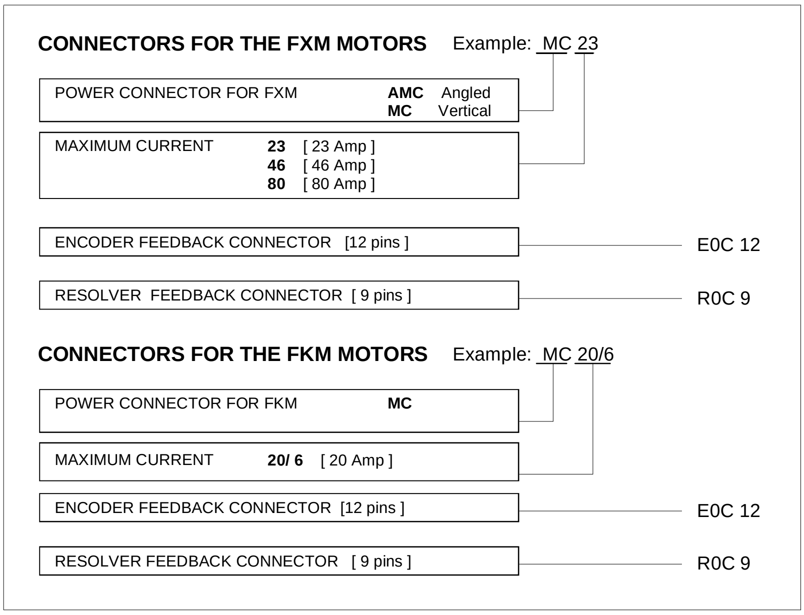


fig. 20 Sales reference of the connectors for synchronous servo motors

Order example

QTY	FAGOR AUTOMATION S. COOP. REFERENCE	DESCRIPTION	UNIT PRICE US $	NET PRICE US $
1	FXM 33.30A.R0.000	Axis Motor 5,77 Nm, 3.000 with resolver		
1	FXM 33.30A.R0.000	Axis Motor 5.77 Nm, 3,000 with resolver		
2	MC 23	Motor power connectors (socket)		
2	AXD 1.15-A1-1	15 Amp axis drives with encoder simulator		
1	SPM 112LE.E0.00000.0	7.5 Kw S1 spindle (1,500 at 7,500 rpm)		
1	SPD 2.50-A1-1	50 Amp spindle drive with encoder simulator		
1	PS-25A	25 Kw Power supply		
2	REC - 5	5 m Resolver extension Cable		
1	EEC - 5	5 m Resolver extension Cable		
3	SEC - 1	1m Signal Encoder Cable		
	TOTAL DRIVE SYSTEM			

fig. 21 Order example

User notes:

COMPATIBILITY

D

Mains voltage

Originally, the drives and power supplies were designed for a mains voltage of 380 Vac (50 - 60 Hz). They have now been redesigned to work with mains voltage ranging between 380 - 460 Vac (50 - 60 Hz).

They are identified as:

	Elements for 380 Vac	Elements for 380 - 460 Vac
Power Supplies	Fagor Automation, S.Coop.(Spain) MODEL PS-25 INPUT 3x380 Vac 50/60Hz OUTPUT 600 Vdc 45A	Fagor Automation, S.Coop.(Spain) MODEL PS-25A INPUT 3x380÷460Vac 50/60Hz OUTPUT 537-650 Vdc 45A
Drives	Fagor Automation, S.Coop.(Spain) MODEL AXD 1.15-A1-1 INPUT 600-800 Vdc OUTPUT 3x380 Vac 7A 0-800Hz	Fagor Automation, S.Coop.(Spain) MODEL AXD 1.15-A1-1 INPUT 456-800 Vdc OUTPUT 3x0÷460 Vac 7A 0-800Hz

Compatibility:

The elements ready for mains voltage between 380 and 460 V_{ac} :

- Drive [version MSC 12A and later]
- Auxiliary power supply APS 24 [version PF 05A and later]
- Capacitor module CM 602 [version 01A and later] or CM 1.60 [version [CAP 00A] [VAR 02A] and later] replacing the previous one.
- Mains filters EMK & DLC

are compatible with all the PS and XPS power supplies.

The elements ready for a mains voltage of 380 V_{ac} :

- Drive [version MSC 11A and older],
- Auxiliary power supply APS 24 [version PF 04A and older],
- Capacitor module CM 60 [version 00A] or CM 1.60 [version [CAP 00A] [VAR 02A] and later] replacing the previous one.
- Mains filters Power - Pro

are not compatible with PS-xxA, PS-25Bx and XPS power supplies.

Replacing 380 Vac module with a Vac module:

Drive **MSC 12A**

New capacitor module: CM 1.60 **[CAP 00A] [VAR 02A]**

Auxiliary power supply APS 24 **PF 05A**

They may be incorporated into any servo drive system regardless of its power supply.

Power supply **PS - xxA**

If the system includes any element for a mains voltage of 380 V_{ac} :

- An **MSC 11A** drive
- An APS 24 power supply **PF 04A** or
- A capacitor module CM - 60 **00A**

it needs a PS - xx power supply.

Note that a power supply PS - xx, is like a PS - xxA limited to work only at 380 Vac. Therefore, it will admit a mains voltage limited to 380 Vac.

Power supply **PS - 25Bx**

If the system includes an element for a Mains voltage of 380 V_{ac} :

- An **MSC 11A** drive
- A capacitor module CM - 60 **00A**

the PS - 25B3 must be installed to work at 380 Vac.

The compact drive [version MSC 05A and later] are designed to also run at 380 - 460 Vac. The PS - 25B4 must be installed. They have no compatibility problems with previous equipment.

VECON® board

The compatibility between this board and the software versions is:

VECON® board version	Software version
VEC® 03A and older	v.03.07
VEC® 04A and later	v.03.24 v.04.08

i

It is not possible to regulate with direct feedback when using a drive with software versions v.04.xx and v.05.xx and an asynchronous motor FM7.

It is possible with version v.06.xx .

VECON2® board

New board that replaces the VECON® expanding the capacity of the flash memory and improves the operating speed of the flash and the RAM memories.

VECON® board version	Software version
VEC2® 01A and later	v. 05.08 v. 06.01

Drive software versions v.04.xx and v.05.xx have the same features. Their only difference consists in that they are supported by different hardware platforms because they have only VECON® and VECON2® boards respectively.
The software version v.06.xx of the drive is supported only by the hardware platform with VECON2® board.

It is possible but not recommended to have the same machine with several units where one controls its motor with a v.04.xx version and hardware with VECON®, another one that controls its motor with a v.05.xx version and hardware with VECON2® and a third one that control its motor with v.06.xx version and hardware with VECON2®.

Boot for VECON2®

The boot of version v.06.02 of the WinDDSSetup allows loading the software version on VECON 2® board (version VEC2 02A).

¡ The boot of previous WinDDSetup versions is incompatible with boards versions VEC2 02A !

SERCOS® board (at 16 MBaud)

This board will not be compatible with software versions older than v.06.05.

With software versions v.06.05 and later, this new board may be used to exchange data between the CNC and the drives that make up the Sercos® ring at 2, 4, 8 and 16 Mbaud.

Therefore, in order to select baudrates higher than 4 Mbaud, the drive must have this Sercos® board and software version v.06.05 or newer !

The Sercos® ring can have drives that have this board or the previous ones. However, all the drives must be set to the same transmission rate.

User notes:

PROTECTIONS ON DRIVE AND MOTOR

E

Introduction

This document describes the various limitations and monitoring that the drive carries out to protect the servo system against excessive temperature and current.

Protections of the drive

The elements setting the current limit through the drive are power semiconductors (IGBTs). The range of Fagor drives carry IGBTs whose maximum current (I_{IGBT}) ranges between 5.6 A and 130 A.

The IGBTs 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 (icommand) and watches the real instantaneous current (ireal). See section: "Peak current limit at the drive" in this appendix.

- The drive works with over - demanding duty cycles that cause the (Irms) to exceed the maximum permitted. This causes the IGBTs to overheat.

  To prevent this, there are two protections:

  - Some thermal sensors located on the heat - sink watch the actual temperature of these power semiconductors.
    See section: "Temperature sensors on the heat - sink" in this appendix.

  - The drive estimates this (Irms) with the integral of the I^2t product. This gives an estimate of the temperature of the IGBTs.
    See section: "Permanent duty cycles allowed for the drive. Calculating the I2t product" in this appendix.

Peak current limit at the drive

The operator may adjust the value of parameter CP20 [F307] to limit the current command. This way, the drive will never attend to current commands exceeding the Ipeak.

Parameter setting:

CP20 < I_{peak}

Bear in mind that:

I_{peak} = I_{IGBT} on synchronous motors.

I_{peak} = ➔ see this value in the corresponding table of the asynchronous motor manual.

If (I_{real} > 1.6 · I_{IGBT}) it will issue error 212

Exceeding this limit would damage the IGBTs.

In versions v.04.10, v.05.10 and later, a number of currents are calculated for each defined cycle (see the section: **Drive's duty cycles for asynchronous motors** later on). 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 (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 Tambient > 40°C (104°F) the drive is properly protected.
- For Tambient < 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 error temperature.

  Monitoring the heatsink temperature and compare it with the error limit. It % value of the drive's load may be displayed on the screen. To use this feature at the CNC, use variables KV10 [F1102]CoolingTemperature and KV12 [S205] Cooling TemperatureErrorLimit.

Temperature sensors on the heat - sink

There is a temperature sensor [gage] on the drive's heat sink. KV10 [F1102] variable provides information about this temperature.

KV1 [F1102] CoolingTemperature

Function:	Reading of the heat - sink temperature of the module (°C)
Units:	Tenths of degree centigrade (°C).

Permanent duty cycles allowed for the drive. Calculating the I^2t product

Chapter 1 indicates which is the maximum current allowed for permanent duty cycles (S1). The higher the ambient temperature, the lower the capabilities of the drive. Thus, 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 periods of 10 seconds, with tc = 5 s. and tv= 9.5.

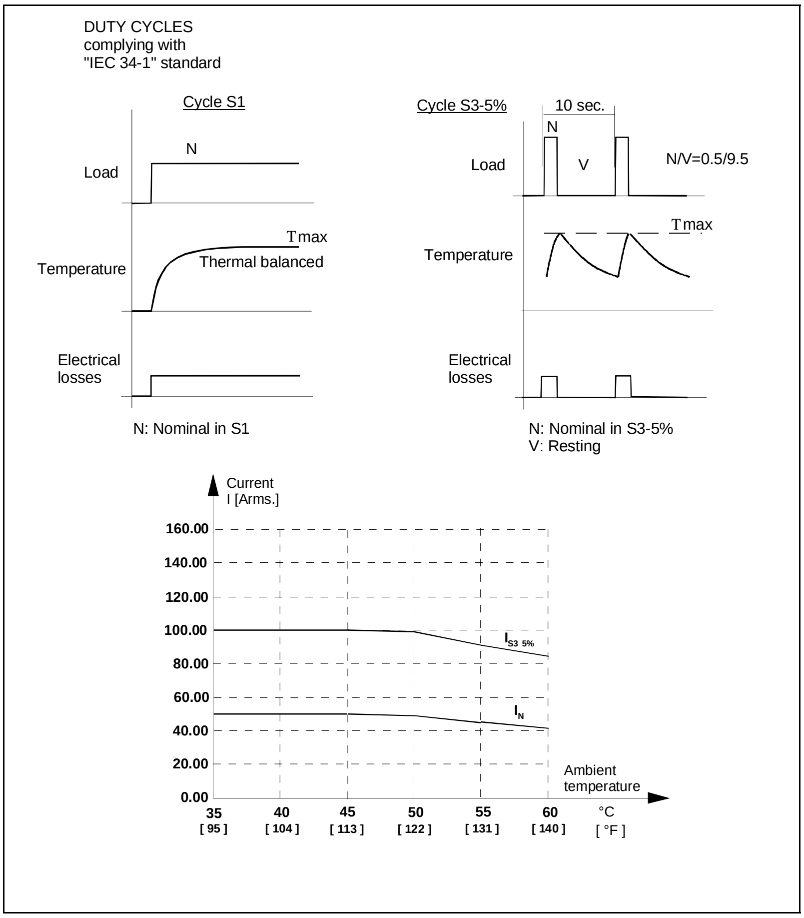


fig. 1 Duty cycles and derating example (AXD 3.100)

The S6-40% cycle reproduces intermittent work conditions in periods of 10 minutes, with tc = 4 min and tv = 6 min and the S6-15% cycle reproduces intermittent work conditions in periods of 60 s with tc = 10 s and tv = 50 s.

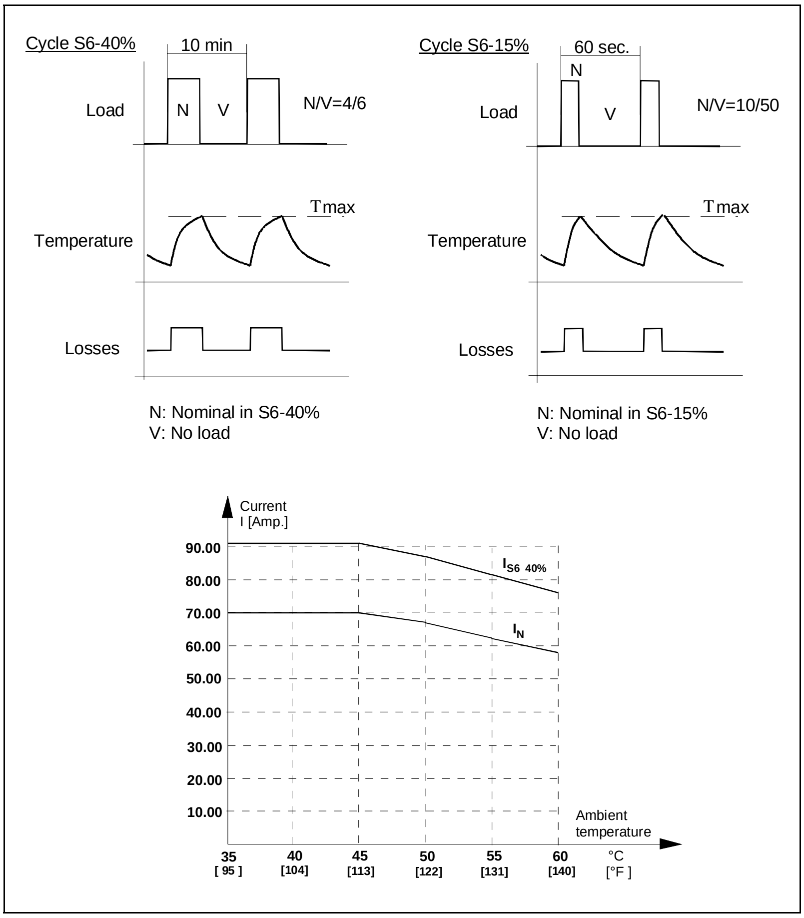


fig. 2 Duty cycles and derating cycles (SPD 3.100)

The drive estimates the temperature of the IGBTs based on the rms current circulating through them.

The following equation calculates the rms current:

$$I_{rms} = \int_{(t+\tau)}^{t} I^2 t \, dt$$

This temperature estimate is based on the calculation we call I^2t. If this temperature exceeds a predetermined value, error 202 will be activated Drive Overload.

For a system with some particular IGBTs, the drive allows rms current [estimated by calculating the I^2t] of:

$I_{rms} = 0.5\ I_{IGBT}$	for synchronous motors;
I_{rms} = ➔	see this value in the relevant table of the asynchronous motor manual.

Calculating the I^2t implies an ambient temperature of 40°C (104°F). For temperatures of up to 55°C (131°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 I^2t 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.

fig.3 shows an example of two equivalent duty cycles.

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).

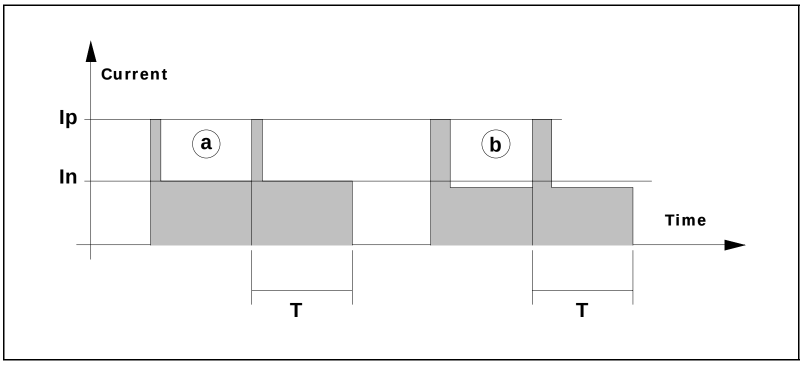
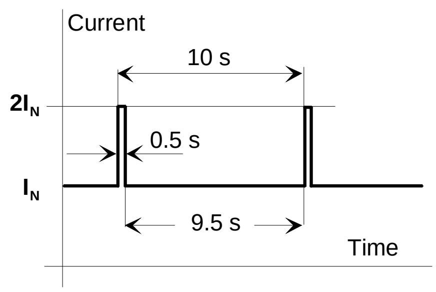


fig. 3 Equivalent duty cycles

Drive cycle for synchronous motors

The synchronous drive withstands cycles equivalent to the one shown in the figure below:



$$I_{S3\text{-}5\%} = I_{IGBT} = 2I_N$$

$$I_{rms} = \sqrt{(2 \bullet I_N)^2 \bullet \frac{0.5}{10} + I_N^2 \bullet \frac{9.5}{10}} = 1.07 \bullet I_N$$

fig. 4 Drive cycles for an asynchronous motor

Where In is the rated current given in the table below for each drive in amperes:

With internal fan	AXIS DRIVE (synchronous)									
Currents at fc = 4 kHz (A)	**AXD 1.08**	**AXD 1.15**	**AXD 1.25**	**AXD 1.35**	**AXD 2.50**	**AXD 2.75**		**AXD 3.100**	**AXD 3.150**	
I S1 (= I_N) (Arms)	4	7.5	12.5	17.5	23.5	31.5		50	62	
I S3 - 5% (Arms)	8	15	25	35	47	63		100	124	
Dissipated current (W)	33	69	115	156	225	285		513	617	

table 1 Axis drives. fc = 4 kHz

With internal fan	AXIS DRIVE (synchronous)									
Currents at fc = 4 kHz (A)	**AXD 1.08**	**AXD 1.15**	**AXD 1.25**	**AXD 1.35**	**AXD 2.50**	**AXD 2.75**		**AXD 3.100**	**AXD 3.150**	
I S1 (= I_N) (Arms)	4	7.5	12.5	17.5	23.5	31.5		50	62	
I S3 - 5% (Arms)	8	15	25	35	47	63		100	124	
Dissipated current (W)	44	89	148	195	305	395		695	847	

table 2 Axis drives. fc = 8kHz

f_c : IGBT switching frequency

As long as the IGBTs are below their rated working temperature (for example, on start - up) they will be allowed some more demanding initial cycles.

Drive's load cycles for asynchronous motors

For versions older than v.04.09 and v.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 .

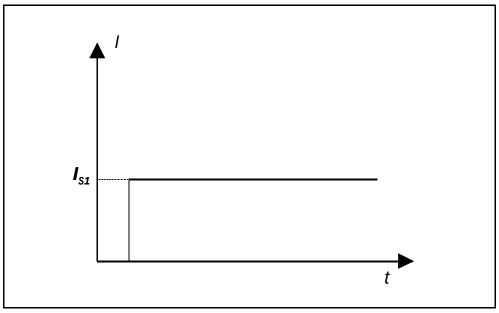


fig. 5 Drive cycle S1 for an asynchronous motor

where I_N is the rated (nominal) current which, in Amps and for each drive is:

SPD SCD	1.08	1.15	1.25	1.35	2.50	2.75	2.85	3.100	3.150	3.200
In = Ipeak	5.6	10.6	19.6	28.0	35.4	53	65	80	106	130

For newer versions than v.04.09 and v.05.09, the current values in S1 are decreased and the S6 - 40% cycle is the most commonly used when selecting the spindle motor.
Usually, the drive associated with the motor is chosen so it is capable of supplying enough current for the motor to reach this cycle.

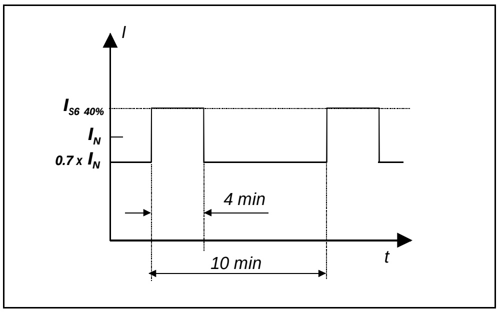


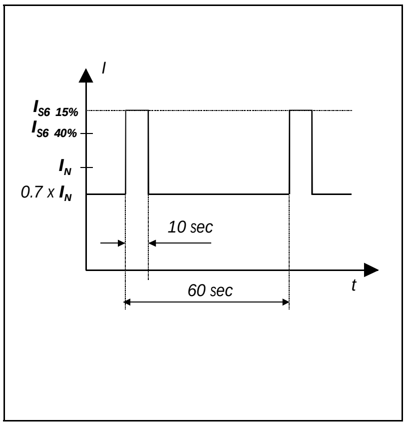
fig. 6 Load cycle S6 - 40%

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 [F613] FluxReduction that sets the desired % of magnetizing current when the motor turns without load. By default, it has a value of 100%.

Note that the value for C axis applications must be 100%.

Load cycle S6 -15% admits greater acceleration peaks since higher maximum currents are provided.



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 seconds).

fig. 7 Load cycle S6-15%.

The current with no load corresponds to the motor magnetizing current (0.7 x I_N).

Note that when using parameter FP40 [F613] FluxReduction the current of the low portion of the cycle will be reduced in the same proportion.

The values of these currents for SPD modular drives are given in Amperes in the following table:

With internal fan	SPINDLE DRIVE (asynchronous)									
Currents at f_c = 4 kHz (A)			SPD 1.25	SPD 1.35	SPD 2.50	SPD 2.75	SPD 2.85	SPD 3.100	SPD 3.150	SPD 3.200
I S1 (= I_N) (Arms)			16	23.1	31	42	50	70	90	121
0.7 x I_N (Arms)			11.2	16.17	21.7	29	35	49	63	84.7
I S6 - 40% (Arms)			20.8	30.03	40.3	54.6	65	91	117	157.3
I S6 - 15% (Arms)			22	32	45	65	72.5	91	140	170
Dissipated power (W)			146	195	349	390	432	724	904	1163

table 3 Spindle drives. fc = 4kHz

With internal fan	SPINDLE DRIVE (asynchronous)									
Currents at f_c = 8 kHz (A)			SPD 1.25	SPD 1.35	SPD 2.50	SPD 2.75	SPD 2.85	SPD 3.100	SPD 3.150	SPD 3.200
I S1 (= I_N) (Arms)			13	18	27	32	37	56	71	97
0.7 x I_N (Arms)			9.1	12.6	18.9	22.4	25.9	39.2	49.7	67.9
I S6 - 40% (Arms)			16.9	23.4	35.1	41.6	48.1	72.8	92.3	126.1
I S6 - 15% (Arms)			17.8	24.9	39.1	65	53.6	72.8	110.4	136.5
Dissipated power (W)			145	201	350	395	438	743	930	1187

table 4 Spindle drives. fc = 8kHz

f_c : IGBT switching frequency

Protections of the motor

The mechanical power limit of a motor is determined, among other causes, by the maximum temperature allowed in its windings and, in motors with permanent magnets, by the conservation of its magnetic properties.

As with the protection of the drives, the protection of the motors is watched in three modes at the same time:

- Watch that the current does not exceed the maximum peak value permitted. To prevent this, the drive limits the current command which it will attend to (icommand) and it watches the real instantaneous current (ireal).

  See section: "Peak current limit at the motor" in this appendix.
- In permanent duty cycles, the motor temperature is monitored by:
  - Thermal sensors located in the motor.
    See section: "Temperature sensors in the motor" in this appendix.
  - Estimating the rms current based on the integral of the I^2t product. This offers a temperature estimate.
    See section: "Permanent duty cycles allowed for the motor. Calculating the I2t product." in this appendix.

Peak current limit at the motor

The operator may adjust the value of its parameter CP20 [F307] to limit the current command. Thus, the drive will never attend to current commands exceeding MP4 [S109] which is the maximum peak current allowed at the motor.

This maximum peak current is given by the motor tables in the corresponding motor manual. This data only sets a preventive current limit by thermal characteristics.

CP20 < MP4

MP4 [S109] is a parameter for synchronous motors only.

In asynchronous motors, the current command is not monitored.

Temperature sensors in the motor

The motors have an overtemperature sensor (gage) PTC.

It is a triple sensor which permits detecting overtemperatures in the windings of each phase. This sensor is connected to the drive through the feedback cable of the motor itself.

Error 108 will be issued when the limit temperature for the motor is reached (which in Class F is 150 °C (302°F)).

The asynchronous motor also has a thermal klixon switch that opens when those 150 °C are reached. This switch must be included in the emergency chain of the electrical cabinet.

Permanent duty cycles allowed for the motor. Calculating the I^2t product.

The drive software offers a procedure to calculate the integral I^2t applied to both the synchronous and asynchronous motors.

The permanent watch of the I^2t product tolerates any equivalent duty cycle producing a maximum temperature equal to the one produced in the S1 cycle with a time constant set by parameter MP13 [F1209] MotorThermalTime Constant.

However, the overheating caused by very high peak currents cannot be modeled with the I^2t calculation. In this case, the temperature sensors of the motors will be the ones detecting the overheating.

Synchronous motors

The manual: AC servomotors: FXM and FKM indicates the rated currents and maximum peak currents for the motors.

Asynchronous motors

The manual: AC spindle motor SPM (for SPM motor) and the manual: AC spindle motor FM7 (for FM7 motor) indicate 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.

External monitoring of the real I^2t levels

The user may know the effort level of the drive by checking the value of the I^2t product through the variable:

real value: **KV32 [F1109] I^2tDrive**

The user may know the effort level of the motor by checking the value of the I^2t through the variable:

real value: **KV36 [F1111] I^2tMotor**

These values are given as **percentage used over the maximum**. *In software versions prior to v. 04.01 the units were absolute and it used two more parameters.*

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 I^2t 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 I^2t and check whether the drive can withstand it or not.

Protection of the external ballast resistor

From software version v.03.07 on, the drive internally calculates the I^2t 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 [F1113] ExtBallastResistance

Funtion: Contains the Ohm value of the external Ballast resistor in a compact drive. It is useful for the I^2t protection of that resistor.

Valid values: 0 ... 6553.5 (.).

Default value: 0.

KP3 O [F1114] ExtBallastPower

Function: Contains the power value of the external Ballast resistor in a compact drive. It is useful for the I^2t protection of that resistor.

Valid values: 0 ... 65535 (W).

Default value: 0.

KP4 O [F1116] ExtBallastEnergyPulse

Function: Contains the value of the energy pulse that can be dissipated through the external Ballast resistor in a compact drive. It is useful for the I^2t protection of that resistor.

Valid values: 0 ... 400000 (J).

Default value: 0.

KV40 F [F1115] I2tCrowbar

Function: Shows the load percentage over the external Ballast resistor in a compact drive. It is useful for the I^2t protection of that resistor. A value over 100% in this variable causes error 301.

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 I^2t value on its own.

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If any of the KP2, KP3 or KP4 parameter is set to 0, the I^2t 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 65535 the I^2t protection will be disabled.

Protection against a mains phase drop

From drive software v.03.07 on and with MSC board version 06A or later, the compact modules [ACD and SCD] monitor the presence of all three mains phases.

Should any them drop for over 10 msecs, Error 3 will be triggered.

User notes: