FAGOR AUTOMATION S.COOP.

# Brushless AC Servo Drives

## ~ MCSi-S0 series ~

Ref.1504


FAGOR

14460069

Original instructions

| | |
|---|---|
| **Title** | Brushless AC servo drives. MCSi-S0 series. |
| **Type of documentation** | Description, installation and startup of motors and digital drives MCS INNOVA with SERCOS interface. |
| **Name** | **MAN REGUL MCSi-So (IN)** |
| **Manual reference** | Ref.1504 |
| **Software** | Version 01.0x |
| **Electronic document** | man_mcsi_s0.pdf |
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**April 2015 / Ref.1504**

# Warranty

## 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.

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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.

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## Service contracts

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

# Declaration of conformity

**Manufacturer:** Fagor Automation, S. Coop.

B.º San Andrés 19, C.P. 20500, Mondragón - Gipuzkoa - (SPAIN)

We hereby declare, under our responsibility that the product:

**FAGOR AC Brushless Servo Drive System**

consisting of the following modules and motors:

| | |
|---|---|
| **Drive modules** | MCS Innova MCSi-S0 series |
| **AC motors** | FS. FSA and FSP series |

mentioned on this declaration,

with the basic requirements of the European Directives 2006/95/EC on Low Voltage (Basic Safety Regulation; Machinery Electrical Equipment EN 60204-1:2006) and 2004/108/EC on Electromagnetic Compatibility (EN 61800-3:2004, Specific Regulation on Electromagnetic Compatibility for Servo Drive System).

Fagor Automation, S. Coop.

Director Gerente
Pedro Ruiz de Aguirre

In Mondragón, July 1st, 2009

# Introduction

FAGOR offers a range of servo systems (AC brushless motor FS plus digital drive) for application between 0.318 and 2.39 N·m at a rated speed of 3000 rev/min.

This manual describes the elements in detail and guides step by step through the installation and setup of the drive system.

**When installed for the first time, it is a good idea to read the whole document.**

Should you have any doubts or questions, please do not hesitate to contact our technicians at any of our subsidiaries worldwide.

Thank you for choosing FAGOR.

# General index

# BRUSHLESS AC MOTORS, FS

## Introduction

FS synchronous servo motors (FSA and FSP series) are AC Brushless with permanent magnets.

They are ideal for any application requiring great positioning accuracy.

They have a uniform output torque, high reliability and low maintenance.

## General characteristics

**TABLE 1.** General characteristics of FS motors.

| | |
|---|---|
| **Excitation** | Permanent magnets |
| **Temperature sensor** | Not available |
| **Shaft end** | Cylindrical with keyway (optional: without keyway) |
| **Mounting** | Face flange |
| **Mounting method** | IM B5, IM V1, IM V3 (as per IEC-34-3-72) |
| **Mechanical tolerances** | Eccentricity: 0.02<br>Concentricity: 0.04<br>Perpendicularity: 0.04 |
| **Roller bearings' life** | 20000 hours |
| **Vibration resistance** | Vibration acceleration: 49 m/s² |
| **Vibration class** | 15 µm or lower |
| **Electrical insulation** | Class B (130 °C / 266 °F) |
| **Insulation resistance** | 500 V DC, 10 MΩ or greater |
| **Dielectric rigidity** | 200 V motors: 1500 V AC, one minute |
| **Body or housing** | Totally enclosed and self-ventilated |
| **Protection degree** | General: standard IP 55 (shaft section excluded) |
| **Storage temperature** | From - 20 °C to 60 °C (- 4 °F to 140 °F) |
| **Ambient temperature allowed** | From 0 °C to 40 °C (from 32 °F to 104 °F) |
| **Working ambient humidity** | From 20 % to 80 % (non condensing) |
| **Voltage supply for the brake** | 24 V DC - the brake is optional - |
| **Feedback** | Standard: Incremental encoder 13 bits: 2028 ppt<br>Optional: Absolute encoder 16 bits: 16384 ppt |

**TABLE 2.** Characteristics table of non-ventilated FSA/FSP motors with “F” winding (220 V AC).

| FSA SERIES | Stall torque | Stall peak torque | Rated speed | Maximum speed | Stall current | Peak current | Power | Torque constant | Acceleration time | Inertia [1] | Mass [2] | Peak torque (for 3 seconds) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mo<br>Nm | Mp<br>Nm | nN<br>rev/min | nmax<br>rev/min | Io<br>Arms | Ip<br>Arms | P<br>W | Kt<br>Nm/Arms | tac<br>ms | J<br>kg·cm² | M<br>kg | MCSi -07L-S0<br>Nm | MCSi -11L-S0<br>Nm | MCSi -15L-S0<br>Nm |
| FSA01.50F.□□.□□□ | 0.318 | 0.95 | 3000 | 5000 | 0.9 | 2.8 | 100 | 0.378 | 1.19 | 0.036 | 0.5 | **0.95** | | |
| FSA02.50F.□□.□□□ | 0.637 | 1.91 | 3000 | 5000 | 2.1 | 6.5 | 200 | 0.327 | 1.74 | 0.106 | 1.1 | **1.91** | | |
| FSA04.50F.□□.□□□ | 1.27 | 3.82 | 3000 | 5000 | 2.8 | 8.5 | 400 | 0.498 | 1.42 | 0.173 | 1.7 | 3.24 | **3.82** | |
| FSA08.50F.□□.□□□ | 2.39 | 7.16 | 3000 | 5000 | 4.4 | 13.4 | 750 | 0.590 | 2.95 | 0.672 | 3.4 | 3.84 | 6.19 | **7.16** |

| FSP SERIES | Stall torque | Stall peak torque | Rated speed | Maximum speed | Stall current | Peak current | Power | Torque constant | Acceleration time | Inertia [1] | Mass [2] | Peak torque (for 3 seconds) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mo<br>Nm | Mp<br>Nm | nN<br>rev/min | nmax<br>rev/min | Io<br>Arms | Ip<br>Arms | P<br>W | Kt<br>Nm/Arms | tac<br>ms | J<br>kg·cm² | M<br>kg | MCSi -07L-S0<br>Nm | MCSi -11L-S0<br>Nm | MCSi -15L-S0<br>Nm |
| FSP01.50F.□□.□□□ | 0.318 | 0.95 | 3.000 | 5.000 | 0.9 | 2.8 | 100 | 0.392 | 1.62 | 0.491 | 0.7 | **0.95** | | |
| FSP02.50F.□□.□□□ | 0.637 | 1.91 | 3.000 | 5.000 | 2.0 | 6.0 | 200 | 0.349 | 3.17 | 0.193 | 1.4 | **1.91** | | |
| FSP04.50F.□□.□□□ | 1.27 | 3.82 | 3.000 | 5.000 | 2.6 | 8.0 | 400 | 0.535 | 2.72 | 0.331 | 2.1 | 3.48 | **3.82** | |
| FSP08.50F.□□.□□□ | 2.39 | 7.16 | 3.000 | 5.000 | 4.1 | 13.9 | 750 | 0.641 | 9.21 | 2.100 | 4.2 | 4.17 | 6.73 | **7,16** |

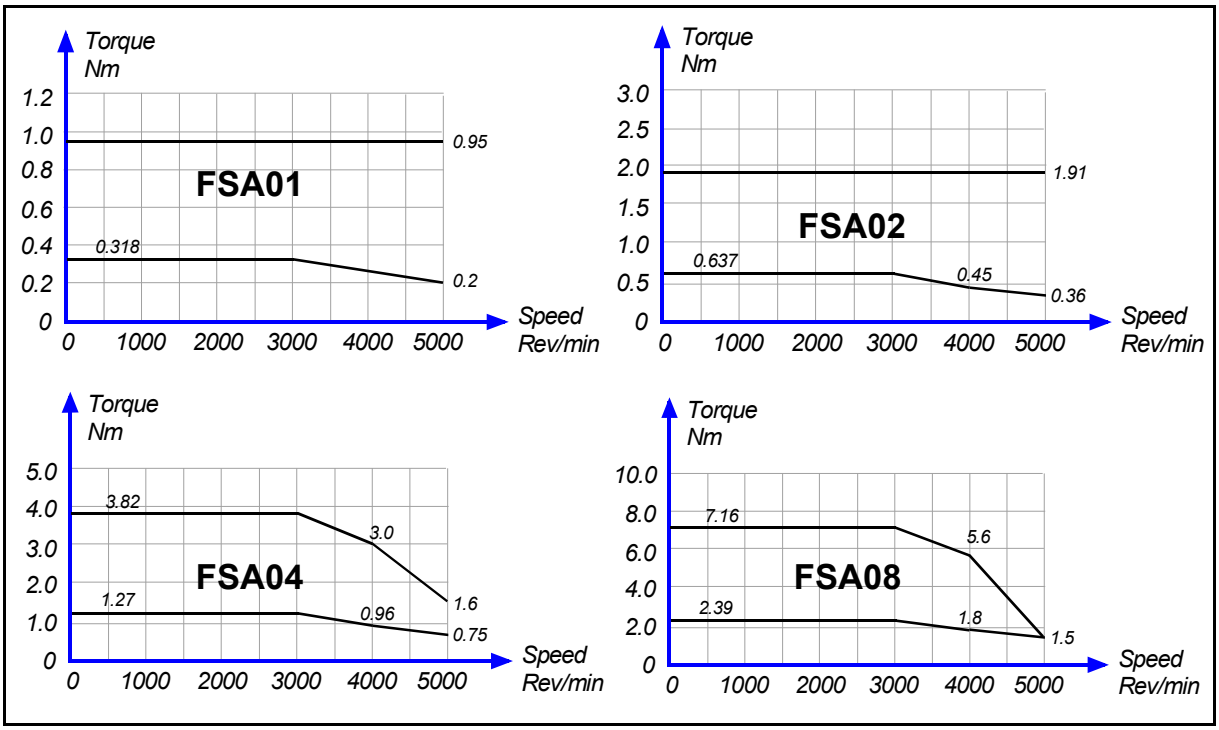
**1]** If the motor has a brake (option), its inertia must also be taken into account. See «brake characteristics».

**2]** If the motor has a brake (option), its mass must also be taken into account. See «brake characteristics».

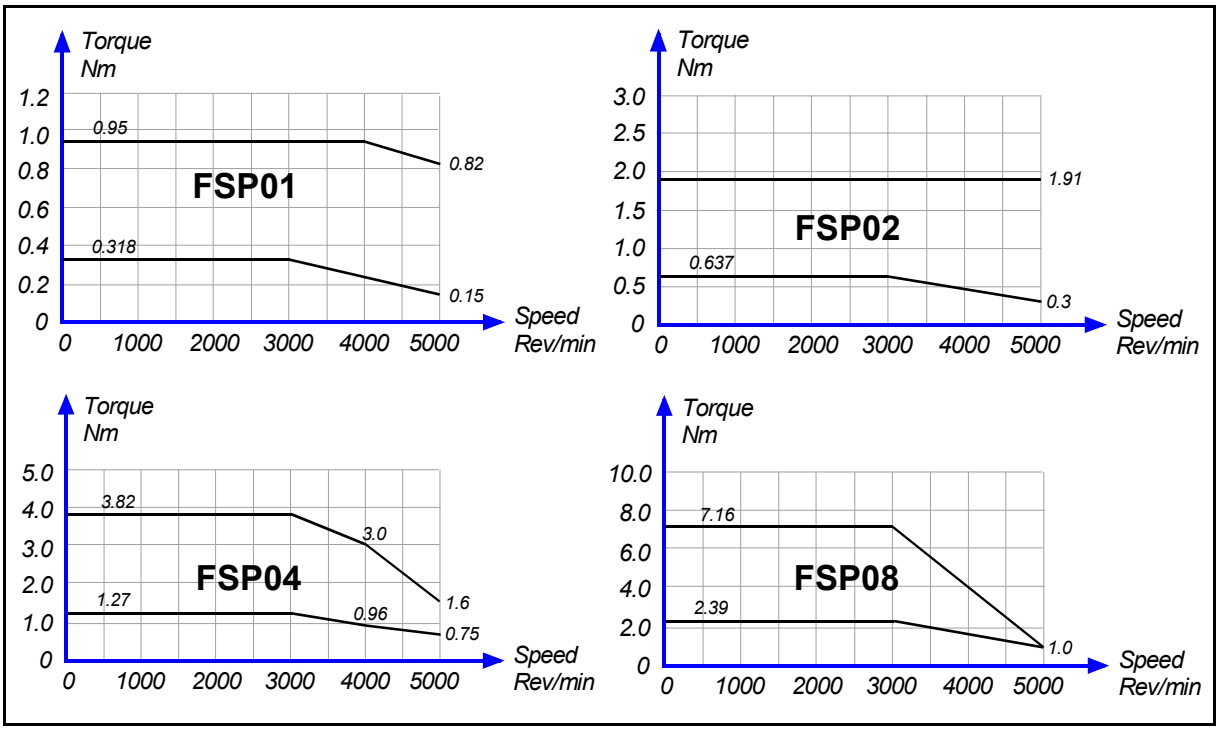
**Note.**The drive recommended to govern each motor must supply the rated current needed to obtain the rated torque from the motor.

# Torque-speed curves

## Synchronous AC servomotors FSA series




## Synchronous AC servomotors FSP series



# Dimensions

## Synchronous AC servomotors. FSA series

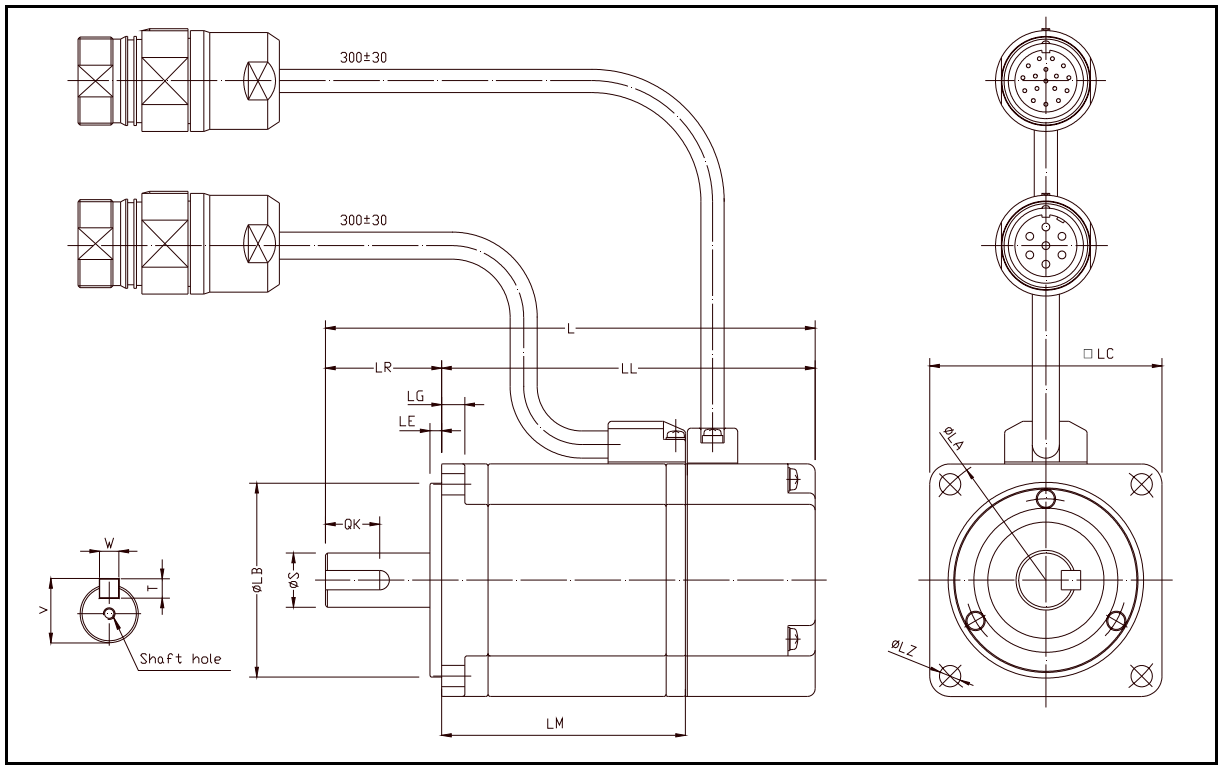



**FIGURE 1**

Dimensions of FSA series synchronous servo motors.

**TABLE 3.** Motor. Dimensions in mm.

| Dimensions | Motor length | | | | | Flange surface | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Motor type** | **LM** | **L** | **LL** | **Δbrake** | **LR** | **LA** | **LB** | **L** | **LE** | **LG** | **LZ** |
| **FSA01** | 61.5 | 119.5 | 94.5 | 40.5 | 25 | 46 | 30h | 40 | 2.5 | 5 | 4.3 |
| **FSA02** | 63.0 | 126.5 | 96.5 | 39.5 | 30 | 70 | 50h | 60 | 3 | 6 | 5.5 |
| **FSA04** | 91.0 | 154.5 | 124.5 | 39.5 | 30 | 70 | 50h | 60 | 3 | 6 | 5.5 |
| **FSA08** | 111.5 | 185.0 | 145.0 | 44.5 | 40 | 90 | 70h | 80 | 3 | 8 | 7.0 |

The «Δ brake» column shows the length increment for the L and LL measurements when using a motor configuration "with brake".

**TABLE 4.** Shaft. Dimensions in mm.

| Dimensions | Shaft end | | | | | Shaft hole |
|---|---|---|---|---|---|---|
| **Motor type** | **S** | **QK** | **W** | **T** | **V** | |
| **FSA01** | 8h6 | 14 | 3 | 3 | 9.2 | M3 x 6 |
| **FSA02** | 14h6 | 20 | 5 | 5 | 16 | M5 x 8 |
| **FSA04** | 14h6 | 20 | 5 | 5 | 16 | M5 x 8 |
| **FSA08** | 16h6 | 30 | 5 | 5 | 18 | M5 x 8 |

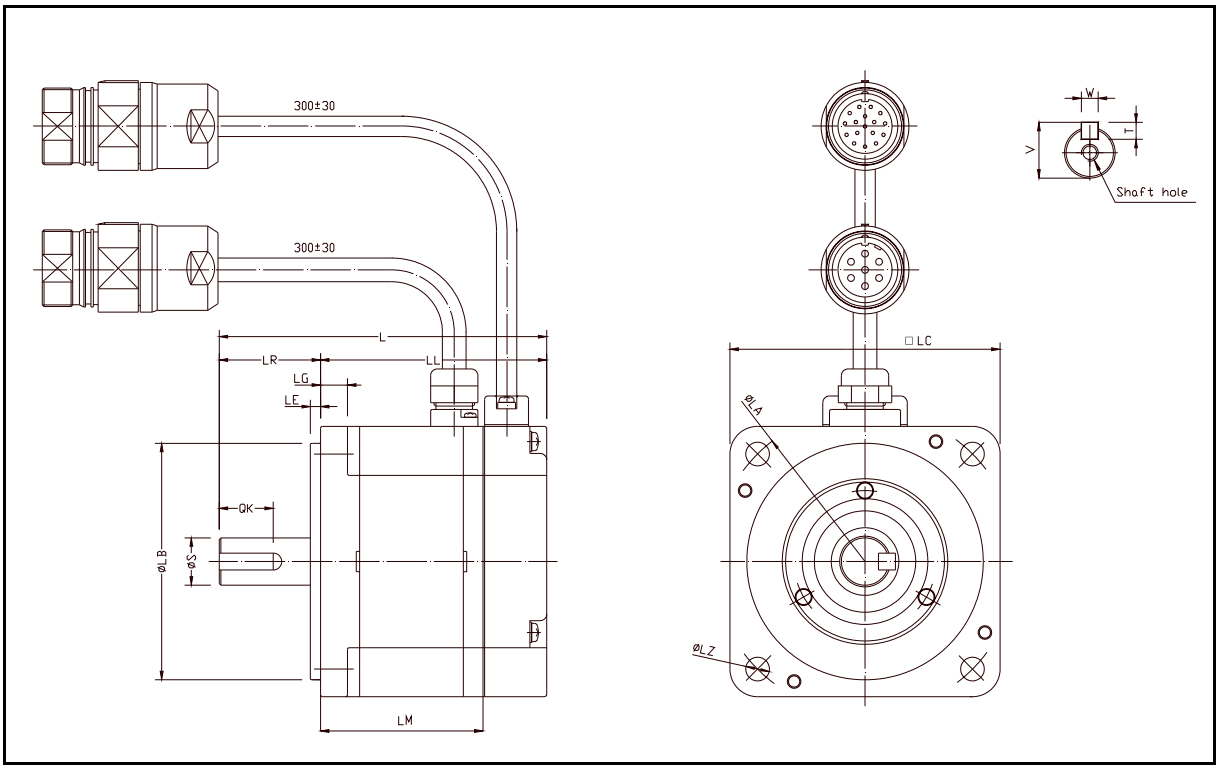



**FIGURE 2**

Dimensions of FSP series synchronous servo motors.

**TABLE 5.** Motor. Dimensions in mm.

| Dimensions | Motor length | | | | | Flange surface | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Motor type** | **LM** | **L** | **LL** | **Δ** | **LR** | **LA** | **LB** | **LC** | **LE** | **LG** | **LZ** |
| **FSP01** | 42.5 | 87 | 62 | 29.0 | 25 | 70 | 50h7 | 60 | 3 | 6 | 5.5 |
| **FSP02** | 48.1 | 97 | 67 | 31.5 | 30 | 90 | 70h7 | 80 | 3 | 8 | 7 |
| **FSP04** | 68.1 | 117 | 87 | 31.5 | 30 | 90 | 70h7 | 80 | 3 | 8 | 7 |
| **FSP08** | 66.7 | 126.5 | 86.5 | 33.5 | 40 | 14 | 110h | 12 | 3.5 | 10 | 10 |

The «Δ brake» column shows the length increment for the L and LL measurements when using a motor configuration "with brake".

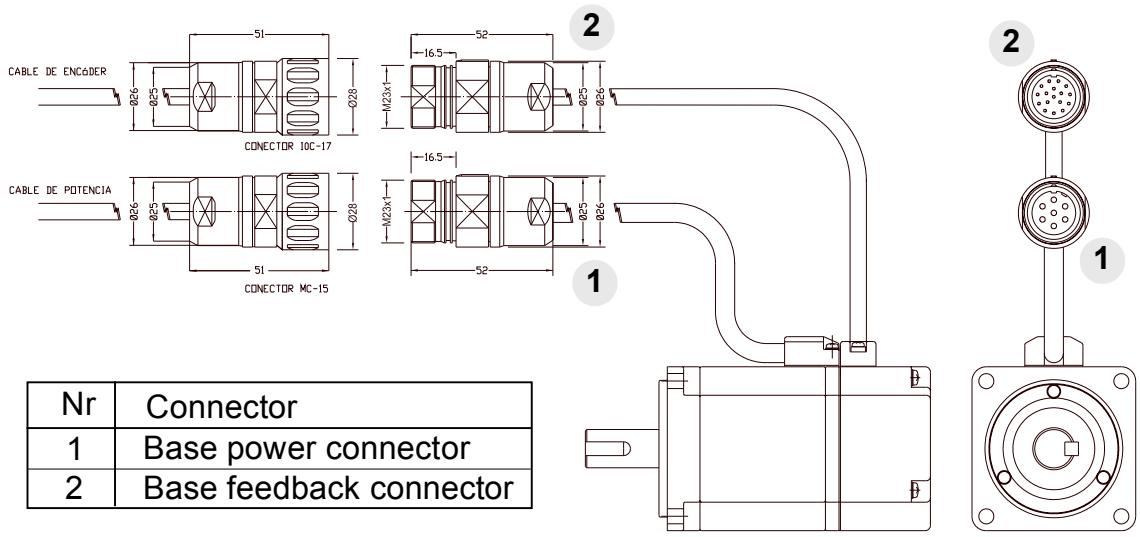
**TABLE 6.** Shaft. Dimensions in mm.

| Dimensions | Shaft end | | | | | Shaft hole |
|---|---|---|---|---|---|---|
| **Motor type** | **S** | **QK** | **W** | **T** | **V** | |
| **FSP01** | 8h6 | 14 | 3 | 3 | 9.2 | M3 x 6 |
| **FSP02** | 14h6 | 16 | 5 | 5 | 16 | M5 x 8 |
| **FSP04** | 14h6 | 16 | 5 | 5 | 16 | M5 x 8 |
| **FSP08** | 16h6 | 22 | 5 | 5 | 18 | M5 x 8 |

# Connectors

## Power connector

The following figure shows the identification of these connectors:




| Nr | Connector |
|---|---|
| 1 | Base power connector |
| 2 | Base feedback connector |

**FIGURE 3**

Power and feedback connector.

**Note that** although the figure shows the FSA series motor, the dimensions of all the connectors will be the same for the FSP series.

The base power connector includes pins 4 and 5 of the brake. Remember that it has no polarity and, therefore, the 24 V DC may be applied to either pin. A voltage between 22 V DC and 26 V DC applied to the brake releases the shaft .

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

Connecting the motor windings in the order indicated on the connector (U, V, W) of the figure below, the shaft will turn clockwise (CWR, clockwise rotation).

**BASE POWER CONNECTOR**

On FSA and FSP motors (200 V)

| Pin | Signal | Color |
|---|---|---|
| **1** | U phase | Red |
| **2** | W phase | White |
| **3** | V phase | Blue |
| **4** | brake * | Black |
| **5** | brake * | Black |
| **6** | Ground | Green / Yellow |

* No polarity

Viewed from the outside of the motor

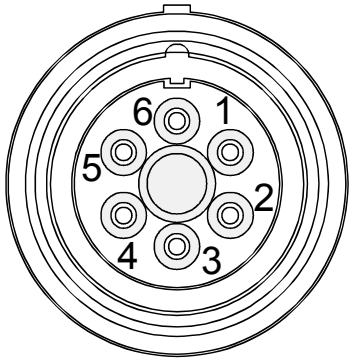



**FIGURE 4**

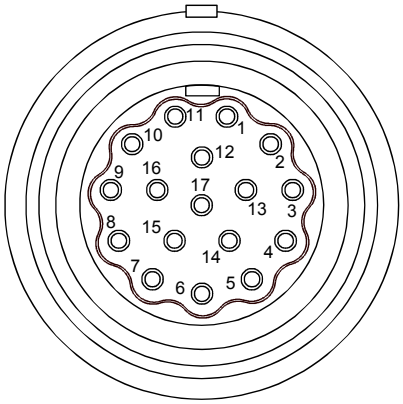
Power base connector pinout.

**BASE FEEDBACK CONNECTOR**

On FSA and FSP motors (200 V)

| Pin | Signal | Color |
|---|---|---|
| **1** | 0 V (16 bit absolute) | Pink |
| **2** | 3.6 V (16 bit absolute) | Grey |
| **3** | + RS485 | Green |
| **4** | - RS485 | Yellow |
| **8** | + 5 V | White |
| **9** | 0 V | Brown |

Note 1. The rest of pins are not connected
Note 2. Connector housing connected to ground




Viewed from the outside of the motor

**FIGURE 5**

Feedback base connector pinout.

# Holding brake

FSA and FSP series motors have an optional brake that applies friction to the shaft. Its purpose is to immobilize or lock vertical axes, **not to brake a moving axis**.

**WARNING.** NEVER use this brake to stop a moving axis !

Its main characteristics depending on the type of brake are:

**TABLE 7.** Technical characteristics of the brake.

| Brake | Holding torque | Power consumption | Supply voltage | Inertia | Mass |
|---|---|---|---|---|---|
| | N·m (lbf·in) | W (hp) | V DC | kg·cm² | kg (lbf) |
| **FSA01** | 0.318 (2.814) | 6.0 (0.008) | 24 | 0.0085 | 0.300 (0.66) |
| **FSA02** | 0.637 (5.637) | 6.9 (0.009) | 24 | 0.058 | 0.500 (1.10) |
| **FSA04** | 1.270 (11.240) | 6.9 (0.009) | 24 | 0.058 | 0.500 (1.10) |
| **FSA08** | 2.390 (21.153) | 7.7 (0.010) | 24 | 0.058 | 0.900 (1.98) |
| **FSP01** | 0.318 (2.814) | 8.1 (0.010) | 24 | 0.029 | 0.200 (0.44) |
| **FSP02** | 0.637 (5.637) | 7.6 (0.010) | 24 | 0.109 | 0.500 (1.10) |
| **FSP04** | 1.270 (11.240) | 7.6 (0.010) | 24 | 0.109 | 0.500 (1.10) |
| **FSP08** | 2.390 (21.153) | 7.5 (0.010) | 24 | 0.875 | 1.500 (33.1) |

**WARNING.**

- The brake must never exceed its maximum turning speed.
- A voltage between 22 V DC and 26 V DC releases the shaft from being locked up. Make sure that no voltage over 26 V DC is applied that prevents the shaft from turning.
- When installing the motor, make sure that the brake fully releases the shaft before making it turn for the first time.

# Sales model

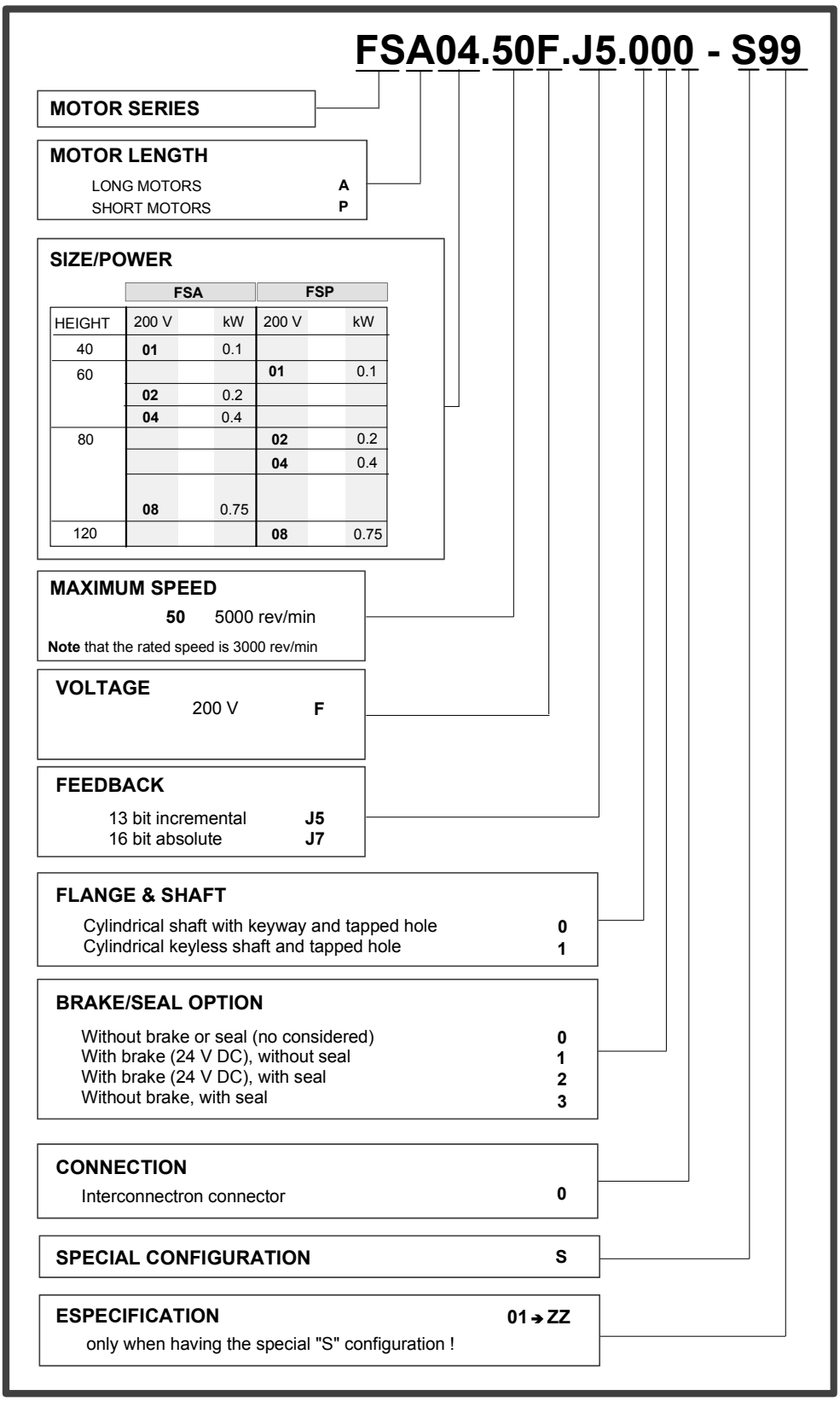



**FIGURE 6**

Sales model of FS series axis feed motors.

# MCSi-S0 SERVODRIVE

## Introduction

The **MCS Innova** servo drive (MCSi) family is a compact speed servo drive family for controlling small synchronous AC brushless motors.

There are three modules of different power offering peak currents of 6.5, 10.5 and 15.0 Arms for single-phase 220 V AC.

## General characteristics

Their main characteristics are:

- 220 V AC single-phase voltage supply.
- Dynamic braking in case of mains failure.
- PWM IGBTs.
- Serial encoder feedback.
- USB service communication line.
- Two logic inputs to control the motor: Speed Enable and Drive Enable.
- SERCOS communication protocol.

## Dimensions

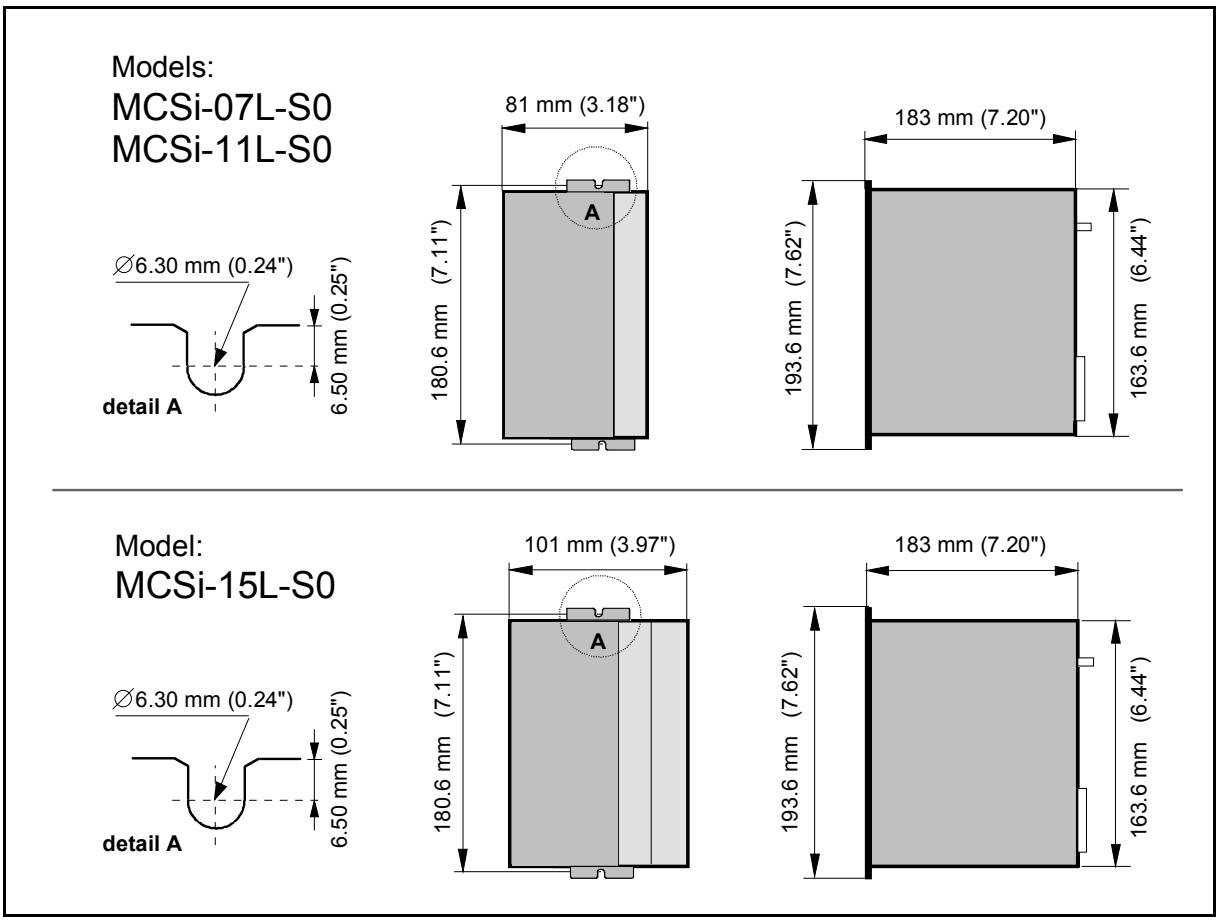



**FIGURE 7**

Dimensions of the MCSi-☐☐L-S0 drives.

# Technical data

**TABLE 8.** Technical data.

| | MODELS | | |
|---|---|---|---|
| | **MCSi 07L** | **MCSi 11L** | **MCSi 15L** |
| Rated output current | 2.1 Arms | 3.5 Arms | 5.0 Arms |
| Peak current (3 s) | 6.5 Arms | 10.5 Arms | 15.0 Arms |
| Power supply | Single phase 50/60 Hz. Voltage range between 220 -10 % V AC and 230 +10 % V AC | | |
| Consumption | 12.5 Arms | 20.0 Arms | 29.0 Arms |
| Over-voltage protection | 390 V DC | | |
| Frequency | Lower than 600 Hz | | |
| Internal Ballast resistor | - | - | 45 Ω |
| Internal Ballast power | - | - | 15 W |
| Ballast trigger | 380 V DC | | |
| Thermal protection of the heatsink | 90 °C (194 °F) | | |
| Operating temperature | 5 °C / 45 °C (41 °F / 113 °F) | | |
| Storage temperature | - 20 °C / 60 °C (- 4 °F / 140 °F) | | |
| Protection degree * | IP 20 | | |
| Module dimensions | 81x163.6x183 mm (3.18x6.44x7.20 “) | | 101x163.6x183 mm (3.97x6.44x7.20 “) |
| Module mass | 1.9 kg (4.18 lb) | | 2.1 kg (4.62 lb) |

* **IP 20** means that it is protected against objects of a diameter larger than 12.5 mm, but not against water splashes. Therefore, the unit must be mounted inside an electrical cabinet.

# Connectors

## Power terminals

### CONNECTOR X4

**POWER INPUTS L1, L2.** Mains input terminals.

**POWER OUTPUTS U, V, W.** Output terminals for the voltage applied to the motor. Current control with PWM on a carrier frequency of 8 kHz. When connecting to the motor, watch the matching of phases U-U, V-V and W-W.

### CONNECTOR X9

**L+, Ri, Re.** Terminals to configure and connect the external ballast resistor.

### CONNECTOR X5

**CONTROL POWER INPUTS L1, L2, GROUND.** Input terminals for the voltage supply of the drive's control circuits from mains. The maximum cable section at these power terminals is 2.5 mm².

**ACTIVATION OF THE INTERNAL FAN.** The internal fan that cools the drive's power elements starts when enabling the Drive Enable signal. The fan will stop when the heat-sink temperature is lower 70 °C since the Drive Enable signal is turned off. This method decreases the fan's operating time, thus increasing its useful life.

## Control signals

### CONNECTOR X3

### ENABLES

**Drive Enable input, pin 13.** No current circulates through the motor stator winding at 0 V DC, thus it no longer supplies torque. It is activated with +24 V DC.

**Speed Enable input, pin 15.** At 0 V DC, it forces an internal zero velocity command. It is activated with +24 V DC.

**Common to inputs Drive Enable and Speed Enable, pin 14.** Reference point for inputs Drive Enable and Speed Enable.

**+24 V DC and 0 V DC, pins 43 and 44.** Output of the internal 24 V DC power supply that may be used for the control of inputs Drive Enable and Speed Enable as well as the programmable digital input. It offers a maximum current of 50 mA limited internally.

| | |
|---|---|
| **pin 13** | Drive Enable |
| **pin 15** | Speed Enable |
| **pin 14** | Pin common to inputs Drive Enable and Speed Enable |
| **pin 43** | +24 V DC of the auxiliary power supply ( max. 50 mA) |
| **pin 44** | GND of the auxiliary 24 V DC power supply |

### DIGITAL INPUTS AND OUTPUTS

**Programmable digital input, pins 11 and 12.** Digital input (servo drive at +24 V DC and 0 V DC).

**Programmable digital output, pins 27 and 28:** Opto-coupled open collector output.

### DRIVE OK.

**Drive Ok, pins 29 and 30.** Relay contact that closes when the internal status of the drive control is OK.

**Note.** Remember that this relay contact must be necessarily included in the electrical maneuver.

### RELAY FOR SAFETY

**Safe-disable relay, pins 41 and 42.** Second, normally closed contact (NC) used as an external acknowledgement of the status of the safety relay.

**Note.** Remember that this relay contact must be necessarily included in the electrical maneuver.

### CHASSIS

**Metal housing of the connector.** Drive chassis connection point.

**CONNECTOR X2**

**MOTOR FEEDBACK INPUT** (feedback Input)

Standard IEEE 1394 type connector for input of the serial encoder signals, installed on the motor itself for position + speed feedback.

**CONNECTOR X6**

**SERVICE**

Standard USB mini AB type connector for connecting to a PC and updating the firmware. Any standard USB cable with a miniA or miniB connector may be connected at the drive side.

**CONNECTOR X7**

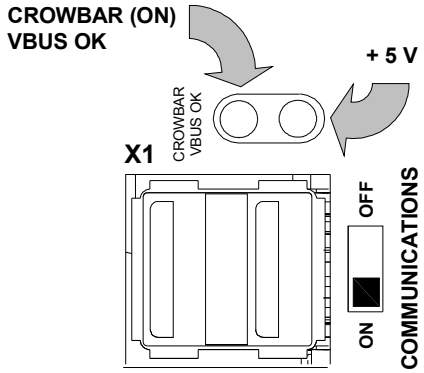
**SERCOS RING**

Connector with two pins (IN and OUT) that may be used to connect the drive modules of the system with the CNC that governs them. The connection is made through fiber optic lines and it has a ring structure. It comes with two rotary switches and two status-indicating LED's (Light Emitting Diodes).

# Indicators

**+5 V.** LED located on top of connector X1. When lit, it indicates that the internal +5V are being applied.

**CROWBAR (ON) / VBUS OK.** Two-color (green/red) light indicator located next to the +5 V LED. It indicates its status according to the following table:




**STATUS OF THE LED CROWBAR (ON) / VBUS OK**

| | |
|---|---|
| **OFF** | No voltage at power circuit |
| **ON (GREEN)** | Voltage at power circuit |
| **ON (RED)** | The internal bus voltage is higher than preset values and the recovery resistor has been activated |

**FIGURE 8**

"Crowbar (on) / VBus OK" LED states.

**Module Status & Network Status.** Indicator lights on top of the X1 connector above the two rotary "Node Select" selectors. It has several lighting sequences that indicate the status of both the SERCOS ring and the drive. For further detail, see section: Initialization and setup of this manual.

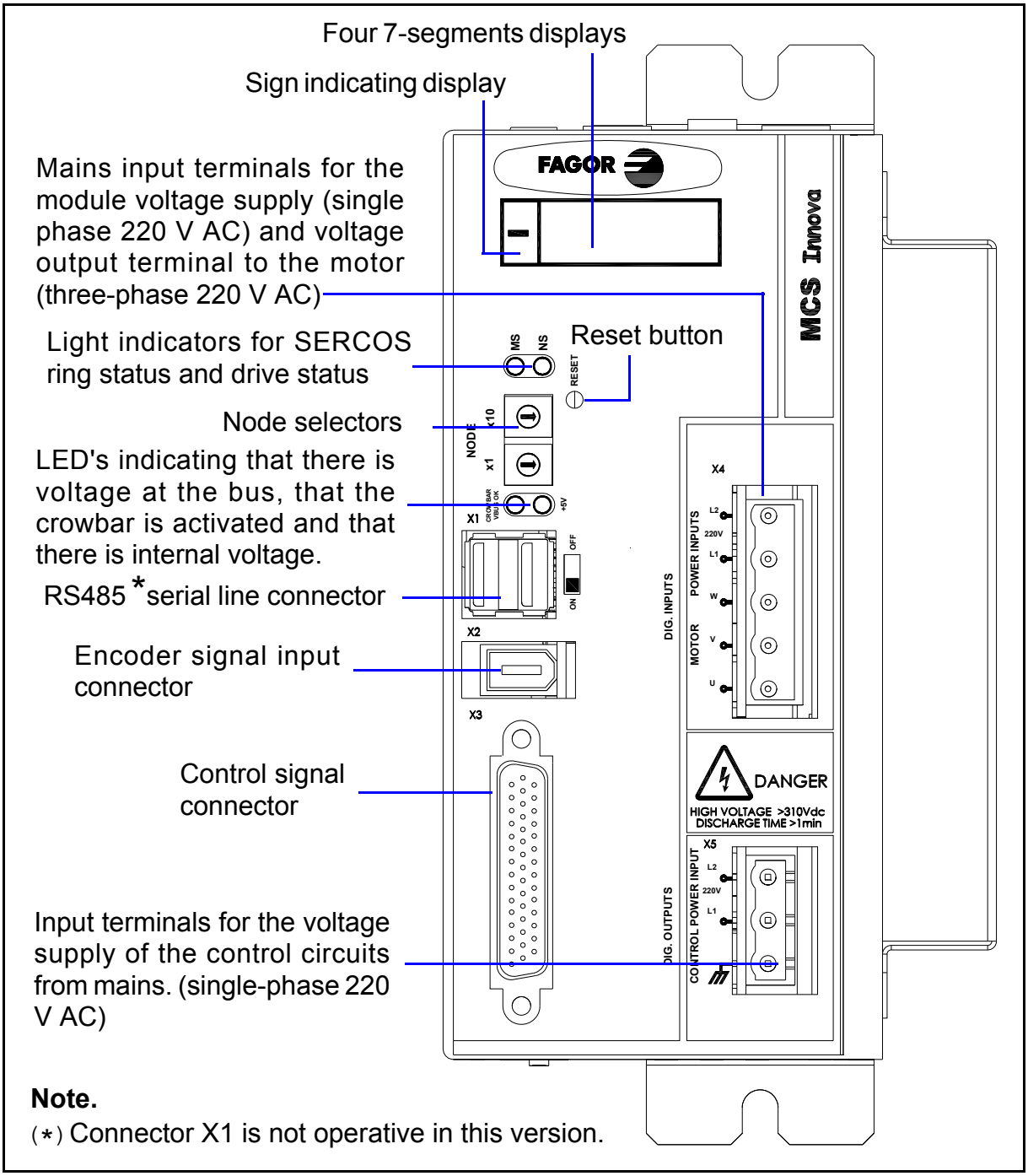
**Numerical displays.** It has four 7-segment numerical displays and a sign light to display the drive status.

## Push-buttons and switches

**RESET.** Push-button for resetting the system.

**NODE SELECT.** Consisting in two rotary switches used to determine the node number assigned to the drive in the SERCOS ring and also select the communication speed and the light power of the SERCOS LED's. For further detail, see section: Initialization and setup of this manual.

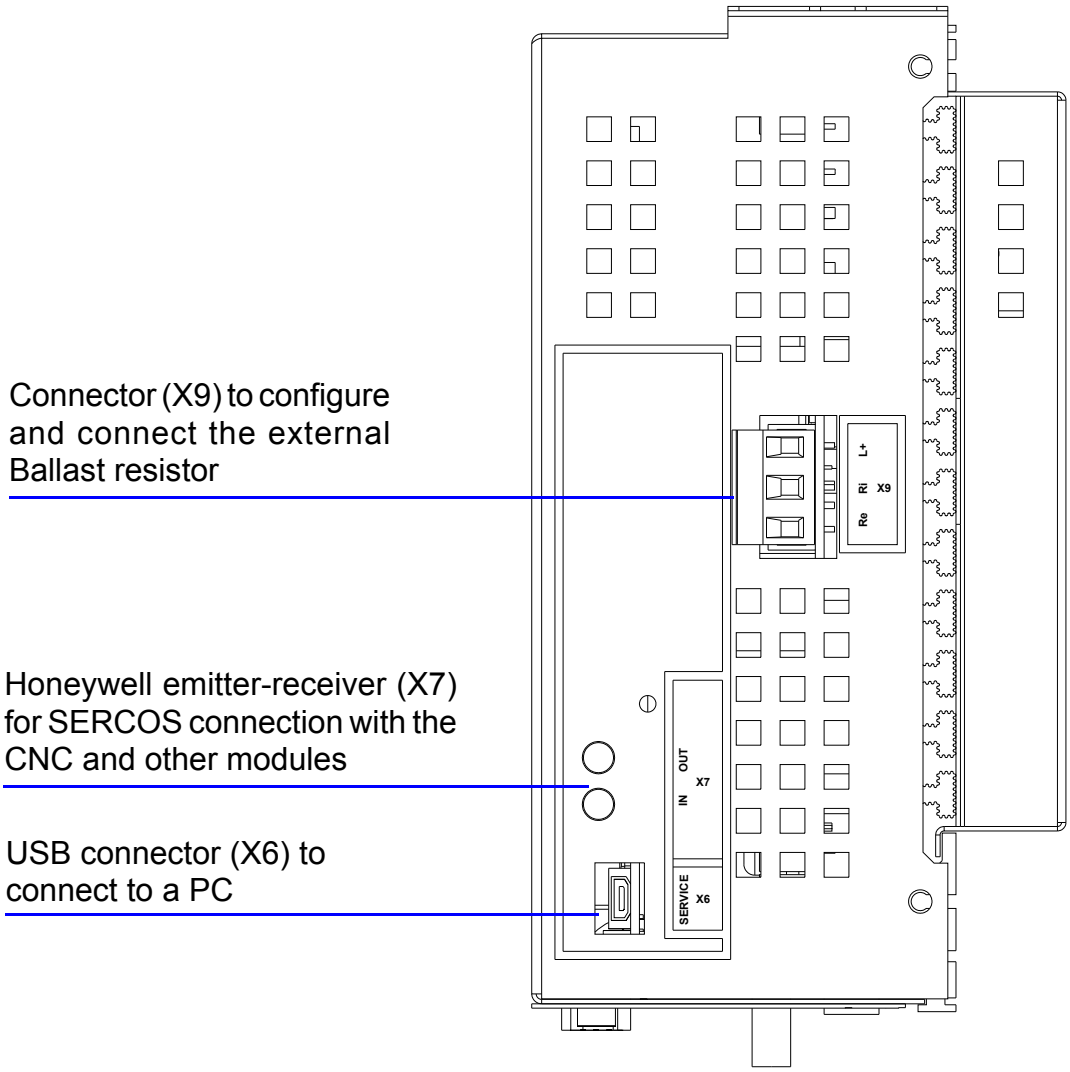
## Front view



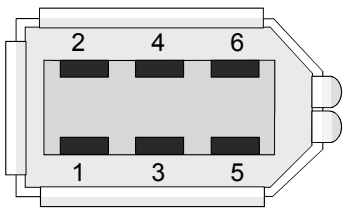

**Note.**

(*) Connector X1 is not operative in this version.

# Top view



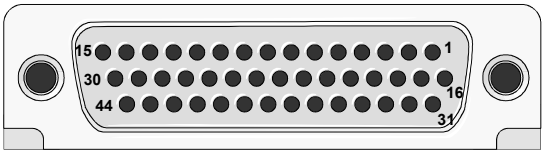

# Pinout of the connectors




**FEEDBACK INPUT (X2)**

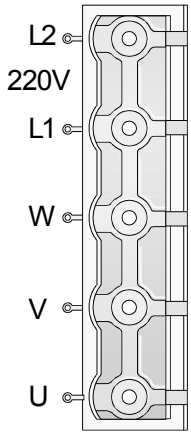
| Pin | Signal | Description |
|---|---|---|
| **1** | + 5 V | Voltage supply for the encoder |
| **2** | GND | Encoder voltage supply GND |
| **3** | + BAT | + battery (with absolute encoder) |
| **4** | - BAT | - Battery (with absolute encoder) |
| **5** | + 485 | Encoder communication |
| **6** | - 485 | Encoder communication |
| | Chassis | Connector housing |

## CONTROL SIGNALS (X3)



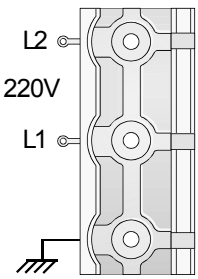

| Pin | Signal | I/O | Description | |
|---|---|---|---|---|
| **34** | AUX. ±12 V | O | + 12 V (20 mA max) output | |
| **33** | | | - 12 V (20 mA max) output | |
| **19** | | | GND | |
| **43** | AUX 24 V DC | O | + 24 V DC (50 mA max) output | |
| **44** | | | GND AUX 24 V DC | |
| **13** | DRIVE ENABLE | I | DRIVE ENABLE input (range from 0 to 24 V DC) | |
| **15** | SPEED ENABLE | I | SPEED ENABLE input (range from 0 to 24 V DC) | |
| **14** | COMMON DRIVE | - | Common to inputs DRIVE ENABLE and SPEED ENABLE | |
| **11** | PROG. DIGIT. INPUT | I | Programmable digital input + | Range from 0 to 24 V DC |
| **12** | | | Common of the digital input - | |
| **27** | PROG. DIGIT. OUTPUT | O | Programmable digital output (collector) | 100 mA max, 50 V DC |
| **28** | | | Programmable digital output (emitter) | |
| **29** | DRIVE OK | O | Open contact of the DRIVE OK signal (0.6 A - 125 V DC, 0.5 A - 110 V DC, 2 A - 30 V DC) | |
| **30** | | | | |
| **41** | SAFETY RELAY | O | Second contact (N. C. normally closed) used as external acknowledgment of the status of the safety relay. | |
| **42** | | | | |

Out of the 44 pins of the connector, those not identified in this table are NC pins (Not Connected).
The < I/O > column indicates whether it is an input signal (**I**nput) or an output signal (**O**utput) through the relevant pin at connector X3.



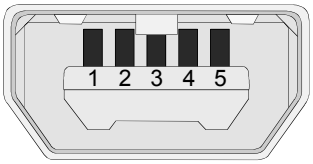

## POWER INPUTS & MOTOR (X4)

| Pin | Signal | Description |
|---|---|---|
| **L2** | S phase | 220 V mains voltage input terminals. |
| **L1** | R phase | |
| **W** | W phase | Output terminals for the voltage applied to the motor (200 V). |
| **V** | V phase | |
| **U** | U phase | |



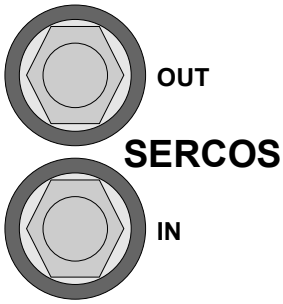

## CONTROL POWER INPUTS (X5)

| Pin | Signal | Description |
|---|---|---|
| **L2** | S phase | 220 V mains input terminal for the control circuits. |
| **L1** | R phase | |
| | Chassis | Ground |




**SERVICE (X6)**

| Pin | Signal | Description |
|---|---|---|
| **1** | N. C. | Not connected |
| **2** | DMO | DMO |
| **3** | DPO | DPO |
| **4** | N.C. | Not connected |
| **5** | GND | GND |
| | Chassis | Housing |




**HONEYWELL RECEIVER-EMITTER (X7)**

| Pin | Signal | Description |
|---|---|---|
| **IN** | SERCOS (in) | SERCOS signal receiver |
| **OUT** | SERCOS (out) | SERCOS signal emitter |

# Sales model

Codes of the sales model of FAGOR MCS Innova drives with FAGOR SERCOS board.

**MCS INNOVA DIGITAL DRIVE** **EXAMPLE. MCSi - 07 L - S0**

**Model** MCS Innova

**Current (A)**

| | Rated | Peak (3 s) |
|---|---|---|
| **07** | 2.1 | 6.5 |
| **11** | 3.5 | 10.5 |
| **15** | 5.0 | 15.0 |

**Power Supply** 220 V AC

**With SERCOS board**

# INSTALLATION

## General considerations

### At the motor

Remove the anti-corrosion paint of the rotor and of the flange before installing the motor on the machine. The motor may be mounted as IM B5 and IM V1.

Watch for the ambient conditions mentioned in the section on "technical data" and also:

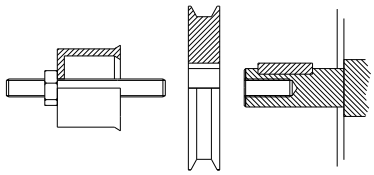
- ❑ Mount it somewhere that is dry, clean and accessible for maintenance.

**Note.** The degree of protection is IP 55 (standard), shaft section excluded.

- ❑ It must be easily cooled.
- ❑ Avoid corrosive or flammable environments.
- ❑ Guard the motor with a cover if it is exposed to splashes.
- ❑ Use flexible coupling for direct transmission.
- ❑ Avoid radial and axial loads on the motor shaft.

**MANDATORY.** Do not hit the shaft when installing transmission pulleys or gears!

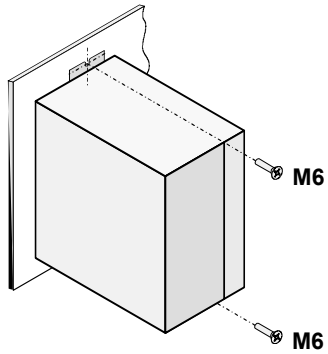
Use some tool that is supported in the threaded hole on the shaft to insert the pulley or the gear.



### At the drive

The module must be installed in an electrical cabinet that is clean, dry, free of dust, oil and other pollutants. Remember that its degree of protection is IP 20.

Never install it exposing it to flammable gases. Avoid excessive heat and humidity. The ambient temperature must never exceed 45 °C (113 °F). Install the modules vertically, avoid vibrations and respect the gaps to allow air flow. See figure.



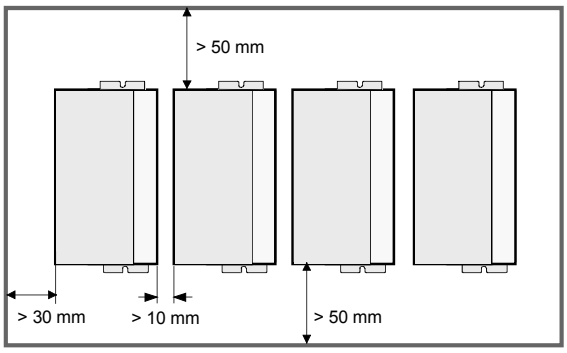




**FIGURE 9**

Module installing method.

## About the connection

All the cables must be shielded, to reduce the interference on the control of the motor due to the commutation of the PWM.

The shield of the motor power cable must be connected to the chassis screw at the bottom of the module and it, in turn, taken to mains ground. The command signal lines must be shielded twisted pairs. The shield must be connected to the housing of connector X3.

**Note.** Keep the signal cables away from the power cables.

# Electrical connections

## Basic interconnection diagram

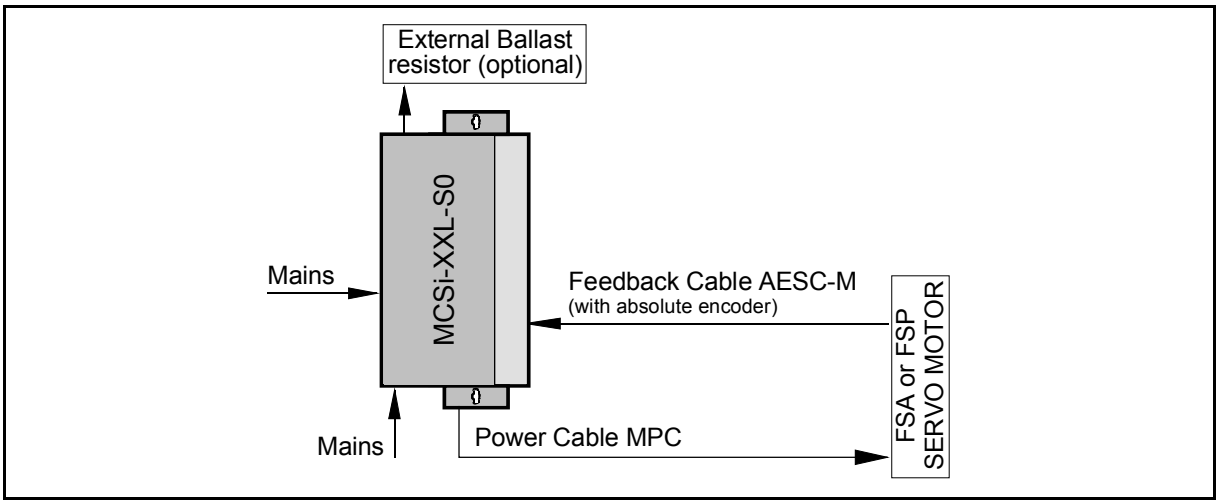



**FIGURE 10**

Basic module interconnection diagram.

## Power connection. Mains-Drive

The drive is powered with single-phase 220 V AC.

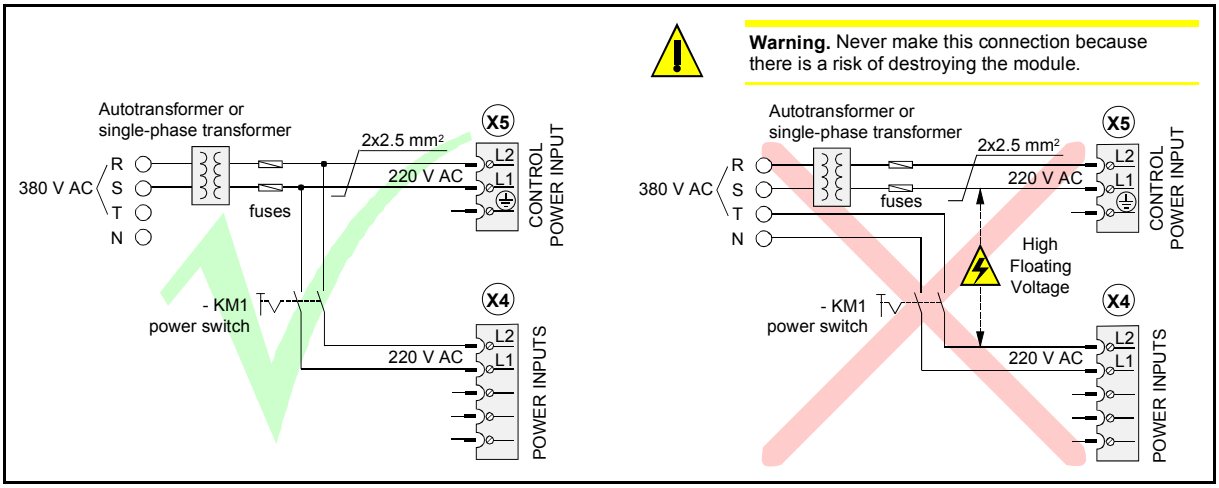



**FIGURE 11**

Mains power connection of the drive, with transformer.

**Note.** It is required to install a transformer.

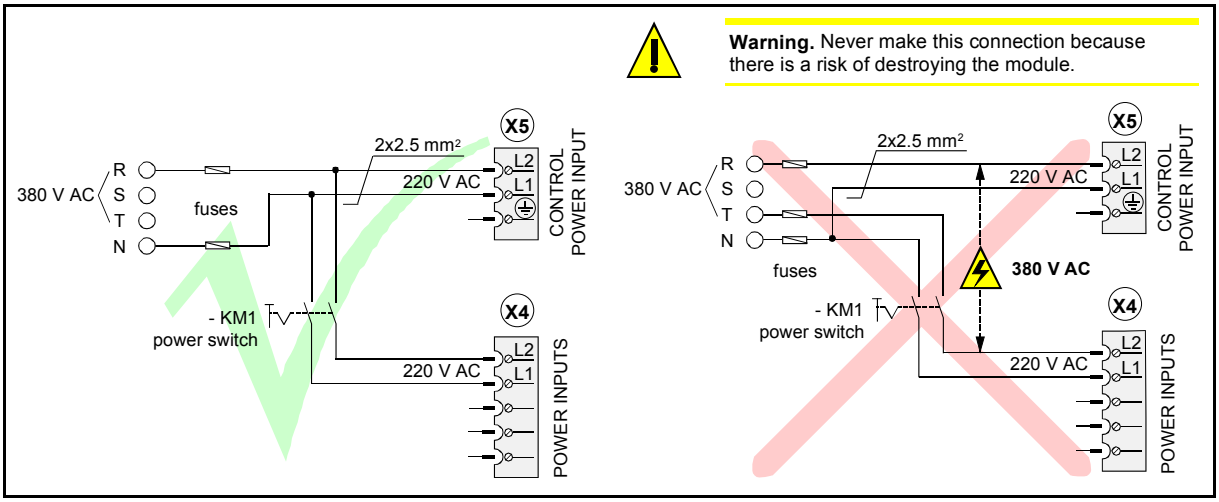



**FIGURE 12**

Mains power connection of the drive, without transformer.

The table below shows the values recommended for the fuses shown in the previous figure. They are slow general purpose fuses. If they are installed on the Mains input lines, their maximum currents will depend on the value of the Mains voltage.

**TABLE 9.** Fuses.

| Model | Peak current ( Arms ) | Fuse (A) |
|---|---|---|
| **MCSi-07L-S0** | 6.5 | 16 |
| **MCSi-11L-S0** | 10.5 | 16 |
| **MCSi-15L-S0** | 15.0 | 25 |

**Note.** A thermal switch may optionally replace the fuses.

## Power connection. External Ballast resistor

If the application requires a Ballast resistor with a power greater than the one indicated in this table according to model:

**TABLE 10.** Ballast resistor.

| Model | Internal resistor Ri | | Max. power that may be dissipated in Ri | External resistor |
|---|---|---|---|---|
| **MCSi-07L-S0** | - | - | - | Max. value 65 Ω<br>Min. value 45 Ω |
| **MCSi-11L-S0** | - | - | - | |
| **MCSi-15L-S0** | 45 Ω | 60 W | 15 W | |

therefore:

❑ Remove the cable joining the terminals Ri and L+.

❑ Install the external resistor between the terminals Re and L+.

- ❑ Make sure that the resistance (Ohms) of the external ballast resistor is the same as that of the internal resistor of that module. See **TABLE 8. Technical data.**
- ❑ Use KV41 to indicate to the drive that an external Ballast resistor has been connected.

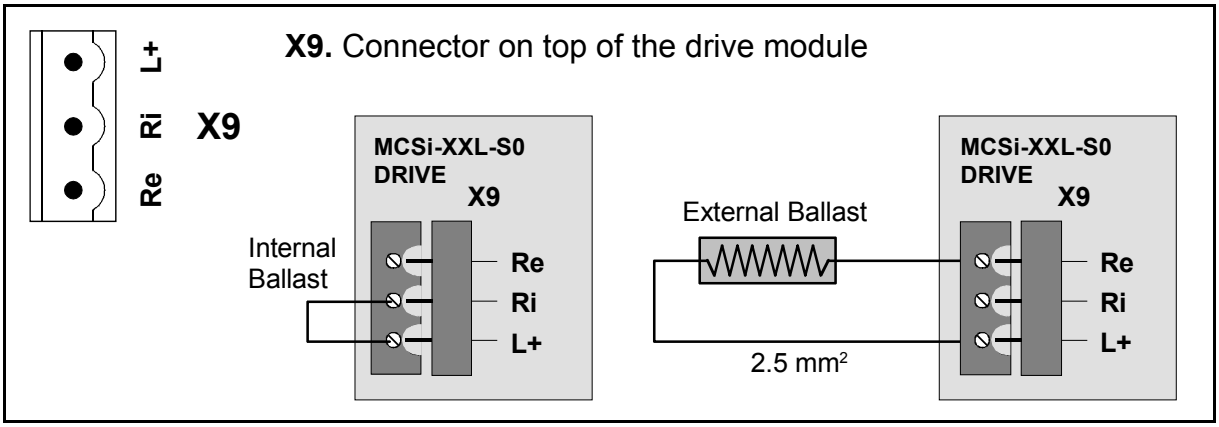



**FIGURE 13**

Power connection for the external Ballast resistor.

## Power connection. Inductance for reducing high frequency harmonics

It is recommended to connect an inductance at the input of one of the power phases **L1 or L2** of the drive (connector X4) to reduce high frequency harmonics coming from mains with a value of 5 mH and and rms current of 6 Arms. This inductance reduces the disturbances in mains, but it does not ensure compliance with CE regulations. **Connect the inductance as shown in the figure.**

## Power connection. Mains filter to suppress electromagnetic interference

In order for the Fagor DDS servo drive system to meet the European Directive on Electromagnetic Compatibility 2004/108/EC, the mains filter FAGOR FEHV-XXX must be inserted (see the table in the next section connection**) at the input of the MCSi (power phases L1** and **L2** of connector X4) against electromagnetic interference.

### Connection

Install the proper filter that can handle the sum of the rated Arms currents of the MCSi drives installed in the system.

| Mains filters | Imax (A) |
|---|---|
| FEHV-10Z | 10 |
| FEHV-16Z | 16 |
| FEHV-30B | 30 |

**Note.** Remember that the rated currents of the drives are 2.1 A for the MCSi 07L-S0; 3.5 A for the MCSi 11L-S0 and 5 A for the MCSi 15L-S0.

Connect the filter using 6.3 mm Faston terminals as shown in the figure.

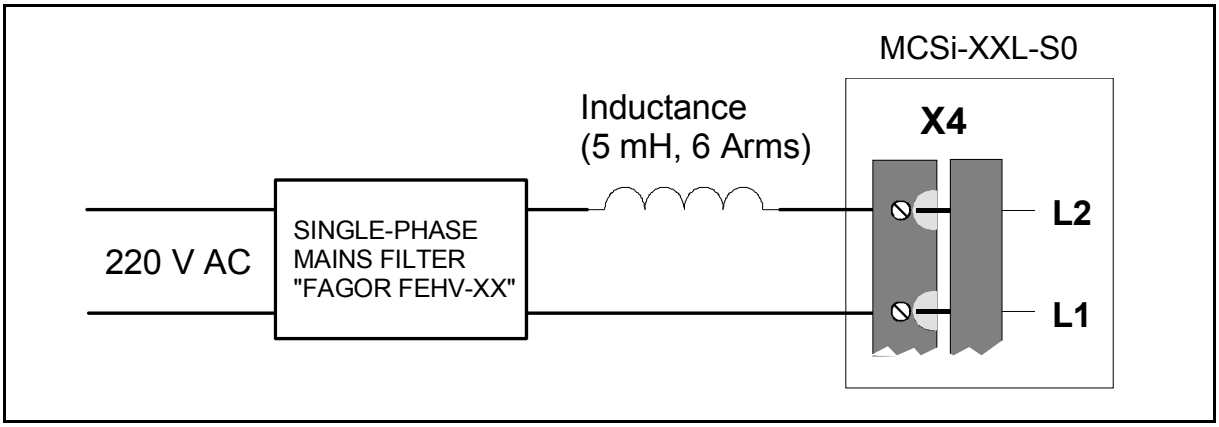



**FIGURE 14**

Power connection. Choque and mains filter.

## Dimensions

**Mains filters FAGOR FEHV-10Z/16Z**

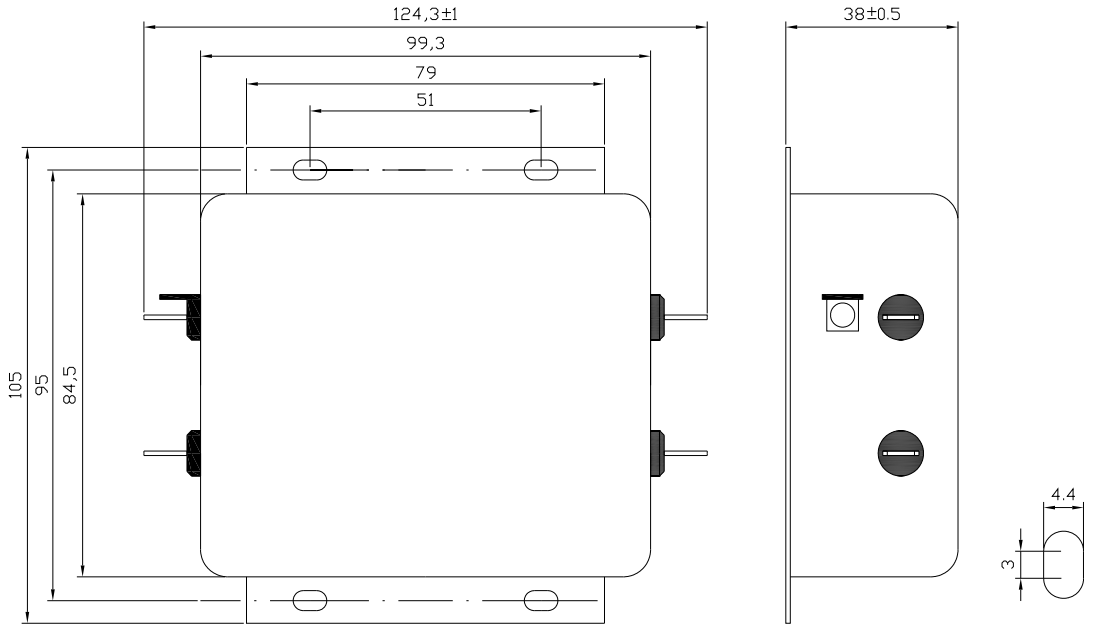



**FIGURE 15**

Dimensions of the mains filter FAGOR FEHV-10Z/16Z.

**Mains filters FAGOR FEHV- 30B**

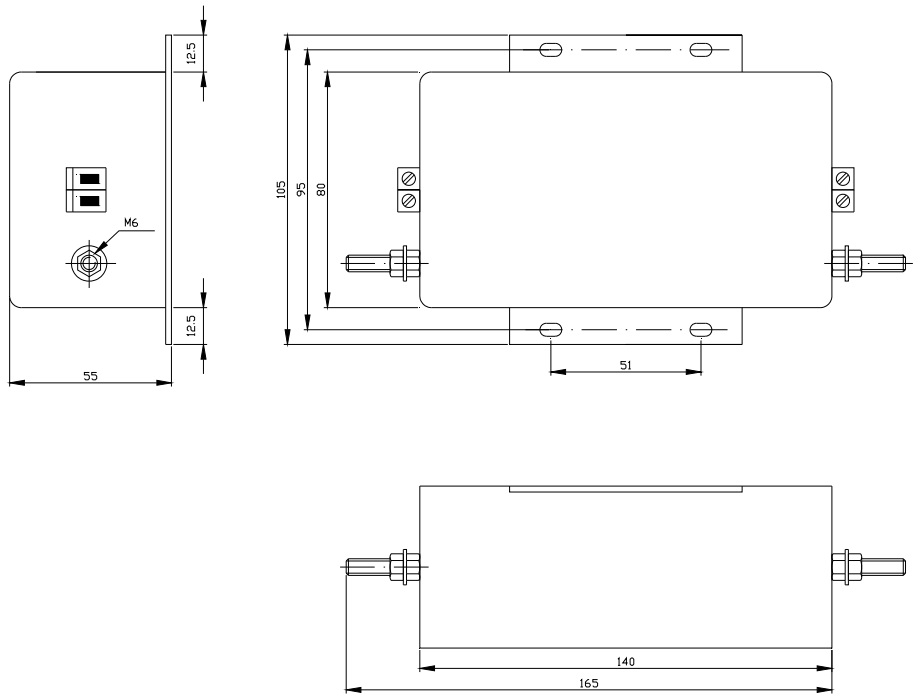



**FIGURE 16**

Dimensions of the mains filter FAGOR FEHV-30B.

# Power connection. Drive-motor

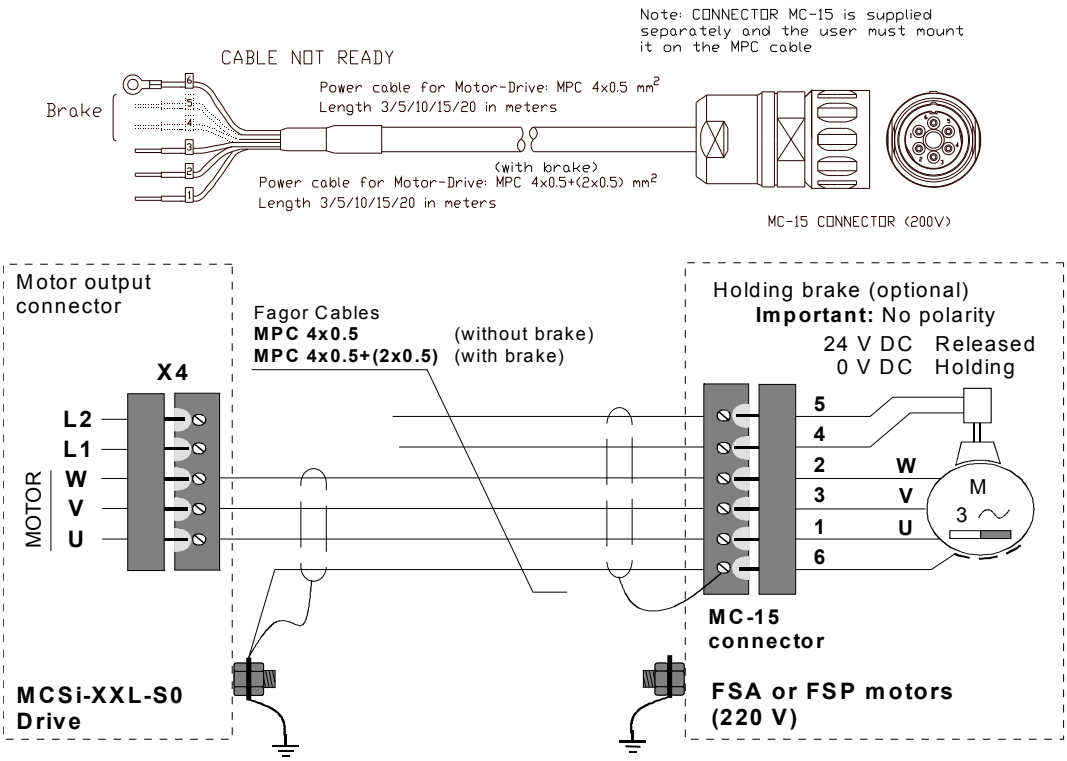



**FIGURE 17**

Power connection between a motor (FSA/FSP 220 V) and MCSi-XXL-S0 drive.

## Power cables

**TABLE 11.** Power cables.

| For motors with brake | For motors without brake |
|---|---|
| MPC-4x0.5 | MPC-4x0.5+(2x0.5) |

**Note.** The length of the MPC power cable must be specifically ordered (in meters).

The code of the sales model of FAGOR power cables is:

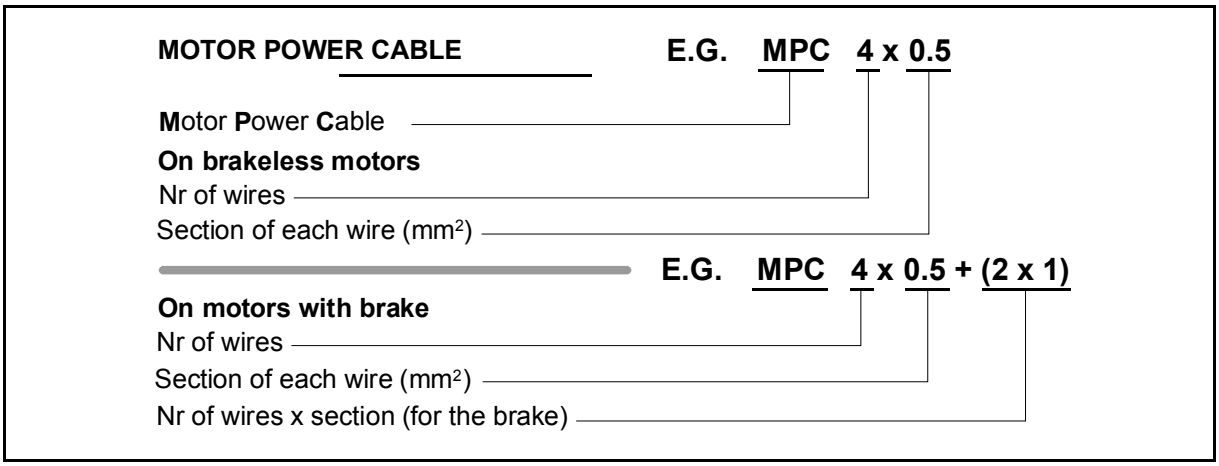
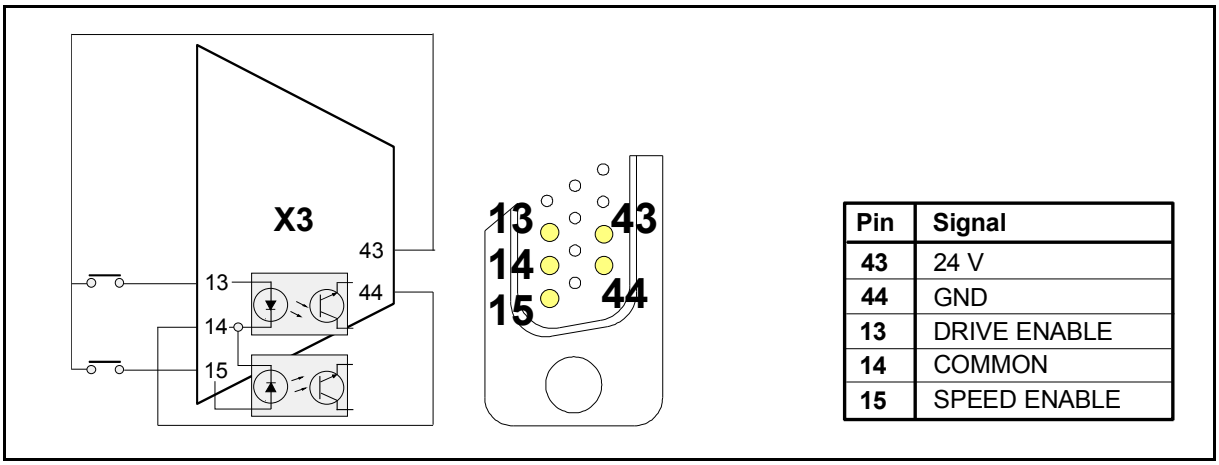



**FIGURE 18**

Sales model of FAGOR power cables.

### ❑ Enable signals using 24 V

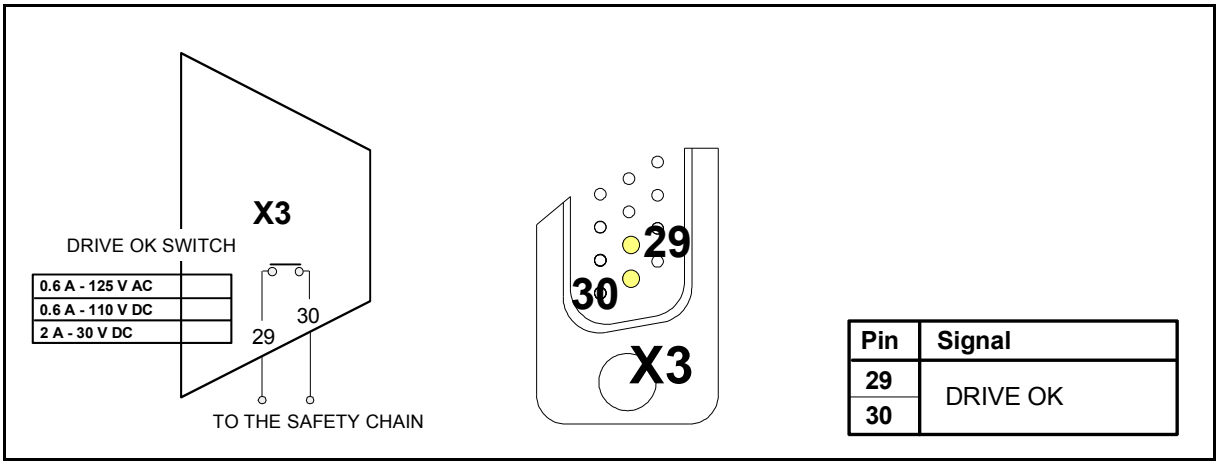



| Pin | Signal |
|---|---|
| 43 | 24 V |
| 44 | GND |
| 13 | DRIVE ENABLE |
| 14 | COMMON |
| 15 | SPEED ENABLE |

**FIGURE 19**

Enable signals using 24 V.

### ❑ Signal indicating that the Servodrive is running properly

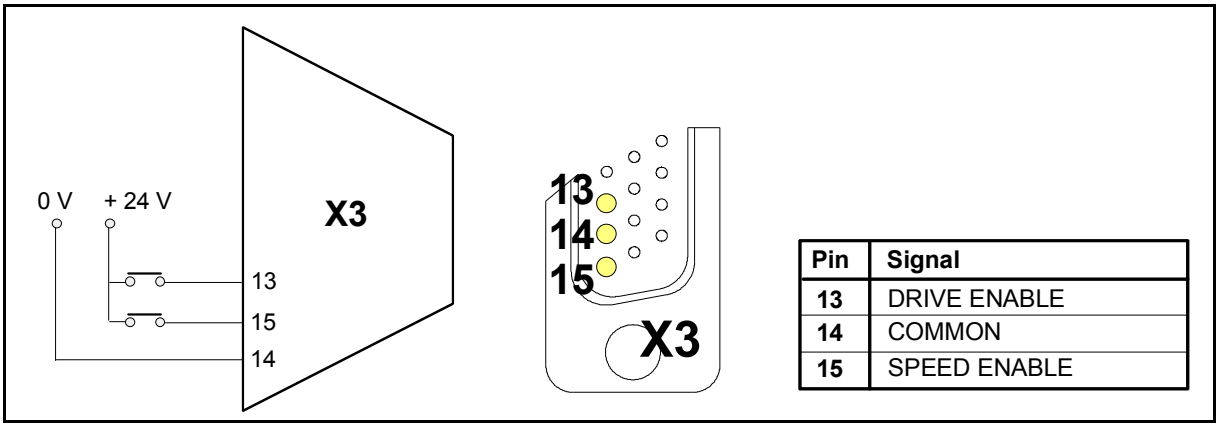



| Pin | Signal |
|---|---|
| 29 | DRIVE OK |
| 30 | |

**FIGURE 20**

Signal indicating that the Servodrive is running properly.

### ❑ Enable signals

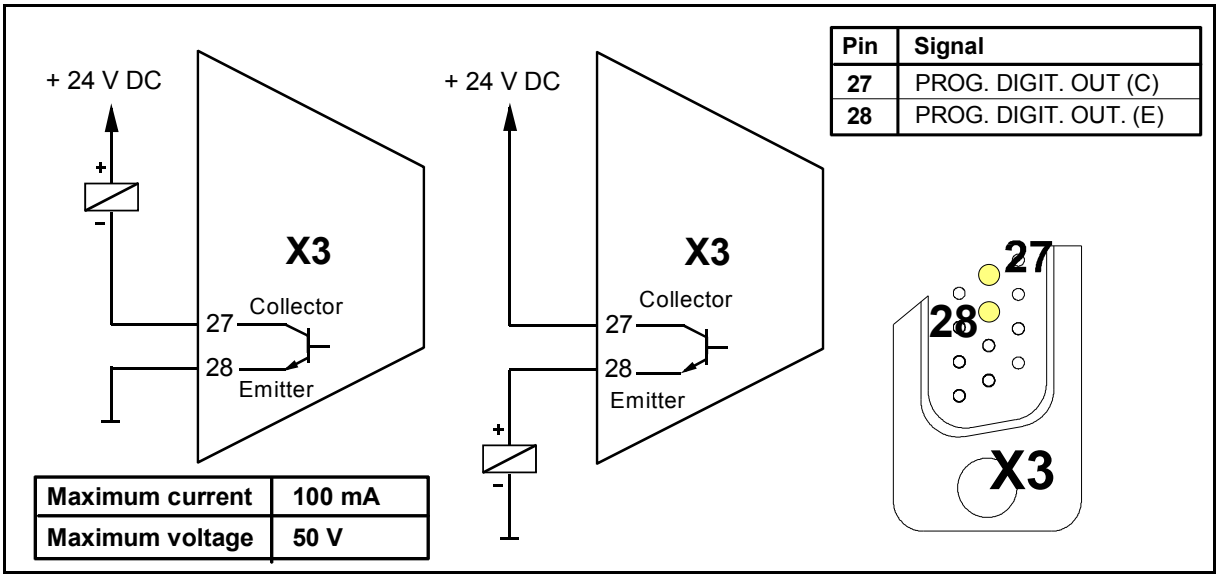



| Pin | Signal |
|---|---|
| 13 | DRIVE ENABLE |
| 14 | COMMON |
| 15 | SPEED ENABLE |

**FIGURE 21**

Enable signals.

## ❑ Programmable digital outputs



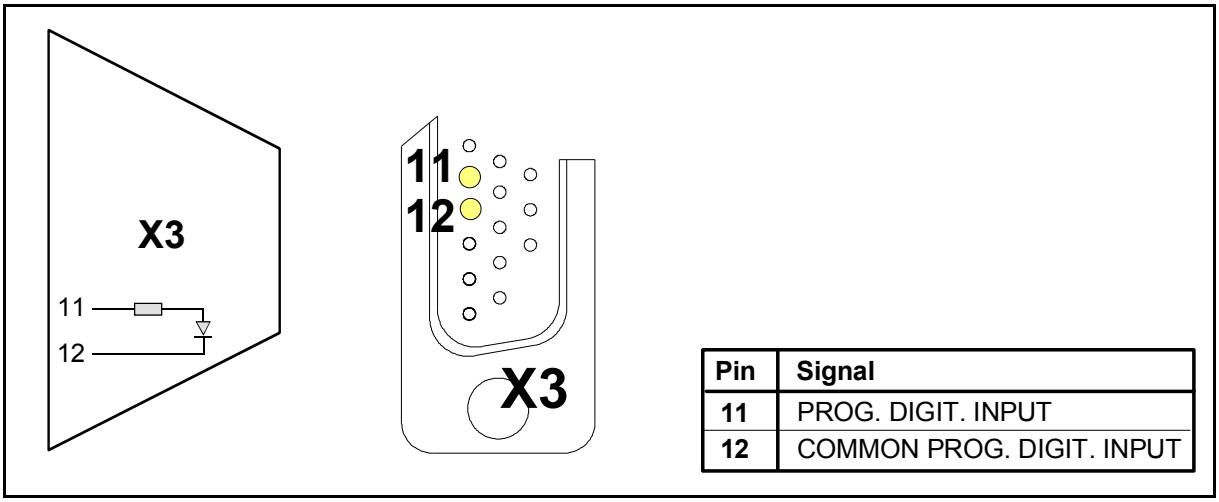

| Pin | Signal |
|---|---|
| 27 | PROG. DIGIT. OUT (C) |
| 28 | PROG. DIGIT. OUT. (E) |

| | |
|---|---|
| **Maximum current** | **100 mA** |
| **Maximum voltage** | **50 V** |

**FIGURE 22**

Programmable digital outputs.

## ❑ Programmable digital input




| Pin | Signal |
|---|---|
| 11 | PROG. DIGIT. INPUT |
| 12 | COMMON PROG. DIGIT. INPUT |

**FIGURE 23**

Programmable digital input.

## Encoder feedback connection

The signals generated by the encoder are taken to connector (X2) FEEDBACK INPUT of the MCSi-XXL-S0 drive. The encoder must be mounted on to the motor shaft and cannot be installed anywhere else in the transmission chain.

**Note.** The motors may have use an incremental encoder J5 (13 bit) or an absolute encoder J7 (16 bit). But, when choosing an absolute encoder to use this characteristic, you must also obtain a battery with a mounting clip "Battery for Absolute Encoders in FS motor". The battery will not be necessary if you only wish to increase the resolution.

The connection cable is:

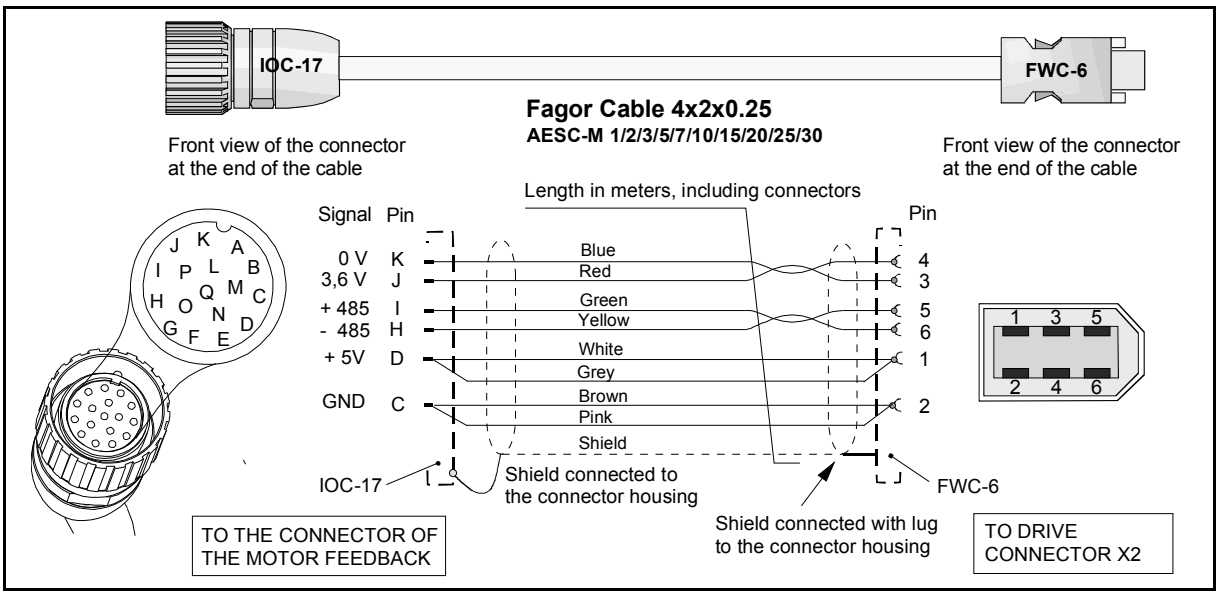



**FIGURE 24**

Encoder feedback connection cable.

## Sales model of the FAGOR feedback cable

The sales model of the feedback cable is AESC-M-☐☐ where the last two digits shown as "☐☐" indicate its length in meters. For example the AESC-M-**3** is a 3 meter encoder cable. The available lengths are: 1, 2, 3, 5, 7, 10, 15, 20, 25 and 30 meters.

**Note.** Remember that this encoder cable may be used both under static and dynamic work conditions.

## Sales reference of FAGOR feedback extension cables

FAGOR also provides, upon request and in meters, the feedback cable (without connectors) with sales model **FSA/FSP Encoder Cable** up to 30 meters in case the user wants to make his own cable.

## Service port. USB line

Connecting a PC compatible computer with an MCSi-XXL-S0 drive via USB (**U**niversal **S**erial **B**us) makes it possible to update the software and the motor table. The connection cable is a standard USB cable with a mini A or mini B type male connector at the drive side. The maximum length of the cable should not exceed 3 meters.

# SERCOS ring connection

The SERCOS interface is an international standard for digital communications between CNC's and servo drives of CNC machines. This ring structure integrates different functions:

- ❑ It carries the velocity command from the CNC to the drive in digital format with greater accuracy and immunity against outside disturbances because the transmission takes place through a fiber optic cable.
- ❑ It transmits 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 using simple standard procedures.

All this helps drastically reduce the amount of hardware required at the drive, thus making the system more reliable.

The different MCSi-XXL-S0 drive modules and the CNC are connected through the SERCOS Honeywell receiver-emitter of each of them (see the top side of the module) through the specific SERCOS fiber optic cable supplied by FAGOR.

## Particular

Each ACSD-S0 has a NODE SELECT; in other words, their front panel has two 10-position (0-9) rotary switches for assigning a node number to each drive, an address that identifies and differentiates it within the SERCOS ring from the rest of the drives connected to it. This way, it is possible to assign values from 1 through 97 (both included) as identifiers (node number).

Values 98 and 99 can also be assigned; not as identifier, but as described next:

- ❑ **NODE SELECT = 98** may be used to define the SERCOS power, i.e. the light power transmitted through the optical fiber.
- ❑ **NODE SELECT = 99** may be used to set the transmission speed through the SERCOS ring.

For further detail, see section **Initialization and adjustment**.

**Note.** In order to make effective any changes on the NODE-SELECT rotary switches of the drive, the module must be RESET afterwards.

**INFORMATION.** Note that parameter DRIBUSID of the parameter table of each drive at the CNC must match the node number assigned to the drive using its two NODE-SELECT rotary switches.

## Interconnection

Each drive to be governed by the CNC must be connected to the SERCOS ring through the SFO (Fiber optic) cable (see references later on) using the following procedure:

- ❑ Connect the OUT terminal of the first drive with the IN terminal of the next drive (adjacent to it).
- ❑ Repeat this procedure with the second drive, then with the third and so on up to the last drive.
- ❑ Now connect the OUT terminal of the last drive with the IN terminal of the CNC.
- ❑ Finally connect the OUT terminal of the CNC with the IN terminal of the first drive.

When all these connections have been made, the ring will be closed. See figure.

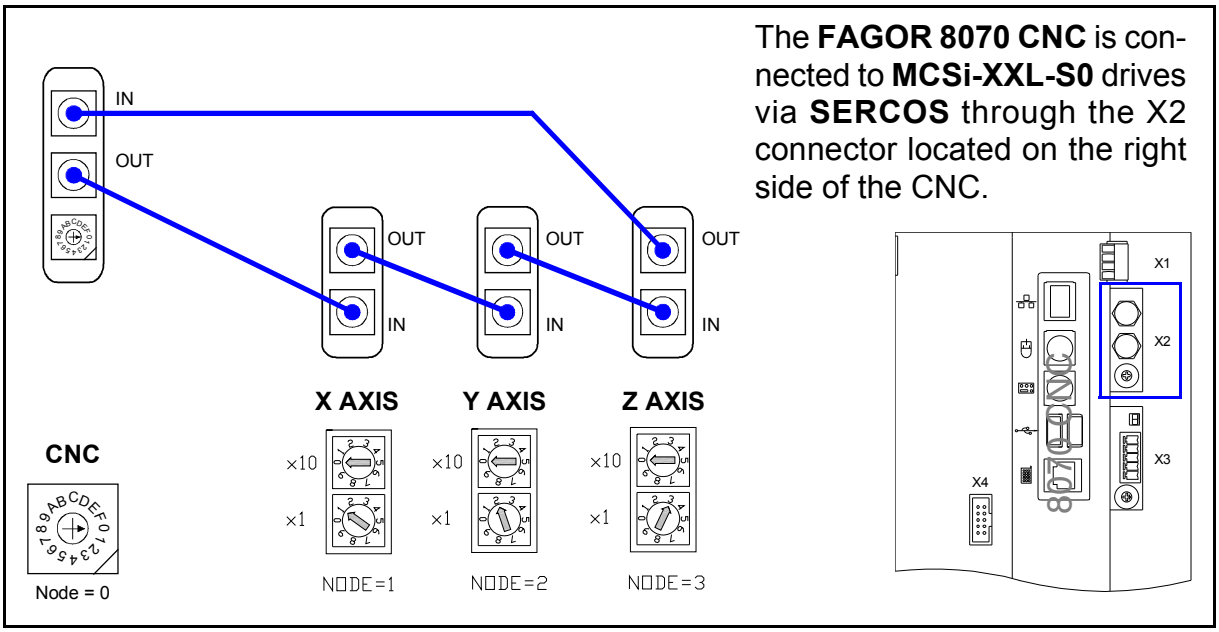



**FIGURE 25**

SERCOS ring connection.

## Cabling

SERCOS fiber optic cable. See the minimum bending radii and sales references of these FAGOR cables later on.

**FIGURE 26**

Fiber optic cable for SERCOS communication.

FAGOR supplies the fiber optic cable with its terminals protected with a hood. Remove the terminal protecting hood before connecting the cable.Either to remove the terminal protecting hood or to connect and disconnect the cable, the cable must always be held by the terminal, never pull at the cable because it could get damaged. See figure.

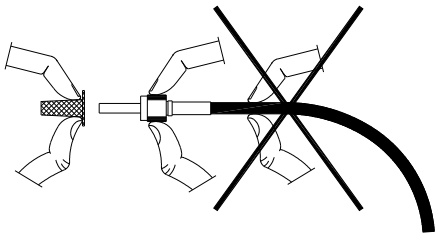


**FIGURE 27**

Handling of the fiber optic cable.

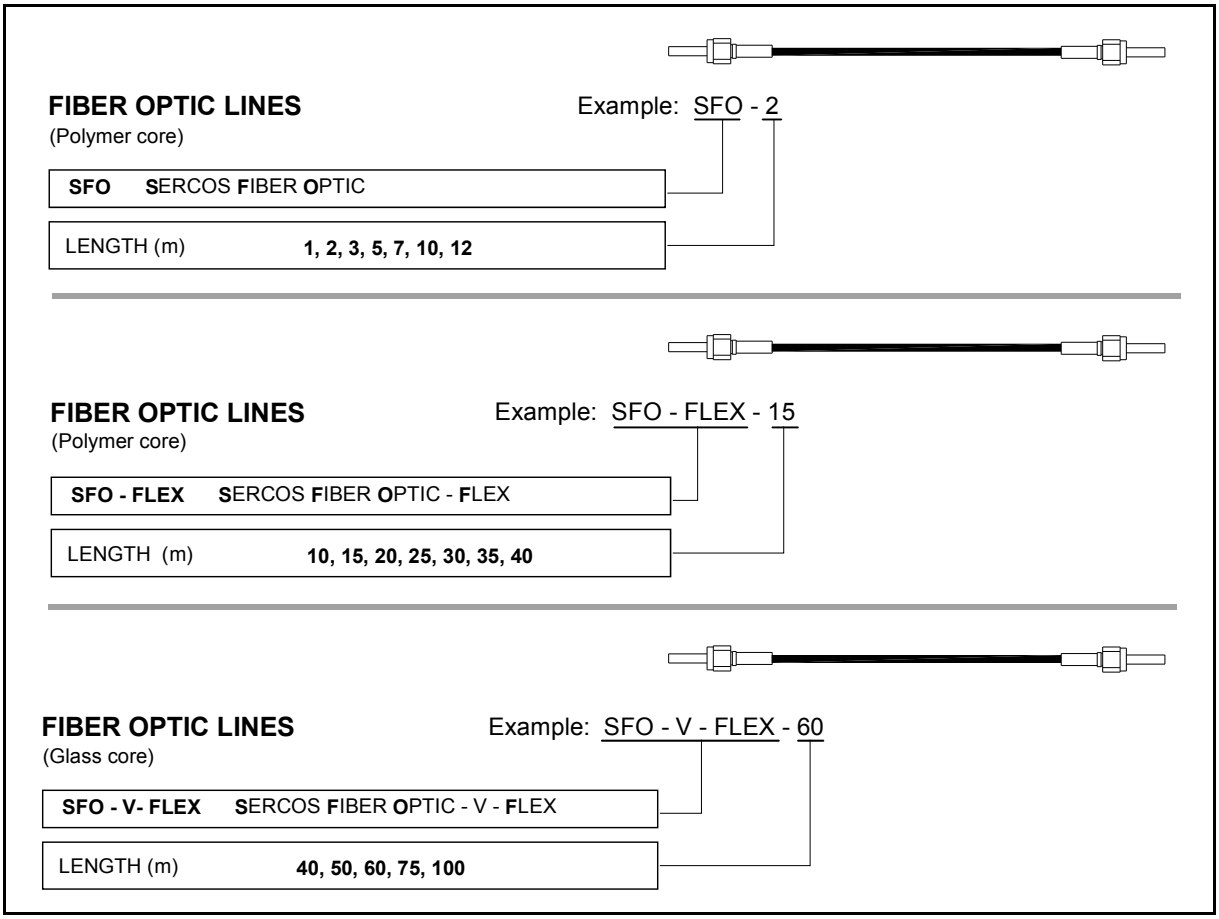



**FIGURE 28**

Sales models of FAGOR SERCOS fiber optic cables.

### In connections with fiber optic cables up to 40 meters

When the optic fiber connection between the CNC and the drives does not exceed 40 meters, always use the SFO-FLEX cable if it is going to be under dynamic conditions (moving) and the SFO cable if it is going to be under static conditions (not moving). The useful life of the SFO-XX cable will not be guaranteed when installed under dynamic operating conditions.

| Reference | Minimum bending radius (under static conditions) | Minimum bending radius (under dynamic conditions) |
|---|---|---|
| **SFO** | 30 mm | - |
| **SFO-FLEX** | 50 mm | 70 mm |

### In connections with fiber optic cables over 40 meters

If the fiber optic connection between the CNC and the drives exceeds 40 meters, always use the SFO-V-FLEX cable.

| Reference | Minimum bending radius (under static conditions) | Minimum bending radius (under dynamic conditions) |
|---|---|---|
| **SFO-V-FLEX** | 45 mm | 60 mm |

# Diagram of the electrical cabinet

Here is an example of a connection diagram for the electrical cabinet that may be modified depending on the needs of each application. It includes a simple circuit for the voltage supply of the brake of the servo motors.

**MANDATORY.** The use of fuses is a must.

## Mains connection and maneuver diagram

The delayed disconnection of KA3 contacts is useful so:

- ❑ The Drive Enable stays active while the motor brakes at maximum torque.
- ❑ The brake holds the motor after it has stopped (only on vertical axes).

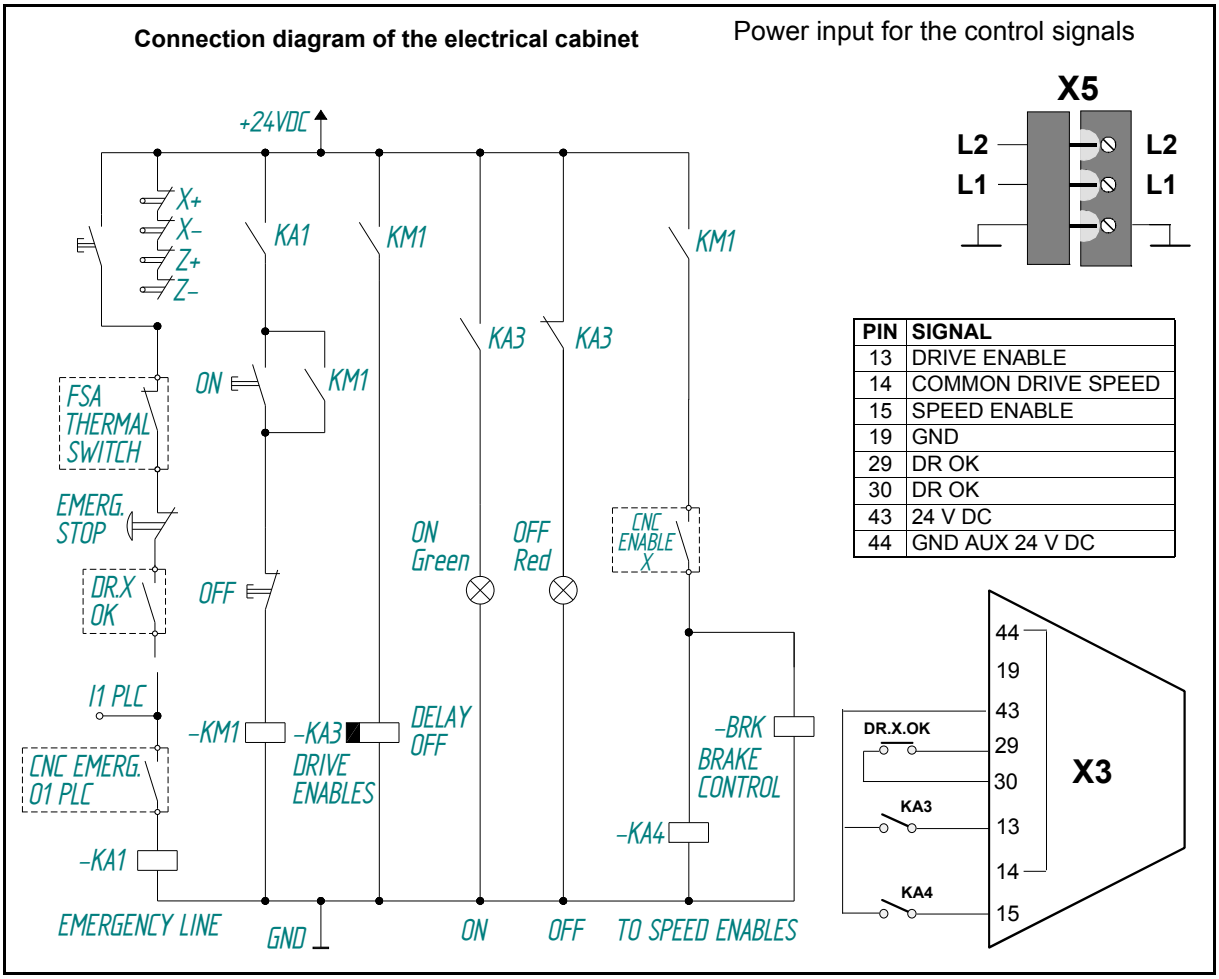



**FIGURE 29**

Diagram of the maneuver. See also **FIGURE 11** and **FIGURE 12**.

# Safety. **S**afe **D**isable

The Safe Disable function (SD) offered by FAGOR MCSi-XXL-S0 drives permits disabling the power output of the drive making sure that the motor torque is eliminated as a safe situation.

This function is available through the "Drive Enable" section so called in standard Fagor servo drive systems. Techniques and elements approved to be used in safety systems have been considered for its design and internal operation.

Thus, with a conventional drive (without SD), a contactor would have to be installed to assure a safe disable of the motor. However, using the safety techniques (implemented in Fagor MCSi-XXL-S0 drives) guarantees the same or greater safety without having to use external contactors, thus saving material and room in the electrical cabinet.

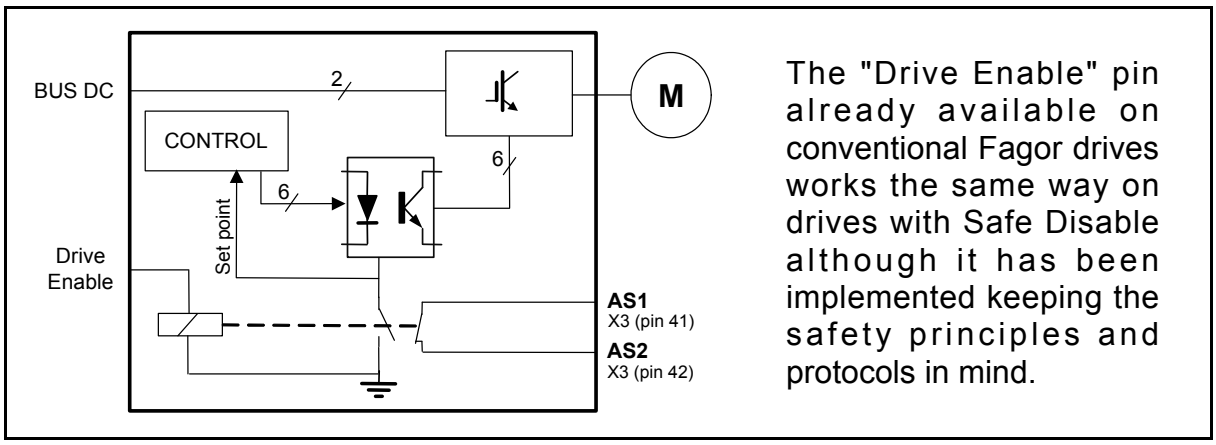



**FIGURE 30**

Block diagram of the safety circuit.

For that, a safety relay with guided contacts has been considered so:

- ❑ The first contact (N.O.) enables the power inverter and sets the control part to rest assuring a redundancy when locking up.
- ❑ The second contact (N.C.) is used as an external acknowledgement of the status of the safety relay. This contact is available between pins 41 and 42 of connector X3 located on the face of the module.

The following figure shows the diagram of the safe disable (SD) of an MCSi-XXL-S0 and as an example of application, a diagram to control the access to areas with moving elements.

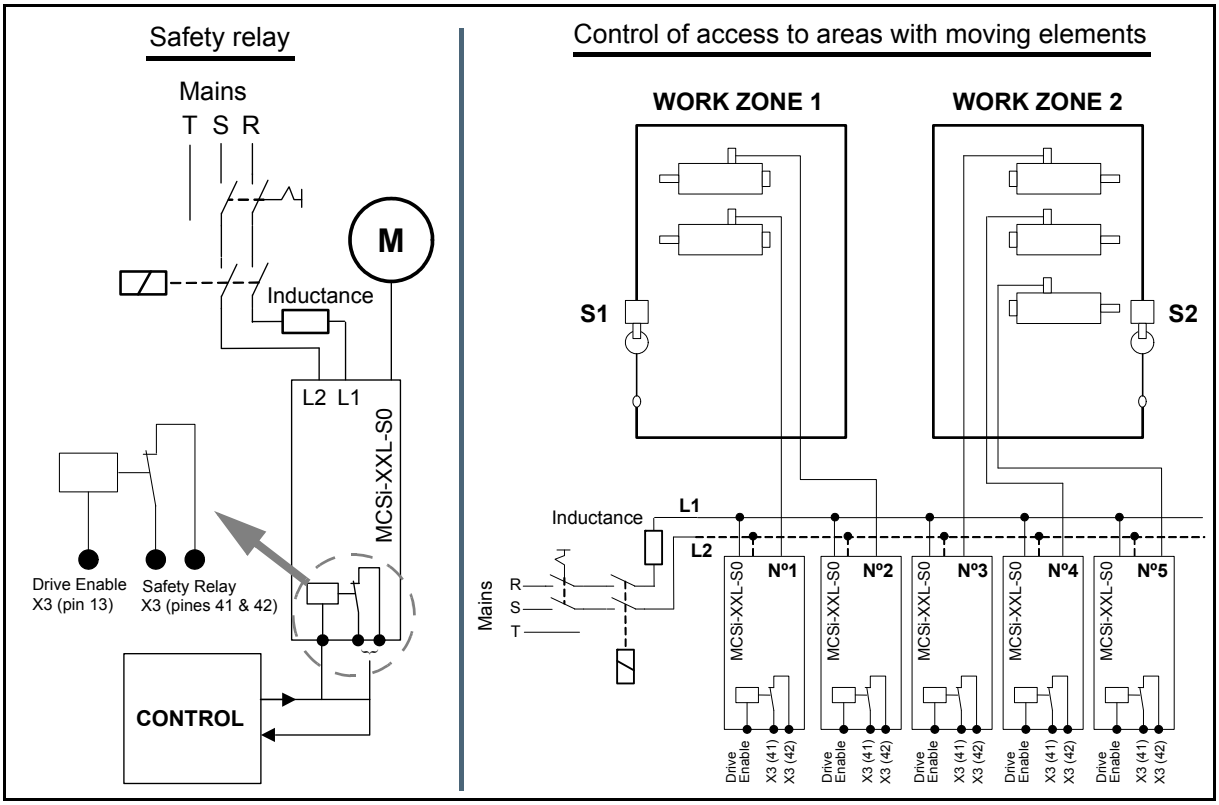



**FIGURE 31**

Safety relay and access control diagram with moving elements.

The diagram to control the access to areas with moving elements is:

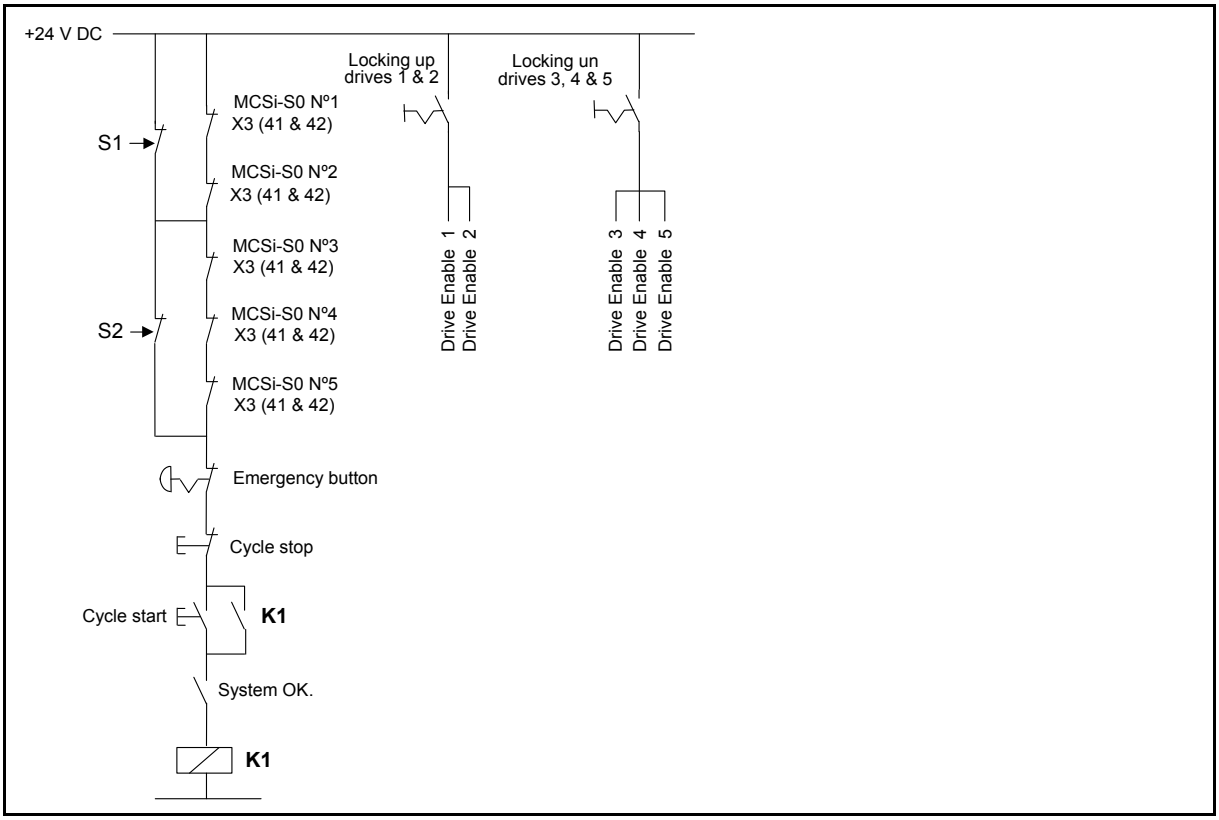



**FIGURE 32**

Diagram to control the access with moving elements.

# Initialization and adjustment

The system can only be initialized and adjusted using the SERCOS ring (only means of communication offered by the MCSi-XXL-S0 drive). This process is carried out from the master device (CNC).

**Note.** Remember that the USB serial line can only be used to transfer the software to the drive.

**INFORMATION.** To update the software version of the MCSi-XXL-S0 drive, the CNC must be disconnected. If this condition is not met, the user must re-set it with a <SHIFT+RESET> once the software has been loaded.

Initially, bear in mind the elements that make up each drive in order to configure the communication with the master device. These elements are:

## NODE SELECTION. <NODE SELECT>

Two rotary switches identified on the face plate of the MCSi-XXL-S0 with the labels (x1, x10) used to set the node number assigned to the drive in the SERCOS ring. The node number must be selected before starting up the drive, otherwise it will only be valid after restarting and resetting the drive again. Node numbers 1 through 97 (both included) are valid as address identifiers. Node 0 must always be assigned to the master device.

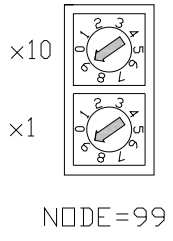
Nodes 98 and 99 must be used to define the light power transmitted through the fiber optic cable (SERCOS power) and to set the transmission speed in the ring, respectively.

## COMMUNICATION SPEED SELECTION

The transmission speeds shown in the following table may be selected when using SERCOS interface:

**TABLE 12.** Transmission speeds with SERCOS interface.

| Node Select "x1" | Transmission speed | |
|---|---|---|
| 1 | 2 MBd | |
| 2 | 4 MBd | |
| 3 | 8 MBd | |
| 4 | 16 MBd | |




**How is the SERCOS ring transmission speed selected?**

The transmission speed selecting mode is activated when starting up any unit and whenever both rotary switches x1 and x10 of the NODE SELECT are set to 9 (selecting node 99). From this state, now, to:

❑ **Verify the selected transmission speed.**

To know the communication speed at the ring at that very instant, turn the rotary selector "x1" of the NODE SELECT to the "0" position. The NS indicator LED will blink red and it will then turn off for about 1 second. It will repeat this sequence indefinitely.

The number of blinks between the off intervals indicates the communication speed according to **TABLE 12.**; Thus, for example, 3 blinks between two OFF intervals of the NS LED will mean that the communication speed is 8 MBd at that very instant.

❑ **Select a new baudrate.**

To **SELECT** the communication speed of the unit, turn the rotary selector switch "x1" of the NODE SELECT to position 1, 2, 3 or 4 depending on the associated transmission speed according to **TABLE 12.**; the NS indicator LED will blink green showing the speed that has been selected.

**Note.** When selecting a value higher than 4 at the "x1" selector, it will assume a value of 4.

Once the transmission speed is selected, it must be CONFIRMED. Turn the "x10" rotary switch to position zero. The MS indicator LED will turn red and the selected speed will be saved in the "non-volatile" memory of the unit.

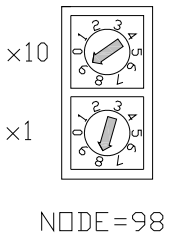
From this moment on, after the unit is turned on, it will assume as the transmission speed the last one confirmed before turning it on.

## SELECTING THE LIGHT POWER TRANSMITTED THROUGH OPTICAL FIBER

It will set the light power to be transmitted through the optical fiber depending on cable length.

**TABLE 13.** Transmission speeds with SERCOS interface.

| Node Select "x1" | Fiber optic cable length L (in meters) |
|---|---|
| 1, ..., 4 | $L < 15$ |
| 5, 6 | $15 \leq L < 30$ |
| 7 | $30 \leq L < 40$ |
| 8 | $L \geq 40$ |




**How is the SERCOS ring transmission light power selected?**

The transmission light power selecting mode is activated when starting up any unit and whenever the x1 rotary switch of the NODE SELECT is set to 9 and the x10 is set to 9 (selecting node 98).

From this state, now, to:

Verify the selected light power and/or select a new one, use the same procedure followed in the previous section for selecting the transmission speed. Note that for this case, the possible number of blinks between off intervals of the NS LED is 8. See **TABLE 13.** to interpret the equivalence between the number of blinks and the light power transmitted depending on the length of the cable being used.

## MS INDICATOR LED. <MODULE STATUS>

This indicator light informs about the unit status as such. The states that may be currently reached are:

**TABLE 14.** Indicator Led **M**odule **S**tatus.

| MS LED status | Meaning |
|---|---|
| Steady green LED | The drive is error and warning free |
| Blinking green LED | The drive is in a warning state |
| Blinking red LED | The drive is in an error state |

## NS INDICATOR LED. <NETWORK STATUS>

This light indicator informs about the phase the SERCOS ring is in and whether there are distortions or not. The phase will be indicated by the number of LED blinks and the distortions by the LED color. The states that may be currently reached are:

**TABLE 15.** Indicator Led **N**etwork **S**tatus. Phases.

| NS LED status | Meaning |
|---|---|
| Steady LED | Drive in phase 0. No activity in the SERCOS ring or the master device has not been able to close the communication ring. |
| One blink | Drive in phase 1. The master device is locating and identifying each and every drive connected to the SERCOS ring. |
| Two blinks | The service channel is on. Here are defined the communications parameters for the following stages and the data to be transmitted through the cyclic channel. |
| Three blinks | Drive in phase 3. State prior to normal operation. Defining more parameters required for the drive to operate. |
| Four blinks | Drive in phase 4. Normal operation. |

**TABLE 16.** Indicator Led **N**etwork **S**tatus. Distortions.

| NS LED color | Meaning |
|---|---|
| Green | Lack of distortions. |
| Red | Lack of distortions. The counter that counts distortion errors indicating the number of times that a distortion error has come up in phase 4 of SERCOS communication has exceeded the value of 100. |

# PARAMETERS, VARIABLES & COMMANDS

The parameters, variables and commands of the drive that are shown next may be used with any device that works as master. Besides all these, there are others that may be used to communicate the drive with the CNC.

## Notation used

| GROUP | TYPE | INDEX |
|---|---|---|

where:

**GROUP.** Identifying character of the logic group to which the parameter or variable belongs. There are the following groups of parameters:

**TABLE 17.** Groups of parameters, variables and commands.

| Nr | Function | Group | Letter |
|---|---|---|---|
| 1 | Operating mode | Application | A |
| 2 | Control signals | Terminal box | B |
| 3 | Current control loop | Current | C |
| 4 | Error diagnosis | Diagnosis | D |
| 5 | General of the system | General | G |
| 6 | System hardware | Hardware | H |
| 7 | Analog and digital inputs | Inputs | I |
| 8 | Temperatures and voltages | Monitoring | K |
| 9 | Motor properties | Motor | M |
| 10 | Mechanical elements | Mechanical | N |
| 11 | Analog and digital outputs | Outputs | O |
| 12 | Position control loop | Position | P |
| 13 | System communication | SERCOS communication | Q |
| 14 | Velocity control loop | Speed | S |
| 15 | Torque and power parameters | Even | T |

**TYPE.** Character identifying de type of data which the information corresponds to. May be:

- ❑ Parameter (P) defining the system operation.
- ❑ Variable (V) that can be read and modified dynamically.
- ❑ Command (C) that carries out a specific action.

**INDEX.** Number identifying the parameter or the variable within the group to which it belongs.

Definition examples:

| Mnemonic | Group | Type | Index |
|---|---|---|---|
| SP10 | S | (P) Parameter | Nr 10 |
| CV11 | C | (V) Variable | Nr 11 |
| GC1 | G | (C) Command | Nr 1 |

**ACCESS LEVEL.** The access level is defined by the number following the ID SERCOS. Thus:

- ❑ FAGOR level (1)
- ❑ USER level (2)
- ❑ BASIC level (3)

Examples of access levels

| | Group | Type | Index | Access | Type of variable |
|---|---|---|---|---|---|
| SP10 BASIC | S | (P) Parameter | Nr 10 | Basic | - |
| CV11 FAGOR, RO | C | (V) Variable | Nr 11 | Fagor | (RO) Read Only |

**MODIFIABLE VARIABLE.** Any modifiable variable, in other words, that can be read and written, will carry the (RW) label to identify it as such next to its access level. The (RO) label means that the variable is Read Only.

**Note.** All the parameters have the (RW); i.e. they can be read and written.

Example of a modifiable variable

| | Group | Type | Index | Access | Type of variable |
|---|---|---|---|---|---|
| DV32 FAGOR, RW | D | (V) Variable | Nr 32 | FAGOR | (RW) Read-Write |

**PARAMETER THAT CANNOT BE MODIFIED WITH TORQUE.** Any parameter that for any reason cannot be modified while the unit has torque will have an asterisk (*) identifying it as such next to its access level.

Example of a parameter that cannot be modified with torque

| | Group | Type | Index | Access | * RW |
|---|---|---|---|---|---|
| MP1 BASIC, *RW | M | (P) Parameter | Nr 1 | Basic | Example of read and write, but cannot be modified with torque. |

# A group. Application

| AP1 | USER, RW | S00032 | PrimaryOperationMode |
|---|---|---|---|

Function. It sets how it works in terms of system configuration.

Valid values. 2. Velocity command (without position loop).

# B group. Non-programmable inputs-outputs

| BV14 | FAGOR, RO | F00204 | NotProgrammableIOs |
|---|---|---|---|

Function. Indicates the logic values of the electrical signals of the drive's control. 24 V at the electrical input mean a logic 1 at the bits of this variable.

| Bit | Function |
|---|---|
| 15, ..., 4 | Reserved |
| 3 | Programmable input<br>Pins 11 and 12 of terminal strip X3 |
| 2 | "Drive OK" output<br>Pins 29 and 30 of terminal strip X3 |
| 1 | Speed Enable input<br>Pin 15 of terminal strip X3 |
| 0 | Drive Enable input<br>Pin 13 of terminal strip X3 |

# C group. Current

| CP1 | *FAGOR, RW | S00106 | CurrentProportionalGain |
|---|---|---|---|

Funtion. Value of the proportional action of the current PI.

Valid values. 0, ..., 999.

Default value. Depends on the motor-drive combination.

| CP2 | *FAGOR, RW | S00107 | CurrentIntegralTime |
|---|---|---|---|

Function. Value of the integral action of the current PI.

Valid values. 0, ..., 999.

Default value. Depends on the motor-drive combination.

| CP20 | *BASIC, RW | F00307 | CurrentLimit |
|---|---|---|---|

Function. Limit of the current command that reaches the system's current loop.

Valid values. 0.00, ..., 50.00 Arms. CP20 must never exceed the smallest value given by the peak current of the motor (5 x MP3) and of the drive.

Default value. CP20 takes the lowest value of the ones given by the motor and drive peak currents.

| CP30 | FAGOR, RW | F00308 | CurrentCommandFilter1Type |
|---|---|---|---|

Function. Parameter in charge of enabling / disabling the current filter.

Valid values. 1/0. Enables/disables the current filter.

Default value. 0. Current filter disabled.

| CP31 | FAGOR, RW | F00312 | CurrentCommandFilter1Frequency |
|---|---|---|---|

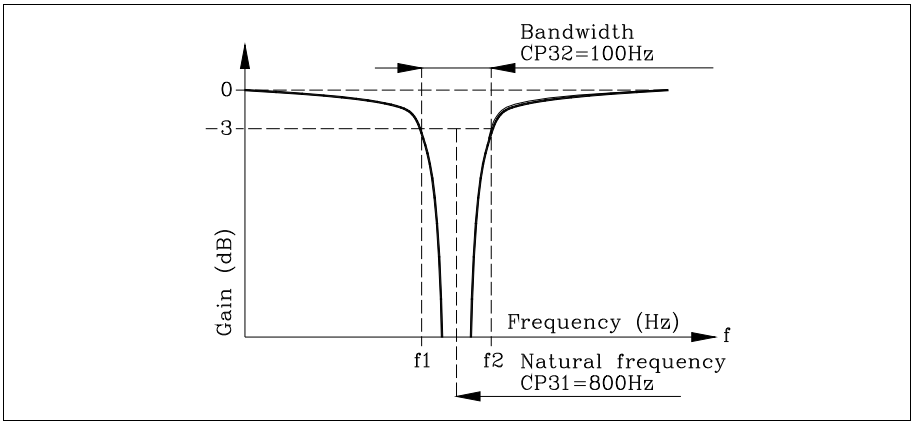
Function. Sets the natural frequency in Hz of a notch filter that acts upon the current command.

Valid values. 0, ..., 4 000 Hz.

Default value. 0.

| CP32 | FAGOR, RW | F00313 | CurrentCommandFilter1Damping |
|---|---|---|---|

Function. Sets the bandwidth in Hz of a notch filter that acts upon the current command.



Valid values. 0, ..., 1 000 Hz.

Default value. 0.

| CV1 | USER, RO | F00309 | Current1Feedback |
|---|---|---|---|

Function. Display the value of the feedback of the current going through phase V.

Valid values. - 50.00, ..., 50.00 A (instant values).

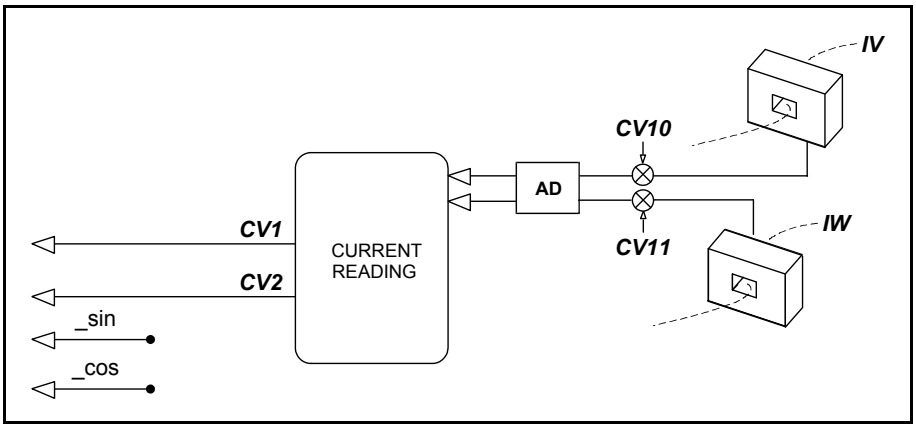
| CV2 | USER, RO | F00310 | Current2Feedback |
|---|---|---|---|

Function. Display the value of the feedback of the current going through phase W.

Valid values. - 50.00, ..., 50.00 A (instant values).

| CV3 | USER, RO | F00311 | CurrentFeedback |
|---|---|---|---|

Function. Display the rms current circulating through the motor.




Valid values. - 50,00, ..., 50,00 A (rms values).

| CV10 | FAGOR, RO | F00305 | Current1Offset |
|---|---|---|---|

Function. Value of the automatic compensation of the current feedback offset of phase V.

Valid values. -2.000, ..., 2.000 A (depends on the connected drive).

| CV11 | FAGOR, RO | F00306 | Current2Offset |
|---|---|---|---|

Function. Value of the automatic compensation of the current feedback offset of phase W.

Valid values. -2.000, ..., 2.000 A (depends on the connected drive).

# D group. Diagnosis

| DV1 | BASIC, RO | S00011 | Class1Diagnostics ( Errors ) |
|---|---|---|---|

Function. Variable that contains a numerical data coded into 16 binary bits and represents the error status as shown by the attached table.

| Bit | Name | Error |
|---|---|---|
| 0 | OverloadShutdown | E.201, E.202, E.314 |
| 1 | | |
| 2 | MotorOvertempShutdown | E.108 |
| 3 | CoolingErrorShutdown | E.106 |
| 4 | | |
| 5 | FeedbackError | E.801, E.802 |
| 6 | | |
| 7 | OverCurrentError | E.214 |
| 8 | OverVoltageError | E.304 |
| 9 | UnderVoltageError | E.307 |
| 10 | PowerSupplyPhaseError | E.003 |
| 11 | | |
| 12 | CommunicationError | E.400 → E.499 |
| 13 | | |
| 14 | | |
| 15 | ManufacturerSpecificError | Rest. |

| DV9 | BASIC, RO | S00012 | Class2Diagnostics (Warnings) |
|---|---|---|---|

Function. Variable that contains a numerical data coded into 16 binary bits and represents the warning status as shown by the attached table.

| Bit | Name | Warning | |
|---|---|---|---|
| 0 | OverloadShutdown | A000 caused by: | |
| | | 201 | Motor overload |
| | | 202 | Drive overload |
| | | 314 | Ballast overload |

| DV17 | USER, RO | F00410 | HistoricOfErrors |
|---|---|---|---|

Function. Stores the last 5 errors that came up at the drive. It consists in a 5-word register that stores the code of each one of them.

Valid values. All the codes of the list of possible errors of the software version currently loaded. Code 0 means no error.

| DV18 | BASIC, RO | F02105 | DisplayError |
|---|---|---|---|

Function. Variable that may be used to display the code of an error that comes up at the drive. If no errors come up, its value will be zero.

| DV19 | BASIC, RO | F02106 | DisplayWarning |
|---|---|---|---|

Function. Variable that may be used to display the code of a warning that comes up at the drive. If no warnings come up, its value will be zero.

| DV31 | FAGOR, RO | S00135 | DriverStatusWord |
|---|---|---|---|

Function. Variable that contains a numerical data coded into 16 binary bits and represents the system status in certain aspects as shown by the attached table. This variable communicates with the CNC through the SERCOS interface.

| Bits | Meaning |
|---|---|
| 15, 14 | Power & Torque Status<br>(0,0) DoingInternalTest (DRVSTS_INITIALIZATING)<br>(0,1) ReadyForPower (DRVSTS_LBUS)<br>(1,0) PowerOn (DRSTS_POWER_ON)<br>(1,1) TorqueOn (DRSTS_TORQUE_ON) |
| 13 | Error bit. |
| 12 | Warning bit |
| 11 | 0 |
| 10, 9, 8 | = 0, PrimaryOperationMode |
| 7 | Real time status bit |
| 6 | Real time status bit |
| 5, 4, 3, 2, 1, 0 | Reserved |

| DV32 | FAGOR, RW | S00134 | MasterControlWord |
|---|---|---|---|

Function. Variable that contains a numerical data that in 16-bit binary code represents the control signals that the CNC sends to the drive through the SERCOS interface. See attached table. This variable communicates with the CNC through the SERCOS interface.

| Bits | Name |
|---|---|
| 15 | Speed Enable (SPENA) |
| 14 | Drive Enable (DRENA) |
| 13 | Halt |
| 12, 11, 10 | Reserved |
| 9, 8, 7, 6, 5 | Reserved |
| 4, 3, 2, 1, 0 | Reserved |

| DC1 | USER, RW | S00099 | ResetClassDiagnostics |
|---|---|---|---|

Function. **Reset of the unit's errors**. When an error occurs, this command may be used to reset it and restart the unit by first updating the error bit of DV31, DriveStatusWord, and then setting the drive in the ReadyForPower state. Note its difference with the unit's reset because the action carried out by this command **keeps the RAM memory intact** and therefore the parameter settings of the unit.

| DC2 | USER, RW | F00402 | ClearHistoricOfErrorsCommand |
|---|---|---|---|

Function. Reset of the "DV17 (F00410) HistoricOfErrors (array)" variable. This command sets it to 0.

# G group. General

| GP1 | BASIC, RW | F00700 | PwmFrequency |
|---|---|---|---|

Function. It returns the switching frequency of the transistors.

Valid values. 0, ..., 8 000 Hz.

Default value. 8 000 Hz.

| GP3 | BASIC, RW | F00702 | StoppingTimeout |
|---|---|---|---|

Function. After deactivating the Speed Enable and after the GP3 time has elapsed, if the motor has not stopped, it cancels the torque automatically and issues error E.004. If the motor stops within the GP3 time, it also cancels the torque but does not issue an error. To make this time infinite (never generating error E.004), set this parameter to "0".

Valid values. 1, ..., 9 999 ms, 0 (infinite).

Default value. 500 ms.

| GP4 | BASIC, RO | F00703 | SetNumber |
|---|---|---|---|

Function. Number of sets of useful parameters.

Valid values. 0/1.

Default value. Always 1. A single set.

| GP5 | BASIC, RO | F00704 | ParameterVersion |
|---|---|---|---|

Function. This parameter represents the version of the parameter table that has been loaded at the drive.

Valid values. 0, ..., 9 999.

| GP6 | BASIC, RW | F00717 | GearRatioNumber |
|---|---|---|---|

Function. Number of useful gear ratios.

Valid values. 0, ..., 8

Default value. Always 1. A single gear ratio.

| GP9 | BASIC, RW | S00207 | DriveOffDelayTime |
|---|---|---|---|

Function. After the motor has stopped because the Speed Enable function has been disabled, the cancellation of the the Drive Enable function (that implies PWM-OFF) is delayed by a time period indicated by GP9. It is useful on axes not compensated with a holding brake.

To make this time period infinite, set it to 0 and to remove it, set it to 1.

Valid values. 1, ..., 9 999 ms, 0 (infinite).

Default value. 50 ms.

| GV2 | BASIC, RO | S00030 | ManufacturerVersion |
|---|---|---|---|

Function. Displays the software version in use.

Valid values. 0, ..., 9 999.

| GV5 | BASIC, RO | F00706 | CodeChecksum |
|---|---|---|---|

Function. It registers the checksum value of the software version loaded at the drive.

Valid values. - 32 768, ..., 32 767 (although the range goes up to 65 535 because it is a 16-bit variable).

| GV6 | BASIC, RO | F00723 | RamParameterChecksum |
|---|---|---|---|

Function. It informs on the checksum of the parameters contained in RAM memory.

Valid values. 0, ..., 65 535.

| GV8 | FAGOR, RW | F00707 | AccessLevel |
|---|---|---|---|

Function. It informs about the current access level of the user.

Valid values. 1. BASIC

2. OEM (User)

3. FAGOR

| GV9 | BASIC, RO | S00140 | DriveType |
|---|---|---|---|

Function. This variable informs of the drive's sales model.

| GV11 | BASIC, RW | F00708 | SoftReset |
|---|---|---|---|

Function. Variable that resets the unit by software.

| GV16 | BASIC, RO | F00716 | MotorTableVersion |
|---|---|---|---|

Function. Version of the motor table.

| GV26 | BASIC, RW | S00218 | GearRatioPreselection |
|---|---|---|---|

Function. It determines which will be the active gear ratio (software) when the change is carried out via SERCOS.

Valid values. Always 0. Gear ratio 0.

| GC1 | BASIC, RW | S00264 | BackupWorkingMemoryCommand |
|---|---|---|---|

Function. Command to execute the parameter transfer from RAM to E²PROM.

| GC10 | BASIC, RW | S00262 | LoadDefaultsCommand |
|---|---|---|---|

Function. Command to initialize parameters. This command loads the default drive parameters for a motor that has been previously selected with parameter MP1.

# H group. Hardware

| HV1 | BASIC, RO | S00110 | DrivePeakCurrentSercos |
|---|---|---|---|

Function. Peak rms current of the drive.

Valid values. 0.00, ..., 50.00 A.

| HV5 | BASIC, RO | F00295 | PLDVersion |
|---|---|---|---|

Function. Software version installed in the unit's PLD's

# I group. Inputs

| IP6 | USER, RW | F00910 | DigitalInputPolarity |
|---|---|---|---|

Function. Sets the polarity (inverted or not inverted) of the programmable digitalinput (pins 11 and 12 of X3).

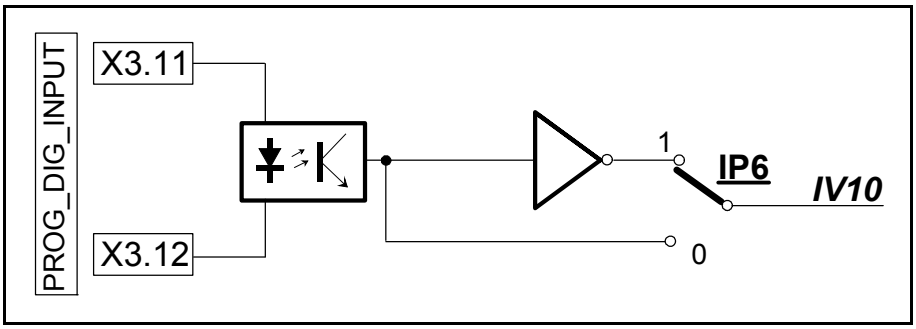
Valid values. 0/1. Not inverted/inverted.

Default value. 0. Not inverted.

| IV10 | USER, RO | F00907 | DigitalInputs |
|---|---|---|---|

Function. This variable reflects the status of the programmable digital input at pins 11-12 of connector X3. The status of this variable is affected by IP6.

Valid values. 0 and 1.



# K group. Monitoring

| KP3 | USER, RW | F01114 | ExtBallastPower |
|---|---|---|---|

Function. Contains the value of power of the external ballast resistor.

Valid values. 200, ..., 2000 W.

Default value. 200 W.

| KP4 | USER, RW | F01116 | ExtBallastEnergyPulse |
|---|---|---|---|

Function. Contains the value of the energy pulse that can be dissipated by the external ballast resistor.

Valid values. 200, ..., 2000 J.

Default value. 200 J.

| KV10 | USER, RO | F01102 | CoolingTemperature |
|---|---|---|---|

Function. It displays the temperature of the heatsink of the power stage.

Valid values. 0, ..., 200 °C.

| KV32 | USER, RO | F01109 | I2tDrive |
|---|---|---|---|

Function. Variable internally useful to the system. It measures the internal load level of the calculation of the i²t at the drive in percentage used over the maximum.

Valid values. 0, ..., 100 %.

| KV36 | USER, RO | F01111 | I2tMotor |
|---|---|---|---|

Function. Variable internally useful to the system. It measures the internal load level of the calculation of the i²t at the motor in percentage used over the maximum.

Valid values. 0, ..., 100 %.

| KV40 | USER, RO | F01115 | I2tCrowbar |
|---|---|---|---|

Function. Shows the load percentage on the ballast resistor in a drive. Useful for the i²t protection of the resistor. A value greater than 100 % in this variable causes error E.314.

Valid values. 0, ..., 100 %.

| KV41 | USER, RW | F01117 | BallastSelect |
|---|---|---|---|

Function. Selector that determines whether the ballast resistor is external or internal.

Valid values: 0/1. External/internal (by default).

# M group. Motor

| MP1 | BASIC, RW | S00141 | MotorType |
|---|---|---|---|

Function. Motor identification. The limits of certain parameters depend on the value of MP1 (e.g.: The upper limit of SP10 is 110 % of the motor rated speed) like its default parameter initialization through GC10. See command **GC10**.

| MP2 | FAGOR, RW | F01200 | MotorTorqueConstant |
|---|---|---|---|

Function. Contains the torque constant of the synchronous motor, (motor torque according to the rms current)

Valid values. 0.00, ..., 10.00 N·m/Arms.

| MP3 | FAGOR, RW | S00111 | MotorContinuousStallCurrent |
|---|---|---|---|

Function. Contains the motor rated current. Manipulating MP3 may affect parameter CP20 directly. See parameter **CP20**.

Valid values. 0.00, ..., 50.00 Arms. Depends on the motor connected.

| MP4 | FAGOR, RO | S00109 | MotorPeakCurrent |
|---|---|---|---|

Function. Contains the motor peak current. This current value must NEVER be exceeded in the motor. See parameter **CP20**.

Valid values. 0.00, ..., 50.00 Arms. Depends on the motor connected.

Default value: It depends on the motor connected.

| NP116 | USER, RO | S00116 | ResolutionOfFeedback1 |
|---|---|---|---|

Function. Parameter that cannot be modified by the user that "tells" the CNC the number of pulses of the motor feedback.

Valid values. 1, ..., 65 535.

| NP121 | USER, RW | S00121 | InputRevolutions |
|---|---|---|---|

| NP122 | USER, RW | S00122 | 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 NP121=5 and NP122=3.

Valid values. 1, ..., 32767 turns

Default value. 1 turn in both parameters (direct coupling).

| NP123 | USER, RW | S00123 | FeedConstant |
|---|---|---|---|

Function. It defines the gear ratio between the linear movement of the machine and the axis moving it. For example, if every turn of the leadscrew means a 4 mm displacement of the table, the value for this parameter is NP123=4.
For a rotary axis NP123=360, which means 360° per turn.

Valid values. 0, ..., 2 147 483 647.

# O group. Analog and digital outputs

| OP6 | USER, RW | F01416 | DigitalOutputPolarity |
|---|---|---|---|

Function. Sets the polarity (inverted or not inverted) of the programmable digital input (pins 27 and 28 of X3).

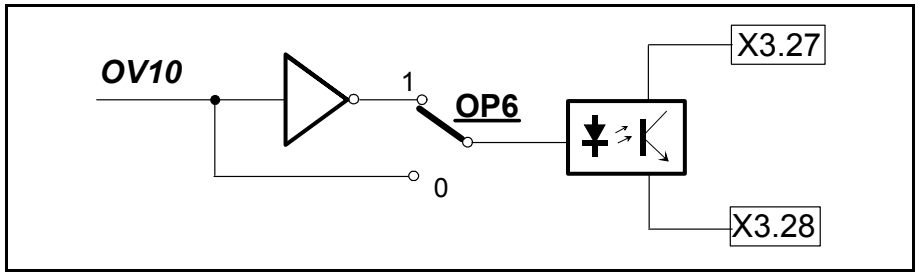
Valid values. 0/1. Not inverted (by default) / inverted.

Default value. 0. Not inverted.

| OV10 | USER, RO | F01410 | DigitalOutputs |
|---|---|---|---|

Function. The OV10 variable contains the value of the status of the programmable digital output. The programmable digital output is activated (with a 1) or deactivated (with a 9) via SERCOS (see pins 27-28 of X3).

Valid values. 0 (activate programmable digital output) and 1 (deactivate programmable digital output).



| PP52 | USER, RW | S00052 | ReferenceDistance1 |
|---|---|---|---|

Function. With motor feedback, this parameter describes the distance between the machine reference zero and the machine reference point.

Valid values. - 214 748.3648, ..., 214 748.3647 (mm for linear axes or degrees for rotary axes).

| PP55 | USER, RW | S00055 | PositionPolarityParameters |
|---|---|---|---|

Function. 16-bit register that may be used to invert the sign of the various position data.

| Bit | Function |
|---|---|
| 2 | Sign of the value of the motor feedback.<br>= 0, Not inverted<br>= 1, Inverted (by default) |

| PP76 | USER, RW | S00076 | PositionDataScalingType |
|---|---|---|---|

Function. 16-bit register that configures the measuring scale for the positioning.

| Bit | Function |
|---|---|
| 15 (MSB), 14, 13, 12, 11, 10, 9, 8 (reserved) = 0 | |
| 7 | Format:<br>= 0, absolute<br>= 1, module. See parameter **PP103**.<br>**Note.** Verify that the CNC defines the axis the same way (module or linear format). |
| 6 | The position command refers to:<br>= 1, The position of the load. **ALWAYS !** |
| 5, 4, 3, 2 | Reserved |
| 1, 0 (LSB) | Position command scaling method.<br>= 01, Linear scaling (by default)<br>= 10, rotary scaling |

| PP103 | USER, RW | S00103 | ModuleValue |
|---|---|---|---|

Function. Module value. If bit 7 of PP76 selects the module format, this parameter defines the range of the position data being used.

Valid values. 0, ..., 214 748.3648 (mm for linear axes or degrees for rotary axes).

Default value. 360°. Normally used on rotary axes.

| PP150 | BASIC, RW | S00150 | ReferenceOffset1 |
|---|---|---|---|

Function. Parameter that gives the position of the machine reference point with respect to the reference mark (I0), depending on motor feedback.

Valid values. - 214 748.3648, ..., 214 748.3647 (mm for linear axes or degrees for rotary axes).

Default value. 0.0000.

| PP177 | BASIC, RW | S00177 | AbsoluteDistance1 |
|---|---|---|---|

Function. For motors with absolute encoder, this parameter indicates the distance between the zero coordinate of the drive and the theoretical zero coordinate according to the absolute encoder feedback.

Valid values. - 214 748.3648, ..., 214 748.3647 (mm for linear axes or degrees for rotary axes).

Default value. 0.0000.

| PV51 | USER, RO | S00051 | PositionFeedback1 |
|---|---|---|---|

Function. Motor feedback position that is transferred to the CNC.

Valid values. - 214 748.3648, ..., 214 748.3647 (mm for linear axes or degrees for rotary axes).

| PV173 | USER, RO | S00173 | MarkerPositionA |
|---|---|---|---|

Function. In the home searching process, when the drive detects the I0 signal, it saves the value of the PositionFeedback1 (not yet homed) in this variable.

Valid values. - 214 748.3648, ..., 214 748.3647 (mm for linear axes or degrees for rotary axes).

Default value. 0.0000.

| PV175 | BASIC, RW | S00175 | DisplacementParameter1 |
|---|---|---|---|

Function. Offset of the coordinate system after the home search carried out by the drive (with motor feedback).

Valid values. - 214 748.3648, ..., 214 748.3647 (mm for linear axes or degrees for rotary axes).

Default value. 0.0000.

| PV203 | BASIC, RW | S00403 | PositionFeedbackStatus |
|---|---|---|---|

Function. The drive activates this binary variable to inform that it interprets the position feedback as being referred to the machine reference zero point. The variable is canceled when executing the home search command and is activated when the execution ends successfully.

Valid values. 0. Position data referred to any point.

1. Position data referred to machine zero.

Default value. 0.

| PV204 | BASIC, RW | S00404 | 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 zero.

Default value. 0.

| PV207 | BASIC, RW | S00407 | HomingEnable |
|---|---|---|---|

Function. Enabling of the Homing function.

Valid values. 0. Home search disabled.

1. Home search enabled.

Default value. 0.

| PC146 | USER, RW | S00146 | NCControlledHoming |
|---|---|---|---|

Function. Homing function controlled by CNC.

# Q group. Communication

| QP1 | USER, RW | S00001 | ControlUnitCycleTime |
|---|---|---|---|

Function. Read parameter that indicates every how long the drives close the loop. Therefore, it defines the loop time.

Valid values: 2, ..., 8 ms.

Default value. 4 ms.

| QP11 | BASIC, RW | F02000 | SercosMbaud |
|---|---|---|---|

Function. It sets the transmission speed through the SERCOS ring. The CNC has a similar parameter with SERCOS interface.

Both speeds (at the CNC and at the drive) must be the same in order to establish communication.

Valid values. 2, 4, 8 and 16 Mbd.

Default value. 4 Mbd.

| QP12 | BASIC, RW | F02002 | SercosTransmisiónPower |
|---|---|---|---|

Function. It defines the SERCOS power, i.e. the light power transmitted through the optical fiber.

Valid values. 1, ..., 8.

| Value | Fiber optic cable length L (in meters) |
|---|---|
| 1, ..., 4 | $L < 15$ |
| 5, 6 | $15 \leq L < 30$ |
| 7 | $30 \leq L < 40$ |
| 8 | $L \geq 40$ |

Default value. 2.

| QV30 | USER, RO | F00727 | FiberDistErrCounter |
|---|---|---|---|

Function. This variable may be used to diagnose SERCOS problems. It is a counter that counts distortion errors indicating the number of times that a distortion error has come up in phase 4 of SERCOS communication.

Valid values. 0,..., 65 535.

# S group. Velocity

| SP1 | BASIC, RW | S00100 | VelocityProportionalGain |
|---|---|---|---|

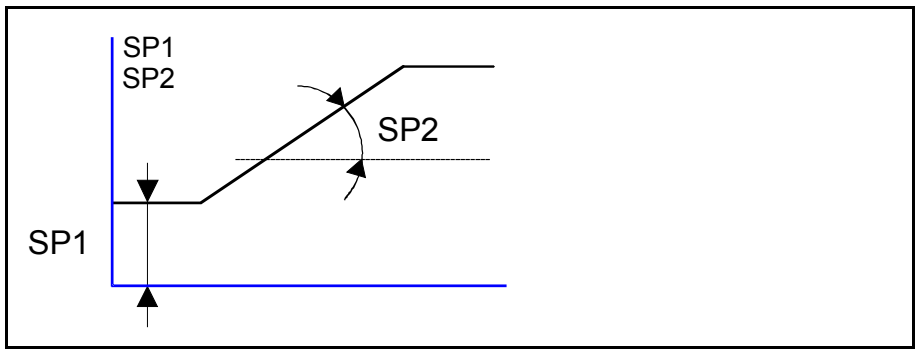
| SP2 | BASIC, RW | S00101 | VelocityIntegralTime |
|---|---|---|---|

Function. Value of the proportional / integral action of the velocity PI.

Valid values. SP1: 0, ..., 999.9 mArms/rpm.

SP2: 0, ..., 999.9 ms.

Default value. Depends on the motor-drive combination.




| SP3 | BASIC, RW | S00102 | VelocityDerivativeGain |
|---|---|---|---|

Function. Value of the derivative action of the velocity PI.

Valid values. SP3: 0, ..., 9 999.

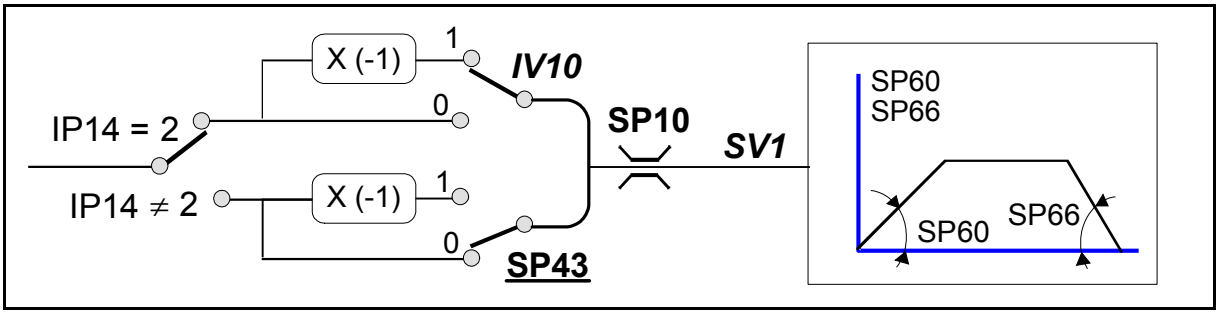
Default value. SP1: 0.

| SP10 | BASIC, RW | S00091 | VelocityLimit |
|---|---|---|---|

Function. Maximum velocity limit for SV7 (VelocityCommandFinal).

Valid values. 0, ..., 110 % motor rated speed in rev/min.

Default value. 1000 rev/min.




| SP42 | USER, RW | S00124 | StandStillWindow |
|---|---|---|---|

Function. Determines the value of the velocity window around zero that will be considered to be zero speed.

Valid values. 0, ..., motor rated speed in rev/min.

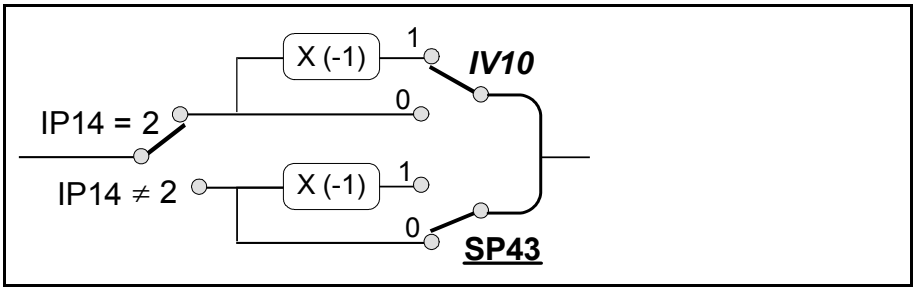
Default value. 20 rev/min.

| SP43 | BASIC, RW | S00043 | VelocityPolarityParameters |
|---|---|---|---|

Function. This parameter is used to change the sign of the velocity command in specific applications. It cannot be used to solve a positive feedback problem (axis runaway).

Valid values. 0/1. Not inverted / inverted.

Default value. 0. Not inverted.

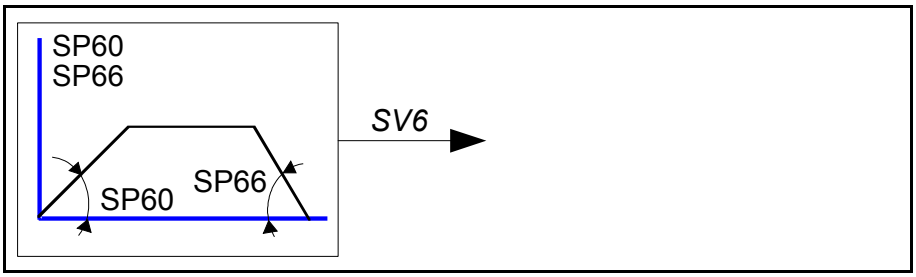



| SP60 | BASIC, RW | S00138 | AccelerationLimit |
|---|---|---|---|

Function. Determines the value of the acceleration ramp applied to the velocity command. Setting this parameter with a zero value means that no ramps will be applied.

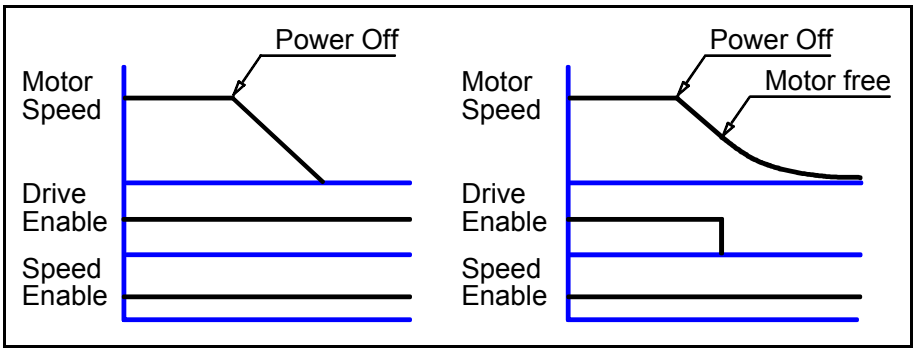
Valid values. 0.0, ..., 400.0 (rev/min)/ms.

Default value. 0.0.




| SP65 | BASIC, RW | F01609 | EmergencyAcceleration |
|---|---|---|---|

Function. In emergency stop. If the bus voltage drops or there is a power outage for the unit in the acceleration, deceleration or constant power mode, the drive will get into the dynamic braking sequence. It stops with the emergency ramp until its speed is zero as long as the mechanical energy stored in the motor allows it. Therefore, it limits the command acceleration for stopping the motor. If anytime during the sequence, the Drive Enable is interrupted, the motor will turn by inertia. SP65=0 cancels this limiting effect.



Valid values. 0.0, ..., 400.0 (rev/min)/ms.

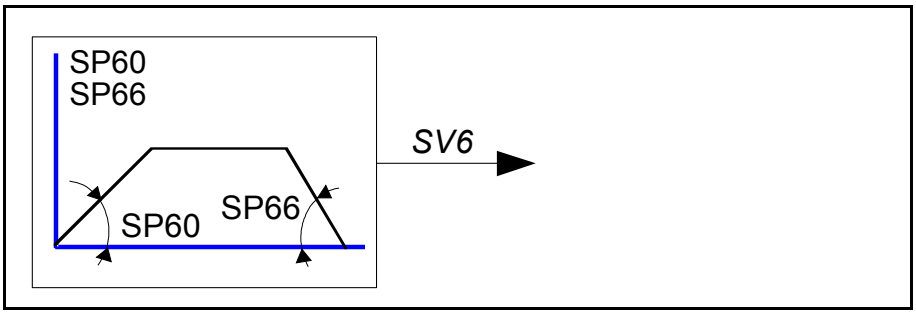
Default value. 0.0.

| SP66 | BASIC, RW | F01618 | VelocityDecelerationTime |
|---|---|---|---|

Function. Determines the value of the deceleration ramp applied to the velocity command. Setting this parameter with a zero value means that no ramps will be applied.

Valid values. 0.0, ..., 400.0 (rev/min)/ms.

Default value. 0.0.




| SV1 | BASIC, RW | S00036 | VelocityCommand |
|---|---|---|---|

Function. Velocity command.

Valid values. - 4 950.0000, ..., 4 950.0000 rev/min.

| SV2 | BASIC, RO | S00040 | VelocityFeedback |
|---|---|---|---|

Function. Velocity feedback.

Valid values. - 6 000.0000, ..., 6 000.0000 rev/min.

| SV6 | BASIC, RO | F01622 | VelocityCommandAfterFilters |
|---|---|---|---|

Function. Velocity command after applying limits, ramps, etc.

Valid values. - 6 000.0000, ..., 6 000.0000 rev/min.

| SV7 | BASIC, RO | F01612 | VelocityCommandFinal |
|---|---|---|---|

Function. Final velocity command applied to the loop.

Valid values. - 6 000.0000, ..., 6 000.0000 rev/min.

# T group. Torque and power

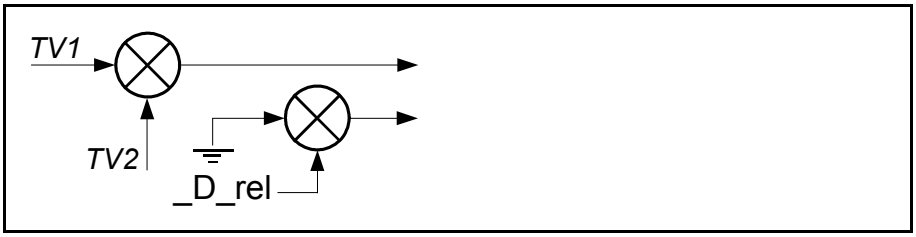
| | | | |
|---|---|---|---|
| **TV1** | **USER, RO** | **S00080** | **TorqueCommand** |

| | | | |
|---|---|---|---|
| **TV2** | **USER, RO** | **S00084** | **TorqueFeedback** |

Function. Displays the values of the command and torque feedback.

Valid values. - 999.9, ..., 999.9 N·m.

Default value. 0.0 N·m.



# ERROR CODES

| E.001 | Internal | E.001 |
|---|---|---|

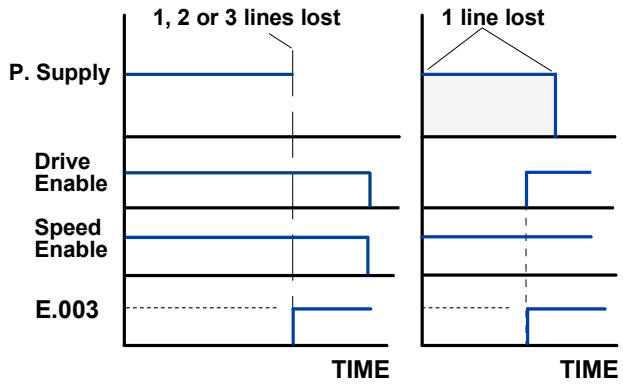
Contact Fagor Automation.

| E.003 | With torque, the power bus drops | E.003 |
|---|---|---|

**Error.**
When having torque; probably, one of the three-phase lines has dropped.

**Warning.**
When starting the unit up, maybe:

- ❑ The connector of the Ballast resistor has not been installed.
- ❑ The Ballast resistor is open.

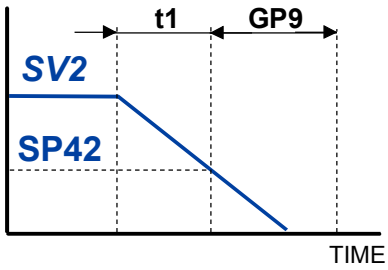



**Solution.**
Verify that the lines and the drives are in good condition and restart the system.

| E.004 | Emergency stop exceeding time limit GP3 | E.004 |
|---|---|---|

An attempt has been made to stop the motor by canceling Speed Enable. The system has tried to stop the motor at full torque, but it has not been able to stop it in the time frame set by parameter GP3 (StoppingTimeout = maximum time allowed for braking, before considering the error for being unable to stop it in the set time) or

If t1<GP3, then after GP9, MOTOR TORQUE ON = 0; else, MOTOR TORQUE ON = 0 and E.004




the parameter that determines when the motor is considered to be stopped (SP42) Minimum velocity threshold, is too small.

Bear in mind that zero speed (total lack of velocity) does not exist, there is always a minimum amount of speed noise due to feedback.

**Solutions.**
The load that must stop the motor is too large to stop it in the time frame set by GP3 and the value given to this parameter must be increased.

The threshold or velocity window considered zero (SP42) is too small; thus, increase the value of this parameter.

The module is performing poorly and is unable to stop the motor. The module may be defective.

| E.106 | Extreme temperature at the heatsink of the IGBT's | E. 106 |
|---|---|---|

The drive is carrying out a task that overheats the power devices.

**Solution.**

Stop the system for several minutes and decrease the effort demanded from the drive.

| E.108 | Motor overheated | E. 108 |
|---|---|---|

The motor has overheated. The motor temperature measuring cables (position sensor cable) or the temperature sensor itself are defective. The application may be demanding high current peaks.

**Solution.**

Stop the system for several minutes and decrease the effort demanded from the drive. Cool the motor.

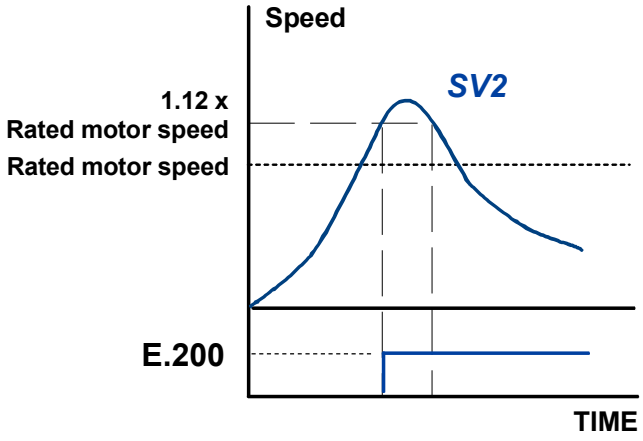
| E.200 | overspeed | E.200 |
|---|---|---|

The motor speed has exceeded the value of SP10 in a 12 %.

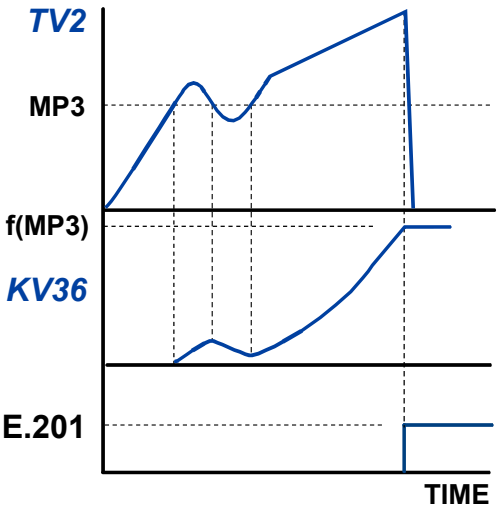
Bad cabling of the position sensor or of the motor power or the velocity loop is adjusted wrong.

**Solution.**

Decrease the speed overshoot in the system response.




| E.201 | Motor overload | E.201 |
|---|---|---|




The I2t protection of the motor has been activated.

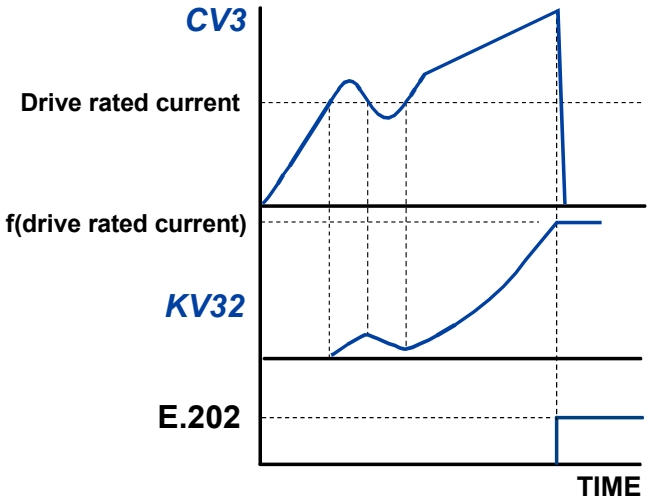
The duty cycle is greater than the motor can provide.

**Solution**

Decrease the duty cycle.

| E.202 | Drive overload | E.202 |
|---|---|---|

The I2t protection of the drive has been activated. The duty cycle is greater than the system can provide.




**Solution.**

Decrease the speed overshoot in the system response.

| E.214 | Short-circuit | E.214 |
|---|---|---|

There is short-circuit at the drive module.

**Solution.**

Reset the error.

If it persists, may be because:

- ❑ An erroneous sequence when connecting the power cables or a short-circuit between them.
- ❑ Wrong parameters or malfunction at the drive.

**Solution.**

Contact Fagor Automation.

After displaying E.214, one of the codes of the following table will be displayed. The drive where the alarm has been detected is:

| | |
|---|---|
| ABS | Over the absolute value of the output current |
| IGBT | At the IGBT's |
| OUT | At the output |

| E.304 | Drive's power bus voltage too high | E.304 |
|---|---|---|

The hardware of the drive module has detected that the voltage at the power bus is too high.

With external Ballast, maybe the connection is wrong or the Ballast resistor is defective.

**Solution.**

Disconnect the power supply and check the proper connection of the Ballast circuit.

| | | |
|---|---|---|
| **E.307** | **Power bus voltage too low** |  |

The mains voltage is lower than the required minimum voltage.

**Solution.**

Disconnect the power supply and check the proper condition of the lines.

| | | |
|---|---|---|
| **E.314** | **Ballast overload** |  |

Due to the duty cycle, the Ballast resistor is overloaded.

**Solution.**

- ❑ Resize the Ballast resistor.
- ❑ Decrease the duty cycle.
- ❑ Smooth the duty cycle by applying acceleration ramps.

| | | |
|---|---|---|
| **E.403** | **MSTfault** |  |
| **E.404** | **MDTfault** |  |
| **E.405** | **Err_InvalidPhase** |  |
| **E.406** | **Err_PhaseUpshift** |  |
| **E.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.

| | | |
|---|---|---|
| **E.410** | **SERCON reset due to noise** |  |

Noise entering the drive and causing the RESET of the SERCON but not of the drive.

| | | |
|---|---|---|
| **E.411** | **Error indicating telegram received. Is wrong** |  |
| **E.412** | **SERCOS synchronism error** |  |

The master device (CNC) sends a synchronism message in every cycle (usually every 4 ms) that synchronizes the drives.
If they cannot be synchronized or lose their synchronism, it causes this error. Maybe the CNC has not sent this message or if it has, it did it at the wrong time.

Check the transmission cable or verify that the transmission is not noisy.

| | | |
|---|---|---|
| **E.502** | **Incompatible parameters** |  |

Parameter incompatibility.

**Example.**

A drive controls a motor that admits a peak current of 20 A (e.g.: being the current limit CP20=20 A). If now, a 16A peak motor is connected, the current limit will be beyond the value allowed for this new motor. It will readjust in RAM memory certain parameters related to speed and current issuing E.502. Resetting the unit without saving the parameters causes the error to come up again. The error will go away when executing the GC1 command because the parameters readjusted to the right values by the drive in RAM memory are saved in E²PROM memory:

| | | |
|---|---|---|
| **E.506** | **Motor table missing** |  |

Contact Fagor Automation.

| | | |
|---|---|---|
| **E.510** | **Incoherent combination of motor and feedback** |  |

Motor not accepted by the drive. Motor's power voltage is different from that of the drive.

| | | |
|---|---|---|
| **E.801** | **Encoder not detected** |  |

The drive has not detected the rotor sensor.

**Solution.**

Check the cabling and the motor connection regarding connector X2. Then do a RESET.

If it doesn't fix it, contact Fagor Automation.

| | | |
|---|---|---|
| **E.802** | **Defective encoder** |  |

Communication error. After an initial connection, communication errors keep coming up.

**Solution**

Check the cabling and the motor connection regarding connector X2. Then do a RESET.

If it doesn't fix it, contact Fagor Automation.

# LIST OF PARAMETERS, VARIABLES & COMMANDS. SERCOS ID's

| Mnem. | Name | Level | ID SERCOS | Acc. | Min. | Max. | Def. | Units | Page |
|---|---|---|---|---|---|---|---|---|---|
| AP1 | PrimaryOperationMode | USER | S00032 | RW | 1 | 13 | - | - | 44 |
| BV14 | NotProgrammableIOs | FAGOR | F00204 | RO | 0 | 65535 | - | - | 44 |
| CP1 | CurrentProportionalGain | FAGOR | S00106 | RW | 0 | 999 | - | - | 45 |
| CP2 | CurrentIntegralTime | FAGOR | S00107 | RW | 0 | 999 | - | - | 45 |
| CP20 | CurrentLimit | BASIC | F00307 | RW | 0 | 50,00 | 0 | A | 45 |
| CP30 | CurrentCommandFilter1Type | FAGOR | F00308 | RW | 0 | 1 | 0 | - | 45 |
| CP31 | CurrentCommandFilter1Frequency | FAGOR | F00312 | RW | 0 | 4000 | 0 | Hz | 45 |
| CP32 | CurrentCommandFilter1Damping | FAGOR | F00313 | RW | 0 | 1000 | 0 | Hz | 45 |
| CV1 | Current1Feedback | USER | F00309 | RO | - 50.00 | 50.00 | - | A | 46 |
| CV2 | Current2Feedback | USER | F00310 | RO | - 50.00 | 50.00 | - | A | 46 |
| CV3 | CurrentFeedback | USER | F00311 | RO | - 50.00 | 50.00 | - | A | 46 |
| CV10 | Current1Offset | FAGOR | F00305 | RO | - 2.000 | 2.000 | - | A | 46 |
| CV11 | Current2Offset | FAGOR | F00306 | RO | - 2.000 | 2.000 | - | A | 46 |
| DC1 | ResetClass1Diagnostics | USER | S00099 | RW | 0 | 15 | 0 | - | 49 |
| DC2 | ClearHistoricOfErrorsCommand | USER | F00402 | RW | 0 | 15 | 0 | - | 49 |
| DV1 | Class1Diagnostics (Errors) | BASIC | S00011 | RO | 0 | 65535 | - | - | 47 |
| DV9 | Class2Diagnostics (Warnings) | BASIC | S00012 | RO | 0 | 65535 | - | - | 47 |
| DV17 | HistoricOfErrors | USER | F00410 | RO | 0 | 999 | - | - | 47 |
| DV18 | DisplayError | BASIC | F02105 | RO | 0 | 65535 | - | - | 47 |
| DV19 | DisplayWarning | BASIC | F02106 | RO | 0 | 65535 | - | - | 48 |
| DV31 | DriverStatusWord | FAGOR | S00135 | RO | 0 | 65535 | - | - | 48 |
| DV32 | MasterControlWord | FAGOR | S00134 | RW | 0 | 65535 | - | - | 48 |
| GC1 | BackupWorkingMemoryCommand | BASIC | S00264 | RW | 0 | 15 | 0 | - | 51 |
| GC10 | LoadDefaultsCommand | BASIC | S00262 | RW | 0 | 15 | 0 | - | 51 |
| GP1 | PwmFrequency | BASIC | F00700 | RO | 0 | 8000 | 8000 | - | 50 |
| GP3 | StoppingTimeout | BASIC | F00702 | RW | 0 | 9999 | 500 | ms | 50 |
| GP4 | SetNumber | BASIC | F00703 | RO | 0 | 1 | 1 | - | 50 |
| GP5 | ParameterVersion | BASIC | F00704 | RO | 0 | 9999 | - | - | 50 |
| GP6 | GearRatioNumber | BASIC | F00717 | RW | 0 | 8 | 1 | - | 50 |
| GP9 | DriveOffDelayTime | BASIC | S00207 | RW | 0 | 9999 | 50 | ms | 50 |
| GV2 | ManufacturerVersion | BASIC | S00030 | RO | 0 | 9999 | - | - | 51 |
| GV5 | CodeChecksum | BASIC | F00706 | RO | - 32768 | 32767 | - | - | 51 |
| GV6 | RamParameterChecksum | BASIC | F00723 | RO | 0 | 65535 | - | - | 51 |
| GV8 | AccessLevel | FAGOR | F00707 | RW | 1 | 3 | - | - | 51 |
| GV9 | DriveType | BASIC | S00140 | RO | - 32768 | 32767 | - | - | 51 |
| GV11 | SoftReset | BASIC | F00708 | RW | 0 | 16 | - | - | 51 |
| GV16 | MotorTableVersion | BASIC | F00716 | RO | 0 | 32767 | - | - | 51 |
| GV26 | GearRatioPreselection | BASIC | S00218 | RW | 0 | 7 | - | - | 51 |
| HV1 | DrivePeakCurrentSercos | BASIC | S00110 | RO | 0 | 50,00 | - | A | 52 |
| HV5 | PLDVersion | BASIC | F00295 | RO | 0 | 65535 | - | - | 52 |
| IP6 | DigitalInputPolarity | USER | F00910 | RW | 0 | 1 | - | - | 52 |
| IV10 | DigitalInputs | USER | F00907 | RO | 0 | 1 | - | - | 52 |
| KP3 | ExtBallastPower | USER | F01114 | RW | 200 | 2000 | 200 | W | 53 |
| KP4 | ExtBallastEnergyPulse | USER | F01116 | RW | 200 | 2000 | 200 | J | 53 |
| KV10 | CoolingTemperature | USER | F01102 | RO | 0 | 200 | - | °C | 53 |
| KV32 | I2tDrive | USER | F01109 | RO | 0 | 100 | - | % | 53 |
| KV36 | I2tMotor | USER | F01111 | RO | 0 | 100 | - | % | 53 |
| KV40 | I2tCrowbar | USER | F01115 | RO | 0 | 100 | - | % | 53 |
| KV41 | BallastSelect | USER | F01117 | RW | 0 | 1 | 1 | - | 53 |
| MP1 | MotorType | BASIC | S00141 | RW | - 32768 | 32767 | - | - | 54 |
| MP2 | MotorTorqueConstant | FAGOR | F01200 | RW | 0 | 10.00 | - | N·m/A | 54 |
| MP3 | MotorContinuousStallCurrent | FAGOR | S00111 | RW | 0 | 50.00 | - | A | 54 |
| MP4 | MotorPeakCurrent | FAGOR | S00109 | RO | 0 | 50.00 | - | A | 54 |
| NP116 | ResolutionOfFeedback1 | USER | S00116 | RO | 0 | 65535 | - | - | 55 |

| Mnem. | Name | Level | ID SERCOS | Acc. | Min. | Max. | Def. | Units | Page |
|---|---|---|---|---|---|---|---|---|---|
| NP121 | InputRevolutions | USER | S00121 | RW | 1 | 32767 | 1 | - | 55 |
| NP122 | OutputRevolutions | USER | S00122 | RW | 1 | 32767 | 1 | - | 55 |
| NP123 | FeedConstant | USER | S00123 | RW | 0 | 2147483647 | - | - | 55 |
| OP6 | DigitalOutputPolarity | USER | F01416 | RW | 0 | 1 | - | - | 56 |
| OV10 | DigitalOutputs | USER | F01410 | RO | 0 | 1 | - | - | 56 |
| PC146 | NCControlledHoming | USER | S00146 | RW | 0 | 3 | - | - | 59 |
| PP52 | ReferenceDistance1 | USER | S00052 | RW | -214748.3648 | 214748.3647 | - | mm or ° | 57 |
| PP55 | PositionPolarityParameters | USER | S00055 | RW | 0 | 65535 | - | - | 57 |
| PP76 | PositionDataScalingType | USER | S00076 | RW | 1 | 65535 | - | - | 57 |
| PP103 | ModuleValue | USER | S00103 | RW | 0 | 214748.3647 | 360 | mm or ° | 57 |
| PP150 | ReferenceOffset1 | BASIC | S00150 | RW | -214748.3648 | 214748.3647 | 0 | mm or ° | 58 |
| PP177 | AbsoluteDistance1 | BASIC | S00177 | RW | -214748.3648 | 214748.3647 | 0 | mm or ° | 58 |
| PV51 | PositionFeedback1 | USER | S00051 | RO | -214748.3648 | 214748.3647 | - | mm or ° | 58 |
| PV173 | MarkerPositionA | USER | S00173 | RO | -214748.3648 | 214748.3647 | 0 | - | 58 |
| PV175 | DisplacementParameter1 | BASIC | S00175 | RW | -214748.3648 | 214748.3647 | 0 | mm or ° | 58 |
| PV203 | PositionFeedbackStatus | BASIC | S00403 | RW | 0 | 1 | 0 | - | 58 |
| PV204 | PositionCommandStatus | BASIC | S00404 | RW | 0 | 1 | 0 | - | 59 |
| PV207 | HomingEnable | BASIC | S00407 | RW | 0 | 1 | 0 | - | 59 |
| QP1 | ControlUnitCycleTime | USER | S00001 | RW | 2 | 8 | 4 | ms | 60 |
| QP11 | SercosMbaud | BASIC | F02000 | RW | 0 | 16 | 4 | Mbd | 60 |
| QP12 | SercosTransmisionPower | BASIC | F02002 | RW | 1 | 8 | 2 | - | 60 |
| QV30 | FiberDistErrCounter | USER | F00727 | RO | 0 | 65535 | - | - | 60 |
| SP1 | VelocityProportionalGain | BASIC | S00100 | RW | 0 | 999,9 | - | mArms/rpm | 61 |
| SP2 | VelocityIntegralTime | BASIC | S00101 | RW | 0 | 999,9 | - | ms | 61 |
| SP3 | VelocityDerivativeGain | BASIC | S00102 | RW | 0 | 9999 | 0 | - | 61 |
| SP10 | VelocityLimit | BASIC | S00091 | RW | 0 | 9999 | 1000 | rev/min | 61 |
| SP42 | StandStillWindow | USER | S00124 | RW | 0 | 9999 | 20 | rev/min | 61 |
| SP43 | VelocityPolarityParameters | BASIC | S00043 | RW | 0 | 1 | 0 | - | 62 |
| SP60 | AccelerationLimit | BASIC | S00138 | RW | 0 | 400.0 | 0 | rpm/ms | 62 |
| SP65 | EmergencyAcceleration | BASIC | F01609 | RW | 0 | 400.0 | 0 | rpm/ms | 62 |
| SP66 | VelocityDecelerationTime | BASIC | F01618 | RW | 0 | 400.0 | 0 | rpm/ms | 63 |
| SV1 | VelocityCommand | BASIC | S00036 | RW | - 4950.0000 | 4950.0000 | 0 | rev/min | 63 |
| SV2 | VelocityFeedback | BASIC | S00040 | RO | - 6000.0000 | 6000.0000 | - | rev/min | 63 |
| SV6 | VelocityCommandAfterFilters | BASIC | F01622 | RO | - 6000.0000 | 6000.0000 | - | rev/min | 63 |
| SV7 | VelocityCommandFinal | BASIC | F01612 | RO | - 6000.0000 | 6000.0000 | - | rev/min | 63 |
| TV1 | TorqueCommand | USER | S00080 | RO | - 999.9 | 999.9 | 0 | Nm | 64 |
| TV2 | TorqueFeedback | USER | S00084 | RO | - 999.9 | 999.9 | - | Nm | 64 |

**FAGOR AUTOMATION S. COOP.**

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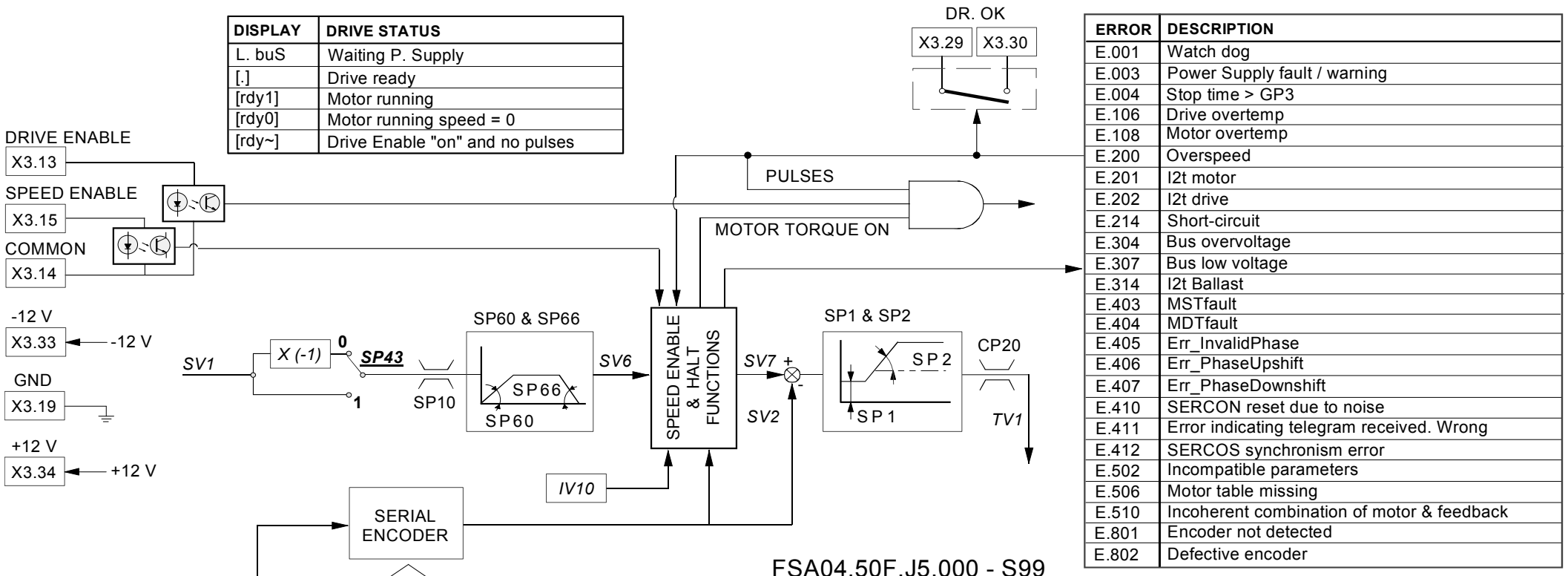
**Fagor Automation S. Coop.**

# VELOCITY CONTROL BLOCK DIAGRAM

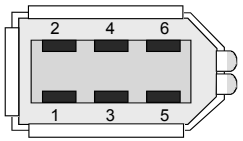
| DISPLAY | DRIVE STATUS |
|---|---|
| L. buS | Waiting P. Supply |
| [.] | Drive ready |
| [rdy1] | Motor running |
| [rdy0] | Motor running speed = 0 |
| [rdy~] | Drive Enable "on" and no pulses |




| ERROR | DESCRIPTION |
|---|---|
| E.001 | Watch dog |
| E.003 | Power Supply fault / warning |
| E.004 | Stop time > GP3 |
| E.106 | Drive overtemp |
| E.108 | Motor overtemp |
| E.200 | Overspeed |
| E.201 | I2t motor |
| E.202 | I2t drive |
| E.214 | Short-circuit |
| E.304 | Bus overvoltage |
| E.307 | Bus low voltage |
| E.314 | I2t Ballast |
| E.403 | MSTfault |
| E.404 | MDTfault |
| E.405 | Err_InvalidPhase |
| E.406 | Err_PhaseUpshift |
| E.407 | Err_PhaseDownshift |
| E.410 | SERCON reset due to noise |
| E.411 | Error indicating telegram received. Wrong |
| E.412 | SERCOS synchronism error |
| E.502 | Incompatible parameters |
| E.506 | Motor table missing |
| E.510 | Incoherent combination of motor & feedback |
| E.801 | Encoder not detected |
| E.802 | Defective encoder |

**MP1** WITH FEEDBACK TYPE

**F5** INCREMENTAL ENCODER: 13 bits (2048 ppt)
**F7** ABSOLUTE ENCODER: 16 bits (16384 ppt)




**X2 CONNECTOR**
MOTOR SENSOR INPUT

FSA04.50F.J5.000 - S99

**MOTOR SERIES**

**MOTOR LENGTH**

| | |
|---|---|
| LONG MOTORS | A |
| SHORT MOTORS | P |

**SIZE/POWER**

| | | FSA | | FSP | |
|---|---|---|---|---|---|
| HEIGTH | LFe | 200V | kW | 200V | kW |
| 60 | 28 | **02** | 0.2 | | |
| | 56 | **04** | 0.3<br>0.4 | | |
| 80 | 20 | | | **02** | 0.2 |
| | 40 | | | **04** | 0.4 |
| | 80 | **08** | 0.65<br>0.75 | | |
| 120 | 28 | | | **08** | 0.75 |

**MAXIMUM SPEED**

**50** 5000 rev/min
Note that rated speed is 3000 rev/min

**VOLTAGE**

200 V **F**

**SPECIFICATION** 01 → ZZ
only when having the special "S" configuration !

**SPECIAL CONFIGURATION** S

**CONNECTION**
Interconnectron connector **0**

**BRAKE/SEAL OPTION**

| | |
|---|---|
| Without brake or seal (not considered) | 0 |
| With brake (24 V DC), without seal | 1 |
| With brake (24 V DC), with seal | 2 |
| Without brake, with seal | 3 |

**EJE Y BRIDA**

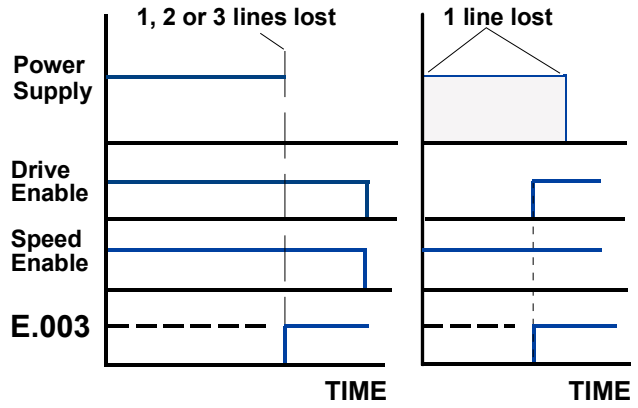
| | |
|---|---|
| Cylindrical shaft with keyway and tapped hole | 0 |
| Cylindrical keyless shaft and tapped hole | 1 |

**FEEDBACK**

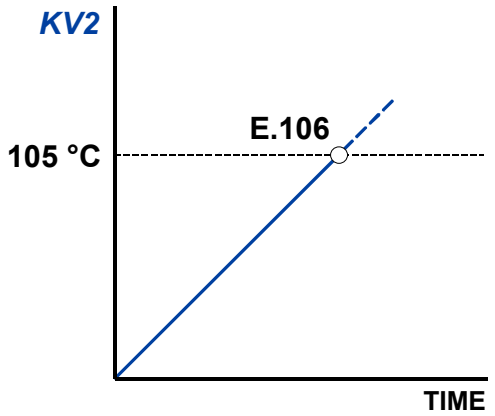
| | |
|---|---|
| 13 bit incremental | J5 |
| 16 bit absolute | J7 |

# ERROR FUNCTIONS

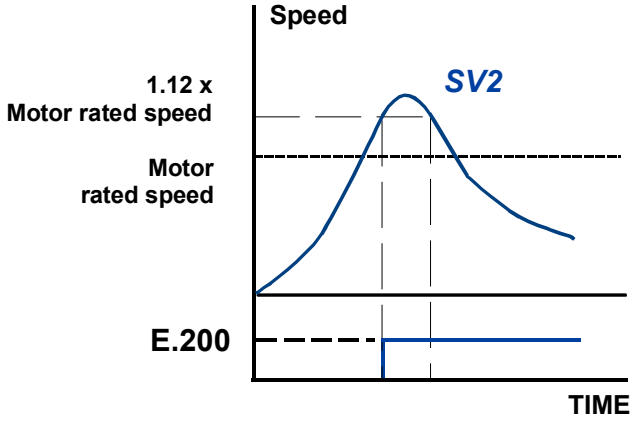
**Function E.003** — **Power Supply fault**



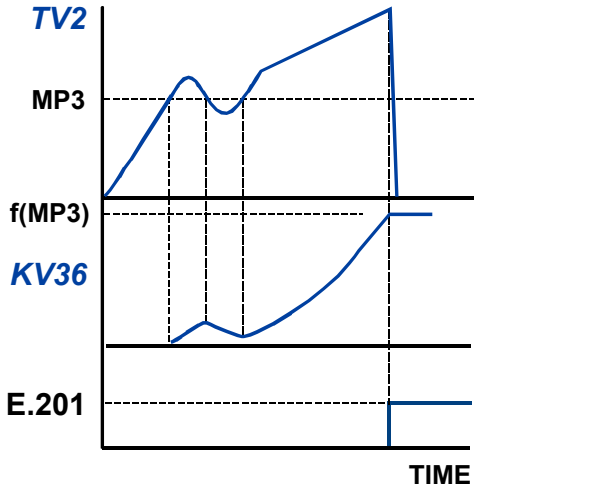

**Funtion E.106** — **Drive overtemp**



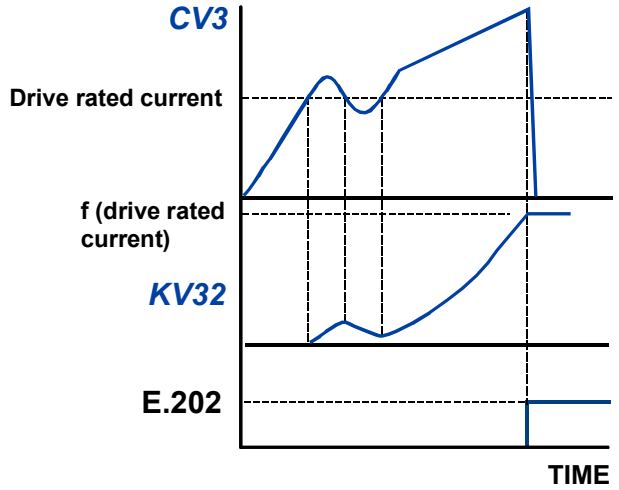

**Function E.200** — **Overspeed**




**Function E.201** — **Motor overload**




**Function E.202** — **Drive overload**




**Function E.314** — **Ballast overload**

| | | |
|---|---|---|
| **KV41** | 1 | Internal Ballast resistor |
| **KV41** | 0 | External Ballast resistor |