FAGOR AUTOMATION S.COOP.

Brushless AC servo drives

~ MCSi-C0 series ~

Ref.1504

FAGOR

14460090

Original instructions

Title	Brushless AC servo drives. MCSi-C0 series.
Type of documentation	Description, installation and startup of motors and MCS INNOVA digital drives with CAN interface.
Name	**MAN REGUL MCSi-Co (IN)**
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The contents of this manual have been verified and matched with the product described here. Even so, it may contain involuntary errors that make it impossible to ensure an absolute match. However, the contents of this document are regularly checked and updated implementing the necessary corrections in a later edition.

DUAL-USE products.
Products manufactured by Fagor Automation S. Coop. included on the list of dual-use products according to regulation (UE) Nr 1382/2014. Their product identification includes the text -MDU and require an export license depending on destination.

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.

FAGOR is committed to repairing or replacing its products from the time when the first such product was launched up to 8 years after such product has disappeared from the product catalog.

It is entirely up to FAGOR to determine whether a repair is to be considered under warranty.

EXCLUDING CLAUSES

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

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

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

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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:

Drives	MCS Innova. MCSi-XXX-C0 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, April 1th, 2015

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 Concentricity: 0.04 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 (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: 2048 ppt Optional: Absolute encoder 16 bits: 16384 ppt

TABLE 2. Characteristics table of non-ventilated FSA and 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 Nm	Mp Nm	nN rev/min	nmax rev/min	Io Arms	Ip Arms	P W	Kt Nm/Arms	tac ms	J kg·cm^2	M kg	MCSi -07L-C0 Nm	MCSi -11L-C0 Nm	MCSi -15L-C0 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.□□.□□□	1.270	3.82	3000	5000	2.8	8.5	400	0.498	1.42	0.173	1.7	3.24	**3.82**	
FSA08.50F.□□.□□□	2.390	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 Nm	Mp Nm	nN rev/min	nmax rev/min	Io Arms	Ip Arms	Pow kW	Kt Nm/Arms	tac ms	J kg·cm^2	M kg	MCSi -07L-C0 Nm	MCSi -11L-C0 Nm	MCSi -15L-C0 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.□□.□□□	1.270	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.□□.□□□	2.390	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**

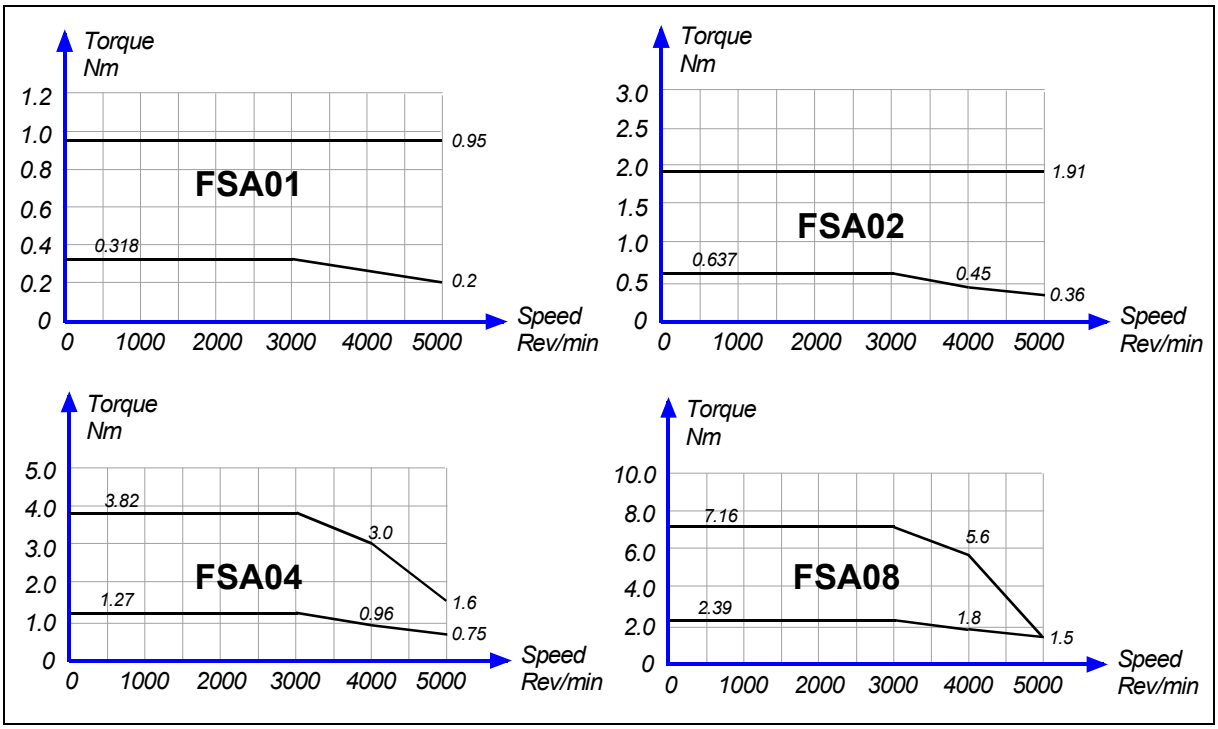
1 If the motor has a brake (option), its inertia must also be taken into account. See «brake characteristics».

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

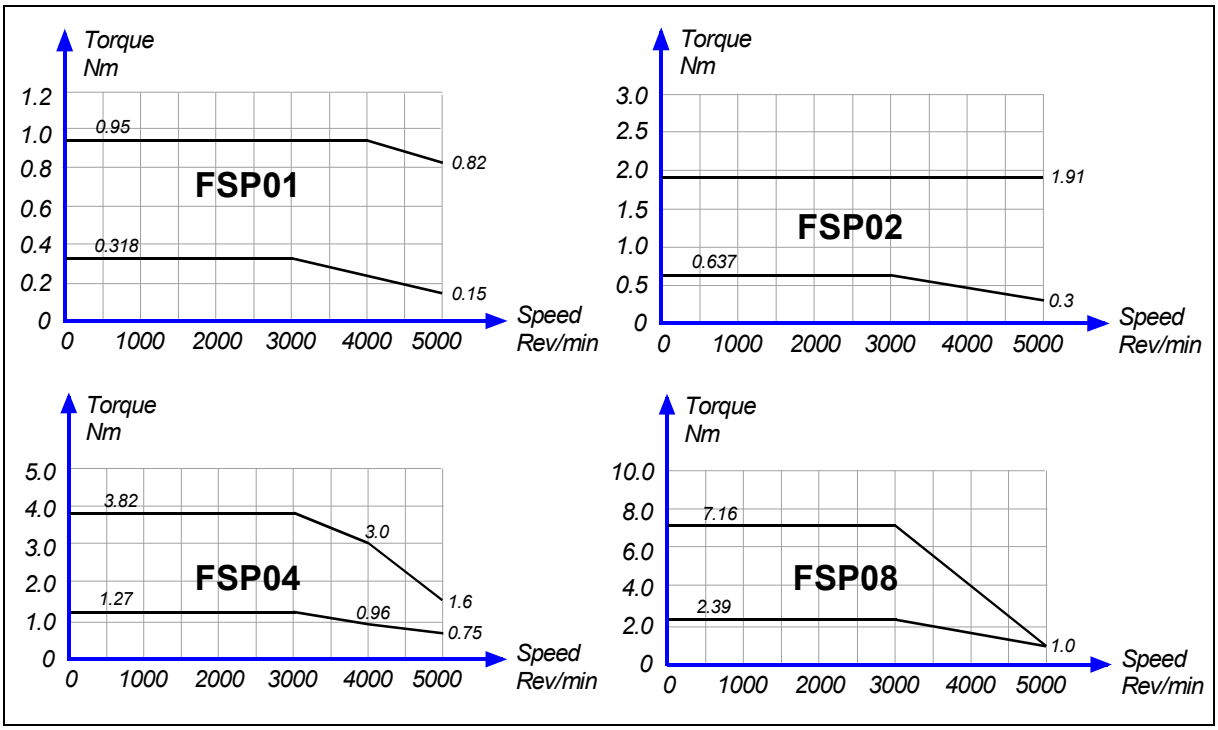
Note. The drive recommended to govern each motor must supply the rated current needed to obtain the rated torque from the motor.

Torque-speed curves

Synchronous AC servomotors FSA series



Synchronous AC servomotors FSP series



Synchronous AC servomotors. FSA series

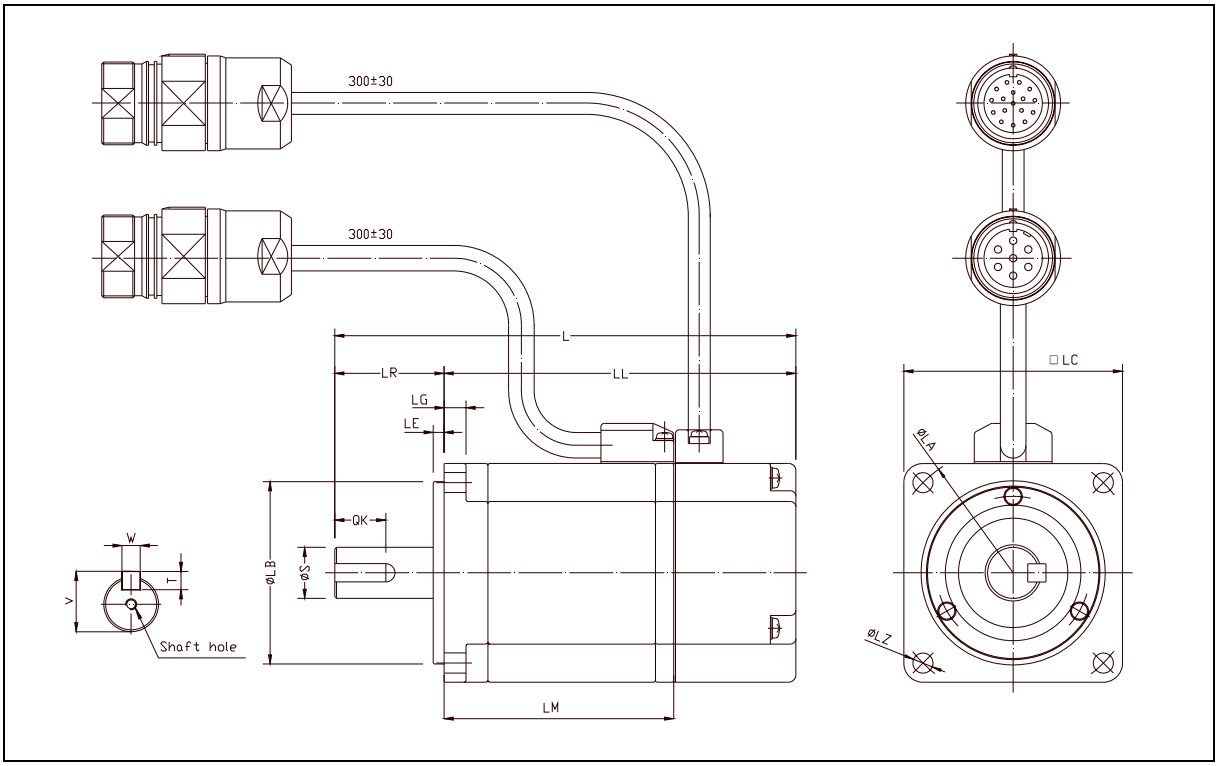


FIGURE 1.

Dimensions of FSA series synchronous servo motors.

TABLE 3. Motor. Dimensions in mm.

Dimensions	Motor length					Flange surface					
Motor type	**LM**	**L**	**LL**	**Δ brake**	**LR**	**LA**	**LB**	**LC**	**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

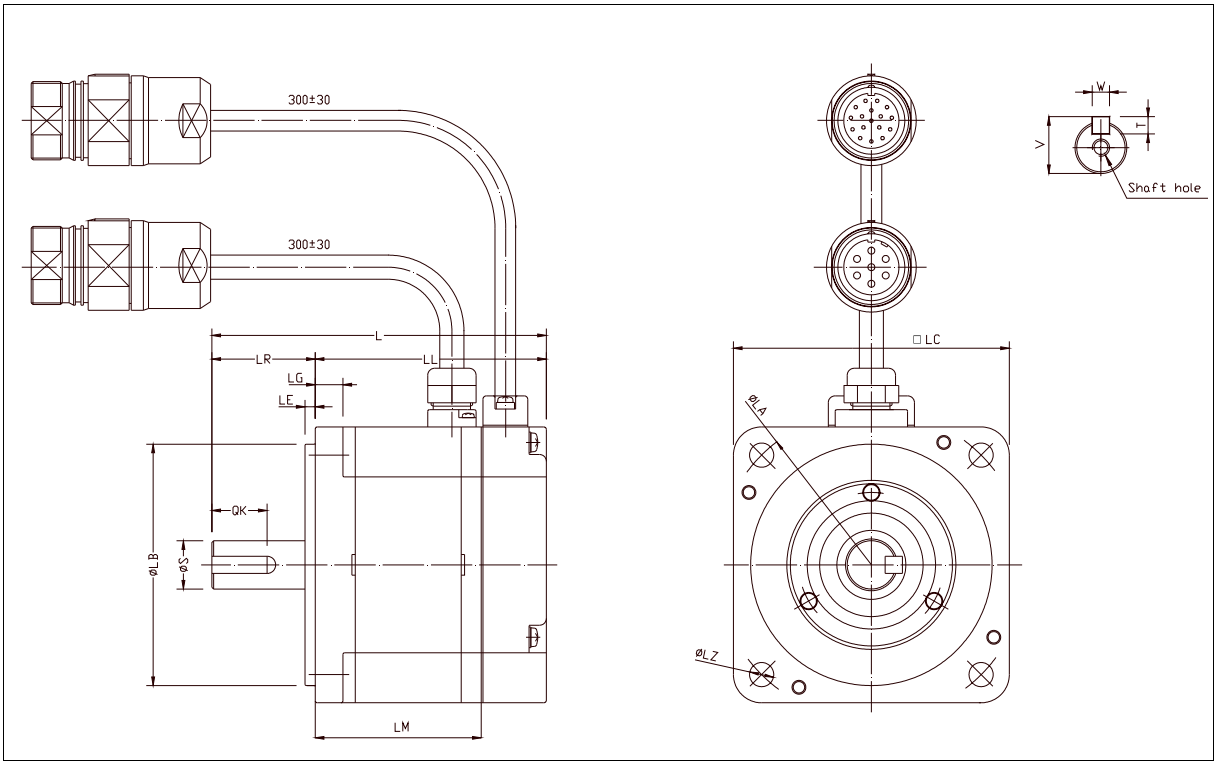


FIGURE 2.

Dimensions of FSP series synchronous servo motors.

TABLE 5. Motor. Dimensions in mm.

Dimensions	Motor length					Flange surface					
Motor type	**LM**	**L**	**LL**	**Δ brake**	**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

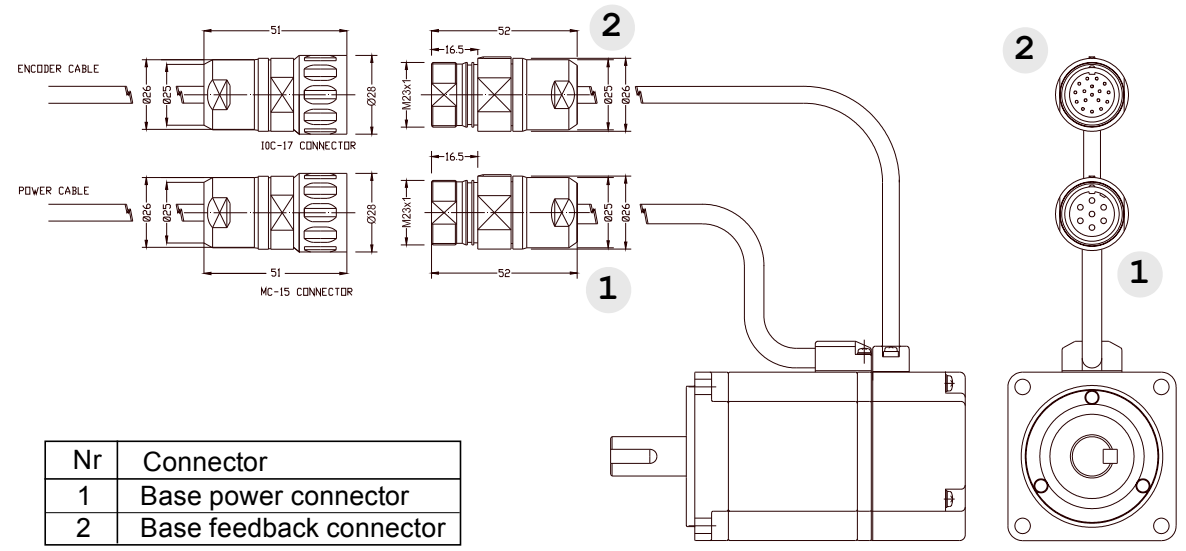
The Δ brake column shows the length increment for the L and LL measurements when using a motor configuration «with brake».

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	M3x6
FSP02	14h6	16	5	5	16	M5x8
FSP04	14h6	16	5	5	16	M5x8
FSP08	16h6	22	5	5	18	M5x8

Power connectors and encoder output

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 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

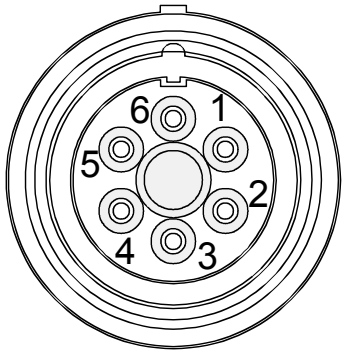


FIGURE 4.

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

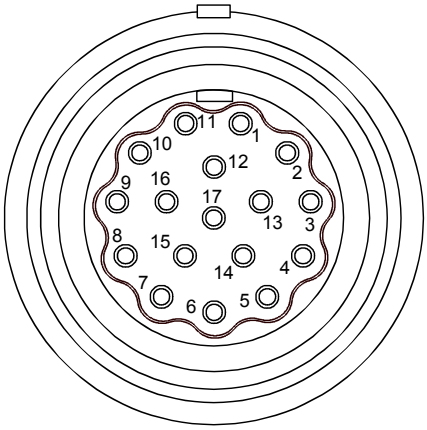


FIGURE 5.

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

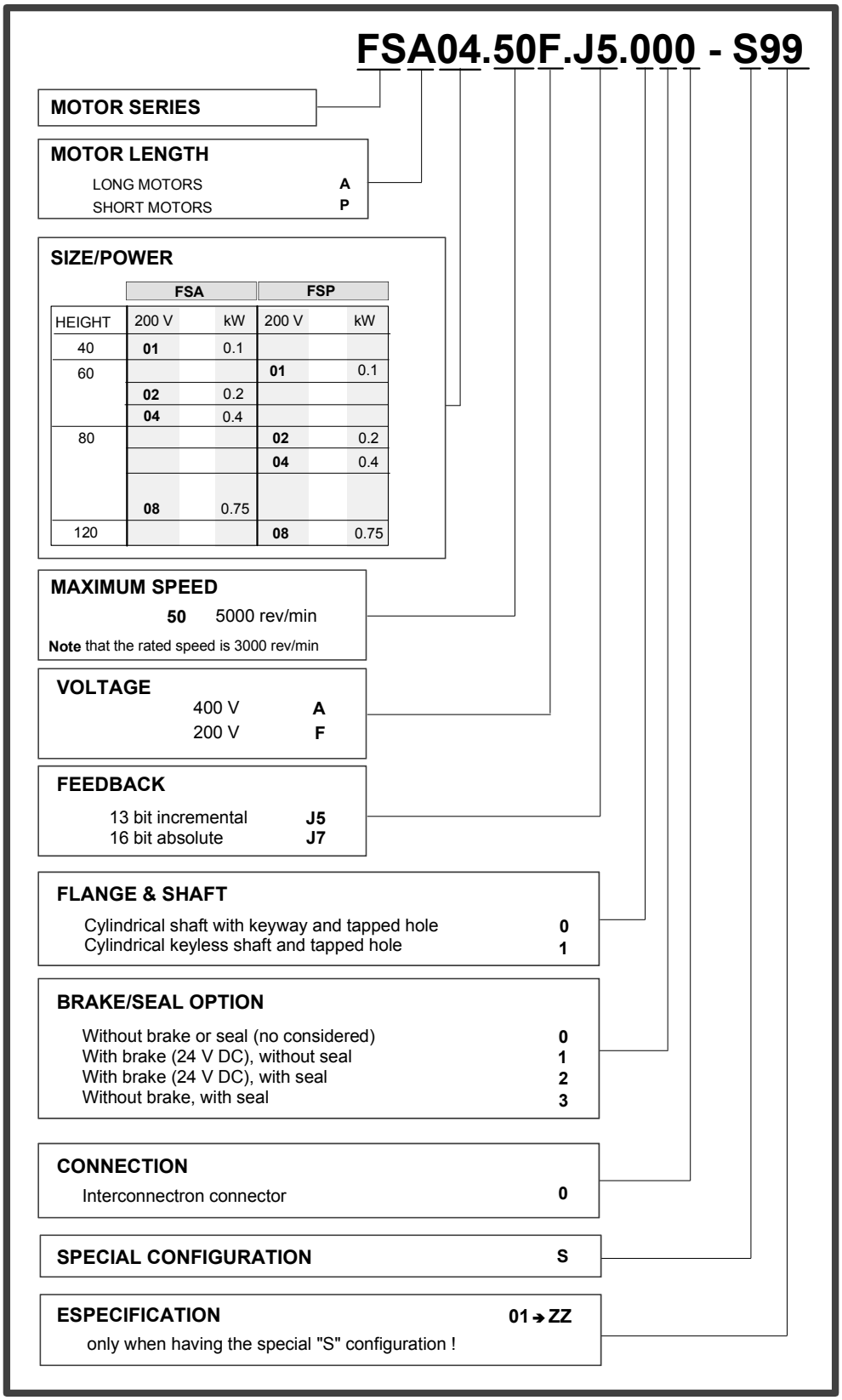


FIGURE 6.

Sales model of FS series axis feed motors.

MCSi-C0 SERVODRIVE

Introduction

The **MCS i**nnova 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.
- CAN based field bus communication interface.
- USB service communication line.
- Two logic inputs to control the motor: Speed Enable and Drive Enable.
- CANopen® communication protocol.

Dimensions

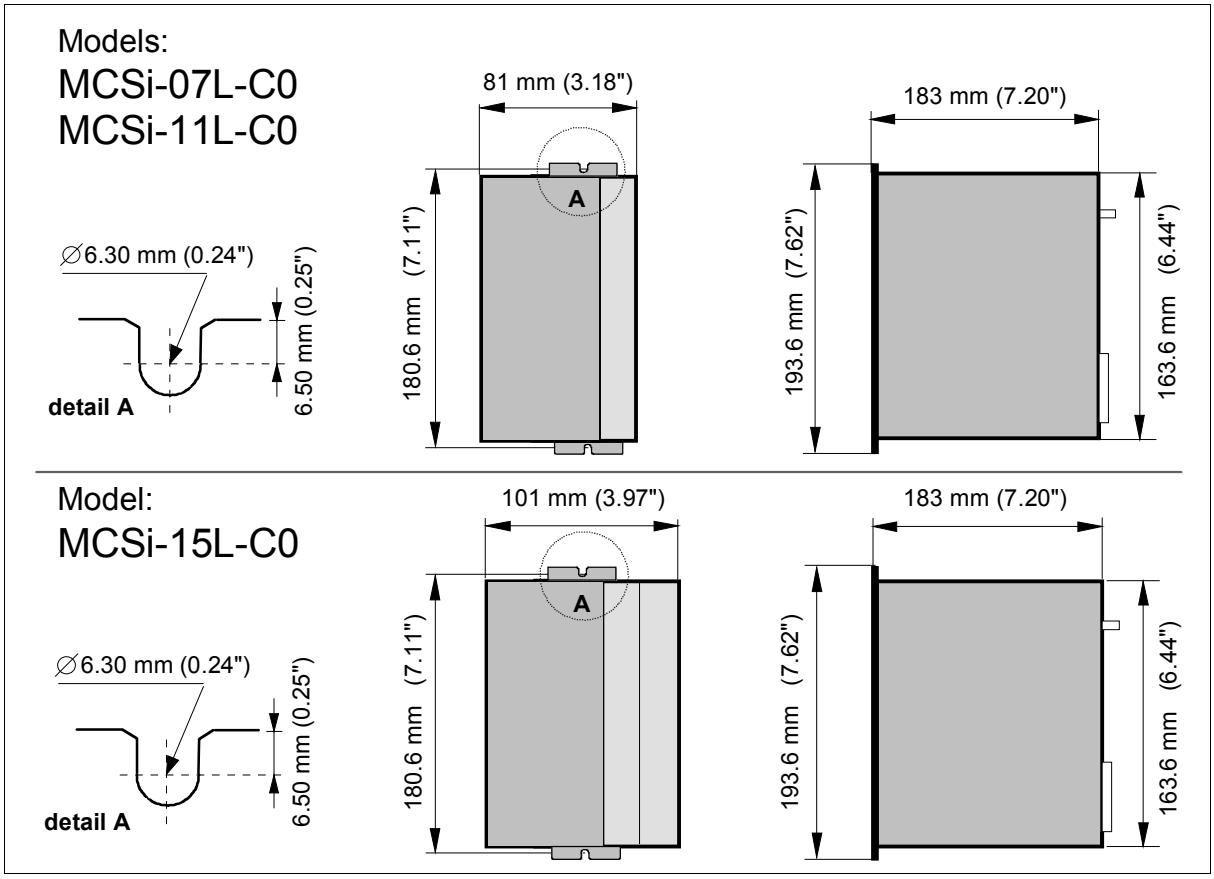


FIGURE 7.

Dimensions of the MCSi-☐☐L-Co 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 % 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	IP 20	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 X8

CAN FIELD BUS

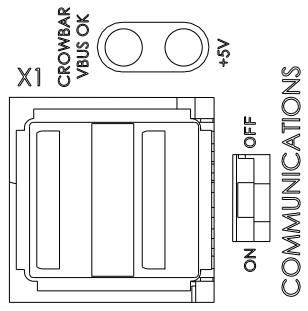
(meets DS-301 standard regarding communications).

«Open Style» 5-pin female connector of the CAN communication board that may be used to connect the drive modules of the system with the CNC that governs them. The connection is made through CAN cable and it has a bus type structure. It comes with two rotary switches and two status-indicating LED's (**L**ight **E**mitting **D**iodes).

Light indicators

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

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



«CROWBAR VBUS OK» LED states

OFF	No voltage in the power circuit.
ON «green»	With voltafe in the power circuit.
ON «red»	The voltage of the internal bus has exceeded the preset voltage values and the Ballast resistor has been activated.

FIGURE 8.

"CROWBAR 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 CAN bus and the drive. For further detail, see section *- Initialization and adjustment -* of this manual.

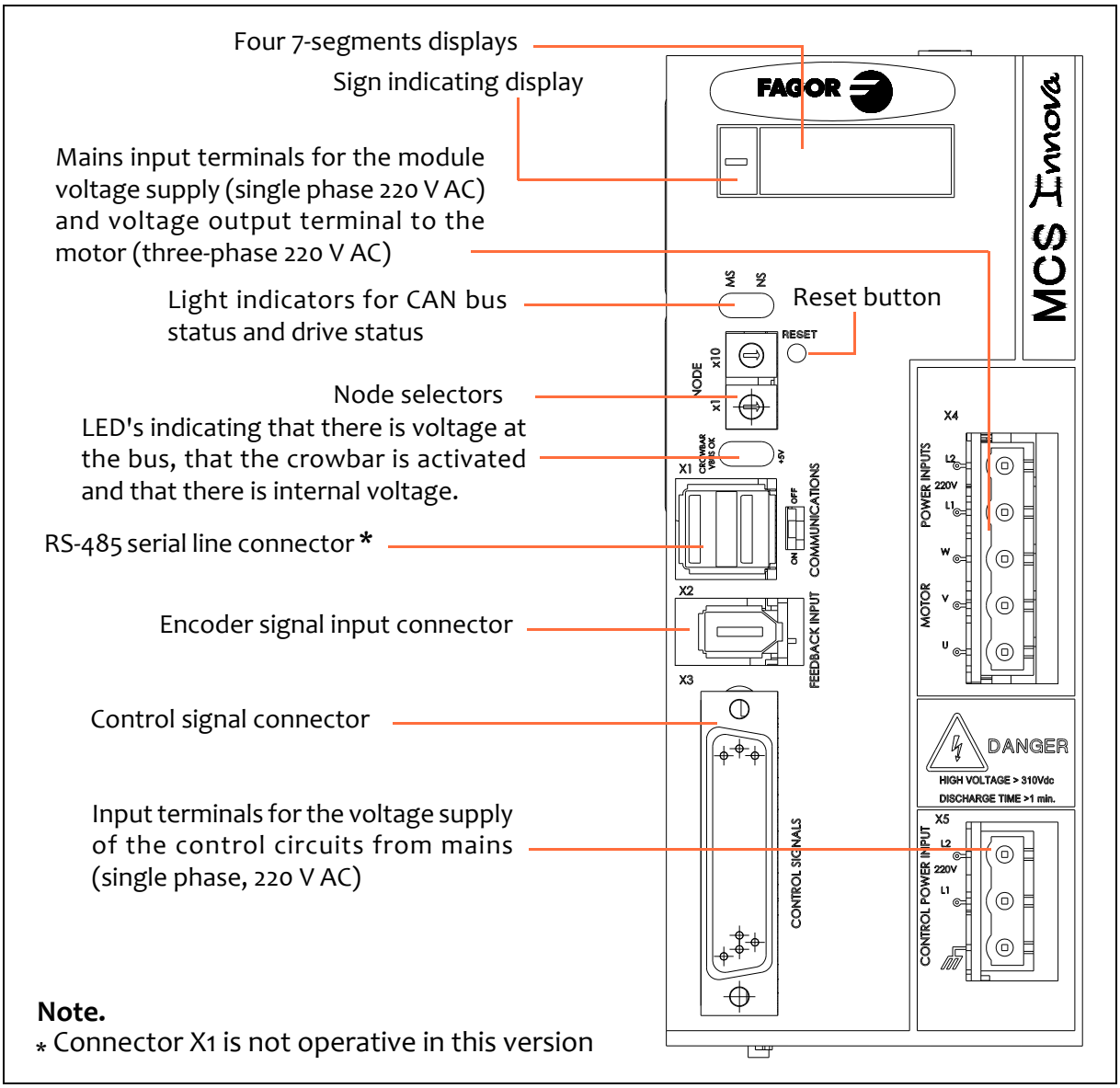
Numerical displays. It has four 7-segment numerical displays and a sign light to display the drive status.

Push-buttons and rotary 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 CAN bus and also select the communication speed of the bus. For further detail, see section *- Initialization and adjustment -* of this manual.

Front view



Note.
* Connector X1 is not operative in this version

FIGURE 9.

Front view of the module.

Top view

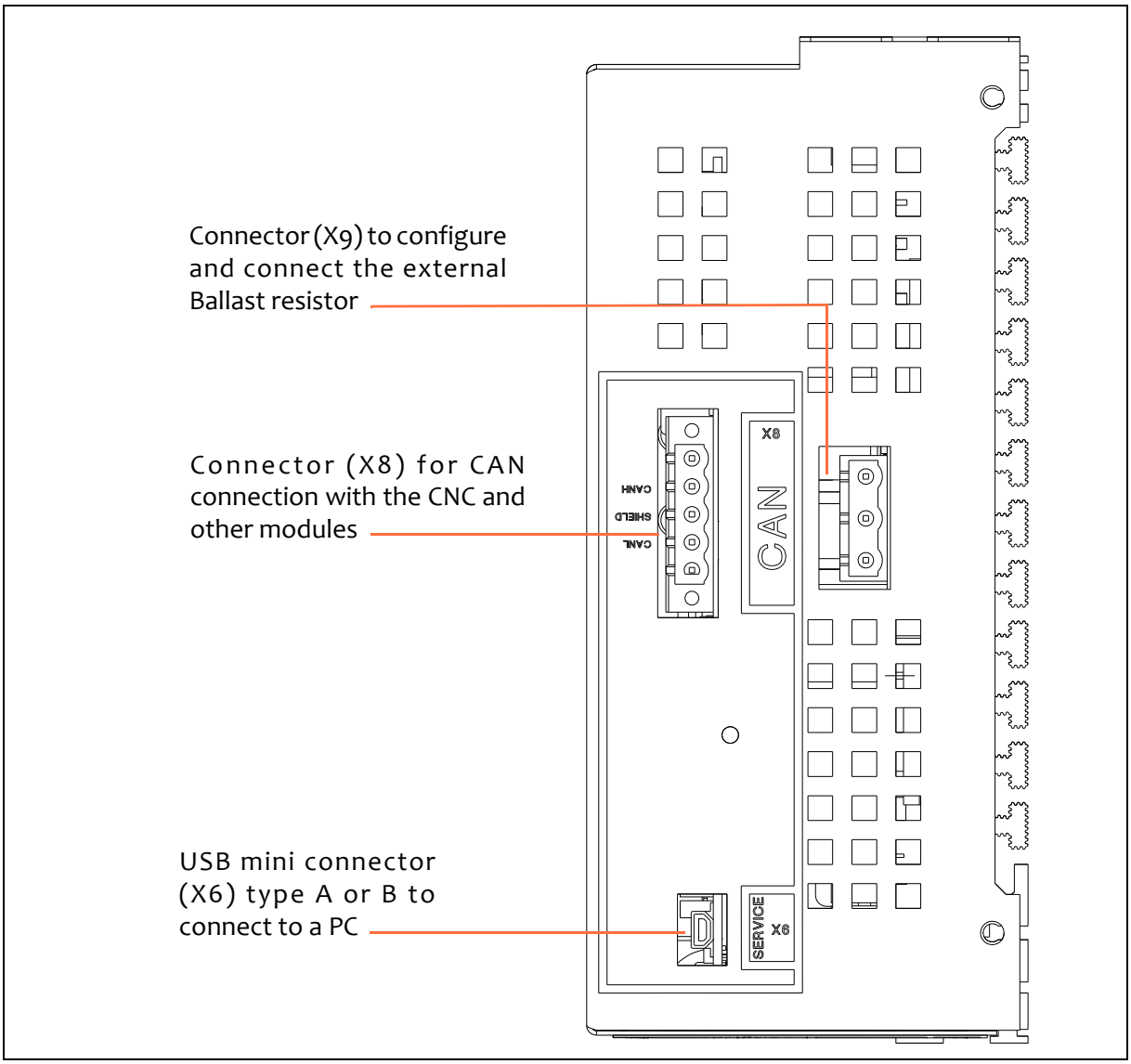
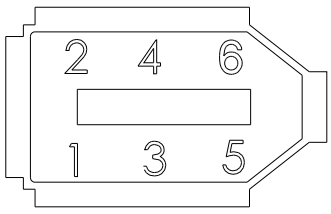


FIGURE 10.

Top view of the module.

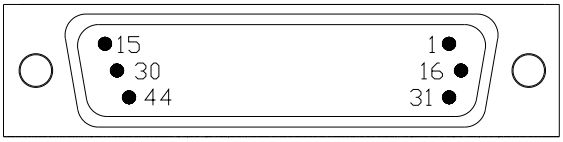
Pinout of the connectors



FEEDBACK INPUT (X2)

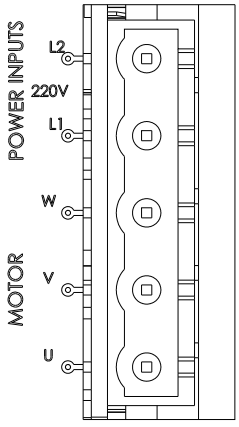
Pin	Signal	Description
1	+ 5 V	Voltage supply for the encoder
2	GND	Encoder voltage supply GND
3	+ BAT	+ battery (with absolute encoder)
4	- BAT	- Battery (with absolute encoder)
5	+ 485	Encoder communication
6	- 485	Encoder communication
	Chassis	Connector housing

CONTROL SIGNALS (X3)



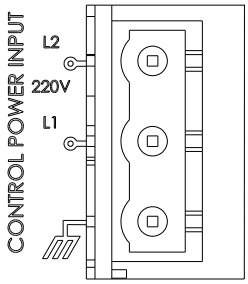
Pin	Signal	I/O	Description	
34	AUX. ±12 V	O	+12 V (20 mA max) output	
33			-12 V (20 mA max) output	
19			GND	
43	AUX 24 V DC	O	+24 V DC (50 mA max) output	
44			GND AUX 24 V DC	
13	DRIVE ENABLE	I	DRIVE ENABLE input (range from 0 to 24V DC)	
15	SPEED ENABLE	I	SPEED ENABLE input (range from 0 to 24V DC)	
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 (NC normally closed) used as external acknowledgment of the status of the integrated 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.



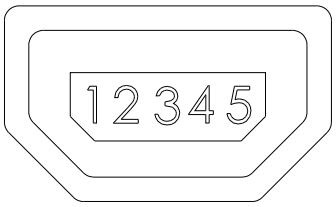
POWER INPUTS & MOTOR (X4)

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	



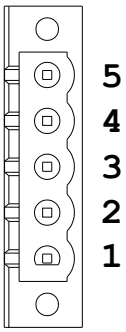
CONTROL POWER INPUTS (X5)

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



CAN (X8)

Pin	Signal	Description
1	GNDa	(N.C.) Not Connected
2	CANL	CAN_L bus line (low dominant)
3	SHIELD	CAN cable shield
4	CANH	CAN_H bus line (high dominant)
5	SHIELD	(N.C.) Not Connected

Sales model

Sales model codes for **MCS i**nnova drives with CAN communication bus (meets CANopen® standard at DS-301 communication level).

MCS INNOVA DIGITAL DRIVE **EXAMPLE. MCSi - 07 L - C0**

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 CAN 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.

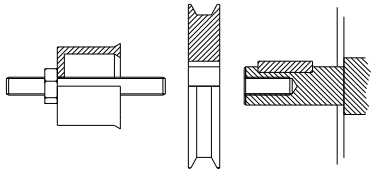
❑ Guard the motor with a cover if it is exposed to splashes.

❑ 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.

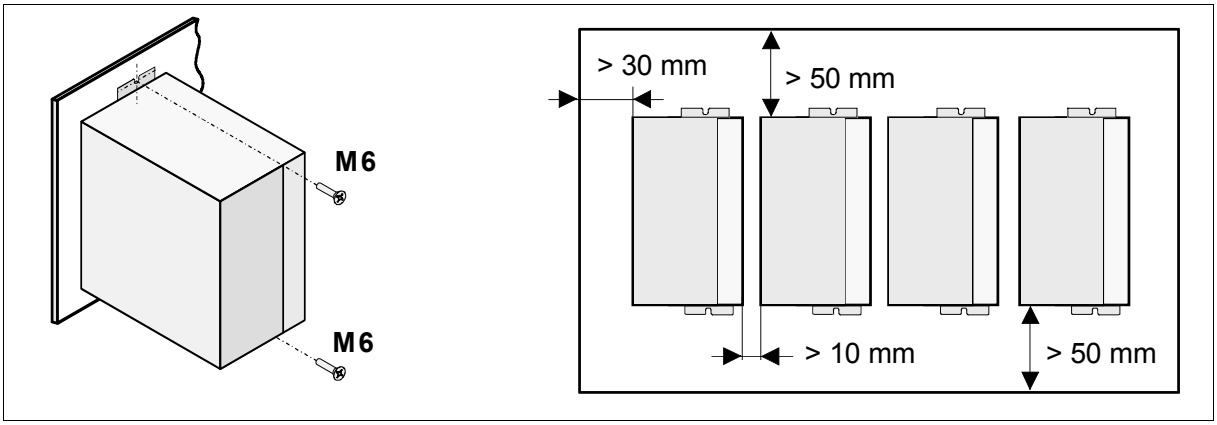


FIGURE 11.

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

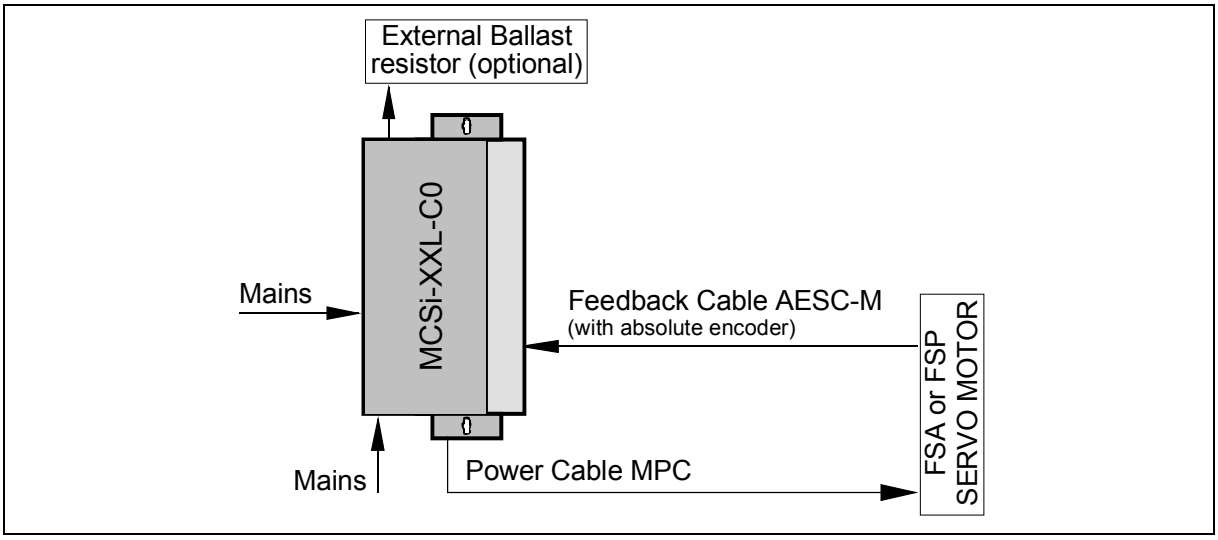


FIGURE 12.

Basic module interconnection diagram.

Power connection. Mains-drive

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

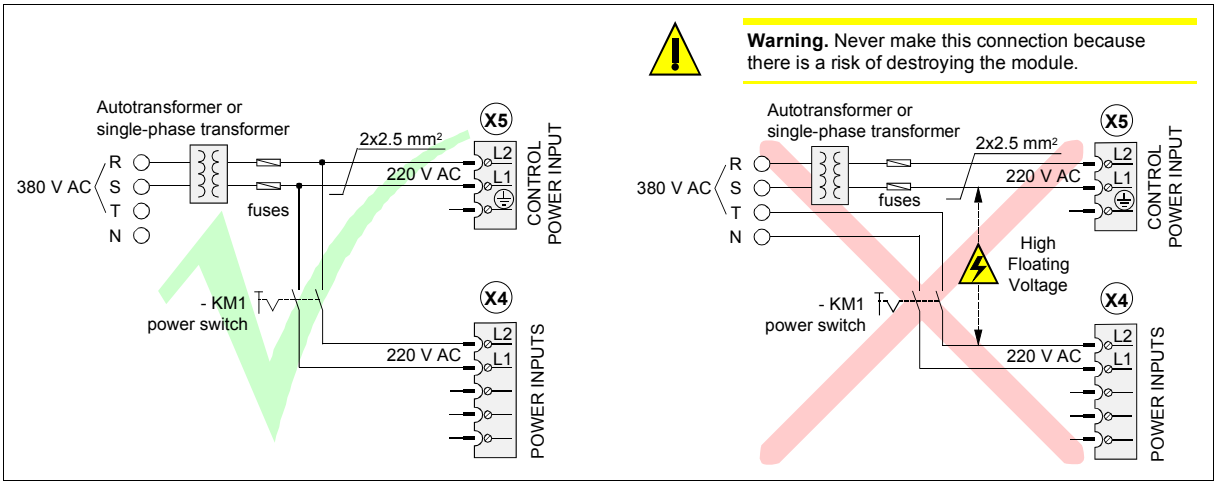


FIGURE 13.

Mains power connection of the drive, with transformer.

Note. It is required to install a transformer.

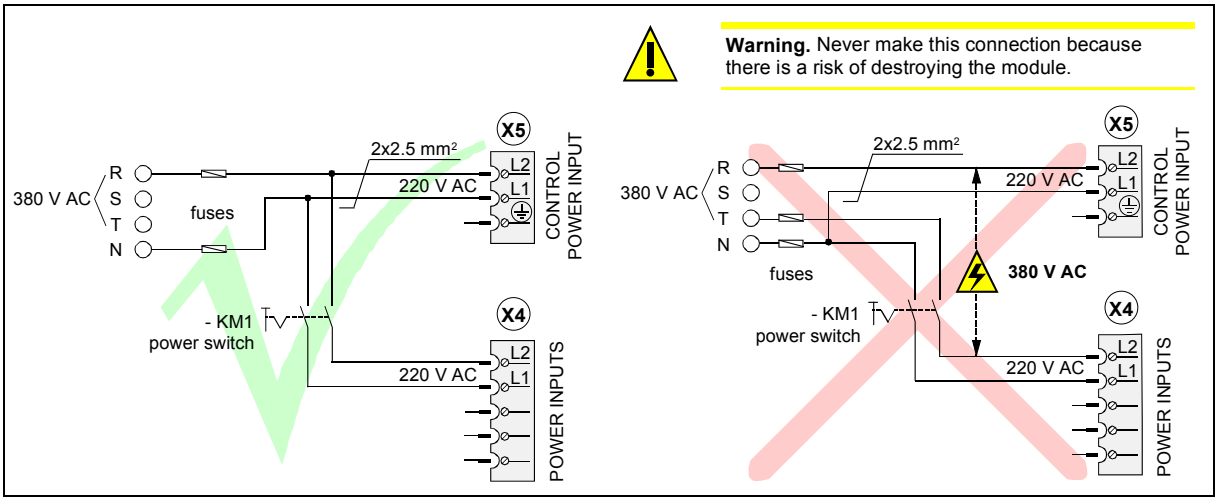


FIGURE 14.

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-C0	6.5	16
MCSi-11L-C0	10.5	16
MCSi-15L-C0	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-C0	-	-	-	Max. value 65 Ω Min. value 45 Ω
MCSi-11L-C0	-	-	-	
MCSi-15L-C0	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.

❑ Use KV41 to indicate to the drive that an external ballast resistor has been connected.

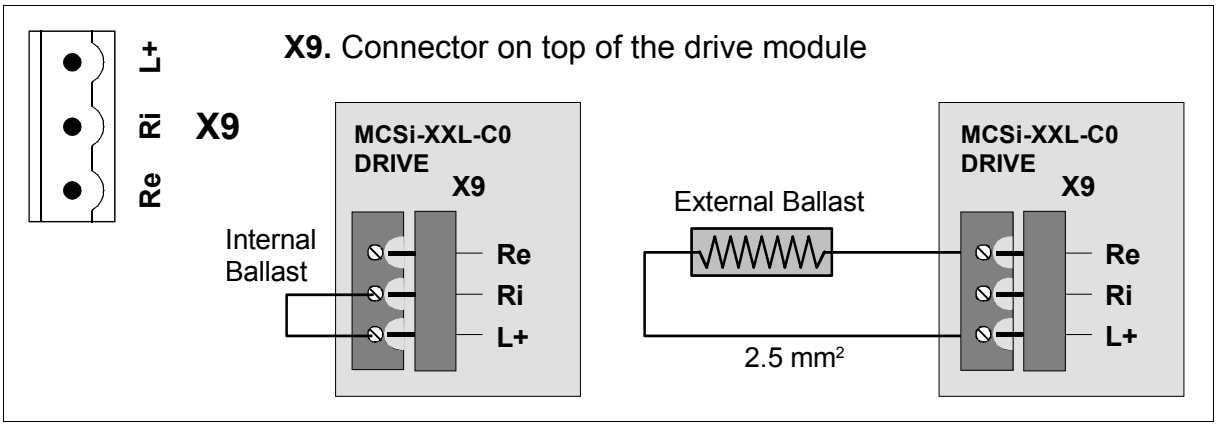


FIGURE 15.

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 EC regulations. See FIGURE 16.

Power connection.
Mains filter to suppress electromagnetic interference

In order for the FAGOR DDS 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-C0; 3.5 A for the MCSi-11L-C0 and 5 A for the MCSi-15L-C0.

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

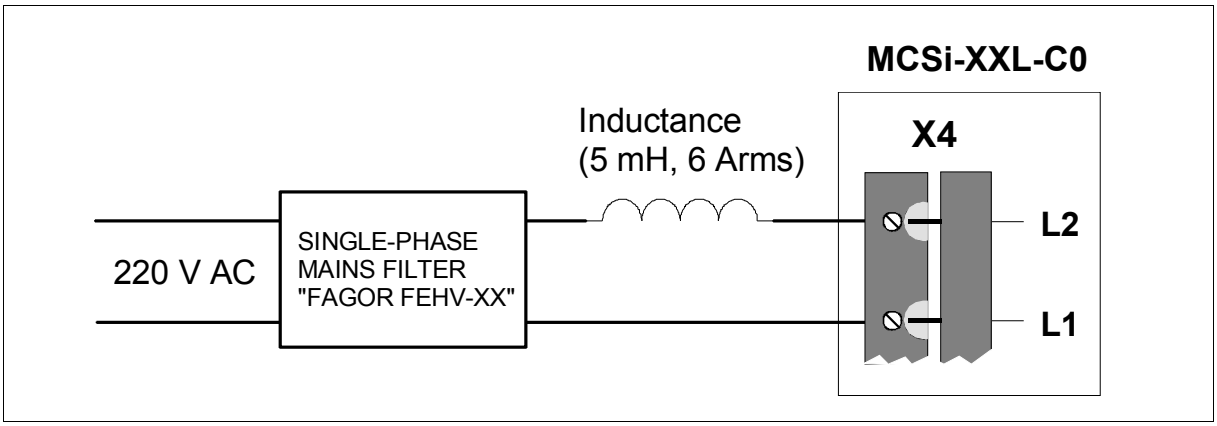


FIGURE 16.

Power connection. Choque and mains filter.

DIMENSIONS

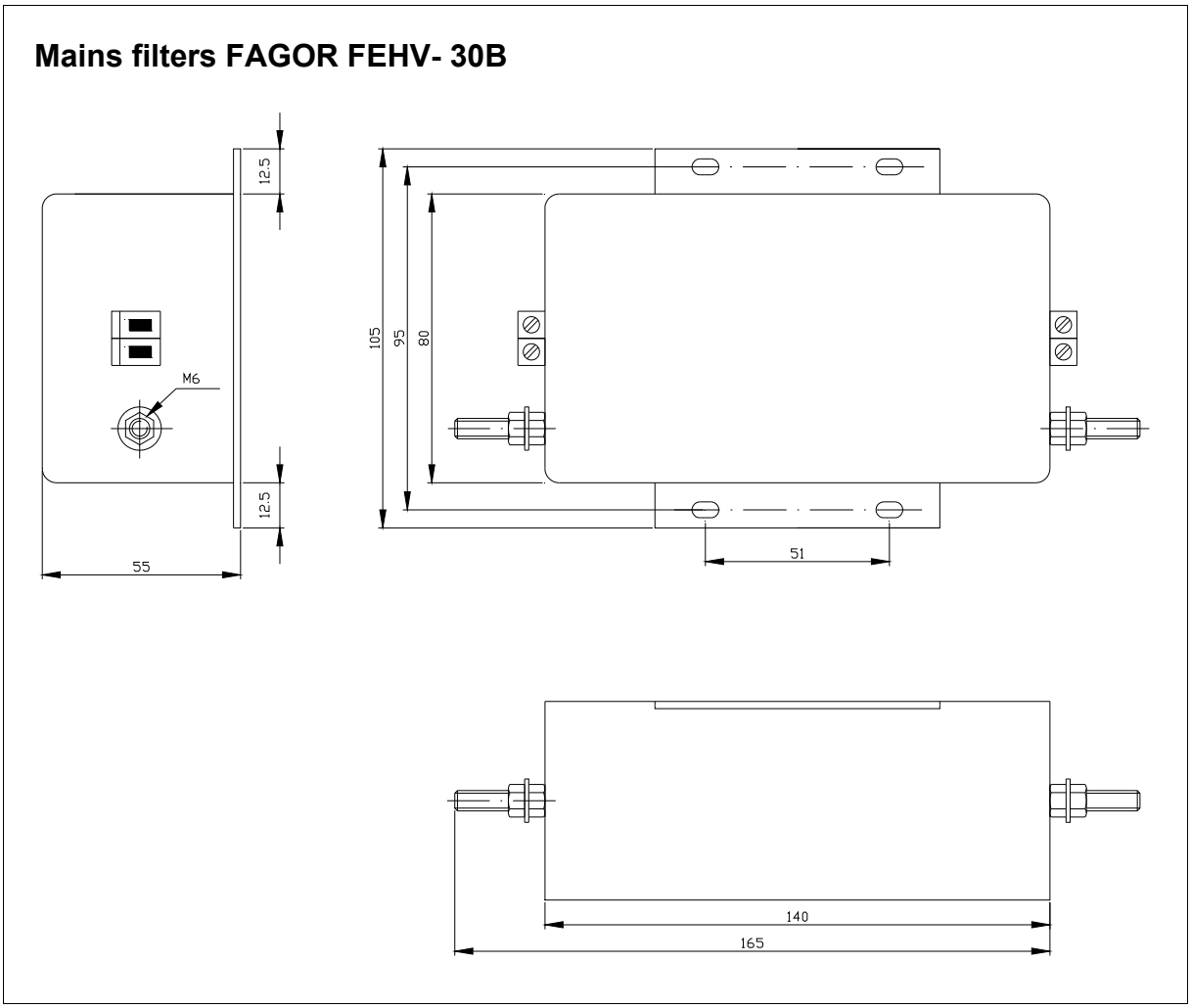


FIGURE 17.

Dimensions of the mains filter FAGOR FEHV-30B.

Mains filters FAGOR FEHV-10Z/16Z

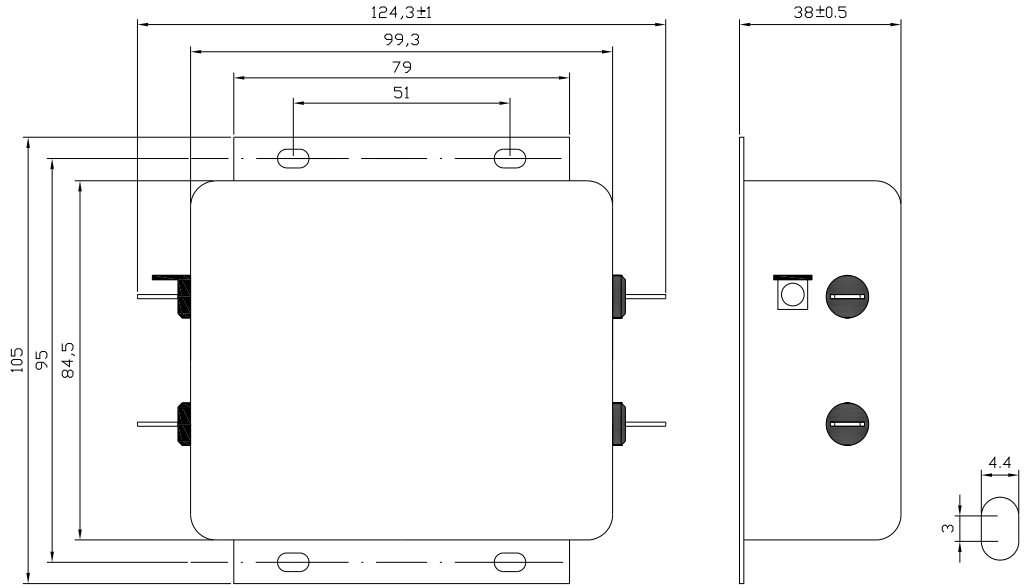


FIGURE 18.

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

Power connection. Drive-motor

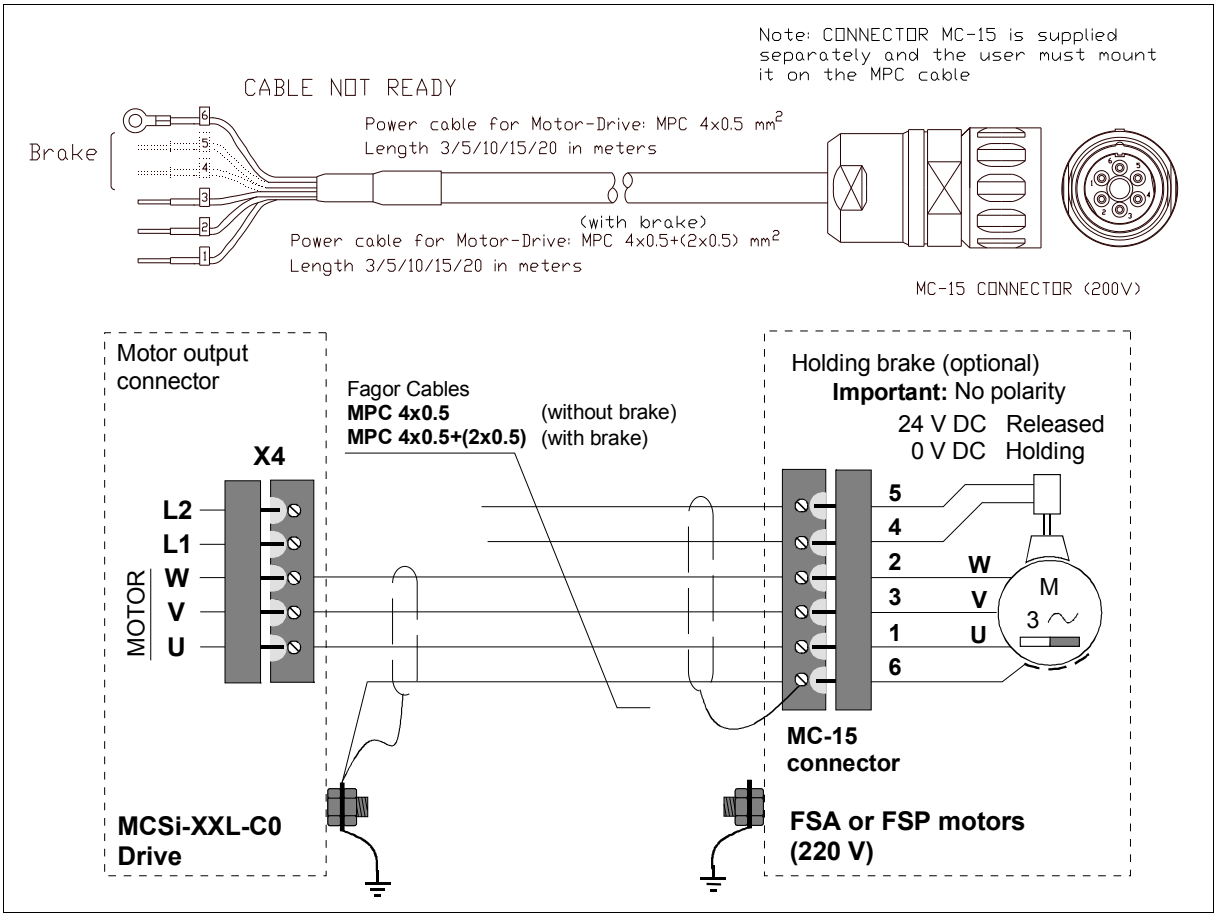


FIGURE 19.

Power connection between a motor (FSA or FSP - 220 V) and an MCSi-XXL-Co drive.

POWER CABLES

TABLE 11. Power cables.

For motors without brake	For motors with 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:

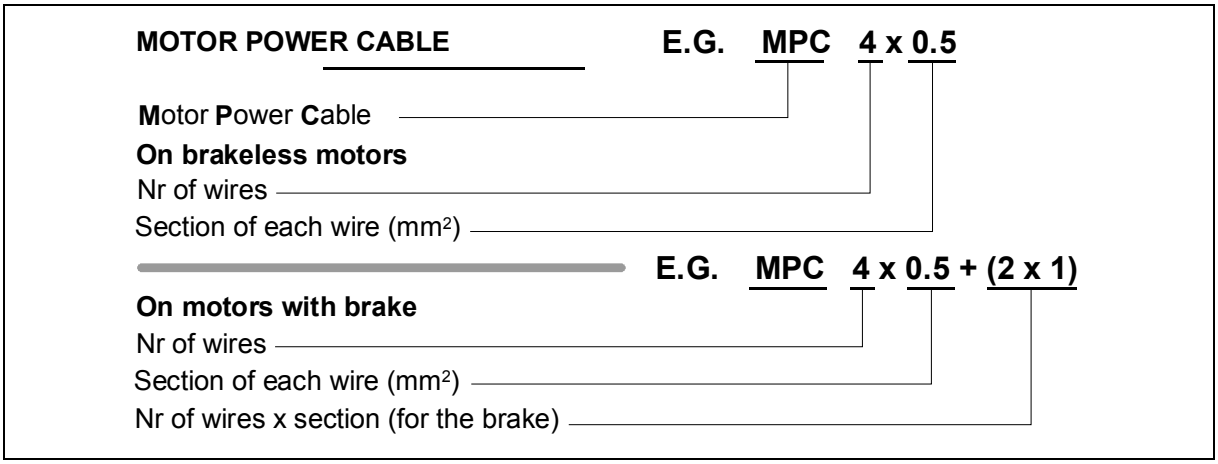
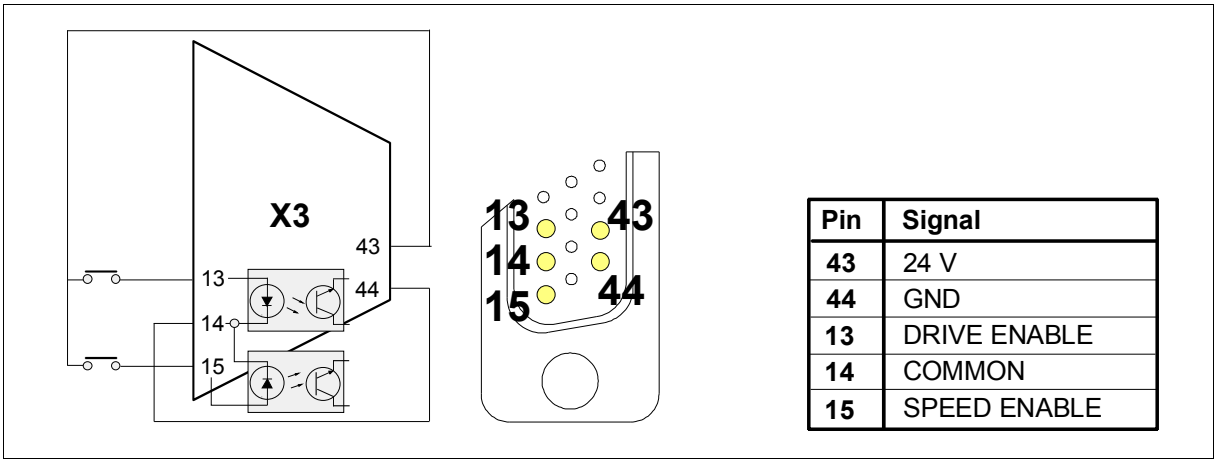


FIGURE 20.

Sales model of FAGOR power cables.

Connection of the monitoring and control signals

❑ Enable signals using 24 V.

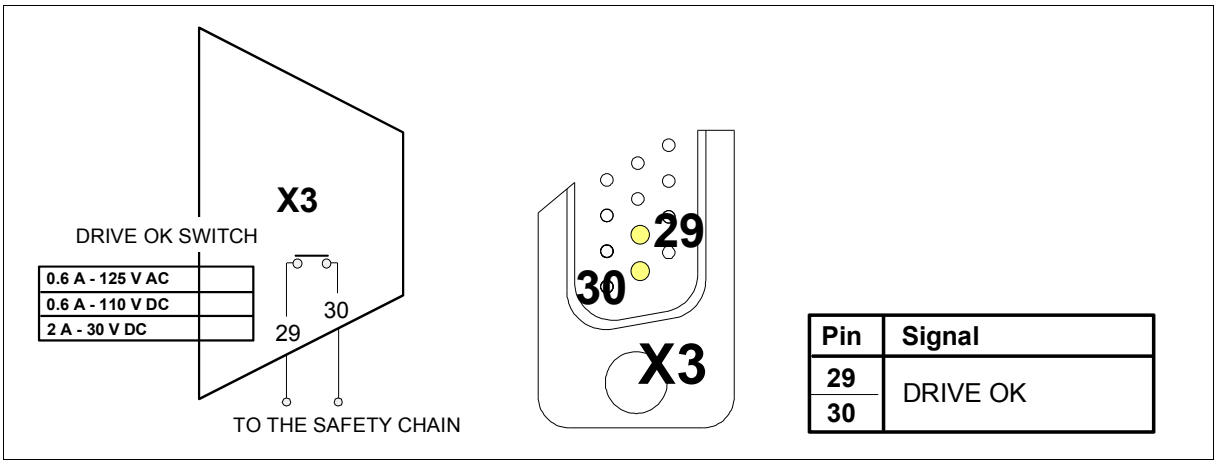


Pin	Signal
43	24 V
44	GND
13	DRIVE ENABLE
14	COMMON
15	SPEED ENABLE

FIGURE 21.

Enable signals using 24 V.

❑ Signal indicating that the drive is running properly

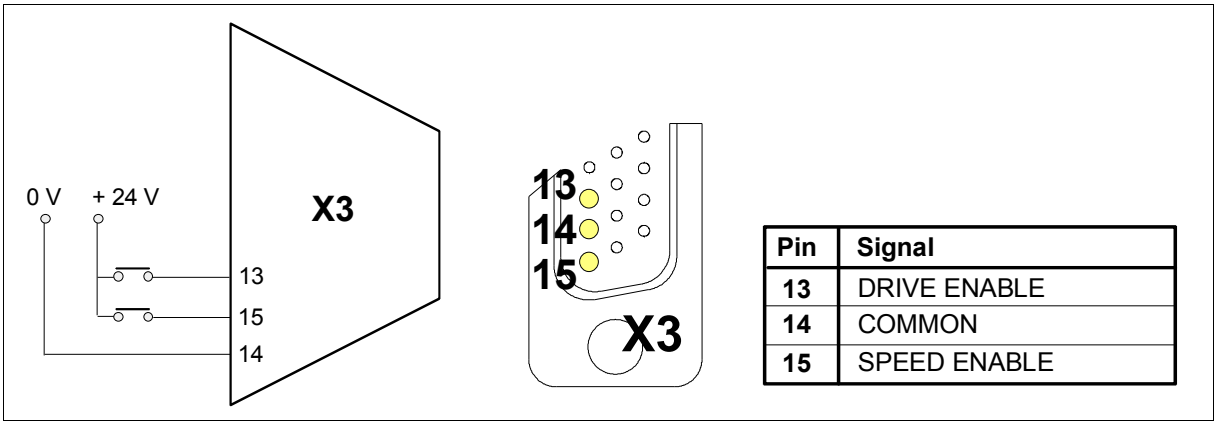


Pin	Signal
29 30	DRIVE OK

FIGURE 22.

Signal indicating that the drive is running properly.

❑ Enable signals

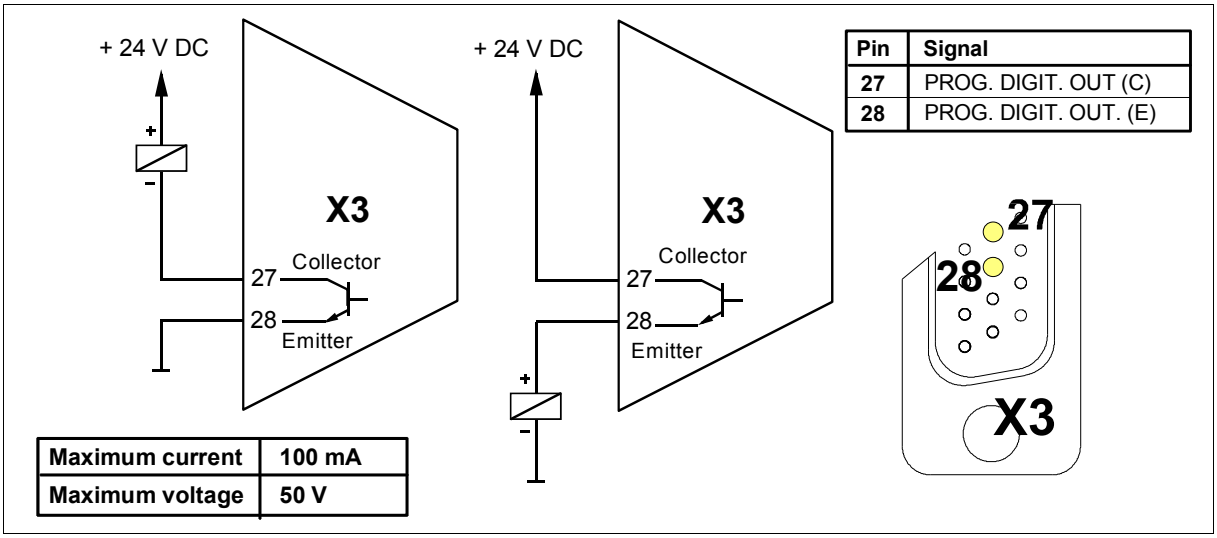


Pin	Signal
13	DRIVE ENABLE
14	COMMON
15	SPEED ENABLE

FIGURE 23.

Enable signals.

❑ Programmable digital outputs



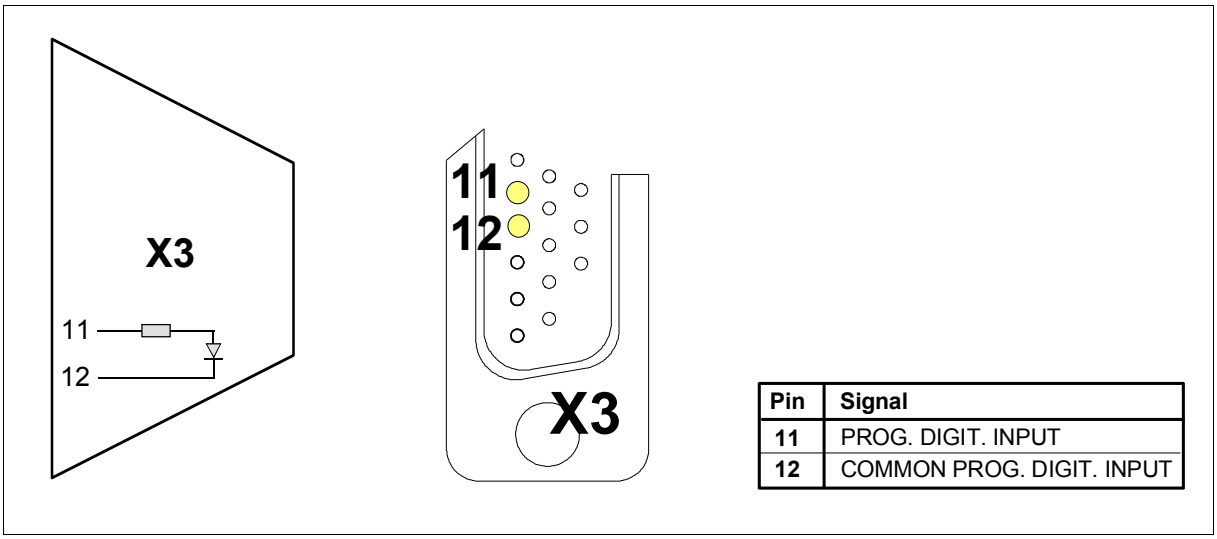
Pin	Signal
27	PROG. DIGIT. OUT (C)
28	PROG. DIGIT. OUT. (E)

Maximum current	100 mA
Maximum voltage	50 V

FIGURE 24.

Programmable digital outputs.

❑ **Programmable digital input**



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

FIGURE 25.

Programmable digital input.

Encoder feedback connection

The signals generated by the encoder are taken to connector (X2) FEEDBACK INPUT of the MCSi-XXL-C0 drive. The encoder must be mounted on to the motor shaft and cannot be installed anywhere else in the transmission chain.

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:

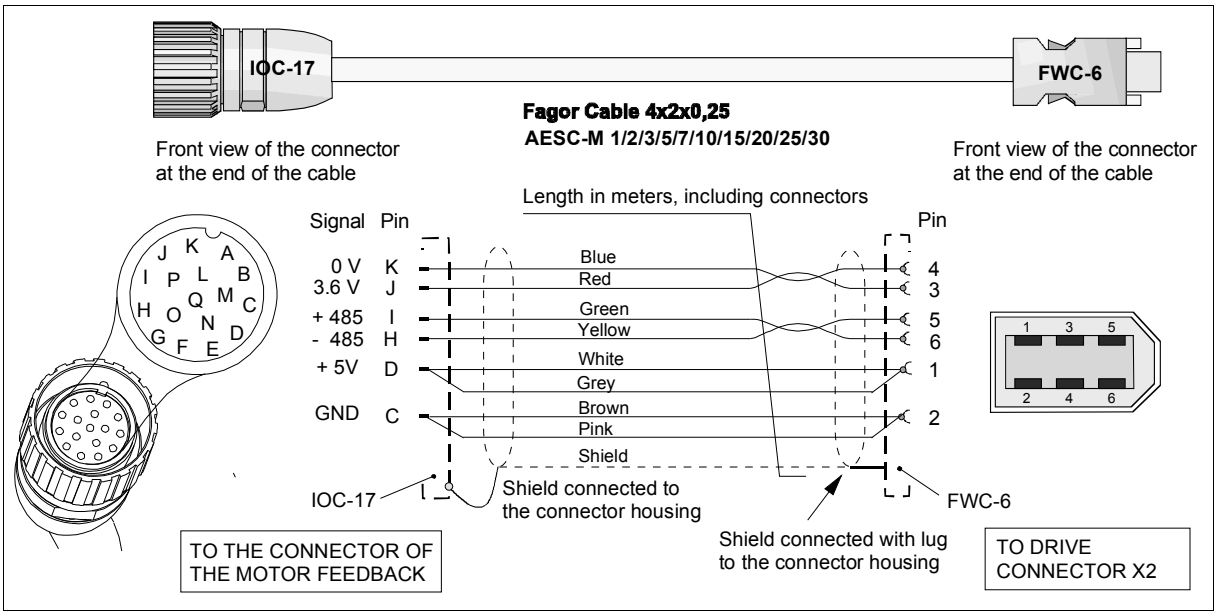


FIGURE 26.

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 model 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-C0 drive via USB (**U**niversal **S**erial **B**us) makes it possible to set and monitor system variables facilitating its adjustment. The motor table and the unit software may be updated through this line. 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.

CAN field bus connection

CANopen® is a network communication protocol based on the BusCAN system and provides a fast and safe communication standard that lets a master device (CNC) control digitally one or more slave devices (MCSi-XXL-C0 drives).

The digital control of the drives permits:

- ❑ Send the velocity command (CNC ➔ drive) and send the position feedback (drive ➔ CNC) in digital format increasing both accuracy and immunity against external disturbances.
- ❑ Communicate the errors and manage the basic control signals of the drive (enables).
- ❑ Make it easier to set, monitor and diagnose 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.

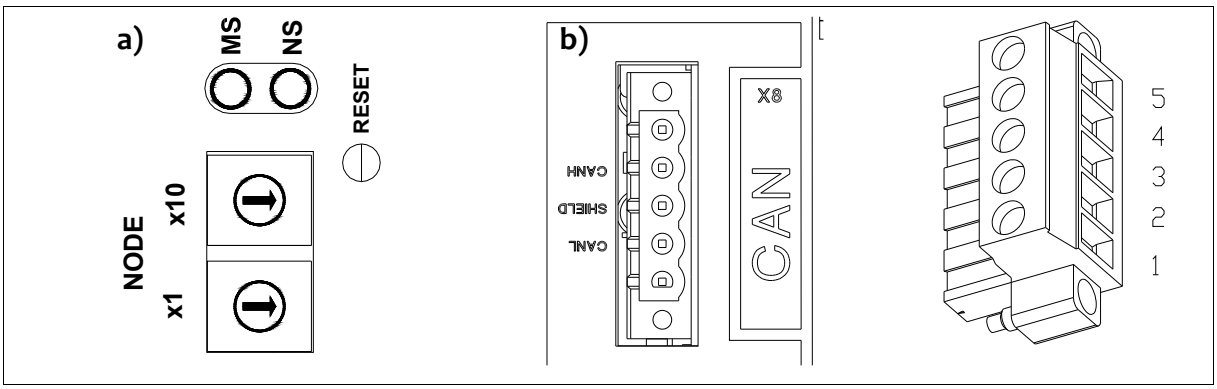


FIGURE 27.

a. LED's and rotary switches, **b.** CAN connector.

IDENTIFICATION

Each MCSi-XXL-C0 has a NODE SELECT; in other words, their front panel has two 10-position (0-9) rotary switches (x1 and x10) for assigning a node number to each drive, an address that identifies and differentiates it within the CAN bus from the rest of the drives connected to it. This way, it is possible to assign values from 1 through 98 (both included) as identifiers (node number).

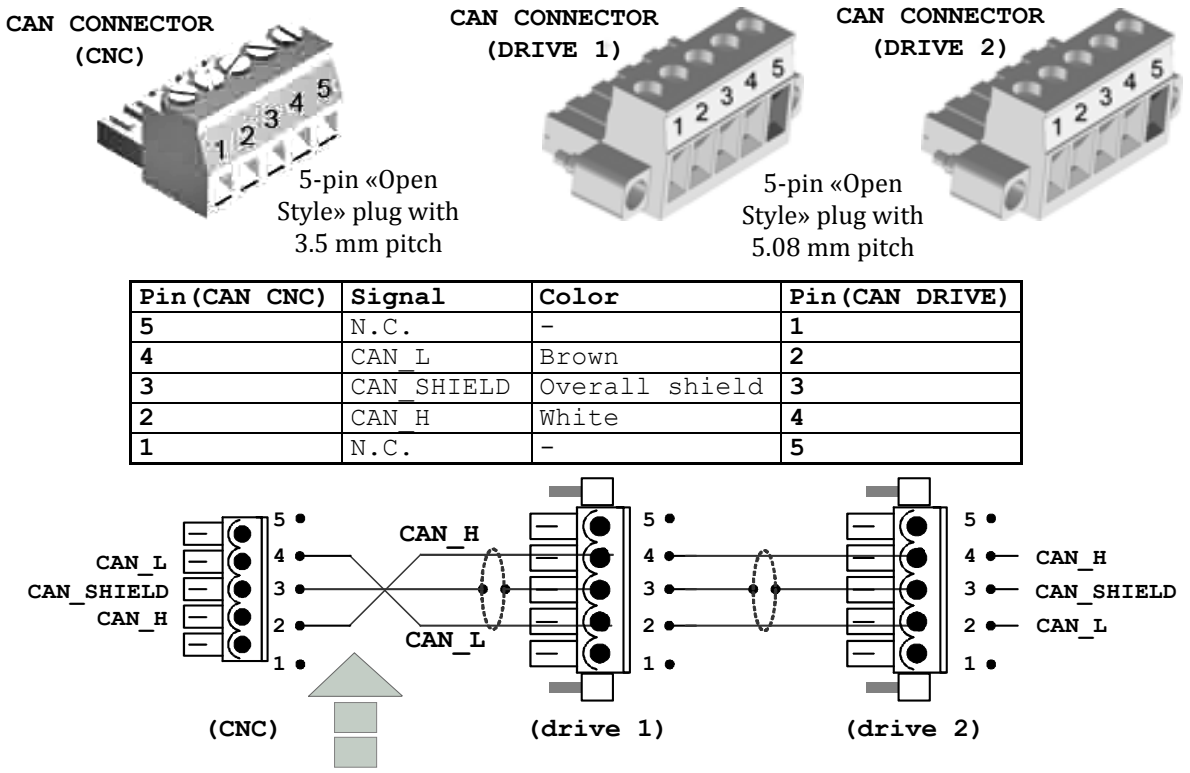
Assigning the value of 99 (NODE SELECT=99) lets accessing the specific transmission speed selecting and checking mode.

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.

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

INTERCONNECTION

The CNC and the various MCSi-XXL-C0 drive modules are inter-connected through the CAN (X8) connector that incorporates each of these modules (see the top of the module) using a specific CAN cable supplied by FAGOR (twisted pair with a section of 0.25 mm², overall shield and an impedance of 120 Ohms). The connection is carried out in parallel connecting all the lines CAN_H, CAN_L and CAN_SHLD between the drives and with the CNC.



Pin(CAN CNC)	Signal	Color	Pin(CAN DRIVE)
5	N.C.	-	1
4	CAN_L	Brown	2
3	CAN_SHIELD	Overall shield	3
2	CAN_H	White	4
1	N.C.	-	5

Caution. Note that the positions of pins CAN_H and CAN_L are different at the CAN connector of the CNC and at the CAN connector of the MCSi-XXL-C0 drive. When installing the cable between these two elements, make sure that these wires are criss-crossed.

FIGURE 28.

CAN bus connection.

INFORMATION. Be especially careful when connecting the CAN cable. Observe that the CAN_H and CAN_L wires are connected to a different pin number depending on whether it is the CAN connector of the CNC or that of the drive.

The far end modules connected to the CAN bus (and only these) must have a terminating resistor of 120 Ω between CAN_H and CAN_L in order to prevent signal bouncing (communication problems). In the case of the CNC, the terminating resistor is factory installed, assuming that the CNC is always at one of the ends of the bus.

The drive must be installed at the other end of the bus. If it is an MCSi-XXL-C0 drive, the user must install the Ω terminating resistor externally between pins 2 and 4 of connector X8.

CAN CABLE LENGTH

The following table shows the maximum length **of the network** depending on the possible transmission speeds.

TABLE 12. Max. length of a CAN network depending on the transmission speed.

Transmission speed (rate)	Length of the CAN network
1000 kbit/s	30 meters
800 kbit/s	50 meters
500 kbit/s	100 meters
250 kbit/s	250 meters
125 kbit/s	500 meters
50 kbit/s	1000 meters

CAN CABLE DIAGRAM

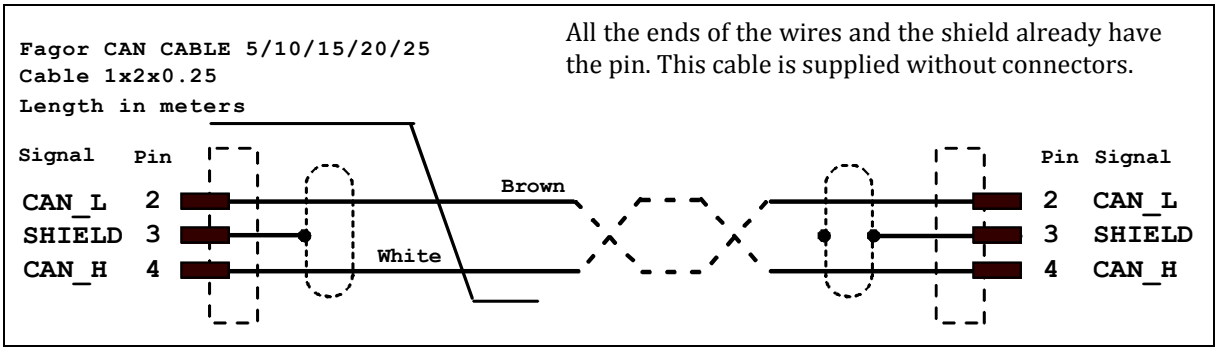


FIGURE 29.

CAN cable diagram.

MECHANICAL CHARACTERISTICS OF THE CAN CABLE

TABLE 13. Mechanical characteristics of the CAN cable.

Type	Shield. It ensures EMC compatibility.
Outside diameter	∅ext = 6.3 mm
Flexibility	High. Special to be used in cable carrying chains with a bending radius of 15∅ext under dynamic conditions and 8∅ext under static conditions.
Covering	PUR. Polyurethane resistant to chemical agents used in machine-tools.
Temperature	Work: - 30 °C to + 70 °C (- 22 °F to 158 °F) Storage: - 5 °C to + 70 °C (33 °F to 158 °F)
Rated voltages	Uo / U: 250/1000 V

SALES MODEL OF THE CAN CABLE

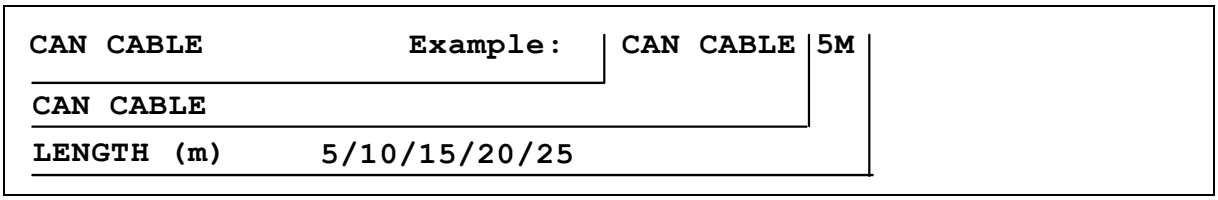


FIGURE 30.

CAN cable sales model.

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 ELECTRICAL 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).

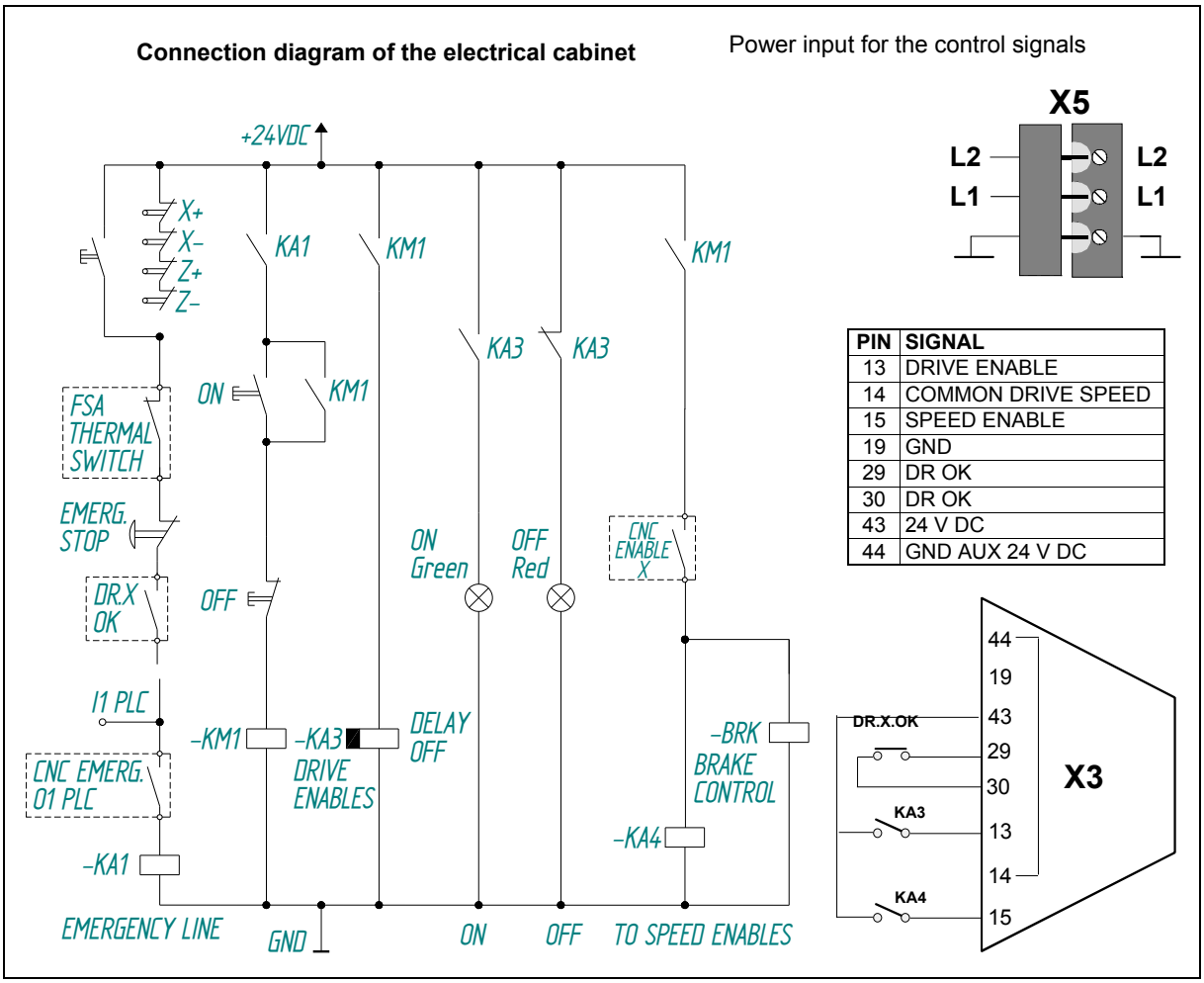


FIGURE 31.

Diagram of the maneuver.

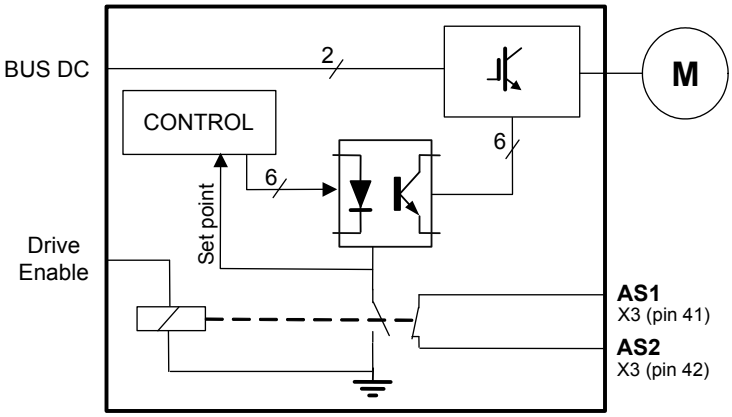
Also see FIGURE 13. and FIGURE 14.

Safety Disable

The **S**afe **D**isable function (SD) offered by FAGOR MCSi-XXL-C0 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-C0 drives) guarantees the same or greater safety without having to use external contactors, thus saving material and room in the electrical cabinet.



The «Drive Enable» pin already available on conventional FAGOR drives works the same way on drives with **S**afe **D**isable although it has been implemented keeping the safety principles and protocols in mind.

FIGURE 32.

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 **S**afe **D**isable (SD) of an MCSi-XXL-C0 and as an example of application, a diagram to control the access to areas with moving elements.

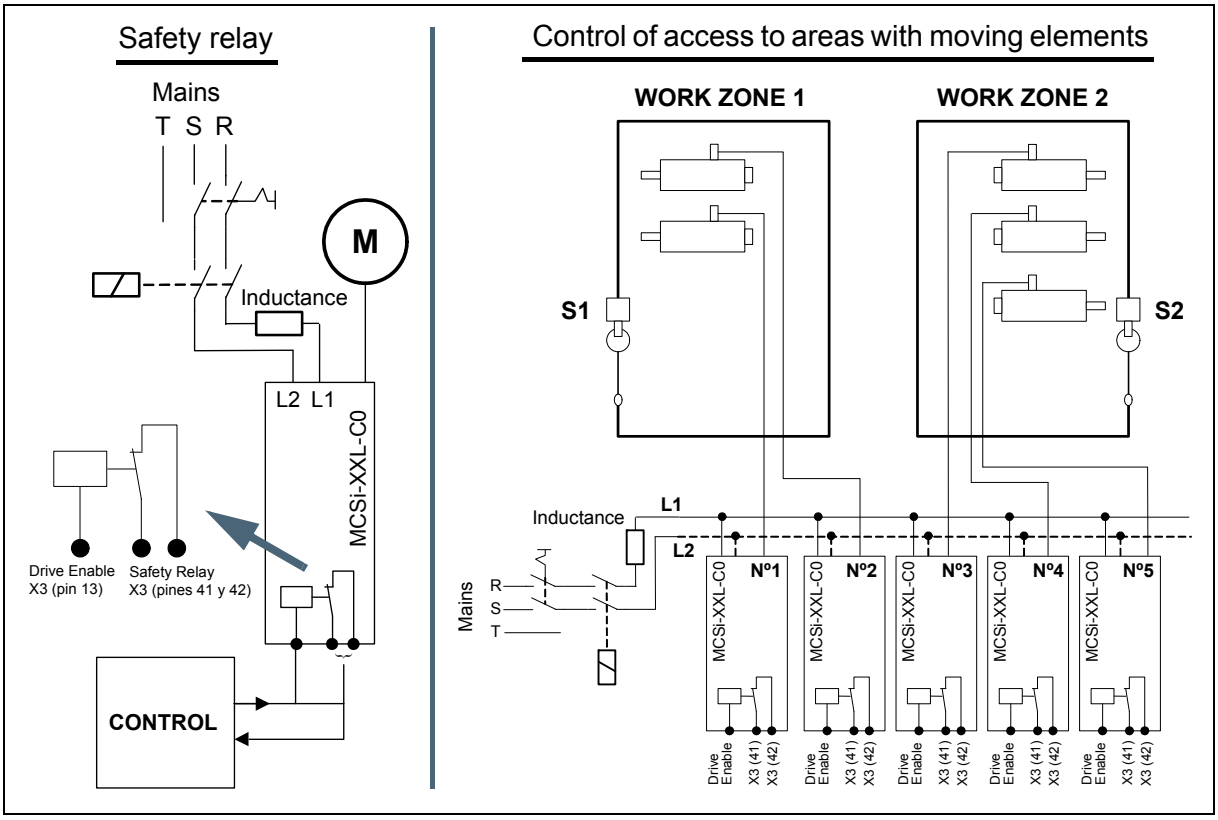


FIGURE 33.

Safety relay and access control diagram with moving elements.

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

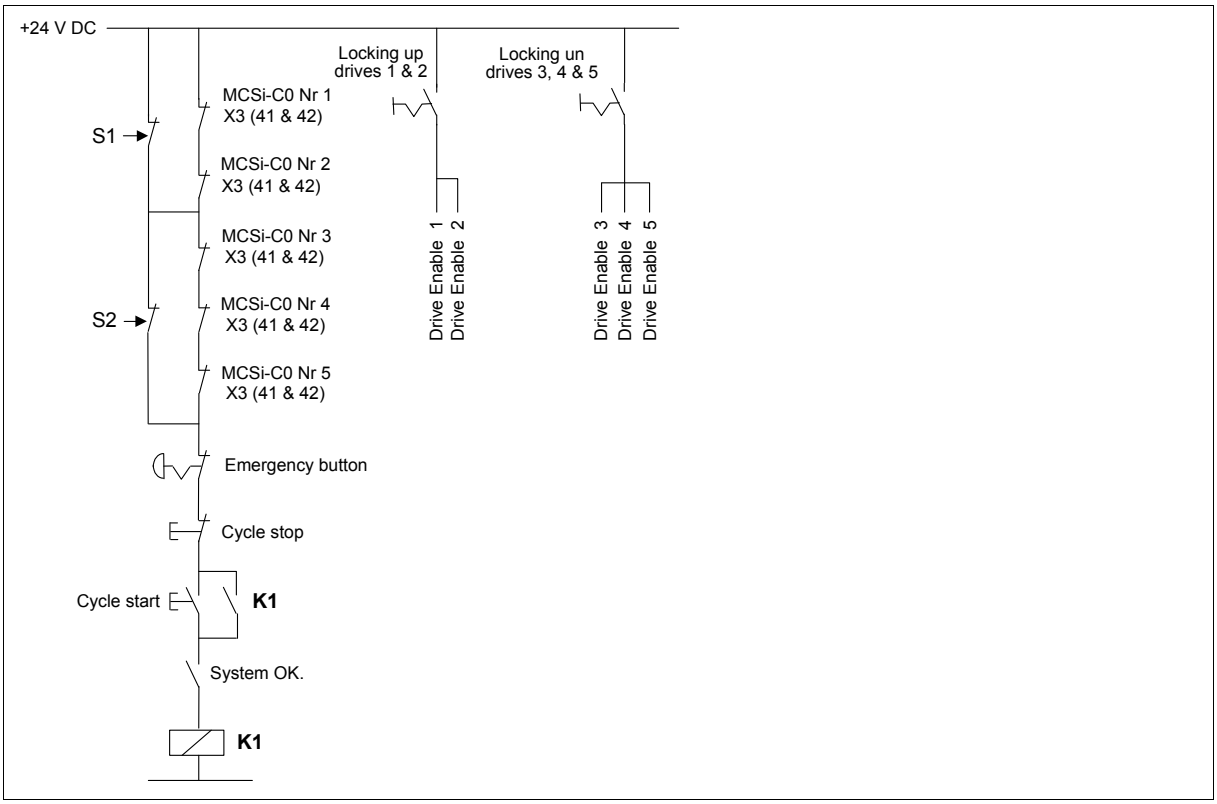


FIGURE 34.

Diagram to control the access with moving elements.

Initialization and adjustment

The initialization and setup process on MCSi-XXL-C0 units may be done through the interface provided by the CNC or also through the FAGOR's PC software (WinDDS-Setup).

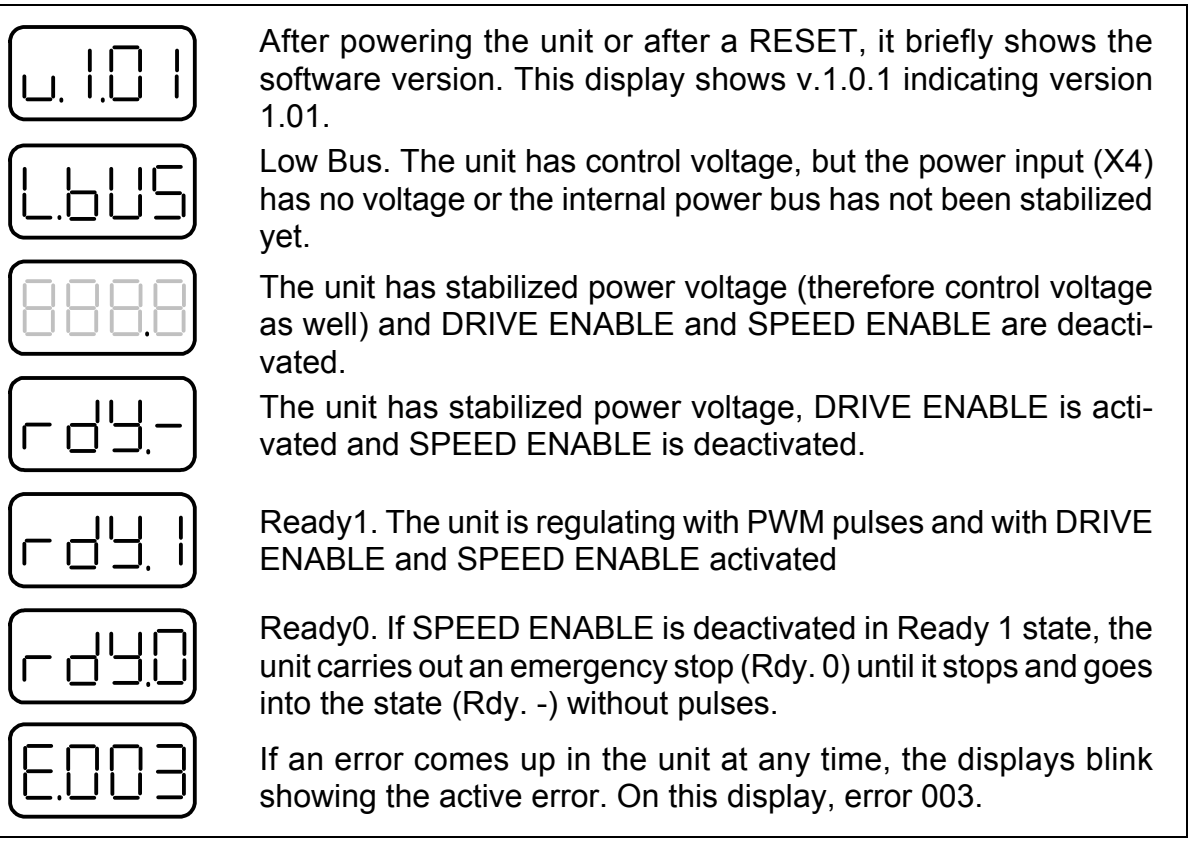
On startup, the drive will look, in the memory of the digital feedback device integrated into the motor, for the information on the type of motor connected. If the motor recognized by the drive is different from the one it was governing up to that moment, it will automatically adjust the critical parameters related to the motor type.

However, it is recommended to initialize it using the GC10 command the first time a unit is started up or every time a motor is changed in order to set the initial values (by default) of all the parameters of the drive verifying them with the selected motor.

The GC1 command must be executed in order for these default values to stay saved in the static memory of the unit (flash, E²PROM, etc.).

Likewise, the GC1 command must also be executed to change a particular parameter after loading the default parameters, and have the new value saved permanently

MCSi-XXL-C0 units have four 7-segment displays on its face plate for showing the different states of the drive and, in case of error, the error code active at the module To interpret the error code, refer to the section - *ERROR CODES* -.



After powering the unit or after a RESET, it briefly shows the software version. This display shows v.1.0.1 indicating version 1.01.

Low Bus. The unit has control voltage, but the power input (X4) has no voltage or the internal power bus has not been stabilized yet.

The unit has stabilized power voltage (therefore control voltage as well) and DRIVE ENABLE and SPEED ENABLE are deactivated.

The unit has stabilized power voltage, DRIVE ENABLE is activated and SPEED ENABLE is deactivated.

Ready1. The unit is regulating with PWM pulses and with DRIVE ENABLE and SPEED ENABLE activated

Ready0. If SPEED ENABLE is deactivated in Ready 1 state, the unit carries out an emergency stop (Rdy. 0) until it stops and goes into the state (Rdy. -) without pulses.

If an error comes up in the unit at any time, the displays blink showing the active error. On this display, error 003.

FIGURE 35.

Codes that may be shown at the displays of the module.

Standard CAN parameter setting

MCSi-XXL-C0 have three transmission PDO channels and three reception channels for transferring certain predetermined variables at high speed. These are called fast channels and make it possible to control modules in real time.

The messages transmitted through these channels carry words for status, control, velocity command and feedback.

INFORMATION. We recommend to set QP17=32 when the master device is not a FAGOR CNC. See QP17 in section - *PARAMETERS, VARIABLES & COMMANDS* - of this manual.

Observe that on drives to be governed by a master device other than a FAGOR CNC, these PDO messages (messages used by CAN through the fast channel) may have to be modified in order to adapt them to the master device.

The actions to «save» and «load» parameters by the drive are handled through the standard objects 1010h (save parameters) and 1011h (restore default parameters). In order for the action to have an effect, the «save» and «load» values must be written respectively in those parameters. For the object 1011h, the default parameters will be restored after the next RESET of the unit.

Both actions may be carried out by groups of parameters depending on the subindex being accessed. See the following tables.

TABLE 14. Indexes.

Index	Description	Hex. value	ASCII
1010	Save parameters into FLASH	65766173h	"save"
1011	Restore default (factory set)	64616f6Ch	"load"

TABLE 15. Sub-indexes.

Sub-index	Description
1	All parameters
2	Communication parameters (indexes 1000h through 1FFFh)
3	Not supported. Application parameters (6000h through 9FFFh)
4	OEM parameters (2000h through 5FFFh)

This way, when writing the hexadecimal value 64616f6Ch in object 1011.4, it loads the default OEM parameters, i.e. all the ones appearing in section - *PARAMETERS, VARIABLES & COMMANDS* - of this manual.

INFORMATION. Observe that commands GC1 and GC10 carry out the actions to «save» and «load» all parameters of the drive and are the same as executing the subindex 1 of objects 1010h and 1011h, with the only difference that the actions of these commands are immediate (they do not need a RESET like the object 1011h).

Default PDO mapping

The following table shows the mapping of sending and receiving PDO 1 that are loaded by default (object 1011.2h, load communication parameters) for node 1. PDO 2 and PDO 3 have a null mapping.

TABLE 16. Mapping of sending and receiving PDO 1.

Object 1A00h - sending PDO 1 mapping		
Sub-index	**Value**	**Meaning**
0	2	Two objects are mapped in this PDO
1	50870010h	Index: 5087h Subindex: 00h Data: 16 bits (DriverStatusWord)
2	50330020h	Index: 5033h Subindex: 00h Data: 32 bits (PositionFeedback)
Object 1600h - receiving PDO 1 mapping		
Sub-index	**Value**	**Meaning**
0	2	Two objects are mapped in this PDO
1	50860010h	Index: 5086h Subindex: 00h Data: 16 bits (MasterControlWord)
2	50240020h	Index: 5024h Subindex: 00h Data: 32 bits (VelocityCommand)

Default PDO communication

The following table shows the default communication parameters of sending and receving PDO 1.

TABLE 17. PDO 1 communication types, send and receive.

Object 1800h - Type of sending PDO 1 communication			
Subindex	**Value**	**Meaning**	
0	5	Five objects are mapped in this PDO	
1	00000181h	Bit 31	0 - PDO enabled
			1 - PDO disabled
		Bits 10-0	Message ID
2	1	Type of transmission (read the describing section)	
3	0	Inhibit time (*100 µs) - see example 1 -	
4	-	Reserved	
5	0	Event timer (*1ms) - see example 1 -	
Object 1400h - Type of receiving PDO 1 communication			
Subindex	**Value**	**Meaning**	
0	2	Two objects are mapped in this PDO	
1	00000201h	Bit 31	0 - PDO enabled 1 - PDO disabled
		Bits 10-0	Message ID
2	1	Type of transmission (read the describing section)	

Type of transmission (value of sub-index 2)

TABLE 18. Type of transmission (value of sub-index 2).

Type of transmission	PDO trigger condition (B = both required; O = one or both required)			PDO transmission
	SYNC SYNC object received	RTR Received request for remote transmission	Event Value change of the interruption of the timer	
0	B		B	Synchronous (SYNC), non-cyclic
1-240	O			Synchronous (SYNC), cyclic
241-251				Reserved
252	B	B		Synchronous (SYNC), after RTR
253		O		Asynchronous (ASYNC), after RTR
254(*)		O	O	Asynchronous (ASYNC), OEM-specific event
255(*)		O	O	Asynchronous (ASYNC),device-profile-specific event

(*) in either case, a message will be sent when the value of any variable to be sent changes or when an event of the timer takes place (object 1800.5h).

<SYNC> means that the transmission of the PDO has to do with the reception of the synchronism message.

<ASYNC> means that the transmission of the PDO has nothing to do with the reception of the synchronism message.

Type of transmission = 0. Synchronous and non-cyclic. The messages are only sent when an event takes place and, in that case, the message is sent in synchronism with the next synchronism message.

An event is a change of value of the variable or (if it is supported by the equipment, communication objects with subindex 5) to a particular amount of time elapsed.

Type of transmission = 1 to 240. The PDO is transmitted after receiving the number of synchronism messages specified in the type of transmission.

Type of transmission = 252 to 253. Values only possible in transmission PDO's. In either case, the PDO is sent as response to an RTR frame of the master device. The difference is that in the type of transmission equal to 252 it updates the variables when receiving the synchronism and the transmission equal to 253 updates the variables and sends them when receiving the RTR frame.

Type of transmission = 254. The PDO is transmitted when some OEM-specific event occurs.

Type of transmission = 255. The PDO is transmitted when some device-profile-specific event occurs.

Example 1. Explanation for the inhibit time and the event timer.

When programming a type-254 transmission PDO that includes a position variable, two different scenarios occur. As long as the device sending the PDO is stopped (its position has not changed), it will not be necessary to send anything. However, when programming an event timer with a value of 10 (10 x 1 ms), even if the element does not move (it does not change its position variable), it will send PDO's every 10 ms indicating its position. Then, when starting to move, it will try sending PDO's constantly, thus taking up the whole bus with this information. In order to prevent this situation, an inhibit time of 20 (20 x 100 µs = 20 ms) may be programmed so it only sends PDO's every 2 ms while it is moving.

Speed selection and node number

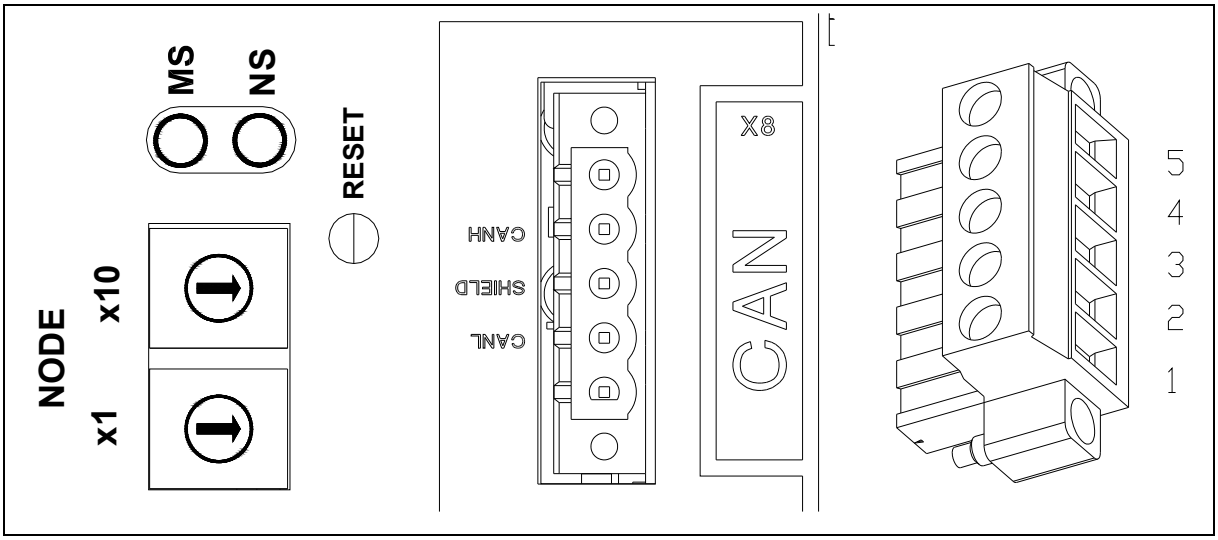


FIGURE 36.

Drive elements involved in CAN communication.

- **MS Led ➔ M**odule **S**tatus **Led**. Two-color light emitting diode (red and green) to indicate the status of the drive.
- **NS Led ➔ N**etwork **S**tatus **Led**. Two-color light emitting diode (red and green) to indicate the status of the unit within the communications CAN bus.
- **"x1" and "x10" switches ➔** Rotary switches for selecting a digit between 0 and 9 on each one and whose combination gives a number between 0 (when both are set to 0) and 99 (when both are set to 9). Each node of the bus differs from the rest in the node number assigned to it using these rotary switches. **A unit may assume any node number between 01 and 98.**

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.

Note. 0 and 99 can only be used in special cases that are described later on.

Communication speed selection

When incorporating a new unit in a CANopen network, the first thing to do is to adapt the communication speed to the speed of the network. There are two rotary selector switches (x10, x1) and two indicators MS (**M**odule **S**tatus) and NS (**N**etwork **S**tatus) to make the selection.

The transmission speeds (baudrate) that may be selected in CANopen are 10, 20, 50, 100, 125, 250, 500, 800 and 1000 (in kbits/s).

Selecting procedure

The transmission speed selection mode is enabled when powering the unit up as long as the rotary selector switches are selecting the number 99 (that is when **both switches are set to 9**). The MS and NS LED's blink a green light at the same time with a period of about 500 ms indicating that the communication baudrate selection mode is enabled. The following operations are possible in this state:

❑ **Verify the selected transmission speed**

To **know** the communication speed on the network at that very instant, turn the rotary selector "x1" to the "0" position. The MS indicator blinks a red light a number of times and it then turns off for about 1 second. After that time, it starts this same sequence again.

The number of red blinks between two intervals where the LED is off indicates the **communication baudrate** (saved in memory) used to connect the unit to the network.

The table shows the relationship between the number of red blinks of the MS LED and the network's baudrate:

TABLE 19. Baudrate verification.

Nr of blinks of the MS LED	Transmission speed (rate)
1	1000 kbit/s
2	800 kbit/s
3	500 kbit/s
4	250 kbit/s
5	125 kbit/s

Nr of blinks of the MS LED	Transmission speed (rate)
6	100 kbit/s
7	50 kbit/s
8	20 kbit/s
9	10 kbit/s

Example

If the red MS LED blinks 3 times (between the periods when it's off), it will indicate, according to this table, that the transmission speed (baudrate) is 500 kbits/s.

❑ Selecting the transmission speed

To **set** the same baudrate at the new unit as that of the communication on the network, turn its rotary selector "x1" to a position between 1 and 9 to select one of the baudrates.

TABLE 20. Baudrate selection.

Position of the rotary switch "x1"	Transmission speed (rate)	Position of the rotary switch "x1"	Transmission speed (rate)
1	1000 kbit/s	6	100 kbit/s
2	800 kbit/s	7	50 kbit/s
3	500 kbit/s	8	20 kbit/s
4	250 kbit/s	9	10 kbit/s
5	125 kbit/s		

Example

If the network communication baudrate is 500 kBd, the unit being connected must also transmit at that speed; i. e. its rotary switch "x1" must be set to position 3.

At the same time and with the same sequences mentioned earlier, the green light of the MS LED will blink identifying the selected baudrate.

Once the position has been selected at the "x1" switch, it is necessary to **confirm the selection**. To do this, rotate the "x10" switch to position 0. The red blinking light of the MS LED will indicate the selected baudrate. After this operation, this baudrate will be saved permanently in the non-volatile memory of the unit. After resetting the unit, it will assume the baudrate saved in memory as the transmission speed.

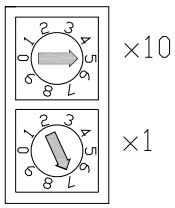
Setting the node number

Once the transmission speed of the unit in the network has been set, it must then be identified within the network. A **unique identifier** must be assigned to the new unit to differentiate it from any other unit of the network, thus avoiding collisions. This identifying number ID will be referred to as **node number** and **must be different for each unit**.

IMPORTANT. It is up to the user to prevent two units from having the same node number.

The unit's node number is set using the two rotary switches x1 and x10.

Example



To assign node number 57 to a unit, turn the rotary switch "x10" to position 5 and rotary switch "x1" to position 7. See attached figure.

Verify that 10 x 5 + 1 x 7 = 57.

After resetting the drive, it will be identified in the network with the node number assigned to it.

The node number selection range on a CANopen network is between 01 and 127. **Remember that** node number 99 is reserved for the baudrate selection process and 00 is treated as 01 since there is no node 00 in CANopen®.

On each start-up, the unit assumes as node number the one assigned at rotary switches "x1" and "x10".

Status indicators

The CAN card of the drive only has two two-color indicator LED's. They are, MS (**M**odule **S**tatus) and NS (**N**etwork **S**tatus). The MS indicator shows the unit status and the NS the status of the unit within the CANopen® network.

In an initial process of the unit, these LED's reach the following states in order to verify the proper state of the drive.

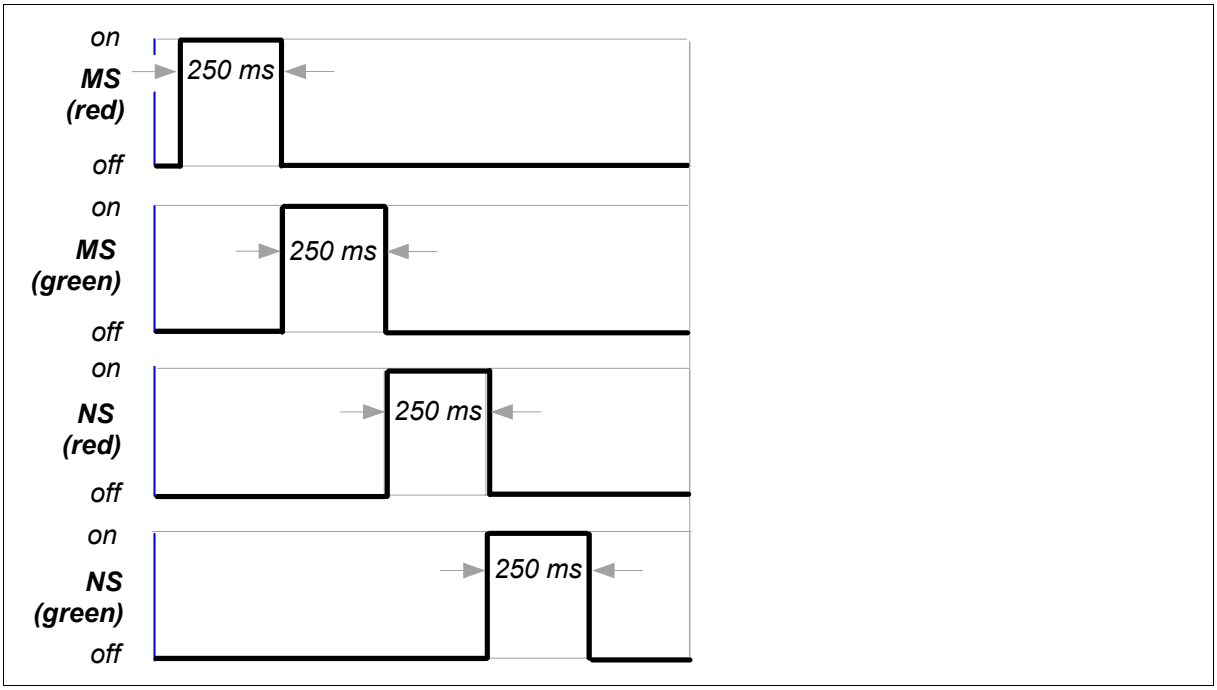


FIGURE 37.

Status indicators.

Note. MS and NS turn on according to the status of the bus and of the unit.

MS (Module Status)

This indicator informs about the unit status as such. The states that may be reached, at this time, are:

Running. The drive is error free. The indicator LED will blink green with a 200 ms on/off period.

In error. The drive is in an error state. The indicator LED will blink red and faster than in the previous state with a 50 ms on/off period.

NS (Network Status)

This indicator informs of the unit status within the CANopen® network; i.e. of the CANopen® Bus status. See the following tables and figures that set the intermittent frequencies of the red and green LED's and their names.

❑ **Red LED. Error indicator LED.**

TABLE 21. Error indicator LED. Red color.

Error LED (red)	Status	Description
OFF	No errors	Unit running properly.
A single blink	Warning limit reached	At least one of the error counters of the CAN driver has reached or exceeded the warning level. Too many error frames.
Double blinking	NMT error control event	Either a «guarding» event (slave NMT or master NMT) or a «heartbeat» event (heartbeat consumer) has occurred.
Triple blinking	Bus off	The CAN control is in "bus off" mode.

See FIGURE 38.

❑ **Green LED. Status indicator LED**

TABLE 22. Status indicator LED. Green color.

Running LED (green)	Status	Description
ON	Operational	The drive is in an operational state.
blinking	Pre-operational	The drive is in a pre-operational state.
A single blink	Stopped	The unit is in a stop state.

See FIGURE 38.

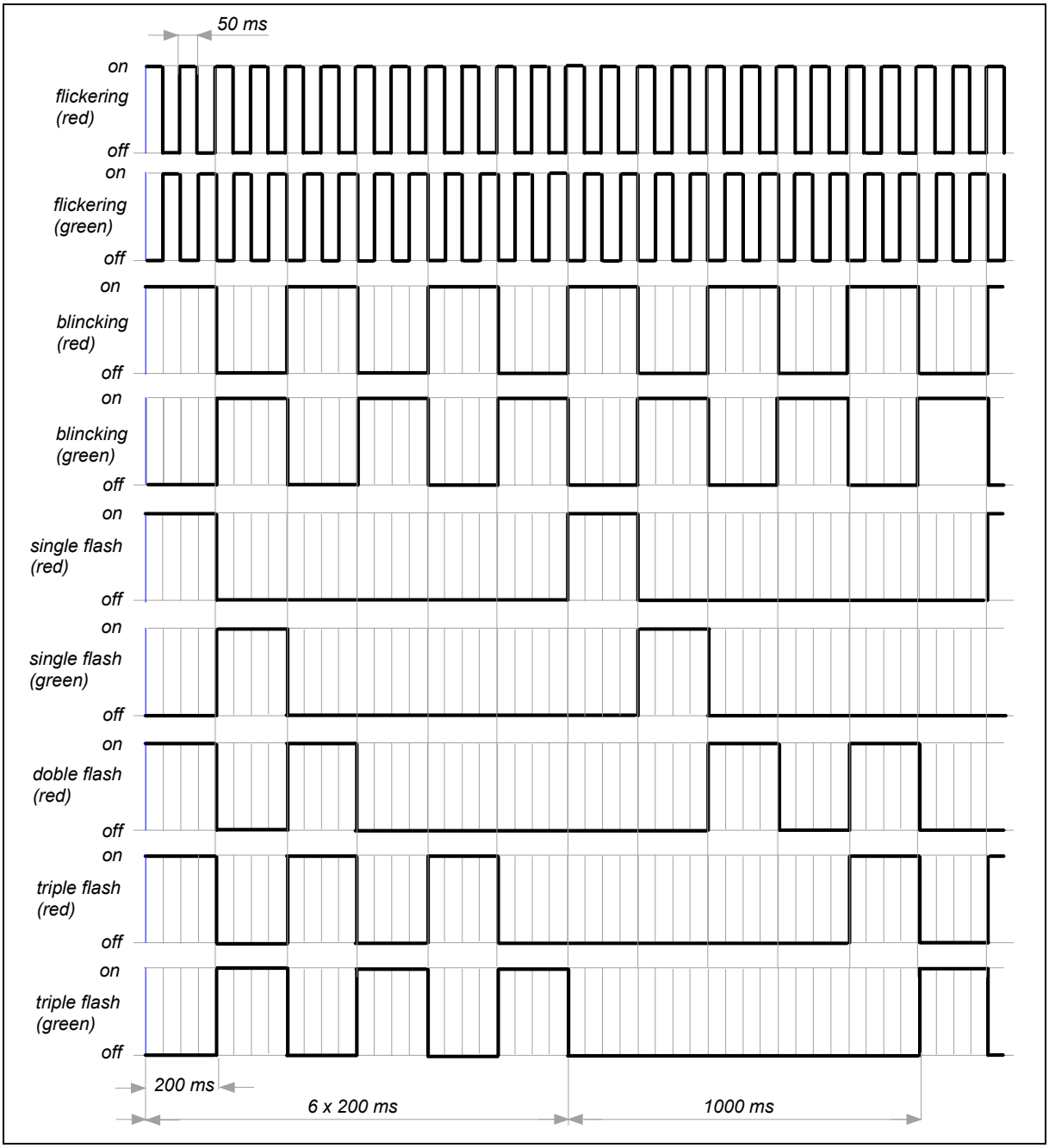


FIGURE 38.

Names and blinking times of the NS (**N**etwork **S**tatus) indicator LED.

WinDDSSetup

It is a FAGOR application for PC. The operator can use the application's interface to read, modify, save to a PC file and download from a PC file all the parameters and variables of the drive and check the status of the motor-drive combination; thus making the final adjustment of the servo drive system easier, faster and more comfortable. This also makes it easier to manufacture many machines that have MCS Innova units.

When installing the WinDDSSetup, the USB drivers are also installed. These drivers generate an additional virtual COM port to those already used by the PC and it will only be present when the unit is connected and is applied control or power voltage.

This is why, the unit should be connected first and then run WinDDSSetup.

The first time the unit is connected to the PC, the operating system will show two messages indicating that «new hardware has been detected».

Do the «default» installation, recommended by the system and ignore the message regarding the incompatibility tests of the software with the operating system Windows® XP that comes up during the installation process. Go on by pressing the «continue» button. This message refers to the drives that have not been certified yet. However, they are fully functional.

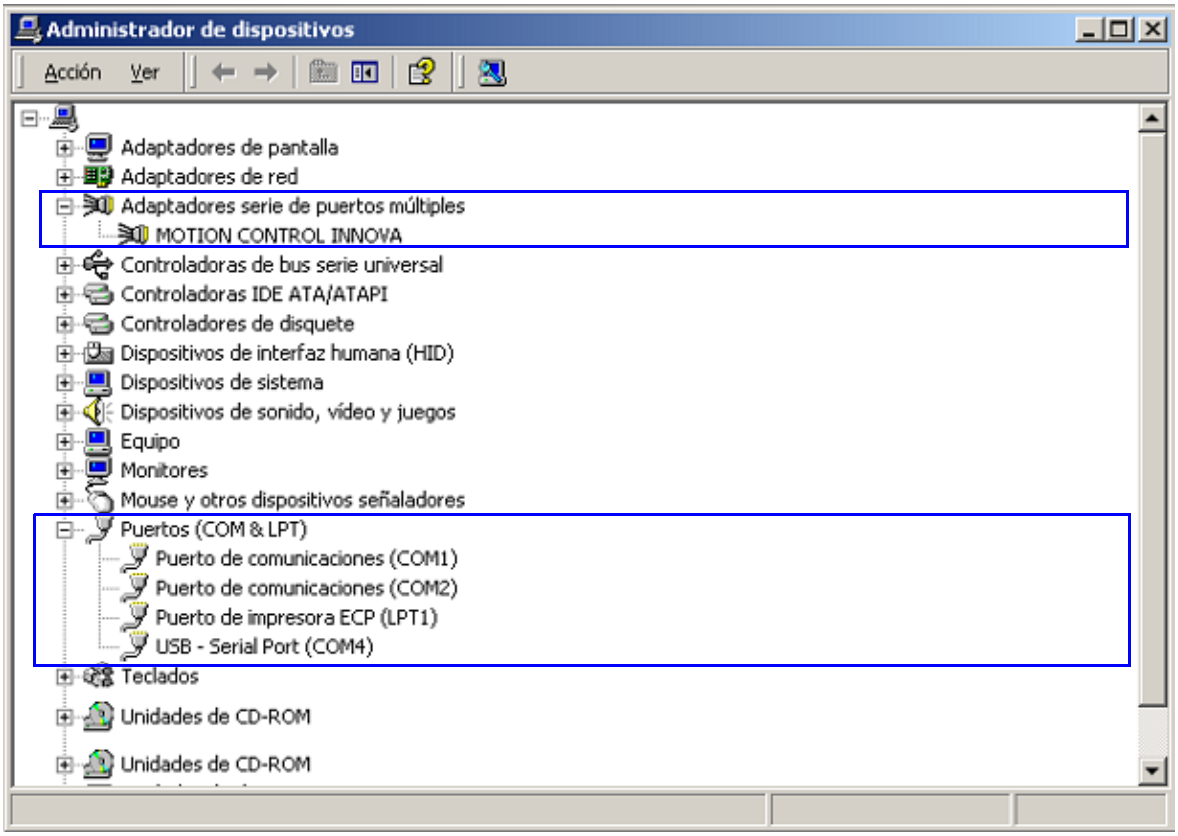
When starting the WinDDSSetup application, you must select the virtual COM port in order establish communication with the unit.

To obtain information on the generated COM port, proceed as follows:

- ❑ Click the right button of the mouse on the icon «My PC».
- ❑ Select the «Properties» option and the «Hardware» label in the next popup window
- ❑ Select «Device administrator»

The window will show them as:

- ❑ **Multiple serial port adapters**, the reference MOTION CONTROL INNOVA.
- ❑ **Ports (COM & LPT)**, reference USB-Serial Port (COMx). The digit appearing in the x position refers to the new virtual COM port for the PC.



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.

Unit interpretation

The number of decimals in the units of all parameters and variables of the drive represented on the CNC screen and on the WinDDSSetup will match strictly the ones described in this manual. However, the same ones requested via CAN or serial line by standard communication programs will be returned with their maximum resolution being up to the user to interpret them correctly.

Example

If the CNC shows the CV3 variable with a value of 1.26 A, this same variable requested via CAN will have a value of 126 and its units will, therefore, be hundredths of an Amp ($x10^{-2}$ A).

Observe that the number of decimals refers to the number of digits after the decimal point (or comma) in the «valid values» field of any parameter, variable or command of the drive documented in this manual.

Notation used and definition of groups

GROUP	TYP	INDEX	NO MOD. EVEN	ACCESS	VAR.MOD	CAN ID	NAME

where:

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

TABLE 23. Groups of parameters, variables and commands.

Nr	Function	Group	Letter
1	Control signals	Terminal box	B
2	Current control loop	Current	C
3	Error diagnosis	Diagnosis	D
4	General of the system	General	G
5	System hardware	Hardware	H
6	Analog and digital inputs	Inputs	I
7	Temperatures and voltages	Monitoring	K
8	Motor properties	Motor	M
9	Mechanical elements	Mechanical	N
10	Analog and digital outputs	Outputs	O
11	Position control loop	Position	P
12	System communication	Communication	Q
13	Rotor sensor properties	Rotor sensor	R
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

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
CP1 *FAGOR, RW	C	(P) Parameter	Nr 1	It cannot be modified with torque	Fagor	Read/ Write

ACCESS LEVEL. The access level is defined after the identifier (*). 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)	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

ID CAN. CAN identifier of the parameter, variable or command.

NAME. Name of the parameters, variable or command.

Handling internal variables

Fast communication channel. The data exchange between the CNC and the drives takes place and is refreshed at every position loop. This data has the commands, the feedback, etc. Each variable written or read at the drive is included in this information package. Every loop time, the CNC transmits to the drive through this channel some fixed variables and others that may be accessed. The variables that may be accessed through the fast channel may be either read (R) or write (W) variables).

INFORMATION. Accessing a drive variable from the CNC set as accessible through the fast channel requires its SERCOS identifier (ID. SERCOS), never the ID CAN even if the communication interface is CAN.

All the drive variables set as accessible from the CNC are:

Variable	Name	R/W	ID SERCOS
BV14	NotProgrammableIOs	R	32972
CV1	Current1Feedback	R	33077
CV2	Current2Feedback	R	33078
CV3	CurrentFeedback	R	33079
DV31	DriverStatusWord	R	00135
DV32	MasterControlWord	W	00134
IV10	DigitalInputs	R	33675
KV10	CoolingTemperature	R	33870
KV32	I2tDrive	R	33877
KV36	I2tMotor	R	33879
KV40	I2tCrowbar	R	33883
OV10	DigitalOutputs	W	34178
PV51	PositionFeedback1	R	00051
QV30	FiberDistErrCounter	R	33495
QV190	CanBusSyncJitter	R	34779
SV1	VelocityCommand	W	00036
SV2	VelocityFeedback	R	00040
SV6	VelocityCommandAfterFilters	R	34390
SV7	VelocityCommandFinal	R	34380
TV2	TorqueFeedback	R	00084

B group. Non-programmable inputs-outputs

BV14	FAGOR, RO	0x40CC	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 Pins 11 and 12 of terminal strip X3
2	"Drive OK" output Pins 29 and 30 of terminal strip X3
1	Speed Enable input Pin 15 of terminal strip X3
0	Drive Enable input Pin 13 of terminal strip X3

Read variable from the CNC through the fast channel. ID.SERCOS: 32972

C group. Current

CP1	*FAGOR, RW	0x506A	CurrentProportionalGain

Function. Value of the proportional action of the current PI

Valid values. 0,..., 999.

Default value. Depends on the motor-drive combination.

CP2	*FAGOR, RW	0x506B	CurrentIntegralTime

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

Valid values. 0,..., 999.

Default value. Depends on the motor-drive combination.

CP20	USER, RW	0x4133	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	0x4134	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	0x4138	CurrentCommandFilter1Frequency

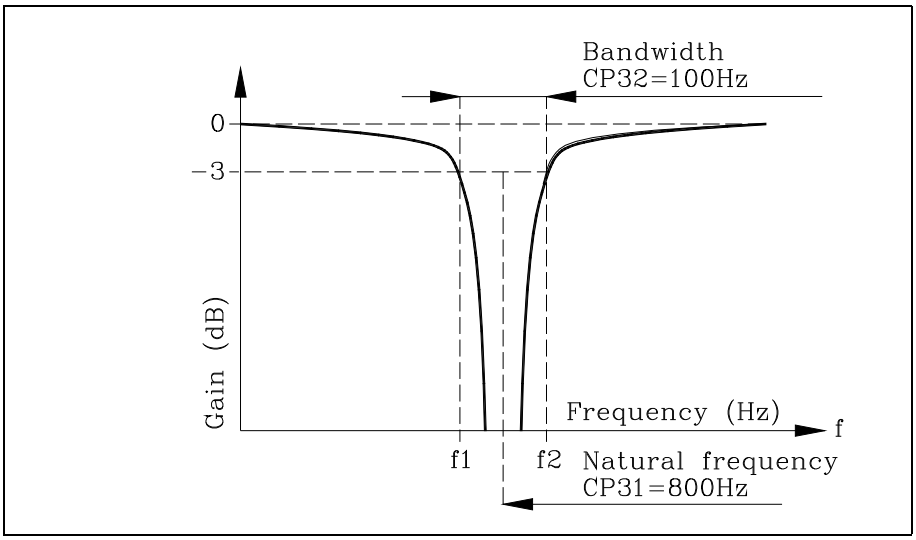
Function. Sets the natural frequency in Hz of a notch filter that acts upon the current command.

Valid values. 0, ..., 4000 Hz.

Default value. 0.

CP32	FAGOR, RW	0x4139	CurrentCommandFilter1Damping

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



Valid values: 0, ..., 1000 Hz.

Default value: 0.

CV1	BASIC, RO	0x4135	Current1Feedback

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

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

Read variable from the CNC through the fast channel. ID.SERCOS: 33077

CV2	BASIC, RO	0x4136	Current2Feedback

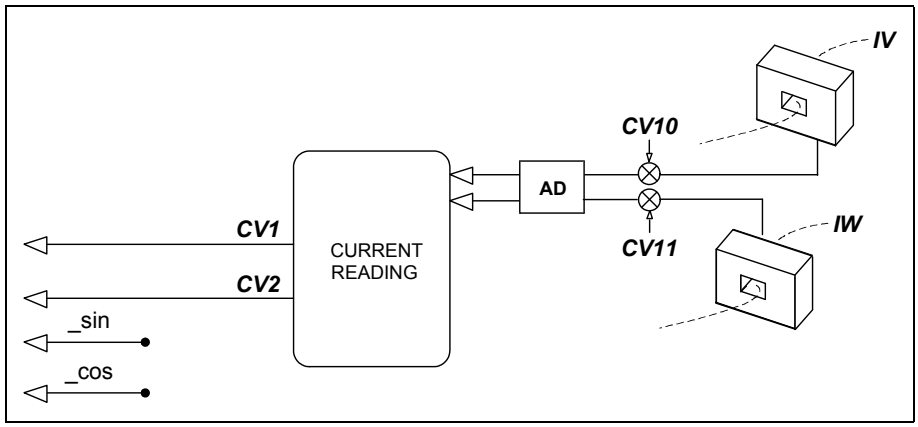
Function. Display the value of the feedback of the current going through phase W.

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

Read variable from the CNC through the fast channel. ID.SERCOS: 33078

CV3	BASIC, RO	0x4137	CurrentFeedback

Function. Display the rms current circulating through the motor.



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

Read variable from the CNC through the fast channel. ID.SERCOS: 33079

CV10	FAGOR, RO	0x4131	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	0x4132	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

DV17	BASIC, RO	0x419A	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.

DV31	FAGOR, RO	0x5087	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 CAN interface.

Bits	Meaning
15, 14	Power & Torque Status (0,0) DoingInternalTest [DRVSTS_INITIALIZATING] (0,1) ReadyForPower [DRVSTS_LBUS] (1,0) PowerOn [DRSTS_POWER_ON] (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

Read variable from the CNC through the fast channel. ID.SERCOS: 00135

DV32	FAGOR, RW	0x5086	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 CAN interface. See attached table. This variable communicates with the CNC through the CAN 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

Write variable from the CNC through the fast channel. ID.SERCOS: 00134

DC1	BASIC, RW	0x5063	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	BASIC, RW	0x4192	ClearHistoricOfErrorsCommand

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

GP3	USER, RW	0x42BE	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 ... 9999 ms, 0 (infinite).

Default value: 500 ms.

GP5	USER, RO	0x42C0	ParameterVersion

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

GP9	USER, RW	0x50CF	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 ... 9999 ms, 0 (infinite).

Default value. 50 ms.

GV2	USER, RO	0x501E	ManufacturerVersion

Function. Displays the software version in use.

GV5	USER, RO	0x42C2	CodeChecksum

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

GV7	USER, RW	0x510B	Password

Function. Variable where the password is entered to change the access level. The system will change the access level corresponding to the password entered.

Valid values. 0,..., 9999.

Default value. 0.

GV9	USER, RO	0x508C	DriveType

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

GV11	USER, RW	0x42C4	SoftReset

Function. Variable that resets the unit by software.

Valid values. 0,..., 16.

Default value. 0.

GV16	USER, RO	0x42CC	MotorTableVersion

Function. Version of the motor table.

GV75	FAGOR, RO	0x5177	ErrorList

Function. List of the error numbers active in the unit.

GC1	USER, RW	0x5108	BackupWorkingMemoryCommand

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

Valid values. 0,..., 15.

Default value. 0.

GC10	*USER, RW	0x5106	LoadDefaultsCommand

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

Valid values. 0,..., 15.

Default value. 0.

H group. Hardware

HV5	USER, RO	0x4127	PLDVersion

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

I group. Inputs

IP6	BASIC, RW	0x438E	DigitalInputPolarity

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

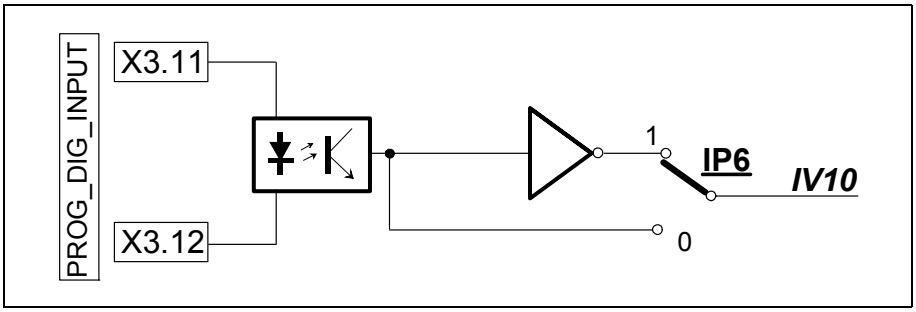
Valid values. 0/1 Not inverted/inverted.

Default value. 0 Not inverted.

IV10	BASIC, RO	0x438B	DigitalInputs

Function. This variable reflects the status of the programmable digital input at pins 11 and 12 of connector X3. Its state is affected by IP6.

Valid values: 0 and 1.



Read variable from the CNC through the fast channel. ID.SERCOS: 33675

KP3	BASIC, RW	0x445A	ExtBallastPower

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

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

Default value: 200 W.

KP4	BASIC, RW	0x445C	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	BASIC, RO	0x444E	CoolingTemperature

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

Valid values. 0, ..., 200 °C.

Read variable from the CNC through the fast channel. ID.SERCOS: 33870

KV32	BASIC, RO	0x4455	I2tDrive

Function. Variable internally useful to the system. It measures the internal load level of the calculation of the i^2t at the drive in percentage used over the maximum.

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

Read variable from the CNC through the fast channel. ID.SERCOS: 33877

KV36	BASIC, RO	0x4457	I2tMotor

Function. Variable internally useful to the system. It measures the internal load level of the calculation of the i^2t at the motor in percentage used over the maximum.

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

Read variable from the CNC through the fast channel. ID.SERCOS: 33879

KV40	BASIC, RO	0x445B	I2tCrowbar

Function. Shows the load percentage on the ballast resistor in a drive. Useful for the i^2t protection of the resistor. A value greater than 100% in this variable causes error E314.

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

Read variable from the CNC through the fast channel. ID.SERCOS: 33883

KV41	BASIC, RW	0x445D	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	USER, RO	0x508D	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 GC10.

MP2	FAGOR, RO	0x44B0	MotorTorqueConstant

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

Valid values. 0.00, ..., 10.00 Nm/Arms.

MP3	FAGOR, RO	0x506F	MotorContinuousStallCurrent

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

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

MP4	FAGOR, RO	0x506D	MotorPeakCurrent

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

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

Default value. It depends on the motor connected.

N group. Mechanical

NP116	FAGOR, RO	0x5074	ResolutionOfFeedback1

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

Valid values. 0, ..., 65535 pulses.

NP121	FAGOR, RW	0x5079	InputRevolutions

NP122	FAGOR, RW	0x507A	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	FAGOR, RW	0x507B	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^{31}-1.

O group. Analog and digital outputs

OP6	BASIC, RW	0x4588	DigitalOutputPolarity

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

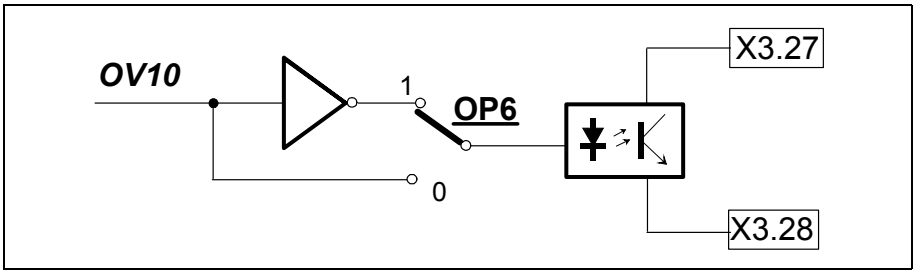
Valid values. 0/1 Not inverted (by default) / inverted.

Default value. 0 Not inverted.

OV10	BASIC, RW	0x4582	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 0) via CAN (see pins 27-28 of X3).

Valid values. 0/1 activate/deactivate a programmable digital output.



Write variable from the CNC through the fast channel. ID.SERCOS: 34178

P group. Position loop

PV51	FAGOR, RO	0x5033	PositionFeedback1

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

Valid values. $-2^{31}-1$, ..., $2^{31}-1$ pulses.

Read variable from the CNC through the fast channel. ID.SERCOS: 00051

PV173	FAGOR, RO	0x50AD	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. $-2^{31}-1$, ..., $2^{31}-1$ pulses.

PC146	FAGOR, RW	0x5092	NCControlledHoming

Function. Homing function controlled by CNC.

Valid values. 0,..., 15.

Default value. 0.

QP1	FAGOR, RW	0x5001	ControlUnitCycleTime

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

Valid values. 0,..., 10000.

Default value. 4000.

QP17	BASIC, RW	0x47E4	CanOpenBorder

Function. Parameter that contains a numerical data in 16-bit binary code that may be used to activate or deactivate, bit by bit, the different specific controls implemented by the unit to work with the FAGOR CNC.

Bits	Meaning
15,..., 7	Reserved.
6	Position latch, cyclic, thorough and anticipated to the SYNC message.
5	The drive can only be enabled if it is in running (operative) state.
4	Internal interpolation between velocity commands.
3	Special behavior in case of errors.
2	Thorough control of the jitter of the SYNC message.
1	Thorough control of the arrival of SYNC messages.
0	Control of the "toggle" bit of the control word DV32.

If the master device is a FAGOR CNC, all the bits must be activated (default value). In other cases, we recommend to set it with the hexadecimal value 0x20, i. e. all bits to zero except bit 5=1.

QV22	FAGOR, RO	0x5016	IDNListOfInvalidOperation DataForCP3

Function. Variable containing the parameters that are readjusted by the drive when it issues the error E.502 (incompatible parameters). The parameters are listed by their bus identifier (the WinDDS-Setup shows the parameter names directly).

QV30	FAGOR, RO	0x42D7	FiberDistErrCounter

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

Valid values. 0,..., 65535.

Read variable from the CNC through the fast channel. ID.SERCOS: 33495

QV190	FAGOR, RO	0x47DB	CanBusSyncJitter

Function. This variable may be used to diagnose CAN problems. It reflects the oscillation of the synchronism messages with respect to the internal time base (clock) of the drive (in clock tick, 25 ns).

Valid values. 0,..., 65535.

Read variable from the CNC through the fast channel. ID.SERCOS: 34779

R group. Rotor sensor

RP77	FAGOR, RO	0x5115	PositionFeedback1Type

Function. Type of encoder installed on the motor.

Valid values. - 32768, ..., 32767.

Default value. 0.

S group. Speed

SP1	USER, RW	0x5064	VelocityProportionalGain

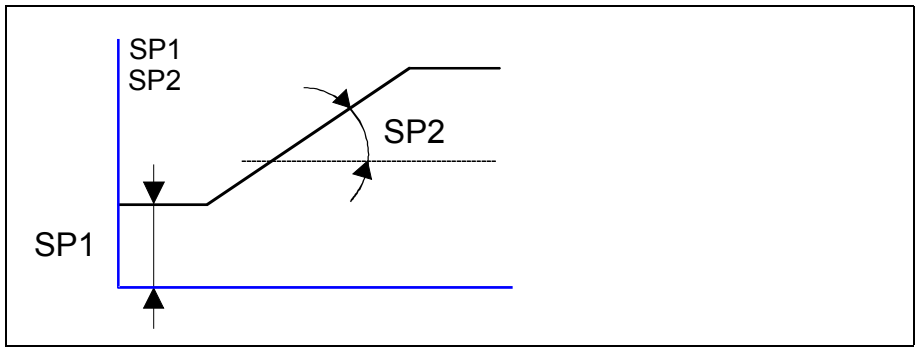
SP2	USER, RW	0x5065	VelocityIntegralTime

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	USER, RW	0x5066	VelocityDerivativeGain

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

Valid values. SP3: 0, ..., 9999.

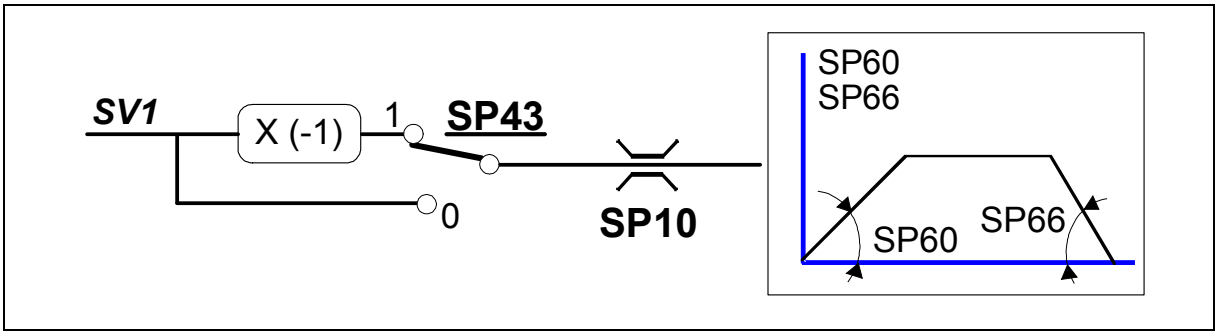
Default value. SP1: 0.

SP10	USER, RW	0x505B	VelocityLimit

Function. Maximum velocity limit for SV7 (VelocityCommandFinal).

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

Default value. 1000 rev/min.



SP42	BASIC, RW	0x507C	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.

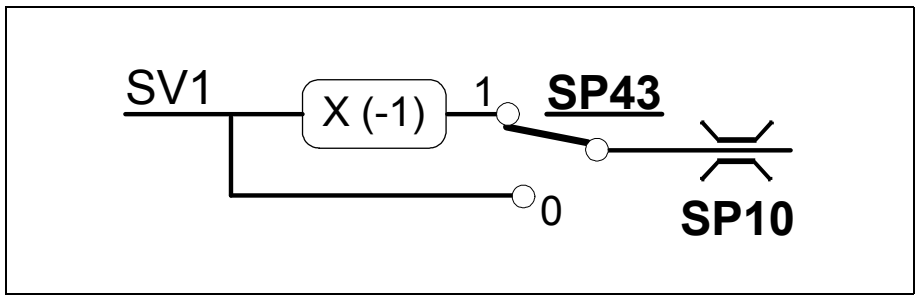
Default value. 20 rev/min.

SP43	USER, RW	0x502B	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.

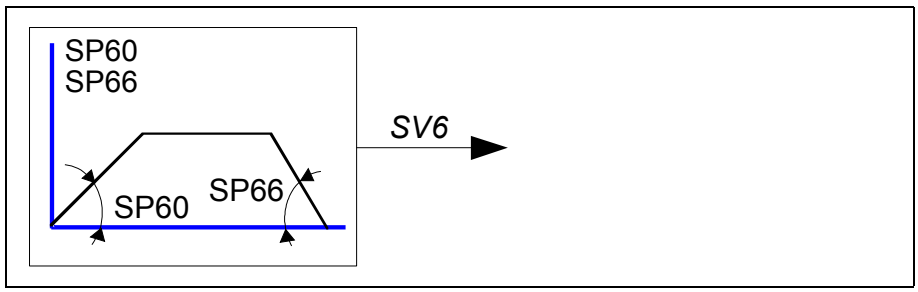


SP60	USER, RW	0x508A	AccelerationLimit

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.



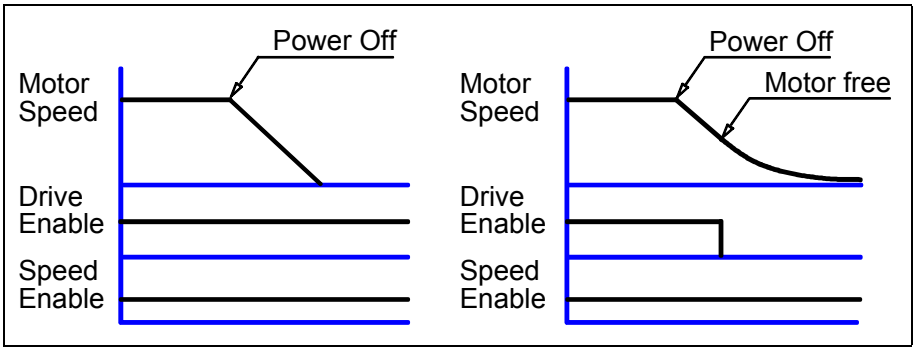
SP65	USER, RW	0x4649	EmergencyAcceleration

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.

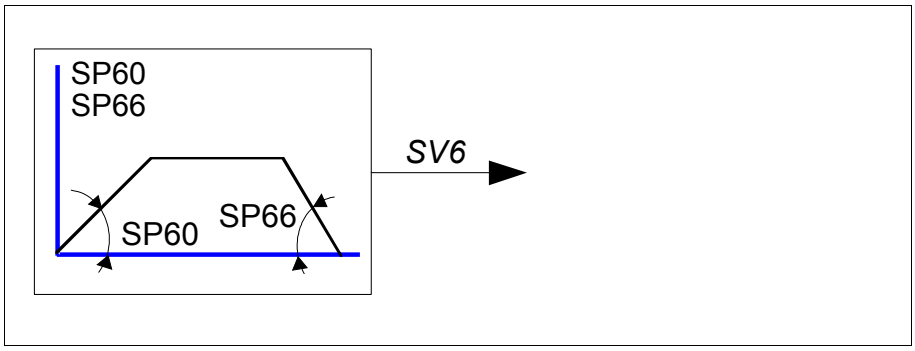
Default value. 0.0.

SP66	USER, RW	0x4652	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	USER, RW	0x5024	VelocityCommand

Function. Velocity command.

Valid values. - 6000.0000, ..., 6000.0000 rev/min.

Write variable from the CNC through the fast channel. ID.SERCOS: 00036

SV2	USER, RO	0x5028	VelocityFeedback

Function. Velocity feedback.

Valid values. - 6000.0000, ..., 6000.0000 rev/min.

Read variable from the CNC through the fast channel. ID.SERCOS: 00040

SV6	USER, RO	0x4656	VelocityCommandAfterFilters

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

Valid values. - 6000.0000, ..., 6000.0000 rev/min.

Read variable from the CNC through the fast channel. ID.SERCOS: 34390

SV7	USER, RO	0x464C	VelocityCommandFinal

Function. Final velocity command applied to the loop.

Valid values. - 6000.0000, ..., 6000.0000 rev/min.

Read variable from the CNC through the fast channel. ID.SERCOS: 34380

T group. Torque and power

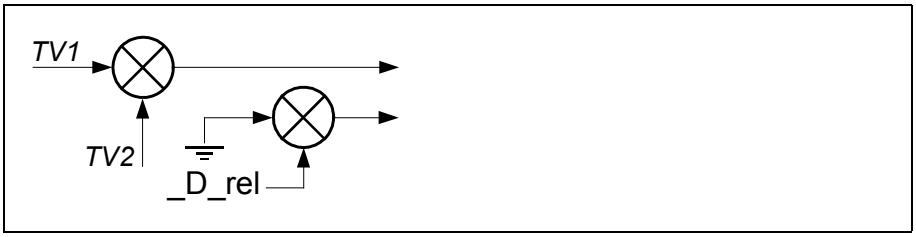
TV1	BASIC, RO	0x5050	TorqueCommand

TV2	BASIC, RO	0x5054	TorqueFeedback

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

Valid values. - 999.9, ..., 999.9 Nm.

Default value. 0 Nm.



Read variable from the CNC through the fast channel. ID.SERCOS: 00084

ERROR CODES

E.001	Internal	E.001

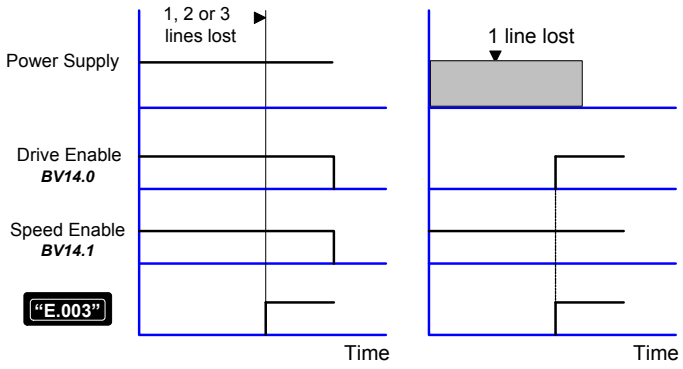
Contact Fagor Automation.

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.

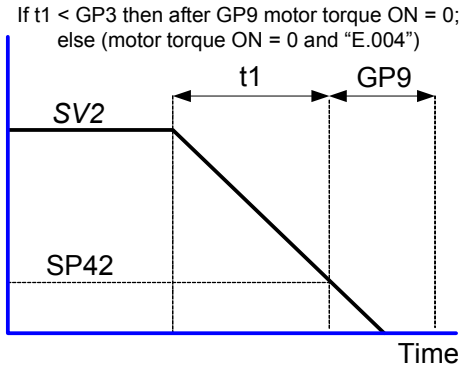


Solution

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 = max. time allowed for braking, before considering the error for being unable to stop it in the set time) or



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.

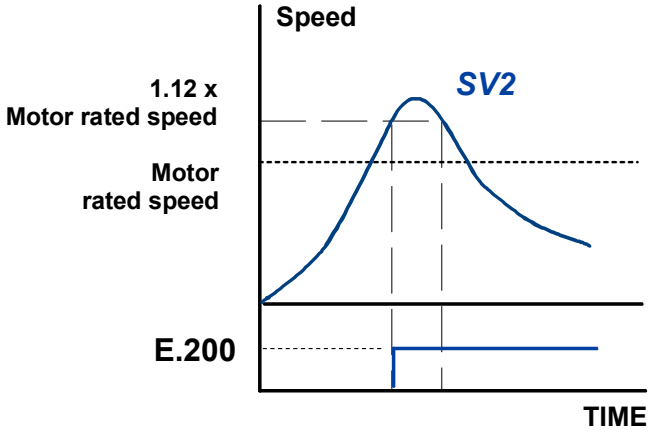
E.200	overspeed	E.200

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

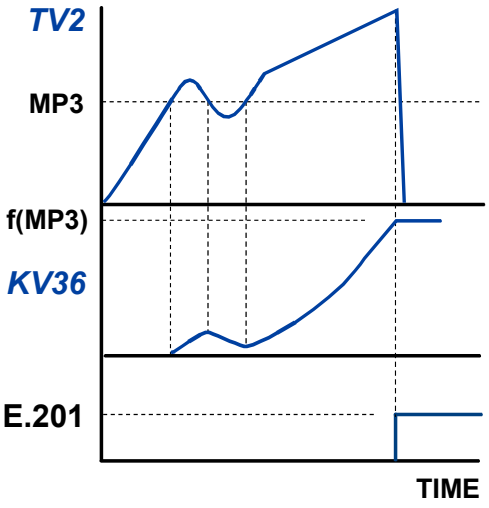
Bad cabling of the position sensor or of the motor power or the velocity loop is adjusted wrong.

Solution

Decrease the speed overshoot in the system response.



E.201	Motor overload	E.201



The I2t protection of the motor has been activated.

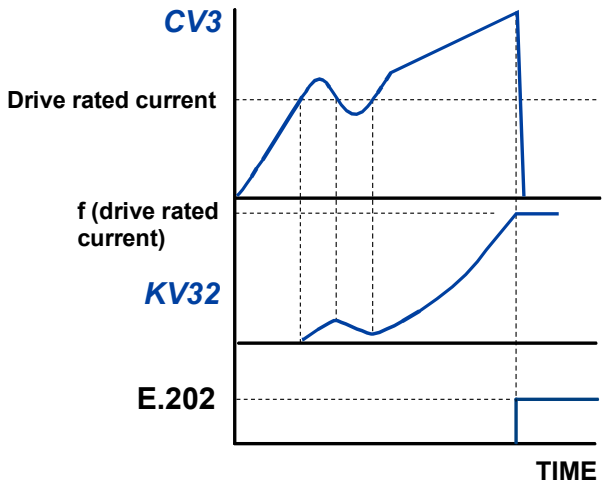
The duty cycle is greater than the motor can provide.

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 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	Synchronism message missing	

The synchronism message is received erroneously during two consecutive cycles or is no longer received. If the error comes up only once, it adds 1 unit to the value of the QV30 variable (distortion on the line).

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

E.412	Synchronism message oscillation	

The synchronism message must be received within a ±10 µs margin of the cycle time indicated in parameter QP1, when starting up the unit. This time margin is usually 4 ms. Therefore, if this is received out of this margin twice in a row, the drive warns about it with this error. If it only occurs one, it adds 1 unit to the value of the QV30 variable.

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

E.413	Wrong handshake	

The handshake bit, included in the master's control word and in the drive's status word, does not follow the indicated sequence.

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. CAN ID´s

Mnem.	Name	Level	ID CAN	ID ModBus	Acc.	Min.	Max.	Def.	Units	Page
BV14	NotProgrammableIOs	FAGOR	0x40CC	08601	RO	0	65535	-	-	53
CP1	CurrentProportionalGain	FAGOR	0x506A	00213	RW	0	999	-	-	53
CP2	CurrentIntegralTime	FAGOR	0x506B	00215	RW	0	999	-	-	53
CP20	CurrentLimit	USER	0x4133	08807	RW	0	50.00	-	A	53
CP30	CurrentCommandFilter1Type	FAGOR	0x4134	08809	RW	0	1	0	-	53
CP31	CurrentCommandFilter1Frequency	FAGOR	0x4138	08817	RW	0	4000	0	Hz	54
CP32	CurrentCommandFilter1Damping	FAGOR	0x4139	08819	RW	0	1000	0	Hz	54
CV1	Current1Feedback	BASIC	0x4135	08811	RO	-50.00	50.00	-	A	54
CV2	Current2Feedback	BASIC	0x4136	08813	RO	-50.00	50.00	-	A	54
CV3	CurrentFeedback	BASIC	0x4137	08815	RO	-50.00	50.00	-	A	55
CV10	Current1Offset	FAGOR	0x4131	08803	RO	-2.000	2.000	-	A	55
CV11	Current2Offset	FAGOR	0x4132	08805	RO	-2.000	2.000	-	A	55
DC1	ResetClass1Diagnostics	BASIC	0x5063	00199	RW	0	15	0	-	56
DC2	ClearHistoricOfErrorsCommand	BASIC	0x4192	08997	RW	0	15	0	-	56
DV17	HistoricOfErrors	BASIC	0x419A	09012	RO	-	-	-	-	55
DV31	DriverStatusWord	FAGOR	0x5087	00271	RO	0	65535	-	-	55
DV32	MasterControlWord	FAGOR	0x5086	00269	RW	0	65535	0	-	56
GC1	BackupWorkingMemoryCommand	USER	0x5108	00529	RW	0	15	0	-	58
GC10	LoadDefaultsCommand	USER	0x5106	00525	RW	0	15	0	-	58
GP3	StoppingTimeout	USER	0x42BE	09597	RW	0	9999	500	ms	57
GP5	ParameterVersion	USER	0x42C0	09601	RO	-	-	-	-	57
GP9	DriveOffDelayTime	USER	0x50CF	00415	RW	0	9999	50	ms	57
GV2	ManufacturerVersion	USER	0x501E	00060	RO	-	-	-	-	57
GV5	CodeChecksum	USER	0x42C2	09605	RO	-	-	-	-	57
GV7	Password	USER	0x510B	00535	RW	0	9999	0	-	57
GV9	DriveType	USER	0x508C	00280	RO	-	-	-	-	57
GV11	SoftReset	USER	0x42C4	09609	RW	0	16	0	-	57
GV16	MotorTableVersion	USER	0x42CC	09625	RO	-	-	-	-	58
GV75	ErrorList	FAGOR	0x5177	00750	RO	-	-	-	-	58
HV5	PLDVersion	USER	0x4127	08783	RO	-	-	-	-	58
IP6	DigitalInputPolarity	BASIC	0x438E	10013	RW	0	1	0	-----	58
IV10	DigitalInputs	BASIC	0x438B	10007	RO	0	1	-	-	58
KP3	ExtBallastPower	BASIC	0x445A	10421	RW	200	2000	200	W	59
KP4	ExtBallastEnergyPulse	BASIC	0x445C	10425	RW	200	2000	200	J	59
KV10	CoolingTemperature	BASIC	0x444E	10397	RO	0	200	-	° C	59
KV32	I2tDrive	BASIC	0x4455	10410	RO	0	100	-	%	59
KV36	I2tMotor	BASIC	0x4457	10415	RO	0	100	-	%	59
KV40	I2tCrowbar	BASIC	0x445B	10423	RO	0	100	-	%	59
KV41	BallastSelect	BASIC	0x445D	10427	RW	0	1	1	-	59
MP1	MotorType	USER	0x508D	00282	RO	-	-	-	-	60
MP2	MotorTorqueConstant	FAGOR	0x44B0	10593	RO	0	10.00	-	Nm/A	60
MP3	MotorContinuousStallCurrent	FAGOR	0x506F	00223	RO	0	50.00	-	A	60
MP4	MotorPeakCurrent	FAGOR	0x506D	00219	RO	0	50.00	-	A	60
NP116	ResolutionOfFeedback1	FAGOR	0x5074	00233	RO	0	65535	-	pulses	60
NP121	InputRevolutions	FAGOR	0x5079	00243	RW	1	65535	1	turns	60
NP122	OutputRevolutions	FAGOR	0x507A	00245	RW	1	65535	1	turns	60
NP123	FeedConstant	FAGOR	0x507B	00246	RW	0	2^{31}-1	-	-	60
OP6	DigitalOutputPolarity	BASIC	0x4588	11025	RW	0	1	0	-	61
OV10	DigitalOutputs	BASIC	0x4582	11013	RW	0	1	0	-	61
PC146	NCControlledHoming	FAGOR	0x5092	00293	RW	0	15	0	-	61
PV51	PositionFeedback1	FAGOR	0x5033	00102	RO	-2^{31}-1	2^{31}-1	-	pulses	61
PV173	MarkerPositionA	FAGOR	0x50AD	00346	RO	-2^{31}-1	2^{31}-1	-	pulses	61
QP1	ControlUnitCycleTime	FAGOR	0x5001	00003	RW	0	10000	4000	-	62
QP17	CanOpenBorder	BASIC	0x47E4	12233	RW	-	-	-	-	62

Mnem.	Name	Level	ID CAN	ID ModBus	Acc.	Min.	Max.	Def.	Units	Page
QV22	IDNListOfInvalidOperationDataForCP3	FAGOR	0x5016	00044	RO	-	-	-	-	62
QV30	FiberDistErrCounter	FAGOR	0x42D7	09647	RO	0	65535	0	-	62
QV190	CanBusSyncJitter	FAGOR	0x47DB	12215	RO	0	65535	0	-	62
RP77	PositionFeedback1Type	FAGOR	0x5115	00555	RO	-32768	32767	0	-	63
SP1	VelocityProportionalGain	USER	0x5064	00201	RW	0	999.9	-	A_{rms}/rpm	63
SP2	VelocityIntegralTime	USER	0x5065	00203	RW	0	999.9	-	ms	63
SP3	VelocityDerivativeGain	USER	0x5066	00205	RW	0	9999	0	-	63
SP10	VelocityLimit	USER	0x505B	00183	RW	0	9999	1000	rpm	63
SP42	StandStillWindow	BASIC	0x507C	00249	RW	0	9999	20	rpm	64
SP43	VelocityPolarityParameters	USER	0x502B	00087	RW	0	1	0	-	64
SP60	AccelerationLimit	USER	0x508A	00277	RW	0	400.0	0	rpm/ms	64
SP65	EmergencyAcceleration	USER	0x4649	11411	RW	0	400.0	0	rpm/ms	64
SP66	VelocityDecelerationTime	USER	0x4652	11429	RW	0	400.0	0	rpm/ms	65
SV1	VelocityCommand	USER	0x5024	00072	RW	-6000	6000	0	rpm	65
SV2	VelocityFeedback	USER	0x5028	00080	RO	-6000	6000	0	rpm	65
SV6	VelocityCommandAfterFilters	USER	0x4656	11436	RO	-6000	6000	0	rpm	65
SV7	VelocityCommandFinal	USER	0x464C	11416	RO	-6000	6000	0	rpm	66
TV1	TorqueCommand	BASIC	0x5050	00161	RO	- 999.9	999.9	0	Nm	66
TV2	TorqueFeedback	BASIC	0x5054	00169	RO	- 999.9	999.9	0	Nm	66

User notes

User notes

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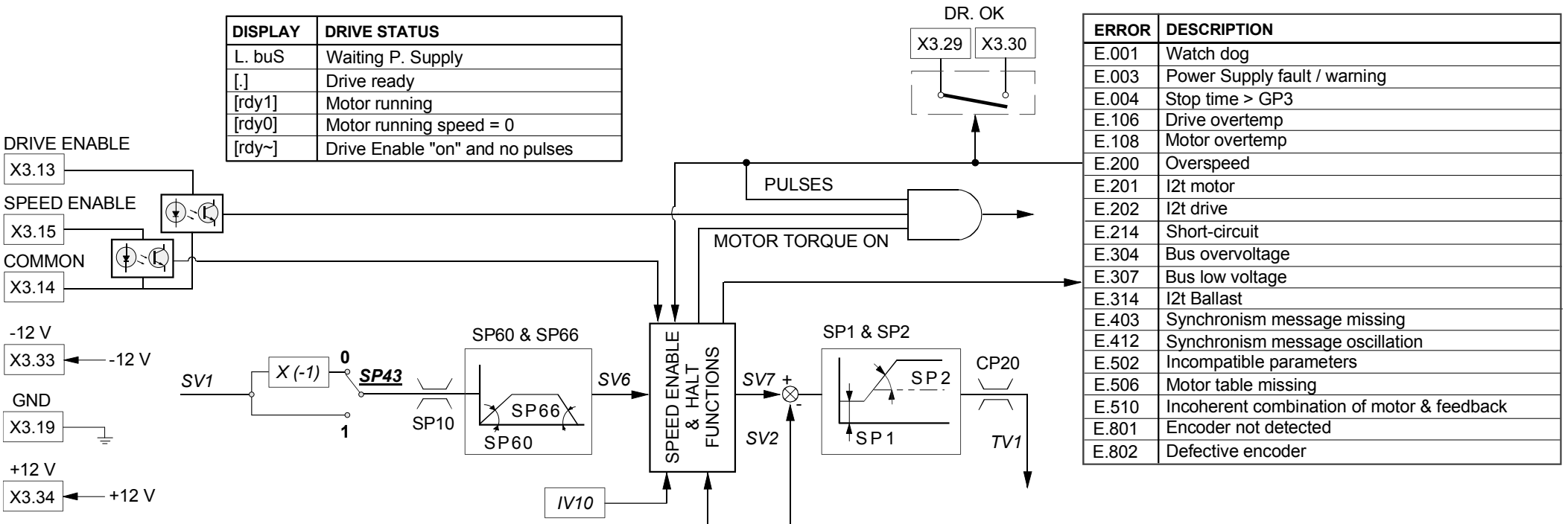
Fagor Automation S. Coop.

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

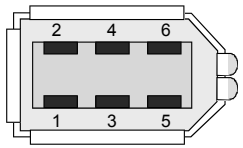


ERROR	DESCRIPTION
E.001	Watch dog
E.003	Power Supply fault / warning
E.004	Stop time > GP3
E.106	Drive overtemp
E.108	Motor overtemp
E.200	Overspeed
E.201	I2t motor
E.202	I2t drive
E.214	Short-circuit
E.304	Bus overvoltage
E.307	Bus low voltage
E.314	I2t Ballast
E.403	Synchronism message missing
E.412	Synchronism message oscillation
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	200V	kW	200V	kW
40	**01**	0.1		
60			**01**	0.1
	02	0.2		
	04	0.4		
80			**02**	0.2
			04	0.4
	08	0.75		
120			**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

SHAFT & FLANGE

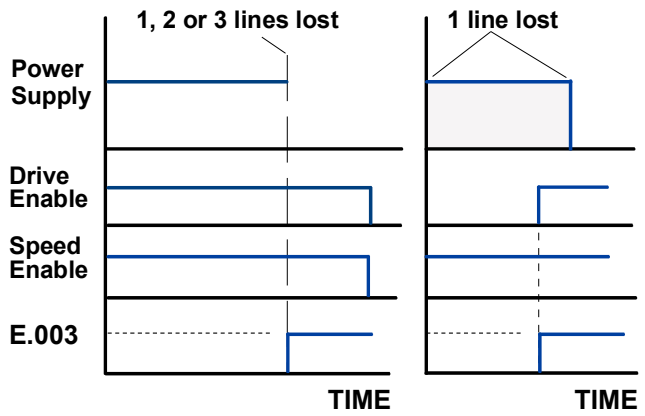
Cylindrical shaft with keyway and tapped hole	0
Cylindrical keyless shaft and tapped hole	1

FEEDBACK

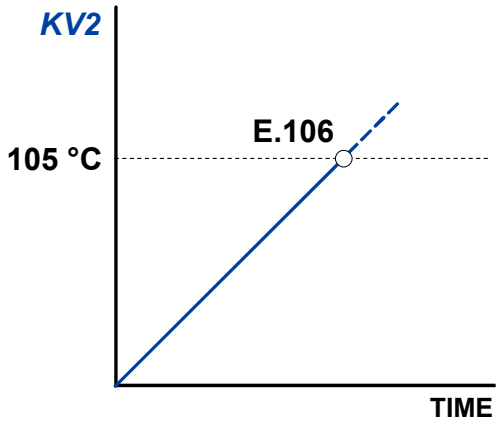
13 bit incremental	J5
16 bit absolute	J7

ERROR FUNCTIONS

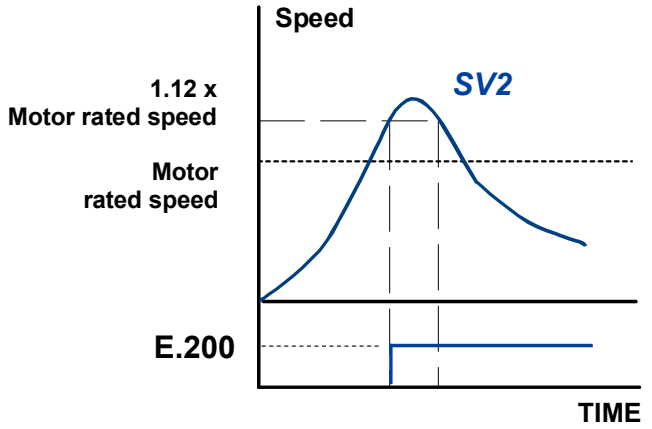
Function E.003 — **Power Supply fault**



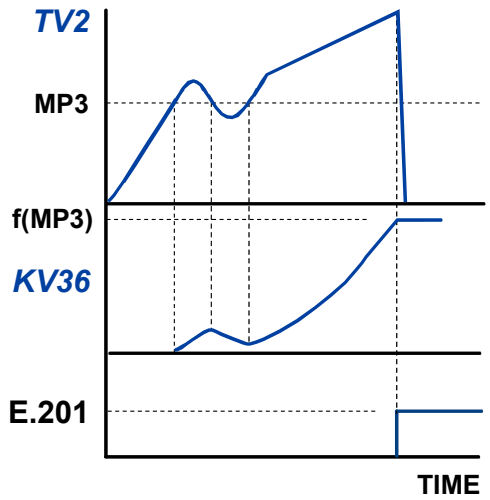
Function E.106 — **Drive overtemp**



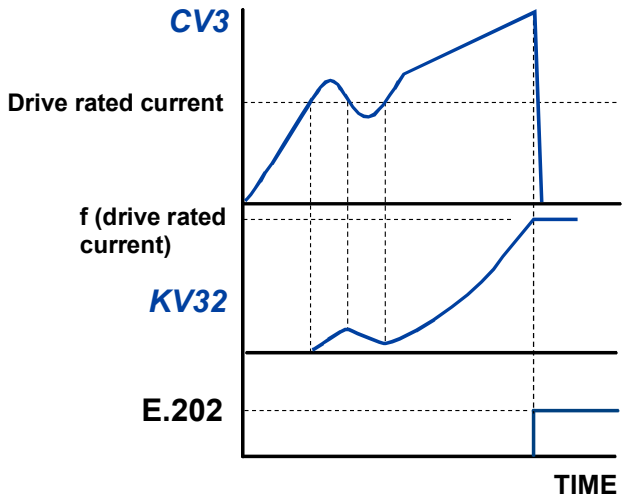
Function E.200 — **Overspeed**



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