FAGOR AUTOMATION S.COOP.

Brushless AC servo drives

~ MCS series ~

Ref.1609

FAGOR AUTOMATION

14460062

Original instructions

Title	Brushless AC Servo Drives. MCS series
Type of documentation	Description, installation and startup of motors and digital drives.
Name	**MAN REGUL MCS (IN)**
Reference	Ref.1609
Software	Version 02.10 and earlier versions
WinDDSSetup	Version 08.15
Electronic document	man_mcs.pdf

Headquarters FAGOR AUTOMATION S. COOP.
B.º San Andrés 19, Apdo. 144
20500 ARRASATE- MONDRAGÓN
www.fagorautomation.com
info@fagorautomation.es

34-943-719200

34-943-771118 (Technical Service Depart.)

The information described in this manual may be subject to changes due to technical modifications. FAGOR AUTOMATION, S. Coop. reserves the right to change the contents of this manual without prior notice.

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 pertinent 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 CONDITIONS

FAGOR AUTOMATION guarantees its products for the period of time with the exceptions indicated below, against defects in design, materials used and manufacturing process that affect the correct operation of the product.

The warranty period will have an initial duration of 24 months, applicable to all FAGOR products from the date the material is shipped to the customer. The manufacturers (OEM) or distributors will have a maximum period of 12 months from the time the product leaves FAGOR AUTOMATION warehouse to register the warranty. If the manufacturer, distributor and/or end user registers or informs FAGOR AUTOMATION regarding the final destination, date of installation and identification of the machine through any of the methods described by FAGOR AUTOMATION Product Warranty registration process, this warranty will be commence for 24 months period from the date of registration, with a maximum limit of 36 months from the time the product leaves the facilities of FAGOR AUTOMATION; i.e., the period between the product shipping date and the date the warranty ends must not exceed a total of 36 months.

If a product has never been registered, the warranty period will end 24 months from the time the product leaves FAGOR AUTOMATION's warehouses. After this period, a warranty extension contract, for the material, must be executed or a specific agreement reached with FAGOR AUTOMATION.

In the case of new replacement parts, the applicable warranty will be 12 months. With repaired products or in those cases where the product exchange option was used, during outside product warranty period-the applicable warranty will be provided by the corresponding repair center. When a repair estimate is provided it pertains to a specific defective item/s hence the warranty only covers the replaced part.

FAGOR guarantees to provide service for all current products and until 8 years after the date they are removed from the current catalog including repair, providing replacement part service or replacing the product with another identical or equivalent model. A backward compatible solution is available for most products i.e. the product can be upgraded to a newer model.

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

During the warranty period, and following identification and diagnosis, FAGOR AUTOMATION will only repair or replace the product/part assessed to be defective. FAGOR AUTOMATION is not liable for any other compensation.

FAGOR AUTOMATION at its sole discretion reserves the right either to repair or replace the affected product during warranty period.

This product warranty covers all costs of materials and labor to repair or correct the cause of defect. The repairs will be carried out at the facilities of FAGOR AUTOMATION, unless it is agreed between FAGOR AUTOMATION and the CUSTOMER to carry out the repairs on the premises of the CUSTOMER or end user. Unless there is a specific agreement in cases of onsite repair all expenses related to diagnosis, labor, travel expenses, shipping costs, etc. are excluded and will be billed according to FAGOR AUTOMATION's established rate. The customer/user will be notified in advance of the estimate of charges when applicable.

The part/s replaced under warranty will be a property of FAGOR AUTOMATION.

FAGOR AUTOMATION offers to its customers an extension to the standard warranty and comprehensive warranty services through SERVICE CONTRACTS that meet the diverse needs of customers.

Excluded from this warranty are:

a) Deteriorated/Defective components as the result of mishandling, in violation of safety rules or the technical specifications of the product, inadequate monitoring or any type of negligence on behalf of the CUSTOMER.

b) Defects caused by improper handling, assembly and/or installation by the CUSTOMER or caused by modifications or repairs carried out without the consent of FAGOR AUTOMATION.

c) Defects caused due to specific materials, fluids/coolants, electricity power or services used by the CUSTOMER.

d) The malfunctions caused by unforeseen circumstances or force majeure (weather or geological events) and accidents or any other type of natural disaster.

e) In a general sense, any indirect, consequential and/or collateral damage.

f) Damage caused during transport.

All service requests during the warranty period must be communicated to FAGOR AUTOMATION, identifying the product (serial number), describing in detail the symptoms observed, the reason for the malfunction (if known) and its scope.

All components replaced within the warranty period are covered by the warranty until the expiration of the original warranty period of the product.

The warranty offered by FAGOR AUTOMATION will become null and void in the event that the CUSTOMER fails to comply with the installation and operation requirements and recommendations regarding preventive and corrective maintenance as indicated in product manuals.

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 drives modules:

MCS- 05L, MCS-10L, MCS-20L, MCS- 30L, MCS- 04H, MCS- 08H, MCS-16H

and axis feed servo motors:

FXM1, FXM3, FXM5, FXM7, FKM2, FKM4, FKM6

Note. Some additional characters may follow the model references indicated above. They all comply with the directives listed here. However, compliance may be verified on the label of the unit itself.

mentioned on this declaration, meet the requirements on:

Safety

EN 60204-1:2007 CORR:2010	Machinery safety. Electrical equipment of the machines. Part 1: General requirements.

Electromagnetic Compatibility

EN 61800-3:2004 /A1:2012	EMC directive on servo drive systems.

In compliance with EC Directives 2014/35/UE on Low Voltage and 2014/30/UE on Electrical Compatibility.

Fagor Automation, S. Coop.

Director Gerente
José Pérez Berdud

In Mondragón September 1st 2016

INTRODUCTION

FAGOR offers you a wide range of servo drive systems (AC Brushless motor and Digital Drive) for applications requiring between 1.2 and 33.6 N·m at speeds between 1200 rev/min and 4000 rev/min for FXM motors and between 1.7 and 23.5 N·m at speeds between 2000 rev/min and 6000 rev/min for FKM motors.

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

This page intentionally left blank

BRUSHLESS AC MOTORS, FXM

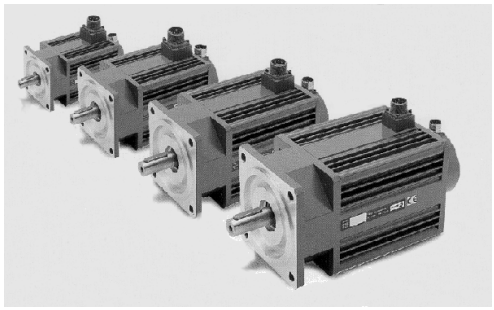
Introduction

FXM series synchronous servo motors 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.

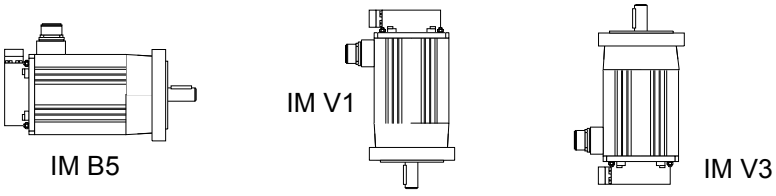
They are designed to meet the IP 64 protection standard and, therefore, they are immune to liquid and dirt.

FXM1 FXM3 FXM5 FXM7



IP 64 means that it is protected against dust and against water jets. They incorporate a temperature sensor for monitoring the internal temperature. They also carry an optional holding brake. The F class isolation on the motor maintains the dielectric properties as long as the work temperature stays below 150°C/302°F.

General characteristics

Excitation	Permanent rare earth magnets (SmCo)
Temperature sensor	PTC thermistor. Triple
Shaft end	Cylindrical with keyway (optional with no keyway)
Mounting	Face flange
Mounting method	IM B5 - IM V1 - IM V3 (as recommended by IEC-34-3-72)
Mechanical tolerances	Normal class (meets IEC-72/1971)
Balancing	Class N (R optional) (DIN 45665) whole-key balancing
Roller bearings' life	20000 hours
Noise	DIN 45635
Vibration resistance	Withstands 1g, along the shaft and 3g sideways (g=9.81 m/s²)
Electrical insulation	Class F (150°C/302°F)
Insulation resistance	500 V DC, 10 MΩ or greater
Dielectric rigidity	1500 V AC, one minute
Protection degree	General: Standard IP 64. Shaft: Standard IP 64, IP 65 with oil seal
Storage temperature	-20°C/+80°C (- 4°F/+176°F)
Ambient temperature	0°C/+40°C (+32°F/+104°F)
Working ambient humidity	From 20 % to 80 % (non condensing)
Holding brake	Optional. See the section ·technical data of the holding brake ·
Feedback	I0 Incremental TTL encoder ·2500 ppt· E1/A1 Sincoder encoder / Multi-turn absolute SinCos ·1024 ppt·
Meaning of the codes of the mounting method.	

Technical data of non-ventilated synchronous FXM motors with "F" winding (220 V AC).

Non-ventilated motors	Stall torque	Stall peak torque	Rated speed	Stall current	Peak current	Calculation power	Torque constant	Acceleration time	Inductance per phase	Resistance per phase	Inertia [1]	Mass [2]	Drive peak torque			
	Mo	**Mp**	**nN**	**Io**	**Imax**	**Pcal**	**kt**	**tac**	**L**	**R**	**J**	**M**	**MCS-05L**	**MCS-10L**	**MCS-20L**	**MCS-30L**
	N·m	N·m	rev/min	A	A	kW	N·m/A	ms	mH	Ω	kg·cm²	kg	N·m	N·m	N·m	N·m
FXM11.40F.□□.□□□	1.2	6	4000	2.0	10.0	0.5	0.6	8.4	12.0	4.60	1.2	3.3	3.0	**6.0**		
FXM12.40F.□□.□□□	2.3	11	4000	3.9	18.7	1.0	0.6	7.2	5.5	1.45	1.9	4.3		6.0	**11.0**	
FXM13.40F.□□.□□□	3.3	16	4000	5.6	27.2	1.4	0.6	6.8	3.5	0.80	2.6	6.4			12.0	**16.0**
FXM14.20F.□□.□□□	4.1	20	2000	3.5	17.1	0.9	1.2	3.5	10.0	2.30	3.3	7.6		12.0	**20.0**	
FXM14.40F.□□.□□□	4.1	20	4000	6.9	33.7	1.7	0.6	6.9	2.6	0.55	3.3	7.6			12.0	18.0
FXM31.20F.□□.□□□	2.6	13	2000	2.2	11.0	0.5	1.2	5.6	24.0	5.05	3.5	5.5	6.0	12.0	**13.0**	
FXM31.40F.□□.□□□	2.6	13	4000	4.4	22.0	1.1	0.6	11.3	6.1	1.25	3.5	5.5		6.0	12.0	**13.0**
FXM32.20F.□□.□□□	5.1	25	2000	4.3	21.1	1.1	1.2	5.0	11.0	1.65	6.0	7.5		12.0	24.0	**25.0**
FXM32.40F.□□.□□□	5.1	25	4000	8.4	41.2	2.1	0.6	10.0	2.9	0.44	6.0	7.5			12.0	18.0
FXM33.20F.□□.□□□	7.3	36	2000	6.3	31.1	1.5	1.2	4.9	6.7	0.90	8.5	9.6			24.0	**36.0**
FXM33.40F.□□.□□□	7.3	36	4000	12.0	59.2	3.1	0.6	9.9	1.8	0.25	8.5	9.6				18.0
FXM34.20F.□□.□□□	9.3	46	2000	7.6	37.6	1.9	1.2	5.0	5.3	0.65	11.0	11.5			24.0	36.0
FXM34.40F.□□.□□□	9.3	46	4000	15.0	74.2	3.9	0.6	10.0	1.3	0.17	11.0	11.5				18.0
FXM53.20F.□□.□□□	11.9	59	2000	9.9	49.1	2.5	1.2	7.8	5.0	0.45	22.0	15.8			24.0	36.0
FXM53.30F.□□.□□□	11.9	59	3000	14.8	73.0	3.7	0.8	11.7	2.2	0.20	22.0	15.8				24.0
FXM54.20F.□□.□□□	14.8	74	2000	12.7	63.5	3.1	1.2	8.2	3.4	0.27	29.0	17.8				36.0
FXM55.12F.□□.□□□	17.3	86	1200	9.1	45.2	2.2	1.9	5.3	7.2	0.55	36.0	20.0			38.0	57.0
FXM55.20F.□□.□□□	17.3	86	2000	15.0	74.6	3.6	1.1	8.8	2.5	0.19	36.0	20.0				33.6
FXM73.12F.□□.□□□	20.8	104	1200	10.7	53.5	2.6	1.9	7.4	9.8	0.60	61.0	29.0				57.0
FXM74.12F.□□.□□□	27.3	135	1200	13.5	66.8	3.4	2.0	7.3	7.8	0.45	79.0	31.6				60.0
FXM75.12F.□□.□□□	29.5	165	1200	15.0	83.9	3.7	2.0	7.4	5.9	0.31	97.0	36.0				60.0

1. When adding the mechanical brake to the motor (option) also take into account the inertia values given in the table of section ·holding brake/technical data·

2. When adding the mechanical brake to the motor (option) also take into account its mass values given in the table of section ·holding brake/technical data·

Note. In the combinations shown in bold letters, the drive will limit its peak current automatically so as not to damage the motor.

Technical data of non-ventilated synchronous FXM motors with "A" winding (400 V AC).

Non-ventilated motors	Stall torque	Stall peak torque	Rated speed	Stall current	Peak current	Calculation power	Torque constant	Acceleration time	Inductance per phase	Resistance per phase	Inertia [1]	Mass [2]	Drive peak torque		
	Mo	**Mp**	**nN**	**Io**	**Imax**	**Pcal**	**kt**	**tac**	**L**	**R**	**J**	**M**	**MCS-04H**	**MCS-08H**	**MCS-16H**
	N·m	N·m	rev/min	A	A	kW	N·m/A	ms	mH	Ω	kg·cm²	kg	N·m	N·m	N·m
FXM11.20A.□□.□□□	1.2	6	2000	0.45	2.2	0.3	2.7	4.2	248	93.5	1.2	3.3	**6.0**		
FXM11.30A.□□.□□□	1.2	6	3000	0.67	3.4	0.4	1.8	6.3	110	43.0	1.2	3.3	**6.0**		
FXM11.40A.□□.□□□	1.2	6	4000	0.90	4.5	0.5	1.3	8.4	62	23.5	1.2	3.3	5.2	**6.0**	
FXM12.20A.□□.□□□	2.3	11	2000	0.86	4.1	0.5	2.7	3.6	111	32.0	1.9	4.3	10.7	**11.0**	
FXM12.30A.□□.□□□	2.3	11	3000	1.29	6.2	0.7	1.8	5.4	49	13.0	1.9	4.3	7.1	**11.0**	
FXM12.40A.□□.□□□	2.3	11	4000	1.72	8.2	1.0	1.3	7.2	28	7.8	1.9	4.3	5.4	10.7	**11.0**
FXM13.20A.□□.□□□	3.3	16	2000	1.23	6.0	0.7	2.7	3.4	71	16.0	2.6	6.4	10.7	**16.0**	
FXM13.30A.□□.□□□	3.3	16	3000	1.85	9.0	1.0	1.8	5.1	32	7.25	2.6	6.4	7.1	14.2	**16.0**
FXM13.40A.□□.□□□	3.3	16	4000	2.50	12.0	1.4	1.3	6.8	18	4.05	2.6	6.4		10.6	**16.0**
FXM14.20A.□□.□□□	4.1	20	2000	1.53	7.5	0.9	2.7	3.5	52	12.0	3.3	7.6	10.7	20.0	
FXM14.30A.□□.□□□	4.1	20	3000	2.30	11.2	1.3	1.8	5.2	23	4.85	3.3	7.6		14.2	**20.0**
FXM14.40A.□□.□□□	4.1	20	4000	3.10	15.0	1.7	1.3	6.9	13	2.95	3.3	7.6		10.6	**20.0**
FXM31.20A.□□.□□□	2.6	13	2000	0.97	4.8	0.5	2.7	5.6	126	29.0	3.5	5.5	10.7	**13.0**	
FXM31.30A.□□.□□□	2.6	13	3000	1.45	7.3	0.8	1.8	8.5	56	12.5	3.5	5.5	7.2	**13.0**	
FXM31.40A.□□.□□□	2.6	13	4000	1.92	9.6	1.1	1.4	11.3	32	7.25	3.5	5.5	5.4	10.8	**13.0**
FXM32.20A.□□.□□□	5.1	25	2000	1.89	9.2	1.1	2.7	5.0	56	9.55	6.0	7.5	10.8	21.6	**25.0**
FXM32.30A.□□.□□□	5.1	25	3000	2.80	14.0	1.6	1.8	7.5	25	4.05	6.0	7.5		14.6	**25.0**
FXM32.40A.□□.□□□	5.1	25	4000	3.80	18.5	2.1	1.4	10.1	14	2.3	6.0	7.5		10.7	21.4

1. When adding the mechanical brake to the motor (option) also take into account the inertia values given in the table of section ·holding brake/technical data·

2. When adding the mechanical brake to the motor (option) also take into account its mass values given in the table of section ·holding brake/technical data·

Note. In the combinations shown in bold letters, the drive will limit its peak current automatically so as not to damage the motor.

Technical data of non-ventilated synchronous FXM motors with "A" winding (400 V AC).

Non-ventilated motors	Stall torque	Stall peak torque	Rated speed	Stall current	Peak current	Calculation power	Torque constant	Acceleration time	Inductance per phase	Resistance per phase	Inertia [1]	Mass [2]	Drive peak torque		
	Mo	**Mp**	**nN**	**Io**	**Imax**	**Pcal**	**kt**	**tac**	**L**	**R**	**J**	**M**	**MCS-04H**	**MCS-08H**	**MCS-16H**
	N·m	N·m	rev/min	A	A	kW	N·m/A	ms	mH	Ω	kg·cm²	kg	N·m	N·m	N·m
FXM33.20A.□□.□□□	7.3	36	2000	2.7	13.4	1.5	2.7	4.9	36	5.05	8.5	9.6		21.6	**36.0**
FXM33.30A.□□.□□□	7.3	36	3000	4.1	20.0	2.3	1.8	7.4	16	2.20	8.5	9.6		14.2	28.5
FXM33.40A.□□.□□□	7.3	36	4000	5.5	27.0	3.1	1.3	9.9	8.6	1.15	8.5	9.6			21.3
FXM34.20A.□□.□□□	9.3	46	2000	3.4	17.0	1.9	2.7	5.0	26	3.45	11.0	11.5		21.9	43.8
FXM34.30A.□□.□□□	9.3	46	3000	5.1	25.0	2.9	1.8	7.5	12	1.60	11.0	11.5			29.1
FXM34.40A.□□.□□□	9.3	46	4000	6.9	34.0	3.9	1.4	10.0	6.6	0.85	11.0	11.5			21.6
FXM53.12A.□□.□□□	11.9	59	1200	2.8	14.0	1.5	4.2	4.7	61	5.85	22.0	15.8		34.0	**59.0**
FXM53.20A.□□.□□□	11.9	59	2000	4.7	23.0	2.5	2.5	7.8	22	2.15	22.0	15.8			40.5
FXM53.30A.□□.□□□	11.9	59	3000	7.1	35.0	3.7	1.7	11.7	9.6	0.91	22.0	15.8			26.9
FXM54.12A.□□.□□□	14.8	74	1200	3.5	17.6	1.9	4.2	4.9	44	3.70	29.0	17.8		33.8	67.7
FXM54.20A.□□.□□□	14.8	74	2000	5.9	30.0	3.1	2.5	8.2	16	1.35	29.0	17.8			40.2
FXM54.30A.□□.□□□	14.8	74	3000	8.7	44.0	4.7	1.7	12.3	7.3	0.64	29.0	17.8			27.2
FXM55.12A.□□.□□□	17.3	86	1200	4.1	20.0	2.2	4.2	5.3	36	2.95	36.0	20.0		33.8	67.5
FXM55.20A.□□.□□□	17.3	86	2000	6.7	33.0	3.6	2.6	8.8	13	1.05	36.0	20.0			41.3
FXM73.12A.□□.□□□	20.8	104	1200	4.9	25.0	2.6	4.2	7.4	46	3.05	61.0	29.0			67.8
FXM73.20A.□□.□□□	20.8	104	2000	8.2	41.0	4.4	2.5	12.3	17	1.10	61.0	29.0			40.6
FXM74.12A.□□.□□□	27.3	135	1200	6.6	32.0	3.4	4.2	7.4	33	1.90	79.0	31.6			66.2
FXM75.12A.□□.□□□	33.6	165	1200	8.0	39.0	4.2	4.2	7.4	27	1.45	97.0	36.0			67.2

1. When adding the mechanical brake to the motor (option) also take into account the inertia values given in the table of section ·holding brake/technical data·

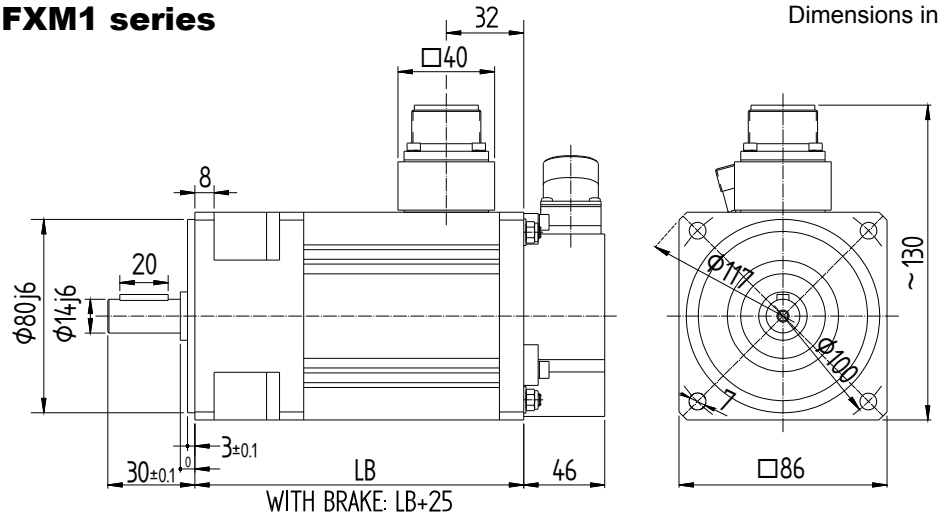
2. When adding the mechanical brake to the motor (option) also take into account its mass values given in the table of section ·holding brake/technical data·

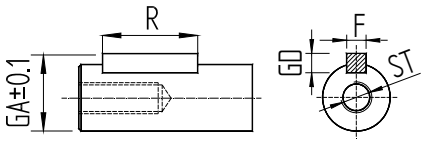
Note. In the combinations shown in bold letters, the drive will limit its peak current automatically so as not to damage the motor.

Dimensions

FXM1 series

Dimensions in mm, 1 in = 25.4 mm



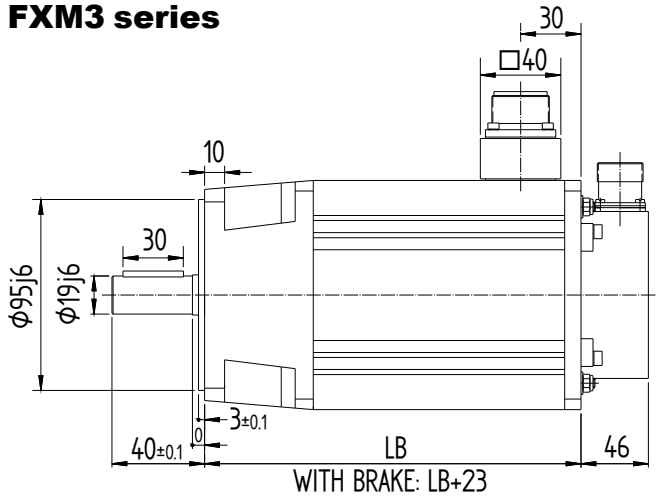


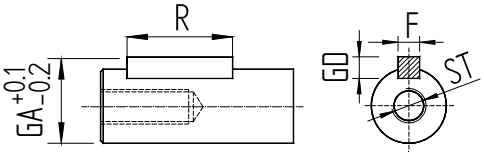
Dimension	LB	
Units	mm	in
FXM11	136	5.35
FXM12	171	6.70
FXM13	206	8.11
FXM14	241	9.48

Dimension	F		GD		R		GA		ST
Units	mm	in	mm	in	mm	in	mm	in	mm
FXM1	5	0.19	5	0.19	20	0.78	16	0.62	M5x12.5

FXM3 series

Dimensions in mm, 1 in = 25.4 mm



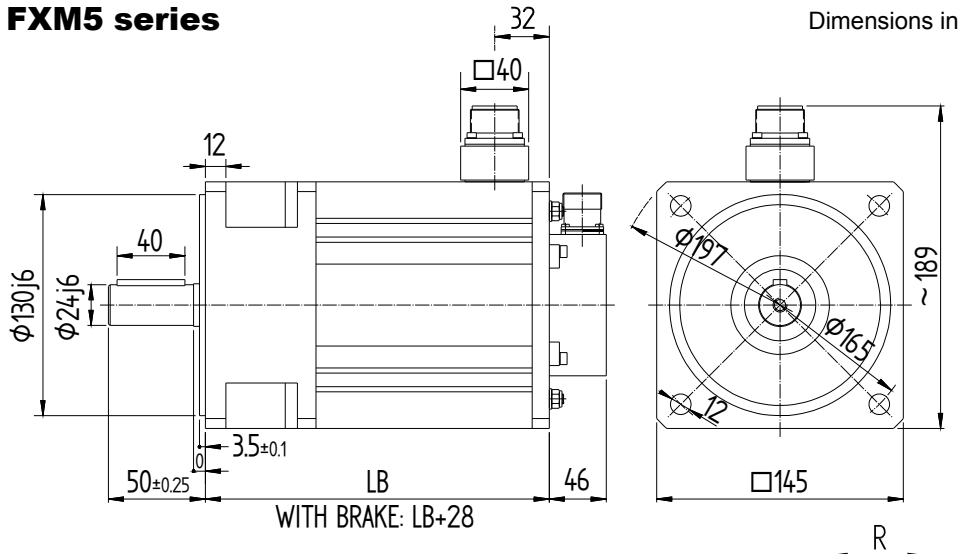


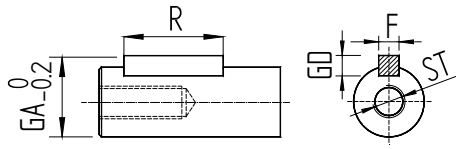
Dimension	LB	
Units	mm	in
FXM31	152	5.98
FXM32	187	7.36
FXM33	222	8.74
FXM34	257	10.12

Dimension	F		GD		R		GA		ST
Units	mm	in	mm	in	mm	in	mm	in	mm
FXM3	6	0.24	6	0.24	30	1.18	21.5	0.85	M6x16

FXM5 series

Dimensions in mm, 1 in = 25.4 mm



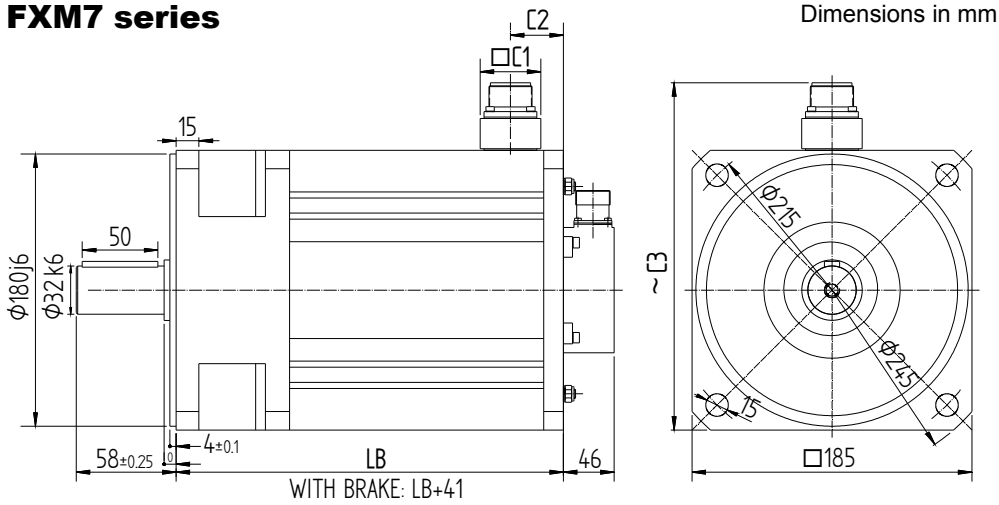


Dimension	LB	
Units	mm	in
FXM53	237	9.33
FXM54	272	10.71
FXM55	307	12.09

Dimension	F		GD		R		GA		ST
Units	mm	in	mm	in	mm	in	mm	in	mm
FXM5	8	0.31	7	0.27	40	1.58	27	1.07	M8x19

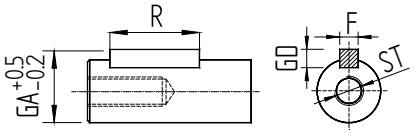
FXM7 series

Dimensions in mm, 1 in = 25.4 mm



Dimension	C1		C2		C3	
Units	mm	in	mm	in	mm	in
Io ≤ 23 A (MC 23)	40	1.57	35	1.37	229	9.01
23 A < Io ≤ 46 A (MC 46)	50	1.96	40	1.57	236	9.29

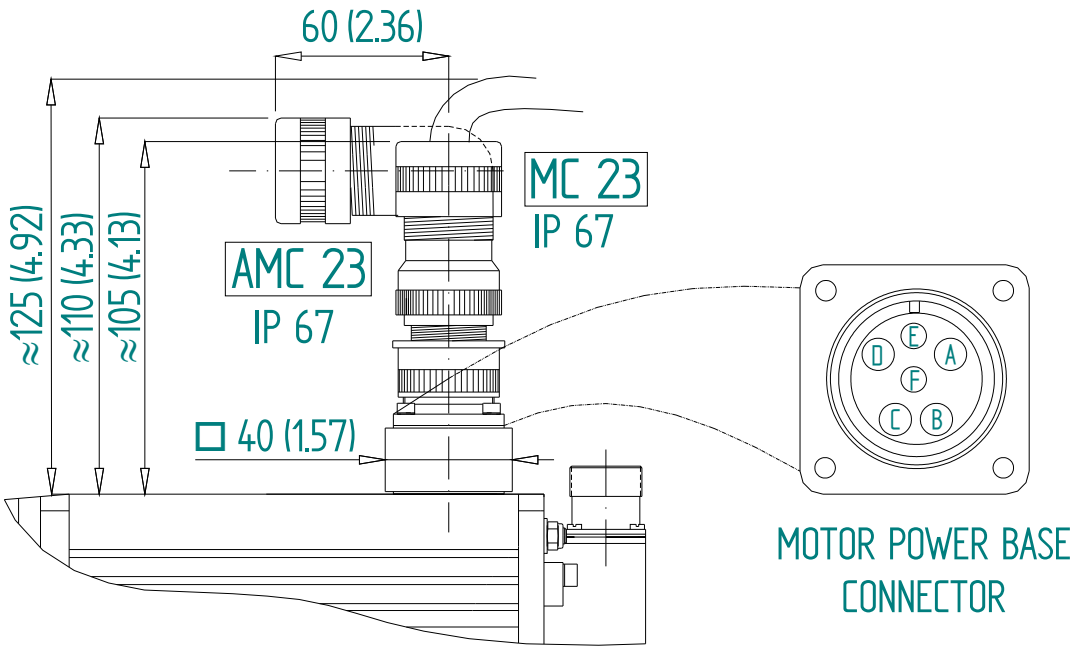
Dimension	LB	
Units	mm	in
FXM73	256	9.33
FXM74	291	10.71
FXM75	326	12.09
FXM76	361	14.21
FXM77	396	15.59
FXM78	431	16.97



Dimension	F		GD		R		GA		ST
Units	mm	in	mm	in	mm	in	mm	in	mm
FXM7	10	0.39	8	0.31	50	1.97	35	1.38	M10x22

Power connectors and encoder output

The power connector includes the brake terminals (E, F). A voltage between 22 and 26 V DC 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), the shaft will turn clockwise (CWR, **C**lock**W**ise **R**otation).



MC 23. POWER AIR CONNECTOR. STRAIGHT
AMC 23. POWER AIR CONNECTOR. ANGLED

PIN	SIGNAL
A	U PHASE
B	V PHASE
C	W PHASE
D	GND
E	BRAKE +
F	BRAKE –

Viewer from outside the motor

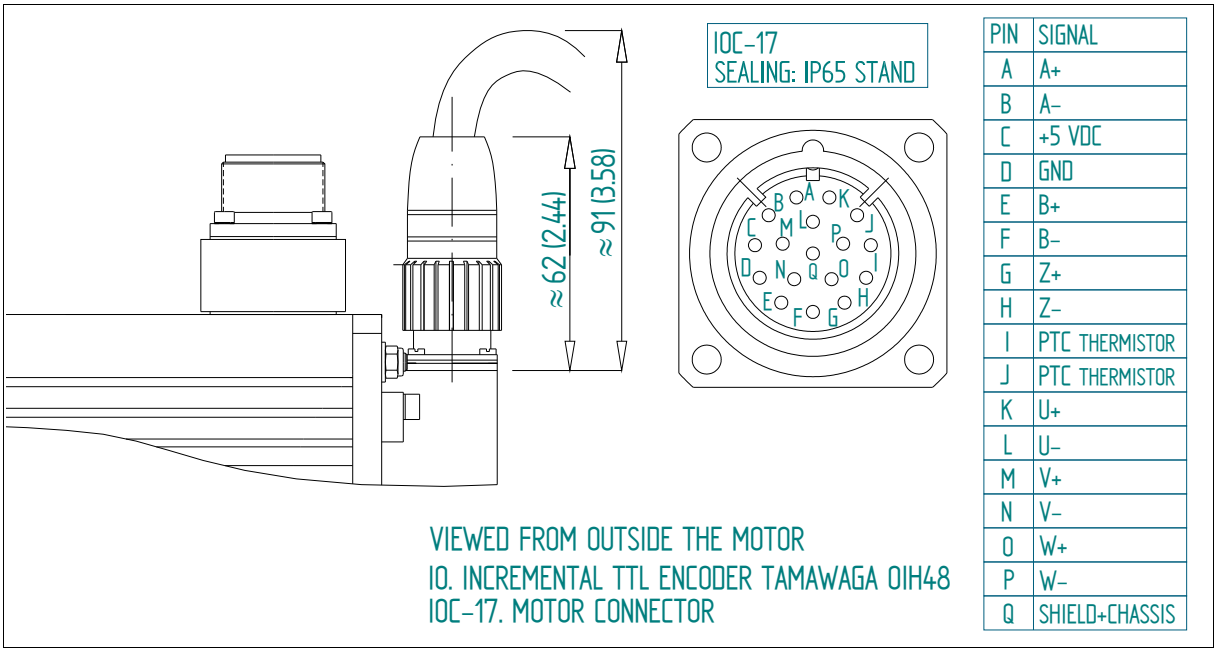
POWER CONNECTORS **EX. MC - 23**

Motor connector — **MC - Straight** / **AMC - Angled**

Current — **23 Amperes**

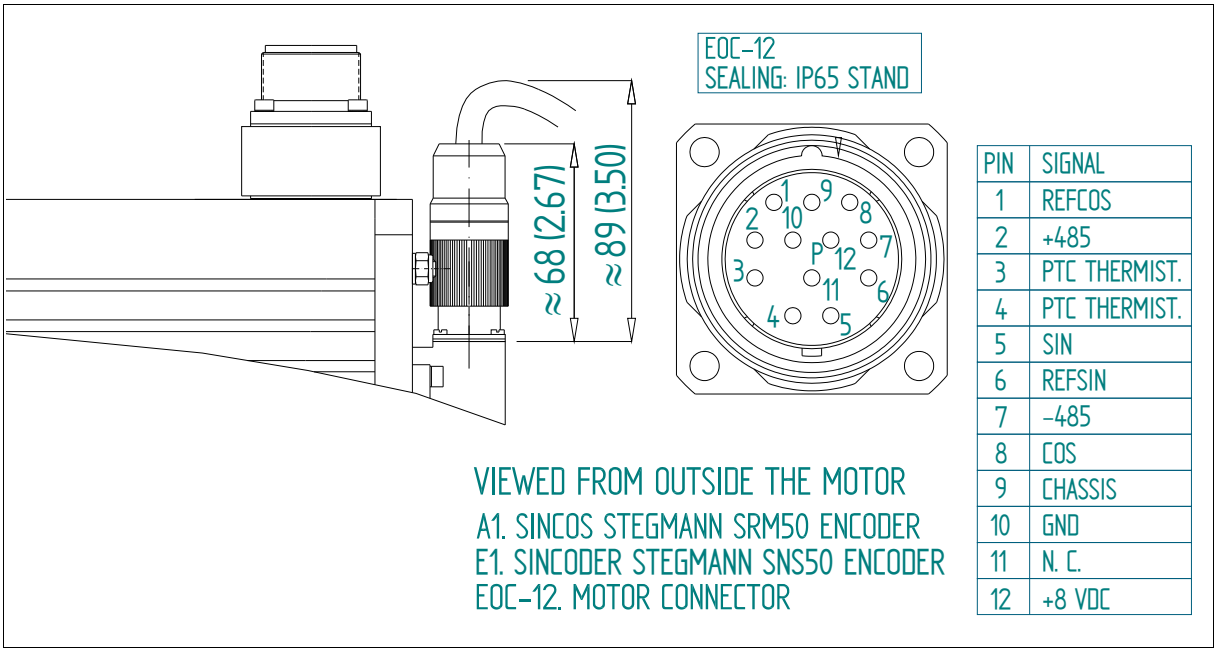
Motor feedback connector

Pins of 9 and 10 of the connector of the incremental TTL encoder correspond to the thermistor used to monitor motor overheating.



PIN	SIGNAL
A	A+
B	A-
C	+5 VDC
D	GND
E	B+
F	B-
G	Z+
H	Z-
I	PTC THERMISTOR
J	PTC THERMISTOR
K	U+
L	U-
M	V+
N	V-
O	W+
P	W-
Q	SHIELD+CHASSIS

Pins of 3 and 4 of the SinCos or SinCoder encoder connector correspond to the thermistor used to monitor motor overheating.



PIN	SIGNAL
1	REFCOS
2	+485
3	PTC THERMIST.
4	PTC THERMIST.
5	SIN
6	REFSIN
7	-485
8	COS
9	CHASSIS
10	GND
11	N. C.
12	+8 VDC

Holding brake

FXM motors have an optional holding brake that applies friction to the shaft. Its purpose is to immobilize or lock vertical axes, not to brake a moving axis.

Technical data

Its main characteristics depending on the type of brake are:

Motor	Holding torque		Power consumption		ON/OFF time	Releasing voltage margin	Inertia	Mass approx.	
Units	N·m	in·lbf	W	hp	ms	V DC	kg·cm²	kg	lbf
FXM1	Mo motor		12	0.016	19/29	22-26	0.38	0.3	0.66
FXM3	Mo motor		16	0.021	20/29	22-26	1.06	0.6	1.32
FXM5	Mo motor		18	0.024	25/50	22-26	3.60	1.1	2.42
FXM7	Mo motor		35	0.047	53/97	22-26	31.80	4.1	9.03

Note. The maximum speed is 10000 rev/min, for all of them except for the brake that may be used on the FXM7 series that is 8000 rev/min.

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

WARNING.

- ❑ The holding brake must never exceed its maximum turning speed.
- ❑ A voltage between 22 and 26 V DC releases the shaft. 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 reference

FXM □□.□□□.□□.□□□ - X□□

FAGOR SYNCHRONOUS MOTOR		
SIZE	**1, 3, 5, 7**	
LENGTH	**1, 2, 3, 4, 5**	
RATED SPEED	**12** 1200 rev/min	**20** 2000 rev/min
	30 3000 rev/min	**40** 4000 rev/min
WINDING	**F** 220 V AC	
	A 400 V AC	
FEEDBACK TYPE	**I0** Incremental encoder (2500 ppt)	
	A1 Absolute multi-turn SinCoder encoder (1024 ppt)	
	E1 SinCoder encoder (1024 ppt)	
FLANGE & SHAFT	**0** IEC Standard	
	1 Keyless shaft	
	8 NEMA standard (USA)	
	9 Special	
BRAKE OPTION	**0** Without brake	
	1 With standard brake (24 V DC)	
FAN	**0** Without fan	
	1 With Standard fan	
	9 With special fan	
SPECIAL CONFIGURATION	**X**	
SPECIFICATION	**01 ➔ ZZ**	
	Only when it has a special configuration (X) !	

Notes.

Encoders with reference:

I0, only available on FXM servomotors, “F” winding.

E1/A1, only available on FXM servomotors, “A” winding.

BRUSHLESS AC MOTORS , FKM

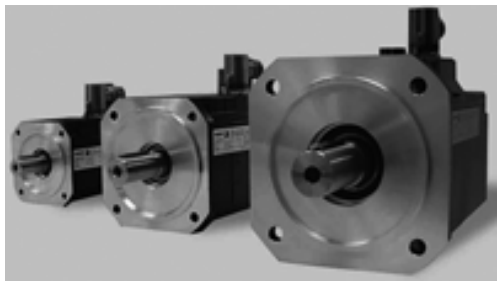
Introduction

FKM synchronous servo motors 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.

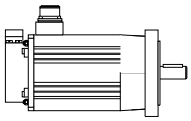
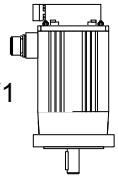
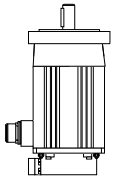
They are designed to meet the IP 64 protection standard and, therefore, they are immune to liquid and dirt.

FKM2 FKM4 FKM6



IP 64 means that is protected against dust and against water jets. They have a temperature sensor to monitor the internal temperature. They also carry an optional electromechanical brake. They have rotating power and feedback connectors. The F class isolation on the motor maintains the dielectric properties as long as the work temperature stays below 150°C/302°F.

General characteristics

Excitation	Permanent rare earth magnets (Nd-Fe-B)
Temperature sensor	Thermistor PTC KTY84-130 Thermistor PTC Pt1000 (shortly)
Shaft end	Cylindrical keyless (optional with keyway)
Mounting	Face flange with through holes
Mounting method	IM B5 - IM V1 - IM V3 (as recommended by IEC-34-3-72)
Mechanical tolerances	Normal class (meets IEC-72/1971)
Balancing	Class N (R optional) (DIN 45665) half-key balancing
Roller bearings' life	20000 hours
Noise	DIN 45635
Vibration resistance	Withstands 1g along the shaft and 3g sideways (g=9.81m/s²)
Electrical insulation	Class F (150°C/302°F)
Insulation resistance	500 V DC, 10 MΩ or greater
Dielectric rigidity	1500 V AC, one minute
Protection degree	General: Standard IP 64. Shaft: Standard IP 64, IP 65 with oil seal
Storage temperature	-20°C/+80°C (- 4°F/+176°F)
Ambient temperature	0°C/+40°C (+32°F/+104°F)
Working ambient	From 20 % to 80 % (non condensing)
Holding brake	Optional. See technical data of the holding brake
Feedback	I0 Incremental TTL encoder ·2500 ppt· E3/A3 Sinusoidal 1Vpp / multi-turn absolute 1Vpp ·1024 ppt·
Meaning of the codes of the mounting method	 IM B5  IM V1  IM V3

Technical data of non-ventilated synchronous FKM motors with "A" winding (400 V AC).

Non-ventilated motors	Stall torque	Stall peak torque	Rated speed	Stall current	Peak current	Calculation power	Torque constant	Acceleration time	Inductance per phase	Resistance per phase	Inertia [1]	Mass [2]	Drive peak torque	
	Mo	**Mp**	**nN**	**Io**	**Imax**	**Pcal**	**kt**	**tac**	**L**	**R**	**J**	**M**	**MCS-08H**	**MCS-16H**
	N·m	N·m	rev/min	A	A	kW	N·m/A	ms	mH	Ω	kg·cm²	kg	N·m	N·m
FKM21.60A.□□.□□□	1.7	7	6000	2.8	11	1.1	0.60	14.4	7.70	2.600	1.6	4.2	4.8	**7.0**
FKM22.30A.□□.□□□	3.2	13	3000	2.4	10	1.0	1.33	7.0	16.00	3.950	2.9	5.3	10.4	**13.0**
FKM22.50A.□□.□□□	3.2	13	5000	4.0	16	1.7	0.80	11.7	5.80	1.400	2.9	5.3	6.4	12.8
FKM22.60A.□□.□□□	3.2	13	6000	4.5	18	2.0	0.71	14.0	4.60	1.100	2.9	5.3	-	11.3
FKM42.30A.□□.□□□	6.3	25	3000	4.6	19	2.0	1.36	10.7	8.60	1.450	8.5	7.8	-	21.7
FKM42.45A.□□.□□□	6.3	25	4500	6.9	28	3.0	0.91	16.0	3.90	0.675	8.5	7.8	-	14.5
FKM42.60A.□□.□□□	6.3	25	6000	8.5	34	3.9	0.74	21.3	2.60	0.450	8.5	7.8	-	11.8
FKM43.20A.□□.□□□	9.0	36	2000	3.9	15.7	1.88	2.30	9.7	14.5	1.720	16.7	11.7	18.4	**36.0**
FKM43.30A.□□.□□□	9.0	36	3000	6.2	25	2.82	1.45	14.5	6.2	0.755	16.7	11.7	-	23.2
FKM43.40A.□□.□□□	9.0	36	4000	9.4	38	3.77	0.95	19.4	2.4	0.315	16.7	11.7	-	15.2
FKM44.20A.□□.□□□	11.6	47	2000	4.6	19	2.4	2.52	7.4	14.51	1.720	16.7	11.7	-	40.3
FKM44.30A.□□.□□□	11.6	47	3000	8.2	33	3.6	1.41	11.2	4.20	0.540	16.7	11.7	-	22.5
FKM44.30A.□□.□□□.2	11.6	47	3000	7.0	28	3.6	1.65	11.1	6.16	0.755	16.7	11.7	-	26.4
FKM62.30A.□□.□□□	8.9	35	3000	7.1	28	2.8	1.25	14.4	7.20	0.770	16.0	11.9	-	20.0
FKM62.40A.□□.□□□	8.9	35	4000	9.3	37	3.7	0.95	19.1	4.10	0.440	16.0	11.9	-	15.3
FKM63.20A.□□.□□□	12.5	51	2000	5.3	21.3	2.6	2.35	12.1	13.2	0.935	29.5	17.1	-	37.6
FKM63.30A.□□.□□□	12.5	51	3000	10.3	40.6	3.9	1.21	18.1	3.8	0.280	29.5	17.1	-	19.3
FKM64.20A.□□.□□□	16.5	66	2000	6.5	26	3.4	2.53	9.3	13.16	0.935	29.5	17.1	-	40.6
FKM66.20A.□□.□□□	23.5	94	2000	10.5	42	4.9	2.23	9.5	4.60	0.315	43.0	22.3	-	35.8
FKM66.20A.□□.□□□.2	23.5	94	2000	9.4	37	4.9	2.50	9.5	8.82	0.410	43.0	22.3	-	40.0

1. Motor inertia without holding brake.
2. Motor mass without holding brake.

Note. In the combinations shown in bold letters, the drive will limit its peak current automatically so as not to damage the motor.

Technical data of non-ventilated synchronous FKM motors with "F" winding (220 V AC).

Non-ventilated motors	Stall torque	Stall peak torque	Rated speed	Stall current	Peak current	Calculation power	Torque constant	Acceleration time	Inductance per phase	Resistance per phase	Inertia [1]	Mass [2]	Drive peak torque		
	Mo	**Mp**	**nN**	**Io**	**Imax**	**Pcal**	**kt**	**tac**	**L**	**R**	**J**	**M**	**MCS-10L**	**MCS-20L**	**MCS-30L**
	N·m	N·m	rev/min	A	A	kW	N·m/A	ms	mH	Ω	kg·cm²	kg	N·m	N·m	N·m
FKM21.60F.□□.□□□	1.7	7	6000	4.7	19	1.1	0.36	14.4	2.6	0.885	1.6	4.2	3.6	**7.0**	-
FKM22.30F.□□.□□□	3.2	13	3000	4.5	18	1.0	0.74	7.0	4.6	1.100	2.9	5.3	7.4	**13.0**	-
FKM22.50F.□□.□□□	3.2	13	5000	7.2	29	1.7	0.45	11.7	1.7	0.425	2.9	5.3	-	9.0	**13.0**
FKM42.30F.□□.□□□	6.3	25	3000	8.5	34	2.0	0.74	10.7	2.6	0.450	8.5	7.8	-	14.8	22.2
FKM42.45F.□□.□□□	6.3	25	4500	12.4	50	3.0	0.51	16.0	1.2	0.210	8.5	7.8	-	18.2	**25.0**
FKM43.30F.□□.□□□	9.0	36	3000	13.8	55.4	2.8	0.65	14.5	1.2	0.150	16.7	11.7	-	-	19.5
FKM44.30F.□□.□□□	11.6	47	3000	15.6	62	3.6	0.74	11.2	1.2	0.150	16.7	11.7	-	-	22.2
FKM62.30F.□□.□□□	8.9	35	3000	13.1	52	2.8	0.68	14.4	2.1	0.225	16.0	11.9	-	-	20.4
FKM62.40F.□□.□□□	8.9	35	4000	16.4	66	3.7	0.54	19.1	1.3	0.180	16.0	11.9	-	-	16.2
FKM63.20F.□□.□□□	12.5	51	2000	11.7	46.6	2.6	1.06	12.1	2.7	0.205	29.5	17.1	-	-	31.8
FKM63.30F.□□.□□□	12.5	51	3000	16.6	66.4	3.9	0.75	18.1	1.3	0.100	29.5	17.1	-	-	22.5
FKM64.20F.□□.□□□	16.5	66	2000	14.3	57	3.4	1.15	9.35	2.7	0.205	29.5	17.1	-	-	34.5
FKM64.30F.□□.□□□	16.5	66	3000	20.0	80	5.1	0.82	14.0	1.3	0.145	29.5	17.1	-	-	24.6
FKM66.20F.□□.□□□	23.5	94	2000	19.2	76.8	4.9	1.22	9.57	0.8	0.135	43.0	22.3	-	-	36.6

1. Motor inertia without holding brake.

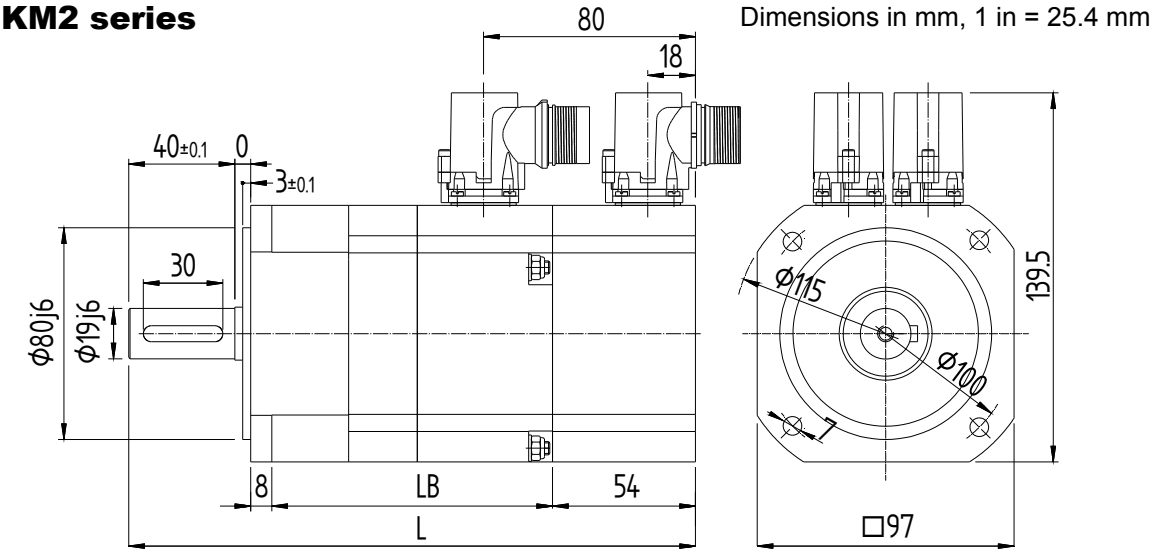
2. Motor mass without holding brake.

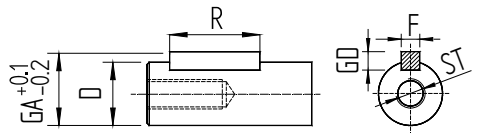
Note. In the combinations shown in bold letters, the drive will limit its peak current automatically so as not to damage the motor.

Dimensions

FKM2 series

Dimensions in mm, 1 in = 25.4 mm





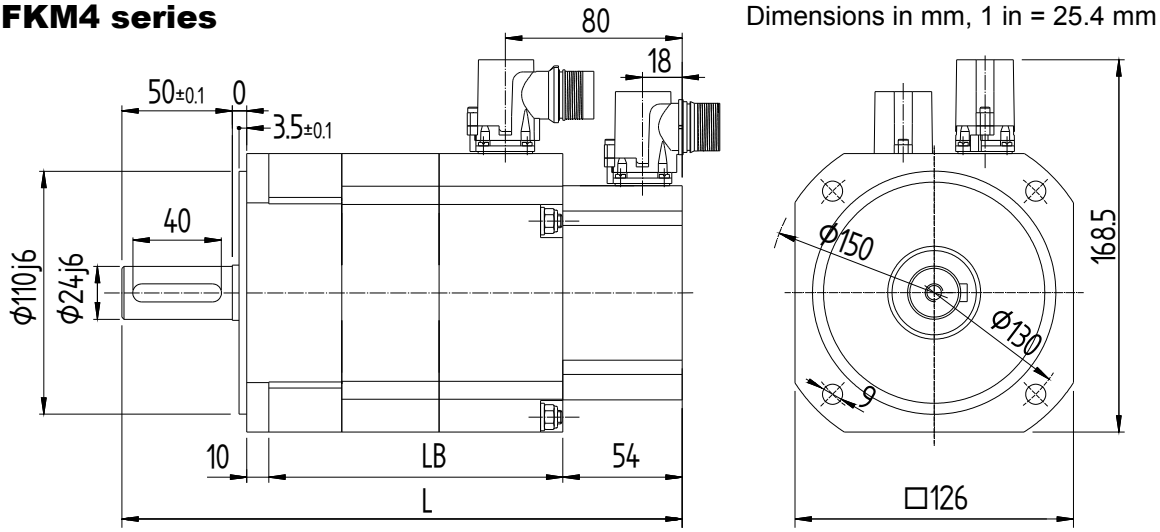
Dimension	LB		L	
Units	mm	in	mm	in
FKM21	106	4.17	208	8.19
FKM22	130	5.11	232	9.13

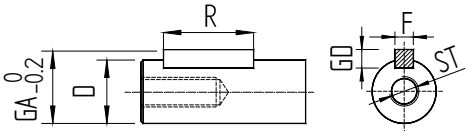
Dimension	ØD j6	
Units	mm	in
FKM2	19	0.74

Dimension	F		GD		R		GA		ST
Units	mm	in	mm	in	mm	in	mm	in	mm
FKM2	6	0.23	6	0.23	30	1.18	21.5	0.84	M6x16

FKM4 series

Dimensions in mm, 1 in = 25.4 mm





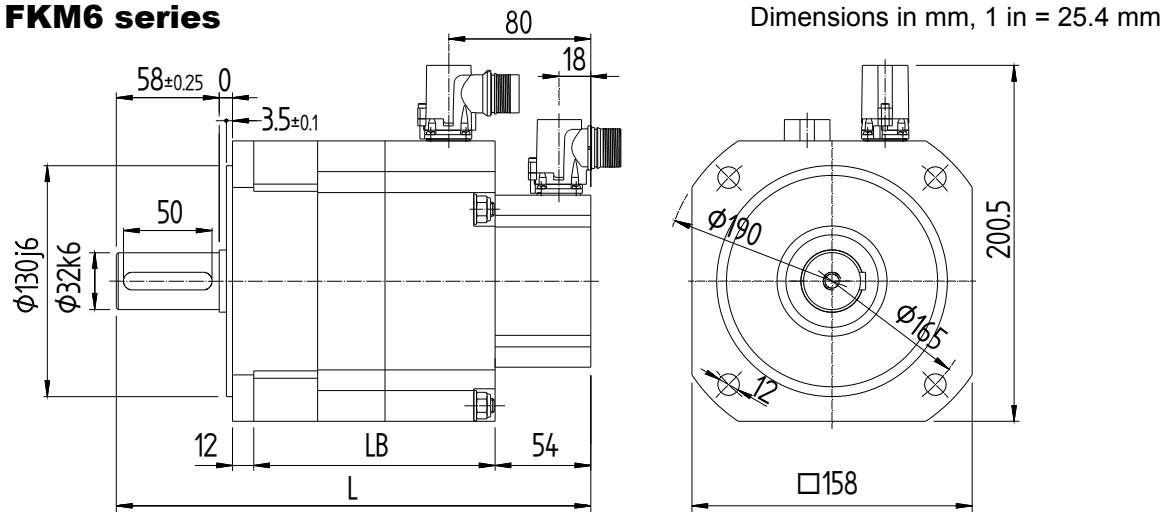
Dimension	LB		L	
Units	mm	in	mm	in
FKM42	133	5.23	247	9.72
FKM43	175	6.88	289	11.38
FKM44	175	6.88	289	11.38

Dimension	ØD j6	
Units	mm	in
FKM4	24	0.94

Dimension	F		GD		R		GA		ST
Units	mm	in	mm	in	mm	in	mm	in	mm
FKM4	8	0.31	7	0.27	40	1.57	27	1.06	M8x19

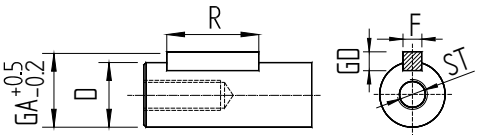
FKM6 series

Dimensions in mm, 1 in = 25.4 mm



Dimension	LB		L	
Units	mm	in	mm	in
FKM62	136	5.35	260	10.24
FKM63	172	6.77	296	11.65
FKM64	172	6.77	296	11.65
FKM66	208	8.18	332	13.07

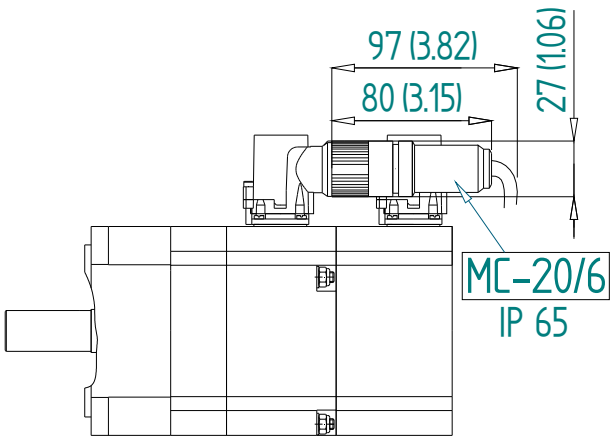
Dimension	ØD k6	
Units	mm	in
FKM6	32	1.26

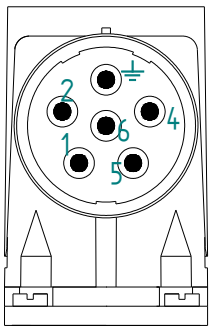


Dimension	F		GD		R		GA		ST
Units	mm	in	mm	in	mm	in	mm	in	mm
FKM6	10	0.39	8	0.31	50	1.96	35	1.37	M10x22

Power connector

The power connector includes the pins of the holding brake itself (pins 4 and 5). A voltage between 22 and 26 V DC 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), the shaft will turn clockwise (CWR, **C**lock**W**ise **R**otation).





PIN	SIGNAL
1	U PHASE
2	V PHASE
6	W PHASE
3	GND
4	BRAKE +
5	BRAKE -

POWER CONNECTOR — **E.g. MC - 20/6**

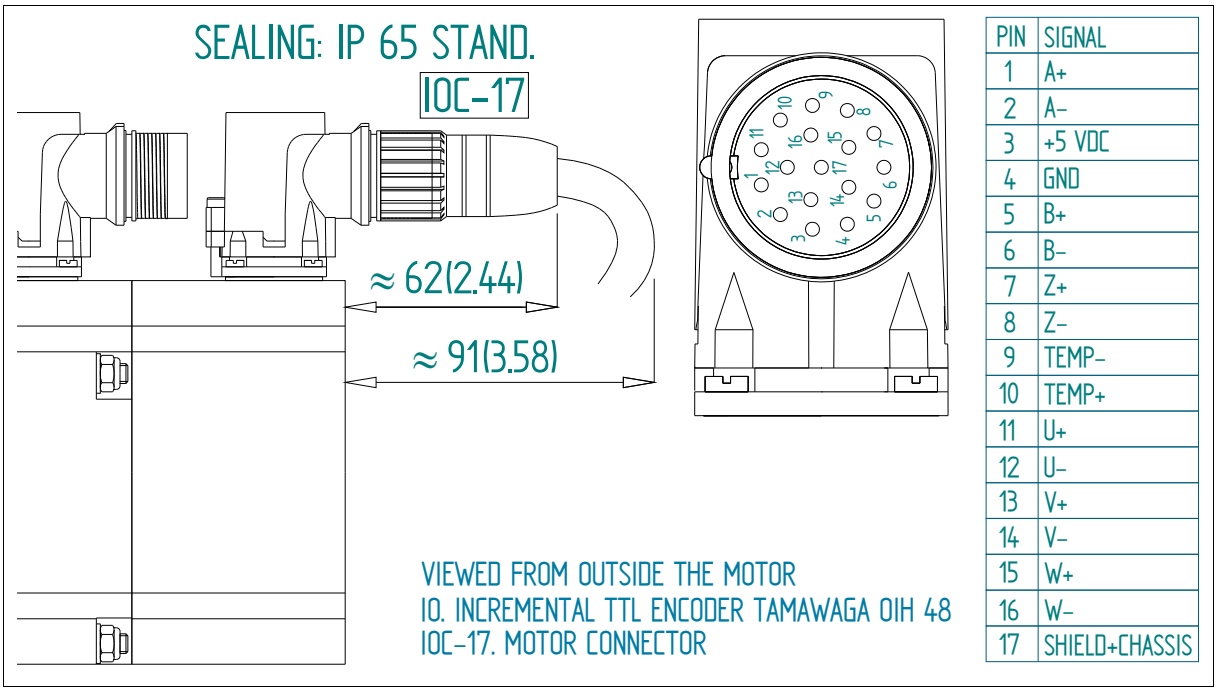
Power cable connector — **MC - 20/6**

Current — **20 Amperes**

FAGOR AUTOMATION

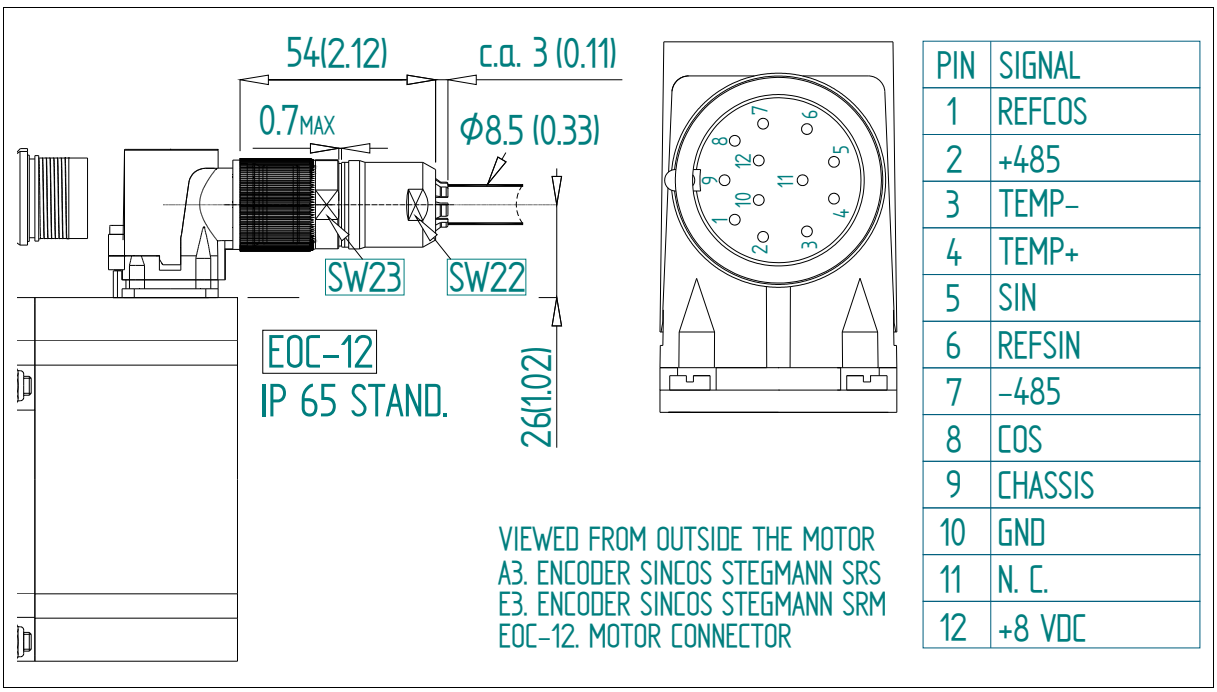
Motor feedback connector

Pins 9 and 10 on the connector of the TTL incremental encoder (ref. I0) correspond to the thermal sensor of the motor that monitors its heating. Note that the PTC KTY84-130 thermistor has polarity, pin 9 - / pin 10 +, while the PTC Pt1000 does not.



PIN	SIGNAL
1	A+
2	A-
3	+5 VDC
4	GND
5	B+
6	B-
7	Z+
8	Z-
9	TEMP-
10	TEMP+
11	U+
12	U-
13	V+
14	V-
15	W+
16	W-
17	SHIELD+CHASSIS

Pins 3 and 4 on the connector of the SinCos encoder correspond to the thermal sensor of the motor that monitors its heating. Note that the PTC KTY84-130 thermistor has polarity, pin 3 - / pin 4 +, while the PTC Pt1000 does not.



PIN	SIGNAL
1	REFCOS
2	+485
3	TEMP-
4	TEMP+
5	SIN
6	REFSIN
7	-485
8	COS
9	CHASSIS
10	GND
11	N. C.
12	+8 VDC

Holding brake

FKM motors have an optional holding brake that applies friction to the shaft. Its purpose is to immobilize or lock vertical axes, not to brake a moving axis.

Technical data

Its main characteristics depending on the type of brake are:

Motor	Holding torque		Power consumption		ON/OFF time	Range of releasing voltage	Inertia	Mass approx.	
Units	N·m	lbf·ft	W	hp	ms	V DC	kg·cm²	kg	lbf
FKM2	4.5	3.32	12	0.016	7/35	22-26	0.18	0.30	0.66
FKM4	9.0	6.64	18	0.024	7/40	22-26	0.54	0.48	1.06
FKM6	18.0	13.28	24	0.032	10/50	22-26	1.66	0.87	1.92

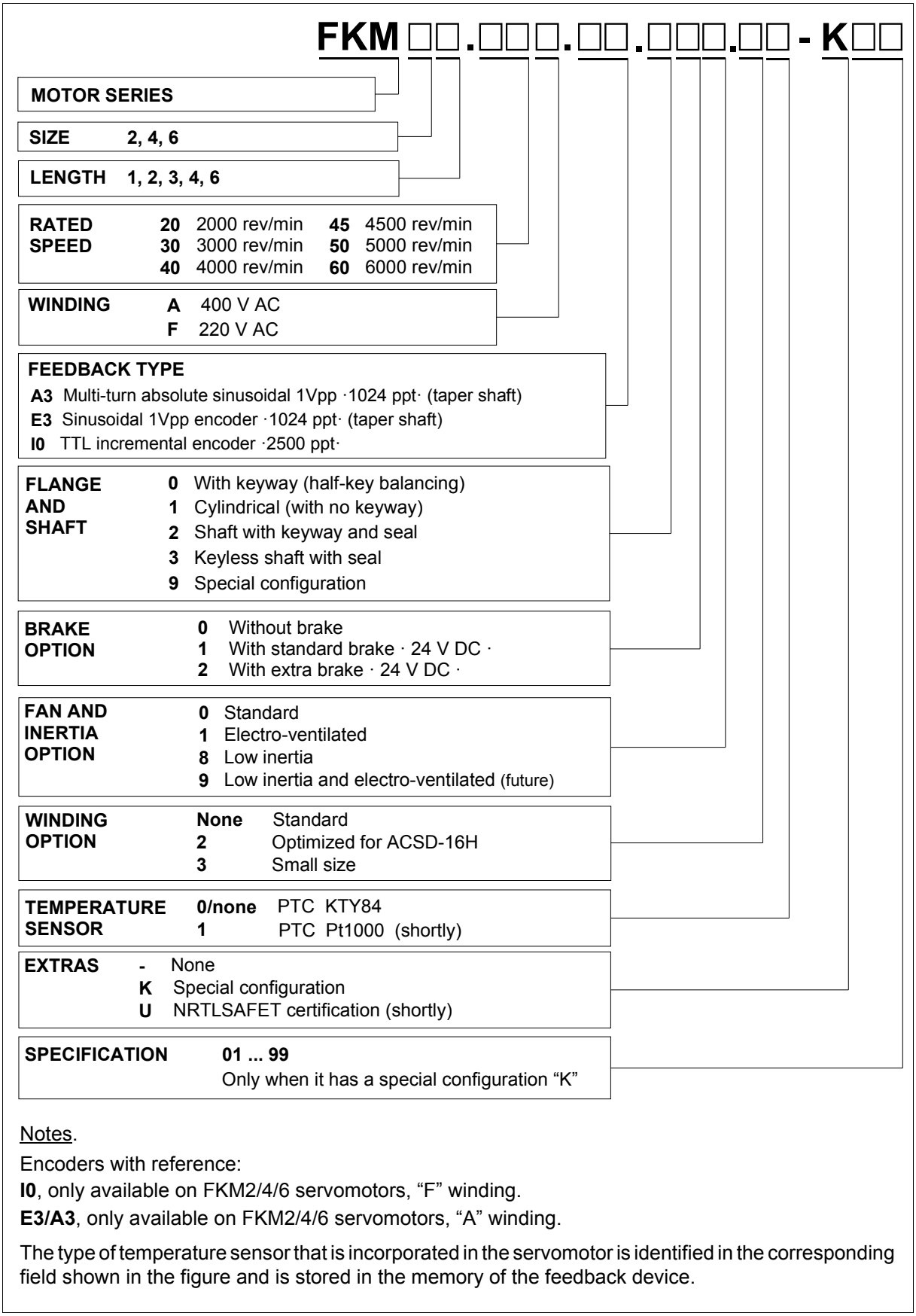
Note. Maximum speed for all of them is 10000 rev/min.

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

WARNING.

- ❑ The holding brake must never exceed its maximum turning speed.
- ❑ Voltage between 22 and 26 V DC releases the shaft. 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 reference



Notes.

Encoders with reference:

I0, only available on FKM2/4/6 servomotors, “F” winding.

E3/A3, only available on FKM2/4/6 servomotors, “A” winding.

The type of temperature sensor that is incorporated in the servomotor is identified in the corresponding field shown in the figure and is stored in the memory of the feedback device.

COMPACT DRIVES, MCS

Introduction

The MCS family is a compact speed servo drive family for controlling synchronous AC brushless motors.

It has two series depending on the supply voltage they can be connected to: Thus, we will refer to:

MCS (H series) if the power supply voltage is 400 V AC
MCS (L series) if the power supply voltage is 220 V AC

where each of them will have the following models depending on their peak current:

- For the MCS-xxH series:

MCS-04H	**MCS-08H**	**MCS-16H**	

with peak currents of 4, 8 and 16 A.

- For the MCS-xxL series:

MCS-05L	**MCS-10L**	**MCS-20L**	**MCS-30L**

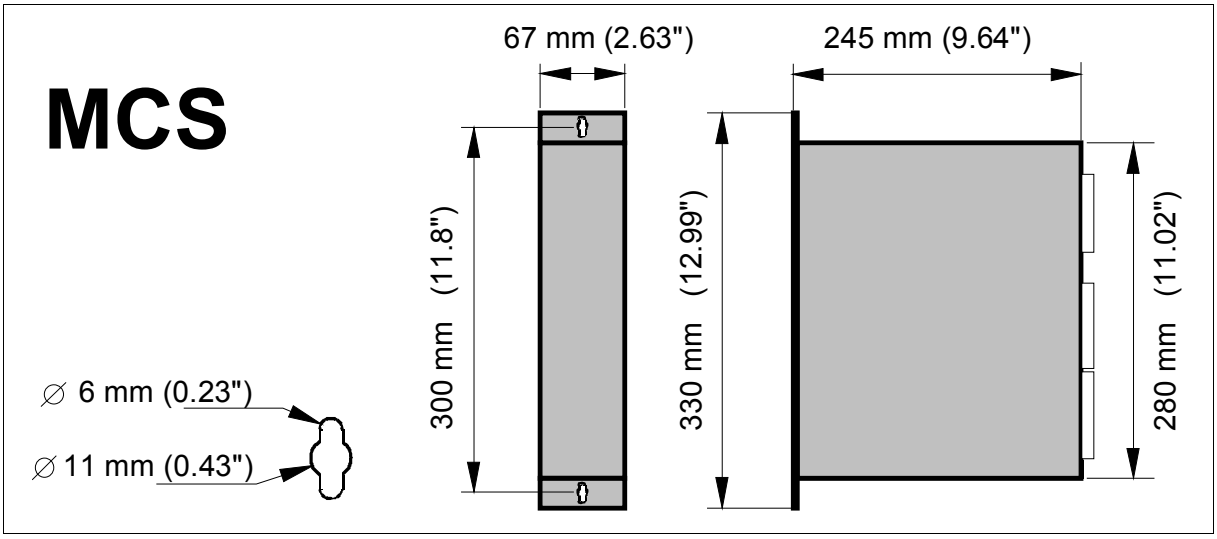
with peak currents of 5, 10, 20 and 30 A.

General characteristics

Their main characteristics are:

- Three phase power supply.
- Dynamic braking in case of mains failure.
- PWM IGBTs.
- 2500-line incremental TTL encoder feedback or 1Vpp sinusoidal encoder.
- Programmable encoder simulator output.
- RS-422 serial line.
- Two logic inputs for motor control: Speed Enable and Drive Enable.
- One programmable logic input.
- One programmable logic output.
- Two programmable logic outputs.
- Integrated functions.
- “On-line” parameter editing.
- Integrated programming module.
- Typical protections in velocity drives.
- RS-232, RS-422 and RS-485 communications interfaces.
- Communication protocol: ModBus.

Dimensions



Technical data

	· 220 V · L series				· 400 V · H series		
	05	10	20	30	04	08	16
Irated output (A)	2,5	5	10	15	2	4	8
Ipeak (0.5 s) (A)	5	10	20	30	4	8	16
Power sypply	3 AC 220/240 V ±10% 50/60 Hz ±10%				3 AC 400/460 V ±10% 50/60 Hz ±10%		
Consumption (A)	5.6	11.1	22.2	33.3	4.4	8.9	16.7
Consumption (A) on single-phase models*	9.5	18.5	-	-	-	-	-
Over-voltage protection	430 V DC				803 V DC		
Frequency	Lower than 600 Hz						
Internal Ballast (Ω)	112	56	28	18	132	132	66
Power of the internal Ballast	150 W						
Ballast trigger	416 V DC				780 V DC		
Thermal protect. 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						
Dimensions	67 x 280 x 245 mm (2.48 x 11.8 x 9.05 in)						
Mass	3.85 kg (8.5 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.

INFORMATION. * Modules MCS-05L and MCS-10L (220 VAC) may be supplied with a single-phase power voltage.

Connectors

Power terminals

POWER INPUTS L1, L2, L3. 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.

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

CONTROL POWER INPUTS L1, L2, GROUND (X3). 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. Total isolation between the power and the control circuits.

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 heatsink 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

Voltage ± 12 V (pins 1, 2 and 3 of X1). Output of an internal power supply so the user can easily generate a command signal. It offers a maximum current of 20 mA limited internally.

Velocity command (pins 4, 5 and 6 of X1). Velocity command input for the motor. It admits a range ±10 V and offers an impedance of 22 kΩ.

Programmable analog input (pins 4 and 7 of X1). Input of the analog command used by some integrated function. It offers an impedance of 10 kΩ.

Programmable analog output 1 (pins 8 and 10 of X1). Voltage range of ± 10 V.

Programmable analog output 2 (pins 9 and 10 of X1). Voltage range of ±10V. They offer an analog value of a set of internal variables of the drive.

Programmable digital output 1 (pins 1 and 2 of X2). Optocoupled open collector output that reflects the output of some integrated functions.

Common (pin 5 of X2). Reference point for the following:

Drive Enable (pin 4 of X2). At 0 V DC no current can circulate through the motor and it has no torque.

Speed Enable (pin 3 of X2). At 0 V DC, it forces an internal zero velocity command.

NOTE. These control signals are activated with + 24 V DC.

Drive Ok (pins 6 and 7 of X2). Relay contact that closes when the internal status of the drive control is OK. It must be included in the electrical maneuver.

Programmable digital input (pins 8 and 9 of X2). Digital input that is used as input to some integrated functions (0 and + 24 V). By default, it is selected as error reset.

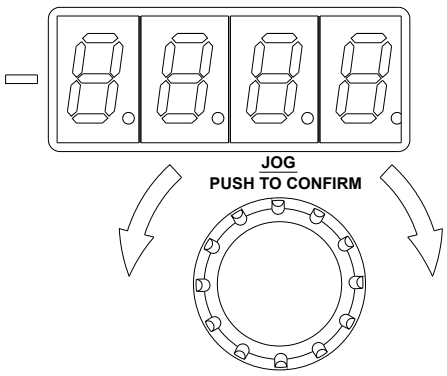
Motor feedback input + motor temp. sensor. Input of the encoder signals installed on the motor for “position+velocity” feedback and of the temperature sensor of the motor.

Encoder simulator output. Outputs of those same encoder signals, divided by the preset factor, for closing the position loop at the CNC.

NOTE. The maximum cable section at these terminals is 0.5 mm². See the chapter on installation.

RS232/RS422/RS485 communications. Connector used to communicate with other equipment with the RS-232, RS-422 or RS-485 serial line.

Programming module



The programming module (present on MCS model) has four numeric displays of 7 segments, a sign indicator and a rotary decoder with a push button for confirmation incorporated on the knob itself.

The rotating direction may be:

▶ **Clockwise** being possible to:

- To scroll through the list of parameters, variables and commands and display a particular one.
- To increase its value (if parameters).

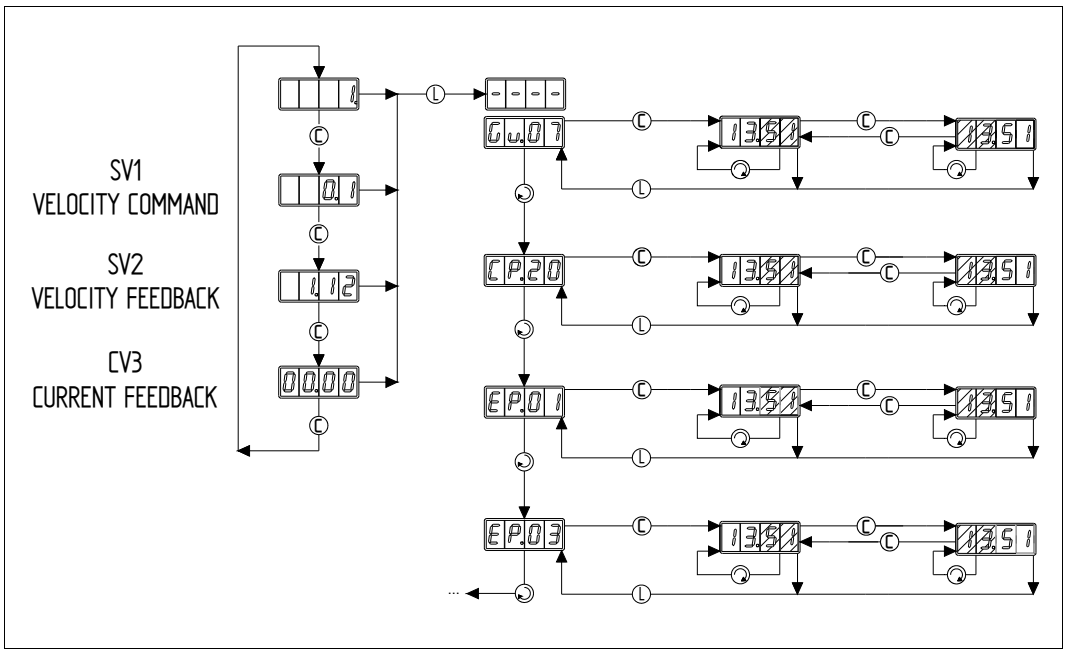
▶ **Counterclockwise** being possible to:

- To decrease its value.

The push-button may be pressed in two ways:

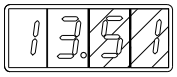
- Short push (C).
- Long push (L).

The following diagram shows the sequence to follow to display parameters, variables, commands; modify the value of a parameter, confirm its new value, ...

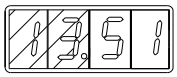


There are also a set of variables and certain commands of special characteristics whose meaning and sequences to follow are described in section **"Initialization and setup"** in this manual.

Interpretation of the symbols used in some diagrams of this manual.



Blinking status of the two rightmost digits of the display.



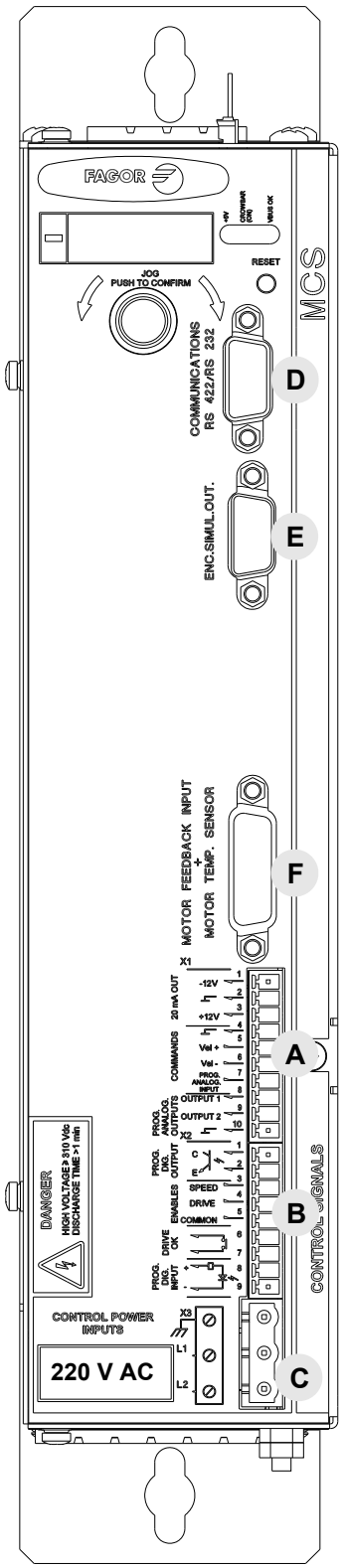
Blinking status of the two leftmost digits of the display.

Long push on the programming module.

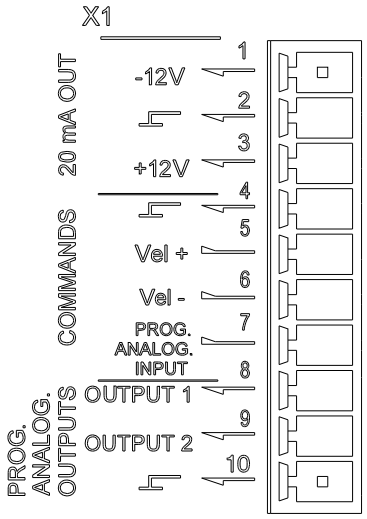
Short push on the programming module.

Rotary decoder on the programming module.

Front panel and pinout of the connectors



A. CONNECTOR X1

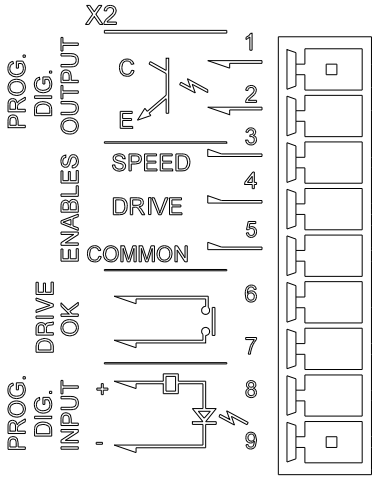


± 12 V
power supply

Commands

Monitoring

B. CONNECTOR X2



Programmable digital output

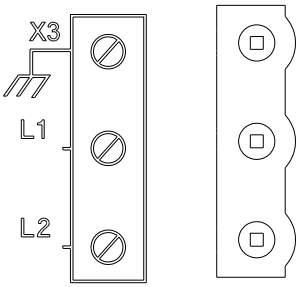
Enables

Drive ok

Programmable digital input

C. CONNECTOR X3

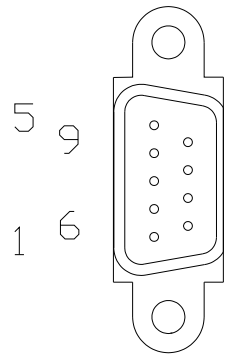
Control voltage supply



Power input pins to the auxiliary power supply

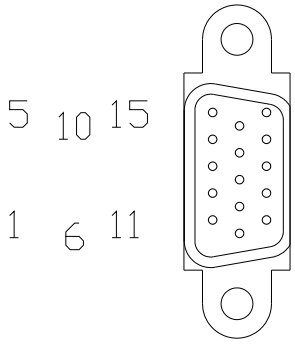
NOTE. The label 220 V AC will indicate 400 V AC on the corresponding models.

D. Communications connector



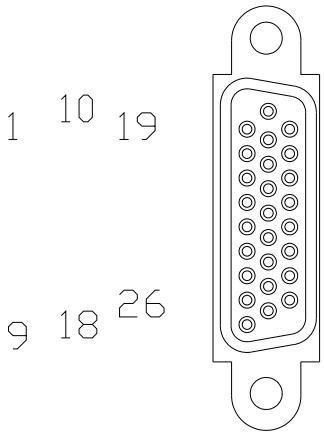
Pin	Signal	Function
1	N.C.	Not connected
2	R x D	R x D (232)
3	T x D	T x D (232)
4	+ 5 V	Voltage supply
5	GND	GND
6	T x D +	T x D + (422)
7	T x D -	T x D - (422)
8	R x D +	R x D + (422) T x D / R x D + (485)
9	R x D -	R x D - (422) T x D / R x D - (485)
	CHASSIS	Screws

E. Output connector of the encoder simulator



Pin	Signal	Function
1	A +	A + signal
2	A -	A - signal
3	B +	B + signal
4	B -	B - signal
5	Z +	Z + signal
6	Z -	Z - signal
7	+ 485	RS485 serial line transmission signal
8	- 485	
9	N.C.	Not connected
10	N.C.	Not connected
11	GND	0 volts
12	REFCOS	Cosine signal ref. level
13	COS	Encoder cosine signal
14	REFSIN	Sine signal ref. level
15	SIN	Encoder sine signal
	CHASSIS	Screws

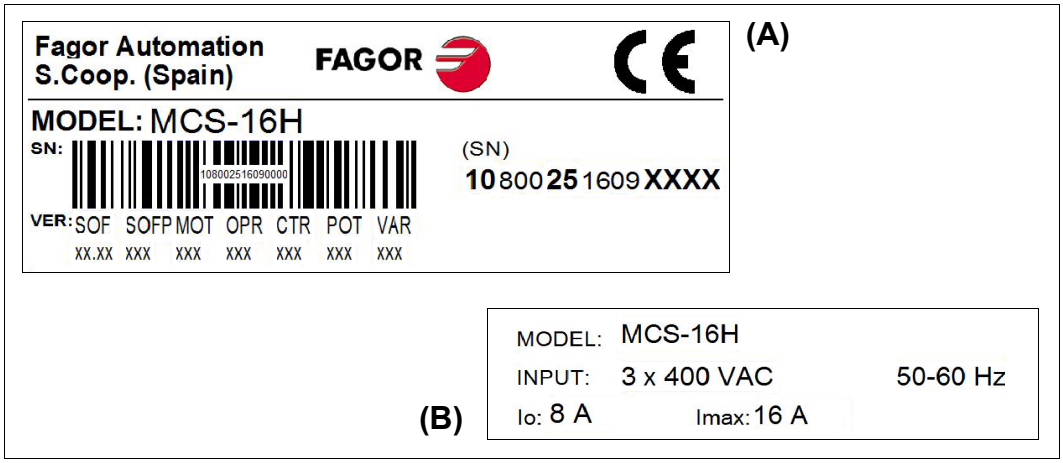
F. Input connector of the motor feedback and temperature sensor



Pin	Signal	Function
1	A+	A+ signal
2	B+	B+ signal
3	Z+	Z+ signal
4	U-	Phase switching U -
5	W-	Phase switching W -
6	V-	Phase switching V -
7	N.C.	Not connected
8	N.C.	
9	N.C.	
10	A-	A- signal
11	B-	B- signal
12	Z-	Z- signal
13	U+	Phase switching U+
14	W+	Phase switching W+
15	V+	Phase switching V+
16	N.C.	Not connected
17	SELSEN1	Information of the installed sensor given to the drive via hardware
18	SELSEN2	
19	+485	RS-485 serial line for sinusoidal encoder (refs. E1/A1/E3/A3)
20	- 485	
21	TEMP-	Thermal sensor of the motor PTC KTY-84 or PTC Pt1000
22	TEMP+	
23	+8 V DC	Voltage supply for the sinusoidal encoder. Refs. E1/A1/E3/A3
24	+5 V DC	Supply voltage for the incremental TTL encoder Ref. I0
25	GND	0 volts
26	CHASSIS	Pin
	CHASSIS	Screws

Unit identification

The version label (**A**) and specifications label (**B**) that come with each FAGOR MCS digital drive show the following information:



SOF, SOFP, MOT, OPR, CTR, POT and VAR indicate manufacturing related aspects (hardware design versions) that are useful for technical consultations and repairs.

Sales reference

Codes of the sales reference of FAGOR drives.

MCS DIGITAL SERVO DRIVE			Example:	MCS -	05	L
MODEL	MCS					
CURRENT		Rated	Peak (0.5 s)			
	05	2.5 A	5 A			
	10	5 A	10 A			
	20	10 A	20 A			
	30	15 A	30 A			
SUPPLY VOLTAGE			220 V AC			

MCS DIGITAL SERVO DRIVE			Example:	MCS -	04	H
MODEL	MCS					
CURRENT		Rated	Peak (0.5 s)			
	04	2 A	4 A			
	08	4 A	8 A			
	16	8 A	16 A			
SUPPLY VOLTAGE			400 V AC			

INSTALLATION

General considerations

At the motor

Remove the anti-corrosion paint of the shaft before mounting them on to the machine.

The motor may be mounted as described in the first chapter (B5, V1 and V3).

Watch for the ambient conditions mentioned in the section on general characteristics and also:

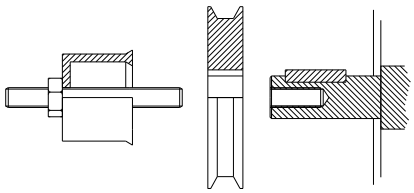
- ❑ Mount it somewhere that is dry, clean and accessible for maintenance.

NOTE. Remember that the degree of protection is IP 64.

- ❑ 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

Always install the module vertically and in an electrical cabinet that is clean, dry, free of dust, oil and other pollutants.

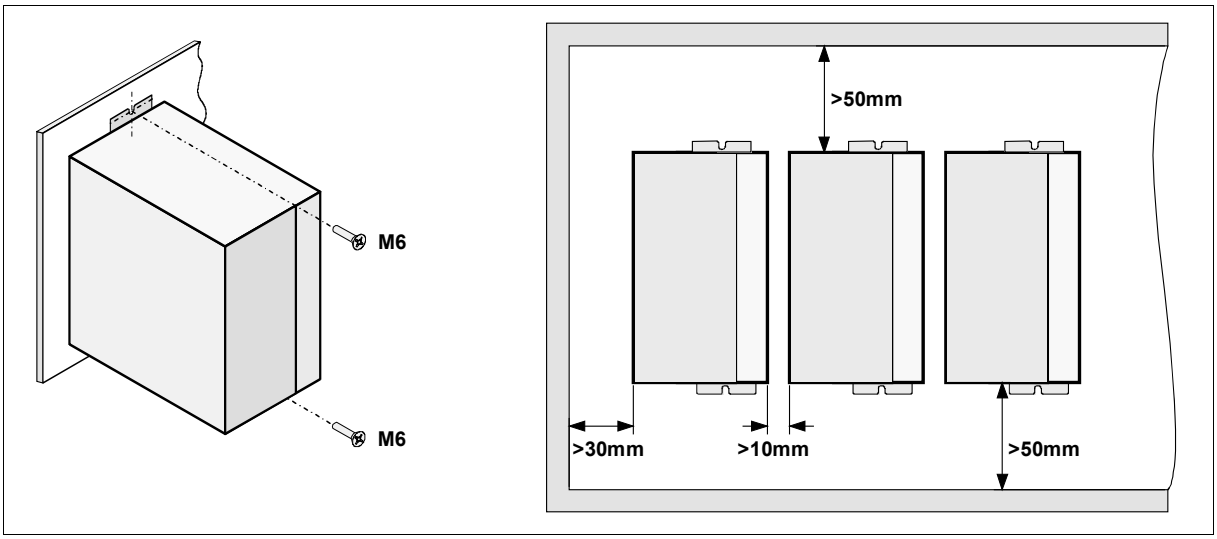
NOTE. Remember that the degree of protection is IP 20.

Never install it exposing it to flammable gases.

Avoid excessive heat and humidity.
Never exceed the room temperature of 45°C/113°F.

Avoid vibrations.

Respect the gaps inside the electrical cabinet to let air flow freely.
See the following figure.



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.

Connect the shield of the motor power cable to the chassis screw at the bottom of the module and it, in turn, to mains ground.

The command signal lines must be shielded twisted pairs.

Connect the shield to the voltage reference at the module, i.e. pins 2, 4 and 10 of X1.

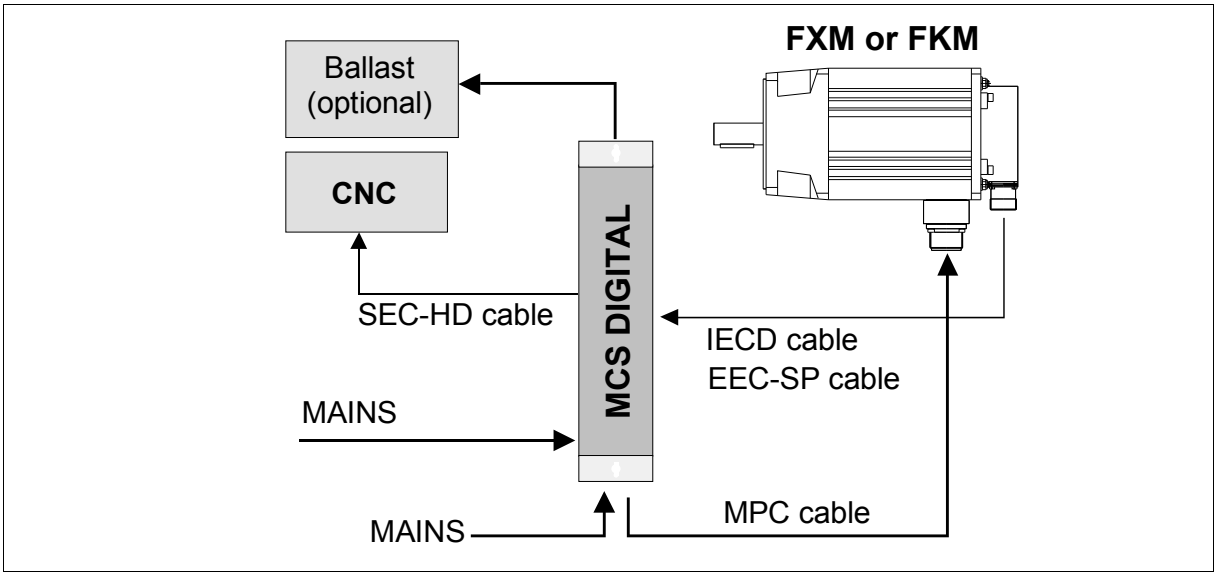
NOTE. Keep the signal cables away from the power cables.

All the pins with the GND symbol (2, 4 and 10) are the same electrical point and are interchangeable.

Electrical connections

Basic interconnection diagram

See section, “**Encoder feedback connection**”

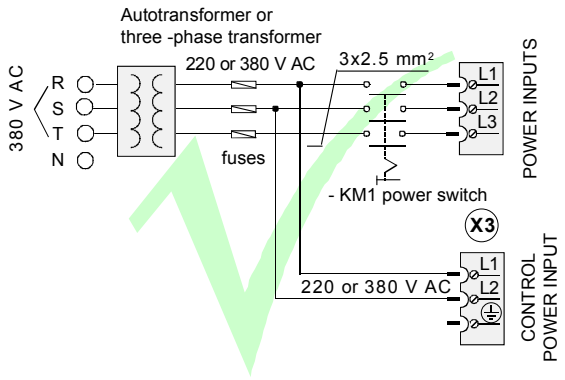


Power connection. Mains-Drive

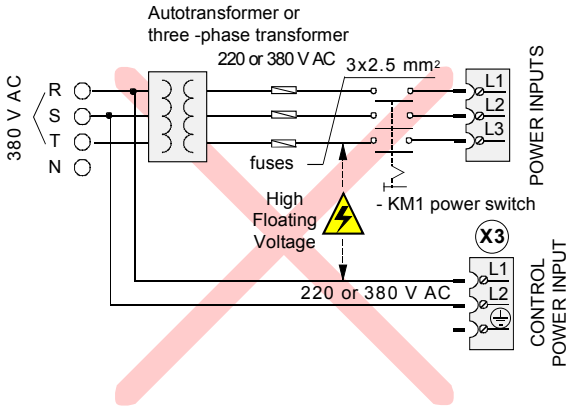
The drive power supply must be three-phase, except in modules MCS-05L and MCS-10L **that can also be single-phase**. See parameter GP16.

NOTE. The use of a transformer is not a must.

THREE PHASE

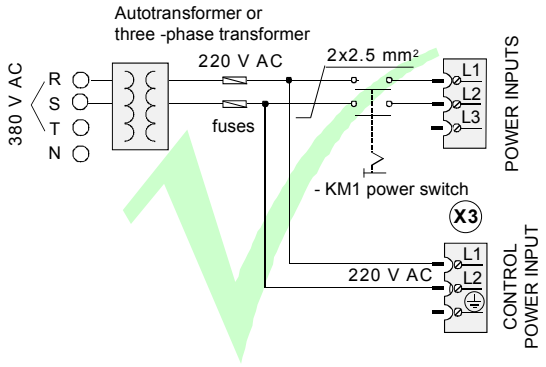


Warning. Never make this connection because there is a risk of destroying the module.

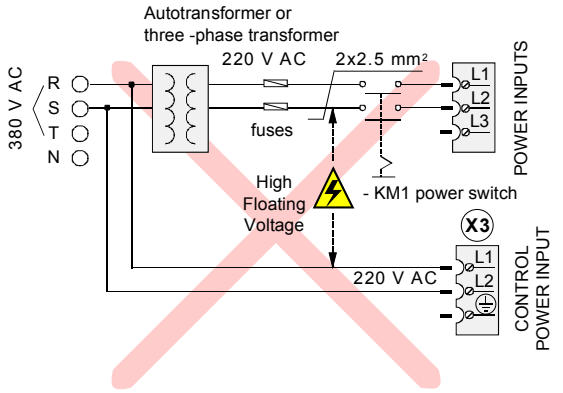


SINGLE - PHASE

Note. Only in MCS-05L and MCS-10L models



Warning. Never make this connection because there is a risk of destroying the module.



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.

Model	Ipeak	Fuse
Units	A	A
MCS-05L	05	04
MCS-10L	10	08
MCS-20L	20	16
MCS-30L	30	25

Model	Ipeak	Fuse
Units	A	A
MCS-04H	04	04
MCS-08H	08	08
MCS-16H	16	16

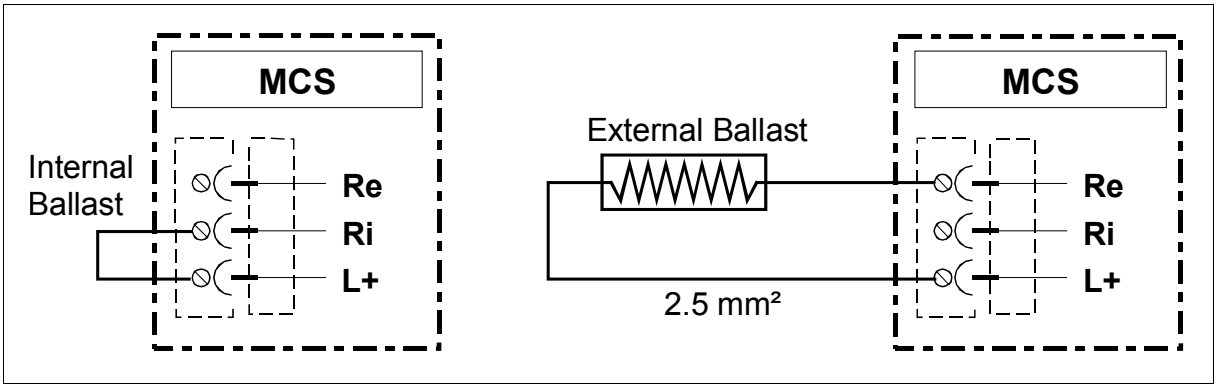
NOTE. A thermal switch may optionally replace the fuses.

NOTE. The secondary windings must have a star connection with its middle point connected to ground.

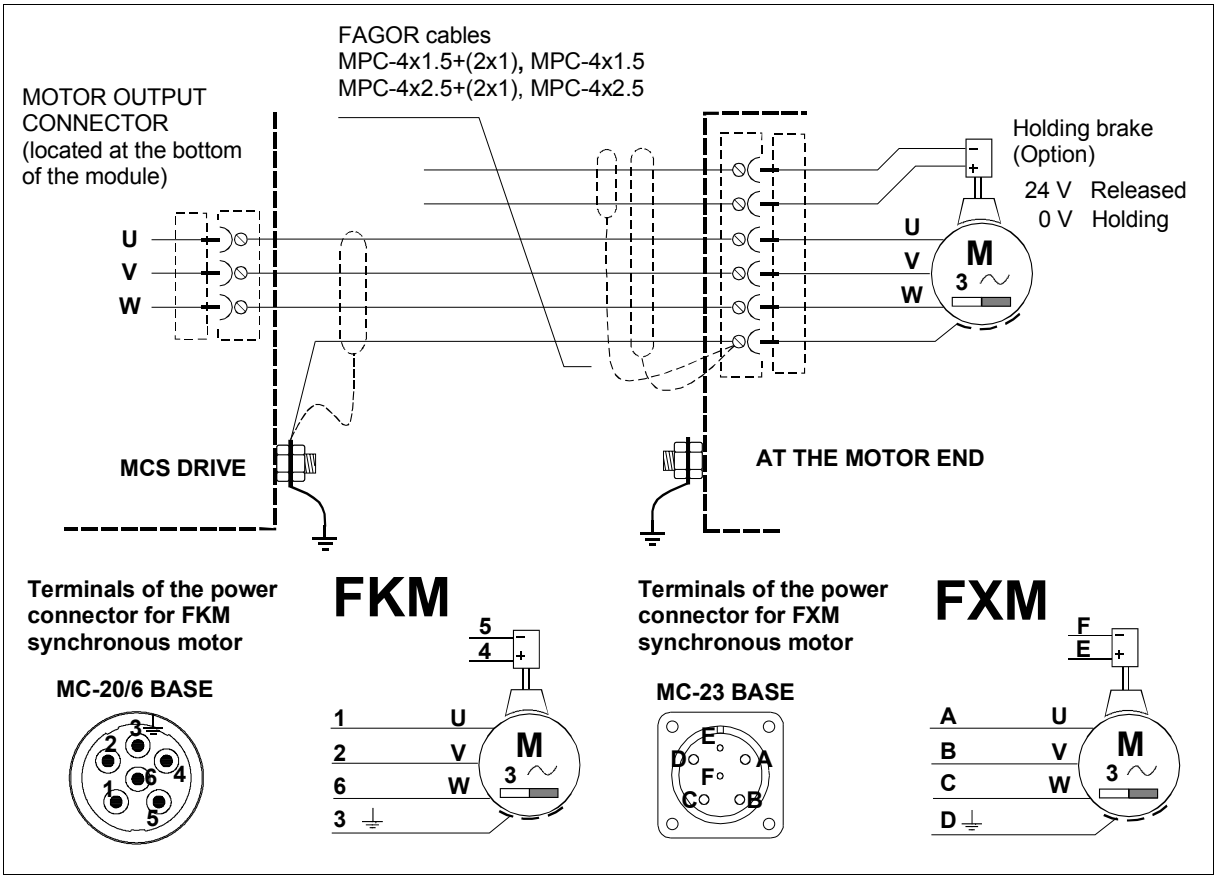
Power connection. External Ballast resistor

If the application requires a Ballast resistor with more than 150 W:

- ❑ 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 the value in the technical data table.
- ❑ Use KV41 to indicate to the drive that an external ballast resistor has been connected.



Power connection. Drive-motor

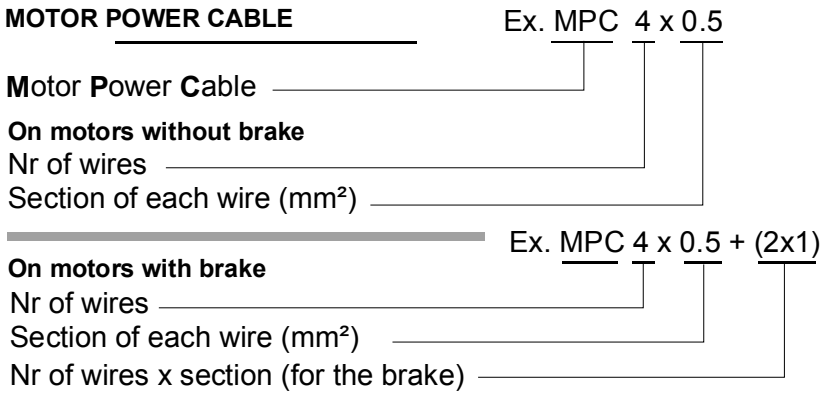


Power cables

If the motor does not have a	If the motor has a brake
MPC-4x1.5	MPC-4x1.5+(2x1)
MPC-4x2.5	MPC-4x2.5+(2x1)

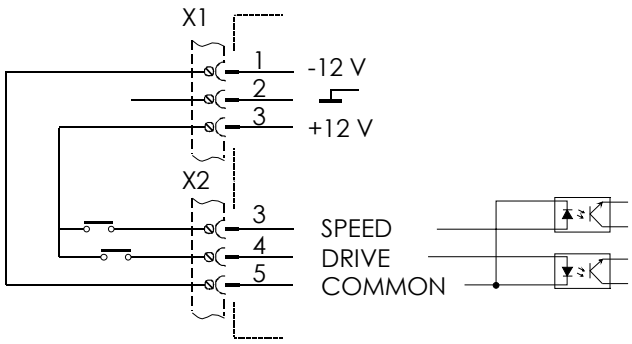
NOTE. The length of the MPC power cable must be specifically ordered (in meters).

Codes of the sales reference of FAGOR power cables.

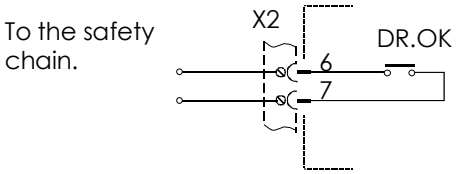


Connection of the monitoring and control signals

Enable signals using ±12V voltage



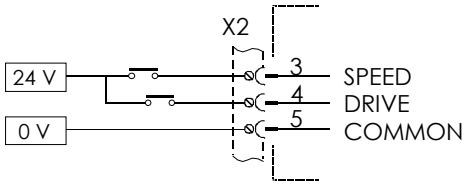
Drive OK switch



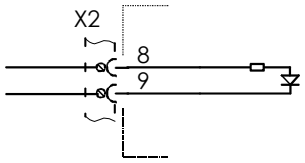
Drive OK :

0.6 A - 125 V AC
0.6 A - 110 V DC
2 A - 30 V DC

Enable signals

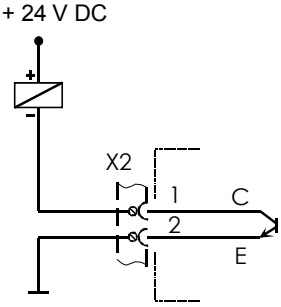


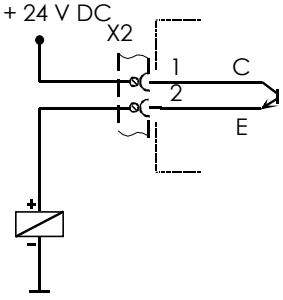
Programmable digital input



Programmable digital outputs

Maximum current	100 mA
Maximum voltage	50 V





Encoder feedback connection

The signals generated by the encoder are taken to the ENCODER INPUT of the MCS drive. The MCS amplifies these signals and may divide their frequency. The division factor is given by the values of parameter EP1 (see parameter) and the sequence between A and B by parameter EP3. The MCS drive offers these signals by the connector ENC. SIMUL. OUT. The encoder must be mounted on to the motor shaft and cannot be installed anywhere else in the transmission chain.

The encoders that can be found on the motors depending on the series are:

At FXM servomotors	At FKM servomotors
I0 Incremental TTL encoder 2500 ppt	**I0** Incremental TTL encoder 2500 ppt
E1 Sinusoidal Sincoder encoder 1024 ppt	**E3** Sinusoidal SinCos encoder (taper shaft) 1024 ppt
A1 Multi-turn absolute SinCos encoder 1024 ppt	**A3** Multi-turn absolute SinCos encoder (taper shaft) 1024 ppt

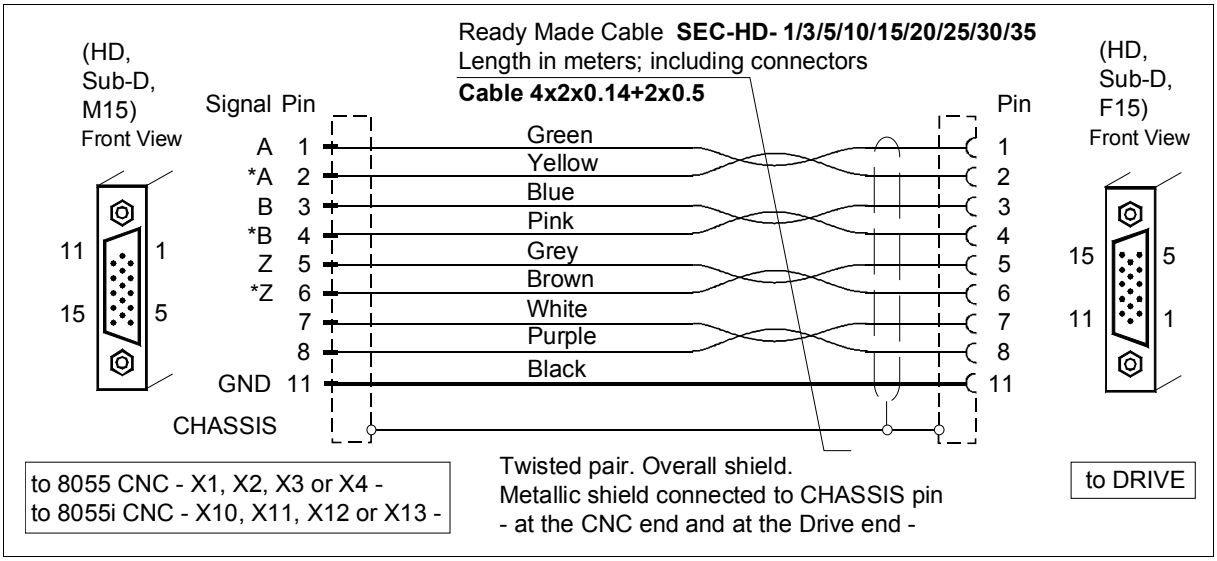
With motor feedback E1 or E3, the output of the encoder simulator multiplies by 4 the number of pulses of the encoder (1024x4=4096 ppt). This (4096) is the highest value to be set in EP1. Note that it may be programmed (it is not a fixed value).

Cabling

FAGOR provides these full connections (cables+connectors): **SEC-HD, IECD and EEC-SP**.

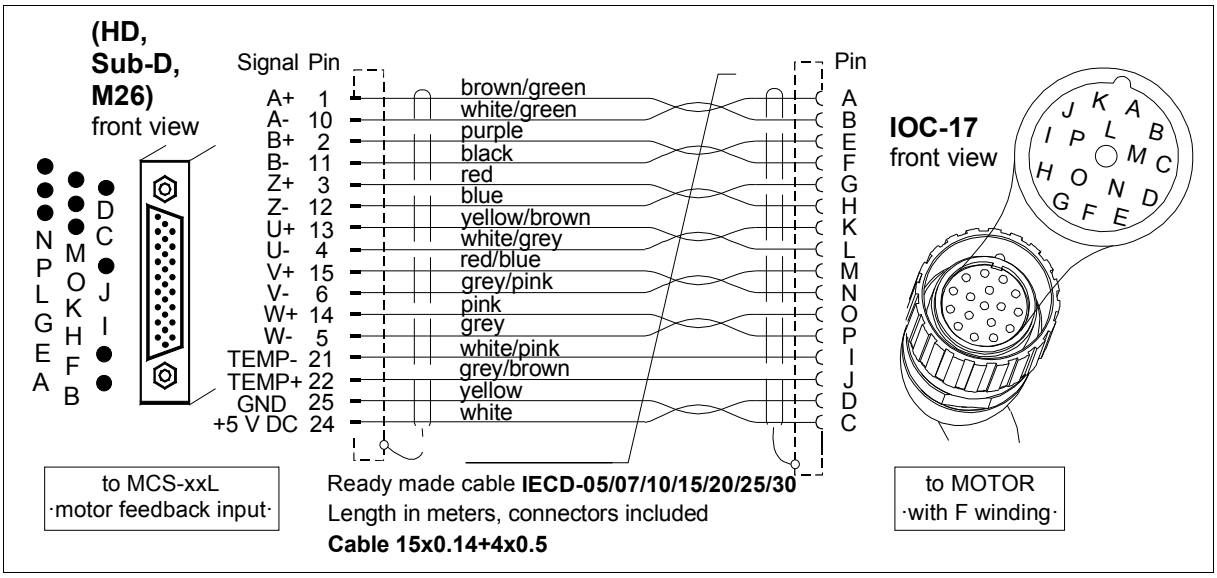
Encoder simulator connecting cable, SEC-HD

Depending on motor feedback, the drive can generate a set of signals that simulate those of a TTL encoder attached to the rotor of the motor. The SEC-HD cable transfers these signals from the drive to the 8055/55i CNC.



TTL encoder connecting cable, IECD

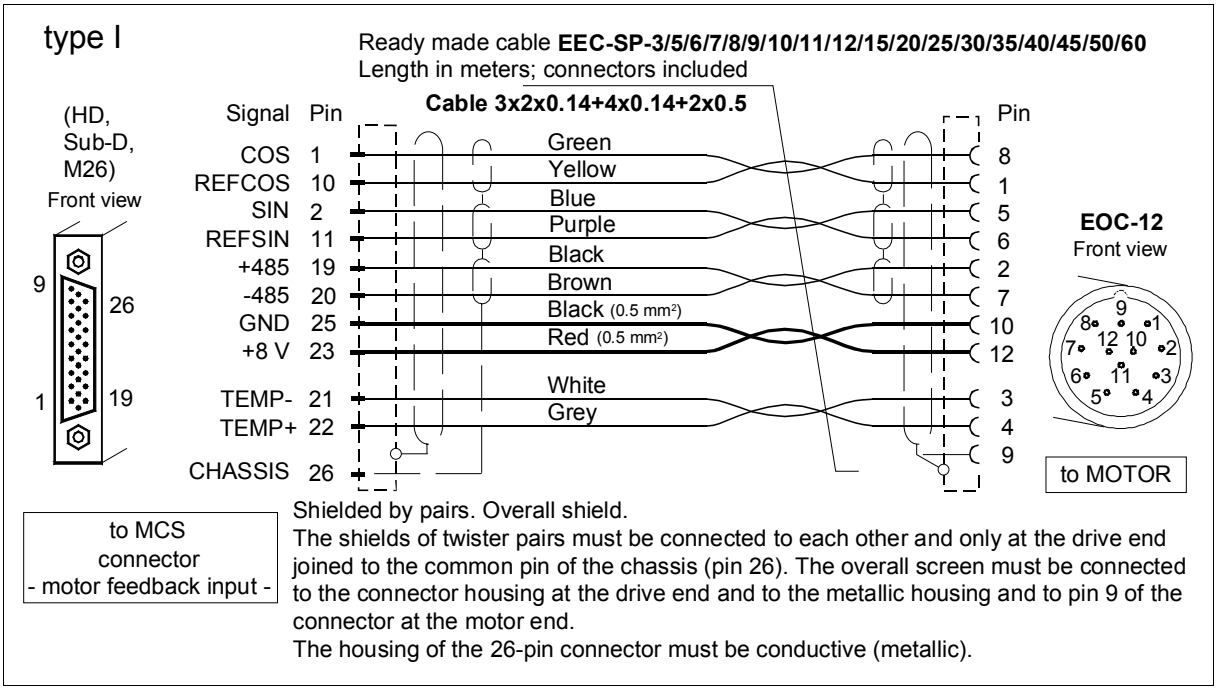
The IECD cable transfers the motor feedback signals from the incremental TTL encoder (ref.I0) to the drive.



Sinusoidal encoder connecting cable, EEC-SP

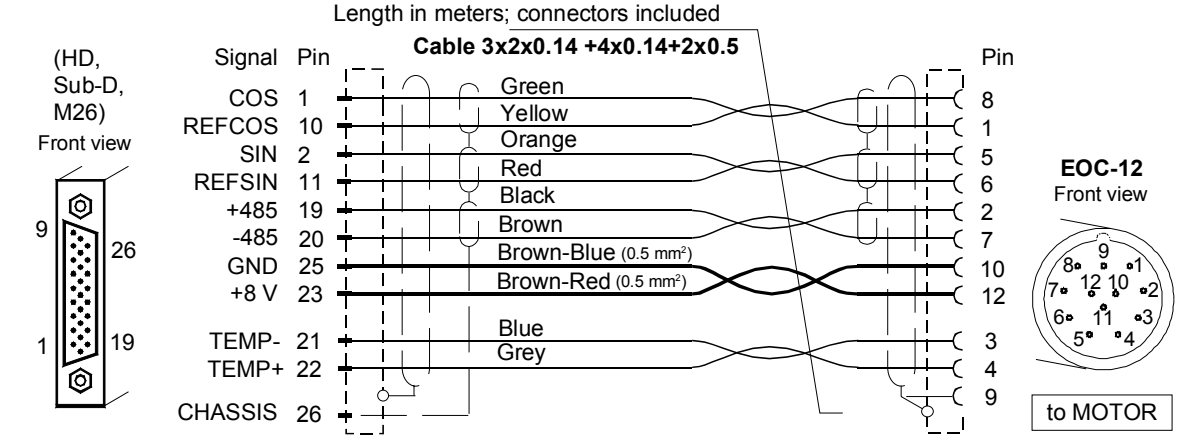
The EEC-SP cable transfers the motor feedback signals from the sinusoidal encoder (ref. A1/A3/E1/E3) to the drive.This cable has overall shield and shielded twisted pairs.

INFORMATION. Note that type I and II of the EEC-SP extension cables **are the same** except the color of their wires. The user must check which one of them matches the one being installed.



type II

Ready made cable **EEC-SP-3/5/6/7/8/9/10/11/12/15/20/25/30/35/40/45/50/60**
Length in meters; connectors included



to MCS connector
- motor feedback input -

Shielded by pairs. Overall shield.
The shields of twister pairs must be connected to each other and only at the drive end joined to the common pin of the chassis (pin 26). The overall screen must be connected to the connector housing at the drive end and to the metallic housing and to pin 9 of the connector at the motor end.
The housing of the 26-pin connector must be conductive (metallic).

Codes of the sales reference of FAGOR cables

ENCODER-DRIVE CABLE	Example:	IECD-	20
CABLE OF INCREMENTAL ENCODER			
LENGTH (m)	05, 07, 10, 15, 20, 25, 30		

SUB-D HD M26 — IOC-17

ENCODER-DRIVE CABLE	Example:	EEC-SP-	20
SINUSOIDAL ENCODER CABLE			
LENGTH (m)	03, 05, 06, 07, 08, 09, 10, 11, 12, 15, 20, 25, 30, 35, 40, 45, 50, 60		

SUB-D HD M26 — EOC-12

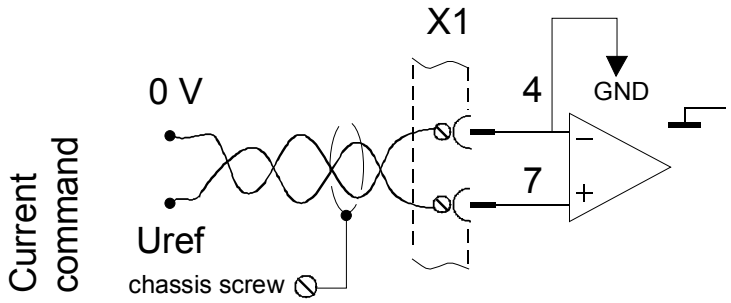
ENCODER-CNC CABLE	Example:	SEC-HD-	20
ENCODER SIMULATOR CABLE			
LENGTH (m)	05, 10, 15, 20, 25, 30, 35		

SUB-D HD M15 — SUB-D HD F15

Analog command signal connection

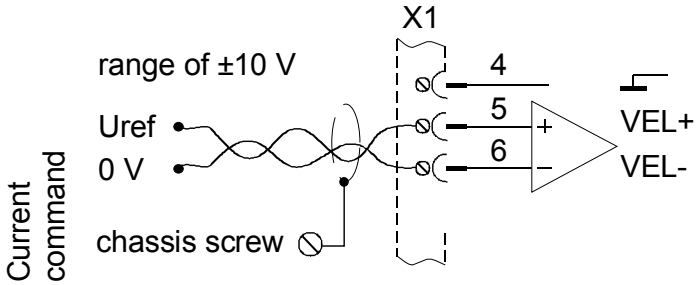
The command governing the motor may be a velocity or current command. All the command signal lines must be shielded twisted pairs. The shield must be connected to the voltage reference at the module (pins 2, 4 and 10).

Current command input

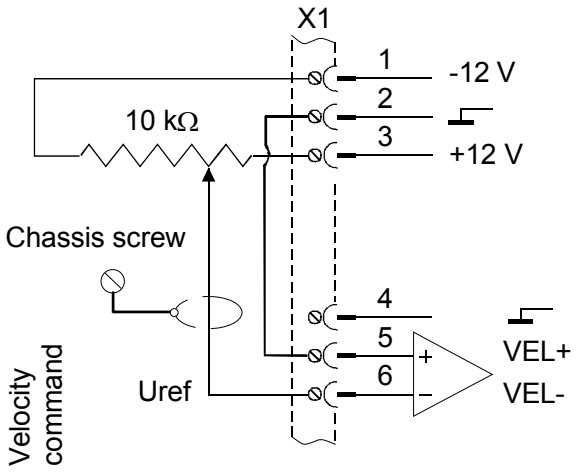


The input impedance of the velocity command is 56 kΩ (a range ± 10 V). The input impedance of the current command is 56 kΩ (a range ± 10 V).

Differential velocity command input



Generation of the inverted velocity command and application to the drive



MCS-PC connection. RS-232 serial line

Connecting a PC compatible computer with an MCS drive via RS-232 makes it possible to set and monitor system variables facilitating its adjustment.

The motor table may be updated in the E²PROM through this line.

The connection cable is:

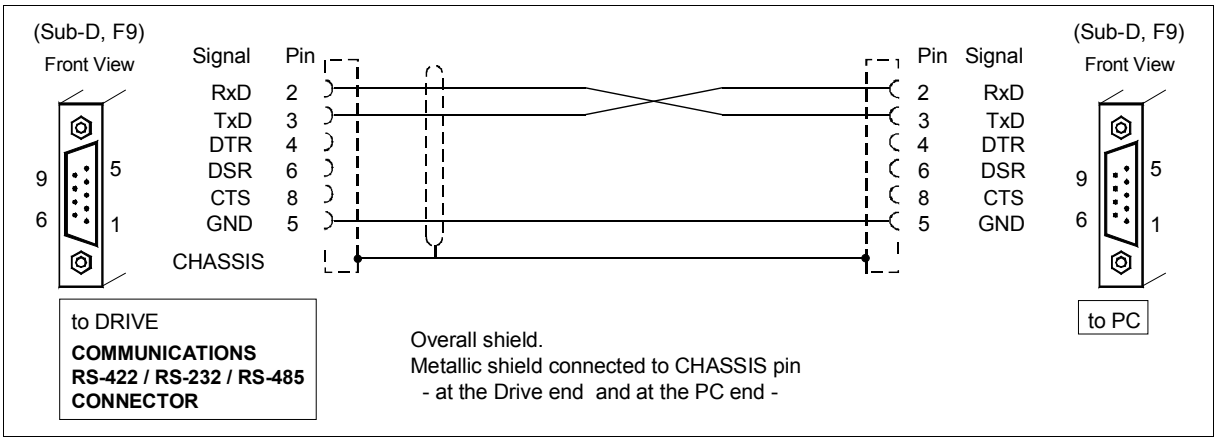


Diagram of the electrical cabinet

This is an orientative diagram for the installation of the electrical cabinet. This diagram may be modified according to the requirements of each application. It includes a simple circuit for the voltage supply of the brake of the servo motors.

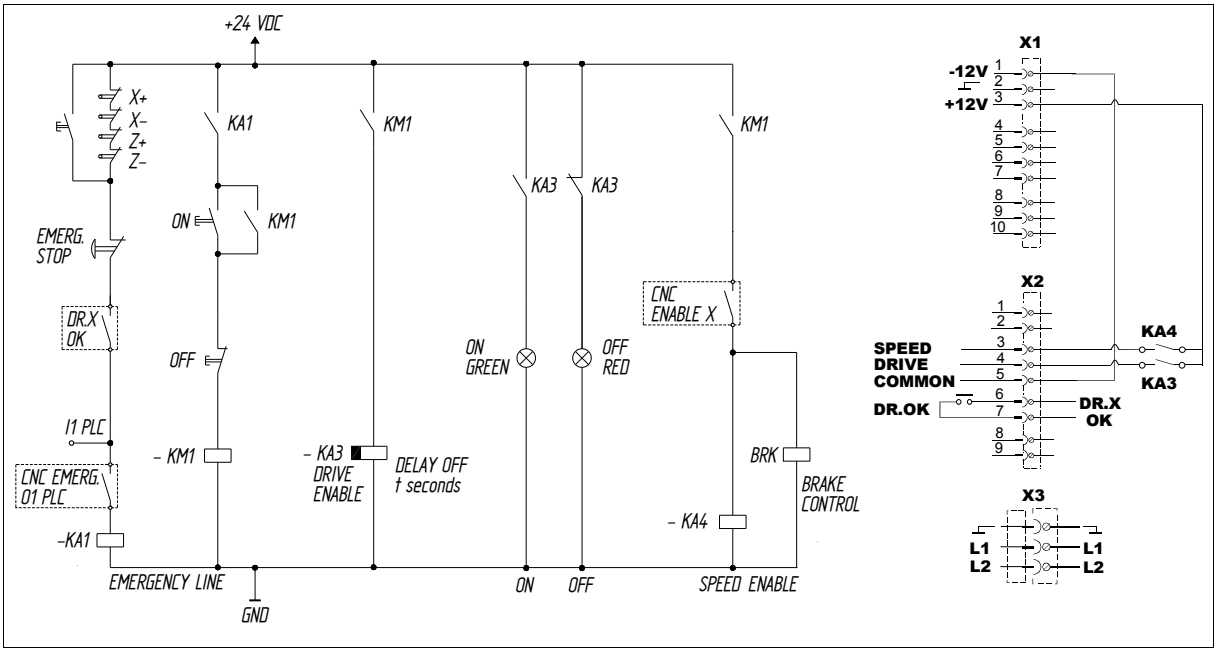
NOTE. When installing an auto-transformer, the secondary must have a star connection and its middle point must be connected to GND.

MANDATORY. The use of fuses is a must.

Mains connection and maneuver diagram

The delayed disconnection of KA3 contacts is useful so:

- ❑ The Drive Enable stays active while the motor brakes at maximum torque.
- ❑ The brake holds the motor after it has stopped.



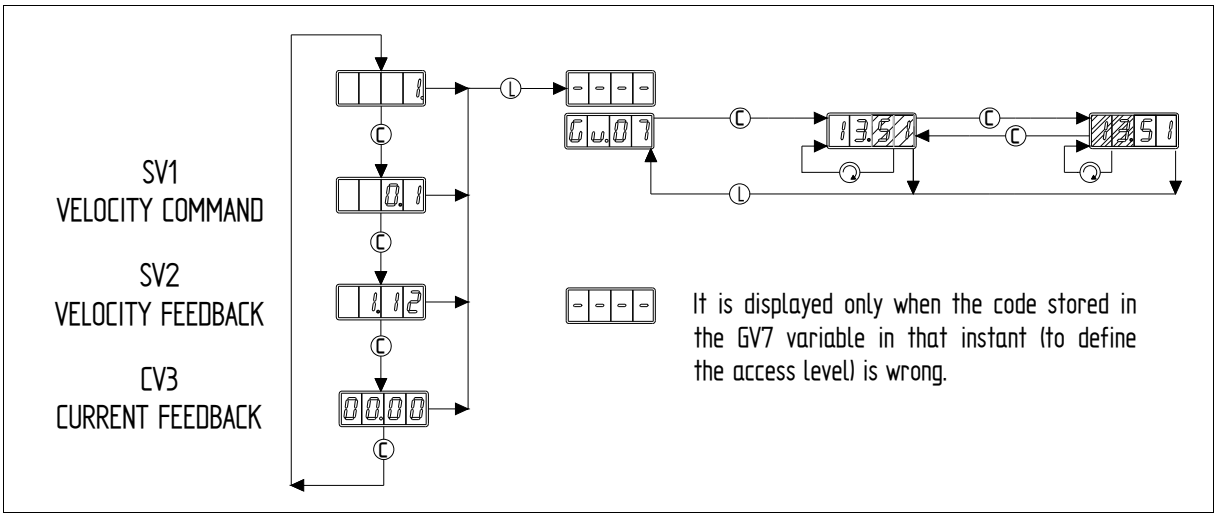
Initialization and adjustment

After starting the motor-drive system, the way the parameters, variables and commands will be displayed and edited will be determined by the access level: FAGOR level, user level or basic level restricting, depending on the level, the access to some or all of them.

This access level is determined by entering its corresponding code in the GV7 variable. This way, with no access level, the following variables may be displayed in this order:

- ❑ SV1: VelocityCommand
- ❑ SV2: VelocityFeedback
- ❑ CV3: CurrentFeedback

To access the rest, access GV7 and browse through as shown below:



If the code is correct, all the parameters, variables and commands permitted by that level may be accessed by turning the rotary decoder. If it is not correct, it will display 4 horizontal lines and the GV7 again allowing to write the level code again.

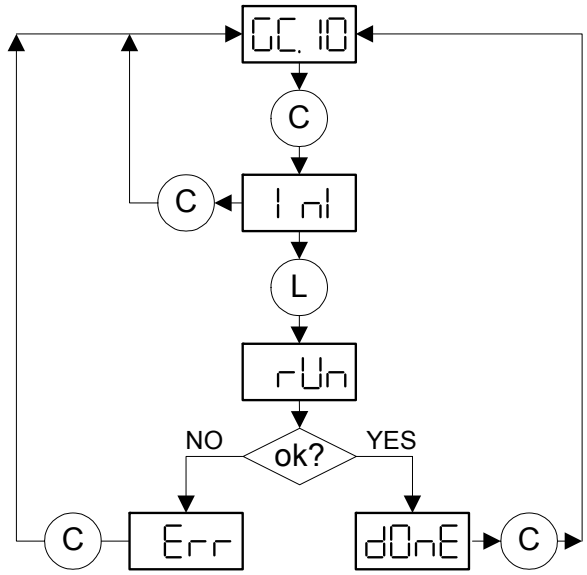
If the system consist of an MCS drive with a motor having an **encoder with an incremental I0**, the drive must be told which type motor it must govern by means of parameter **MP1**. When connecting a motor that uses a SinCos or SinCoder encoder, this is not necessary because the encoder will “tell” the drive which type of motor it is mounted on.

Although it is less frequent, in the case of the sincoder, it is also possible that the sincoder does not inform the drive about the type of motor it is installed in; thus the MP1 parameter must be edited like encoder I0. To operate in this mode, the automatic initialization of the encoder must be disabled by setting parameter GP15=0.

Once the MP1 has been found by turning the decoder until it appears on the display, follow the sequences indicated in the section “**PARAMETERS, VARIABLES & COMMANDS**” in this manual.

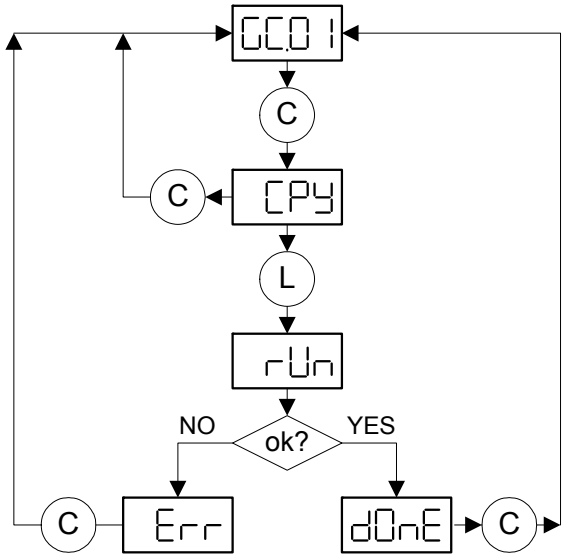
Once the motor has been defined, it must be initialized with the GC10 variable in order to set the initial values for the drive that matches the selected motor. Once the GC10 has been found by turning the decoder until appears on the display.

The sequence to follow is shown below:



Therefore, to store all these modifications permanently, the information stored in RAM memory must be saved (transferred) into E²PROM memory using the GC1 command. Once the GC1 command has been found by turning the decoder until it appears on the display, follow this sequence:

Everything done so far is stored in RAM memory, but not permanently. So, all these modifications will be ignored if a reset is carried out because, when starting up again, the drive assumes the configurations stored in its E²PROM.



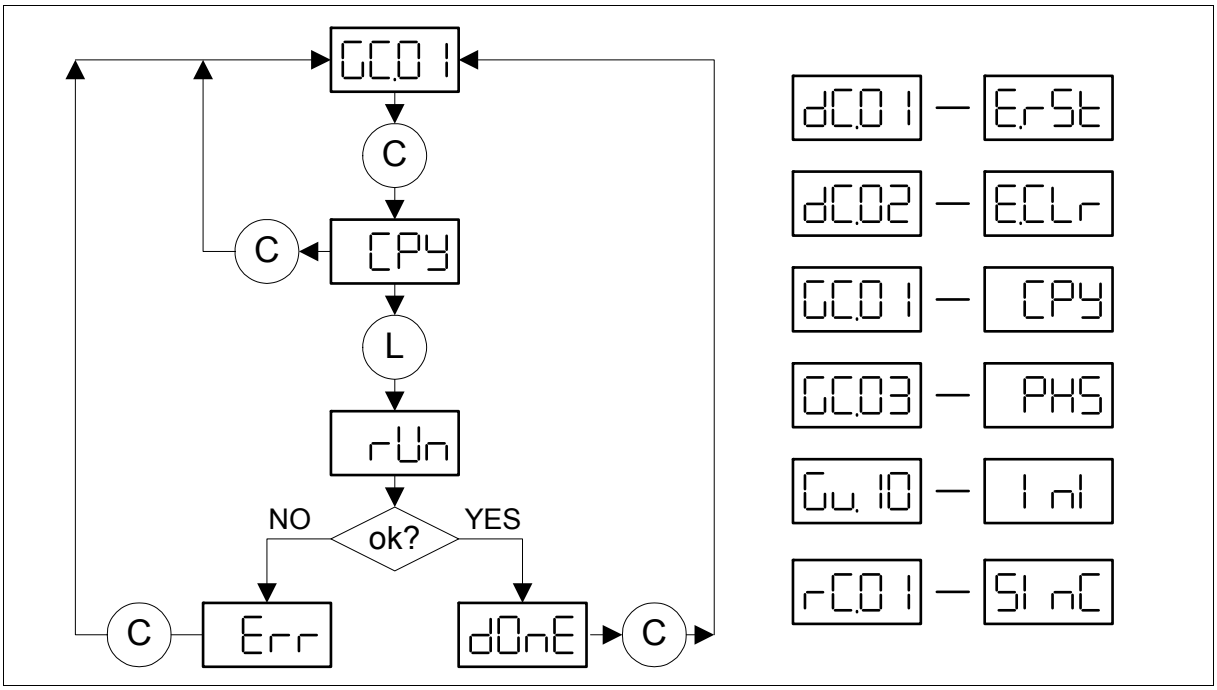
Besides these two commands whose sequences have been shown in the previous two figures, there are others that follow the same sequences but with the mnemonic of the functionality of the command itself. They may be displayed as shown here.

After finding the command, use a short push to display the function mnemonic of the command. A long push confirms its execution whereas a short push returns it to its initial state.

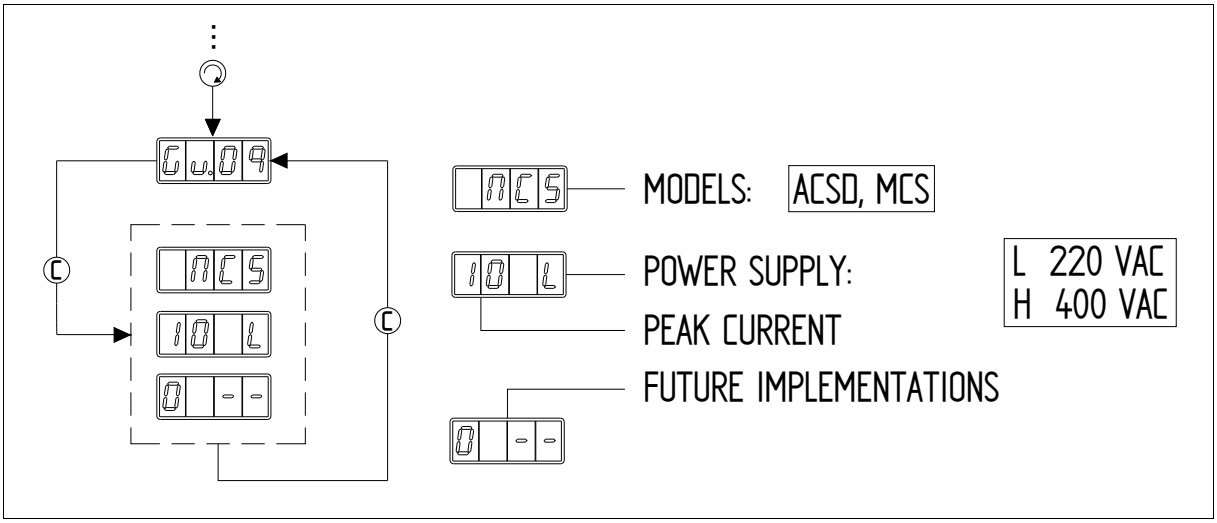
While executing the command, the display shows the word: **rUn** (it is not displayed in commands that are executed very fast).

If the command has been executed properly, the displays shows the word: **dOnE.** Otherwise, in case of an error, it displays the word: **Err**.

In any of these instances, a short push returns it to its initial state.



To obtain information on the type of drive (it can be read but not edited) coherent with the selected motor, find GV9 and follow the indication of the figure below to display the different fields that show their characteristics:



If for any reason, the access level must be changed, display the GV7 variable and write the new code. Then, display GC1 and apply the command as described earlier. Finish the procedure with a RESET.

On the other hand, when adjusting it, proceed as follows:

- ❑ Verify that desired velocity or current command is selected. To do this, make sure that all the parameters involved (such as SP45, WV4,...) are properly set.
- ❑ When using external analog command, verify that it is output to the proper pins.

When using analog command, set parameters SP20 and SP21 with the proper values in order to obtain the desired response to the velocity command entered.

- ❑ Use parameter CP20 to set the maximum peak current value of the drive to obtain the best dynamic response.
- ❑ Set the velocity PI gain using parameter SP1 (proportional gain K) and SP2 (integral K) until the desired system performance is obtained.
- ❑ Adjust the velocity offset using parameter SP30.
- ❑ Send a 0 V velocity command to the drive (jumpering pins 4, 5 and 6 of connector X1).
- ❑ Measure the motor speed and adjust the offset using parameter SP30 until the motor stops. Be careful because this method only eliminates the offset of the drive. The CNC may have an offset of its own which must be adjusted at the CNC.

In order to adjust the offset for the whole control loop:

- ❑ Set the CNC in DRO mode keeping the Drive_Enable and Speed_Enable signals active.
- ❑ Change parameter SP30 until the motor stops.

Another method would consist in setting an axis position with the CNC and adjusting parameter SP30 until the following error (axis lag) is symmetrical.

WinDDSSetup

FAGOR application for PC. Establish communication between the MCS unit and the PC via serial port.

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 units.

NOTE. Only MCS units whose software version is 02.04 or later can communicate with the WinDDSSetup application installed on the PC. It is recommended to always install the latest version WinDDSSetup indicated at the beginning of this manual.

PARAMETERS, VARIABLES & COMMANDS

Notation

< group > < type > < index > where:

Group. Identifying character of the logic group to which the parameter or variable belongs.

There are the following groups of parameters:

GROUPS OF PARAMETERS, VARIABLES & COMMANDS			
Nº	**FUNCTION**	**GROUP**	**LETTER**
1	Control signals	Terminal box	B
2	Current control loop	Current	C
3	Error diagnosis	Diagnosis	D
4	Encoder simulator	Encoder	E
5	General of the system	General	G
6	System hardware	Hardware	H
7	Analog and digital inputs	Inputs	I
8	Temperatures and voltages	Monitoring	K
9	Motor properties	Motor	M
10	Analog and digital outputs	Outputs	O
11	System communication	RS232/422/485 Modbus	Q
12	Rotor sensor properties	Rotor	R
13	Velocity control loop	Velocity	S
14	Torque and power parameters	Torque	T
15	Internal function generator	Internal generator	W

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. Character identifying the parameter or the variable within the group to which it belongs.

Definition examples:

SP10: **S** group, **P** Parameter, Nr 10.

CV11: **C** group, **V** Variable, Nr 11.

GC1: **G** group, **C** Command, Nr 1.

Access level.

The access level is defined by the number following the ID: Thus:

- ❑ FAGOR level
- ❑ USER level
- ❑ BASIC level

Examples of access levels

SP10 **basic** : **S** group, Parameter **P**, Nr **10**, Access level **(BASIC)**

CV11 **FAGOR**, RO: **C** Group,**V** variable, Nr **11**, Access level **(FAGOR)**, read-only variable **(RO)**.

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 that all the parameters have the (RW), i.e. they can be read and written.

Example of a modifiable variable

DV32 FAGOR, **RW**: D Group, V Variable, Nr 32, (FAGOR) Access level, **(RW)** modifiable.

B. Non-programmable inputs-outputs

BV14 FAGOR, RO NotProgrammableIOs 

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

Bit	Function
15, ..., 4	Reserved
3	Programmable input Pins 8-9 of terminal strip X2 Default value (IP14=4), error reset
2	Drive_OK output Pins 6-7 of terminal strip X2
1	Speed_Enable input Pin 3 of terminal strip X2
0	Drive_Enable input Pin 4 of terminal strip X2

C. Current

CP1 FAGOR, RW 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 CurrentIntegralTime 

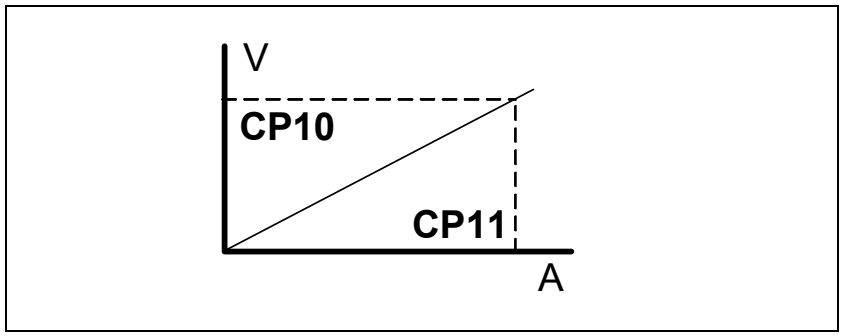
Function Value of the integral action of the current PI.

Valid values 0 ... 999.

Default value Depends on the motor-drive combination.

CP10 USER, RW	VoltageAmpVolt	CP.10

Function Parameters CP10 and CP11 define the relationship between the voltage of the analog input IV2 and the current that this input generates in IV3.



Valid values 1.000 ... 9.999 V.

Default value 9.500 V.

CP11 USER, RW	AmpAmpVolt	CP.11

Function See parameter CP10 .

Valid values 1.00 ... 50.00 A. Depends on the connected drive.

Default value MP3. Rated motor current (in amperes).

CP20 BASIC, RW	CurrentLimit	CP.20

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 (5xMP3) 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	CurrentCommandFilter1Type	CP.30

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

Valid values

Value	Function
1	Enables the filter
0	Disables the filter (by default)

CP31 FAGOR, RW	CurrentCommandFilter1Frequency	CP.31

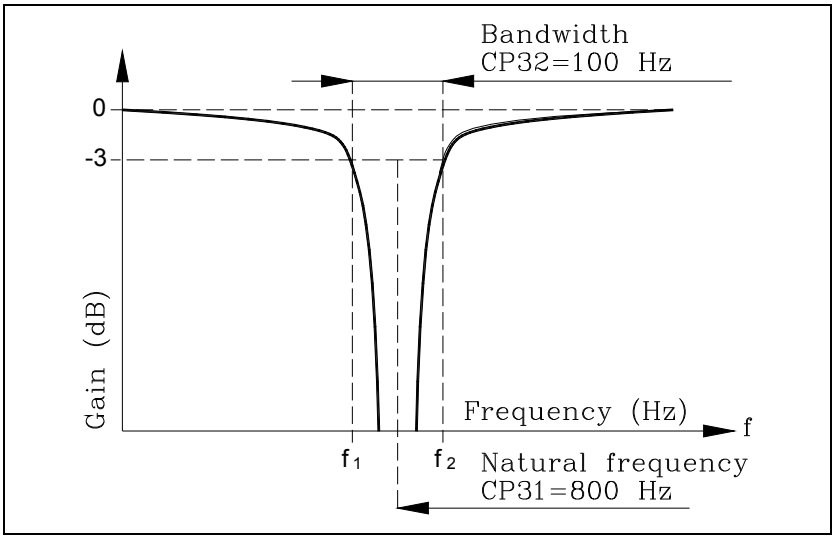
Function Sets the natural frequency in Hz of a notch filter that acts upon the current command.

Valid values 0 ... 4 000.

Default value 0.

CP32 FAGOR, RW	CurrentCommandFilter1Damping	CP.32

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



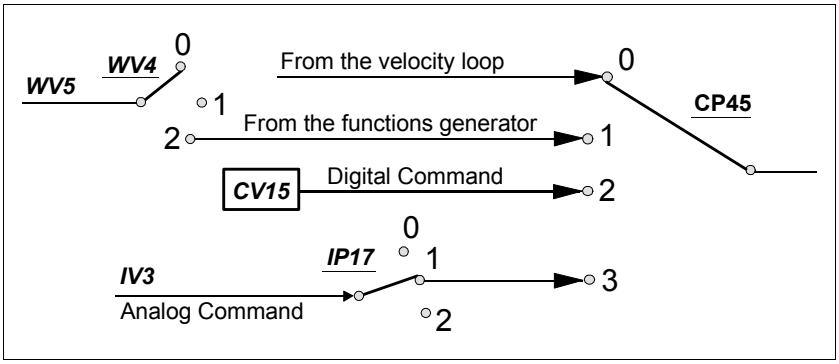
Valid values 0 (by default) ... 1 000.

CP45 USER, RW	CurrentCommandSelector	CP.45

Function This parameter is used to determine the command source of the current loop.

Valid values 0 (by default), 1, 2 and 3.

Value	Function
0 by default	Normal operation. The current command comes from the velocity loop.
1	Function generator. Value of WV5 if the output of the function generator is applied to the current loop (WV4=2).
2	Digital. Value of CV15 that can be modified through the serial line.
3	External analog. It applies the value of the external auxiliary input (pins 4 & 7 of connector X1) after being treated, IV3, if IP17 has the right value (IP17=1).



CV1	USER, RO	Current1Feedback	Cu.01

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

Valid values - 50 ... + 50 A (instant values).

CV2	USER, RO	Current2Feedback	Cu.02

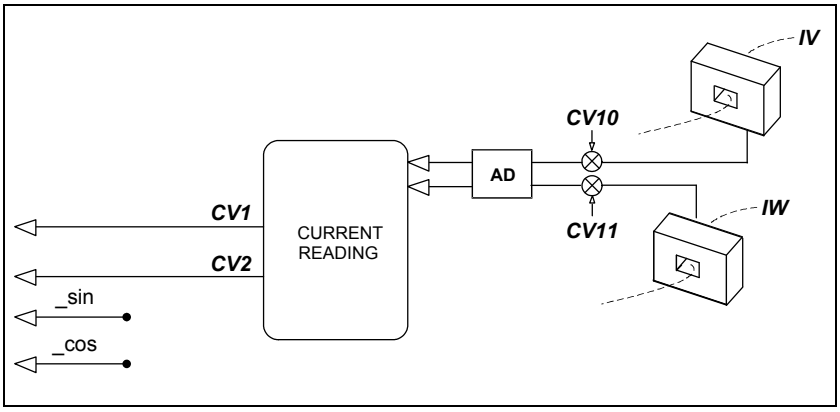
Function Display the value of the feedback of the current going through phase W.

Valid values - 50 ... + 50 A (instant values).

CV3	USER, RO	CurrentFeedback	Cu.03

Function Display the rms current circulating through the motor.

Valid values 0 ... 50 Arms (rms values).



CV10	FAGOR, RO	Current1Offset	Cu. 10

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

Valid values - 2 000 ... + 2 000 mA (depends on the connected drive).

CV11 FAGOR, RO	Current2Offset	Cu. 11

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

Valid values - 2 000 ... + 2 000 mA (depends on the connected drive).

CV15 USER, RW	DigitalCurrentCommand	Cu. 15

Function This variable registers the value of the digital current command.

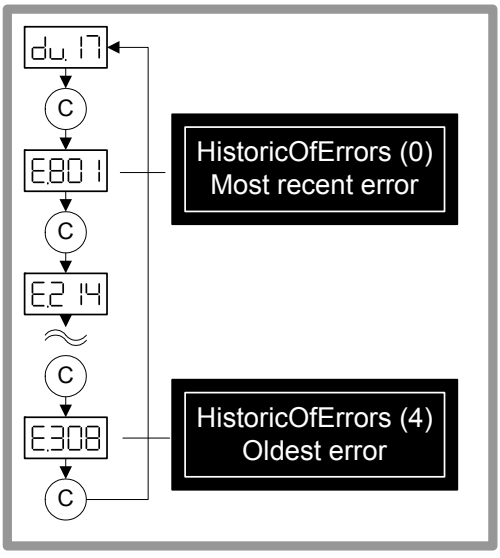
Valid values - 50.00 ... + 50.00 Arms.

D. Diagnosis

DV17 USER, RO	HistoricOfErrors	du. 17

Function 5-word register containing the numbers of the last 5 errors occurred in the drive module.

The programming module can display each one of these 5 errors one by one using short pushes from the most recent to the oldest.



Valid values All the possible error codes implemented in the loaded software version. Code 0 means no error.

DV31 FAGOR, RO DriveStatusWord

Function

The DV31 variable contains a numerical data coded into 16 binary bits and represents the system status as shown by the attached table. Bits (from the most to the least significant).

Bit	Function
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
11	OperationStatusChangeBit
10 ... 7	Reserved
6	ReferenceMarkerPulseRegistered
5	ChangeCommandsBit
4 ... 1	Reserved
0	DriveStatusWordToggleBit

DV32 FAGOR, RW MasterControlWord

Function

The DV32 variable contains a numerical data coded into 16 binary bits and represents the control signals that act upon the drive through the serial line.

Bit	Function
15	Speed Enable
14	Drive Enable
13 ... 7	Reserved
6	Homing Enable
5 ... 1	Reserved
0	MasterControlWordToggleBit

DC1 USER, RW ResetClassDiagnostics

Function

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

DC2	USER, RW	ResetHistoricOfErrors	dC.02

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

E. Encoder simulator

EP1	BASIC, RW	EncoderSimulatorPulsesPerTurn	EP 01

Function Number of pulses generated by the encoder simulator per rotor revolution. If the encoder is ref. I0 (2500 ppt), the parameter value of the encoder simulator output is set in 5 ppt increments and in 2 ppt increments if it is ref. E1, E3 or A0. Note that the unit can limit the bandwidth of the simulator output. Hence, if the encoder is:

- ❑ I0 (2500 ppt), it is not limited.
- ❑ SinCos and the it is a 3000 motor or less, it is not limited.
- ❑ SinCos and the it is a motor of more than 3000 motor, it is limited to 2048 output pulses.

Valid values 0 ... 4096.

Default value Number of pulses of the selected feedback device.

EP3	BASIC, RW	EncoderSimulatorDirection	EP.03

Function Selection of the turning direction of the simulated encoder.

Valid values 0/1 Clockwise (by default) / Counterclockwise.

EP4	BASIC, RW	EncoderSimulatorHighFreqEnable	EP.04

Function Bandwidth limitation of the pulse simulator output. It only has an effect with SinCos type motor feedback. See parameter EP1.

Valid values 0/1 Activate/Desactivate.

Default value 0 Limitation activated. The high frequency of the encoder simulator output is not enabled.

GP3	BASIC, RW	StoppingTimeout	GP.03

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

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

Default value 500 ms.

GP5	BASIC, RO	ParameterVersion	GP.05

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

GP9	BASIC, RW	DriveOffDelayTime	GP.09

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.

GP11	USER, RW	IOFunctionsTime	GP. 11

Function Value of the time used in functions OutFunc1 & OutFunc2.

Valid values 0 ... 9 999 ms.

Default value 2 000 ms.

GP15	FAGOR, RW	AutomaticInitialization	GP. 15

Function When having a SinCos or SinCoder encoder, it enables reading MP1 directly from the sensor and consequently loading certain drive parameter automatically. See section "**Initialization and adjustment**" in this manual.

If GP15 = 0, it does not check the format of MP1.

Valid values

0 Disabled.

1 Enabled (by default).

GP16 BASIC, RW	MonoPhaseSelector	

Function Drives MCS-5L (220 V) and MCS-10L (220 V) can work with single-phase power voltage without launching the “phase missing” warning. This parameter has no effect on the rest of the units.

Valid values

0 Disabled (by default).

1 Enabled.

GV2 BASIC, RO	ManufacturerVersion	

Function Displays the software version in use.

GV5 BASIC, RO	CodeChecksum	

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

Valid values - 32 768 ... 32 767 (although the programming module can only display the 4 least significant digits). E.g.: If GV5=27 234, the display of the programming module shows 7234.

GV7 BASIC, RW	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 ... 9 999.

GV9 BASIC, RO	DriveType	

Function This variable informs of the drive's sales reference. See section “**Initialization and adjustment**” in this manual.

GV11 BASIC, RW	SoftReset	

Function Variable that resets the unit by software.

Valid values 0 and 1 (with 1, it resets the unit).

GV16 USER, RO	MotorTableVersion	GV. 16

Function Version of the motor table.

GV75 FAGOR, RO	ErrorList	GV. 75

Function List of the error numbers active in the unit.

Valid values 0 ... 999.

GC1 BASIC, RW	BackupWorkingMemoryCommand	GC.01

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

GC3 FAGOR, RW	AutophasingCommand	GC.03

Function Command that lets activate the autophasing sequence.

Procedure to follow:

- ❑ Connect the drive to the motor with the SinCos or SinCoder encoder installed (power and feedback cables) and without a load on the shaft.
- ❑ Apply control voltage and power.
- ❑ Activate the Drive Enable input of the drive (pin 4 of X2).
- ❑ Select GC3 and do a short push at the selector of the programming module. The display will show TUNN.
- ❑ Do a long push. The display will show RUN. Note that if the drive is not enabled, it will display ERR, do a short push to get out of this situation.

The motor will start positioning and after about 30 or 40 seconds the display shows DONE (do a short push to get out). At this instant, the new Rho has been calculated. Its value may be displayed in the RV3 variable.

- ❑ Select MP1 and edit the motor type.
- ❑ Select RC1 and execute it to save the new values of RV3 and MP1 in the E²PROM of the encoder.

GC10 BASIC, RW	LoadDefaultsCommand	GC. 10

Function Command to initialize parameters. This command loads the default parameters of the drive for the motor whose ID is stored in parameter MP1. See section "**Initialization and adjustment**" in this manual.

H. Hardware

HV5 BASIC, RO PLDVersion Hu.05

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

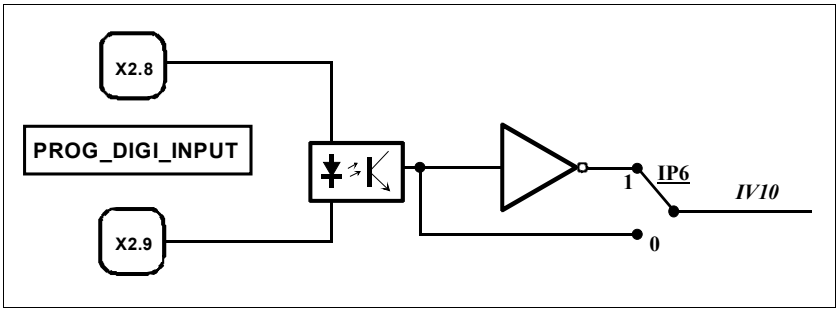
I. Inputs

IP6 USER, RW DigitalInputPolarity IP.06

Function Sets the polarity (inverted or not inverted) of the programmable input (pins 8 and 9 of X2).

Valid values 0/1 Not inverted / Inverted.

Default value 0 Not inverted.



IP14 USER, RW DigitalInputFunctionSelector IP.14

Function Determines the function assigned to the digital input of the unit. The programmable digital input (pins 8 and 9 of X2) is configured as remote input for resetting errors (IP=04).

Valid values 0 ... 4.

Value	Function	Description
0	Missing	
1	InFunc1	Reset of the integral action of the velocity loop
2	InFunc2	Invert the velocity command
3	InFunc3	Halt function (drive management)
4	InFunc4	Error reset (ResetClassDiagnostics, DC1=3)

Default value 4 Error RESET.

IP17 USER, RW AnalogFunctionSelector

Function Determines the analog function assigned to the programmable analog input.

Valid values 0 ... 2.

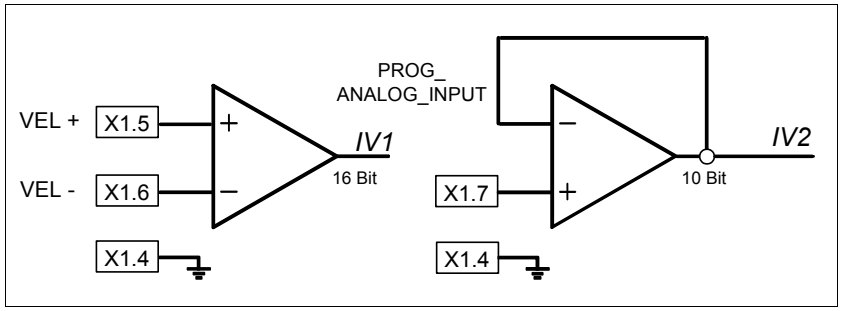
Default value 0.

IV3 as input to function Nr ▶▶▶

IP17	Function
00	Not used
01	Func1
02	Func2

IV1 BASIC, RO AnalogInput1

Function Monitors the input voltage through analog input 1 (pins 5-6 of X1). It's display is in volts.



IV2 USER, RO AnalogInput2

Function Monitors the input voltage through analog input 2 (pin 7 of X1). It's display is in volts.

IV3 USER, RO CurrentCommandAfterScaling

Function Contains the value of the auxiliary analog command (pin 7 of X1; usually current command) after being affected by CP10 and CP11. It must never exceed the value of the maximum current of the unit.

Valid values - 50.00 ... + 50.00 Arms.

IV10 USER, RO DigitalInputs

Function This variable reflects the status of the programmable digital input at pins 8-9 of connector X2. The status of this variable is affected by IP6.

Valid values 0 (by default) and 1.

KP3	USER, RW	ExtBallastPower	hP.03

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

Valid values 200 ... 2 000 W.

Default 200 W.

KP4	USER, RW	ExtBallastEnergyPulse	hP.04

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

Valid values 200 ... 2 000 J.

Default value 200 J.

KV6	BASIC, RO	MotorTemperature	hu.06

Function Motor temperature in degrees centigrade. For the time being, it is now only valid for the FKM family.

Valid values -20 ... 200 °C.

KV10	USER, RO	CoolingTemperature	hu. 10

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

Valid values 0 ... 200 °C.

KV32	USER, RO	I²tDrive	hu.32

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

Valid values 0 (by default) ... 100 %.

KV36	USER, RO	I²tMotor	hu.36

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

Valid values 0 (by default) ... 100 %.

KV40 USER, RO	IntBallastOverload	hu.40

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

Valid values 0 (by default) ... 100 %.

KV41 USER, RW	BallastSelect	hu.41

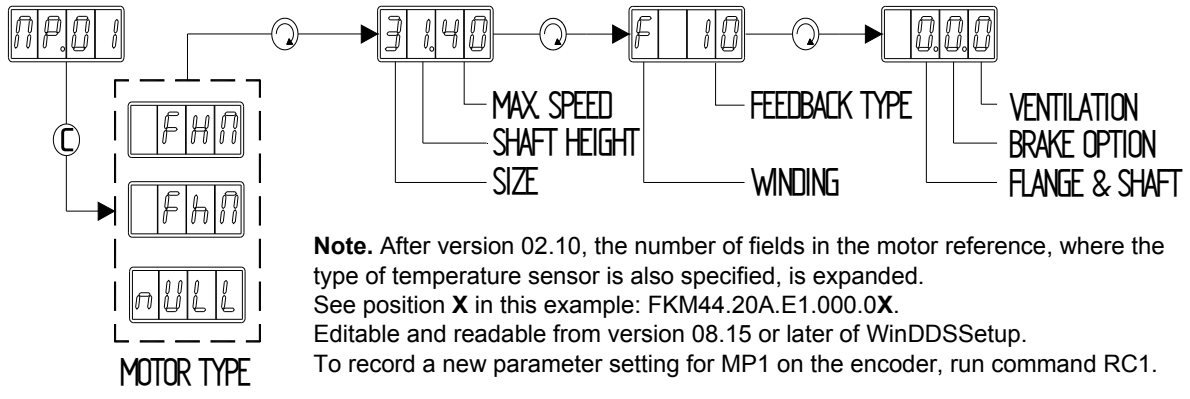
Function Selector that determines whether the ballast resistor is external or internal.

Valid values 0/1 External/Internal (by default).

M. Motor

MP1 BASIC, RW	MotorType	MP.01

Function Motor identification. The limits of certain parameters depend on the value of MP1 (e.g.: the upper limit of SP10 is 110 % of the motor rated speed) like its default parameter initialization through GC10. See command GC10. To govern a non-FAGOR motor, insert the NULL value in the first field of MP1.



Note. After version 02.10, the number of fields in the motor reference, where the type of temperature sensor is also specified, is expanded.
See position **X** in this example: FKM44.20A.E1.000.0**X**.
Editable and readable from version 08.15 or later of WinDDSSetup.
To record a new parameter setting for MP1 on the encoder, run command RC1.

MP2 FAGOR, RW	MotorTorqueConstant	MP.02

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

Valid values 0.0 ... 10.0 N·m/Arms.

Default value It depends on the motor connected (N·m/Arms).

MP3	FAGOR, RW	MotorContinuousStallCurrent	nP.03

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

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

Default value It depends on the motor connected (Arms).

O. Analog and digital outputs

OP1	USER, RW	DA1IDN	OP.01

OP2	USER, RW	DA2IDN	OP.02

Function They identify the internal analog variables of the drive that will be reflected at the electrical outputs and will be affected by the OP3 and OP4 gains respectively. Channel 1 (pin 8 of X1) and channel 2 (pin 9 of X1).

Valid values Name of any parameter or variable of the table.

Default value 04 for OP1 and 07 for OP2.

OP1	variable	Name	OP2	variable	Units
00	SV15	DigitalVelocityCommand	00	SV15	rev/min
01	SV1	VelocityCommand	01	SV1	
02	SV6	VelocityCommandAfterFilters	02	SV6	
03	SV7	VelocityCommandFinal	03	SV7	
04	SV2	VelocityFeedback	04	SV2	
05	TV1	TorqueCommand	05	TV1	dN·m
06	TV2	TorqueFeedback	06	TV2	
07	CV3	CurrentFeedback	07	CV3	cA
08	WV5	GeneratorOutput	08	WV5	-
09	IV1	AnalogInput1	09	IV1	mV
10	IV2	AnalogInput2	10	IV2	
11	RV1	FeedbackSine	11	RV1	bits
12	RV2	FeedbackCosine	12	RV2	

OP3	USER, RW	DA1ValuePer10Volt	OP.03

OP4	USER, RW	DA2ValuePer10Volt	OP.04

Function They define the gain of channel 1 (pin 8 of X1) and channel 2 (pin of X1). There are 10 V at these outputs when the selected variable reaches this value.

Units The units of the variable being displayed.

Valid values 0 ... 9 999.

Default value 4 000 and 3 000, respectively.

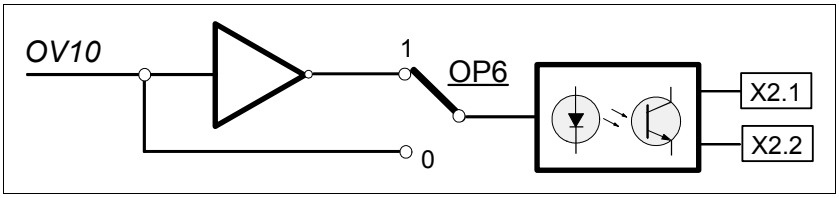
Example If OP1=04 ➔ SV2, VelocityFeedback, in rpm (see previous table) and OP3=3 000.

It means that when the value of SV2 is 3 000 rev/min the analog output will be 10 V and it maintains this rpm/V ratio throughout its full range ± 10 V.

OP6	USER, RW	DigitalOutputPolarity	OP.06

Function Sets the polarity (inverted or not inverted) of the programmable digital input (pins 1 and 2 of X2).

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



OP14	USER, RW	DigitalOutputFunctionSelector	OP.14

Function They determine the activation of the various outputs of the digital functions available.

OP14	Function
00	Not used
01	OutFunc1
02	OutFunc2
03	OutFunc3
04	OutFunc4
05	OutFunc5
06	OutFunc6
07	OutFunc7

◄◄◄ **OV10** as output from function Nr

OP15 USER, RW	DigitalOutputWarningSelector	OP. 15

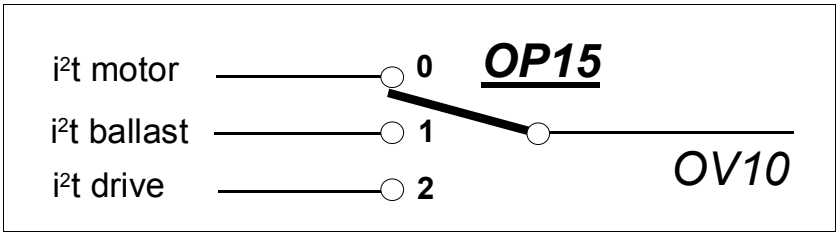
Function Selector of the warning that will be displayed by the programmable output when function OutFunc7 is selected.

Valid values

0 I²t motor (by default)

1 I²t ballast.

2 I²t drive.



OV10 USER, RO	DigitalOutputs	Ou. 10

Function The OV10 variable contains the value of the output status of the various functions that may be selected with OP14.

Valid values 0 (by default) and 1.

Q. Communication

QP14 USER, RW	ProtocolTypeSelector	QP.14

Function Determines which hardware communication mode has been established (RS-232, RS-485, RS-422) with ModBus communication protocol and it is established through the serial COMMUNICATIONS line connector.

Valid values 0 ... 7.

Value	MODBUS	
0, 1, 2	(RTU) & RS232	
3	(RTU) & RS485	
4	(RTU) & RS422	
5	(ASCII) & RS232	
6	(ASCII) & RS485	
7	(ASCII) & RS422	

Default value 0 (RTU) & RS232.

QP16 USER, RW SerialSettings

Function

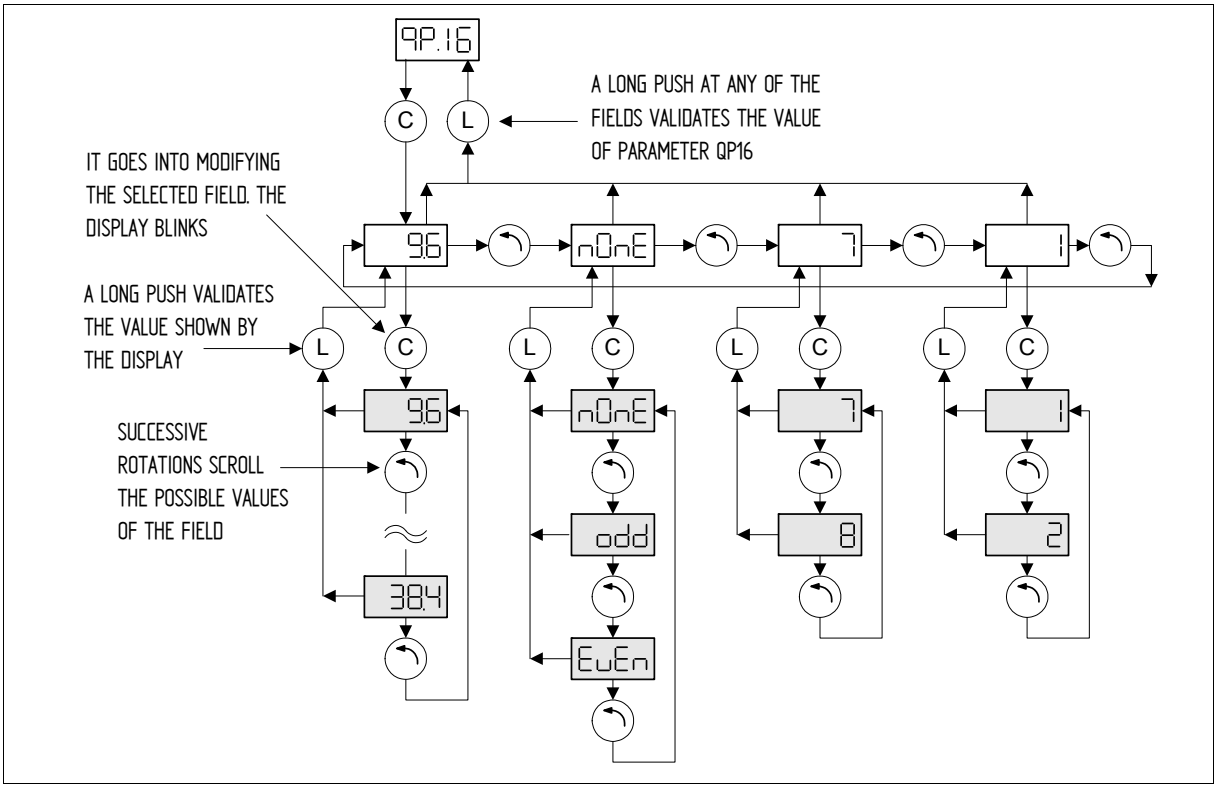
Determines the communications parameters of the UART (**U**niversal **A**synchronous **R**eceiver/**T**ransmitter) of the serial line: baudrate, parity, Nr of bits, Nr of stop bits.

Bit	Function
15 ... 12	Reserved
11, 10	Stops bits **1** Stop bits **2** Stop bits
9 ... 6	Data bits **7** Data bits **8** Data bits
5, 4	Parity bits **0** no parity **1** even parity **2** even parity
3 ... 0	Communication speed (baudrate) **0** 2400 Bd **4** 9600 Bd **1** 3600 Bd **5** 19200 Bd **2** 4800 Bd **6** 38400 Bd **3** 7200 Bd

Default value

1540 (9600, no parity, 8 data bits, 1 stop bit).

To edit this parameter, the programming module has a submenu like the one in the figure:



FAGOR AUTOMATION

QV22 FAGOR, RO	IDNListOfInvalidOperationData	9u.22

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 WinDDSSetup shows the parameter names directly).

Valid values Any parameter bus identifier.

QV96 USER, RW	SlaveArrangement	9u.96

Function This variable contains the number of the node assigned to the drive for communication.

Valid values 0 ... 127.

Value	ModBus protocol
0	Number Nr 0 (not commonly used)
1 ... 127	Node Nr assigned to the unit in a bus type communication.

R. Rotor sensor

RP1 FAGOR, RW	FeedbackSineGain	rP.01

RP2 FAGOR, RW	FeedbackCosineGain	rP.02

Function Compensation (proportional gain mode) of the amplitude of the sine/cosine signal that goes from the motor feedback to the drive. Entering 4 096 is the same as multiplying by 1. To assign a gain of 1.5 to the sine signal, set RP1 to 6 144 (= 4 096x1.5).

Valid values 0 (0 %) ... 8 192 (200 %).

Default value 4 096 (100 %).

RP3 FAGOR, RW	FeedbackSineOffset	rP.03

RP4 FAGOR, RW	FeedbackCosineOffset	rP.04

Function Compensation (offset mode) of the sine/cosine signal that goes from the motor feedback to the drive.

Valid values - 2 000 ... 2 000.

Default value 0.

RP20	USER, RW	StegmanABLevelSense	rP.20

Function Feedback failure protection sensitivity adjustment. See “E.605” error code.

Valid values 30 ... 100 %.

Default value 100 %.

RV1	USER, RO	FeedbackSine	ru.01

RV2	USER, RO	FeedbackCosine	ru.02

Function Sine and cosine of the feedback that goes from the motor to the drive as internal system variables.

Valid values - 512 ... 511.

RV3	FAGOR, RO	FeedbackRhoCorrection	ru.03

Function Corrects the phase shift between the encoder shaft and the motor shaft. The motors are factory set and the value of this variable is stored in the encoder memory.

Valid values 0 ... 65 535 although the programming module can only display the 4 most significant digits. E.g. If RV3=27 500, the display of the programming module shows 2 750.

RC1	FAGOR, RW	EncoderParameterStoreCommand	rC.01

Function Command that could be used to store the content of MP1 and RV3 in the E²PROM of the SinCos or SinCoder encoder.

SP1	BASIC, RW	VelocityProportionalGain	SP.01

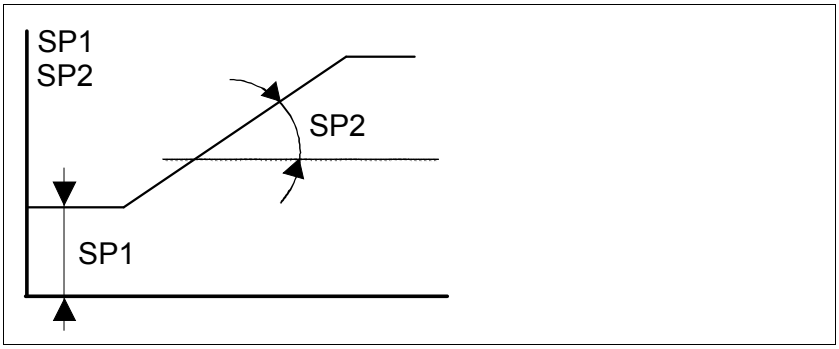
SP2	BASIC, RW	VelocityIntegralGain	SP.02

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

Valid values SP1: 0 ... 999.9 mArms/(rev/min).

SP2: 0.1 ... 999.9 ms.

Default value Depends on the motor-drive combination.



SP3	BASIC, RW	VelocityDerivativeGain	SP.03

Function Value of the derivative action of the velocity PI.

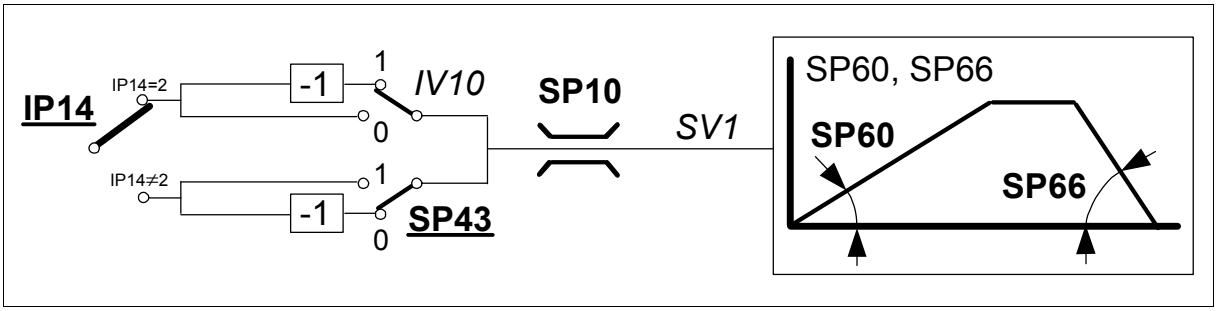
Valid values SP3: 0 (by default) ... 9 999.

SP10	BASIC, RW	VelocityLimit	SP.10

Function Maximum velocity limit for SV7 (VelocityCommandFinal).

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

Default value 1 000 rev/min.

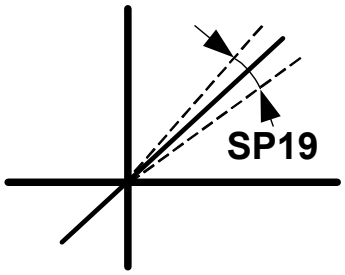


SP19 BASIC, RW	SymmetryCorrection	SP.19

Function Its purpose is to correct the possible difference in analog command generated to obtain exactly the same speed in both turning directions.

Valid values - 500 ... + 500 mV.

Default value 0 mV.

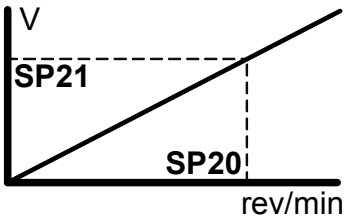


SP20 BASIC, RW	VoltageRpmVolt	SP.20

Function Parameter SP20 and SP21 set the necessary ratio between the analog command and the motor speed. They correspond to the reference of the CNC concept G00 Feed.

Valid values 1.00 ... 10.00 V.

Default value 9.50 V.



SP21 BASIC, RW	RpmRpmVolt	SP.21

Function See parameter SP20.

Valid values 10 ... Motor rated speed in rev/min.

Default value Motor rated speed in rev/min.

SP30 BASIC, RW	VelocityOffset	SP.30

Function Correction of the analog velocity command offset It is applied after the analog input is treated by SP19, SP20 and SP21.

Valid values - 2 000... + 2 000 (x 0.01 rpm)

Default value 0 rpm.

SP40 USER, RW	VelocityThresholdNx	SP.40

Function Velocity level over which the OV10 variable is activated when function OutFunc3 (MotorSpeed > SP40) is active.

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

Default value 1 000 rev/min.

SP41 USER, RW	VelocityWindow	SP.41

Function Velocity window assigned to the “reached speed” function. It is used to know when the speed of a motor (SV2) has reached the supplied command (SV7) within the margins of this window SP41.

Valid values 0 ... 12 % of SP10 (speed limit) in rev/min.

Default value 20 rev/min.

SP42 USER, RW	StandStillWindow	SP.42

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

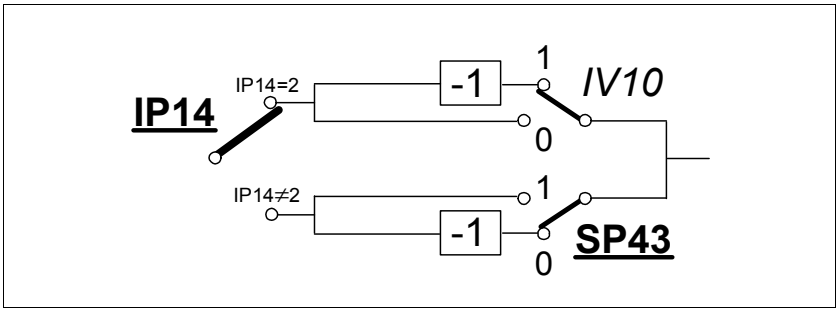
Valid values 0 ... motor rated speed in rev/min.

Default value 20 rev/min.

SP43 BASIC, RW	VelocityPolarityParameter	SP.43

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

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



SP45 BASIC, RW VelocityCommandSelector

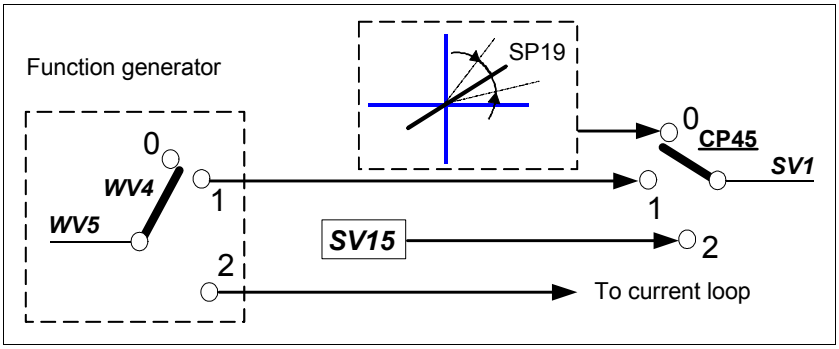
Function

This parameter is used to determine the velocity command source.

Valid values

0, 1 and 2.

Value	Function
0 (by default)	**Analog.** Input through pins 5 and 6 of connector X1 after being adapted by SP19, SP20 and SP21.
1	**Function generator.** Value of WV5 if the output of the function generator is applied to the velocity loop (WV4=1).
2	**Digital.** Value of SV15.



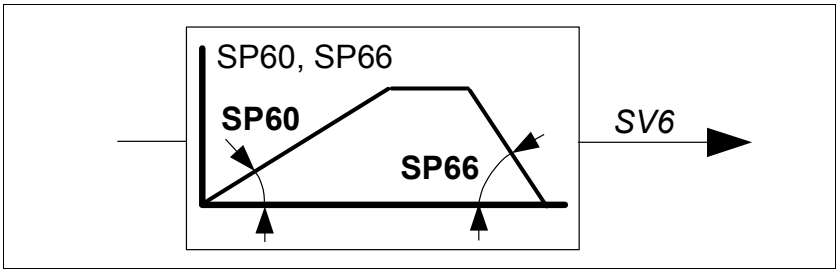
SP60 BASIC, RW VelocityAccelerationTime

Function

Determines the value of the acceleration ramp applied to the velocity command. Setting this parameter with a 0 value means that no ramps will be applied.

Valid values

0.0 (by default) ... 400.0 (rev/min)/ms.

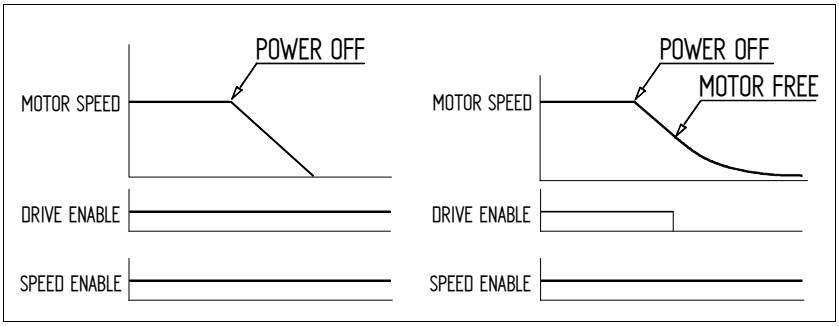


SP65 BASIC, RW EmergencyAcceleration

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.

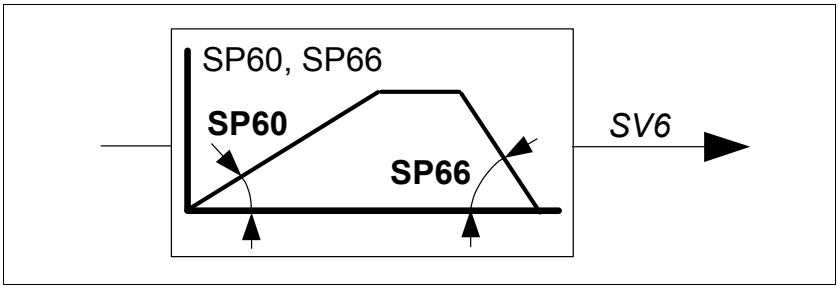


Valid values 0.0 (by default) ... 400.0 (rev/min)/ms.

SP66	**BASIC, RW**	**VelocityDecelerationTime**	SP.66

Function Determine the value of the deceleration ramp applied to the velocity command. Setting this parameter with a 0 value means that no ramps will be applied.

Valid values 0.0 (by default) ... 400.0 (rev/min)/ms.



SV1	**BASIC, RW**	**VelocityCommand**	Su.01

Function Velocity command after the SP45 selector.

Valid values - 6 000 ... 6 000 rev/min.

SV2	**BASIC, RO**	**VelocityFeedback**	Su.02

Function Velocity feedback.

Valid values - 9 999 ... + 9 999 rev/min.

SV6	BASIC, RO	VelocityCommandAfterFilters	Su.06

Function Velocity command after applying limits, ramps, etc

Valid values - 9 999 ... + 9 999 rev/min.

SV7	BASIC, RO	VelocityCommandFinal	Su.07

Function Final velocity command applied to the loop.

Valid values - 9 999 ... + 9 999 rev/min.

SV15	USER, RW	DigitalVelocityCommand	Su. 15

Function Digital velocity command.

Valid values - 6 000 ... 6 000 rev/min.

T. Torque and power

TP1	USER, RW	TorqueThresholdTx	tP.01

Function Parameter that determines the threshold for the activation of OV10 when function OutFunc2 (TorqueLimitModeCero Search) is activated.

Units Fraction of the rated value of the motor torque.

Valid values 0 ... 100 %.

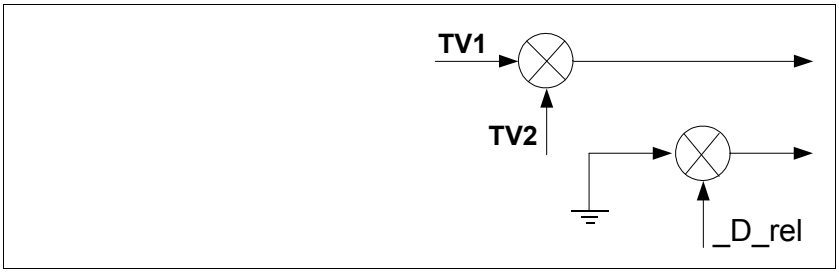
Default value 5 %.

TV1	USER, RO	TorqueCommand	tu.01

TV2	USER, RO	TorqueFeedback	tu.02

Function Displays the values of the command and torque feedback.

Valid values - 99.9 ... + 99.9 N·m.



W. Internal generator

WV1	USER, RW	GeneratorShape	uu.01

Function It indicates the waveform of the internal command generator.

Valid values **0** Sinusoidal, **1** Square wave, **2** Triangular

WV2	USER, RW	GeneratorPeriod	uu.02

Function It indicates the signal period of the internal command generator.

Valid values 2 ... 9 999 ms.

Default value 200 ms.

WV3	USER, RW	GeneratorAmplitude	uu.03

Function It indicates the signal amplitude of the internal command generator.

Valid values 0 ... 9 999 rev/min if it is a velocity command.

0 ... 9 999 (0.01 Arms) if it is a current command.

WV4	USER, RW	GeneratorType	uu.04

Function It specifies on which magnitude the internal command is applied.

Valid values **0** Generator disconnected (by default).

1 Generator connected. Velocity command.

2 Generator connected. Current command.

WV5	USER, RO	GeneratorOutput	uu.05

Function Variable that reflects the value of the signal generated by the internal function generator.

Valid values - 9 999 ... 9 999.

WV6 USER, RW	GeneratorDutyCycle	uu.06

Function For generating square signals (WV1=1), this variable specifies the ratio of the duty cycle. For example, to simulate an S6-40% cycle, WV6 = 40.

Valid values 1 ... 99 %.

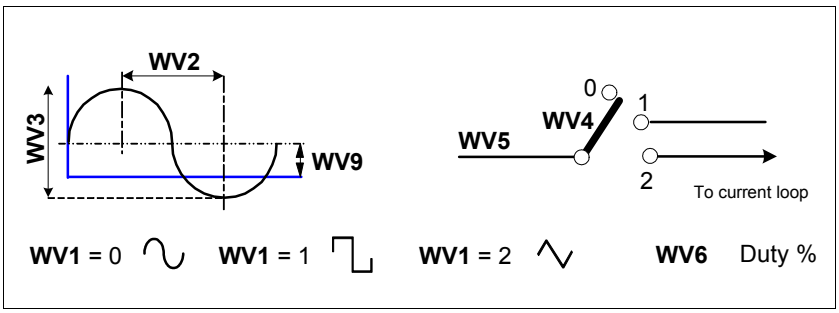
Default value 50 %.

WV9 USER, RW	GeneratorOffset	uu.09

Function It allows entering an offset in the signal of the internal command generator.

Valid values - 9 999 ... + 9 999 (rev/min). Velocity.

- 9 999 ... + 9 999 (0.01 Arms). Current.



ERROR MESSAGES

E.001 **Internal** 

Contact Fagor Automation.

E.003 **At the power bus voltage** 

Cause. **ERROR.** When having torque, one of the phases of the line may have dropped.

WARNING. When starting the unit up, maybe:

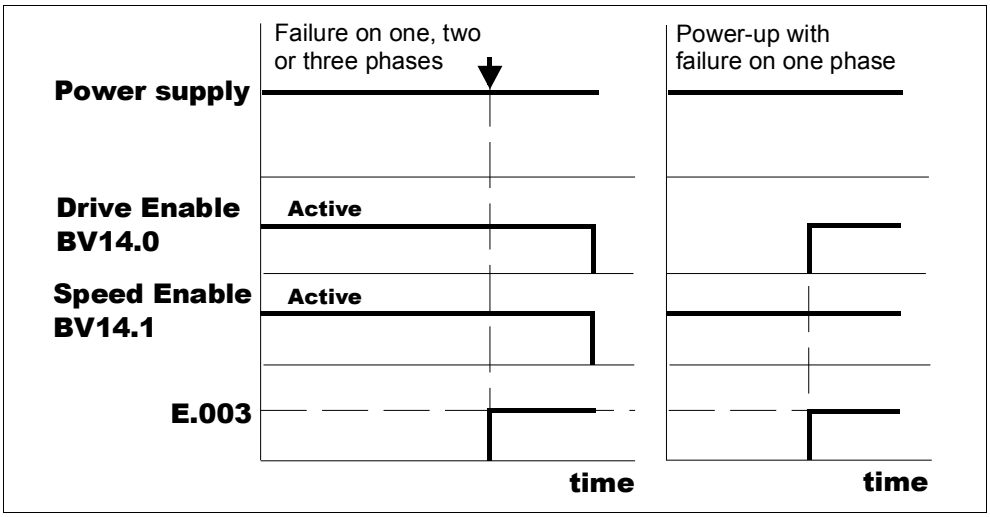
☐ One of the three-phase lines has dropped.

☐ A 400 V AC unit has been supplied with 220 V AC.

☐ The connector of the Ballast resistor has not been installed.

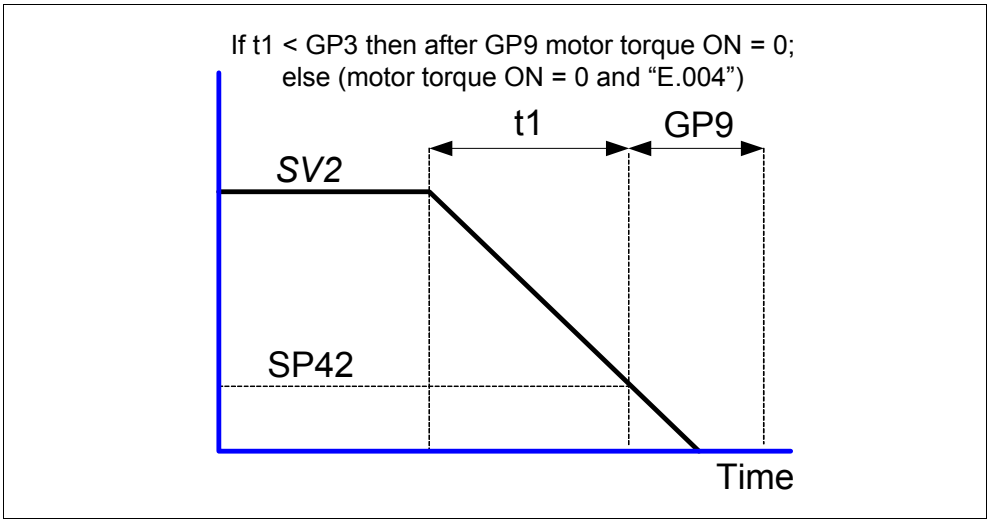
☐ The Ballast resistor is open.

Solution. Check that the line phases and the drives are OK in the direction indicated earlier and start the system back up.



E.004 **Emergency stop exceeding time limit GP3** 

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

Solution. 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 ofthis 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

Cause. 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

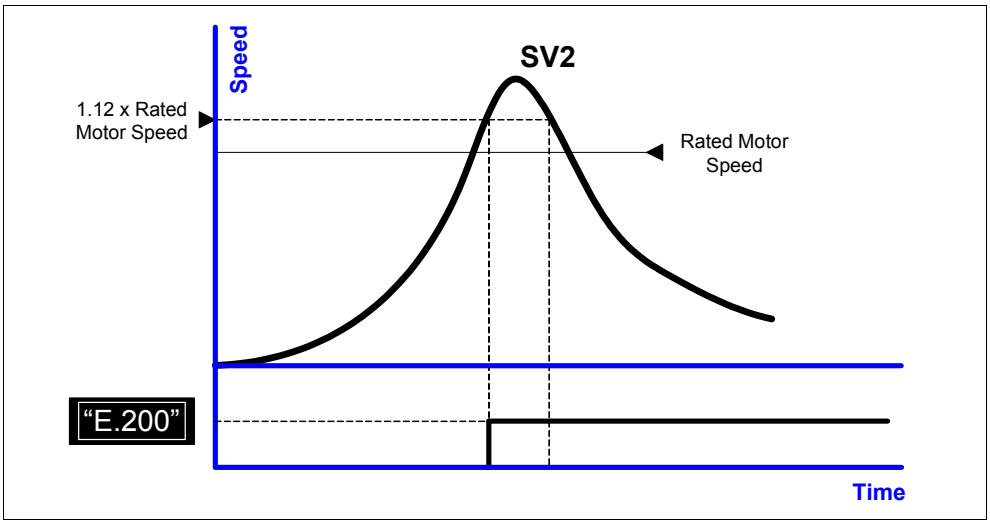
Cause. The motor has overheated. The motor temperature measuring cables (position sensor cable) or the temperature sensor itself are defective. The application may be demanding high current peaks.

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

E.200 Overspeed

E.200

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



Solution. Bad cabling or poor connection of the position sensor or of the motor power.

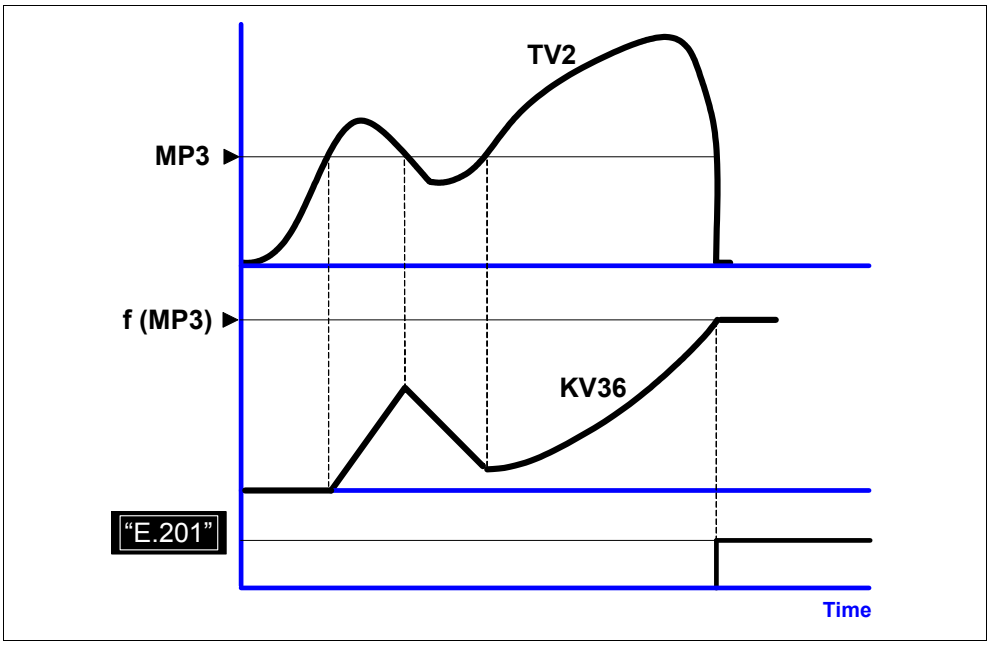
Maybe, the velocity loop is not adjusted properly. There may be a speed overshooting in the system response. Decrease the overshooting.

E.201 Motor overload

E.201

Cause. The duty cycle demanded from the motor is greater than it can provide causing the motor I^2t protection to go off.

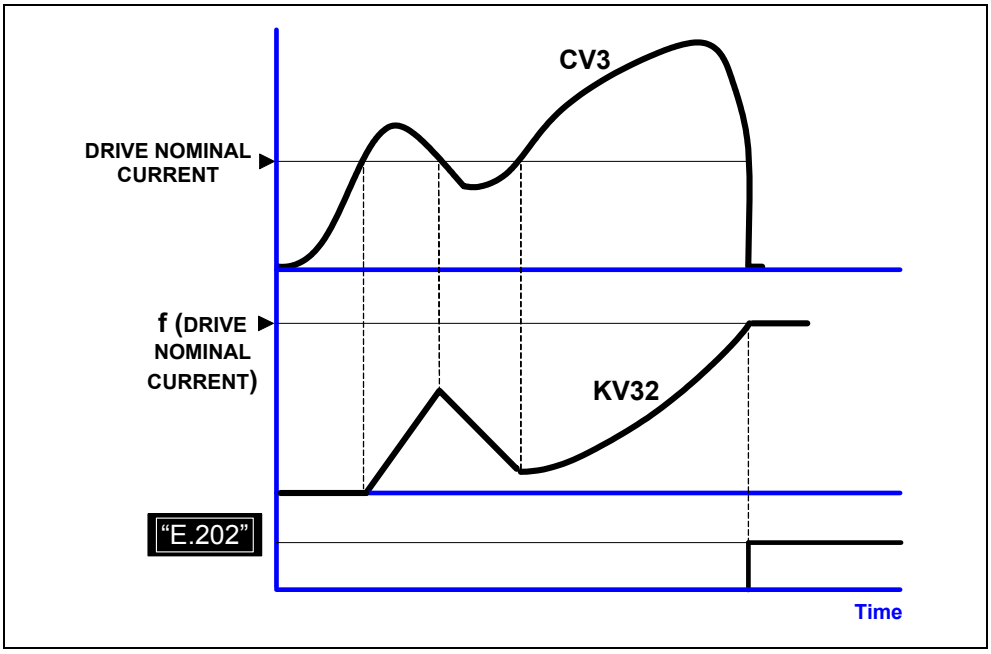
Solution. Change its duty cycle.



E.202 Drive overload

Cause. The duty cycle demanded from the motor is greater than it can provide causing the drive I²t protection to go off.

Solution. Change its duty cycle.



E.214 Short-circuit

Cause. A short-circuit has been detected at the drive module.

Solution. Perform an "error reset". If the error persists, it may be because:

- ☐ An erroneous sequence when connecting the power cables or several of them causing a short-circuit between them.
- ☐ Some wrong parameter or some failure at the drive.

If the error persists, contact Fagor Automation.

Observe that after displaying E.214, one of the codes of the following table will be displayed informing on which drive the alarm has been detected.

1L	The 1st one of the bottom	
1H	The 1st one of the top	
2L	The 2nd one of the bottom	
2H	The 2nd one of the top	
3L	The 3rd one of the bottom	
3H	The 3rd one of the top	
CR	That of the Ballast	

E.304	Power bus voltage of the drive too high	E.304

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

Solution. Check the connection of the external Ballast resistor (if applicable) and make sure it is in good condition.

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

E.307	Power bus voltage too low	E.307

Cause. The mains voltage is lower than the admitted minimum voltage.

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

E.314	Ballast circuit overload	E.314

Cause. Ballast resistor overload because the duty cycle forced on the circuit is too demanding.

Solution. Resize the Ballast resistor for the required duty cycle or set a less demanding duty cycle.

Smooth the duty cycle by applying acceleration ramps.

E.502	Incompatible parameters	E.502

Cause. Incompatible drive parameter setting.

E.g.: A drive to govern a motor. The motor admits a peak current of 20 A. The drive parameter that sets the current limit is set CP20=20.

If now, a 16 A peak motor is connected, the current limit will be beyond the value allowed for this new motor. The CP20 value set previously is higher than the one allowed for this new motor.

The drive notices this incompatibility and readjusts (in RAM memory) certain parameters related to speed and current and issues E.502. The QV22 variable indicates the parameters that are incompatible with each other so they can be set properly.

Observe that resetting the unit without saving the parameters causes the error to come up again. To avoid this, execute the GC1 command that permanently saves into E²PROM memory the parameters readjusted by the drive in RAM memory with their proper values.

E.506	**Motor table missing**	E.506

Solution. Contact Fagor Automation.

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

Cause. The drive does not accept the motor that has been connected to it.

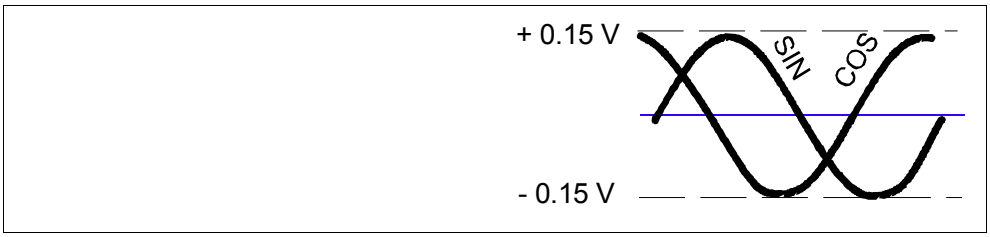
Motor's power voltage is different from that of the drive it is connected to. For example, connecting the motor FXM34.40**A**.E1.000, with A winding (400 V AC) to drive MCS-20**L** (220 V AC).

Solution. Check that the selected motor-drive combination is coherent.

Note. Error that can be reset.

E.605	**Excessive damping of the analog signals of the motor feedback**	E.605

Cause. One of the sine or cosine signals of the encoder has reached a peak level lower than 150 mV.



Solution. Contact Fagor Automation.

E.801	**Encoder not detected**	E.801

Cause. The drive has not detected the rotor sensor.

Solution. Match the selected sensor with the feedback installed and, if the error persists, contact Fagor Automation.

E.802	Defective encoder	

Cause. Communication error when using a SinCos or SinCoder encoder.
Incoherent U, V, W signals when using an incremental I0 encoder.

Solution. Contact Fagor Automation.

E.803	Encoder not initialized	

Solution. Contact Fagor Automation.

PARAMETERS, VARIABLES & COMMANDS. IDs

Mnem.	Name	Level	ID MODB	Ac	Min.	Max.	Def.	Units	Page
BV14	NotProgrammableIOs	FAGOR	08601	RO	0	65535	-	-	52
CP1	CurrentProportionalGain	FAGOR	00213	RW	0	999	-	-	52
CP2	CurrentIntegralTime	FAGOR	00215	RW	0	999	-	-	52
CP10	VoltageAmpVolt	USER	08823	RW	1000	9999	9500	mV	53
CP11	AmpAmpVolt	USER	08825	RW	100	5000	5000	cA	53
CP20	CurrentLimit	BASIC	08807	RW	0	5000	0	cA	53
CP30	CurrentCommandFilter1Type	FAGOR	08809	RW	0	1	0	-	53
CP31	CurrentCommandFilter1Frequency	FAGOR	08817	RW	0	4000	0	Hz	54
CP32	CurrentCommandFilter1Damping	FAGOR	08819	RW	0	1000	0	Hz	54
CP45	CurrentCommandSelector	USER	08821	RW	0	3	0	-	54
CV1	Current1Feedback	USER	08811	RO	- 5000	5000	-	cA	55
CV2	Current2Feedback	USER	08813	RO	- 5000	5000	-	cA	55
CV3	CurrentFeedback	USER	08815	RO	- 5000	5000	-	cA	55
CV10	Current1Offset	FAGOR	08803	RO	- 2000	2000	-	mA	55
CV11	Current2Offset	FAGOR	08805	RO	- 2000	2000	-	mA	56
CV15	DigitalCurrentCommand	USER	08827	RW	- 5000	5000	0	cA	56
DC1	ResetClass1Diagnostics	USER	00199	RW	0	15	0	-	57
DC2	ClearHistoricOfErrorsCommand	USER	08997	RW	0	15	0	-	58
DV17	HistoricOfErrors	USER	09012	RO	-	-	-	-	56
DV31	DriverStatusWord	FAGOR	00271	RO	0	65535	-	-	57
DV32	MasterControlWord	FAGOR	00269	RW	0	65535	0	-	57
EP1	EncoderSimulatorPulsesPerTurn	BASIC	09193	RW	0	4096	-	-	58
EP3	EncoderSimulatorDirection	BASIC	09197	RW	0	1	0	-	58
EP4	EncoderSimulatorHighFreqEnable	BASIC	09201	RW	0	1	0	pulses	58
GC1	BackupWorkingMemoryCommand	BASIC	00529	RW	0	15	0	-	61
GC3	AutophasingCommand	FAGOR	09653	RW	0	15	0	-	61
GC10	LoadDefaultsCommand	BASIC	00525	RW	0	15	0	-	61
GP3	StoppingTimeout	BASIC	09597	RW	0	9999	500	ms	59
GP5	ParameterVersion	BASIC	09601	RO	-	-	-	-	59
GP9	DriveOffDelayTime	BASIC	00415	RW	0	9999	50	ms	59
GP11	IOFunctionsTime	USER	09645	RW	0	9999	2000	ms	59
GP15	AutomaticInitialization	FAGOR	09643	RW	0	1	1	-	59
GP16	MonoPhaseSelector	BASIC	09647	RW	0	1	0	-	60
GV2	ManufacturerVersion	BASIC	00060	RO	-	-	-	-	60
GV5	CodeChecksum	BASIC	09605	RO	-	-	-	-	60
GV7	Password	BASIC	00535	RW	0	9999	0	-	60
GV9	DriveType	BASIC	00280	RO	-	-	-	-	60
GV11	SoftReset	BASIC	09609	RW	0	16	0	-	60
GV16	MotorTableVersion	BASIC	09625	RO	-	-	-	-	61
GV75	ErrorList	FAGOR	00750	RO	-	-	-	-	61
HV5	PLDVersion	BASIC	08783	RO	-	-	-	-	62
IP6	DigitalInputPolarity	USER	10013	RW	0	1	0	-	62
IP14	DigitalInputFunctionSelector	USER	10015	RW	0	4	4	-	62
IP17	AnalogFunctionSelector	USER	10017	RW	0	2	0	-	63
IV1	AnalogInput1	BASIC	10003	RO	- 12000	12000	-	mV	63
IV2	AnalogInput2	USER	10005	RO	- 1200	1200	-	cV	63
IV3	CurrentCommandAfterScaling	USER	10019	RO	- 9999	9999	-	cA	63
IV10	DigitalInputs	USER	10007	RO	0	1	-	-	63
KP3	ExtBallastPower	USER	10421	RW	200	2000	200	W	64
KP4	ExtBallastEnergyPulse	USER	10425	RW	200	2000	200	J	64
KV6	MotorTemperature	BASIC	00767	RO	- 20	200	-	° C	64
KV10	CoolingTemperature	USER	10397	RO	- 20	200	-	° C	64
KV32	I2tDrive	USER	10410	RO	0	100	-	%	64
KV36	I2tMotor	USER	10415	RO	0	100	-	%	64
KV40	I2tCrowbar	USER	10423	RO	0	100	-	%	65
KV41	BallastSelect	USER	10427	RW	0	1	1	-	65
MP1	MotorType	BASIC	00282	RW	-	-	-	-	65
MP2	MotorTorqueConstant	FAGOR	10593	RW	0	100	-	dNm/A	65

Mnem.	Name	Level	ID MODB	Ac	Min.	Max.	Def.	Units	Page
MP3	MotorContinuousStallCurrent	FAGOR	00223	RW	0	5000	-	cA	66
OP1	DA1IDN	USER	10993	RW	0	13	4	-	66
OP2	DA2IDN	USER	10995	RW	0	13	7	-	66
OP3	DA1ValuePer10Volt	USER	10997	RW	0	9999	4000	-	67
OP4	DA2ValuePer10Volt	USER	10999	RW	0	9999	3000	-	67
OP6	DigitalOutputPolarity	USER	11025	RW	0	1	0	-	67
OP14	DigitalOutputFunctionSelector	USER	11021	RW	0	7	0	-	67
OP15	DigitalOutputWarningSelector	USER	11023	RW	0	2	0	-	68
OV10	DigitalOutputs	USER	11013	RO	0	1	0	-	68
QP14	ProtocolTypeSelector	USER	12213	RW	0	7	2	-	68
QP16	SerialSettings	USER	12217	RW	0	65535	1540	-	69
QV22	IDNListOffInvalidOperationData	FAGOR	00044	RO	-	-	-	-	70
QV96	SlaveArrangement	USER	00193	RW	0	127	1	-	70
RC1	EncoderParameterStoreCommand	FAGOR	11219	RW	0	15	0	-	71
RP1	FeedbackSineGain	FAGOR	11193	RW	0	8192	4096	-	70
RP2	FeedbackCosineGain	FAGOR	11195	RW	0	8192	4096	-	70
RP3	FeedbackSineOffset	FAGOR	11197	RW	- 2000	2000	0	-	70
RP4	FeedbackCosineOffset	FAGOR	11199	RW	- 2000	2000	0	-	70
RP20	StegmanABLevelSense	USER	11267	RW	30	100	100	%	71
RV1	FeedbackSine	USER	11205	RO	- 512	511	-	-	71
RV2	FeedbackCosine	USER	11207	RO	- 512	511	-	-	71
RV3	FeedbackRhoCorrection	FAGOR	11209	RO	0	65535	-	-	71
SP1	VelocityProportionalGain	BASIC	00201	RW	0	9999	-	dmArms/rpm	72
SP2	VelocityIntegralTime	BASIC	00203	RW	0	9999	-	dms	72
SP3	VelocityDerivativeGain	BASIC	00205	RW	0	9999	0	-	72
SP10	VelocityLimit	BASIC	00183	RW	0	9999	1000	rev/min	72
SP19	SymmetryCorrection	BASIC	11431	RW	- 500	500	0	mV	73
SP20	VoltageRpmVolt	BASIC	11433	RW	1000	9999	9500	mV	73
SP21	RpmRpmVolt	BASIC	11435	RW	10	9999	4000	rev/min	73
SP30	VelocityOffset	BASIC	11399	RW	- 2000	2000	0	crpm	73
SP40	VelocityThresholdNx	USER	00251	RW	0	9999	1000	rev/min	74
SP41	VelocityWindow	USER	00315	RW	0	9999	20	rev/min	74
SP42	StandStillWindow	USER	00249	RW	0	9999	20	rev/min	74
SP43	VelocityPolarityParameters	BASIC	00087	RW	0	1	0	-	74
SP45	VelocityCommandSelector	BASIC	11427	RW	0	2	0	-	75
SP60	AccelerationLimit	BASIC	00277	RW	0	4000	0	drpm/ms	75
SP65	EmergencyAcceleration	BASIC	11411	RW	0	4000	0	drpm/ms	75
SP66	VelocityDecelerationTime	BASIC	11429	RW	0	4000	0	drpm/ms	76
SV1	VelocityCommand	BASIC	00072	RW	- 6E7	6E7	0	dmrpm	76
SV2	VelocityFeedback	BASIC	00080	RO	- 6E7	6E7	-	dmrpm	76
SV6	VelocityCommandAfterFilters	BASIC	11436	RO	- 6E7	6E7	-	dmrpm	77
SV7	VelocityCommandFinal	BASIC	11416	RO	- 6E7	6E7	-	dmrpm	77
SV15	DigitalVelocityCommand	USER	11438	RW	- 6E7	6E7	0	dmrpm	77
TP1	TorqueThresholdTx	USER	00253	RW	0	100	5	%	77
TV1	TorqueCommand	USER	00161	RO	- 9999	9999	0	dN·m	77
TV2	TorqueFeedback	USER	00169	RO	- 9999	9999	-	dN·m	77
WV1	GeneratorShape	USER	11793	RW	0	2	1	-	78
WV2	GeneratorPeriod	USER	11795	RW	2	9999	200	ms	78
WV3	GeneratorAmplitude	USER	11797	RW	0	9999	0	-	78
WV4	GeneratorType	USER	11799	RW	0	2	0	-	78
WV5	GeneratorOutput	USER	11801	RO	- 9999	9999	0	-	78
WV6	GeneratorDutyCycle	USER	11803	RW	1	99	50	%	79
WV9	GeneratorOffset	USER	11809	RW	- 9999	9999	0	-	79

User notes

User notes

User notes

FAGOR AUTOMATION

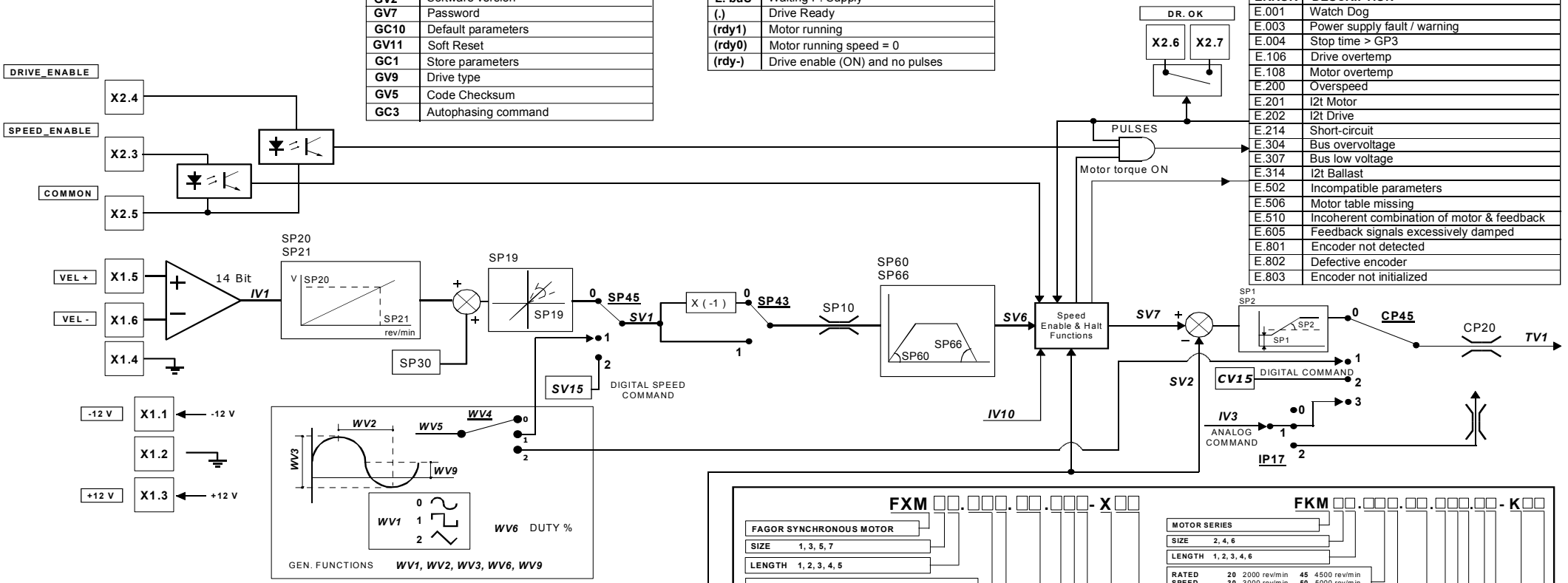
Fagor Automation S. Coop.
B.º San Andrés, 19 - Apdo. 144
E-20500 Arrasate-Mondragón,
Gipuzkoa ·Spain·
Tel: +34 943 719 200
+34 943 039 800
Fax: +34 943 791 712
E-mail: info@fagorautomation.es
www.fagorautomation.com

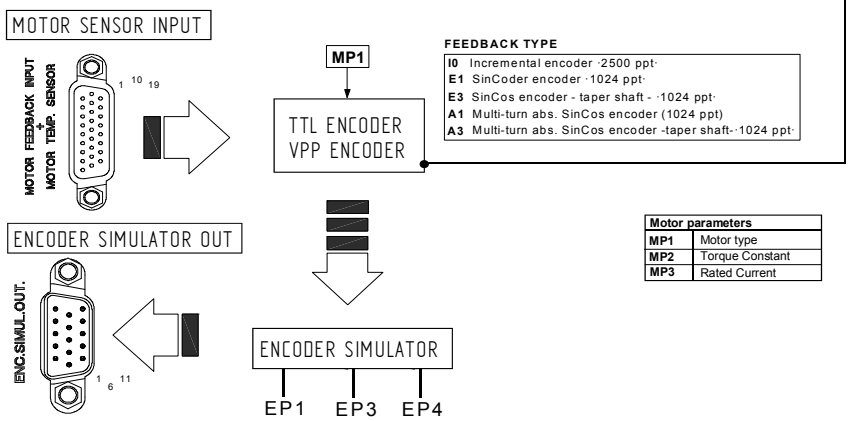
VELOCITY CONTROL BLOCK DIAGRAM

General parameters	
GV2	Software version
GV7	Password
GC10	Default parameters
GV11	Soft Reset
GC1	Store parameters
GV9	Drive type
GV5	Code Checksum
GC3	Autophasing command

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.502	Incompatible parameters
E.506	Motor table missing
E.510	Incoherent combination of motor & feedback
E.605	Feedback signals excessively damped
E.801	Encoder not detected
E.802	Defective encoder
E.803	Encoder not initialized





FEEDBACK TYPE

I0	Incremental encoder ·2500 ppt·
E1	SinCoder encoder ·1024 ppt·
E3	SinCos encoder - taper shaft - ·1024 ppt·
A1	Multi-turn abs. SinCos encoder (1024 ppt)
A3	Multi-turn abs. SinCos encoder -taper shaft-·1024 ppt·

Motor parameters	
MP1	Motor type
MP2	Torque Constant
MP3	Rated Current

FXM □□.□□□.□□.□□□-X□□

FAGOR SYNCHRONOUS MOTOR		
SIZE	1, 3, 5, 7	
LENGTH	1, 2, 3, 4, 5	
RATED SPEED	12 1200 rev/min 20 2000 rev/min	30 3000 rev/min 40 4000 rev/min
WINDING	F 220 V AC A 400 V AC	
FEEDBACK TYPE	I0 Incremental encoder (2500 ppt) A1 Absolute multi-turn SinCos encoder (1024 ppt) E1 SinCoder encoder (1024 ppt)	
FLANGE & SHAFT	0 IEC Standard 1 Keyless shaft 8 NEMA Standard (USA) 9 Special	
BRAKE OPTION	0 Without brake 1 With standard brake (24 V DC)	
VENTILATION	0 Without fan 1 With standard fan 9 With special fan	
SPECIAL CONFIGURATION	X	
SPECIFICATION	01 → ZZ Only when it has a special configuration (X) !	

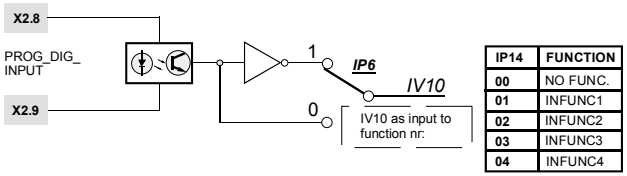
FKM □□.□□□.□□.□□□.□□-K□□

MOTOR SERIES		
SIZE	2, 4, 6	
LENGTH	1, 2, 3, 4, 6	
RATED SPEED	20 2000 rev/min 30 3000 rev/min 40 4000 rev/min	45 4500 rev/min 50 5000 rev/min 60 6000 rev/min
WINDING	A 400 V AC F 220 V AC	
FEEDBACK TYPE	A3 Multi-turn absolute sinusoidal 1Vpp ·1024 ppt· (taper shaft) E3 Sinusoidal 1Vpp encoder ·1024 ppt· (taper shaft) I0 TTL incremental encoder ·2500 ppt·	
FLANGE AND SHAFT	0 With keyway (half-key balancing) 1 Cylindrical (with no keyway) 2 Shaft with keyway and seal 3 Keyless shaft with seal 9 Special configuration	
BRAKE OPTION	0 Without brake 1 With standard brake · 24 V DC · 2 With extra brake · 24 V DC ·	
FAN AND INERTIA OPTION	0 Standard 1 Electro-ventilated 8 Low inertia 9 Low inertia and electro-ventilated (future)	
WINDING OPTION	None Standard 2 Optimized for ACSD-16H 3 Small size	
TEMPERATURE SENSOR	0/none PTC KTY84 1 PTC Pt1000 (future)	
EXTRAS	- None K Special configuration U NRTLSAFET certification (future)	
SPECIFICATION	01 ... 99 Only when it has a special configuration "K"	

Notes.

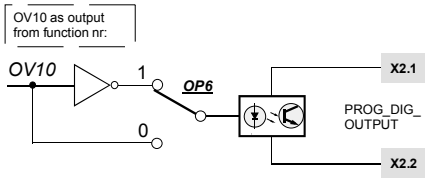
Encoders with reference:
I0, only available on FXM/FKM servomotors, "F" winding.
E1/A1/E3/A3, only available on FXM/FKM servomotors, "A" winding.

I/O FUNCTIONS

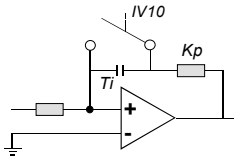


IP14	FUNCTION
00	NO FUNC.
01	INFUNC1
02	INFUNC2
03	INFUNC3
04	INFUNC4

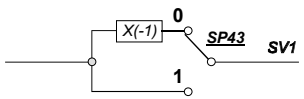
FUNCTION	OP14
NO FUNC.	00
OUTFUNC1	01
OUTFUNC2	02
OUTFUNC3	03
OUTFUNC4	04
OUTFUNC5	05
OUTFUNC6	06
OUTFUNC7	07



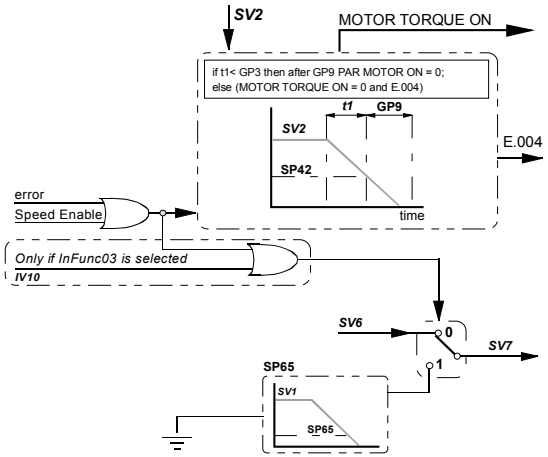
IP14 01 REMOTE P. / P.I. CONTROL



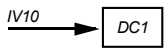
IP14 02 SERVOMOTOR ROTATION DIRECTION



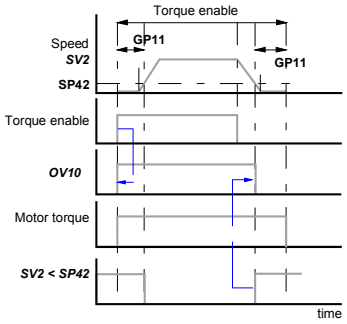
IP14 03 HALT



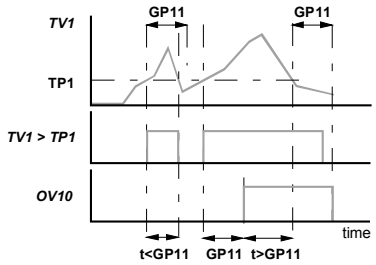
IP14 04 ERROR RESET



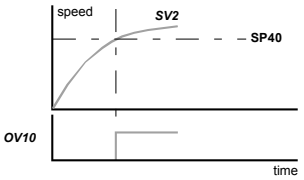
OP14 01 MOTOR BRAKE CONTROL



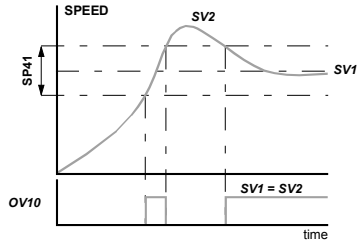
OP14 02 TORQUE LIMIT



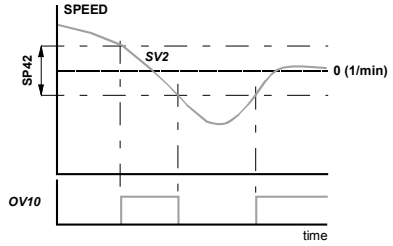
OP14 03 MOTOR SPEED > SP40



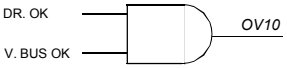
OP14 04 TARGET SPEED



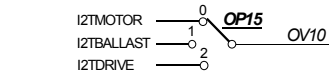
OP14 05 TARGET SPEED < 0 REV/MIN



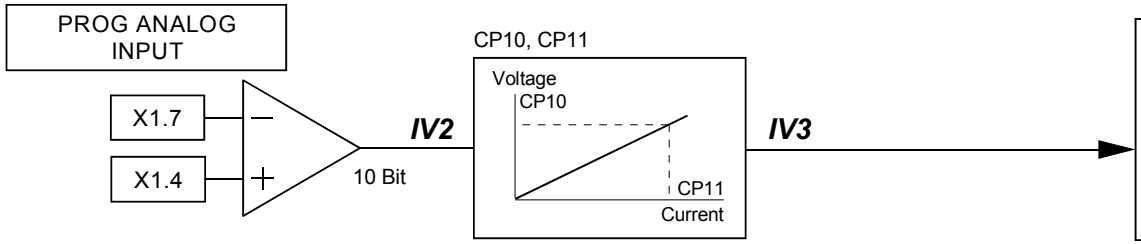
OP14 06 SECOND DR OK



OP14 07 WARNINGS



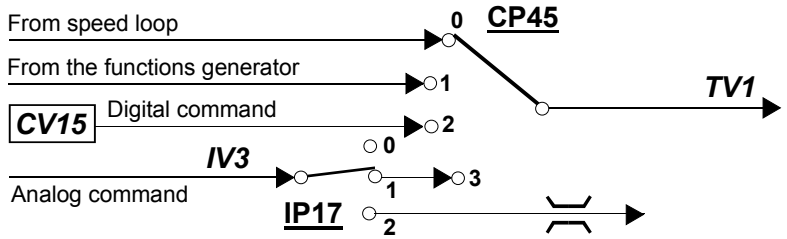
ANALOG FUNCTIONS



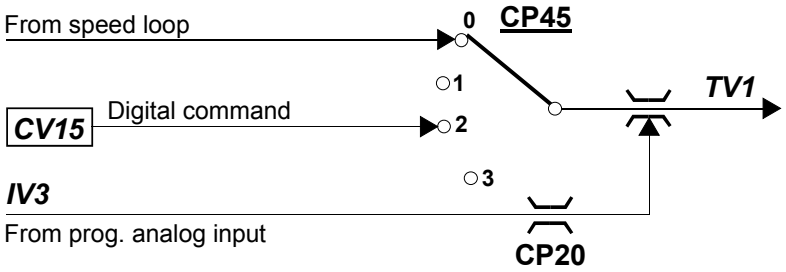
IV3 as input to function nr:

IP17	FUNCTION
00	NO FUNC.
01	FUNCTION 1
02	FUNCTION 2

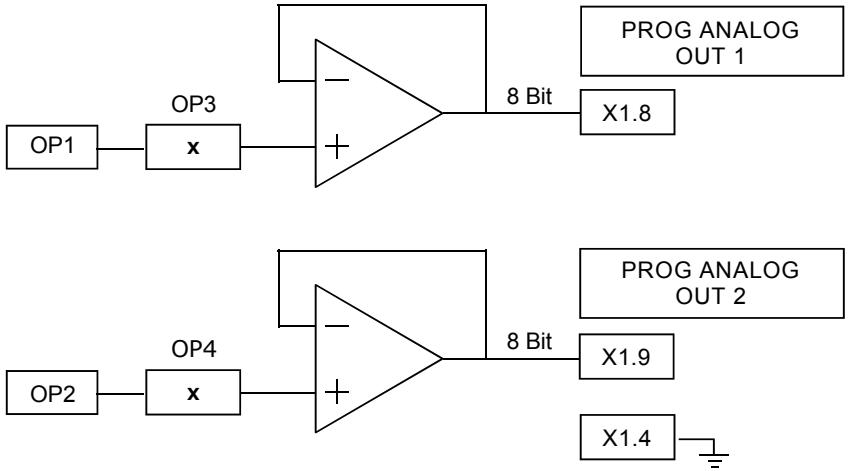
FUNCTION 1 **External current command**



FUNCTION 2 **External current limit command**

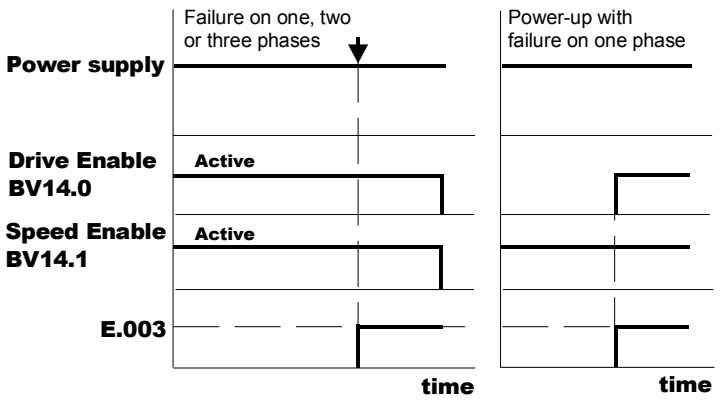


OP1	VARIABLE	OP2	VARIABLE	UNITS
00	SV15	00	SV15	1/min
01	SV1	01	SV1	1/min
02	SV6	02	SV6	1/min
03	SV7	03	SV7	1/min
04	SV2	04	SV2	1/min
05	TV1	05	TV1	$10^{-1}\cdot$Nm
06	TV2	06	TV2	$10^{-1}\cdot$Nm
07	CV3	07	CV3	$10^{-2}\cdot$A
08	WV5	08	WV5	-
09	IV1	09	IV1	mV
10	IV2	10	IV2	mV
11	RV1	11	RV1	bits
12	RV2	12	RV2	bits

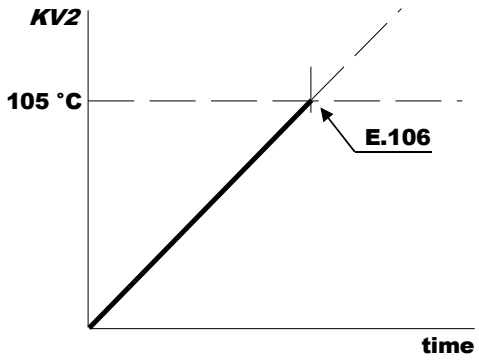


ERROR FUNCTIONS

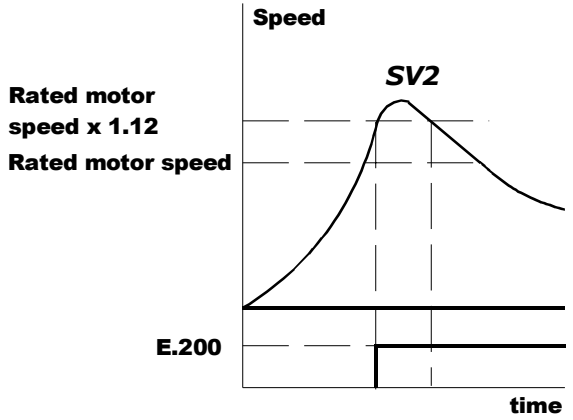
Function «E.003» Power supply fault



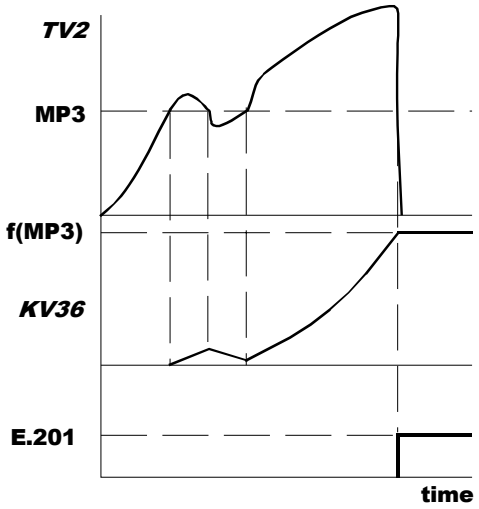
Function «E.106» Drive overtemperature



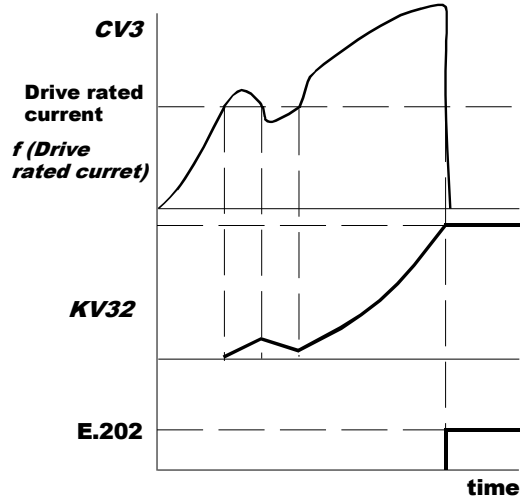
Function «E.200» Overspeed



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