Fagor Automation, S.Coop.

Brushless AC Servodrives (analog)

Ver. 0002

Preliminary

FAGOR

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Declaration of conformity

Manufacturer: Fagor Automation, S. Coop.
Barrio de San Andrés s/n, C.P. 20500, Mondragón -Guipúzcoa- (SPAIN)

We hereby declare, under our responsibility that the product:

Fagor AC Brushless Servo Drive System.

consisting of the following modules and motors:

Servodrives: ACS Series
AC Motors: FXM Series

mentioned on this declaration,
with the basic requirements of the European Directives 73/23/CE on Low Voltage (Basic Safety Regulation, Machinery Electrical Equipment EN60204-1:95) and 89/336/CE on Electromagnetic Compatibility (EN 61800-3:1996, Specific Regulation on Electromagnetic Compatibility for Servo Drive Systems).

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Fagor Automation, S. Coop. Ltda.
Director Gerente

Fdo.: Julen Busturia

In Mondragón, February 15th, 2000

Introduction

Fagor offers you a wide range of servo drive systems (AC brushless motor and Analog drive) for applications requiring between 0.65 and 32 Nm at speeds between 1200 rpm and 4000 rpm.

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

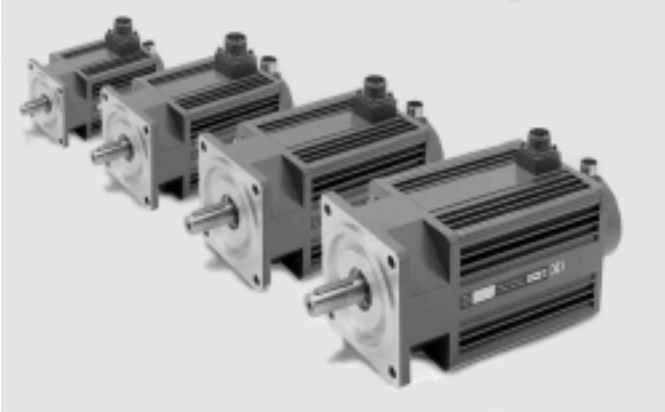
When installed for the first time, it is a good idea to read the whole document.
Should you have any doubts or questions, please do not hesitate to contact our technicians at any of our subsidiaries worldwide.

Thank you for choosing Fagor.

Brushless AC Motors, FXM

1.1 INTRODUCTION

FXM1 FXM3 FXM5 FXM7



FXM series synchronous servo motors are **AC Brushless,** with permanent magnets.

They are ideal for any application requiring great positioning accuracy.

They have a smooth torque output, has no brushes, high reliability and low maintenance.

Its normal protection level is IP64, being immune to liquids and dirt.

The system incorporates a temperature sensor for monitoring the internal temperature. They also carry an optional electromechanical brake.

Excitation	Permanent rare earth magnets (SmCo)
Temperature sensor	Thermistor

Shaft end	Cylindrical with keyway. (Option: with no keyway)
Mounting	Face flange
Mounting method	B5-V1-V3 (as recommended by IEC-34-3-72)
Mechanical tolerances	Normal class (IEC-72/1971)
Balancing	Class N (Class R optional) (DIN 45665) (balanced with the whole key)
Roller bearings' life	20,000 hours
Noise	DIN 45635
Vibration resistance	Withstands 1G along the shaft and 3G sideways (G = 10 m/s²).

Electrical Insulation	Class F (155°C) (311°F)
Isolating resistance	500 Vdc, 10 MOhms or greater
Dielectric Strength	1500 Vac, one minute

Degree of Protection	Overall: IP64 standard, IP54 with fan Axis: IP64 standard, IP65 with oil seal
Storage temperature	From -20°C to +80°C (-4°F / 176°F)
Working ambient temp.	From 0°C to +40°C (32°F / 74°F)
Working ambient humidity	From 20% to 80% (non condensing)

Brake	Optional on all models See "Brake Characteristics"

Feedback	Differential TTL Encoder

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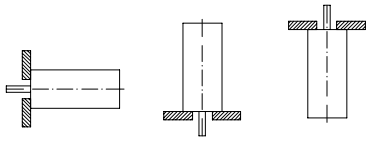
- Meaning of the mounting codes.



B5 V1 V3

- IP64 means that it is protected against dust and against water jets.
- The F class isolation on the motor maintain the dielectric properties as long as the work temperature stays below 155°C (311°F).

	Stall Torque	Peak Torque	Rated Speed	Stall Current	Peak Current	Power	Torque Constant	Acceleration Time	Inductance inter-phases	Resistance inter-phases	Inertia	Weight	Peak Torque (Nm) for 0.5 seconds.			
	Mo -Nm-	Mp -Nm-	nN -rpm-	Io -A-	Imax -A-	Pow -kW-	KT Nm/A	tac -ms-	L -mHr-	R Ohms	J Kg.cm2	P -Kg-	ACS-05 -Nm-	ACS-10 -Nm-	ACS-20 -Nm-	ACS-30 -Nm-
FXM11.40F.I0.xx0	0,65	3,3	4000	1,1	5,5	0,3	0,6	23,2	70,0	8,1	1,8	3,3	3,0			
FXM12.40F.I0.xx0	1,3	6,5	4000	2,1	10,5	0,5	0,6	18,7	18,0	2,7	2,9	4,3	3,1			
FXM13.40F.I0.xx0	1,9	9,5	4000	3,1	15,5	0,8	0,6	21,6	8,3	1,5	4,9	6,4	3,1	6,1		
FXM14.20F.I0.xx0	2,6	13,0	2000	2,1	10,5	0,5	1,2	9,7	19,0	4,3	6,0	7,6	6,2			
FXM14.40F.I0.xx0	2,6	13,0	4000	4,2	21,0	1,1	0,6	19,3	4,9	1,1	6,0	7,6		6,2		
FXM31.20F.I0.xx0	2,0	10,0	2000	1,6	8,0	0,4	1,3	9,4	48,0	8,5	4,5	5,5	6,3			
FXM31.40F.I0.xx0	2,0	10,0	4000	3,2	16,0	0,8	0,6	18,8	13,0	2,4	4,5	5,5	3,1	6,3		
FXM32.20F.I0.xx0	3,9	19,5	2000	3,2	16,0	0,8	1,2	7,9	23,0	3,4	7,4	7,5	6,1	12,2		
FXM32.40F.I0.xx0	3,9	19,5	4000	6,3	31,5	1,6	0,6	15,9	5,8	0,8	7,4	7,5		6,2	12,4	
FXM33.20F.I0.xx0	5,8	29,0	2000	4,7	23,5	1,2	1,2	7,6	13,0	1,7	10,5	9,6		12,3	24,7	
FXM33.40F.I0.xx0	5,8	29,0	4000	9,4	47,0	2,4	0,6	15,2	3,6	0,5	10,5	9,6			12,3	
FXM34.20F.I0.xx0	7,9	39,5	2000	6,4	32,0	1,7	1,2	7,4	10,0	1,3	14,0	11,5		12,3	24,7	
FXM34.40F.I0.xx0	7,9	39,5	4000	12,7	63,5	3,3	0,6	14,8	2,6	0,3	14,0	11,5			12,4	
FXM53.20F.I0.xx0	10,0	50,0	2000	8,1	40,5	2,1	1,2	9,6	9,4	0,8	23,0	15,8			24,7	37,0
FXM53.40F.I0.xx0	10,0	50,0	4000	16,1	80,5	4,2	0,6	19,3	2,4	0,2	23,0	15,8				18,6
FXM54.20F.I0.xx0	13,6	68,0	2000	11,0	55,0	2,8	1,2	11,4	6,5	0,5	37,0	17,8			24,7	37,1
FXM54.30F.I0.xx0	13,6	68,0	3000	16,4	82,0	4,3	0,8	17,1	3,1	0,3	37,0	17,8				24,9
FXM55.12F.I0.xx0	17,0	85,0	1200	8,2	41,0	2,1	2,1	6,6	15,0	1,2	45,0	20,0			41,5	62,2
FXM55.20F.I0.xx0	17,0	85,0	2000	13,7	68,5	3,6	1,2	11,1	5,8	0,4	45,0	20,0				37,2
FXM73.12F.I0.xx0	19,5	97,5	1200	9,4	47,0	2,5	2,1	11,9	19,0	1,1	92,0	29,0			41,5	62,2
FXM73.20F.I0.xx0	19,5	97,5	2000	15,7	78,5	4,1	1,2	19,8	6,9	0,4	92,0	29,0				37,3
FXM74.12F.I0.xx0	26,0	130,0	1200	12,6	63,0	3,3	2,1	11,6	15,0	0,8	120,0	31,6			41,3	61,9
FXM75.12F.I0.xx0	32,0	160,0	1200	15,5	77,5	4,0	2,1	12,6	11,0	0,6	160,0	36,0				61,9

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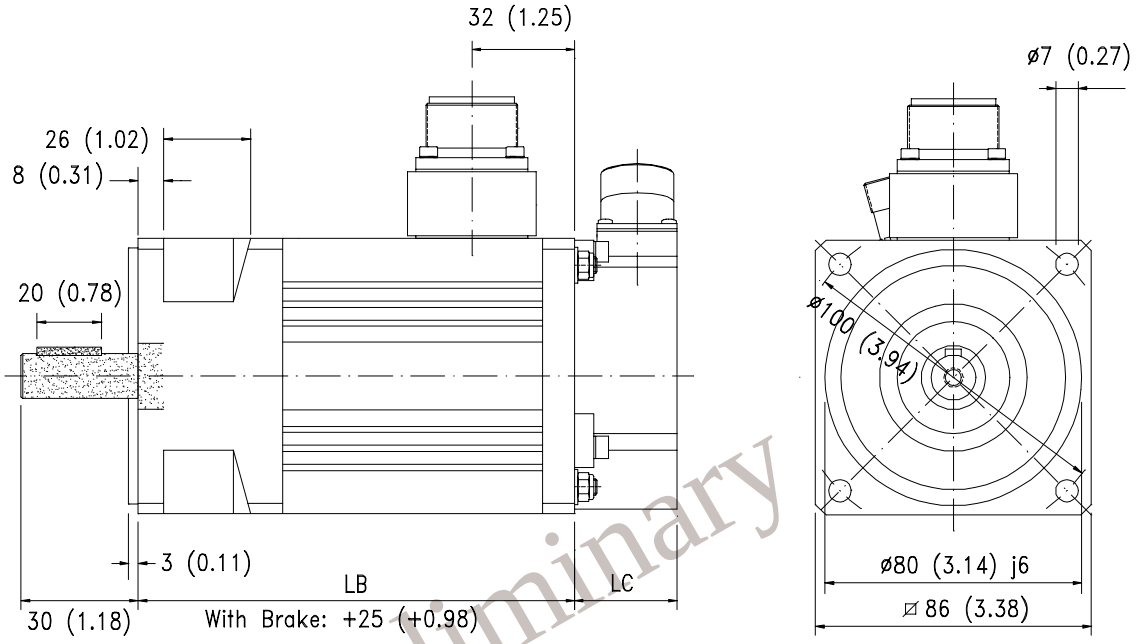
AC MOTORS

FXM1 SERIES mm (inches)

	LB
FXM11	136 (5.35)
FXM12	171 (6.7)
FXM13	206 (8.11)
FXM14	241 (9.48)

	LC
ENCODER (I0)	46 (1.81)



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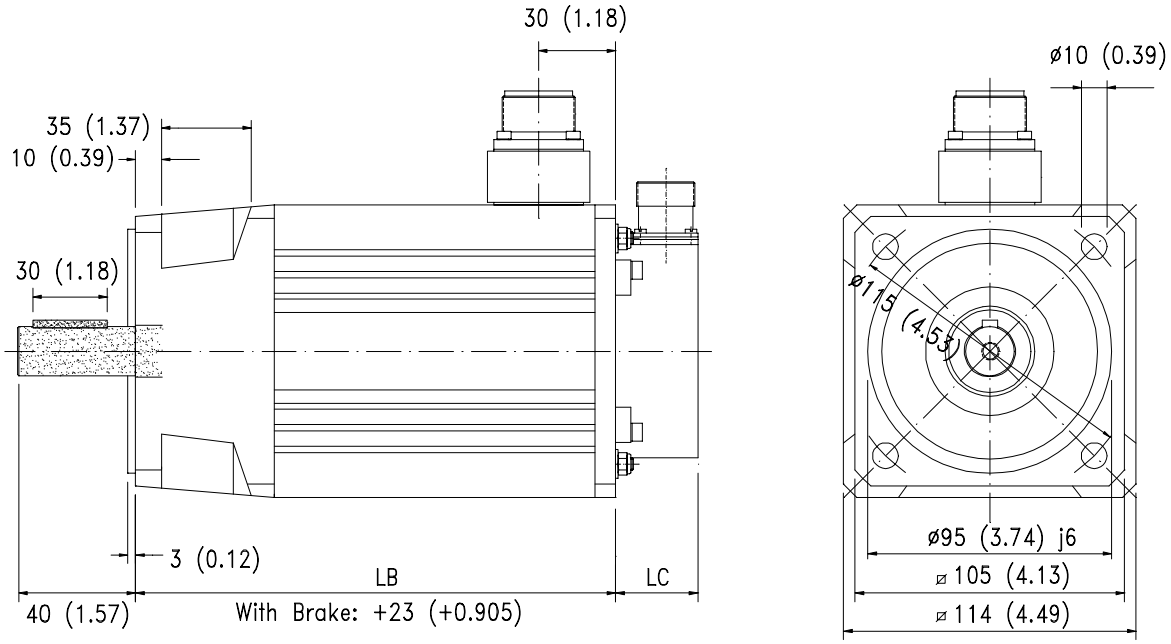
FXM3 SERIES mm (inches)

	LB
FXM31	152 (5.98)
FXM32	187 (7.36)
FXM33	222 (8.74)
FXM34	257 (10.12)

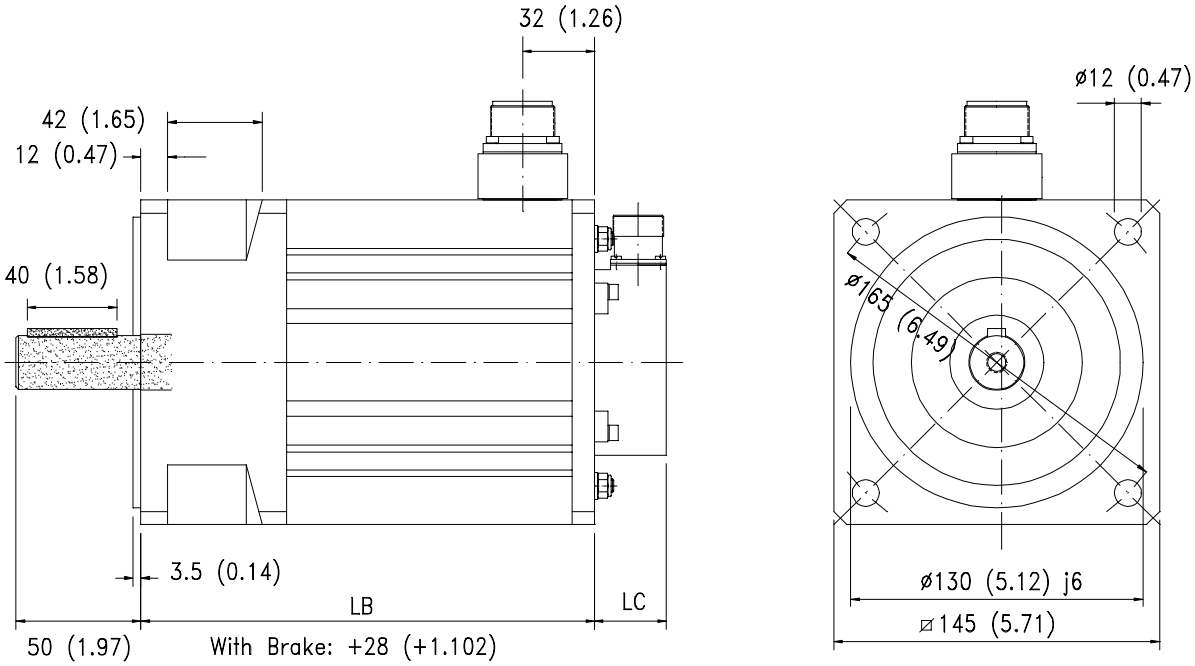
	LC
ENCODER (I0)	46 (1.81)



FXM5 SERIES mm (inches)

	LB
FXM53	237 (9.33)
FXM54	272 (10.71)
FXM55	307 (12.08)

	LC
ENCODER (I0)	46 (1.81)

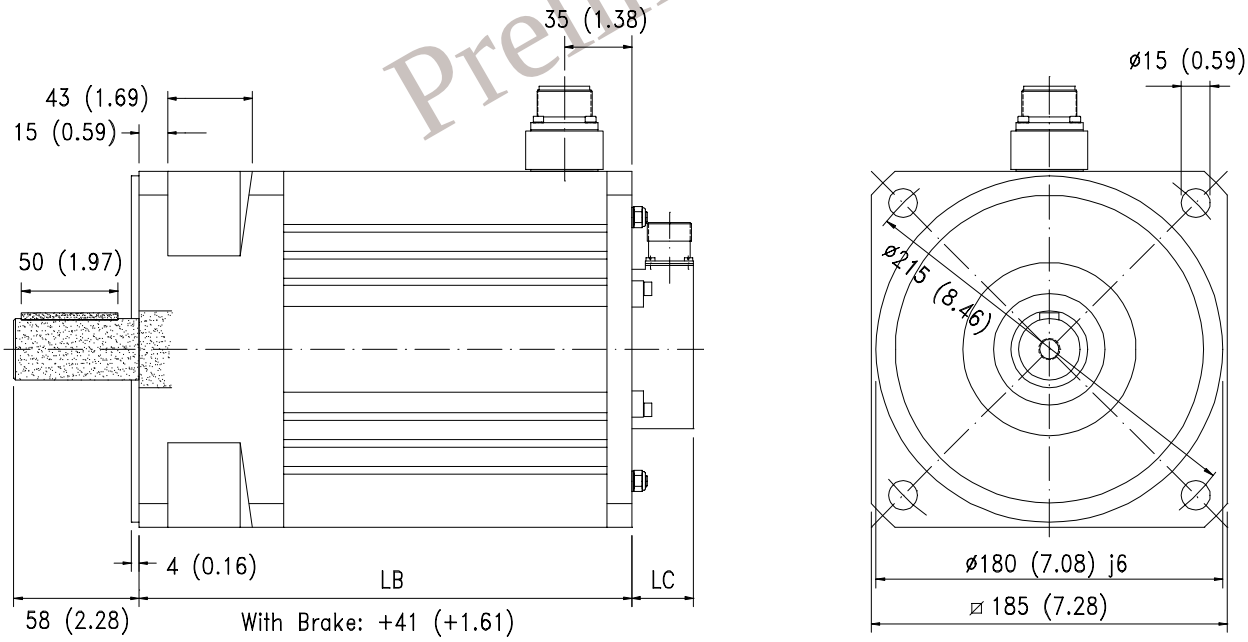


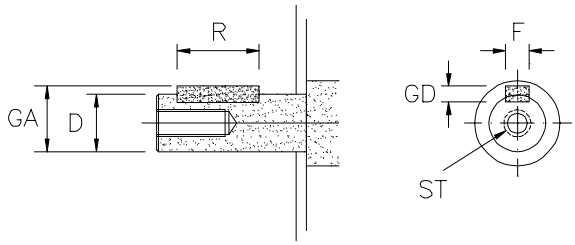
FXM7 SERIES mm (inches)

Preliminary

	LC
ENCODER (I0)	46 (1.81)

	LB
FXM73	256 (10.08)
FXM74	291 (11.46)
FXM75	326 (12.84)





	F	GD	R	D	GA	ST
FXM1	5 (0.19)	5 (0.19)	20 (0.78)	14 (0.55) j6	16 (0.62)	M5x12.5 (0.49)
FXM3	6 (0.24)	6 (0.24)	30 (1.18)	19 (0.75) j6	21.5 (0.85)	M6x16 (0.63)
FXM5	8 (0.31)	7 (0.27)	40 (1.58)	24 (0.94) j6	27 (1.07)	M8x19 (0.75)
FXM7	10 (0.39)	8 (0.31)	50 (1.97)	32 (1.26) k6	35 (1.38)	M10x22 (0.86)

1.3 POWER CONNECTORS AND ENCODER OUTPUT

The power connector includes the brake terminals (E, F). Voltages between 22 and 26 volts release 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).

Encoder connector's terminals 9 and 10 correspond to the thermistor. It watches the motor heating.

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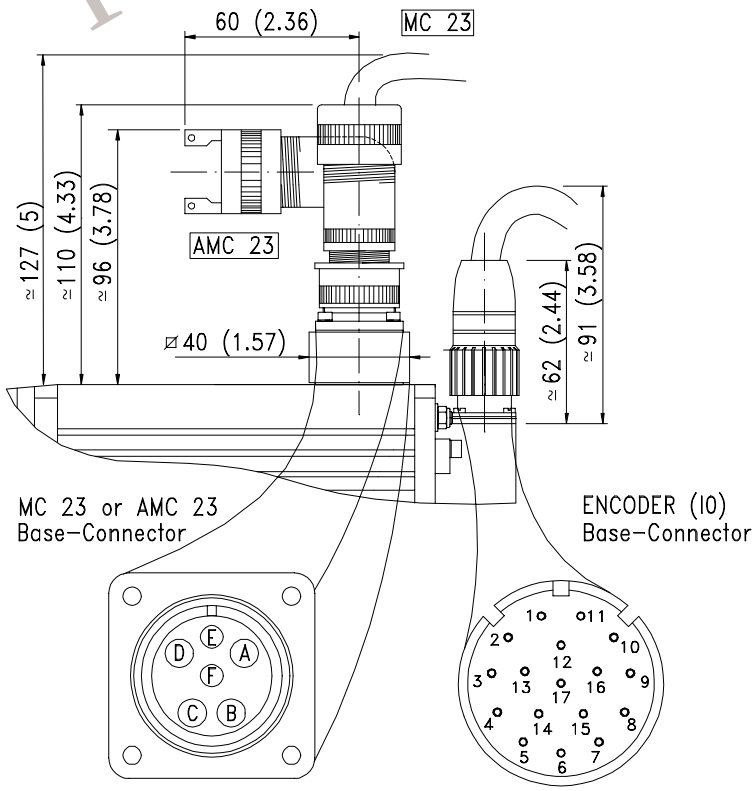
MC 23
AMC 23 Drawings

Sealing:
IP65 standard



PIN	SIGNAL
A	Phase U
B	Phase V
C	Phase W
D	Ground
E	Brake (+)
F	Brake (−)

PIN	SIGNAL
1	A
2	*A
3	+5 Vdc
4	GND
5	B
6	*B
7	Z
8	*Z
9	Tp
10	Tp
11	U
12	*U
13	V
14	*V
15	W
16	*W
17	Chassis

1.4 BRAKE CHARACTERISTICS

Motor Type	Torque	Maximum RPM	Power	On/Off Delay	Unlocking voltage margin	Inertia	Weight
	Nm (in.lb)	rpm	W (HP)	ms	Vdc	Kg.cm^2 (lb.in^2)	Kg (lbf)
FXM 1	2.5 (22.12)	10000	12 (0.016)	7/5	22 - 26	0,38 (0.13)	0,3 (0.66)
FXM 3	5 (44.25)	8000	16 (0.021)	15/7		1,06 (0.36)	0,6 (1.32)
FXM 5	12 (106.2)	6000	18 (0.024)	30/13		3,6 (1.23)	1.1 (2.42)
FXM 7	40 (354)	3600	35 (0.047)	100/30		31,8 (10.86)	3.5 (7.71)

1.5 SALES REFERENCE

FXM MOTORS

Example: FXM 34.20F . I0 . 0 0 0

FAGOR A**X**IS **M**OTOR		
SIZE	**1, 3, 5, 7**	
LENGTH		
MAXIMUM SPEED	**12** 1200 rpm **30** 3000 rpm	**20** 2000 rpm **40** 4000 rpm
WINDING	**F**	
FEEDBACK TYPE	**I0**	Incremental Encoder
FLANGE AND SHAFT	**0** **1**	With Keyway Without Keyway
BRAKE OPTION	**0** **1**	Without brake With standard brake (24 Vdc)
VENTILATION	**0**	Without Fan

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2.1 INTRODUCTION

The A.C.Servo drive is a compact speed drive which includes the power supply and is designed to control a single Brushless ACS motor.
There are four modules of different power offering peak currents of 5, 10, 20 and 30 Amps -rms- and whose main characteristics are:

- Three-phase power supply from Mains.
- Independent Power and Control supplies
- Dynamic braking in case of Mains fault.
- PWM IGBTs.
- Incremental TTL Encoder feedback with 2500 ppt.
- Programmable encoder output 2/n (n, from 2 to 16)
- Velocity or Torque command.
- Velocity command filtered with ramps.
- Logic inputs to control the motor (Speed and Drive Enable).
- Galvanic isolation between power and control.
- Analog outputs to monitor speed and current.
- Control against excessive acceleration/deceleration.
- 7-segment display to monitor the status of the servo drive system.
- Internal fan activation depending on the Drive_Enable signal.
- Protection against feedback loss.
- Protection against excessive drive temperature.
- Protection against Bus overvoltage or undervoltage.
- i2t protection in the motor.
- Protection of the internal Ballast resistor (i2t).
- Short-circuit protection in the motor output terminals.
- Protection against a phase drop.

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2.2 GENERAL CHARACTERISTICS.

	Fagor A.C.S. Drive			
	ACS-05	ACS-10	ACS-20	ACS-30
Rated output current	2,5 Amp-rms-	5 Amp-rms-	10 Amp-rms-	15 Amp-rms-
Peak output current (0.5 sec)	5 Amp-rms-	10 Amp-rms-	20 Amp-rms-	30 Amp-rms-
Power supply	Three-phasic mains 50/60 Hz, from 220Vac -15% to 240Vac +10%			
Consumption, Amp	2,5 Amp-rms-	5 Amp-rms-	10 Amp-rms-	15 Amp-rms-
Overvoltage protection	430 Vdc			
Internal Ballast	112 Ohms	56 Ohms	28 Ohms	18 Ohms
Internal Ballast power	200 W			
Ballast turn-on	416 Vdc			
Heat-sink thermal protection	90°C (194°F)			
Working Ambient temperature	5°C / 45°C (41°F / 113°F)			
Storage temperature	-20°C / 60°C (-4°F / 140°F)			
Protection degree	IP20 (*)			
Module dimensions	67 x 280 x 245 mm (2,48 x 11.8 x 9.05 inches)			
Module weigth	3,85 Kg (8,5 lbs)			

(*) **IP20** means that it is protected against particles with a diameter greater than 12.5 mm but it doesn't against water splashes. The module must be located into the electrical cabinet.

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2.3 CONNECTORS

Power Terminals

POWER INPUTS 220Vac, L1, L2, L3: Main Power Supply terminals.

POWER OUTPUTS, U, V, W: Motor power output terminals.
Current control through PWM. Carry wave frequency of 10 kHz.
Connect the phases between the motor and drive this way, U-U, V-V and W-W.

L+, Ri, Re: External Ballast terminals.

CONTROL POWER INPUTS 220Vac, L, N, Ground: Auxiliar Power Supply terminals.

The maximum cable section at these power terminals is: **2.5 mm²**.
Total isolation between power and control circuits.

INTERNAL FAN ACTIVATION: The internal fan cools the power electronics. The fan turns-on when the Drive_Enable signal is activated. The fan will turn-off two minutes later than the Drive_Enable signal had turned-off. This procedure reduces the stress of the fan and makes the life span longer.

Control Signals.

±10V voltages, Pins 1,2,3 of X1: Internal power supply so the user can easily generate a velocity command. It offers a maximum current of 20mA limited internally.

Velocity command. Pins 4,5,6 of X1: It allows a range voltage of ±10V and offers an impedance of 22 kOhms.

Current command. Pins 4,7 of X1: It allows a range voltage of ±6.2V and offers an impedance of 10 kOhms. The motor torque is directly proportional to the current. "Torque command".

Monitoring, Pins 8, 9, 10 of X1: Voltage outputs for monitoring motor speed and current. Voltage range of ±10V.

Warning output, Pins 1, 2 of X2: Open-collector output to set a warning when the motor i2t or the internal Ballast vigilance is activated.

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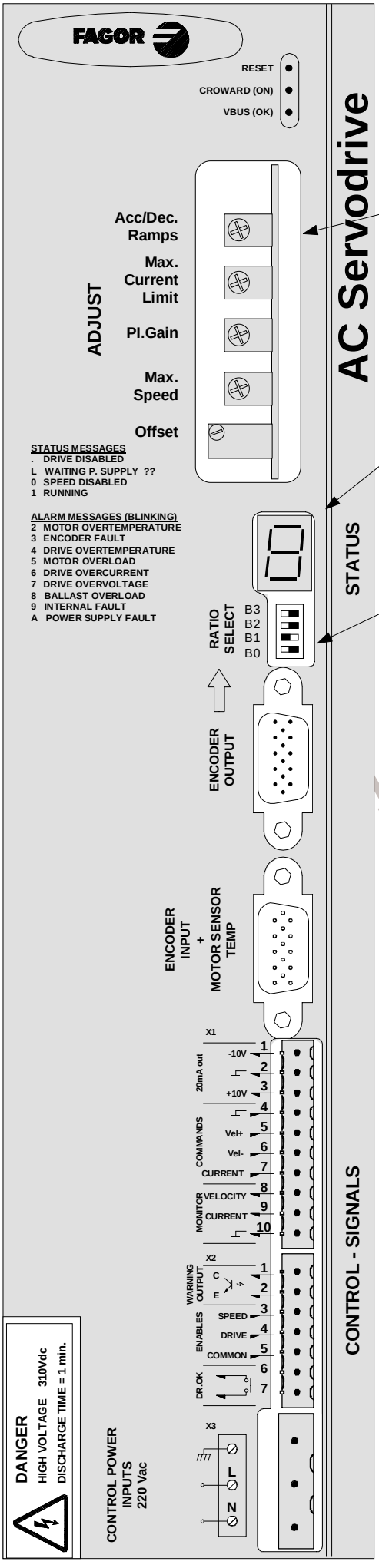
Common, Pin 5 of X2: Reference point for the following Enable signals:
Drive Enable, Pin 4 of X2: At 0Vdc, disables current through the motor which loses its torque.
Speed Enable, Pin 3 of X2: A 0Vdc, forces a "zero speed" command.
These control signals are activated at +24Vdc.

Drive OK. Pines 6, 7 of X2: Relay contact that closes when the internal status of the drive is OK. It must be included in the electrical maneuver.

Encoder Input + Motor Sensor Temp: Encoder signal input from the motor for velocity feedback, and Motor thermistor signals.
Encoder Output + Ratio Select: Encoder output for closing the loop at the CNC. They are splited by the factor selected through the B3-B0 dip-switches.

The maximum section for these cables is **0.5 mm²**.

Connectors and front panel.



Identification Module IM.
-See correspondent section-

Status and Alarm messages from the Status Display.

Status Display.

Dividing factor of the encoder signal.

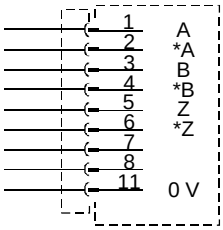
RATIO SELECT

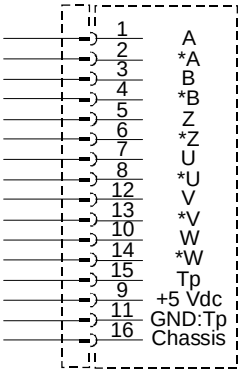
	0	1	
B3			
B2			
B1			
B0			

More significant Bit

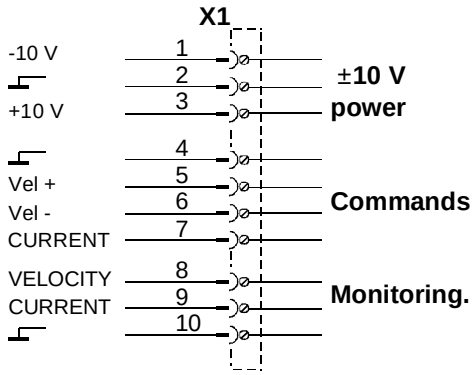
Less significant Bit

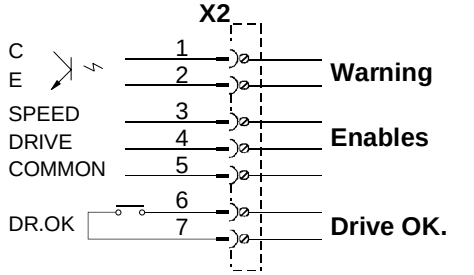
Connector for encoder signal output to CNC.

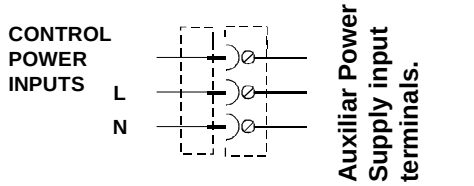




Connector for the encoder input signals.







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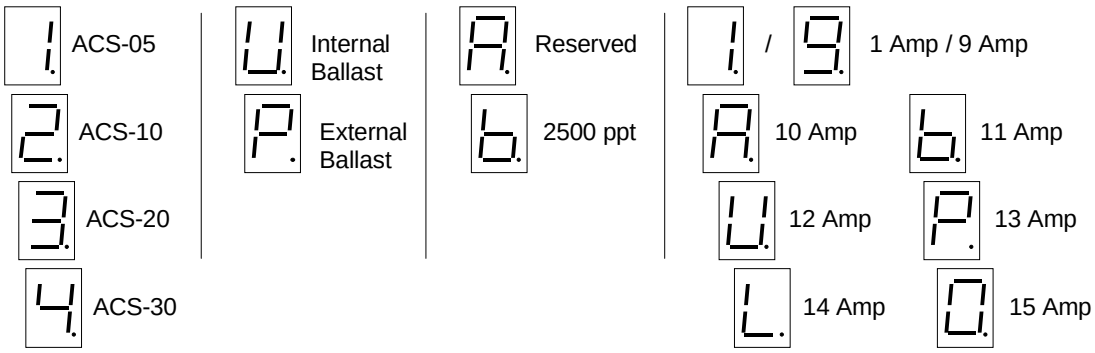
2.4 STATUS DISPLAY

It is a 7-segment display for monitoring the Drive status.

Powering the equipment the Status Display shows a three digit sequence:

Drive identification, Ballast resistor configuration, Number of encoder pulses per turn, Current threshold for motor i2t protection.



After that, a digit is shown steady (status message) or blinking (warning).

Status messages: (steady)

. **The unit is under power, Drive_Enable and Speed_Enable pins are deactivated**, (0 Volts at pins 3 and 4 of X2). The motor has no torque.

L **Waiting.** The drive is waiting for the Bus charge. The control circuits are powered. If this status lasts too long, review the power connection to Mains and the Ballast resistor one.

0 **Speed_Enable off** (0 Volts at pin 3 of X2), and **Drive_Enable on** (+24V at pin 4 of X2). The motor has torque with no velocity command.

1 **Everything is OK. Drive_Enable and Speed_Enable are active** and the Motor responds to the command.

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Warning: (blinking)

2 **Motor overtemperature.**
Solutions: Smooth the duty cycle. Improve its cooling.

3 **No Feedback.**
Solutions: Check that the feedback cable and connectors are properly connected.

4 **Drive overtemperature.**
Solutions: Smooth the duty cycle. Improve its cooling.

5 **Motor overload warning.** (fast blinking)
The motor i2t protections is been exceeded. This event activates the digital output "Warning output" (1 and 2 pins of X2). 60 seconds later, the error will be activated.

5 **Motor overload error.** After the previous warning, the motor i2t protection has gone off. The motor has maintained an average current greater than the maximum allowed for too long. The motor has been working beyond its rated current.

6. **Drive Overcurrent.** There has been an instantaneous current peak greater than the maximum allowed. Get in contact with Fagor Automation.

7. **Drive Overvoltage.** The internal Bus voltage has exceeded 430 Vdc.
Solutions: The Ballast circuit may be defective or the supply voltage is too high. The external Ballast hasn`t been installed correctly, or its value is not right.

8. **Ballast overload warning** (fast blinking)
The Ballast i2t protection is activated. If it goes on, the error will be activated.

8. **Ballast overload error.** After the previous warning, the Ballast i2t protection has gone off.
Solutions: Install an external Ballast resistance, and set the RAPT = 10 Ohms.

9. **Internal fault.** Internal control error, or the RIT value is wrong.

A. **Phase droped.** Any of the main phases has droped, or a mains microcut has been longer than 100 ms.

Note: All the alarms are latched, the unit (control and power supply) must be powered off and turned back on after 30 seconds. Or push the Reset button.

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2.5 SPECIFICATIONS PLATE AND SALES REFERENCE

Examples of the **specs plate** that comes with each Fagor ACS drive.

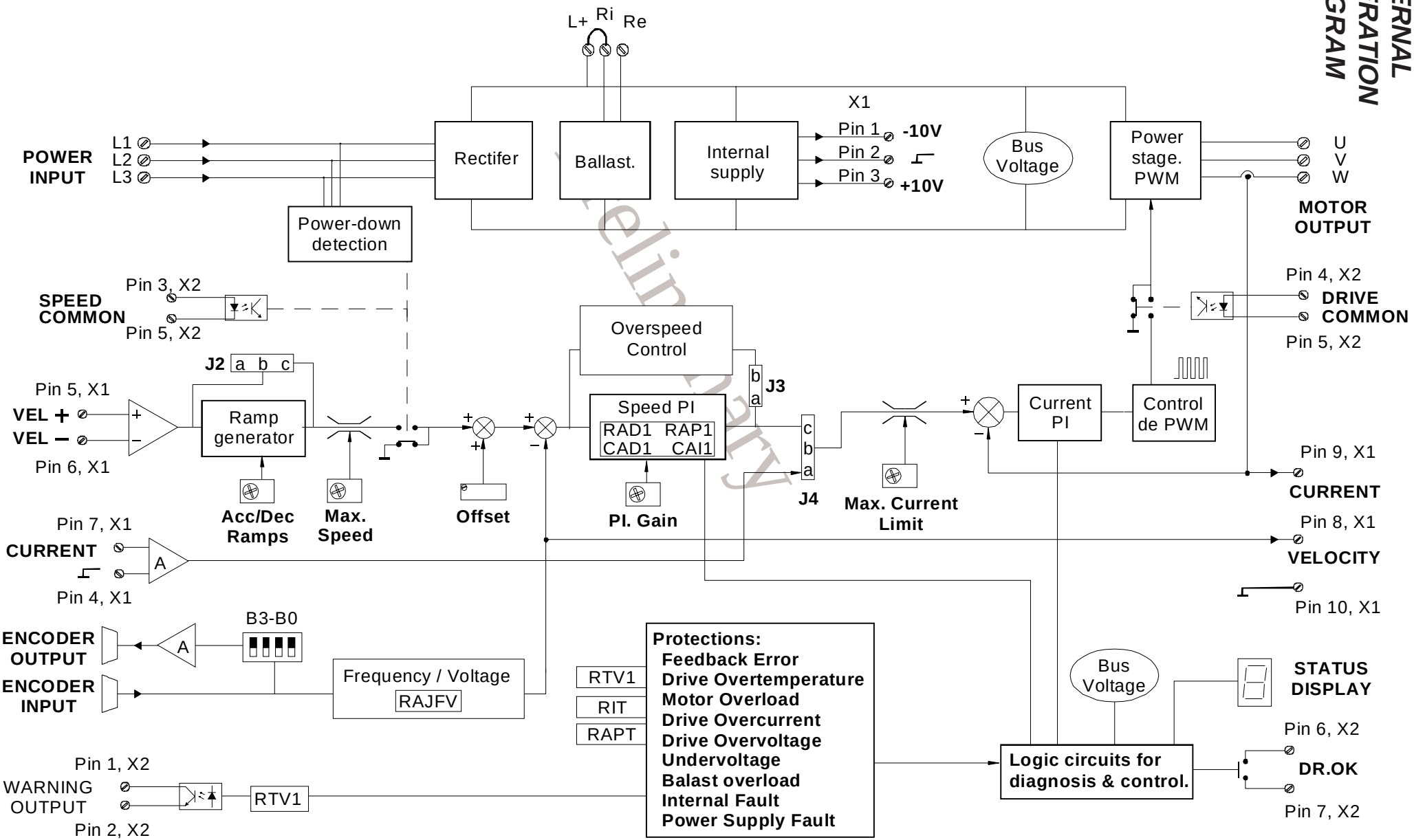
FAGOR				Fagor Automation S. Coop.(Spain) AC SERVODRIVE			CE
MODEL: ACS-05				INPUT : 3 X 220 VAC / 50-60 Hz			
S.N.: 202-1904001				OUTPUT: 0-200 VAC			
PC	PP	VAR	FR	Io	5	Amp	W: 3,85 Kg
00A	00A	00A		Imax	10	Amp	

"PC", "PP", "VAR" and "FR" indicate manufacturing related aspects (hardware design versions) that are useful for technical consultations and repairs.

Codes of the **sales reference** of Fagor ACS drives.

A.C.S. DRIVES			Example: ACS - 05
A.C. SERVODRIVE			
CURRENT		Rated	Peak (0.5 sec)
	05	2,5 Amp	5 Amp
	10	5 Amp	10 Amp
	20	10 Amp	20 Amp
	30	15 Amp	30 Amp

2.6 INTERNAL OPERATION DIAGRAM



Preliminary

User notes:

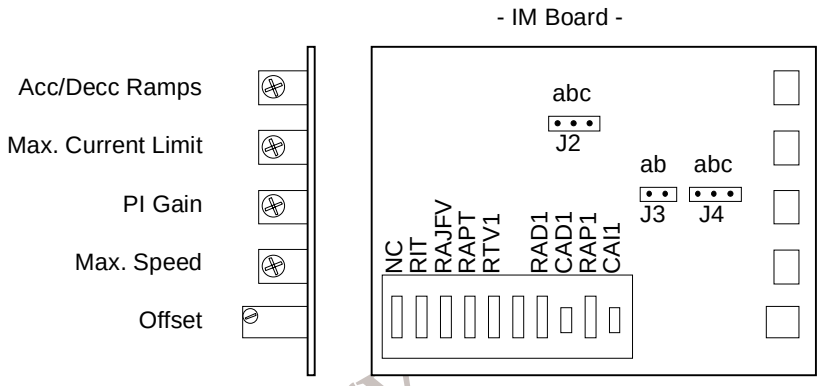
Preliminary

Identity Module, IM

This card is inserted into the ACS drive module. Its passive components and jumpers adjust the drive electronics to the FXM motor it governs. There is an IM card for each correct combination of FXM motor and ACS drive as shown on the next page. The IM-000 board is used for setting DCS Drives with non-Fagor motors. The calculation of the passive components is described on the next page.

The potentiometers accessible from the outside allow a final adjustment of the servo drive system.

The component layout of this card and their functions are described next.



Passive components:

NC: Empty.

RIT: It sets the current value from which the i2t protection starts integrating. RIT has different values for each motor.

RAJFV: It sets the relationship between the frequencies of the encoder pulses and the equivalent voltage in the internal drive circuits.

RAPT: It determines if the Ballast is an internal or external resistor. If an external Ballast is installed RAPT should be equal to 10 Ohms. An open RAPT means internal Ballast. The protection against i2t exceeding doesn't work with external Ballast.

RTV1: (not available yet) It sets the drive acording to the encoder pulses per turn used. If RTV1 is short-circuited the drive will be set for 3000 ppt, if RTV1 is openned it will be set for 2500 ppt.

RAD1, CAD1: They set the derivative compensation at the velocity PI.
RAP1, CAI1: They set the proportional and integral action of the velocity PI.

Jumpers (**in bold**, default position):
J2: Ramp generator, **active** (**ab**), or not (bc).
J3: Activates the acceleration overshooting control. **Active** (**ab**).
J4: Selector for the type of command. Current command (ab) or **velocity** (**bc**).

Preliminary

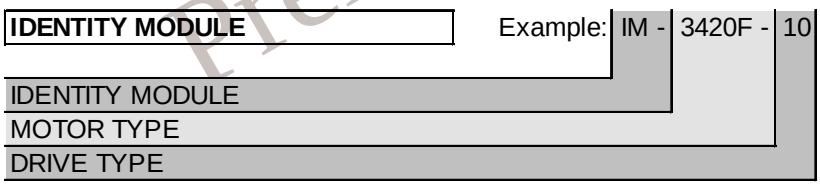
These are the names of the identity modules (IM) for each Motor-Drive set.

And these are the values of the passive components on each of those cards.

	MI Board				RIT	RAJFV
	ACS-05	ACS-10	ACS-20	ACS-30		
FXM11.40F.I0.xx0	**IM-1140F-05**				**Open**	**6,2K**
FXM12.40F.I0.xx0	**IM-1240F-05**				**470K**	**6,2K**
FXM13.40F.I0.xx0	**IM-1340F-05**	**IM-1340F-10**			**220K**	**6,2K**
FXM14.20F.I0.xx0	**IM-1420F-05**				**470K**	**12K**
FXM14.40F.I0.xx0		**IM-1440F-10**			**120K**	**6,2K**
FXM31.20F.I0.xx0	**IM-3120F-05**				**470K**	**12K**
FXM31.40F.I0.xx0	**IM-3140F-05**	**IM-3140F-10**			**220K**	**6,2K**
FXM32.20F.I0.xx0	**IM-3220F-05**	**IM-3220F-10**			**220K**	**12K**
FXM32.40F.I0.xx0		**IM-3240F-10**	**IM-3240F-20**		**68K**	**6,2K**
FXM33.20F.I0.xx0		**IM-3320F-10**	**IM-3320F-20**		**100K**	**12K**
FXM33.40F.I0.xx0			**IM-3340F-20**		**39K**	**6,2K**
FXM34.20F.I0.xx0		**IM-3420F-10**	**IM-3420F-20**		**68K**	**12K**
FXM34.40F.I0.xx0			**IM-3440F-20**		**18K**	**6,2K**
FXM53.20F.I0.xx0			**IM-5320F-20**	**IM-5320F-30**	**47K**	**12K**
FXM53.40F.I0.xx0				**IM-5340F-30**	**12K**	**6,2K**
FXM54.20F.I0.xx0			**IM-5420F-20**	**IM-5420F-30**	**27K**	**12K**
FXM54.30F.I0.xx0				**IM-5430F-30**	**12K**	**8,2K**
FXM55.12F.I0.xx0			**IM-5512F-20**	**IM-5512F-30**	**47K**	**20K**
FXM55.20F.I0.xx0				**IM-5520F-30**	**15K**	**12K**
FXM73.12F.I0.xx0			**IM-7312F-20**	**IM-7312F-30**	**39K**	**20K**
FXM73.20F.I0.xx0				**IM-7320F-30**	**12K**	**12K**
FXM74.12F.I0.xx0			**IM-7412F-20**	**IM-7412F-30**	**18K**	**20K**
FXM75.12F.I0.xx0				**IM-7512F-30**	**12K**	**20K**

RAP1 = 82K **CAI1 = 100nF** **RAPT = Open**

Preliminary



Adjustment potentiometers:

Acc/Dec Ramps: To adjust the ramp filtering the velocity command. Ramps with a duration of up to 10 seconds may be applied for a 10 volt step of analog voltage.
Turning this pot clockwise means smoother behavior (longer ramp).
WATCH OUT! If jumper J2 of the identity module is set in the (bc) position, no ramps will be applied.

Max. Current Limit: Each drive is factory set to provide the maximum current to the motor which corresponds to the maximum value of the current command. This adjustment may be used to decrease (-100%) the value of that current limit.
Turning this pot clockwise allows more current to flow through the motor.

PI Gain: For adjusting the overall gain of the velocity PI.
Turning this pot clockwise increases the gain and, therefore, makes the system perkier.

Max. Speed: Every drive is factory set so the motor turns at its maximum speed when applied maximum velocity command.
In this case, this pot will be turned 3/4 of its full travel. Therefore, it may be used to limit or force slightly the maximum motor speed.
Turning this pot clockwise allows greater speed.

Offset: To compensate for the difference between the velocity command and the actual motor speed.

Preliminary

User notes:

Preliminary

5.1 GENERAL CONSIDERATIONS

About the Motor:

Remove the anti-corrosion paint of the shafts before mounting them on to the machine.
The motor may be mounted as described in the first chapter
Watch for the ambient conditions shown in the general characteristics:
Mount it somewhere that is dry, clean and accessible for maintenance.
-remember that it meets the IP64 degree of protection.
It must be easily cooled. Avoid corrosive or flammable environments.
Guard the motor with a cover if it is exposed to splashes.
Use flexible couplings for direct transmission.
Avoid radial and axial loads on the motor shaft.

About the Drive:

The module must be installed in an electrical enclosure that is clean, dry free of dust, oil or other pollutants - remember that its degree of protection is IP20-. Never install it exposing it to flammable gases. Avoid excessive heat and humidity. The ambient temperature must never exceed 45°C (113°F).
Mount the modules vertically (as shown on the photos). Avoid vibrations.
Leave at least 30 cm of clearance above and below the module for better air flow.

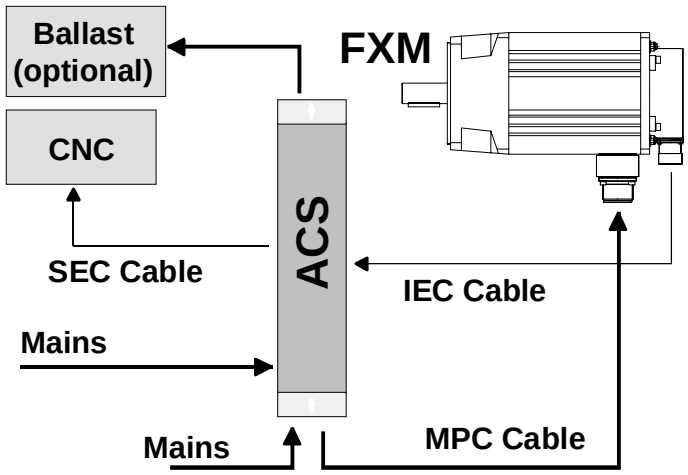
Preliminary

About the connections:

All the cables must be shielded, to reduce the interference on the control of the motor due to the commutation of the PWM. The shield of the motor power cable must be connected to the chassis screw at the bottom of the module and it, in turn, taken to Mains ground.
The command signal lines must be shielded twisted pairs. The shield must be connected to the voltage reference at the module (pins 2, 4 or 10 of X1).
Keep the signal cables away from the power cables.

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

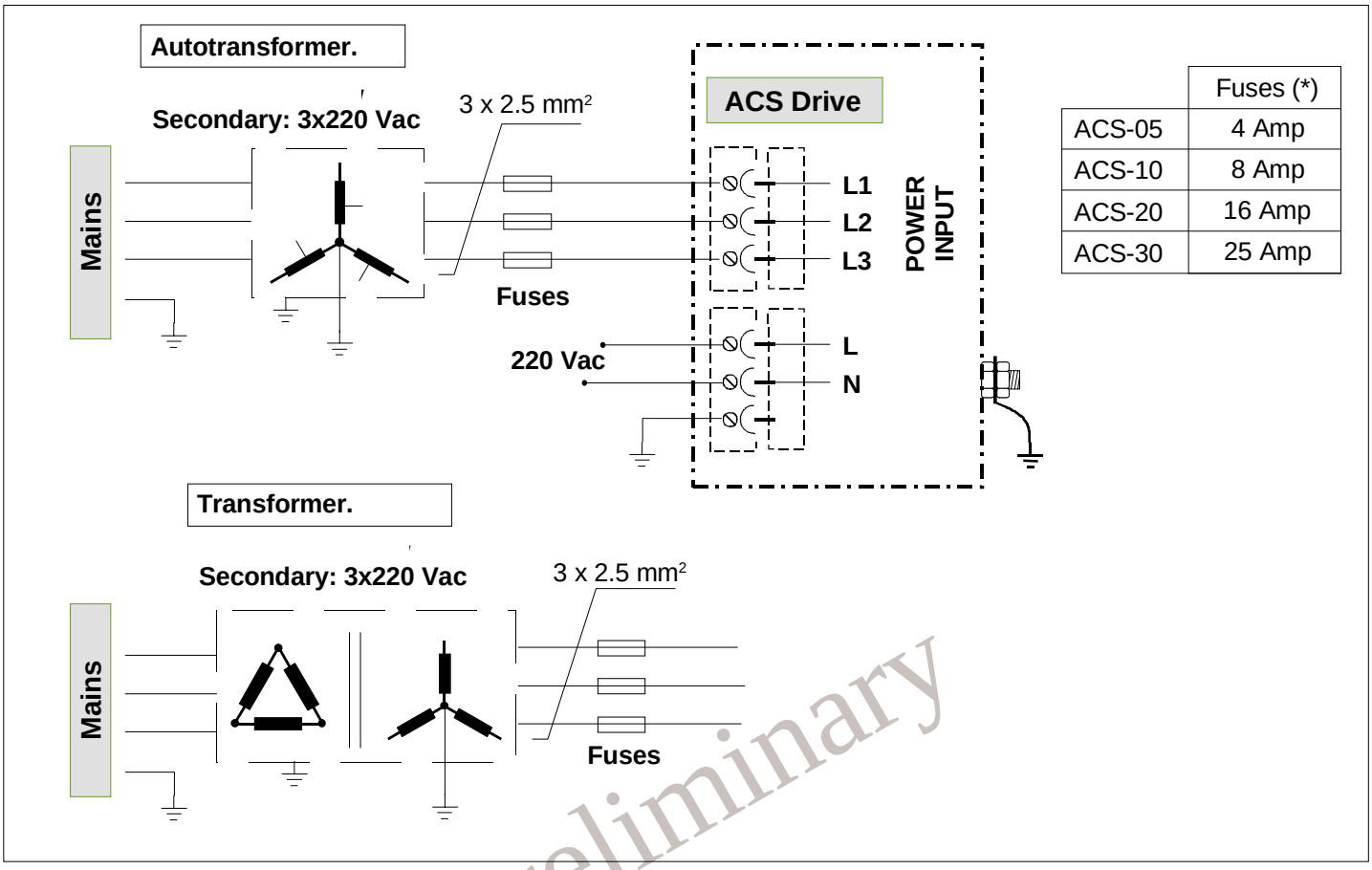
Basic interconnection diagram



5.2 ELECTRICAL CONNECTIONS

Power connection: Mains-Drive.

The drive power supply must be three-phase. The use of a transformer is not a must.



	Fuses (*)
ACS-05	4 Amp
ACS-10	8 Amp
ACS-20	16 Amp
ACS-30	25 Amp

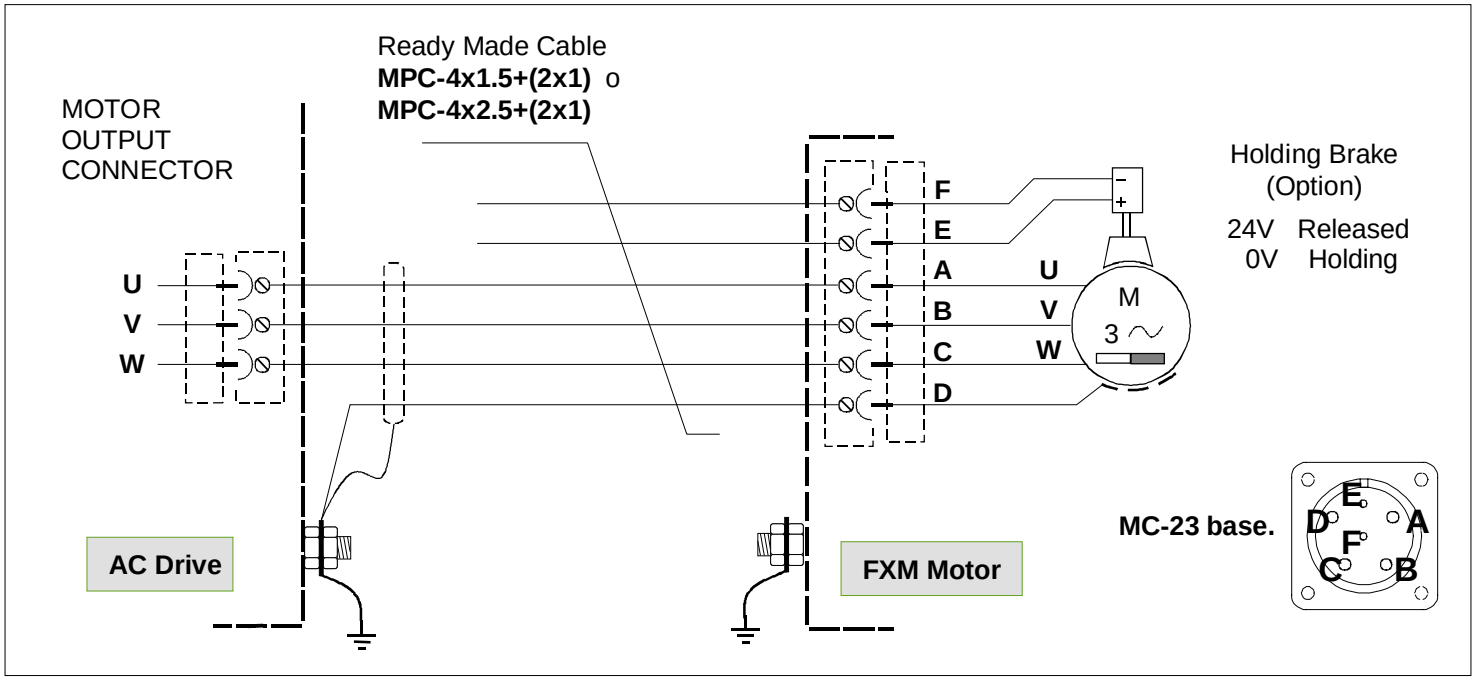
Preliminary

(*) Recommended values. 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.

A thermal switch may optionally replace the fuses.

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

Power connection: Drive-Motor.



MOTOR POWER CABLE	Example:	MPC -	4x2.5+	(2x1)
MOTOR POWER CABLE				
nr LINES x SECTION (mm2)				
nr LINES x SECTION (mm2)	2 x 1			
	No			

Preliminary

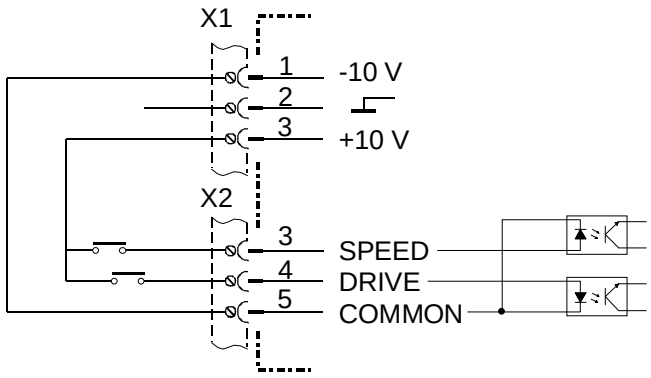
	Stall Current (Amp)	1.5 mm²	2.5 mm²
FXM11.40F.I0.xx0	1,1		
FXM12.40F.I0.xx0	2,1		
FXM13.40F.I0.xx0	3,1		
FXM14.20F.I0.xx0	2,1		
FXM14.40F.I0.xx0	4,2		
FXM31.20F.I0.xx0	1,6		
FXM31.40F.I0.xx0	3,2		
FXM32.20F.I0.xx0	3,2		
FXM32.40F.I0.xx0	6,3		
FXM33.20F.I0.xx0	4,7		
FXM33.40F.I0.xx0	9,4		
FXM34.20F.I0.xx0	6,4		
FXM34.40F.I0.xx0	12,7		
FXM53.20F.I0.xx0	8,1		
FXM53.40F.I0.xx0	16,1		
FXM54.20F.I0.xx0	11,0		
FXM54.30F.I0.xx0	16,4		
FXM55.12F.I0.xx0	8,2		
FXM55.20F.I0.xx0	13,7		
FXM73.12F.I0.xx0	9,4		
FXM73.20F.I0.xx0	15,7		
FXM74.12F.I0.xx0	12,6		
FXM75.12F.I0.xx0	15,5		

Best Option

Connection of the monitoring and control signals.

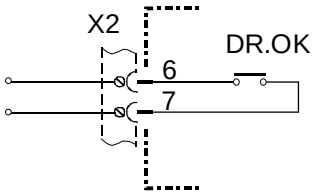
Monitoring: The drive offers +10Vdc at its "velocity" output when, receiving the maximum command of +10V, the motor turns at the calculated speed. The "current" output offers +10Vdc when the drive provides its peak current.

Enable signals using ±10V voltage:



Drive OK switch:

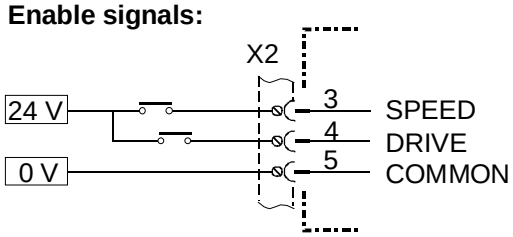
To the safety chain.



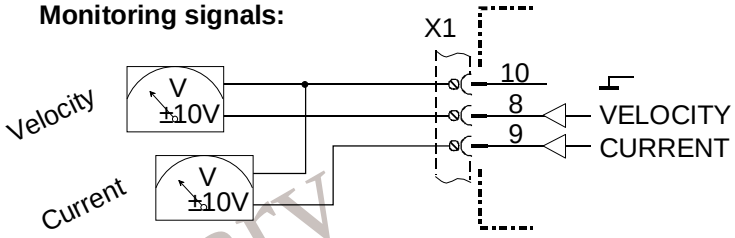
Drive OK:

0.6A - 125Vac
0.6A - 110Vdc
2A - 30Vdc

Enable signals:



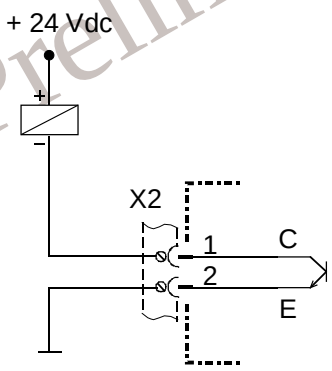
Monitoring signals:

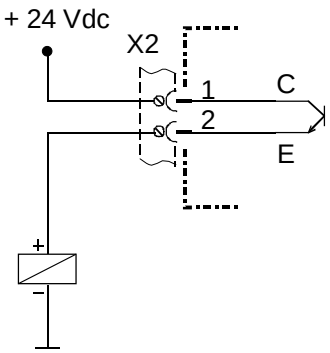


Preliminary

Warning Output:

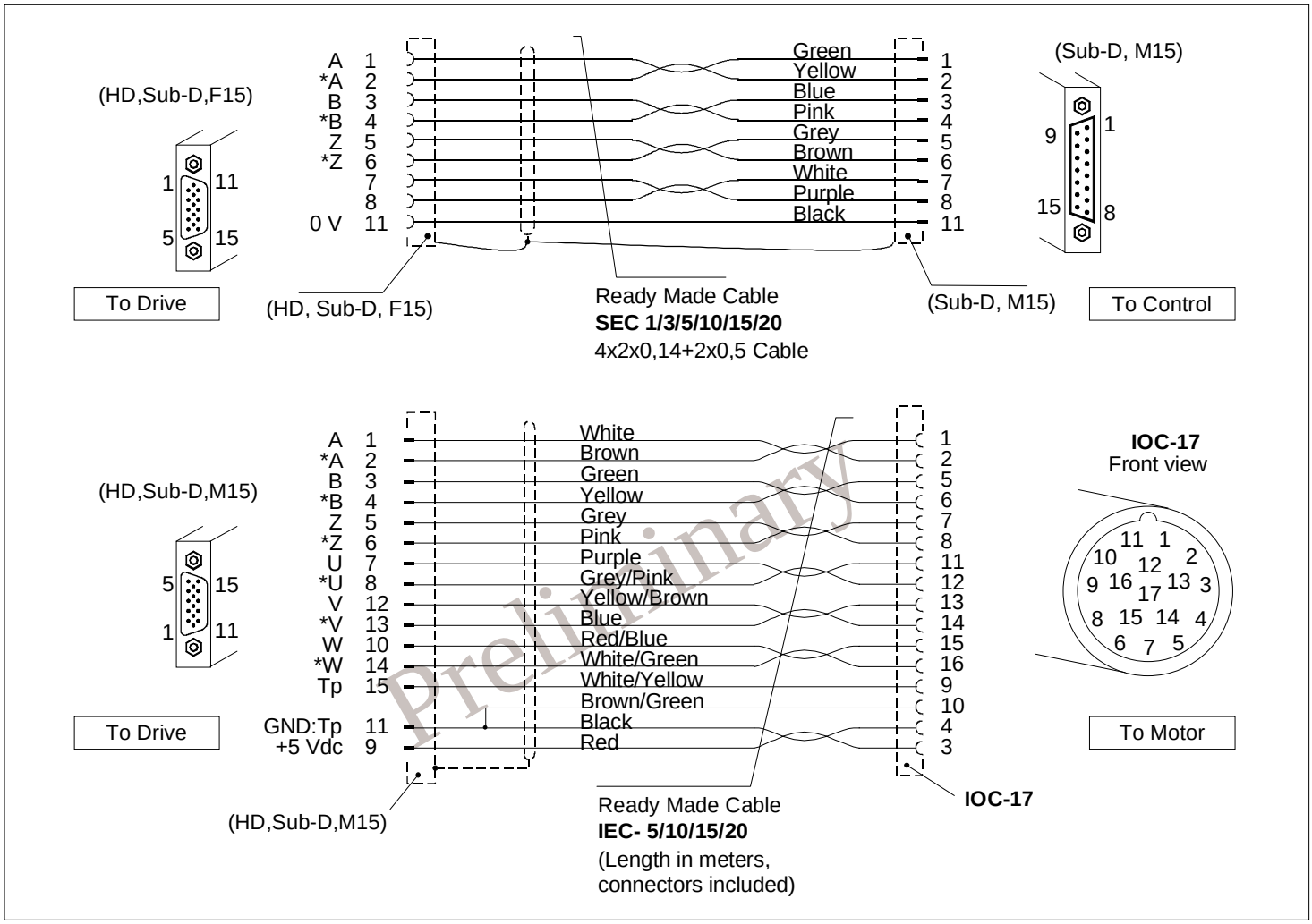
Maximum current	100 mA
Maximum voltage	50 Volts





Encoder feedback connection.

The encoder signals must be taken to the ENCODER INPUT of the ACS.
The ACS amplifies these signals and it is able to divide its frequency. The dividing factor comes from the B3-B0 dip-switches. The ACS drive offers these signal through the ENCODER OUTPUT connector.
The encoder must turn with the motor shaft and it must not be installed anywhere else in the transmission chain. The FXM's encoder outputs 2500 pulses per turn of 5V incremental signals.
Fagor supplies these full connections (cable + connectors), SEC and IEC.



RATIO SELECT

(MSB) B3
B2
B1
(LSB) B0

= ON (1)

= OFF (0)

B3	B2	B1	B0	K	ppt out
0	0	0	1	2/2	2500
0	0	1	0	2/3	1667
0	0	1	1	2/4	1250
0	1	0	0	2/5	1000
0	1	0	1	2/6	833
0	1	1	0	2/7	714
0	1	1	1	2/8	625
1	0	0	0	2/9	555
1	0	0	1	2/10	500
1	0	1	0	2/11	454
1	0	1	1	2/12	417
1	1	0	0	2/13	385
1	1	0	1	2/14	357
1	1	1	0	2/15	333
1	1	1	1	2/16	312

Example:

ENCODER INPUT

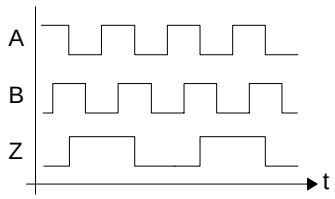
2500 ppt

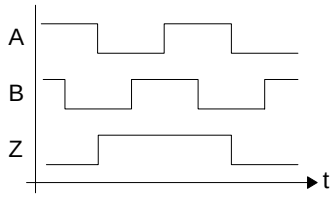
B3 0
B2 0
B1 1
B0 1

K = 2/4

ENCODER OUTPUT

1250 ppt





Codes of the sales references for the cables supplied by Fagor:

MOTOR ENCODER CABLE	Example:	IEC -	20
INCREMENTAL ENCODER CABLE			
LENGTH (m)	**5, 10, 15, 20.**		

SUB-D HD M15 — IOC-17

CNC ENCODER CABLE	Example:	SEC -	20
SIMULATOR ENCODER CABLE			
LENGTH (m)	**1, 3, 5, 10, 15, 20.**		

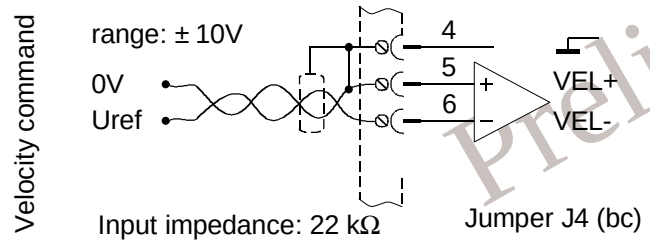
SUB-D M15 — SUB-D HD F15

Command signal connection.

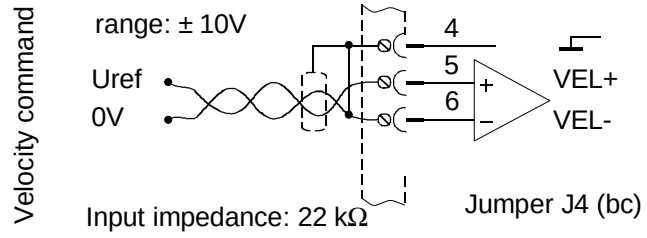
The command governing the motor may be a velocity or current command.
All the command signal lines must be shielded twisted pairs and the shield must be connected to the voltage reference at the module (pins 2, 4 or 10 of X1).
The input impedance of the velocity command is 22 kOhms (a range of ±10 V).
The input impedance of the current command is 10 kOhms (a range of ±6.2 V).

Preliminary

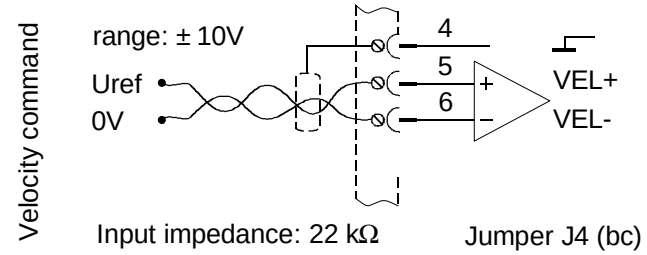
Inverted velocity command input:



Uninverted velocity command input:

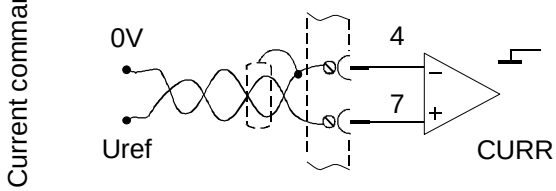


Differential velocity command input:



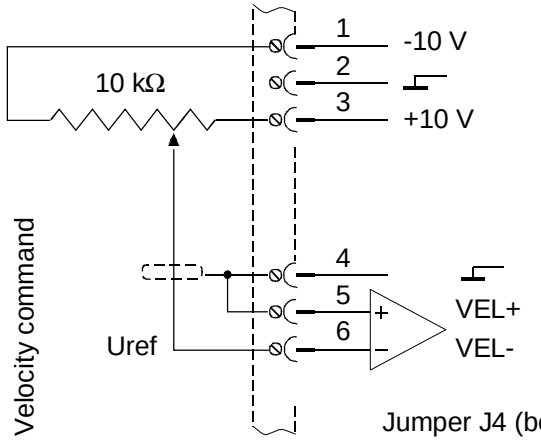
Current command input:

shortcircuit RAPT on the IM. Jumper J4 (ab)



range: ± 6.2 Vdc
Input impedance: 10 kΩ

Generation of the inverted velocity command and application to the drive:



5.3 ELECTRICAL ENCLOSURE DIAGRAM

This is a sample diagram for an electrical enclosure. It may be modified to meet the needs of a particular application.

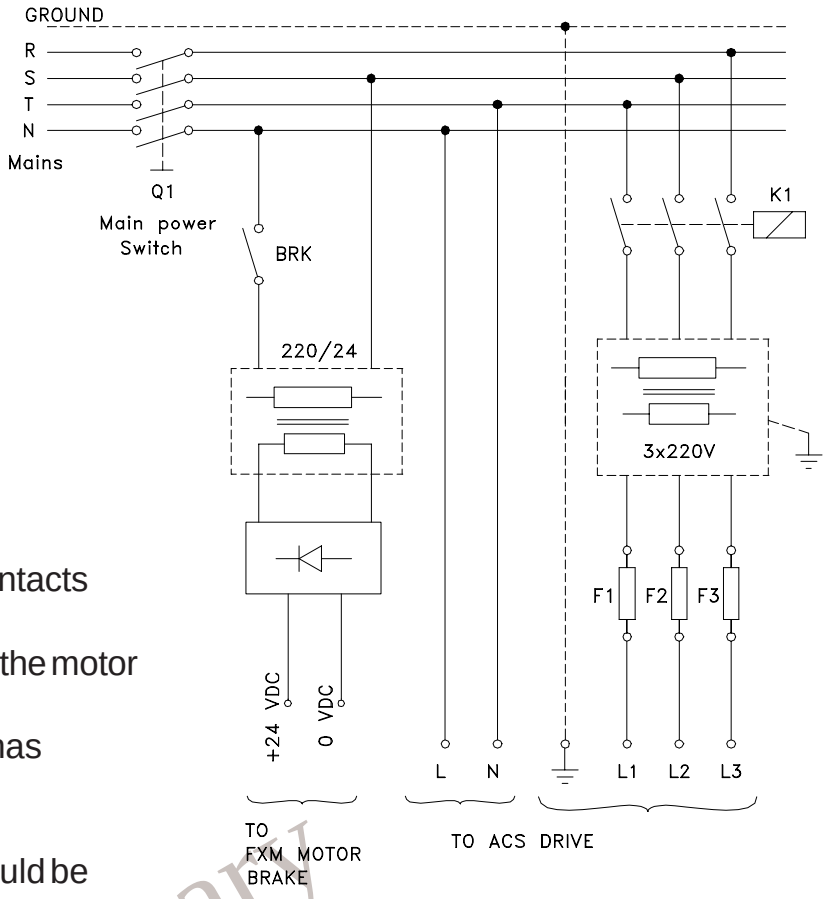
It includes a simple circuit to power the brake of the FXM.

Warning: When using an autotransformer, the secondary must have a star connection with its middle point connected to ground. Fuses are MANDATORY.

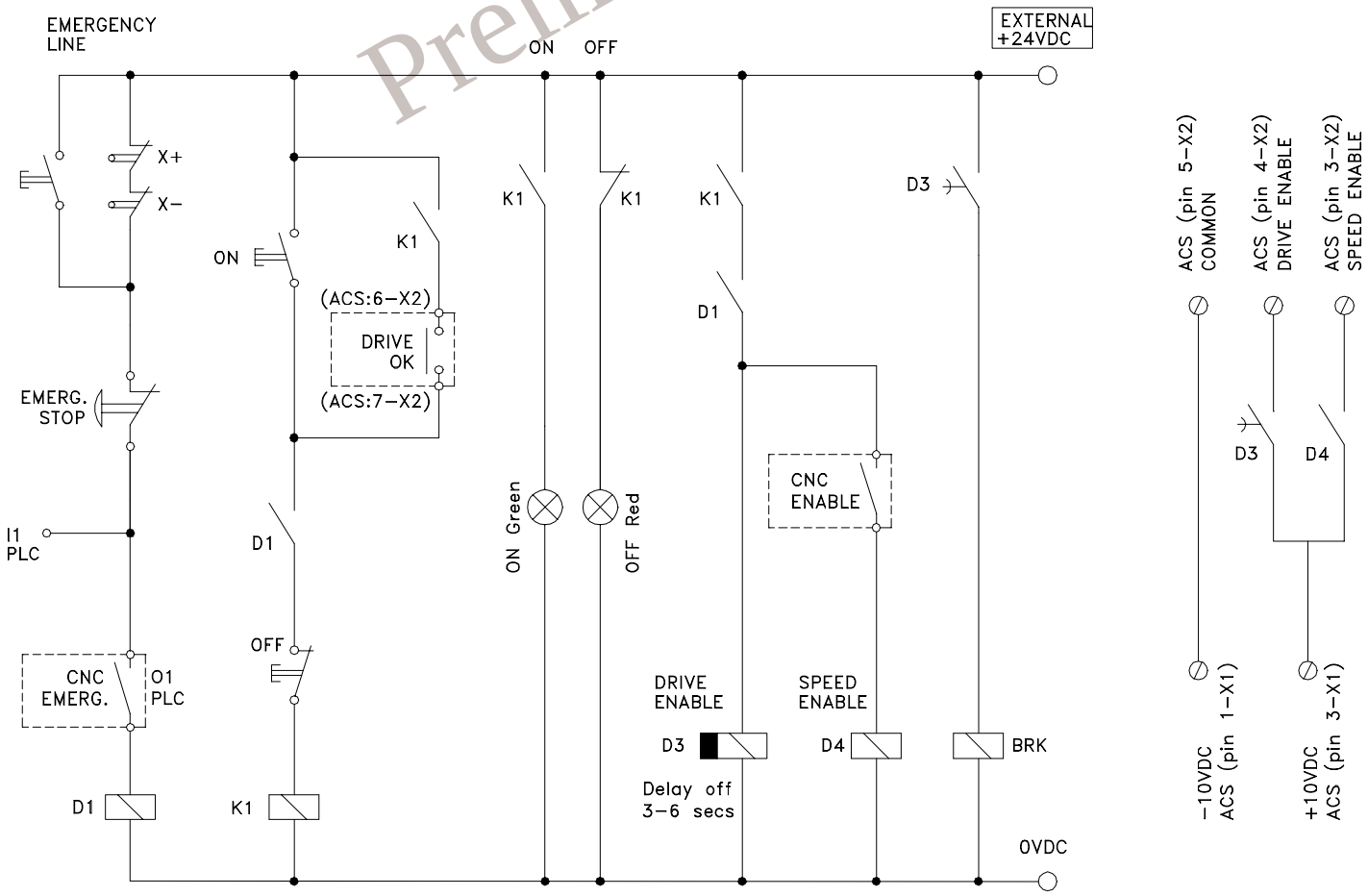
The delay when disconnecting the D3 contacts serves for:

- the "Drive_Enable" to stay active while the motor is braking at maximum torque.
- for the brake to hold the motor after it has stopped.

If the system moves a vertical axis, it should be compensated for (with counterweight).



Preliminary



5.4 INITIALIZATION AND SETUP

Verify that the identity card **IM** is the right one. The name of the card itself indicates which motor and drive combination it has been designed for.

Select whether Ramps are to be generated or not using jumper **J2**.
Yes (J2-ab). No (J2-bc).

To cancel the control of excessive acceleration, change the jumper **J3** position. Active (J3-ab).

Verify that jumper **J4** selects the type of command to govern the motor and that it is applied at the right pins. Current (J4-ab). Velocity (J4-bc).

Measure the motor speed. Apply the maximum velocity command. Then, turn the **Max.Speed** potentiometer until reaching the desired speed for that command. For 10V of velocity command with the motor turning at the maximum speed, the monitoring output (pins 8 and 10 of X2) will provide 10V.

Use the **Max.Current.Limit** potentiometer to adjust the maximum peak current (maximum motor torque). To monitor the peak current, the motor may be turned back and forth at full torque and without generating ramps.

Adjust the gain of the velocity PI with the **PI.Gain** potentiometer until the desired behavior is obtained.

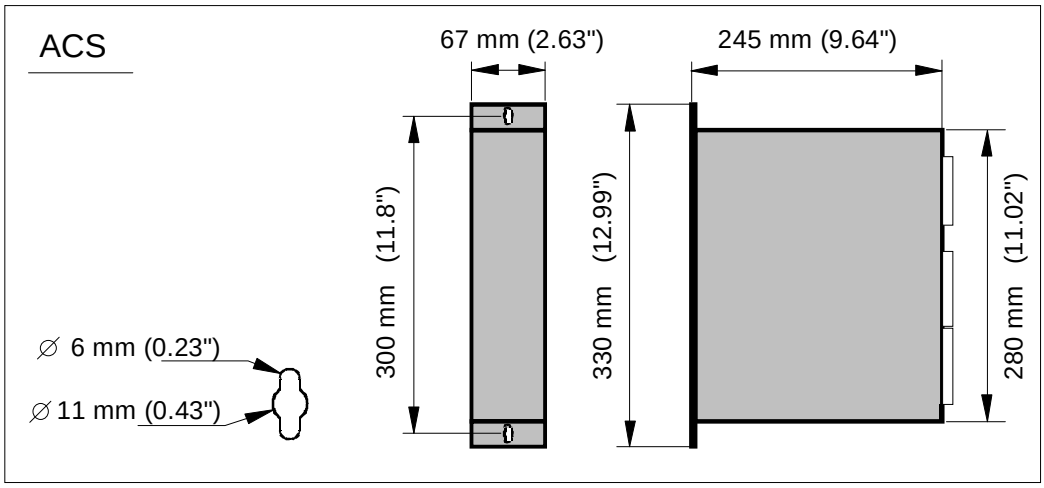
Adjust the velocity offset.

Send to the drive an analog voltage of 0 Volts (by jumpering pins 4,5 and 6 of X1 connector). Measure the motor speed and turn the **Offset** potentiometer on the identity card until the motor stops. But, CAREFUL, by this method, only the drive offset is eliminated, the CNC may have an offset of its own. Now the CNC offset should be adjusted.

To adjust the offset in the complete control loop, set the CNC in DRO mode, but with the Drive_Enable and Speed_Enable signals active. Turn the offset potentiometer until stopping the motor. Another way could be to set a position for the axis with the CNC and turn this potentiometer until a symmetrical following error is obtained.

Adjust the ramp value. If the generation of ramps has been activated with J2, turn the **Acc/Dec Ramps** potentiometer until obtaining the desired behavior.

Preliminary



Product codes.

Preliminary

FXM11.40F.I0.xx0		IM-1140F-05		IM-5320F-30	
FXM12.40F.I0.xx0		IM-1240F-05		IM-5340F-30	
FXM13.40F.I0.xx0		IM-1340F-05		IM-5420F-30	
FXM14.20F.I0.xx0		IM-1420F-05		IM-5430F-30	
FXM14.40F.I0.xx0		IM-3120F-05		IM-5512F-30	
FXM31.20F.I0.xx0		IM-3140F-05		IM-5520F-30	
FXM31.40F.I0.xx0		IM-3220F-05		IM-7312F-30	
FXM32.20F.I0.xx0		IM-1340F-10		IM-7320F-30	
FXM32.40F.I0.xx0		IM-1440F-10		IM-7412F-30	
FXM33.20F.I0.xx0		IM-3140F-10		IM-7512F-30	
FXM33.40F.I0.xx0		IM-3220F-10			
FXM34.20F.I0.xx0		IM-3240F-10			
FXM34.40F.I0.xx0		IM-3320F-10			
FXM53.20F.I0.xx0		IM-3420F-10			
FXM53.40F.I0.xx0		IM-3240F-20			
FXM54.20F.I0.xx0		IM-3320F-20			
FXM54.30F.I0.xx0		IM-3340F-20			
FXM55.12F.I0.xx0		IM-3420F-20			
FXM55.20F.I0.xx0		IM-3440F-20			
FXM73.12F.I0.xx0		IM-5320F-20			
FXM73.20F.I0.xx0		IM-5420F-20			
FXM74.12F.I0.xx0		IM-5512F-20			
FXM75.12F.I0.xx0		IM-7312F-20			
		IM-7412F-20			

ACS-05		SEC-1	84040050	IEC-5	
ACS-10		SEC-3	84040051	IEC-10	
ACS-20		SEC-5	84040052	IEC-15	
ACS-30		SEC-10	84040053	IEC-20	
		SEC-15	84040054		
MPC-4x1,5+(2x1)	04040165	SEC-20	84040055	IOC-17	
MPC-4x2,5+(2x1)	04040166				

Warranty

INITIAL WARRANTY

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

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

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

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

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

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

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

Preliminary

EXCLUDING CLAUSES

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

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

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

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

SERVICE CONTRACTS

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

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34-943-771118 (Service Dept.)

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Preliminary