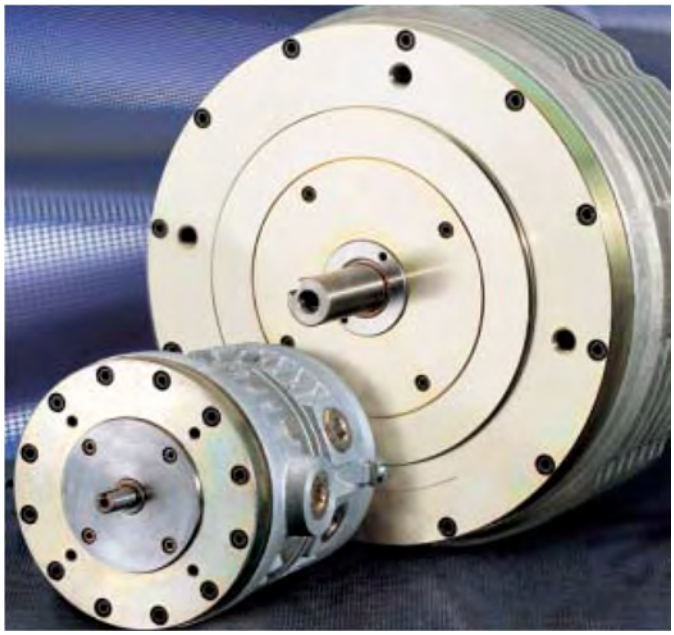


SERVICE MANUAL
XA-Series

Version 21.20

Contents

1.- Introduction to the Product

The XA-Series servomotor is a new product generation that resumes all the knowhow and the new technologies to use in potentially explosive atmospheres .

The improvement can be found in the design, in the harmony with the drives, the performances and optional solutions.

Standards

For the ATEX refer to certificate DEMKO 20 ATEX 2327X
For the IECEx refer to certificate ULD 20.0016X
For the UL CSA refer to file E476572

2. Safety Guidelines

2.1 Appropriate use

Servo motors have been designed, developed and manufactured for use in hazardous areas in the industry. The following safety precautions should be implemented to avoid any risk.

The XA-Series motors are synchronous servomotors. They are not intended to be connected directly to a rotary current power supply system. They have to be operated only by a particular electronic power stage. A direct connection to a main supply will lead to the destruction of the motor.

Personnel that in any way uses our products must first read and understand the relevant safety instructions and be familiar with appropriate use.

Do not mount damaged or faulty products or use them in operation.
Make sure that the products have been installed in the manner described in the relevant documentation.

Servo motors can have bare parts with voltages applied (e.g. terminals) or hot surfaces. Additional sources of danger result from moving machine parts. Improperly removing the required covers, inappropriate use, incorrect installation or incorrect operation can result in severe personal injury or damage to property.

2.2.-Explanations

The safety instructions describe the following degrees of hazard seriousness in compliance with ANSI Z535.4. The degree of hazard seriousness informs about the consequences resulting from noncompliance with the safety instructions.

Signal Word	Definition
DANGER	DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. This signal word is to be limited to the most extreme situations
WARNING	WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury
CAUTION	CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices

2.3 Hazards by Improper Use

DANGER	High voltage and High discharge current! Danger to life or severe bodily harm by electric shock
DANGER	Dangerous movements! Danger to life severe bodily harm or material damage by an unintentional motor movement
WARNING	High electrical voltage due to wrong connections! Danger to life or bodily harm by electric shock
WARNING	Health hazard for persons with heart pacemakers, metal implants and hearing aids in proximity to electrical equipment!
CAUTION	Surface of machine housing could be extremely hot! Danger of injury! Danger of burns!
CAUTION	Risk of injury due to improper handling! Bodily harm caused by crushing, shearing, cutting and mechanical shock

2.4 Transport and Storage

During transport and storage, devices must be protected from excessive stress (mechanical load, temperature, humidity, aggressive atmosphere, etc.).
Servo drives contain components sensitive to electrostatic charges which can be damaged by inappropriate handling. It is therefore necessary to provide the required safety precautions against electrostatic discharges during installation or removal of servo drives.

2.5 Installation

The motor should be mounted to a heat sink according the technical specifications (see table xx) or any dissipation system with a thermal dissipation of 0.0134ºC. In the case that the motor should be mounted without any dissipation system the derating curve of torque should be applied.

The motor can be mounted by means of through holes in the drive end flange external to the casing or by blind tapped holes in the drive end flange

The electrical connection must be carried out by qualified personnel only according to EN/IEC 60079-14 and with the power off. The earthing connection is mandatory.Follow the specifications of the drive.

The general safety regulations and national accident prevention guidelines (Council Directive 89/391/CEE) must be observed when working with high voltage systems.
Electrical installation must be carried out according to the relevant guidelines (e.g. line cross section, fuse, protective ground connection).

See more info on Chap 7.

High voltage and High discharge current! Danger to life or severe bodily harm by electric shock

2.6 Protection against Touching Electrical Parts

Before turning on a servo drive, make sure that the housing is properly connected to ground (PE rail). The ground connection must be made, even when testing the servo drive or when operating it for a short time!
Before turning the device on, make sure that all voltage-carrying parts are securely covered.
During operation, all covers and switching cabinet doors must remain closed.
Control and high power contacts can have voltage applied, even when the motor is not turning.
Touching the contacts when the device is switched on is not permitted.
Before working on servo drives, they must be disconnected from the power mains and prevented from being switched on again.

2.7 Protection against Dangerous Movements

Dangerous movements can be caused by faulty control of the connected motors.
Some common examples are:
- Improper or wrong wiring of cable connections
- Incorrect operation of the equipment components
- Wrong input of parameters before operation
- malfunction of sensors, encoders and monitoring devices
- Defective components
- Software or firmware errors

Dangerous movements can occur immediately after equipment is switched on or even after an unspecified time of trouble-free operation.
The monitoring in the drive components will normally be sufficient to avoid faulty operation in the connected drives. Regarding personal safety, especially the danger of bodily injury and material damage, this alone cannot be relied upon to ensure complete safety. Until the integrated monitoring functions become effective, it must be assumed in any case that faulty drive movements will occur. The extent of faulty drive movements depends upon the type of control and the state of operation.

Dangerous movements! Danger to life severe bodily harm or material damage by motor unintentional movement

- Ensure personal safety by means of qualified and tested higher-level monitoring devices or measures integrated in the installation. Unintended machine motion is possible if monitoring devices are disabled, bypassed or not activated.
- Pay attention to unintended machine motion or other malfunction in any mode of operation.
- Keep free and clear of the machine's range of motion and moving parts. Possible measures to prevent people from accidentally entering the machine's range
of motion:
- use safety fences
- use safety guards
- use protective coverings
- install light curtains or light barriers
- Fences and coverings must be strong enough to resist maximum possible momentum, especially if there is a possibility of loose parts flying off.
- Mount the emergency stop switch in the immediate reach of the operator. Verify that the emergency stop works before starting up. Do not operate the machine if the emergency stop is not working.
- Isolate the drive power connection by means of an emergency stop circuit or use a starting lockout to prevent unintentional start.
- Make sure that the drives are brought to a safe standstill before accessing or entering the danger zone. Safe standstill can be achieved by switching off the power supply contactor or by safe mechanical locking of moving parts.
- Secure vertical axes against falling or dropping after switching off the motor power by, for example:
- mechanically securing the vertical axes
- adding an external braking/ arrester/ clamping mechanism
- ensuring sufficient equilibration of the vertical axes
The standard equipment motor brake or an external brake controlled directly by the drive controller is not sufficient to guarantee personal safety!

2.8 Protection against Contact with Hot Parts

Surface of machine housing could be extremely hot! Danger of injury! Danger of burns!

- Do not touch housing surfaces near sources of heat!
- After switching off the equipment, wait at least ten (10) minutes to allow it to cool down before touching it.
- Do not touch hot parts of the equipment, such as housings with integrated heat sinks and resistors.

2.9 Protection during Handling and Mounting

Under certain conditions, incorrect handling and mounting of parts and components may cause injuries.

Risk of injury due to improper handling! Bodily harm caused by crushing, shearing, cutting and mechanical shock

- Observe general installation and safety instructions with regard to handling and mounting.
- Use appropriate mounting and transport equipment.
- Take precautions to avoid pinching and crushing.
- Use only appropriate tools. If specified by the product documentation, special tools must be used.
- Use lifting devices and tools correctly and safely.
- For safe protection wear appropriate protective clothing, e.g. safety glasses, safety shoes and safety gloves.
- Never stand under suspended loads.
- Clean up liquids from the floor immediately to prevent slipping.

Do not open when an explosive atmosphere is present. Risk of injury by explosion

3.- Technical Data

3.1.- General Description

The three-phase synchronous motors from the XA-Series motors are permanently excited, electronically commutated synchronous motors for applications that require excellent dynamic characteristics and positioning precision as well as compact size and reduced weight.

- NdFeB permanent magnets
- Sinusoidal commutation with encoder or resolver as feedback unit
- Three-phase winding with star connection
- Compact sizes result in low weight
- High overload capability/peak torque
- High dynamic torque at high speeds
- Long life-span, all motor parts except for bearings are free of wear
- Direct diversion of lost power generated in the stator over the housing to the flange
- Preloaded, grooved ball bearings which are sealed on both sides and greased
- Complete motor system with stall torque ranging from 0.25 Nm to 75 Nm
- Connection using two circular plugs or cables

3.2.- Definitions

Max speed

The speed limit is fixed by the bus voltage of the drive

The value is given in RPM

Stall torque

The torque is given by the motor at very low speed, with an increment of the winding temperature of 130ºC and mounted with a heat sink plate and at a Tamb of 25ºC.

The value is given in Nm

Stall current

The current is required to achieve the stall torque

The value is given in A

Peak torque

The maximum torque is available without iron saturation (torque constant still linear)

The value is given in Nm

EMF constant

Voltage that the motor gives as a generator between two terminals at certain speed, the voltage is measured in rms value and the speed in rad/s

The value is given in Vs/rad

Torque constant

The ratio between the current (in rms value) is supplied to the motor and the torque in the output shaft, measured in Nm

The value is given in Nm/A

Reluctance torque (Cogging)

The maximum torque needed to move the shaft without power. It characterizes the stepping effect of the rotor which should be as low as possible.

The value is given in Nm

Winding resistance

The resistance is measured between two phases at 25ºC T ambient

The values is given in Ω

Winding inductance

The inductance is measured between two phases

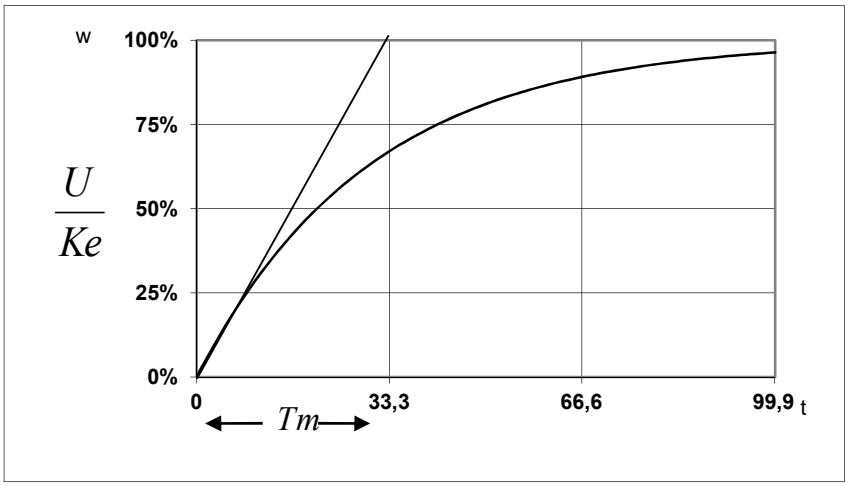
The value is given in mH

Rotor inertia

It is inertia of the rotor without any accessories.
The value is given in kg $m^2 10^{-3}$

Mechanical time constant

It characterizes the speed increase for an input voltage step. The value shows the time to achieve the 63% of the maximum speed for the input voltage.

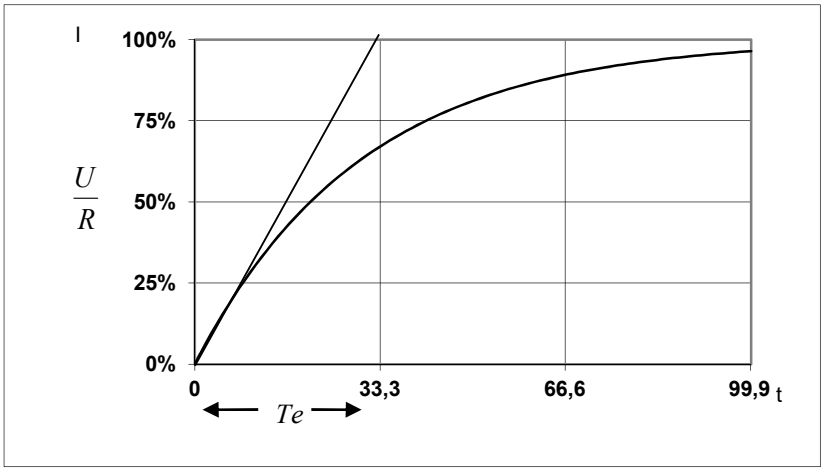


$$Tm = \frac{JxR}{KexKt}$$

The values is given in s

Electrical time constant

It characterizes the current increase in the motor winding for a voltage step



The value is given in ms when L is in mH and R in Ω

Thermal resistance

It is the temperature difference across a structure when a unit of heat energy flows through it in unit time
The value is given in ºC/W

Mass

It is the weight of the motor without accessories. The value is given in kg

Radial load

It expresses the shaft radial load applied in the middle of the output shaft, which will give a basic rating life of the bearings of 20000 hours

Axial load

It expresses the shaft axial load which will give a basic rating life of the bearings of 20000 hours

Insulation

It refers to the maximum operation temperature allowed

3.3.- Characteristics

230 VAC

CHARACTERISTICS	SYMBOL	UNITS	XA-30	XA-45
Max. Speed at 230V (± 10%)	rpm	nm	3600	4180
Stall Torque (± 10%)	Ms	Nm	16	19.4
Stall Current (± 10%)	Is	A	16	22
Nominal Torque at 3000rpm	Mn	Nm	13.3	14.9
Peak Torque (± 10%)	Mj	Nm	96	140
EMF Constant (±10%)	Ke	Vs/rad	0.58	0.5
Torque Constant (±10%)	Kt	Nm/A	1	0.866
Cogging Torque	Ct	Nm	<0.3	<0.4
Winding Resistance (± 5%)	R	W	0.5	0.4
Winding Inductance (± 5%)	L	mH	4	2.7
Rotor Inertia	J	$kgm^2 10^{-3}$	1.6	2.2
Mechanical Time Constant	Tm	ms	1.37	2.03
Electrical Time Constant	Te	ms	8	6.75
Thermal Time Constant	Tth	s	1500	1500
Thermal Resistance	Rth	ºc/W	0.45	0.3
Insulation			F	F
Max. winding temperature		ºc	155	155
Nº of pole pairs			4	4
Axial force	Fa	N	390	410
Radial force	Fr	N	600	830
Weight	M	kg	36	42
Temperature sensor type			PTC/SWITCH	PTC/SWITCH
With an Aluminium heat sink plate		mm	830x830x10	830x830x10

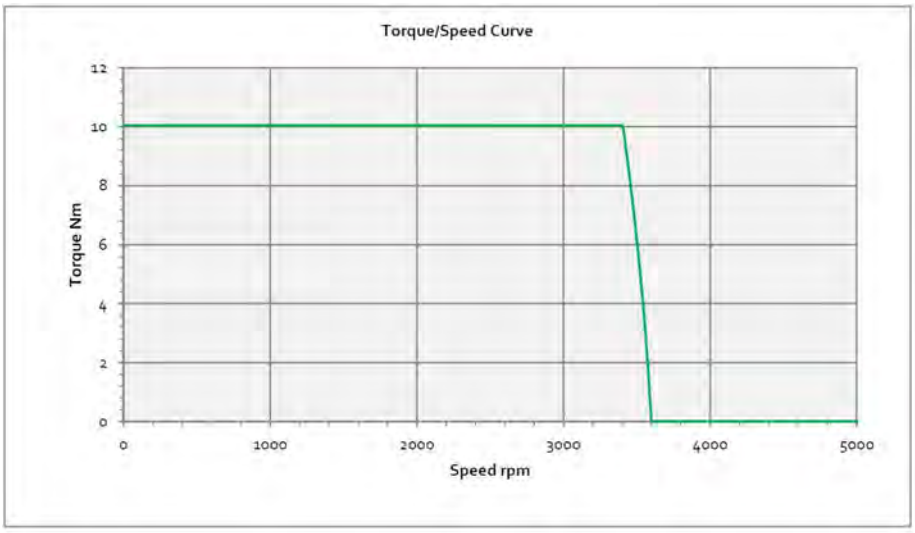
Characteristics at 25ºC T amb.

Values with resolver, when the motor is mounted with encoder, the performances could be changed because of the temperature or speed limit of the electronics, please ask factory for more details.

3.4.- Functional curves

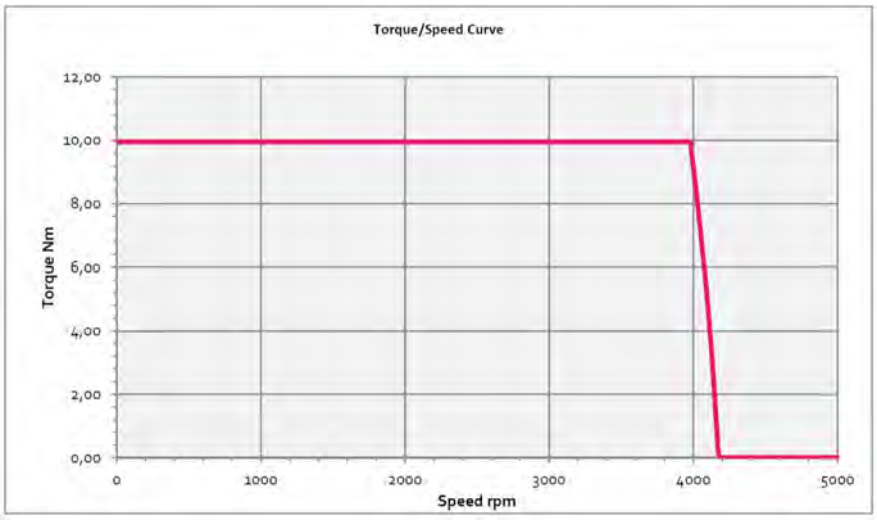
The curves shown here below, have been obtained with a CD1a 400VAC drive. The motors were mounted in a heat sink plate of aluminium see table 2.

XA-30



Inc temp winding 40ºC

XA-45



Inc temp winding 30ºC

3.5.- Cooling

The XA-Series motor are self-cooling. The motors must be installed on the cooling surface equivalent to the aluminium heat sink according to the following table

.

Motor	XA-30	XA-45
Heat Sink Plate	830X830X10	830X830X20

Table 2

Free convection of the motor housing must be guaranteed!

If the motor is mounted without any cooling surface the performances should be derated according the curve in section 3.4

3.6.- Brake functionality

The XA-30 Series motors can be supplied with a holding brake

Motor	XA-30	XA-45
Brake torque Nm	8	16
Power W	22	22
Inertia 10^{-4} kgm^2	0.3	0.3
Weight kg	0.8	0.8

Table 3

3.7.- Bearing grease

The motor can mount NACHI or SKF bearings

Nachi grease. Multitemp SRL operating temp. -40 to +150

SKF grease . LHT23 operating temp -50 to +180

3.8.- Shaft Load

Axial force

The axial force Fa on the shaft end is made up of the installation forces (e.g. stress caused by installation) and operational forces (e.g. thrust caused by slanted pinions). The maximum axial force Fa depends on the bearing type and the desired lifespan of the bearings.

The fixed bearing is secured on the B flange with a retaining plate. The floating ball bearing is preloaded on the A flange with a spring in the direction of the B flange. Axial forces in the direction of the A flange can cause the spring bias to be overcome and the shaft is shifted by the amount of axial play in the bearing (0.1 to 0.2 mm approx). This shift can cause problems on motors with holding brakes or motors with encoders.

⚠ DANGER

Because of the high axial forces on the motor shaft during installation, the bearings could be damaged and the operation of the motor holding brake could be so heavily influenced that it has no or only a reduced braking effect. Encoder errors could also occur.
Therefore, excessive pressure or shocks to the front of the shaft end or the rear housing cover should be avoided at all costs.
Loads caused by a hammer definitely exceed the permissible values!

Radial force

The radial force Fr on the shaft end is made up of installation forces (e.g. belt tension on pulleys) and operation forces (e.g. load torque on the pinion). The maximum radial force Fr depends on the shaft end type, bearing type, average speed, position where the radial force is applied and the desired lifespan of the bearing. As standard 20000 h when the load indicated on the catalogue is applied in the middle of the output shaft.

⚠ WARNING

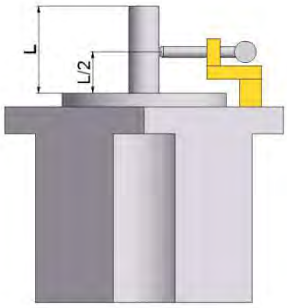
Excessive radial force can cause premature wear on the bearing or, in extreme cases, can cause the output shaft to break

⚠ CAUTION

When installing drive elements on the motor shaft avoid hyperstatic arrangements of the motor shaft bearing. The tolerances that occurs cause additional force on the motor shaft bearings
This can significantly reduce the bearing lifespan or damage the bearing.

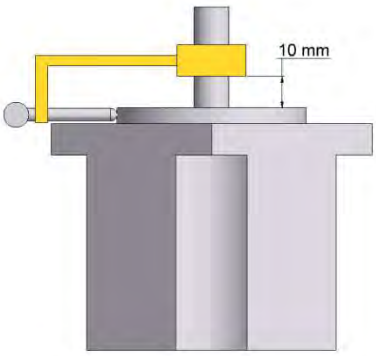
3.9.- Tolerances IEC 60072

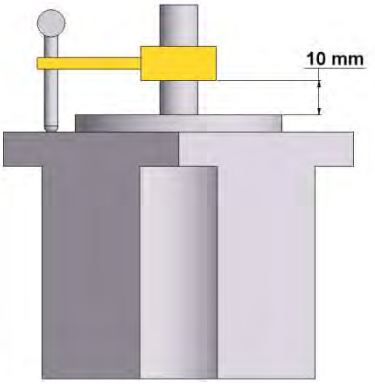
Shaft extension run-out



Shaft diameter	Normal	Reduced
0 < D ≤ 10	0.030	0.015
10 < D ≤ 18	0.035	0.018
18 < D ≤ 30	0.040	0.021

Concentricity and Perpendicularity



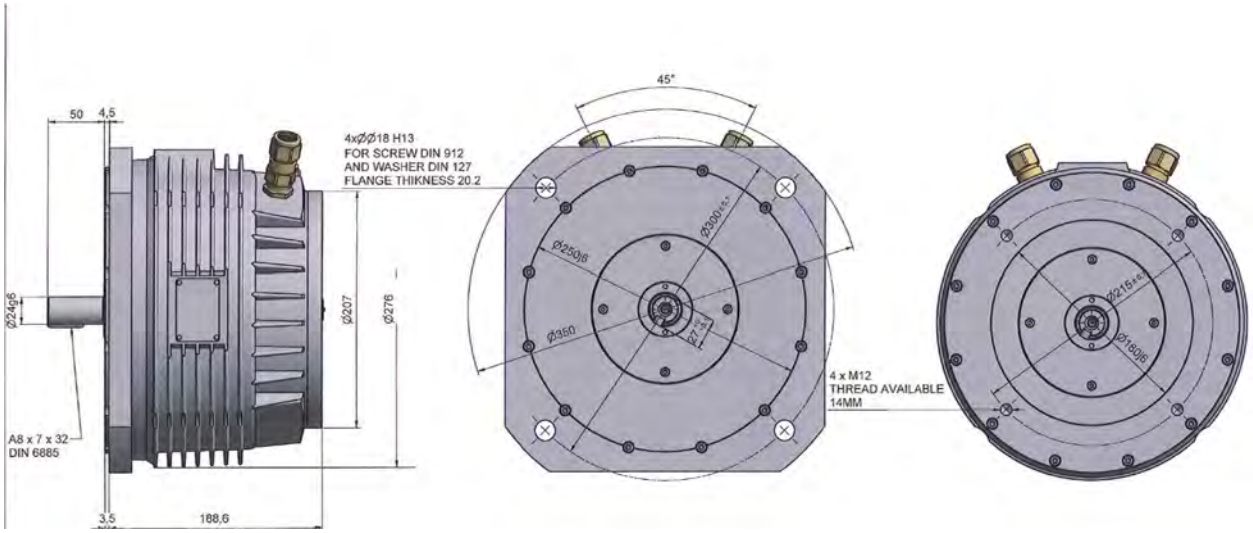


Mounting flange diameter	Normal	Reduced
32	0.08	0.04
40	0.08	0.04
60	0.08	0.04
80	0.08	0.04
95	0.08	0.04
130	0.10	0.05

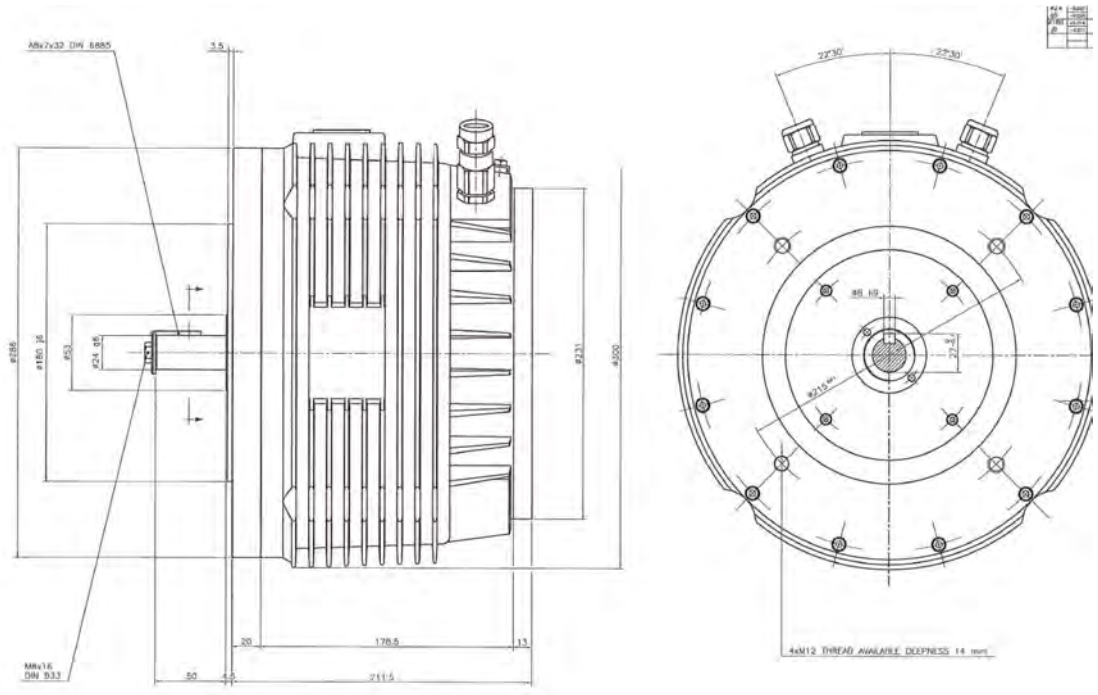
4- Dimensions

4.1.- Dimensions

XA-30



XA-45



4.2.- Type of Output Shaft

All the XA-Series servomotor shafts comply to DIN 748. They can be supplied with a smooth shaft or keyed shaft.

Smooth shaft

A smooth output shaft is used for a force-fit shaft-hub connection that guarantees a zero –play connection between shaft and hub as well as smooth operation.

For connection of pinion gears, belt disks or similar drive elements, please use suitable clamping sets, pressure sleeves or other fastening elements

Drive elements must be protected against unintentional removal

The output shaft has a threaded centre hole which can be used to remove drive elements

4.3.- Keyed shaft

The keyed shaft can be used for a form-fit torque transfer with low demands on the shaft-hub connection and for handling torques with a constant direction.

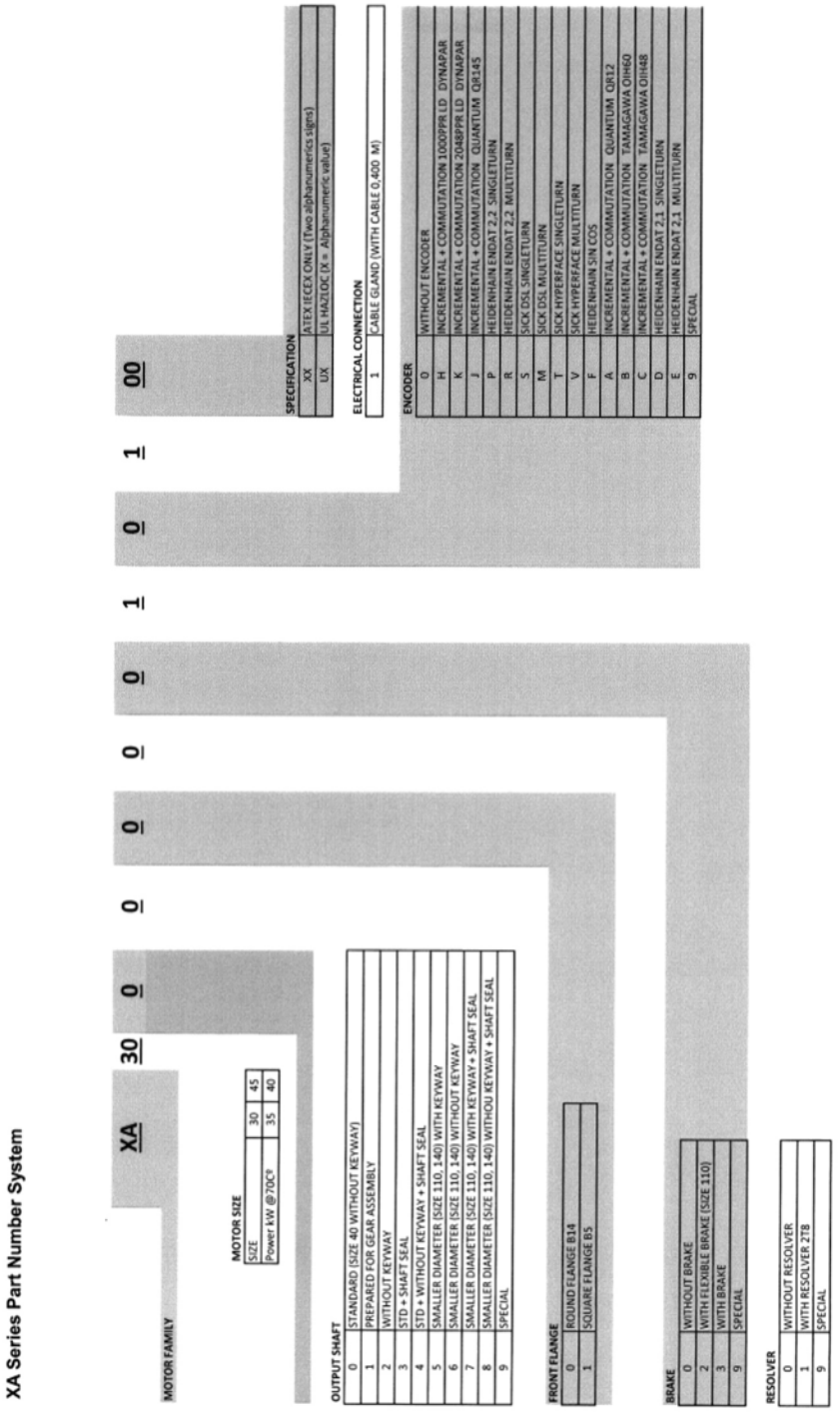
The keyways for the XA-Series servomotors conform to keyway form N1 according to DIN 6885-1. Form A Shaft keys used conforms to DIN 6885-4 . Balancing motors with keyways is done using the half-key convention according to ISO 2372

The end of the shaft has a threaded centre hole which can be used to mount drive elements with shaft end disks.

The shaft key can be deflected during heavy reverse operation. In extreme cases, this can cause the output shaft to break!

Smooth output shaft should be used preferably

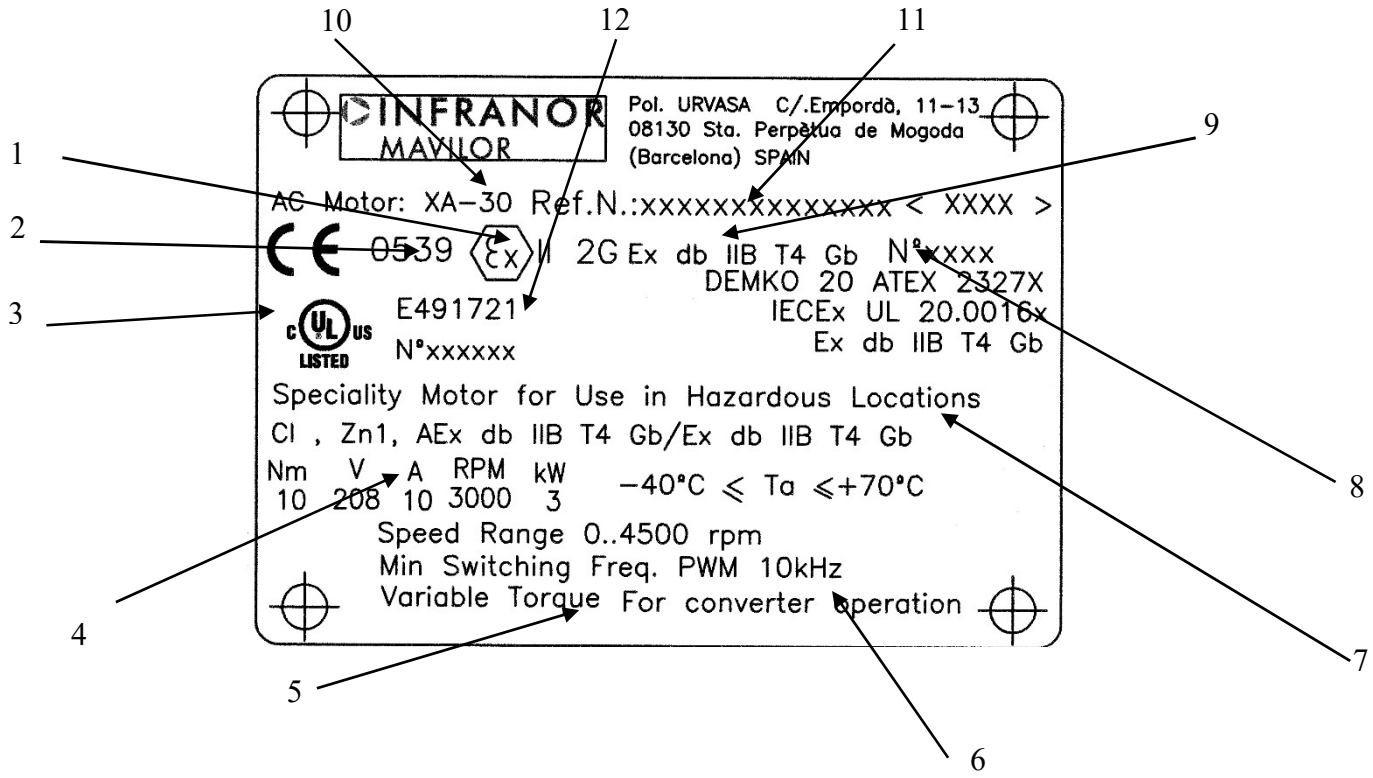
5.- Codification



6.- Marking

RECAPITULATION

Ex	Explosion protection symbol ATEX
II	Group II, means equipment intended for use in other places liable to be endangered by explosive atmosphere
2	Equipment category 2 comprises equipment designed to be capable functioning in conformity with the operational parameters established by the manufacturer ansd of ensuring a high level of protection, suitable for use in Zone 1 and 2
G	Type of atmosphere explosive : Gas
db	Flameproof method of protection
IIB	Gas class Ethylene method of protection
T3	Temperature class T3 200ºC
Gb	Equipment protection level Suitable for Zone 1 and 2



1.- Marking Explosion protection
2.- Notified Body
3.- Complies with EU directives and UL std
4.- Technical parameters
5.- Type of function
6.- Min PWM Frequency of the drive
7.- Reference of the Safety conditions of use
8.- Serial number
9.- Protection type
10.- Motor type
11.- Motor reference
12.- UL file number

7.- Installation

The XA-Series servomotors are not permitted to be connected directly to power mains, they are only permitted to be operated in combination with an Infranor Ac servo drive or equivalent

The cables must be connected and fastened correctly.

Incorrectly connecting the cables and tightening the nuts can cause problems and damage the servomotor or servo drive.

Do not open the enclosure when an explosive gas is present

The electrical connection must be carried out by qualified personal only according to EN/IEC 60079-14 and with the power off

Field wiring connections shall in accordance with Article 504 of ANSI/NFPA 70 when installed in US region.
Field wiring connections shall in accordance with Canadian electrical code (CEC) when installed in Canadian region.

When the optional equivalency marking Class I Division 2 Groups C and D, T5 is employed, is required flameproof cable gland at each specific instructions for maintaining the marked Zone Classification type of protection, in the Division installation.

The plastic cap thread is available only for shipping and cannot be used for operation". The manufacturer include the following additionally temporary paper label near the entries to provide notice to installer: "Remove the plastic caps. Unused cable entries shall be closed off using blanking devices Ex certified, as appropriate, with the type of protection suitable for the use conditions".

Special condition of use:

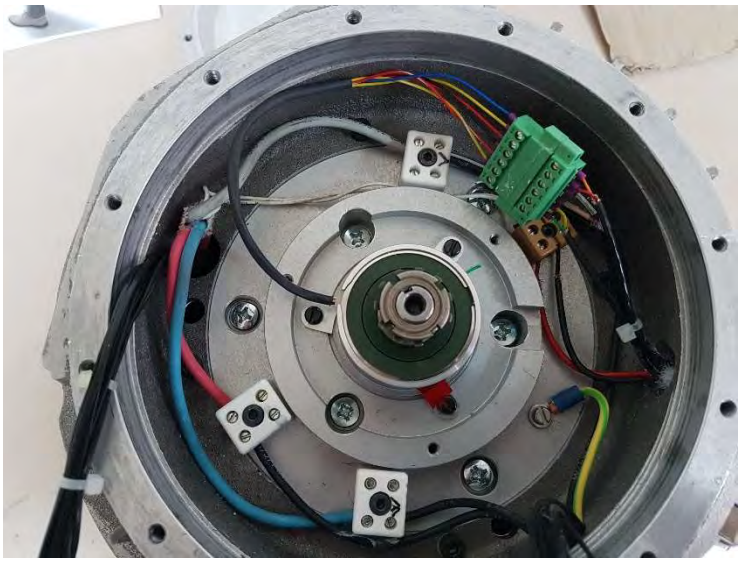
- The screws class used for the assembly of explosion-proof enclosures must be of quality higher or equal to 12.9 (ISO 898-1).
- Flameproof joints are not intended to be repaired.
- Refer to instruction manual for Converter permitted ratings

- See instruction manual for guidance for the user to connection limiting device for the overload protection.

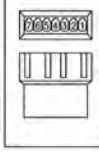
Connection procedure

1.- Open de rear cover unscrewing the M5 x 20mm screws (XA-30) or the M5 x 25mm (XA-45)

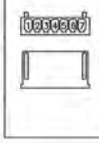
2.- Connect the cables in position, power cables on the ceramic connection block , signal cables on the green plastic connector



COLOR	FUNCTION
RED	PHASE U
GREY	PHASE V
BLUE	PHASE W
GREY GREY	BRAKE BRAKE
WHITE WHITE	TEMP. CONTACT TEMP. CONTACT

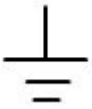


CONTACT.	WIRE COLOUR (ENCODER)	FUNCTION	COLOR*
1	RED	Us	RED
2	WHITE	+ SIN	YELLOW
3	BROWN	REFSIN	BLUE
4	PINK	+ COS	ROSE
5			
6			
7			



CONTACT.	WIRE COLOUR (ENCODER)	FUNCTION	COLOR*
1	BLACK	REFCOS	WHITE
2	BLUE	GND	BLACK
3	GREY OR YELLOW	Data +	GREEN
4	GREEN OR PURPLE	Data −	BROWN
5			
6			
7			

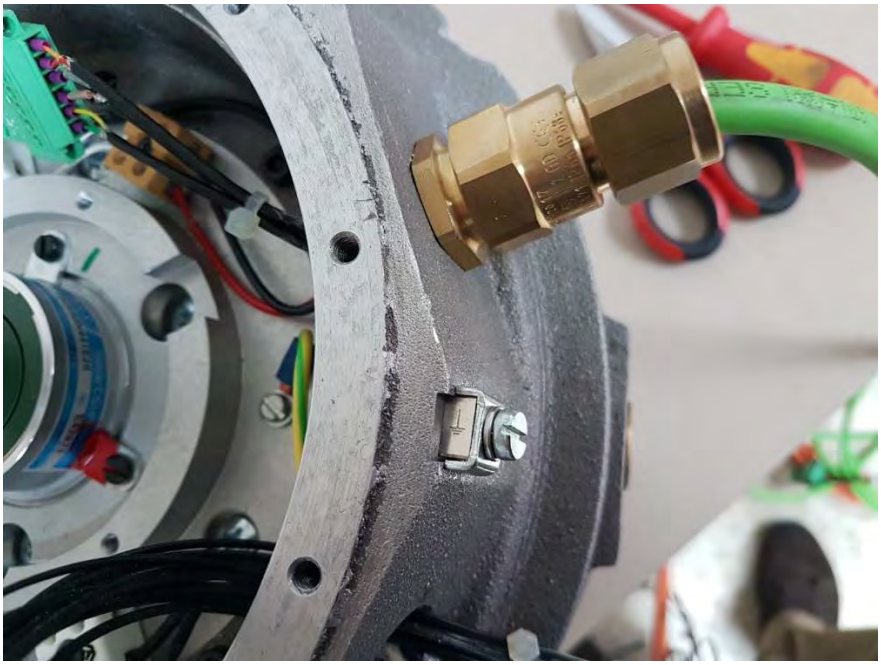
3.- Connect the ground wire using the parts included on the motor in the position marked as Ground. The wire should have a section at least 4mm2



Parts included

1 x Screw M4 x 8 DIN 84
1 x Washer DIN 6798 Form J 4.3
1 x Wire terminal 2.5…6mm2 4.3

4.- It is important to connect the thermal sensor provided by the motor and adjust the drive to stop the motor in case of overtemperature or torque overload (max 20Nm)



The cable gland shall be ATEX / IECEX certified, as appropriate, with “db” type off protection, suitable for the condition of use, installed correctly and must have a minimum thread length of 8mm. Use cable gland with some kind of shielding fixing system to avoid EMC problems, the use of conduit component is not allowed

Use shielded cable suitable for 80C, for cable length > 25m use a sinus filter type B84143V x R127 by company Epcos or similar

If you uses the external earthing screw, use a suitable cable minimum 4mm2 and fix the screw with a tightening torque of 2Nm

The motor could be ordered with 2 or 3 cable entries of M20x1.5 , unused cable entry shall be closed with a suitable Ex certified locking devices with “db” type off protection, suitable for the condition of use and installed correctly .

If you need to use a thread reducer, use a suitable Ex reducer, suitable for the end use conditions and installed correctly
The screws class used for assembly of explosion-proof enclosure must be of quality not less than 12.9 (ISO989-1)

Close the cover with M5x20 (XA-30) or M25x25 (XA-45screws and tightening with a torque of 7.85 Nm

8.- Commissioning

Follow the instructions of the drive manufacturer.

The minimum characteristics of the controller are: Max Bus d.c. power supply voltage 685 Vdc or 480Vac before rectification

Output voltage phase-phase 230 Vac eff

PWM>= 10 Khz EMC filters incorporated on the drive

Minimum inductance before phases 2mH

I2t alarm to avoid overloads, should be adjusted at the stall current of the motor

Refer to instruction manual for Converter permitted ratings

9.-Troubleshootings

Refer to the drive manual about the type of default.

If the error is placed on the motor , do not repair it, contact the authorized distributor, see the address at the end

10.- Conditions of use

10.1.- Ambient temperature

The characteristics specified for the XA-Series servomotor apply in the following conditions

Operating temperature -40 to +70C

Altitude up to 1000 m above sea level

10.2.- Mechanical environmental conditions

According to IEC 68-2-6, the XA-Series servomotors may be operated permanently installed and weather-protected under following conditions:

10.2.1.- Vibration Shock

Sinusoidal vibrations

50 m/s^2 from 10 to 500 Hz (EN 60068-2-6)

Shocks

15 g during 11ms (EN 60068-2-27)

10.3.- Balancing.

XA-Series servomotor motors are dynamically balanced according to DIN ISO 2372, Group K (Veff max 4.5 mm/s)

11.- Maintenance

The bearings are lubricated for life, no re-lubrication needed. After 20000 h of function the motor should be revised by authorized personal

In case of malfunction, cut immediately the power supply of the drive, disconnect the motor and send to a qualified repair service.

Only the repair service of Infranor or authorized distributor is allowed to manipulate and repair this type of motors. See the address at the end

These operation must always carried out in the absence of potentially explosive atmospheres in accordance with the regulation IEC 60079-17

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