Technical manual, mounting and first installation

Synchronous - Servomotors

Series MH0-000x

Edition 1.00

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Range of synchronous - motors

Typ *Type*			MH0- 0003	0006	0009
Flansch *Flange*		mm x mm	25	25	25
Dauerstillstandsmoment *Stall Torque*	M_0	Nm	0,03	0,06	0,09

There is a separate manual available for motors from M_o 0.25 to 25.0Nm with DC bus voltage of 320 / 560V which will be supplied on request.

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Improvement of motors subject to technical alterations.

1. List of contents

2. Safety advices

- All operations on transport, assembly, setup and maintenance have to be done by skilled and qualified personnel. The qualified personnel must know and observe the following standards and guidelines:
  DIN VDE 0105, IEC 364, accident prevention regulations
  Improper conduct may cause serious injury to persons and lead to damage.
- Before mounting and putting into operation read carefully the documents on hand. Follow the instructions for power supply (motor label and manual) and go by the rules of the technical data.
- Ensure a proper, low-impedance earth of the motor frame with the PE-reference potential inside the switch cabinet, as otherwise personal safety is not assured.
- Take suitable steps, that unexpected false move will not lead to injury or damage.

- Power connection can also be live, when motor is not rotating. Do not remove or pull off plugs during operation or power supply. This can lead to arcs which may hurt people or damage contacts.
- Surface temperatures of more than 100°C can arise on the motors. Take care do not stick or fasten any temperature sensitive parts on it. Before touching the motor ensure the motor temperature is below 40°C.

Symbols used in this manual

General warning

Significance: actual bodily harm and damage may occur if the respective precautions ill not be taken.

Danger by electricity

Significance: death, grievous bodily harm or considerable damage may occur, if the respective precautions will not be taken.

3. Important Notes

- Synchronous servomotors within the MH0 range are precision motors. They are not designed to be connected directly to a three-phase power. They have to be operated only by a suitable electronic power stage. A direct connection to main supply will destroy the motor.

- To fit drive elements without backlash strictly use the foreseen thread within the motor shaft and if possible warm up the drive elements. Only use suitable aids to fit the drive elements.

- Avoid strong blows to the motor flange and the motor shaft.

- Take care that the coupling is correctly aligned . Follow the advice of the coupling manufacturer. An eccentric weight produces intolerable vibrations and leads to the destruction of ball bearings and coupling.

- When using toothed belts strictly observe the permissible radial forces. An excessive radial load on the shaft will shorten live of the motor considerably.

- If possible avoid an axial load on the motor shaft. An axial load shortens live of the motor considerably.

- Setting the correct number of poles of the motor and the resolver to the power stage is essential. An incorrect setting can lead to the destruction of the motor and to overheating.

Motor series	Number of motor poles	Number of resolver poles
MH0-000X	6	2

- All torque data of the motors are measured with heat sink. Calculation of the 3.5mm thick heat sink is based on the following formula:

Heat sink length in mm = 6.25 x size of flange in mm

- Example: heat sink for MH0-000 x-motor = 6.25 x 25mm = 156.25mm. Result for the MH0-motor series is a heat sink of 156.25mm x 156.25mm x 3.5mm.

4. In general

4.1. About this manual

This manual describes the synchronous servomotors of the MH0 range and it is directed towards specialist staff having knowledge of electrical and mechanical engineering. The servomotors are operated together with the corresponding servo drives. Therefore absolutely follow the documentation of the servo drive too.

4.2. Use in accordance with the requirements

Synchronous-servomotors are specially designed to run machines with high requirements to dynamics.

It is only allowed to operate the motors taking into consideration the environmental conditions described in this documentation.

The servomotors of the MH0 range are **exclusively** designed to be operated speed and / or torque controlled by suitable power stages.

The motors are used as components built into machines and may only be put into operation as integrated part of the system.

If existing, a thermo-protective element built inside the motor winding has to be analyzed and observed.

4.3. Motor Construction

The synchronous servomotors in the MH0 range are brushless **permanent magnet** synchronous motors with sinusoidal back EMF.
In connection with the according power stages they are particularly suitable for high – quality servo applications, for example positioning, demanding high standards of dynamics and stability.

The servomotors have Neodymium – permanent magnets inside the rotor. A three phase winding is put inside the stator, which in star-delta connection is wired to internal neutral point and which is being supplied by the power stage. The motor has no brushes, the sinusoid commutation is electronically done by the corresponding power stage.
The motors have a 2-pole built-in resolver as feedback.

The MH0 stator windings are designed in pole winding technology.

4.3.1. A-Side Shaft

The power transmission is effected by the cylindrical shaft-A end. Please take into consideration that high radial forces will occur when motors are driven via pinions or toothed belts. The values permitted at the shaft end depend on the number of rotations.

The crest value at 3,000rpm is shown in the chart below. In case of acting force at the middle of the free shaft end, FR can be above 10%.

The axial force FA is not allowed to exceed FR/3.

Double conical gripping collets, probably combined with metal bellows couplings proved to be ideal coupling elements.

Type of motor	FRmax [N]	FAmax [N]
MH0-0003	18	3
MH0-0006	21	4
MH0-0009	23	4

4.3.2. Flange

Flange sizes according to IEC-standards, fit j6, accuracy as per DIN 42955 Tolerance grade: **R**
Please take into account that all motors were tested with heat sinks which are essential for a proper heat abstraction.

4.3.3. Protective classification

The standard protective classification for all motors is IP54.

4.3.4. Connections

Motor series	Resolver	Power
MH0-000X	cable	cable

The mating connectors are not included with the delivery. These, as well as completely assembled cables are available on request.

4.4. Selection criterion

- Stall torque M_0 [Nm]
- Rated speed at nominal power load N_n [min^{-1}]
- Inertia of motor and load J [$kgcm^2$]
- Effective moment (calculated) M_{rms} [Nm]

When calculating the required motors and power stages the static load **and** the dynamic load (acceleration/deceleration) have to be taken into consideration.

4.5. DC bus voltage U_{dc}

This voltage defines the intermediate circuit voltage of the servo amplifier. For the motor series described in this manual the indicated voltage is 24V DC and 48V DC. 24V DC is an often existing and used voltage. 48V DC is the upper limit which still belongs to protection class “low voltage”. In all cases the winding of the motors is the same. There only arise different data and torque curves which are marked accordingly.

4.6. Basic Version of the Motors

2 pole resolver feedback
Degree of protection: IP54
Concentricity tolerance according DIN 42955R
Cable connection

5. Installation / Setup

5.1 Important notes

- Check the relation between power stage and motor. Compare rated voltage and nominal power of the appliances. The wiring has to be carried out in accordance to the circuit diagram shown in the installation/operation manual of the power stage.
- Pay attention to strong earth connection of power stage and motor.
- Route the power and control cables separately from each other. When using motor power cables with integrated brake wires, the brake wires should be shielded. The shield weave has to be put on both sides.
- Lay all circuits with sufficient cross section. Shields to be applied extensively (low-resistance) via metallized encased connectors i.e. EMV – approved cable screw joints.

- Examine the keeping of the permitted radial and axial load FR and FA. Using a toothed belt drive the minimum permitted diameter of the pinion for example results from the equation: $d_{min} \geq M_0/F_R \times 2$.
- Assure sufficient heat elimination in the surroundings and at the flange of the motor to not exceed the maximum permitted flange temperature of 65°C in S1-operation. If necessary use suitable heat sink.

Caution!
Never remove the electric connections of the motor during power supply.
Residual charges inside the capacitor of the power stage can still exist up to 5minutes after the disconnection of the main supply. Power and control connections can be life even if the motor stands idle.

5.2. In general

Before putting into operation respectively before installation check the motors regarding damage in transit. Damages of any part of the motor as well as corrosion at the shaft or flange have to be reported immediately to us.
The rotor should be easily rotating by hand. Existing brakes to be electrically released in advance.

5.3. Environmental conditions

With regard to the installation site of the motor please take into consideration the environmental conditions like ambient temperature: -20...+40°C, maximum mounting height: 1,000m above sea level, relative humidity: 15...85%, no condensing.

A power reduction might possibly be necessary in case of tolerances to the a.m. environmental conditions.
The motors are not suitable for outdoor installation or installation within aggressive or foreign substance afflicted atmosphere.

5.4. Drive elements

The rotor of the motor has been electronically counterbalanced during production. Before fitting your drive elements onto the shaft end, please remove the corrosion prevention (if existing).
Absolutely use suitable aids for fitting or demounting the drive elements and take the advices of the drive element manufacturer into account to avoid damages.

Our recommendation: *Use double conical tensioning devices.*

Absolutely avoid pushes to the motor flange and the motor shaft during fitting or removing. This might lead to damages of the ball bearing or shaft.

5.5. Power connections

The power connections have to be carried out by skilled electricians only. Before starting work make sure that the systems actually is and remains unconnected during the installation time.

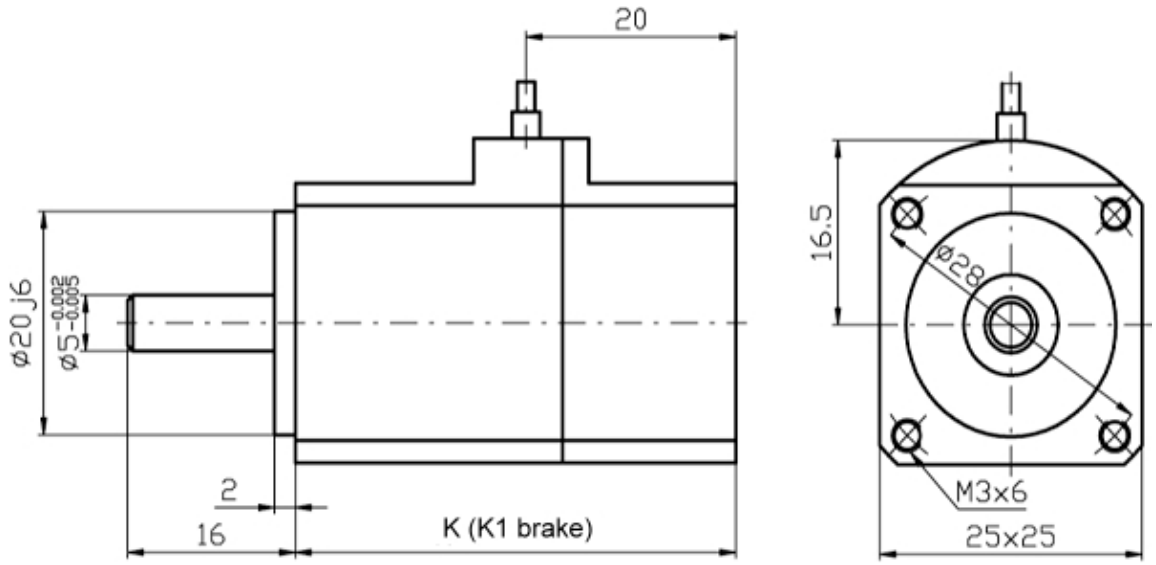
Observe the safety rules according to DIN VDE 0105.

The cross-sectional area of the cable has to be dimensioned out in accordance to the nominal power of the motor. The environmental conditions, the system of laying and the local legal requirements have to be taken into consideration.

Strictly follow the advices of the power stage manufacturer to fulfill EMV-wiring conditions.

When using shielded cables take care of an extensive metal shield connection on both sides of the cable.

6. MH0-000X series



Type of motor	K [mm]	K1 [mm]	Weight w/o. brake kg	Weight incl. brake kg
MH0-0003	42	70	0.107	0.147
MH0-0006	52	80	0.138	0.178
MH0-0009	62	90	0.164	0.204

Data 24 VDC	Sym.	Unit	MH0-0003	MH0-0006	MH0-0009
Nominal speed	N_n	min^{-1}	4,500	3,000	
Power supply	U_{dc}	V	24		
Nominal voltage	U_n	V	16		
Motor poles	P_{Mot}		6		
Resolver poles	P_{Res}		2		
Nominal torque	M_n	Nm	0.03	0.06	0.09
Nominal current	I_n	A	2.40	2.40	3.20
Continuous stall torque	M_o	Nm	0.03	0.06	0.09
Stall current	I_o	A	2.20	2.30	3.00
max. torque	M_{max}	Nm	0.07	0.13	0.17
Max. current	I_{max}	A	5.50	5.00	5.60
Voltage constant	K_E	V/1,000	0.80	1.60	1.80
Torque constant	K_T	Nm/A	0.01	0.03	0.03
Nominal power	P_n	W	14.0	200	300
Winding resistance Phase-Phase	R_{pp}	Ohm	2.40	2.60	2.40
Winding inductivity Phase-Phase	L_{pp}	mH	0.25	0.40	0.30
Moment of inertia	J_m	$kgcm^2$	0.002	0.0038	0.0056
Electr. time constant	T_{el}	ms	0.100	0.1500	0.1300
Winding number			001	002	003

10% tolerance at M_o, M_n und N_n. values ascertained with heat sink.

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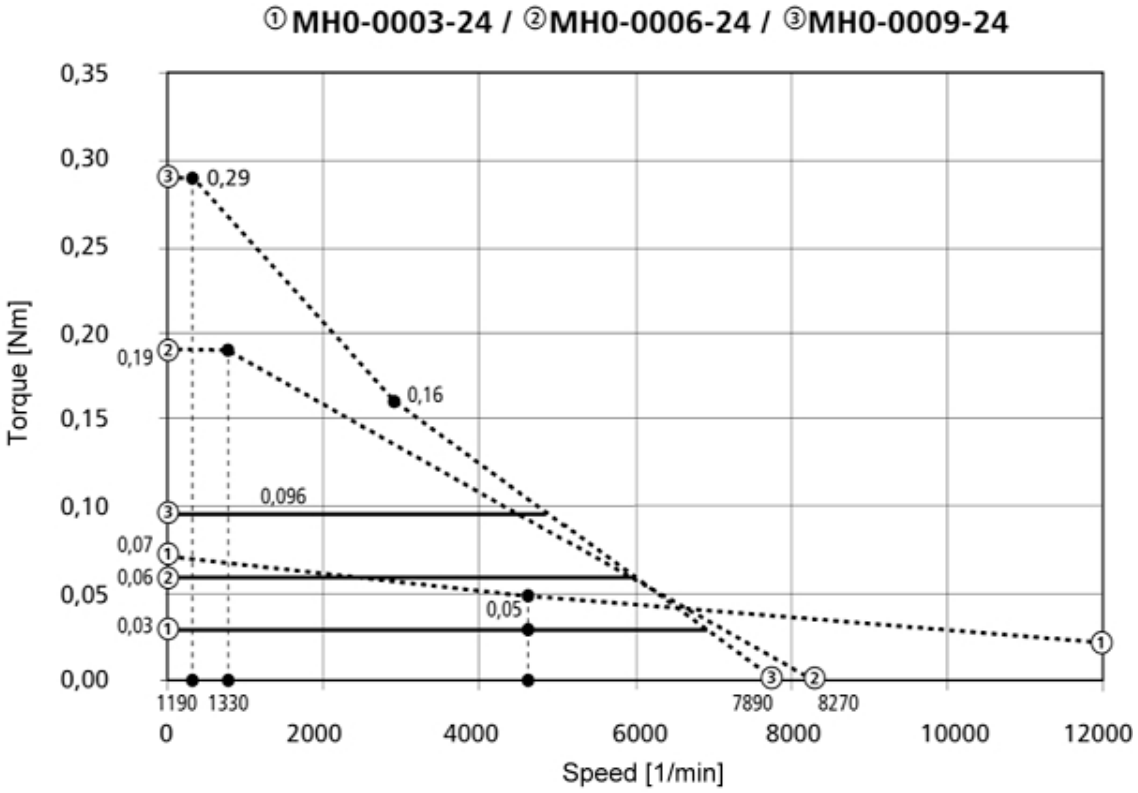
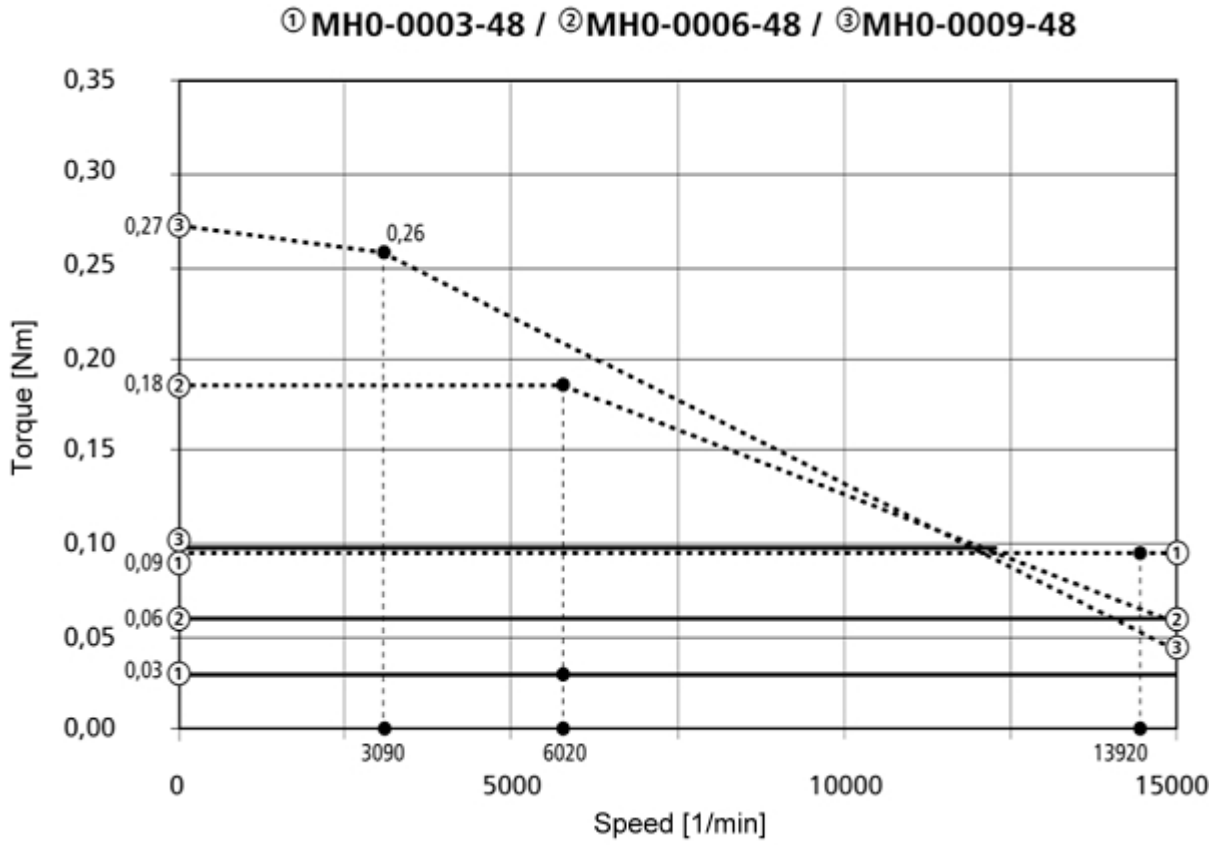


MH0-000X series

Data 48 VDC	Sym	Unit	MH0-0003	MH0-0006	MH0-0009
Nominal speed	N_n	min^{-1}	4,500	3,000	
Power supply	U_{dc}	V	48		
Nominal voltage	U_n	V	32		
Motor poles	P_{Mot}		6		
Resolver poles	P_{Res}		2		
Nominal torque	M_n	Nm	0.03	0.06	0.09
Nominal current	I_n	A	2.40	2.40	3.20
Continuous stall current	M_o	Nm	0.03	0.06	0.09
Stall current	I_o	A	2.20	2.30	3.00
max. torque	M_{max}	Nm	0.09	0.18	0.27
max. current	I_{max}	A	6.90	7.00	9.30
Voltage constant	K_E	V/1,000	0.80	1.60	1.80
Torque constant	K_T	Nm/A	0.01	0.03	0.03
Nominal power	P_n	W	14.0	19.0	29.0
Winding resistance Phase-Phase	R_{pp}	Ohm	2.4	2.6	2.4
Winding inductivity Phase-Phase	L_{pp}	mH	0.25	0.40	0.30
Moment of inertia	J_m	$kgcm^2$	0.002	0.0038	0.0056
Electr. time constant	T_{el}	ms	0.100	0.1500	0.1300
Winding number			001	002	003

10% tolerance at M_o, M_n und N_n. values ascertained with heat sink.



7. Cable occupancy

7.1. Motor MH0-000X

Motor cable	Resolver cable
white = Phase U	blue = Cos +
blue = Phase V	yellow = Cos -
red = Phase W	red = Sin +
	black = Sin -
white/yellow = Earth / SL	black/white = Ref +
	red/white = Ref -

8. Technical Data

8.1. Definition

Continuous stall torque M_0 [Nm]
Thermal max. torque which can be delivered indefinitely when motor stands idle, n=0min^{-1}, within nominal environmental conditions.

Nominal torque M_n [Nm]
When motor takes nominal current at nominal speed, rated torque can be delivered indefinitely in S1 operation.

Stall current I_0 [A]
To supply the continuous stall torque during standstill, the motor takes the stall current. The indications refer to the sinusoidal effective current.

Nominal current I_n [A]
At nominal speed N_n and supply of the nominal the motor takes the nominal current. The indications refer to the sinusoidal effective current.

Peak current I_{max} [A]
The peak current (effective sinusoidal value) is the maximal allowed current for 5sec. The peak current should not be higher then 3.5 times nominal current.

Torque constant K_T [Nm/A]
The torque constant is the relationship between torque and current. This defines how much Nm torque is produced with 1A current.

Voltage constant K_E [V/1,000min^{-1}]
This voltage constant defines the induced motor EMF, as an effective voltage between two terminals per 1,000rpm.

Rotor Moment of Inertia J [kgcm²]
This mechanical value is one of the important parameters to define the rotor acceleration capability.