23 EZHD synchronous servo motors with hollow shaft

Table of contents

23.1 Overview

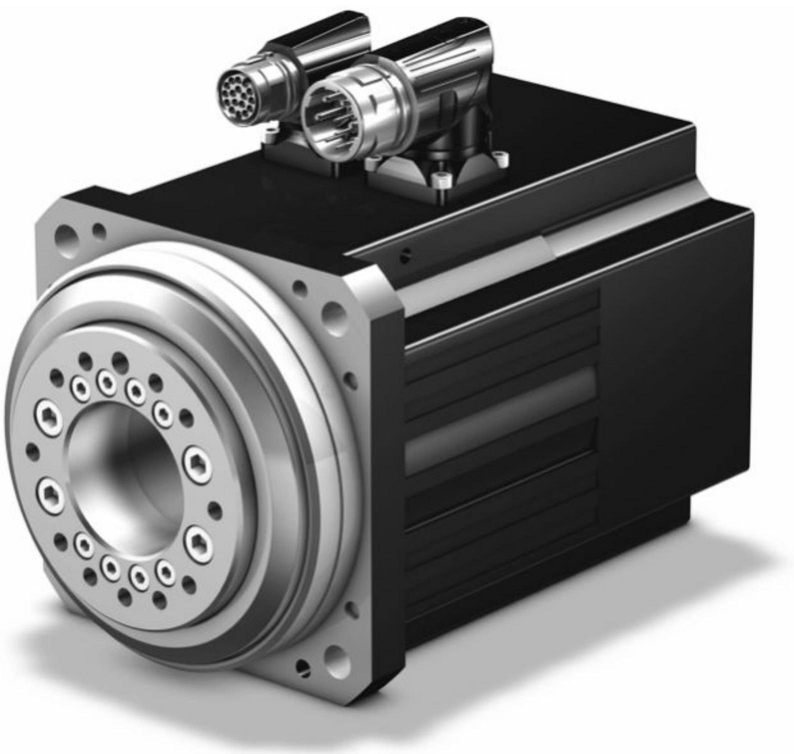
Synchronous servo motors with hollow shaft

Torques

M_N	1.9 – 24.6 Nm
M_0	2.6 – 31.1 Nm

Features

Continuous flange hollow shaft for conveying media	✓
Reinforced A-side bearing for absorbing radial forces	✓
Reinforced B-side bearing for absorbing axial forces	✓
High dynamics	✓
Super compact due to tooth winding technology with the highest possible copper fill factor	✓
Backlash-free holding brake (optional)	✓
Convection cooling	✓
Inductive EnDat absolute value encoder	✓
Multiturn absolute value encoders (optional) eliminate the need for referencing	✓
Electronic nameplate for fast and reliable commissioning	✓
Rotating plug connectors with quick lock	✓



23.2 Selection tables

The technical data specified in the selection tables applies for:

- Installation altitudes up to 1000 m above sea level
- Surrounding temperatures from 0° C to 40° C
- Operation on a STOBER drive controller
- DC link voltage U_{ZK} = DC 540 V
- Paint black matte as per RAL 9005

In addition the technical data apply to an uninsulated design with the following thermal mounting conditions:

Motor type	Steel mounting flange dimensions (thickness x width x height)	Convection surface Steel mounting flange
EZHD04 EZHD05	23 x 210 x 275 mm	0.16 m^2
EZHD07	28 x 300 x 400 mm	0.3 m^2

Note the differing ambient conditions in section [23.7.3]

Formula symbol	Unit	Explanation
I_0	A	Standstill current: RMS value of the line-to-line current with standstill torque M_0 generated (Tolerance ±5 %)
I_{max}	A	Maximum current: RMS value of the maximum permitted line-to-line current with maximum torque M_{max} generated (tolerance ±5%).
		Exceeding I_{max} may lead to irreversible damage (demagnetization) of the rotor.
I_N	A	Nominal current: RMS value of the line-to-line current with nominal torque M_N generated (tolerance ±5 %)
J	10^{-4}kgm^2	Mass moment of inertia
K_{EM}	V/rpm	Voltage constant: peak value of the induced motor voltage at a speed of 1000 rpm and a winding temperature $\Delta\vartheta$ = 100 K (tolerance ±10 %)
K_{M0}	Nm/A	Torque constant: ratio of the standstill torque and frictional torque to the standstill current; $K_{M0} = (M_0 + M_R) / I_0$ (tolerance ±10 %)
$K_{M,N}$	Nm/A	Torque constant: ratio of the nominal torque M_N to the nominal current I_N; $K_{M,N} = M_N / I_N$ (tolerance ±10 %)
L_{U-V}	mH	Winding inductance of a motor between two phases (determined in the oscillating circuit)
m	kg	Weight
M_0	Nm	Standstill torque: the torque the motor is able to deliver long term at a speed of 10 rpm (tolerance ±5 %)
M_{max}	Nm	Maximum torque: the maximum permitted torque the motor is able to deliver briefly (when accelerating or decelerating) (tolerance ±10 %)
M_N	Nm	Nominal torque: the maximum torque of a motor in S1 mode at nominal speed n_N (tolerance ±5 %)
		You can calculate other torques as follows: $M_{N*} = K_{M0} \cdot I* - M_R$.
M_R	Nm	Frictional torque (of the bearings and sealings) of a motor at winding temperature $\Delta\vartheta$ = 100 K
n_N	rpm	Nominal speed: the speed for which the nominal torque M_N is specified

Formula symbol	Unit	Explanation
P_N	kW	Nominal output: the output the motor is able to deliver long term in S1 mode at the nominal point (tolerance ±5 %)
R_{U-V}	Ω	Winding resistance of a motor between two phases at a winding temperature of 20 °C
T_{el}	ms	Electrical time constant: ratio of the winding inductance to the winding resistance of a motor: $T_{el} = L_{U-V} / R_{U-V}$
U_{ZK}	V	DC link voltage: characteristic value of a drive controller

Type	K_{EM} [V/1000 rpm]	n_N [rpm]	M_N [Nm]	I_N [A]	$K_{M,N}$ [Nm/A]	P_N [kW]	M_0 [Nm]	I_0 [A]	K_{M0} [Nm/A]	M_R [Nm]	M_{max} [Nm]	I_{max} [A]	R_{U-V} [Ω]	L_{U-V} [mH]	T_{el} [ms]	J [10^{-4} kgm²]	m [kg]
EZHD0411U	96	3000	1.90	2.36	0.81	0.60	2.60	2.89	1.05	0.44	8.50	16.5	6.70	37.70	5.63	9.35	5.46
EZHD0412U	94	3000	4.20	4.29	0.98	1.3	5.10	4.94	1.12	0.44	16.0	26.5	3.00	21.80	7.26	10.1	6.55
EZHD0414U	116	3000	7.70	6.30	1.22	2.4	8.50	6.88	1.30	0.44	29.0	35.0	1.85	15.00	8.11	11.6	8.55
EZHD0511U	97	3000	3.00	3.32	0.90	0.94	4.10	4.06	1.12	0.44	16.0	22.0	3.80	23.50	6.18	22.3	7.50
EZHD0512U	121	3000	7.00	5.59	1.25	2.2	7.80	6.13	1.34	0.44	31.0	33.0	2.32	16.80	7.24	25.1	8.90
EZHD0513U	119	3000	8.30	7.04	1.18	2.6	10.9	8.76	1.29	0.44	43.0	41.0	1.25	10.00	8.00	27.9	10.3
EZHD0515U	141	3000	14.0	9.46	1.48	4.4	16.4	11.0	1.54	0.44	67.0	52.0	0.93	8.33	8.96	33.6	13.1
EZHD0711U	95	3000	7.30	7.53	0.97	2.3	7.90	7.98	1.07	0.63	20.0	25.0	1.30	12.83	9.87	63.6	13.8
EZHD0712U	133	3000	11.6	8.18	1.42	3.6	14.4	9.99	1.50	0.63	41.0	36.0	1.00	11.73	11.73	72.5	16.2
EZHD0713U	122	3000	17.8	13.4	1.33	5.6	20.4	15.1	1.39	0.63	65.0	62.0	0.52	6.80	13.08	81.4	18.5
EZHD0715U	140	3000	24.6	17.2	1.43	7.7	31.1	21.1	1.50	0.63	104	87.0	0.33	4.80	14.55	100	23.9

23.3 Torque/speed characteristic curves

Torque/speed characteristic curves depend on the nominal speed and/or winding version of the motor and the DC link voltage of the drive controller that is used. The following torque/speed characteristic curves apply to the DC link voltage DC 540 V.

Formula symbol	Unit	Explanation
ED	%	Duty cycle relative to 10 minutes
M_{lim}	Nm	Torque limit without compensating for field weakening
M_{limFW}	Nm	Torque limit with compensation for field weakening (applies to operation on STOBER drive controllers only)
M_{limK}	Nm	Torque limit of the motor with convection cooling
M_{max}	Nm	Maximum torque: the maximum permitted torque the motor is able to deliver briefly (when accelerating or decelerating) (tolerance ±10 %)
n_N	rpm	Nominal speed: the speed for which the nominal torque M_N is specified
$\Delta\vartheta$	K	Temperature difference

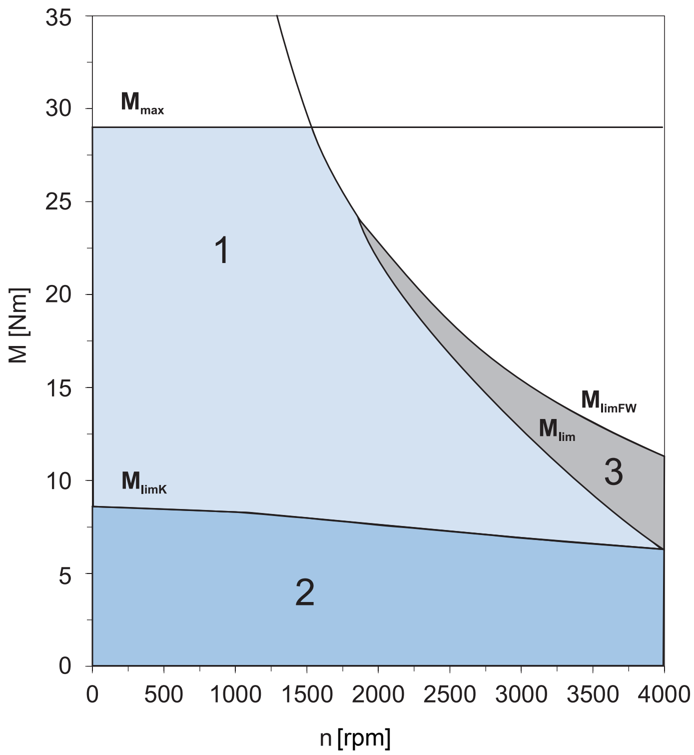
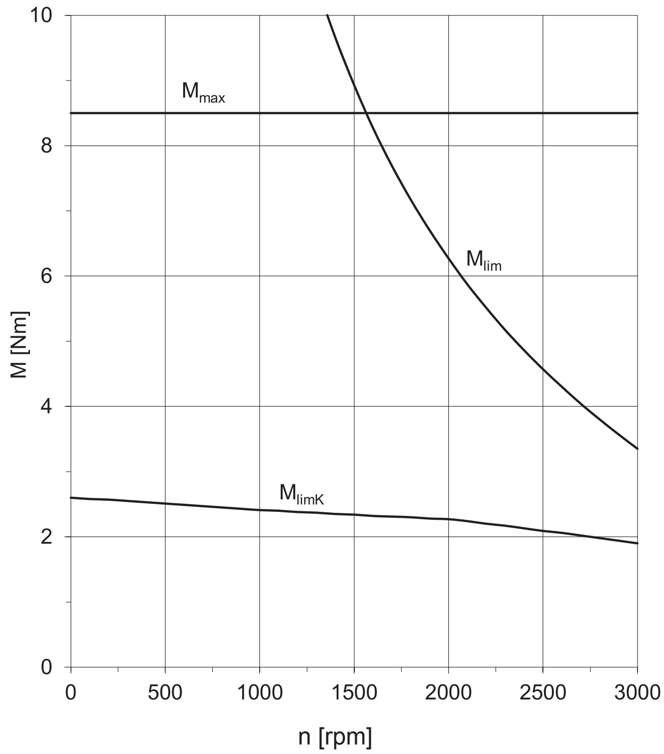


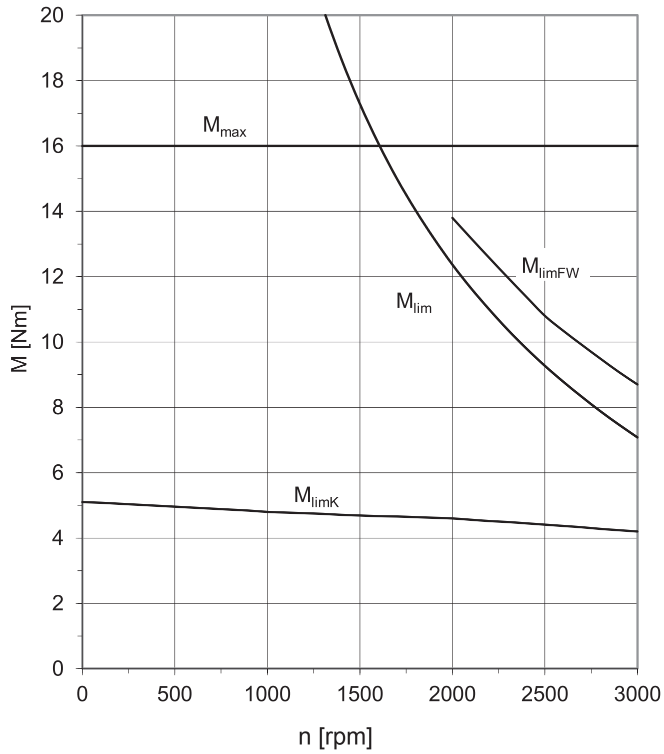
Fig. 1: Explanation of a torque/speed characteristic curve

1	Torque range for brief operation (duty cycle < 100%) with ϑ = 100 K	2	Torque range for continuous operation at a constant load (S1 mode, duty cycle = 100%) with ϑ = 100 K
3	Field weakening range (can only be used with operation on STOBER drive controllers)		

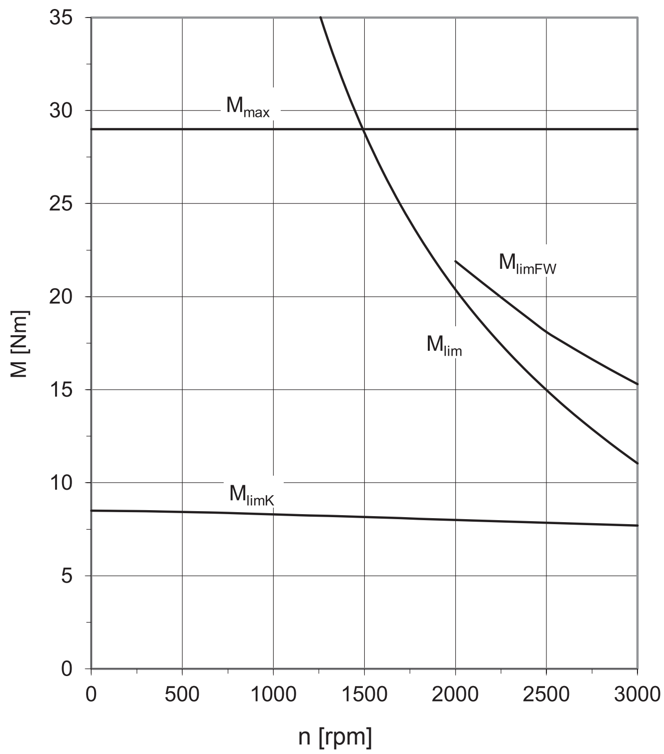
EZHD0411U (n_N=3000 rpm)



EZHD0412U (n_N=3000 rpm)



EZHD0414U (n_N=3000 rpm)



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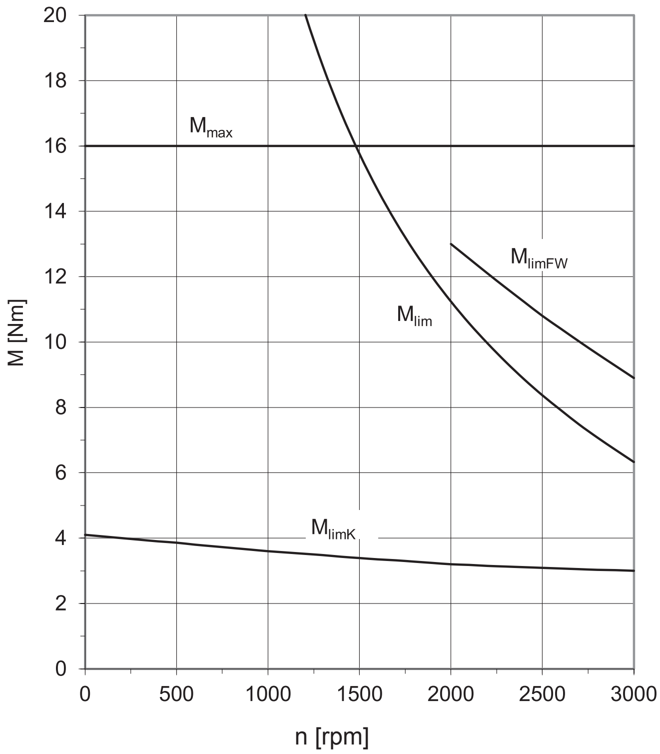
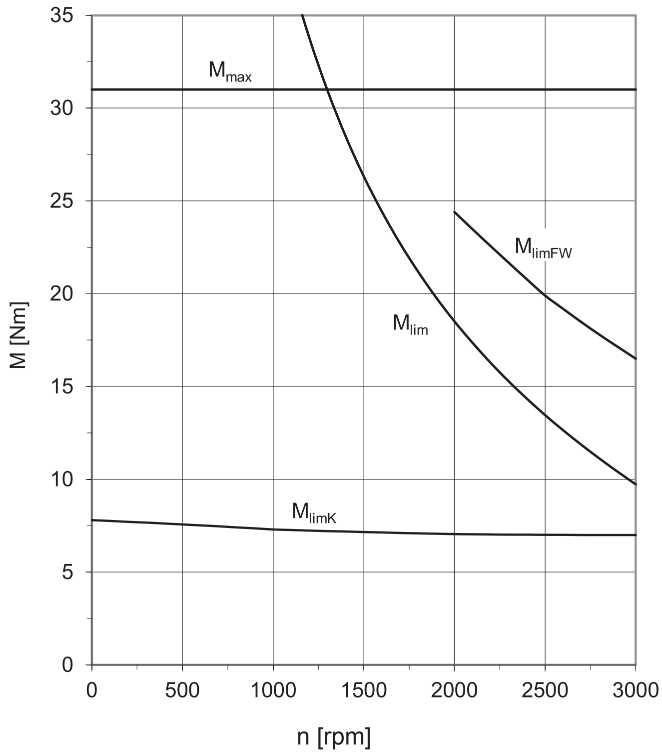
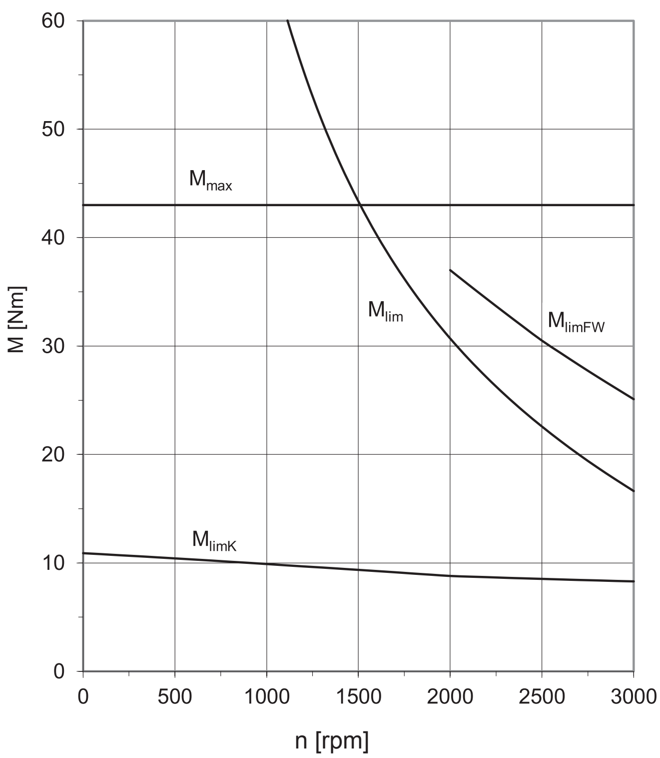
EZHD0511U (n_N=3000 rpm)



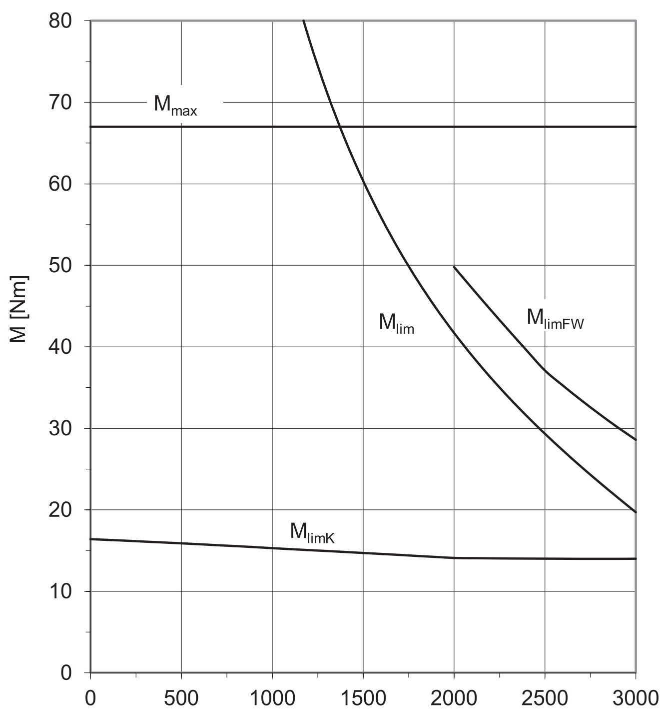
EZHD0512U (n_N=3000 rpm)



EZHD0513U (n_N=3000 rpm)



EZHD0515U (n_N=3000 rpm)



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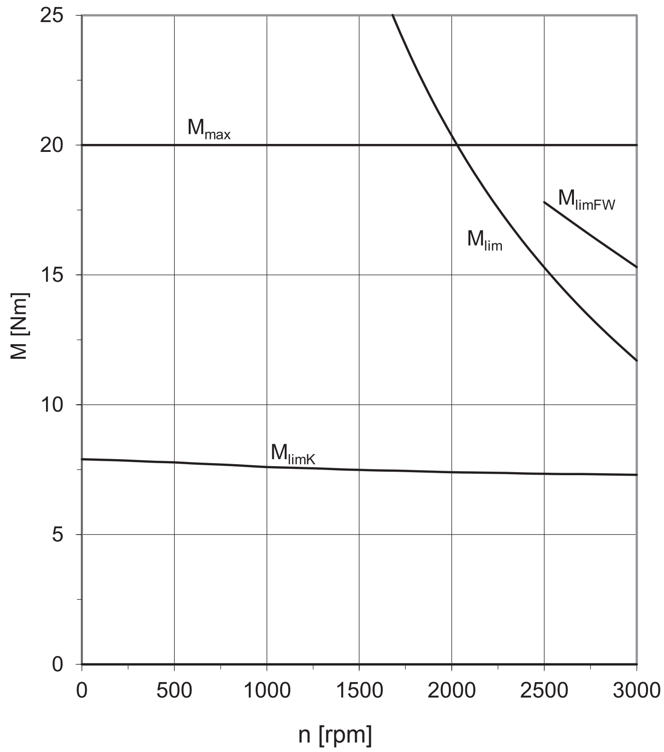
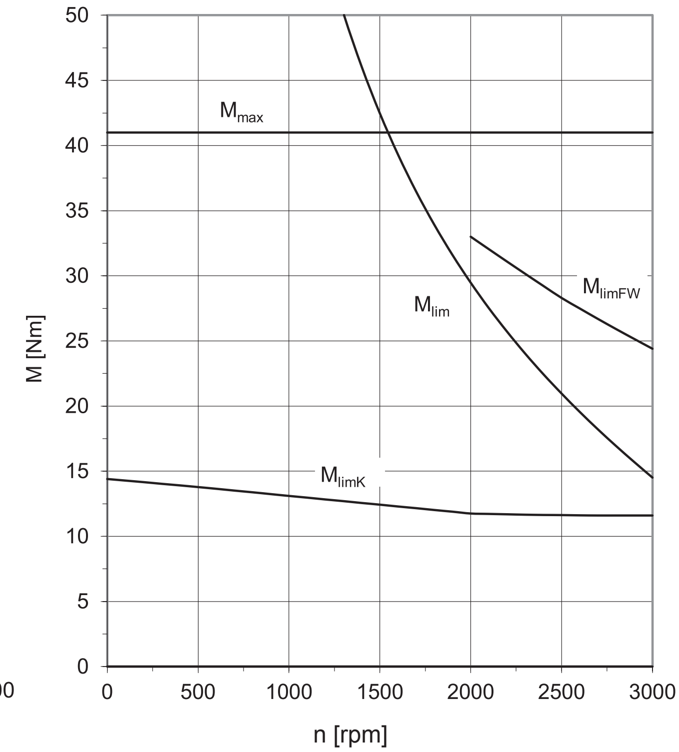
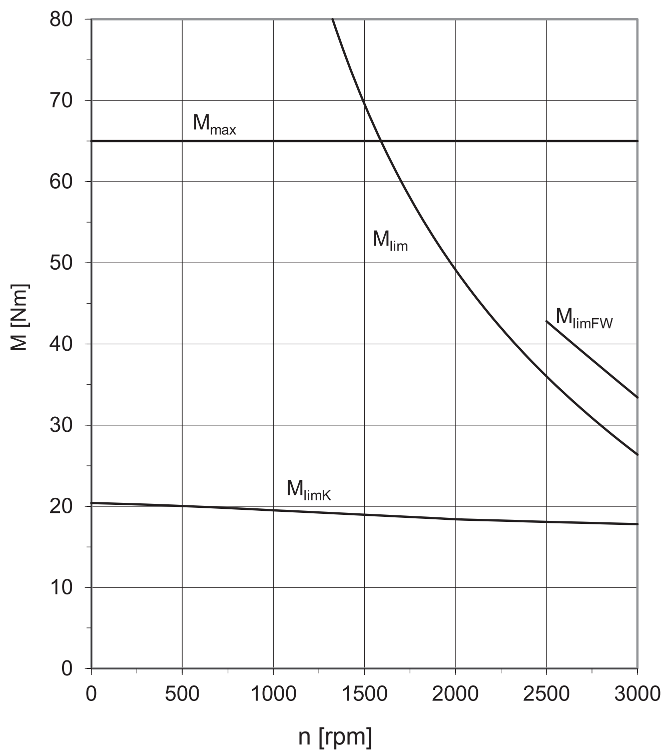
EZHD0711U (n_N=3000 rpm)



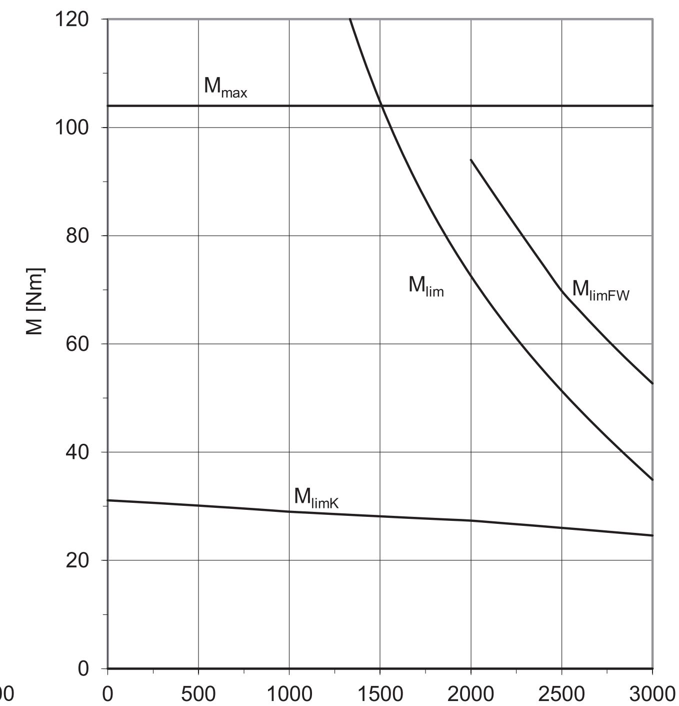
EZHD0712U (n_N=3000 rpm)



EZHD0713U (n_N=3000 rpm)



EZHD0715U (n_N=3000 rpm)



EZHD

23.4 Dimensional drawings

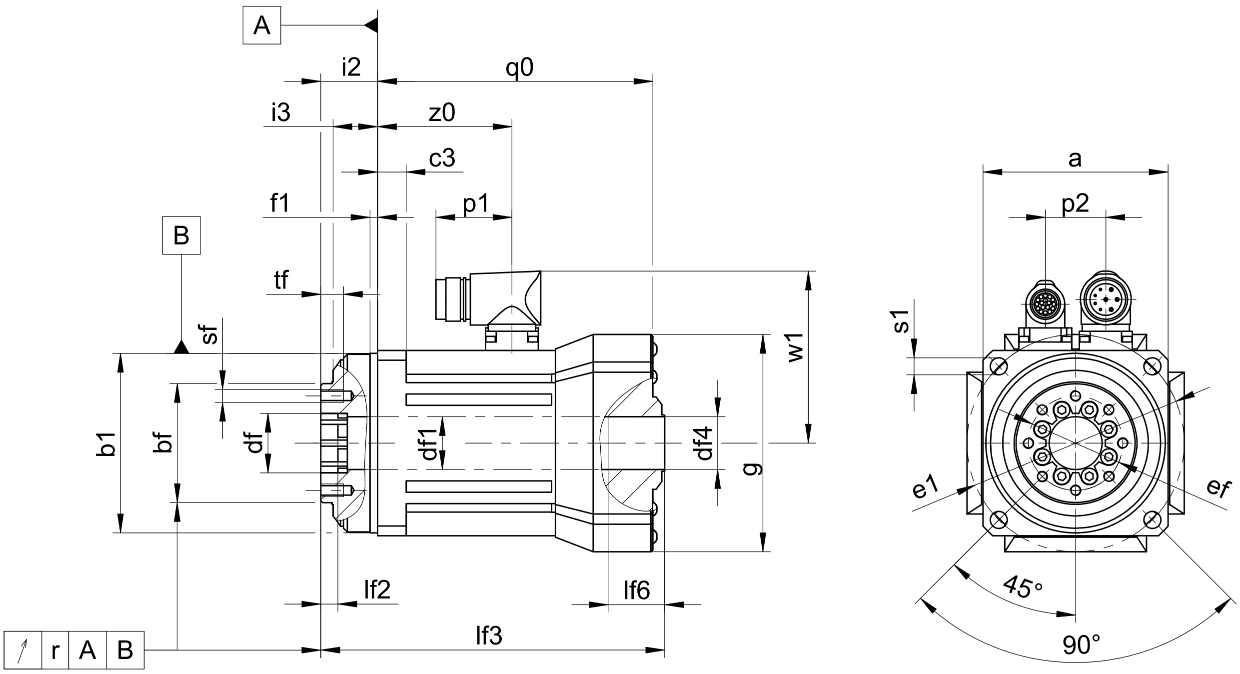
In this chapter you can find the dimensions of the motors.

Dimensions may exceed the requirements of ISO 2768-mK due to casting tolerances or the sum of additional tolerances.

We reserve the right to make modifications to the dimensions due to technical advances.

You can download CAD model of our standard drives from http://cad.stoeber.de.

23.4.1 EZHD04 motors



Type	□a	∅b1	∅bf	c3	∅df	∅df1	∅df4	∅e1	∅ef	f1	□g	i2	i3	lf2	lf3	lf6	p1	p2	q0	r	∅s1	sf	tf	w1	z0
EZHD0411	98	95_{j6}	63_{h7}	15.1	31.5^{H7}	28.4	28^{JS10}	115	50	4	115	30±0.4	23.5	9	182	30	40	32	145.8	0.030	9	M6	11	91	71
EZHD0412	98	95_{j6}	63_{h7}	15.1	31.5^{H7}	28.4	28^{JS10}	115	50	4	115	30±0.4	23.5	9	207	30	40	32	170.8	0.030	9	M6	11	91	96
EZHD0414	98	95_{j6}	63_{h7}	15.1	31.5^{H7}	28.4	28^{JS10}	115	50	4	115	30±0.4	23.5	9	257	30	40	32	220.8	0.030	9	M6	11	91	143

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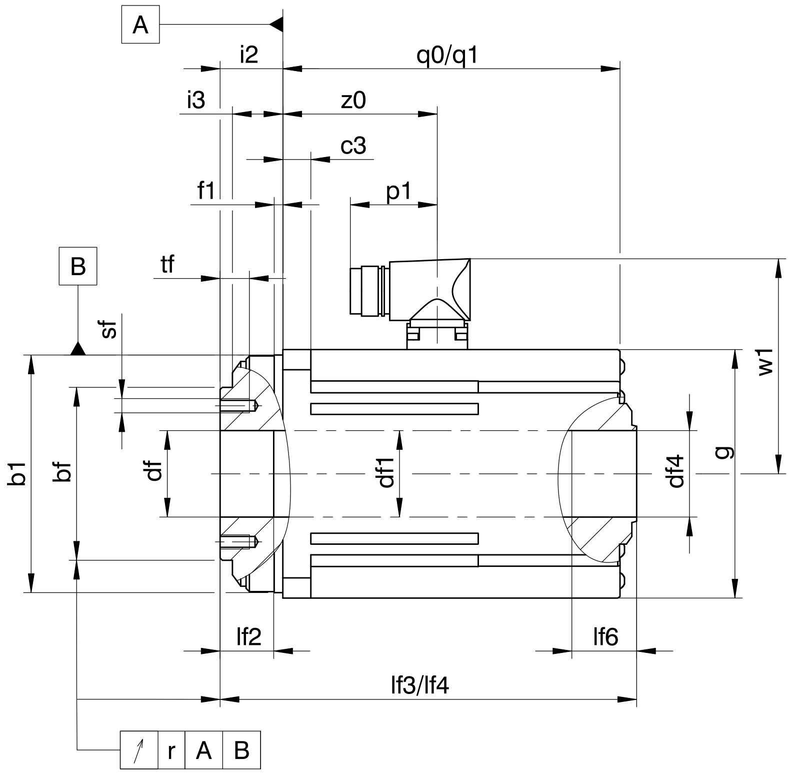
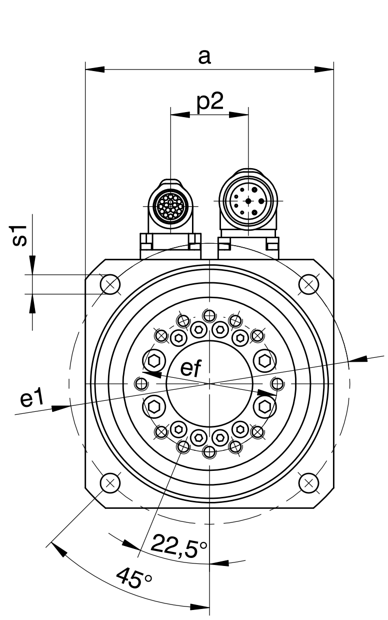
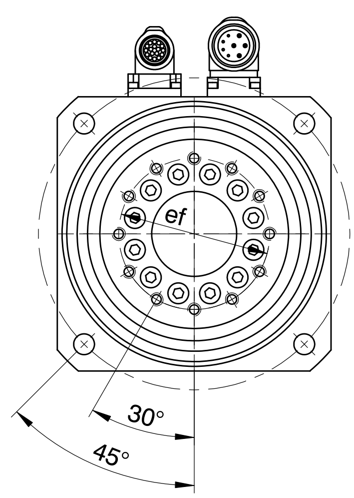
23.4.2 EZHD05 – EZHD07 motors



EZHD05



EZHD07



q0, lf3	Applies to motors without holding brake.	q1. lf4	Applies to motors with holding brake.

Type	□a	Øb1	Øbf	c3	Ødf	Ødf1	Ødf4	Øe1	Øef	f1	□g	i2	i3	lf2	lf3	lf6	p1	p2	q0	q1	r	Øs1	sf	tf	w1	z0
EZHD0511	115	110_{j6}	80_{h7}	13.0	40.0^{H7}	40.5	40^{JS10}	130	63	4	115	29±0.4	23.3	24.8	192.8	30	40	36	156.1	211.4	0.030	9	M6	11	100	71.5
EZHD0512	115	110_{j6}	80_{h7}	13.0	40.0^{H7}	40.5	40^{JS10}	130	63	4	115	29±0.4	23.3	24.8	217.8	30	40	36	181.1	236.4	0.030	9	M6	11	100	96.3
EZHD0513	115	110_{j6}	80_{h7}	13.0	40.0^{H7}	40.5	40^{JS10}	130	63	4	115	29±0.4	23.3	24.8	242.8	30	40	36	206.1	261.4	0.030	9	M6	11	100	121.5
EZHD0515	115	110_{j6}	80_{h7}	13.0	40.0^{H7}	40.5	40^{JS10}	130	63	4	115	29±0.4	23.3	24.8	292.8	30	40	36	256.1	311.4	0.030	9	M6	11	100	171.5
EZHD0711	145	140_{j6}	100_{h7}	14.5	50.0^{H7}	45.5	45^{JS10}	165	80	4	145	38±0.4	24.5	32.5	219.0	30	40	42	172.2	232.2	0.030	11	M8	15	114.3	78.7
EZHD0712	145	140_{j6}	100_{h7}	14.5	50.0^{H7}	45.5	45^{JS10}	165	80	4	145	38±0.4	24.5	32.5	244.0	30	40	42	197.2	257.2	0.030	11	M8	15	114.3	103.7
EZHD0713	145	140_{j6}	100_{h7}	14.5	50.0^{H7}	45.5	45^{JS10}	165	80	4	145	38±0.4	24.5	32.5	269.0	30	40	42	222.2	282.2	0.030	11	M8	15	114.3	128.7
EZHD0715	145	140_{j6}	100_{h7}	14.5	50.0^{H7}	45.5	45^{JS10}	165	80	4	145	38±0.4	24.5	32.5	324.0	30	71	42	277.2	337.2	0.030	11	M8	15	133	179.7

EZHD

23.5 Type designation

Sample code

EZH	**D**	**0**	**5**	**1**	**1**	**U**	**F**	**AD**	**B1**	**O**	**097**

Explanation

Code	Designation	Design
EZH	Type	Synchronous servo motor with hollow shaft
D	Drive	Direct drive
0	Stages	0-stage (direct drive)
5	Motor size	5 (example)
1	Generation	1
1	Length	1 (example)
U	Cooling	Convection cooling
F	Output	Flange
AD	Drive controller	SD6 (example)
B1	Encoder	EBI 135 EnDat 2.2 (example)
O P	Brake	Without holding brake Permanent magnet holding brake[1]
097	Electromagnetic constant (EMC) K_{EM}	97 V/1000 rpm (example)

Instructions

- You can find information about available encoders in section [▸ 23.6.4].
- In section [▸ 23.6.4.3], you can find information about connecting synchronous servo motors to other STOBER drive controllers.
- In section [▸ 27], you can find information about connecting STOBER synchronous servo motors to drive controllers of third-party manufacturers.

23.6 Product description

23.6.1 General features

Feature	Description
Design	IM B5, IM V1, IM V3 in accordance with EN 60034-7/A1
Protection class	IP56
Thermal class	155 (F) as per EN 60034-1 (155 °C, heating $\Delta\vartheta$ = 100 K)
Surface[2]	Black matte as per RAL 9005
Cooling	IC 410 convection cooling
Bearing	Ball bearing with lifetime lubrication and non-contact sealing
Sealing	Gamma ring (on A and B-side)
Vibration intensity	A as per EN 60034-14/A1
Noise level	Limit values as per EN 60034-9/A1

[1] Not available for EZHD_4.
[2] Repainting will change the thermal properties and therefore the performance limits of the motor.

23.6.2 Electrical features

General electrical features of the motor are described in this section. For details see the selection tables section.

Feature	Description
DC-link-voltage	DC 540 V (max. 620 V) on STOBER drive controllers
Winding	Three-phase, single-tooth design
Circuit	Star, center not led out
Protection class	I (protective grounding) as per EN 61140/A1
Number of pole pairs	7

23.6.3 Ambient conditions

Standard ambient conditions for transport, storage and operation of the motor are described in this section. Information about differing ambient conditions can be found in section [▸ 23.7.3].

Feature	Description
Transport/storage surrounding temperature	-30 °C to +85 °C
Surrounding operating temperature	-15 °C to +40 °C
Installation altitude	≤ 1000 m above sea level
Shock load	≤ 50 m/s² (5 g), 6 ms as per EN 60068-2-27

Instructions

- STOBER synchronous servo motors are not suitable for use in potentially explosive atmospheres according to ATEX Directive2014/34/EU.
- Brace the motor connection cables close to the motor so that vibrations of the cable do not place unpermitted loads on the motor plug connector.
- Note that the braking torques of the holding brake (optional) may be reduced due to shock loading.
- Also take into consideration the shock load of the motor with output units (such as gear units and pumps) to which the motor is connected.

23.6.4 Encoder

STOBER synchronous servo motors are available in versions with different encoder types. The following sections include information for choosing the optimal encoder for your application.

23.6.4.1 Selection tool for EnDat interface

The following table provides you with a selection tool for the EnDat interface of absolute value encoders.

Feature	EnDat 2.1	EnDat 2.2
Short cycle times	★★☆	★★★
Additional information transferred with the position value	–	✓
Expanded power supply range	★★☆	★★★
Key: ★★☆ = good, ★★★ = very good		

23.6.4.2 EnDat encoder

In this chapter you can find detailed technical data of the encoder types that can be selected with EnDat interface.

Encoder with EnDat 2.2 interface

Encoder type	Type code	Measuring principle	Recordable revolutions	Resolution	Position values per revolution
EBI 135	B1	Inductive	65536	19 bits	524288
ECI 119-G2	C9	Inductive	–	19 bits	524288

Encoder with EnDat 2.1 interface

Encoder type	Type code	Measuring principle	Recordable revolutions	Resolution	Position values per revolution	Periods per revolution
ECI 119	C4	Inductive	–	19 bits	524288	Sin/cos 32

Instructions

- The type code of the encoder is a part of the type designation of the motor.
- Several revolutions of the motor shaft can only be recorded with multiturn encoders.
- The encoder EBI 135 requires an external buffer battery so that the absolute position information will be retained after the power supply is turned off (AES option for STOBER drive controllers).

23.6.4.3 Possible combinations with drive controllers

The following table shows combination options of STOBER drive controllers with selectable encoder types.

Drive controller		**SDS 5000**	**MDS 5000**	**SDS 5000 sin/cos MDS 5000 sin/cos**	**SD6**	**SD6 sin/cos**	**SI6**	**SI6 sin/cos**
Drive controller type code		AA	AB	AC	AD	AE	**AP**	**AQ**
ID connection plan		442305	442306	442307	442450	442451	**442771**	**442772**
Encoder	**Encoder type code**							
EBI 135	B1	✓	✓	–	✓	–	✓	–
ECI 119-G2	C9	✓	✓	–	✓	–	✓	–
ECI 119	C4	–	–	✓	–	✓	–	–

Instructions

- The type code of the drive controller and the encoder are a part of the type designation of the motor (see type designation chapter).
- In section [▷ 27], you can find information about connecting STOBER synchronous servo motors to drive controllers of third-party manufacturers.

23.6.5 Temperature sensor

In this chapter you can find technical data of the temperature sensors that are installed in STOBER synchronous servo motors for the realization of the thermal winding protection. To prevent damage to the motor, always monitor the temperature sensor with appropriate devices that will turn off the motor if the maximum permitted winding temperature is exceeded.

Some encoders have their own internal analysis electronics with warning and off limits that may overlap with the corresponding values set in the drive controller for the temperature sensor. In some cases this may result in an encoder with internal temperature monitoring forcing the motor to shut down even before the motor has reached its nominal data.

You can find information about the electrical connection of the temperature sensor in the connection technology chapter.

23.6.5.1 PTC thermistor

The PTC thermistor is installed as a standard temperature sensor in STOBER synchronous servo motors. The PTC thermistor is a drilling thermistor as per DIN 44082, so that the temperature of each winding phase can be monitored.

The resistance values in the following table and characteristic curve refer to a single thermistor as per DIN 44081. These values must be multiplied by 3 for a drilling thermistor in accordance with DIN 44082.

Feature	Description
Nominal response temperature ϑ_{NAT}	145 °C ± 5 K
Resistance R −20 °C up to ϑ_{NAT} − 20 K	≤ 250 Ω
Resistance R with ϑ_{NAT} − 5 K	≤ 550 Ω
Resistance R with ϑ_{NAT} + 5 K	≥ 1330 Ω
Resistance R with ϑ_{NAT} + 15 K	≥ 4000 Ω
Operating voltage	≤ DC 7,5 V
Thermal response time	< 5 s
Thermal class	155 (F) as per EN 60034-1 (155 °C, heating $\Delta\vartheta$ = 100 K)

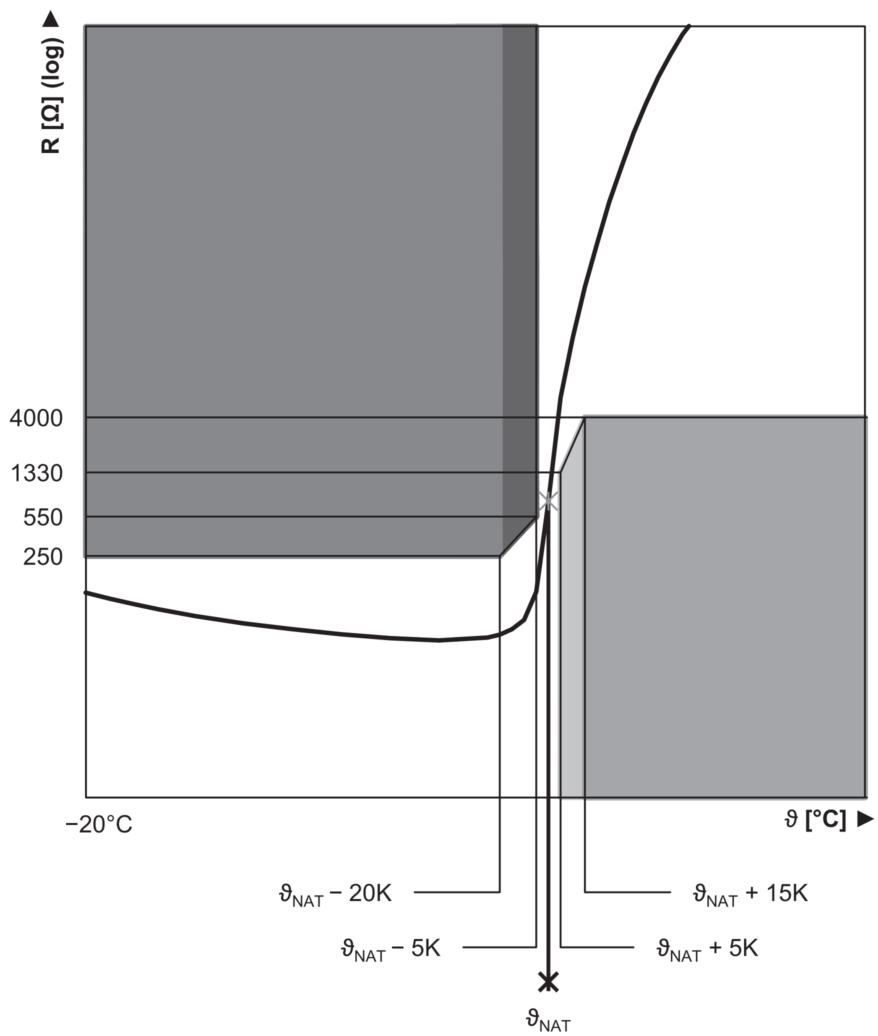


Fig. 2: Characteristic curve of PTC thermistor (single thermistor)

EZHD

23.6.5.2 Pt1000 temperature sensor

STOBER synchronous servo motors are optionally available in versions with a Pt1000 temperature sensor. The Pt1000 is a temperature-dependent resistor with a characteristic resistance curve that follows the temperature linearly. The Pt1000 therefore facilitates measurements of the winding temperature. However these measurements are limited to one phase of the motor winding. To adequately protect the motor from exceeding the maximum permitted winding temperature, use a i²t-model in the drive controller to monitor the winding temperature.

To prevent falsifying the measured values because of self-heating of the temperature sensor, avoid exceeding the specified measurement current.

Feature	Description
Measurement current (constant)	2 mA
Resistance R for ϑ = 0 °C	1000 Ω
Resistance R for ϑ = 80 °C	1300 Ω
Resistance R for ϑ = 150 °C	1570 Ω

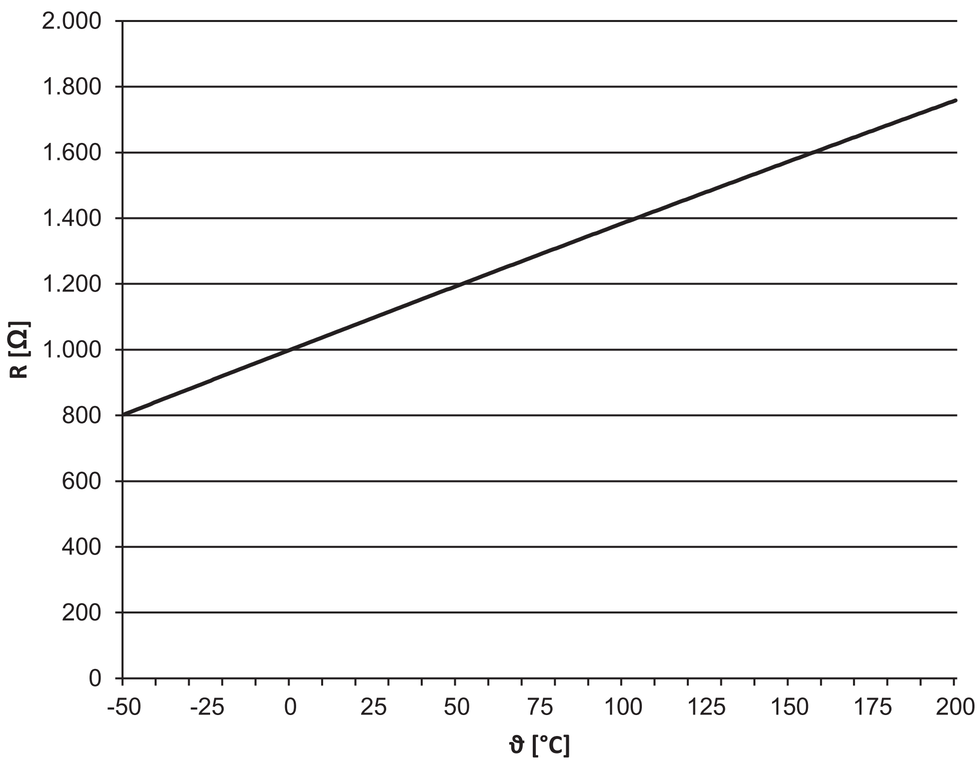


Fig. 3: Pt1000 temperature sensor characteristic curve

23.6.6 Cooling

An EZHD motor is cooled by convection cooling (IC 410 according to EN 60034-6). The air flowing around the motor is heated by the radiated motor heat and rises.

23.6.7 Holding brake

STOBER synchronous servo motors can by equipped with a backlash-free permanent magnet holding brake to keep the motor shaft still when stopped. The holding brake engages automatically if the voltage drops.

Nominal voltage of permanent magnet holding brake: DC 24 V ± 5 %, smoothed. Take into account the voltage losses in the connection lines of the holding brake.

STOBER

Observe the following for the configuration:

- In exceptional circumstances, the holding brake can be used for braking from full speed (following a power failure or when setting up the machine). The maximum permitted friction work $W_{B,Rmax/h}$ may not be exceeded. Activate other braking processes during operation via corresponding brake functions of the drive controller to prevent prematurely wear on the holding brake.
- Note that when braking from full speed the braking torque M_{Bdyn} may initially be up to 50 % less. This causes the braking effect to be introduced later and braking distances will be longer.
- Regularly perform a brake test to ensure the functional safety of the brakes. For further details see the documentation of the motor and the drive controller.
- Connect a varistor of type S14 K35 (or comparable) in parallel to the brake coil to protect your machine from switching surges. (Not necessary for connecting the holding brake to STOBER drive controller with BRS/BRM brake module).
- The holding brake of the synchronous servo motor does not provide adequate safety for person in the hazardous area around gravity-loaded vertical axes. Therefore take additional measures to minimize risk, e.g. by providing a mechanical substructure for maintenance work.
- Take into consideration voltage losses in the connection cables that connect the voltage source to the holding brake connections.
- The braking torque of the brake can be reduced by shock loading. Information about shock loading can be found in the ambient conditions section.

Formula symbol	Unit	Explanation
$I_{N,B}$	A	Nominal current of the brake at 20 °C
ΔJ_B	10^{-4}kgm²	Additive mass moment of inertia of a motor with holding brake
J	10^{-4}kgm²	Mass moment of inertia
J_{Bstop}	10^{-4}kgm²	Reference mass moment of inertia with braking from full speed: $J_{Bstop} = J \times 2$
J_{tot}	10^{-4}kgm²	Total mass moment of inertia (relative to the motor shaft)
Δm_B	kg	Additive weight of a motor with holding brake
M_{Bdyn}	Nm	Dynamic braking torque at 100 °C (Tolerance +40 %, −20 %)
M_{Bstat}	Nm	Static braking torque at 100 °C (Tolerance +40 %, −20 %)
M_L	Nm	Load torque
N_{Bstop}	–	Permitted number of braking processes from full speed (n = 3000 rpm) with J_{Bstop} (M_L = 0). The following applies if the values of n and J_{Bstop} differ: $N_{Bstop} = W_{B,Rlim} / W_{B,R/B}$.
n	rpm	Speed
t_1	ms	Linking time: time from when the current is turned off until the nominal braking torque is reached
t_2	ms	Disengagement time: time from when the current is turned on until the torque begins to drop
t_{11}	ms	Response delay: time from when the current is turned off until the torque increases
t_{dec}	ms	Stop time
$U_{N,B}$	V	Nominal voltage of brake (DC 24 V ±5 % (smoothed))
$W_{B,R/B}$	J	Friction work per braking
$W_{B,Rlim}$	J	Friction work until wear limit is reached

EZHD

Formula symbol	Unit	Explanation
$W_{B,Rmax/h}$	J	Maximum permitted friction work per hour per individual braking
$x_{B,N}$	mm	Nominal air gap of brake

Calculation of friction work per braking process

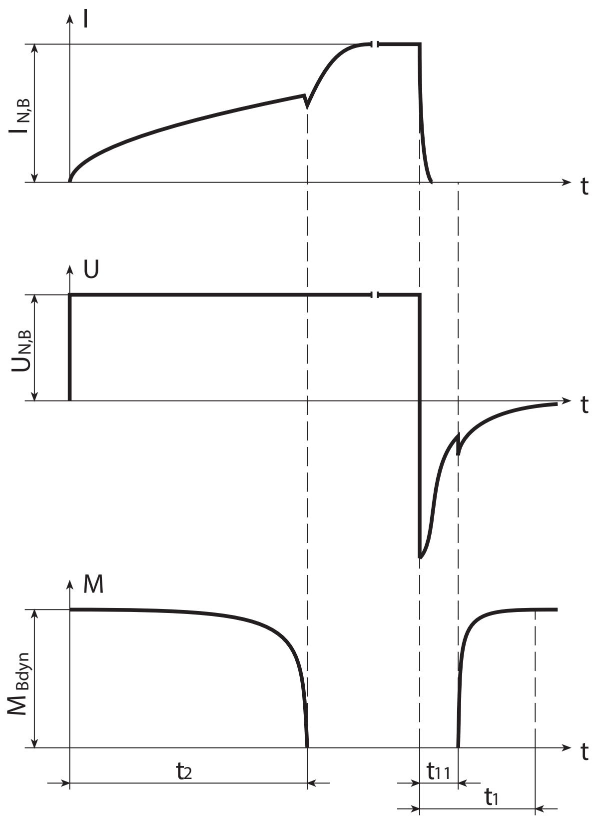
$$W_{B,R/B} = \frac{J_{tot} \cdot n^2}{182.4} \cdot \frac{M_{Bdyn}}{M_{Bdyn} \pm M_L}$$

The sign of M_L is positive if the movement runs vertically up or horizontally and negative if the movement runs vertically down.

Calculation of the stop time

$$t_{dec} = 2.66 \cdot t_1 + \frac{n \cdot J_{tot}}{9.55 \cdot M_{Bdyn}}$$

Switching characteristics



Technical Data

	M_{Bstat} [Nm]	M_{Bdyn} [Nm]	$I_{N,B}$ [A]	$W_{B,Rmax/h}$ [kJ]	$N_{B,stop}$	$J_{B,stop}$ [10^{-4}kgm²]	$W_{B,Rlim}$ [kJ]	t_2 [ms]	t_{11} [ms]	t_1 [ms]	$x_{B,N}$ [mm]	ΔJ_B [10^{-4}kgm²]	Δm_B [kg]
EZHD0511	18	15	1.1	11.0	2050	54.3	550	55	3.0	30	0.3	4.840	2.30
EZHD0512	18	15	1.1	11.0	1850	59.8	550	55	3.0	30	0.3	4.840	2.30
EZHD0513	18	15	1.1	11.0	1700	65.5	550	55	3.0	30	0.3	4.840	2.30
EZHD0515	18	15	1.1	11.0	1450	76.9	550	55	3.0	30	0.3	4.840	2.30
EZHD0711	28	25	1.1	25.0	1850	152	1400	120	4.0	40	0.4	12.280	3.77
EZHD0712	28	25	1.1	25.0	1650	170	1400	120	4.0	40	0.4	12.280	3.77
EZHD0713	28	25	1.1	25.0	1500	187	1400	120	4.0	40	0.4	12.280	3.77
EZHD0715	28	25	1.1	25.0	1250	224	1400	120	4.0	40	0.4	12.280	3.77

23.6.8 Connection method

The following sections describe the connection technology of STOBER synchronous servo motors in the standard version of STOBER drive controllers. You can find further information relating to the drive controller type that was specified in your order in the connection plan that is delivered with every synchronous servo motor.

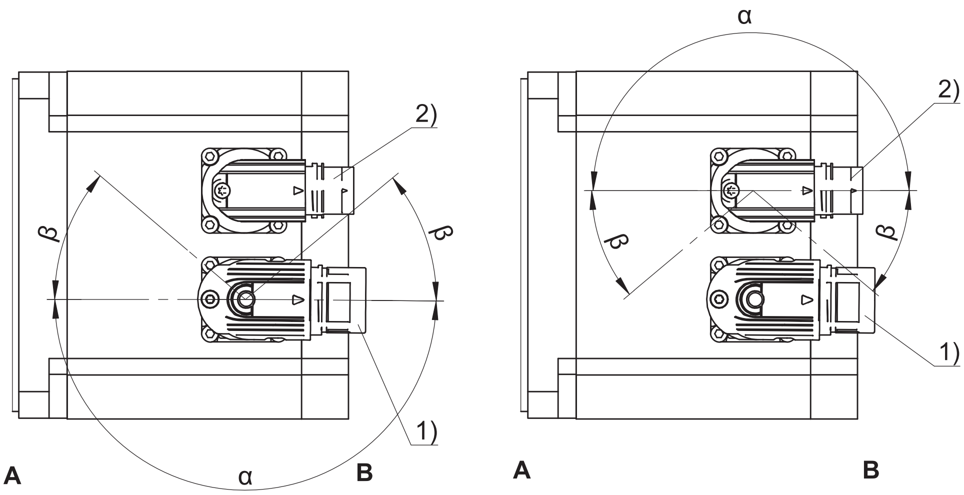
In section [▹ 27], you can find information about connecting STOBER synchronous servo motors to drive controllers of third-party manufacturers.

23.6.8.1 Plug connector

STOBER synchronous servo motors are equipped with twistable quick lock plug connectors in the standard version. For details see this section.

The illustrations represent the position of the plug connectors when delivered.

Turning ranges of plug connectors



1	Power plug connector	2	Encoder plug connector
A	Attachment or output side of the motor	B	Rear of the motor

Power plug connector features

Motor type	Size	Connection	Turning range	
			α	β
EZHD_4, EZHD_5, EZHD_711 – EZHD_713	con.23	Quick lock	180°	40°
EZHD_715	con.40	Quick lock	180°	40°

Encoder plug connector features

Motor type	Size	Connection	Turning range	
			α	β
EZHD	con.17	Quick lock	180°	20°

Instructions

- The number after "con." indicates approximately the external thread diameter of the plug connector in mm (for example con.23 designates a plug connector with an external thread diameter of about 23 mm).
- In turning range β the power and encoder plug connectors can only be turned if they will not collide with each other by doing so.

EZHD

23.6.8.2 Connection of the motor housing to the protective ground system

Connect the motor housing to the protective ground system to protect persons and to prevent the false triggering of fault current protection devices.

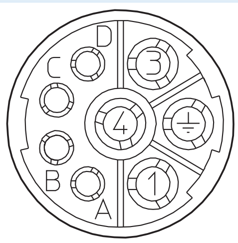
All attachment parts required for the connection of the protective ground to the motor housing are delivered with the motor. The grounding screw of the motor is identified with the symbol ⏚ as per IEC 60417-DB. The minimum cross-section of the protective ground is specified in the following table.

Cross-section of the copper protective grounding in the power cable (A)	Cross-section of the copper protective ground for motor housing (A_E)
A < 10 mm²	A_E = A
A ≥ 10 mm²	A_E ≥ 10 mm²

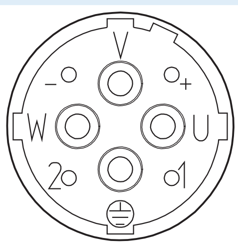
23.6.8.3 Connection assignment of the power plug connector

The size and connection plan of the power plug connector depend on the size of the motor. The colors of the connection strands inside the motor and specified according to IEC 60757.

Plug connector size con.23 (1)

Connection diagram	Pin	Connection	Color
	1	1U1 (phase U)	BK
	3	1V1 (phase V)	BU
	4	1W1 (phase W)	RD
	A	1BD1 (brake +)	RD
	B	1BD2 (brake −)	BK
	C	1TP1/1K1 (temperature sensor)	
	D	1TP2/1K2 (temperature sensor)	
	⏚	PE (protective ground)	GNYE

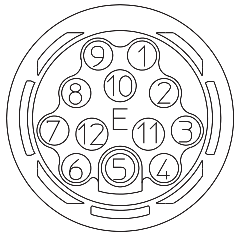
Plug connector size con.40 (1.5)

Connection diagram	Pin	Connection	Color
	U	1U1 (phase U)	BK
	V	1V1 (phase V)	BU
	W	1W1 (phase W)	RD
	+	1BD1 (brake +)	RD
	−	1BD2 (brake −)	BK
	1	1TP1/1K1 (temperature sensor)	
	2	1TP2/1K2 (temperature sensor)	
	⏚	PE (protective ground)	GNYE

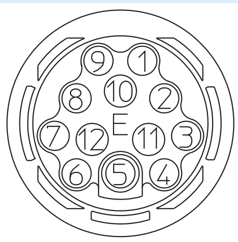
23.6.8.4 Connection assignment of encoder plug connector

The size and connection assignment of the encoder plug connector depend on the type of the installed encoder and the size of the motor. The colors of the connection strands inside the motor and specified according to IEC 60757.

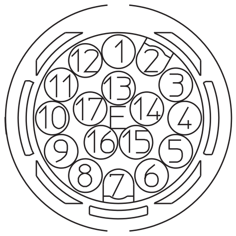
Encoder EnDat 2.1/2.2 digital, plug connector size con.17

Connection diagram	Pin	Connection	Color
	1	Clock +	VT
	2	Up sense	BN GN
	3		
	4		
	5	Data −	PK
	6	Data +	GY
	7		
	8	Clock −	YE
	9		
	10	0 V GND	WH GN
	11		
	12	Up +	BN GN
	Pin 2 is connected with pin 12 in the built-in socket		

Encoder EnDat 2.2 digital with battery buffering, plug connector size con.17

Connection diagram	Pin	Connection	Color
	1	Clock +	VT
	2	UBatt +	BU
	3	UBatt −	WH
	4		
	5	Data −	PK
	6	Data +	GY
	7		
	8	Clock −	YE
	9		
	10	0 V GND	WH GN
	11		
	12	Up +	BN GN
	UBatt+ = DC 3.6 V for encoder type EBI in combination with the AES option of STOBER-drive controllers		

Encoder EnDat 2.1 with sin/cos incremental signals, plug connector size con.17



Connection diagram	Pin	Connection	Color
	1	Up sense	BU
	2		
	3		
	4	0 V sense	WH
	5		
	6		
	7	Up +	BN GN
	8	Clock +	VT
	9	Clock −	YE
	10	0 V GND	WH GN
	11		
	12	B + (sin +)	BU BK
	13	B − (sin −)	RD BK
	14	Data +	GY
	15	A + (cos +)	GN BK
	16	A − (cos −)	YE BK
	17	Data −	PK

23.7 Projecting

You can project your drives with our SERVOsoft design software. SERVOsoft is available at no cost from your consultant in one of our sales centers. Note the limit conditions in this section for a safe design of your drives.

23.7.1 Calculation of the operating point

In this chapter you can find information that is necessary for the calculation of the operating point.

The formula symbols for values actually present in the application are identified by a *.

Formula symbol	Unit	Explanation
ED	%	Duty cycle relative to 10 minutes
M_{op}	Nm	Torque of motor in the operating point from the motor characteristics for n_{1m*}
M_{1*} – M_{6*}	Nm	Existing motor torque in the relevant time segment (1 to 6)
M_{eff*}	Nm	Existing effective torque of the motor
M_{limK}	Nm	Torque limit of the motor with convection cooling
M_{max}	Nm	Maximum torque: the maximum permitted torque the motor is able to deliver briefly (when accelerating or decelerating) (tolerance ±10 %)
M_{max*}	Nm	Existing maximum torque
M_{n*}	Nm	Existing torque of the motor in the n-th time segment
M_N	Nm	Nominal torque of the motor
n_{m*}	rpm	Existing average motor speed

Formula symbol	Unit	Explanation
$n_{m,1*} – n_{m,6*}$	rpm	Existing average speed of the motor in the respective time segment (1 to 6)
$n_{m,n*}$	rpm	Existing average speed of the motor in the n-th time segment
n_N	rpm	Nominal speed: the speed for which the nominal torque M_N is specified
t	s	Time
$t_{1*} – t_{6*}$	s	Duration of the relevant time segment (1 to 6)
t_{n*}	s	Duration of the n-th time segment

Check the following conditions for operating points other than the nominal point specified in the selection tables M_N:

$n_{m*} \leq n_N$

$M_{eff*} \leq M_{limK}$

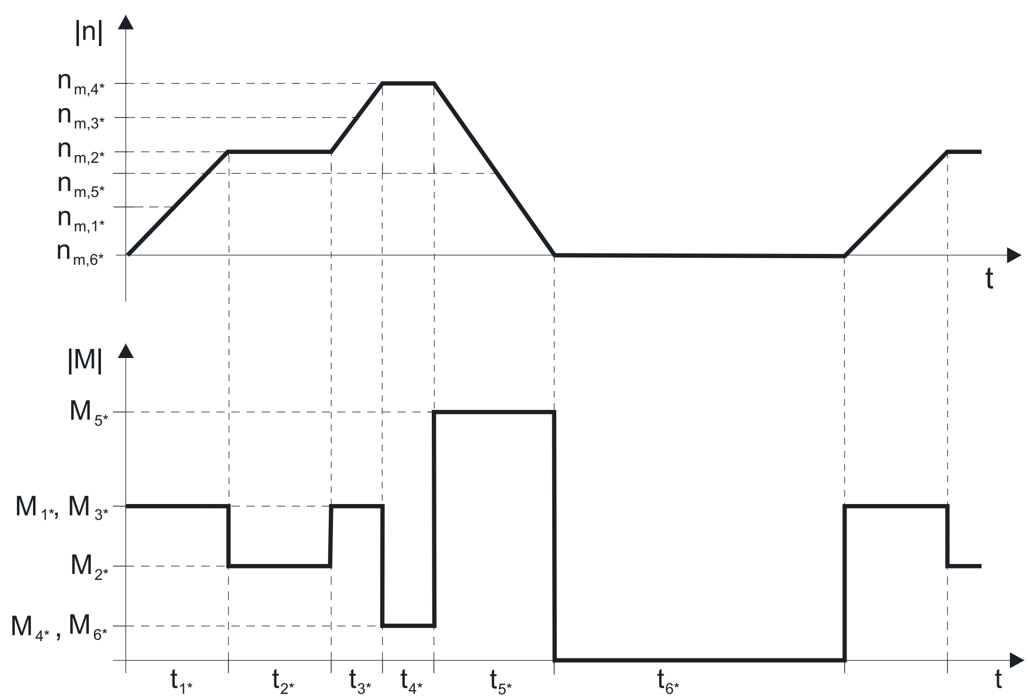
$M_{max*} < M_{max}$

The values for M_N, n_N, M_{max} can be found in the selection tables.

The values for M_{limK} can be found in the torque/speed characteristic curves.

Example of cycle sequence

The following calculations refer to a representation of the power consumed on the motor shaft based on the following example:



Calculation of the existing average input speed

$$n_{m*} = \frac{|n_{m,1*}| \cdot t_{1*} + ... + |n_{m,n*}| \cdot t_{n*}}{t_{1*} + ... + t_{n*}}$$

If t_{1*} + ... + t_{5*} ≥ 10 min, determine n_{m*} without pause t_{6*}.

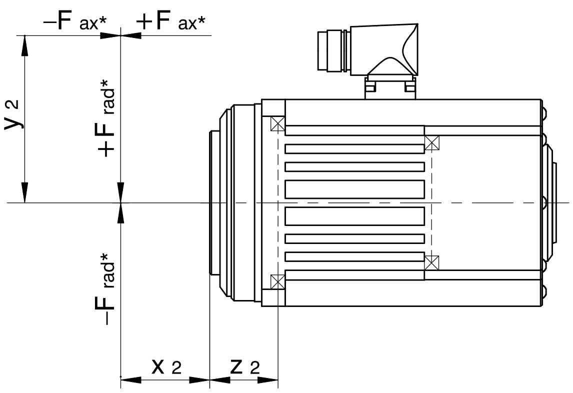
EZHD

Calculation of the existing effective torque

$$M_{eff^*} = \sqrt{\frac{t_{1^*} \cdot M_{1^*}^{\;2} + \ldots + t_{n^*} \cdot M_{n^*}^{\;2}}{t_{1^*} + \ldots + t_{n^*}}}$$

23.7.2 Permissible shaft loads

Formula symbol	Unit	Explanation
C_{2k}	Nm/ar-cmin	Tilting stiffness
F_{ax}	N	Permitted axial force on the output
F_{ax^*}	N	Existing axial force on the output
F_{ax300}	N	Permitted axial force on the output for $n_{m^*} \leq 300$ rpm
F_{rad}	N	Permitted radial force on the output
F_{rad^*}	N	Existing radial force on the output
F_{rad300}	N	Permitted radial force on the output for $n_{m^*} \leq 300$ rpm
l	mm	Length of the output shaft
M_k	Nm	Permitted breakdown torque on the output
M_{k^*}	Nm	Existing breakdown torque on the output
M_{k300}	Nm	Permitted breakdown torque on the output for $n_{m^*} \leq 300$ rpm
n_{m^*}	rpm	Existing average motor speed
x_2	mm	Distance from shaft shoulder to the point of application of force
y_2	mm	Distance from shaft axes to the point of application of axial force
z_2	mm	Distance from shaft shoulder to the center of the output bearing



Permissible shaft loads

	z_2 [mm]	F_{ax300} [N]	F_{rad300} [N]	M_{k300} [Nm]	C_{2k} [Nm/ arcmin]
EZHD0411	29.5	1600	3400	102	60
EZHD0412	29.5	1600	3700	109	66
EZHD0414	29.5	1600	4000	118	44
EZHD0511	30.0	4500	3400	102	111
EZHD0512	30.0	4500	3600	108	126
EZHD0513	30.0	4500	3750	113	130

	z_2 [mm]	F_{ax300} [N]	F_{rad300} [N]	M_{k300} [Nm]	C_{2k} [Nm/ arcmin]
EZHD0515	30.0	4500	4000	120	122
EZHD0711	41.5	7000	5000	208	212
EZHD0712	41.5	7000	5300	220	256
EZHD0713	41.5	7000	5500	229	287
EZHD0715	41.5	7000	5800	241	315

The values specified in the table apply to permitted shaft loads:

- For shaft dimensions according to the catalog
- Output speed $n_{m*} \leq 300$ rpm ($F_{ax} = F_{ax300}$; $F_{rad} = F_{rad300}$; $M_k = M_{k300}$)
- Only if pilots are used (housing, flange hollow shaft)

The following applies for output speeds $n_{m*} > 300$ rpm:

$$F_{ax} = \frac{F_{ax300}}{\sqrt[3]{\dfrac{n_{m*}}{300\text{ rpm}}}} \qquad F_{rad} = \frac{F_{rad300}}{\sqrt[3]{\dfrac{n_{m*}}{300\text{ rpm}}}} \qquad M_k = \frac{M_{k300}}{\sqrt[3]{\dfrac{n_{m*}}{300\text{ rpm}}}}$$

The following formula applies to other points of application of force:

$$M_{k*} = \frac{F_{ax*} \cdot y_2 + F_{rad*} \cdot (x_2 + z_2)}{1000} \leq M_{k300}$$

$$F_{rad*} \leq F_{rad300}$$

$$F_{ax*} \leq F_{ax300}$$

In applications with multiple axial and/or radial forces, the forces must be added vectorially.

23.7.3 Derating

If you use the motor under ambient conditions that differ from the standard ambient conditions, the nominal torque M_N of the motor reduces. In this chapter you can find information about the calculation of the reduced nominal torque.

Formula symbol	Unit	Explanation
H	m	Installation altitude above sea level
K_H	–	Derating factor for installation altitude
K_ϑ	–	Derating factor for surrounding temperature
M_N	Nm	Nominal torque of the motor
M_{N*}	Nm	Reduced nominal torque of the motor
ϑ_{amb}	°C	Surrounding temperature

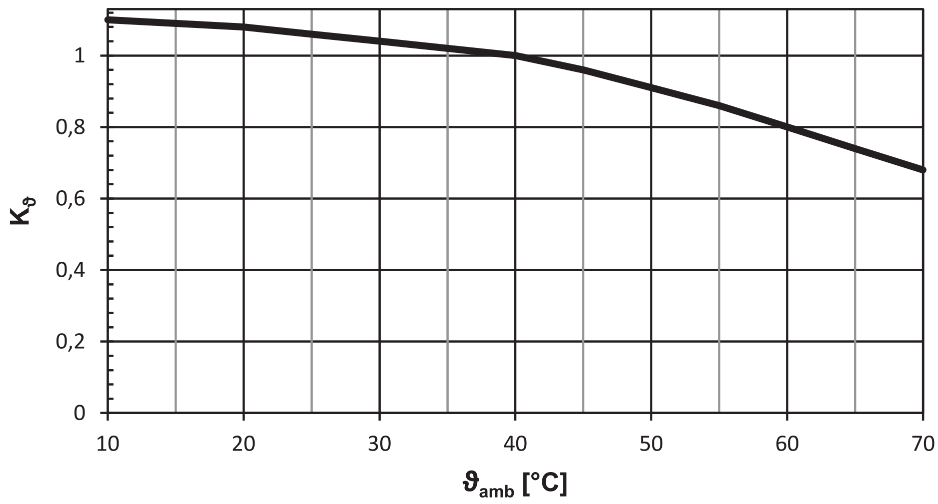


Fig. 4: Derating depending on the surrounding temperature

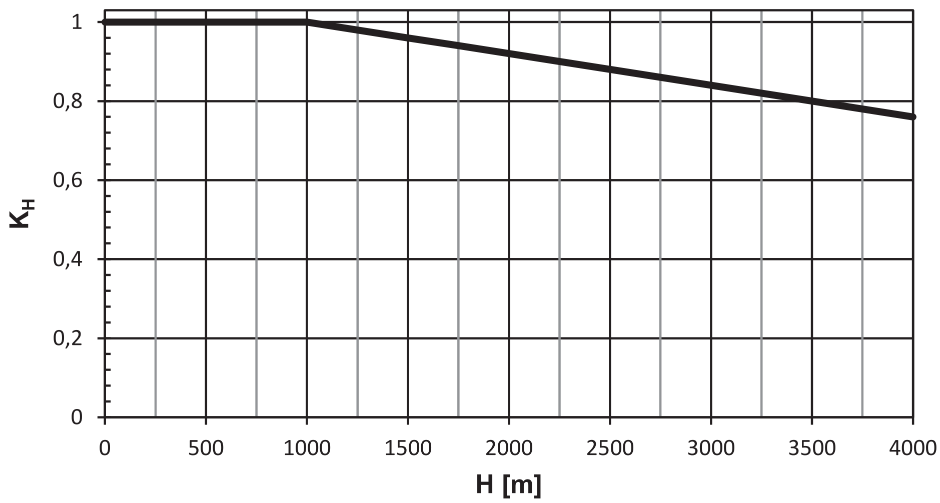


Fig. 5: Derating depending on the installation height

Calculation

If surrounding temperature ϑ_{amb} > 40 °C:

$M_{N^*} = M_N \cdot K_\vartheta$

If installation altitude H > 1000 m above sea level:

$M_{N^*} = M_N \cdot K_H$

If the surrounding temperature ϑ_{amb} > 40 °C and installation altitude H > 1000 m above sea level:

$M_{N^*} = M_N \cdot K_H \cdot K_\vartheta$

23.8 Further information

23.8.1 Directives and Standards

STOBER synchronous servo motors meet the requirements of the following directives and standards:

- Low Voltage Directive 2014/35/EU
- EMC Directive 2014/30/EU
- EN 60204-1:2006-06
- EN 60034-1:2010-10
- EN 60034-5/A1:2007-01
- EN 60034-6:1993-11
- EN 60034-9/A1:2007-04
- EN 60034-14/A1:2007-06

23.8.2 Identifiers and test symbols

STOBER synchronous servo motors have the following identifiers and test symbols:

CE mark: the product meets the requirements of EU directives.

cURus test symbol "Recognized Component Class 155(F)"; registered under UL number E182088 (N) with Underwriters Laboratories USA (optional).

23.8.3 More documentation

More documentation concerning the product can be found at http://www.stoeber.de/de/stoeber_global/service/downloads/downloadcenter.html

Enter the ID of the documentation in the Search... field.

Documentation	ID
Operating manual synchronous servo motors EZ	442585