20.4 Dimensional drawings

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

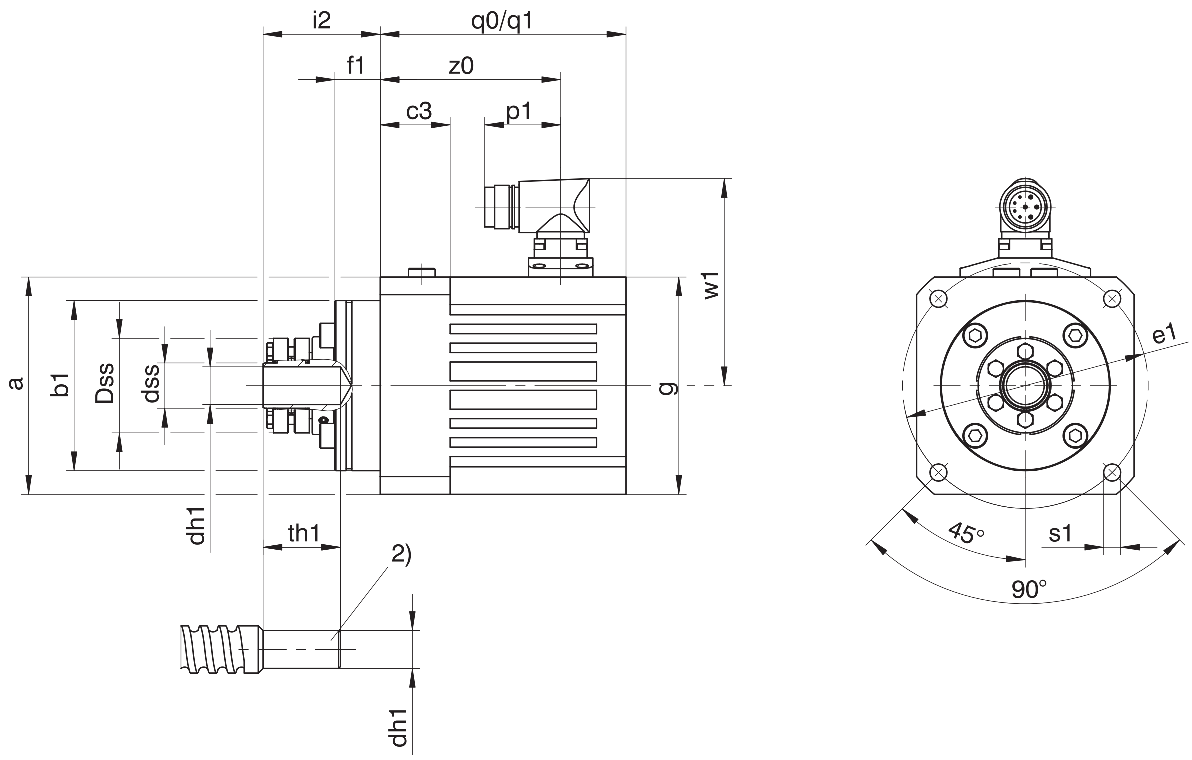
Dimensions can exceed the specifications of ISO 2768-mK due to casting tolerances or accumulation of individual tolerances.

We reserve the right to make dimensional changes due to ongoing technical development.

You can download 3D models of our standard drives at https://configurator.stoeber.de/en-US/.

In this chapter, the dimensions p1 and w1 for standard motor designs are presented. In designs for connection to drive controllers of third-party manufacturers, dimensions p1 and w1 may differ. You can find more details at https://configurator.stoeber.de/en-US/.

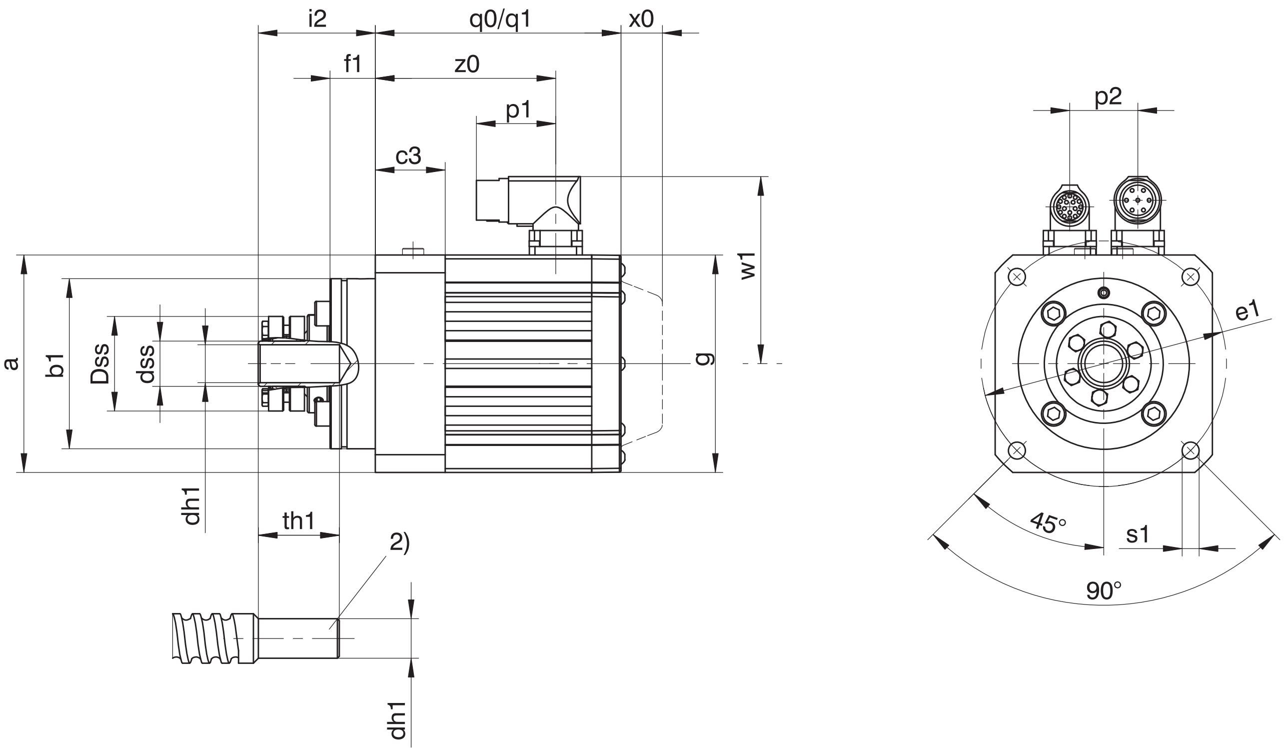
20.4.1 EZS motors with convection cooling (One Cable Solution)



q0	Applies to motors without holding brake	q1	Applies to motors with holding brake
2)	Threaded spindle provided by customer		

Type	□a	⌀b1	c3	⌀dh1	⌀dss	⌀Dss	⌀e1	f1	□g	i2	p1	q0	q1	⌀s1	th1	w1	z0
EZS501U	115	$90_{-0,01}$	37	20_{h6}^{H6}	24_{h7}	50	130	24	115	62.0	40	130	184.5	9	40.5	110	95.5
EZS502U	115	$90_{-0,01}$	37	20_{h6}^{H6}	24_{h7}	50	130	24	115	62.0	40	155	209.5	9	40.5	110	120.5
EZS503U	115	$90_{-0,01}$	37	20_{h6}^{H6}	24_{h7}	50	130	24	115	62.0	40	180	234.5	9	40.5	110	145.5
EZS701U	145	$115_{-0,01}$	46	25_{h6}^{H6}	30_{h7}	60	165	24	145	66.5	40	148	206.7	11	44.5	125	110.2
EZS702U	145	$115_{-0,01}$	46	25_{h6}^{H6}	30_{h7}	60	165	24	145	66.5	40	173	231.7	11	44.5	125	135.2
EZS703U	145	$115_{-0,01}$	46	25_{h6}^{H6}	30_{h7}	60	165	24	145	66.5	40	198	256.7	11	44.5	125	160.2

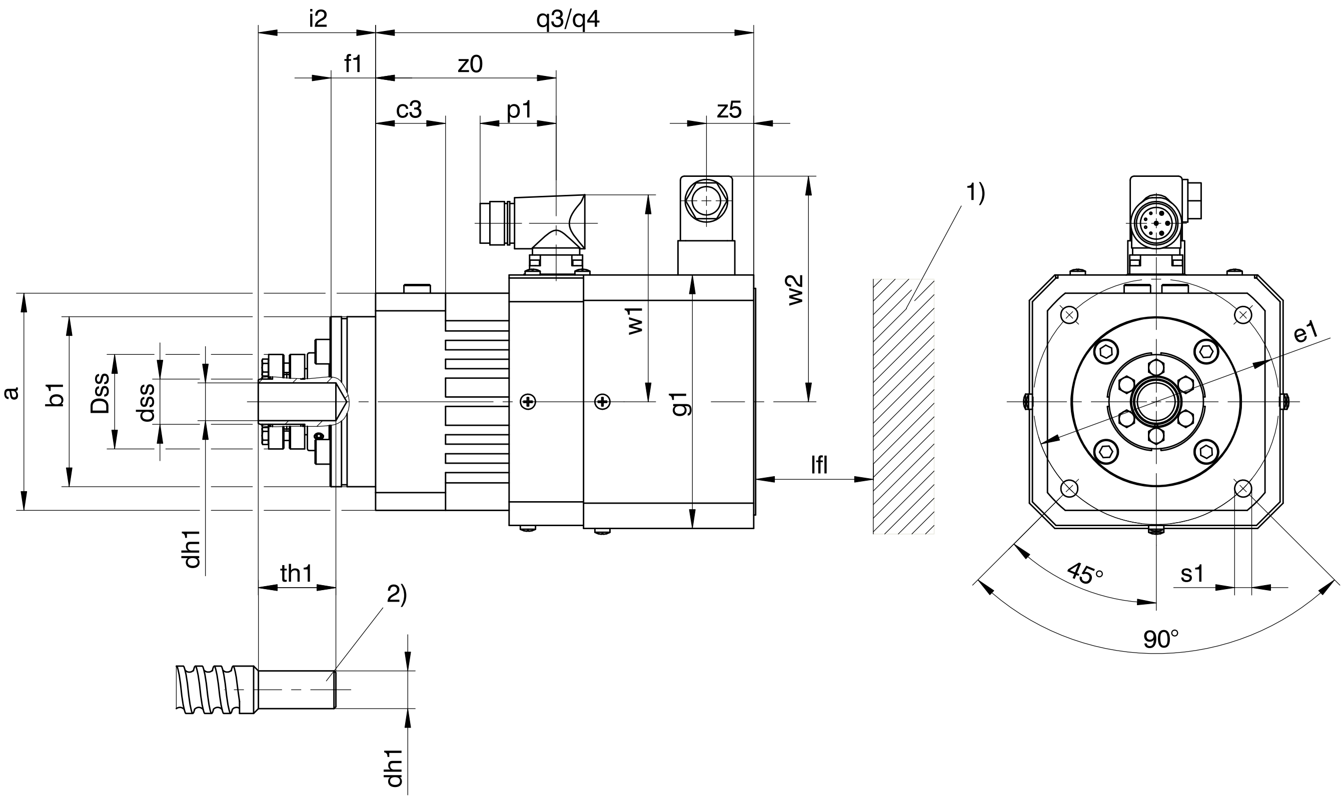
20.4.2 EZS motors with convection cooling



q0	Applies to motors without holding brake	q1	Applies to motors with holding brake
x	Applies to encoders based on an optical measuring method	2)	Threaded spindle provided by customer

Type	□a	∅b1	c3	∅dh1	∅dss	∅Dss	∅e1	f1	□g	i2	p1	p2	q0	q1	∅s1	th1	w1	x0	z0
EZS501U	115	$90_{-0,01}$	37	20_{h6}^{H6}	24_{h7}	50	130	24	115	62.0	40	36	130	184.5	9	40.5	100	22	95.5
EZS502U	115	$90_{-0,01}$	37	20_{h6}^{H6}	24_{h7}	50	130	24	115	62.0	40	36	155	209.5	9	40.5	100	22	120.5
EZS503U	115	$90_{-0,01}$	37	20_{h6}^{H6}	24_{h7}	50	130	24	115	62.0	40	36	180	234.5	9	40.5	100	22	145.5
EZS701U	145	$115_{-0,01}$	46	25_{h6}^{H6}	30_{h7}	60	165	24	145	66.5	40	42	148	206.7	11	44.5	115	22	110.2
EZS702U	145	$115_{-0,01}$	46	25_{h6}^{H6}	30_{h7}	60	165	24	145	66.5	40	42	173	231.7	11	44.5	115	22	135.2
EZS703U	145	$115_{-0,01}$	46	25_{h6}^{H6}	30_{h7}	60	165	24	145	66.5	40	42	198	256.7	11	44.5	115	22	160.2

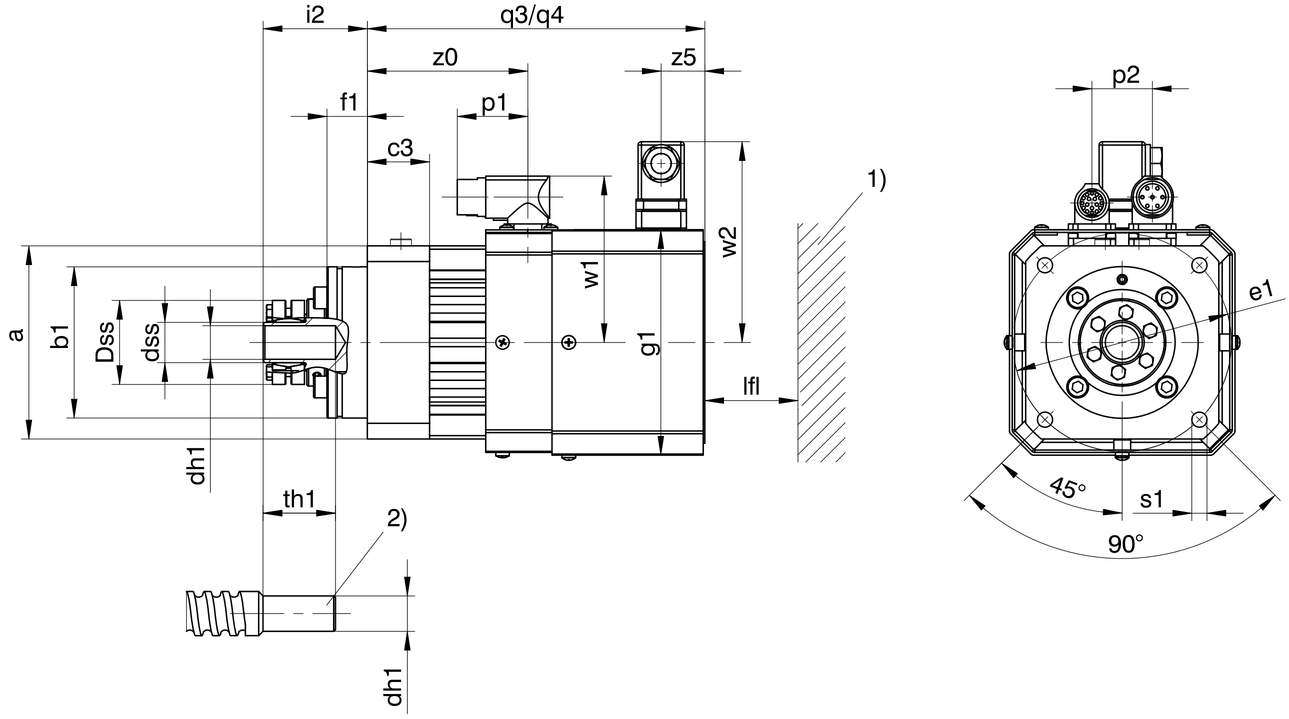
20.4.3 EZS motors with forced ventilation (One Cable Solution)



q3	Applies to motors without holding brake	q4	Applies to motors with holding brake
1)	Machine wall	2)	Threaded spindle provided by customer

Type	□a	∅b1	c3	∅dh1	∅dss	∅Dss	∅e1	f1	□g1	i2	lfl_{min}	p1	q3	q4	∅s1	th1	w1	w2	z0	z5
EZS501B	115	$90_{-0,01}$	37	20_{h6}^{H6}	24_{h7}	50	130	24	134.5	62.0	20	40	200	265.0	9	40.5	110	120	95.5	25
EZS502B	115	$90_{-0,01}$	37	20_{h6}^{H6}	24_{h7}	50	130	24	134.5	62.0	20	40	225	280.0	9	40.5	110	120	120.5	25
EZS503B	115	$90_{-0,01}$	37	20_{h6}^{H6}	24_{h7}	50	130	24	134.5	62.0	20	40	250	305.0	9	40.5	110	120	145.5	25
EZS701B	145	$115_{-0,01}$	46	25_{h6}^{H6}	30_{h7}	60	165	24	164.5	66.5	30	40	240	298.7	11	44.5	125	134	110.2	40
EZS702B	145	$115_{-0,01}$	46	25_{h6}^{H6}	30_{h7}	60	165	24	164.5	66.5	30	40	265	321.7	11	44.5	125	134	135.2	40
EZS703B	145	$115_{-0,01}$	46	25_{h6}^{H6}	30_{h7}	60	165	24	164.5	66.5	30	40	290	348.7	11	44.5	125	134	160.2	40

20.4.4 EZS motors with forced ventilation



q3	Applies to motors without holding brake	q4	Applies to motors with holding brake
1)	Machine wall	2)	Threaded spindle provided by customer

Type	□a	∅b1	c3	∅dh1	∅dss	∅Dss	∅e1	f1	□g1	i2	lfl_{min}	p1	p2	q3	q4	∅s1	th1	w1	w2	z0	z5
EZS501B	115	$90_{-0,01}$	37	20_{h6}^{H6}	24_{h7}	50	130	24	134.5	62.0	20	40	36	200	265.0	9	40.5	100	120	95.5	25
EZS502B	115	$90_{-0,01}$	37	20_{h6}^{H6}	24_{h7}	50	130	24	134.5	62.0	20	40	36	225	280.0	9	40.5	100	120	120.5	25
EZS503B	115	$90_{-0,01}$	37	20_{h6}^{H6}	24_{h7}	50	130	24	134.5	62.0	20	40	36	250	305.0	9	40.5	100	120	145.5	25
EZS701B	145	$115_{-0,01}$	46	25_{h6}^{H6}	30_{h7}	60	165	24	164.5	66.5	30	40	42	240	298.7	11	44.5	115	134	110.2	40
EZS702B	145	$115_{-0,01}$	46	25_{h6}^{H6}	30_{h7}	60	165	24	164.5	66.5	30	40	42	265	321.7	11	44.5	115	134	135.2	40
EZS703B	145	$115_{-0,01}$	46	25_{h6}^{H6}	30_{h7}	60	165	24	164.5	66.5	30	40	42	290	348.7	11	44.5	115	134	160.2	40

20.5 Type designation

Example code

EZS	5	0	1	U	D	BB	Q7	O	097

Explanation

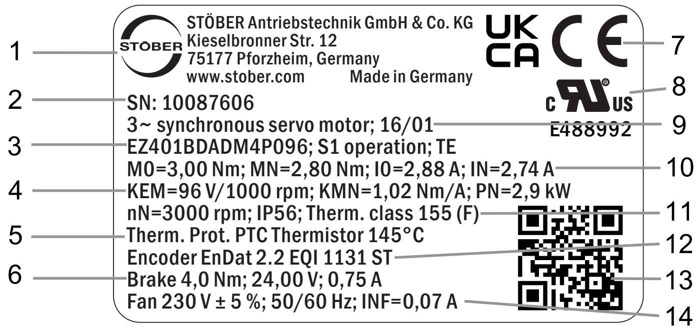
Code	Designation	Design
EZS	Type	Synchronous servo motor for screw drives
5	Motor size	5 (example)
0	Generation	0
1	Length	1 (example)
U	Cooling	Convection cooling
B		Forced ventilation
D	Design	Dynamic
BB	Drive controller	SI6 (example)
Q7	Encoder	EnDat 3 EQI 1131 (example)
O	Brake	Without holding brake
P		Permanent magnet holding brake
097	Voltage constant K_{EM}	97 V/1000 rpm (example)

Notes

- In Chapter [▹ 20.6.5], you can find information about available encoders.
- In Chapter [▹ 20.6.5.6], you can find information about connecting synchronous servo motors to other drive controllers from STOBER.
- In Chapter [▹ 21], you can find information about options for connecting STOBER synchronous servo motors to drive controllers from other manufacturers.

20.5.1 Nameplate

An example nameplate of an EZ401 synchronous servo motor is explained in the figure below.



Line	Value	Description
1	STÖBER Antriebstechnik GmbH + Co. KG	Logo and address of the manufacturer
2	Ser. No. 10087606	Serial number of the motor
3	EZ401BDADM4P096 S1 operation TE	Type designation Operating mode Protection class in accordance with UL1004
4	KEM=96 V/1000 rpm KMN=1.02 Nm/A PN=2.9 kW	Voltage constant Torque constant Nominal power
5	Therm. prot. of PTC thermistor 145 °C	Type of temperature sensor
6	Brake 4.0 Nm 24.00 V 0.75 A	Holding brake (optional) Static braking torque at 100 °C Nominal voltage (DC) of the holding brake Nominal current of the holding brake at 20 °C
7	CE UKCA	CE mark UKCA mark
8	cURus E488992	cURus test symbol, registered under UL number E488992 (optional)
9	3~ synchronous servo motor 16/01	Motor type: Three-phase synchronous servo motor Date of manufacture (year/calendar week)
10	M0=3.00 Nm MN=2.80 Nm I0=2.88 A IN=2.74 A	Stall torque Nominal torque Stall current Nominal current
11	nN=3000 rpm IP56 Therm. class 155 (F)	Nominal speed Protection class Thermal class
12	EnDat 2.2 EQI 1131 ST encoder	Encoder model
13	QR code	Link to product information
14	Fan 230 V ± 5%; 50/60 Hz INF = 0.07 A	Forced ventilation unit (optional) Nominal voltage of the forced ventilation unit Nominal current of the forced ventilation unit

20.6 Product description

20.6.1 General features

Feature	EZS5	EZS7
Threaded spindle ∅ [mm]	25/32	32/40
Pin diameter of the threaded spindle dh1 [mm]	20	25
Shrink ring type	RINGFEDER RfN 4061 24 × 50	RINGFEDER RfN 4061 30× 60
Torque [Nm] that can be transmitted by the shrink ring	324	514
Axial force $F_{ax,ss}$ [N] that can be transmitted by the shrink ring	32000	41000
Surface pressure on the hub of the shrink ring [N/mm²]	272	228
Nominal speed n_N [rpm]	3000	3000
Bearing type[1]	INA ZKLF 3590-2Z[2]	INA ZKLF 50115-2Z[3]
Maximum bearing speed n_{la} [rpm]	3800	3000
Axial bearing load rating, dynamic C_{dyn} [N]	41000	46500
Axial rigidity C_{ax} [N/µm]	500	770
Protection class	IP40	IP40
Thermal class	155 (F) in accordance with EN 60034-1 (155 °C, heating $\Delta\vartheta$ = 100 K)	
Surface[4]	Matte black as per RAL 9005	
Noise level	Limit values in accordance with EN 60034-9	
Cooling	IC 410 convection cooling (IC 416 convection cooling with optional forced ventilation)	

20.6.2 Electrical features

General electrical features of the motor are described in this chapter. Details can be found in the "Selection tables" chapter.

Feature	Description
DC link voltage	DC 540 V (max. 620 V) on STOBER drive controllers
Winding	Three-phase, single-tooth coil design
Circuit	Star, center not led through
Protection class	I (protective grounding) in accordance with EN 61140
Impulse voltage insulation class (IVIC)	C in accordance with DIN EN 60034-18-41 (inverter connection voltage 0 – 480 V ± 10%)
Number of pole pairs	7

[1] Axial angular contact ball bearing for screw drives, grease-lubricated, can be relubricated
[2] Or comparable products from other providers
[3] Or comparable products from other providers
[4] Repainting the motor will change the thermal properties and therefore the performance limits.

20.6.3 Ambient conditions

Standard ambient conditions for transport, storage and operation of the motor are described in this chapter.

Feature	Description
Surrounding temperature for transport/storage	−30 °C to +85 °C
Surrounding temperature for operation	−15 °C to +40 °C
Relative humidity	5% to 95%, no condensation
Installation altitude	≤ 1000 m above sea level
Shock load	≤ 50 m/s² (5 g), 6 ms in accordance with EN 60068-2-27

Notes

- STOBER synchronous servo motors are not suitable for potentially explosive atmospheres.
- Secure the power cables close to the motor so that vibrations of the cable do not place impermissible loads on the motor plug connector.
- Note that the braking torques of the holding brake (optional) may be reduced by shock loading.
- At operating temperatures below 0 °C, note that the discs of the holding brake (optional) may ice up.

20.6.4 Lubrication of the screw drive

Lubricants that enter into the inside of the motor can impair the function of the holding brake and encoder. Therefore, take the protection class of the synchronous servo motor into account when configuring your screw drive, especially when installing the synchronous servo motor vertically with the A side on top.

For detailed information about lubricating the screw drive, contact your screw drive manufacturer.

20.6.5 Encoders

STOBER synchronous servo motors can be designed with different encoder models. The following chapters include information for choosing the optimal encoder for your application.

20.6.5.1 Encoder measuring method selection tool

The following table offers a selection tool for an encoder measuring method that is optimally suited for your application.

Feature	Absolute encoder		Resolver
Measuring method	Optical	Inductive	Electromagnetic
Temperature resistance	★★☆	★★★	★★★
Vibration strength and shock resistance	★★☆	★★★	★★★
System accuracy	★★★	★★☆	★☆☆
FMA version with fault exclusion for mechanical coupling (option with EnDat interface)	✓	✓	–
Elimination of referencing with multi-turn design (optional)	✓	✓	–
Simple commissioning with electronic nameplate	✓	✓	–
Key: ★☆☆ = satisfactory, ★★☆ = good, ★★★ = very good			

20.6.5.2 Selection tool for EnDat interface

The following table offers a selection tool for the EnDat interface of absolute encoders.

Feature	EnDat 2.1	EnDat 2.2	EnDat 3
Short cycle times	★★☆	★★★	★★★
Transfer of additional information along with the position value	–	✓	✓
Expanded power supply range	★★☆	★★★	★★★
One Cable Solution (OCS)	–	–	✓
Key: ★★☆ = good, ★★★ = very good			

20.6.5.3 EnDat 3 encoders

EnDat 3 is a robust, purely digital protocol that functions with minimal connection lines. EnDat 3 facilitates the One Cable Solution, which allows the connection lines between the encoder and drive controller to be routed along in the motor's power cable.

The One Cable Solution offers the following advantages:

- Significantly reduced wiring effort by eliminating the encoder cable
- For cable lengths up to 50 m, a choke between the drive controller and motor is not necessary
- Advanced safety functions possible (up to SIL2 / category 3, PLd)
- Significantly reduced space requirements by eliminating the encoder plug connector
- Transmission of measured values from the temperature sensor using the EnDat 3 protocol

A motor with the EnDat 3 encoder can be operated only on a SI6 or SC6 drive controller from STOBER.

The EnDat 3 encoder has the following features:

Encoder model	Code	Measuring method	Recordable revolutions	Resolution	Position values per revolution	MTTF [years]	PHF [h]
EnDat 3 EQI 1131	Q7	Inductive	4096	19 bit	524288	> 100	≤ 15 × 10^{-9}

20.6.5.4 EnDat 2 encoders

In this chapter, you can find detailed technical data for encoder models that can be selected with EnDat interface.

Encoders with EnDat 2.2 interface

Encoder model	Code	Measuring method	Recordable revolutions	Resolution	Position values per revolution	MTTF [years]	PHF [h]
EnDat 2.2 EQI 1131	Q6	Inductive	4096	19 bit	524288	> 100	≤ 15 × 10^{-9}
EnDat 2.2 EBI 1135	B0	Inductive	65536	18 bit	262144	> 100	≤ 600 × 10^{-9}
EnDat 2.2 ECI 1118-G2	C5	Inductive	–	18 bit	262144	> 76	≤ 1.5 × 10^{-6}
EnDat 2.2 EQN 1135 FMA	M3	Optical	4096	23 bit	8388608	> 100	≤ 15 × 10^{-9}
EnDat 2.2 EQN 1135	Q5	Optical	4096	23 bit	8388608	> 100	≤ 15 × 10^{-9}
EnDat 2.2 ECN 1123 FMA	M1	Optical	–	23 bit	8388608	> 100	≤ 15 × 10^{-9}
EnDat 2.2 ECN 1123	C7	Optical	–	23 bit	8388608	> 100	≤ 15 × 10^{-9}

Encoders with EnDat 2.1 interface

Encoder model	Code	Measuring method	Recordable revolutions	Resolution	Position values per revolution	Periods per revolution	MTTF [years]	PHF [h]
EnDat 2.1 EQN 1125 FMA	M2	Optical	4096	13 bit	8192	Sin/cos 512	> 57	$\leq 2 \times 10^{-6}$
EnDat 2.1 EQN 1125	Q4	Optical	4096	13 bit	8192	Sin/cos 512	> 57	$\leq 2 \times 10^{-6}$
EnDat 2.1 ECN 1113 FMA	M0	Optical	–	13 bit	8192	Sin/cos 512	> 57	$\leq 2 \times 10^{-6}$
EnDat 2.1 ECN 1113	C6	Optical	–	13 bit	8192	Sin/cos 512	> 57	$\leq 2 \times 10^{-6}$

Notes

- The encoder code is a part of the type designation of the motor.
- FMA = Version with fault exclusion for mechanical coupling.
- MTTF = Average time before dangerous failure. MTTF values greater than 100 years were reduced in accordance with DIN EN ISO 13849.
- PFH = Probability of a dangerous failure per hour
- The EnDat 2.2 EBI 1135 encoder requires an external buffer battery so that absolute position information is retained after the power supply is turned off (AES option for STOBER drive controllers).
- Multiple revolutions of the motor shaft can be recorded only using multi-turn encoders.

20.6.5.5 Resolver

In this chapter, you can find detailed technical data for the resolver that can be installed as an encoder in a STOBER synchronous servo motor.

Feature	Description
Number of poles	2
Input voltage U_{1eff}	7 V ± 5%
Input frequency f_1	10 kHz
Output voltage $U_{2,S1–S3}$	$K_{tr} \cdot U_{R1–R2} \cdot \cos \theta$
Output voltage $U_{2,S2–S4}$	$K_{tr} \cdot U_{R1–R2} \cdot \sin \theta$
Transformation ratio K_{tr}	0.5 ± 5%
Electrical fault	±10 arcmin
MTTF	> 100 years
PHF	$\leq 10^{-9}$

20.6.5.6 Possible combinations with drive controllers

The following table shows the options for combining STOBER drive controllers with selectable encoder models.

Drive controller		**SDS 5000**		**SD6**		**SI6**			**SC6**		
Drive controller code		AA	AC	AD	AE	AP	AQ	**BB**	AU	AV	**BA**
Connection plan ID		442305	442307	442450	442451	442771	442772	**443175**	443052	443053	**443174**
Encoder	**Encoder code**										
EnDat 3 EQI 1131	Q7	–	–	–	–	–	–	✓	–	–	✓
EnDat 2.2 EQI 1131	Q6	✓	–	✓	–	✓	–	–	✓	–	–
EnDat 2.2 EQN 1135 FMA	M3	✓	–	✓	–	–	–	–	–	–	–
EnDat 2.2 EQN 1135	Q5	✓	–	✓	–	✓	–	–	✓	–	–
EnDat 2.2 ECN 1123 FMA	M1	✓	–	✓	–	–	–	–	–	–	–
EnDat 2.2 ECN 1123	C7	✓	–	✓	–	✓	–	–	✓	–	–
EnDat 2.2 ECI 1118-G2	C5	✓	–	✓	–	✓	–	–	✓	–	–
EnDat 2.1 EQN 1125 FMA	M2	✓	✓	✓	✓	–	–	–	–	–	–
EnDat 2.1 EQN 1125	Q4	✓	✓	✓	✓	–	–	–	–	–	–
EnDat 2.1 ECN 1113 FMA	M0	✓	✓	✓	✓	–	–	–	–	–	–
EnDat 2.1 ECN 1113	C6	✓	✓	✓	✓	–	–	–	–	–	–
Resolver	R0	✓	–	–	✓	–	✓	–	–	✓	–

Notes

- The drive controller and encoder codes are a part of the type designation of the motor (see the "Type designation" chapter).
- In Chapter [▷ 21], you can find information about options for connecting STOBER synchronous servo motors to drive controllers from other manufacturers.

20.6.6 Temperature sensor

In this chapter, you can find technical data for the temperature sensors that are installed in STOBER synchronous servo motors for implementing 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 feature integrated temperature monitoring, the warning and switch-off thresholds of which may overlap with the corresponding values set for the temperature sensor in the drive controller. In some cases, this may result in an instance where an encoder with internal temperature monitoring forces 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 method" chapter.

20.6.6.1 PTC thermistor

The PTC thermistor is installed as a standard temperature sensor in STOBER synchronous servo motors.

The PTC thermistor is a triple thermistor in accordance with DIN 44082 that can be used for monitoring the temperature of each winding phase. The resistance values in the following table and curve refer to a single thermistor in accordance with DIN 44081. These values must be multiplied by 3 for a triple 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) in accordance with EN 60034-1 (155 °C, heating Δϑ = 100 K)

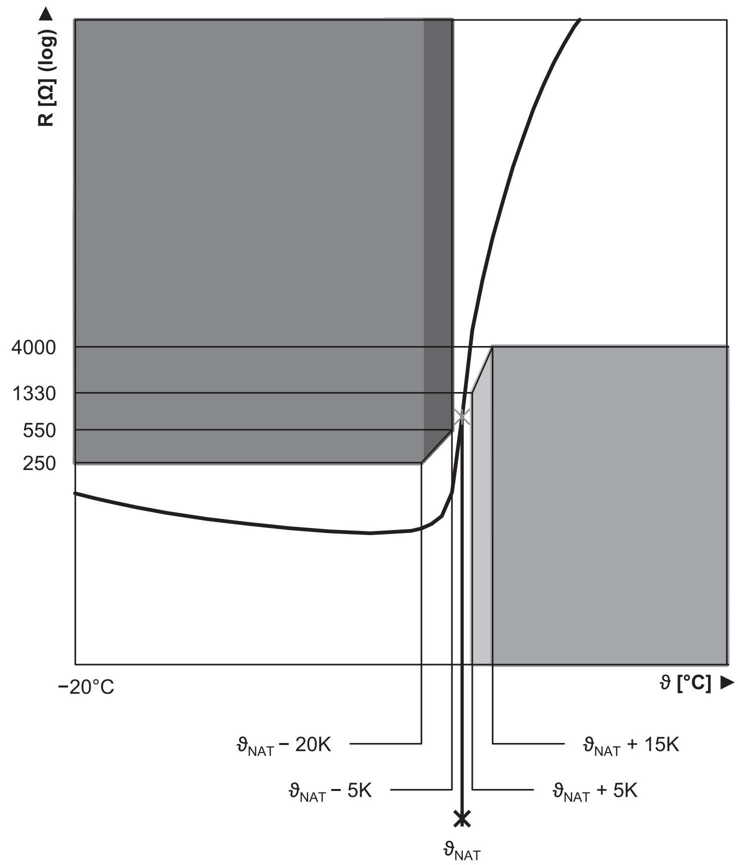


Fig. 2: PTC thermistor curve (single thermistor)

20.6.6.2 Pt1000 temperature sensor

STOBER synchronous servo motors are available in versions with a Pt1000 temperature sensor. The Pt1000 is a temperature-dependent resistor that has a resistance curve with a linear relationship with temperature. As a result, the Pt1000 allows for measurements of the winding temperature. These measurements are limited to one phase of the motor winding, however. In order 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.

Pt1000 temperature sensors can also be used with the One Cable Solution.

Avoid exceeding the specified measurement current so that the measured values are not falsified due to self-heating of the temperature sensor.

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

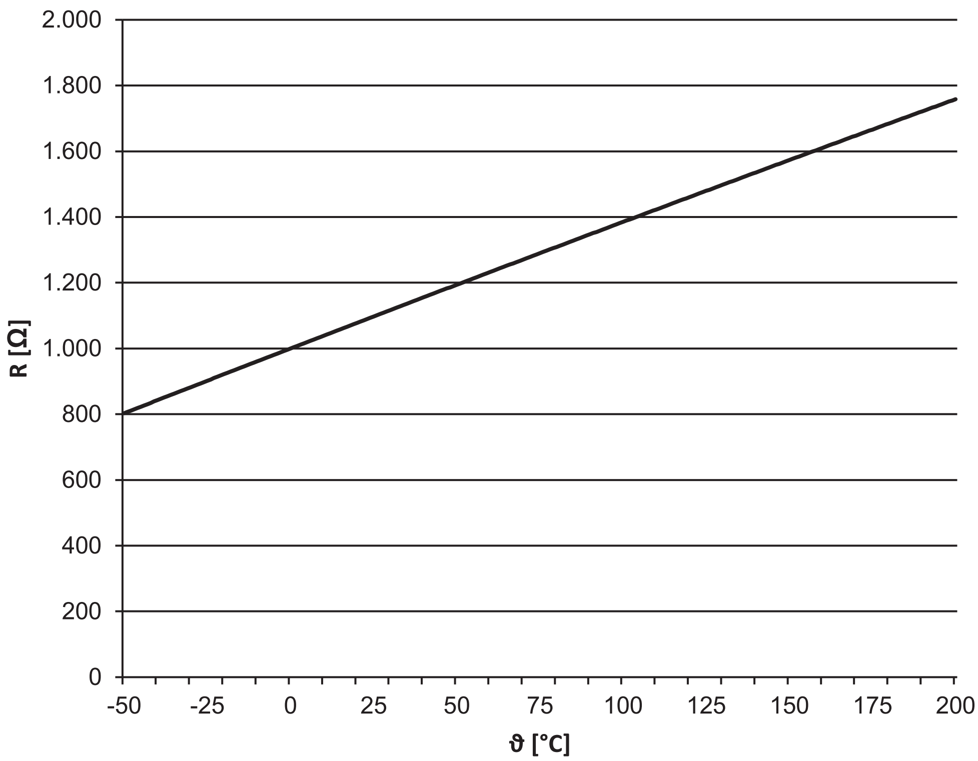


Fig. 3: Pt1000 temperature sensor characteristic curve

20.6.7 Cooling

A synchronous servo motor in the standard version is cooled by convection cooling (IC 410 in accordance with EN 60034-6). Optionally, forced ventilation can be used to cool the motor.

20.6.7.1 Forced ventilation

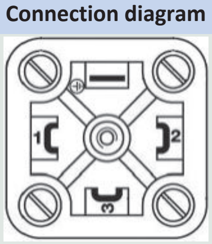
STOBER synchronous servo motors offer the option of being cooled with forced ventilation in order to increase performance data while maintaining the same size. Retrofitting with a forced ventilation unit is also possible in order to optimize the drive at a later date. When retrofitting, check whether the conductor cross-section of the power cable of the motor must be increased. Also take into account the dimensions of the forced ventilation unit.

The performance data for motors with forced ventilation can be found in the chapter Selection tables and the dimensions in the chapter Dimensional drawings.

Technical data

Motor	Forced ventilation unit	$U_{N,F}$ [V]	$I_{N,F}$ [V]	$P_{N,F}$ [W]	$q_{v,F}$ [m³/h]	$L_{pA,F}$ [dBA]	m_F [kg]	Protection class
EZS5_B	FL5	230 V ± 5%,	0.10	14	160	45	1.9	IP54
EZS7_B	FL7	50/60 Hz	0.10	14	160	45	2.9	IP54

Terminal assignment for forced ventilation unit plug connectors

Connection diagram	Pin	Connection
	1	L1 (phase)
	2	N (neutral conductor)
	3	
	⏚	Grounding conductor

20.6.8 Holding brake

STOBER synchronous servo motors can be equipped with a backlash-free holding brake using permanent magnets in order to secure the motor shaft when at a standstill. The holding brake engages automatically if the voltage drops.

The holding brake is designed for a high number of operations (B_{10} = 10 million operations, B_{10d} = 20 million operations).

Nominal voltage of permanent magnet holding brake: DC 24 V ± 5%, smoothed.

Observe the following during project configuration:

- The holding brake is designed to keep the motor shaft from moving. Activate braking processes during operation using the corresponding electrical functions of the drive controller. 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 work done by friction $W_{B,Rmax/h}$ may not be exceeded.
- Note that the braking torque M_{Bdyn} may initially be up to 50% less when braking from full speed. As a result, the braking effect has a delayed action and braking distances become longer.
- Regularly perform a brake test to ensure the functional safety of the brakes. Details can be found in 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 controllers of the 5th and 6th generation with a BRS/BRM brake module).
- The holding brake of the motor does not offer adequate safety for persons in the hazardous area of 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 holding torque of the brake can be reduced by shock loading. Information about shock loading can be found in the "Ambient conditions" chapter.
- At operating temperatures from −15 °C to 0 °C, a cold holding brake in the released state may cause operating noises. As the temperature of the holding brake increases, these noises decrease such that operating noises are not heard when using holding brake at operating temperature in the released state.

Calculation of work done by friction per braking process

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

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

Calculation of the stop time

$$t_{dec} = 2.66 \cdot t_{1B} + \frac{n \cdot J_{tot}}{9.55 \cdot M_{Bdyn}}$$

Switching behavior

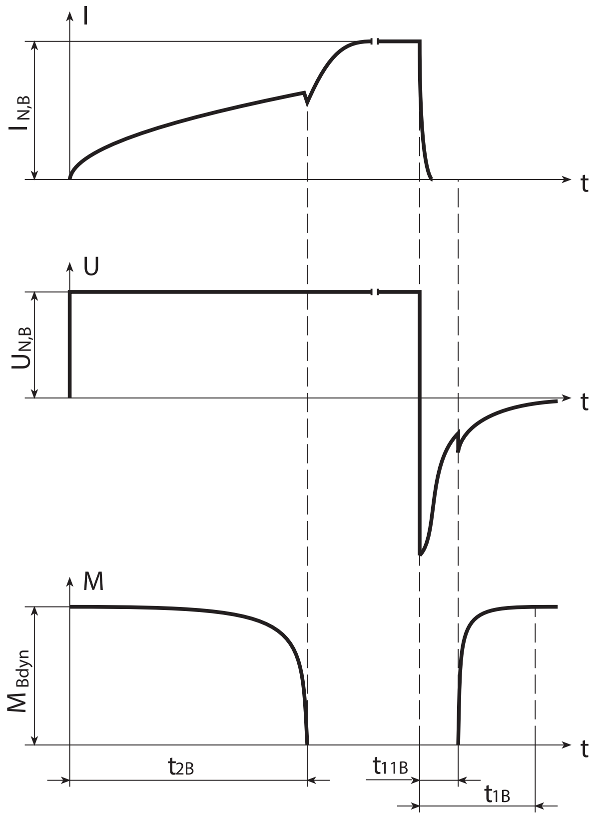


Fig. 4: Holding brake – Switching behavior

Technical data

Type	M_{Bstat} [Nm]	M_{Bdyn} [Nm]	$I_{N,B}$ [A]	$W_{B,Rmax/h}$ [kJ/h]	N_{Bstop}	J_{Bstop} [kgcm²]	$W_{B,Rlim}$ [kJ]	t_{2B} [ms]	t_{11B} [ms]	t_{1B} [ms]	$x_{B,N}$ [mm]	ΔJ_B [kgcm²]	Δm_B [kg]
EZS501	8.0	7.0	0.75	8.5	4300	14.1	300	40	2.0	20	0.3	0.550	1.19
EZS502	8.0	7.0	0.75	8.5	3200	18.7	300	40	2.0	20	0.3	0.550	1.19
EZS503	15	12	1.0	11.0	4300	25.6	550	60	5.0	30	0.3	1.700	1.62
EZS701	15	12	1.0	11.0	2500	44.0	550	60	5.0	30	0.3	1.700	1.94
EZS702	15	12	1.0	11.0	2000	54.6	550	60	5.0	30	0.3	1.700	1.94
EZS703	32	28	1.1	25.0	3800	72.8	1400	100	5.0	25	0.4	5.600	2.81

20.6.9 Connection method

The following chapters describe the connection technology of STOBER synchronous servo motors in the standard version on 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 Chapter [▸ 21], you can find information about options for connecting STOBER synchronous servo motors to drive controllers from other manufacturers.

20.6.9.1 Connection of the motor housing to the grounding conductor system

Connect the motor housing to the grounding conductor system of the machine in order to prevent personal injury and faulty triggering of residual current protective devices.

All attachment parts required for the connection of the grounding conductor to the motor housing are delivered with the motor. The grounding screw of the motor is identified with the symbol ⏚ in accordance with IEC 60417-DB. The cross-section of the grounding conductor has to be at least as large as the cross-section of the lines in the power connection.

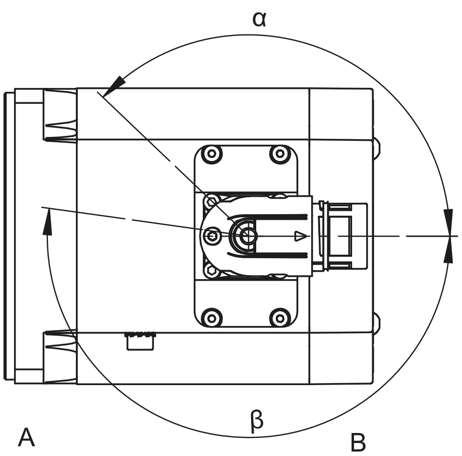
20.6.9.2 Plug connectors (One Cable Solution)

In the One Cable Solution design, the power and encoder lines are connected using a shared plug connector.

For motors with forced ventilation, avoid collisions between the motor connection cables and the plug connector of the forced ventilation unit. In the event of a collision, turn the motor plug connectors accordingly. Details regarding the position of the plug connector for the forced ventilation unit can be found in the "Dimensional drawings" chapter.

The figures represent the position of the plug connectors upon delivery.

Turning ranges of plug connectors



A	Attachment or output side of the motor	B	Rear side of the motor

Motor type	Size	Connection	Turning range	
			α	β
EZS	con.23	Quick lock	130°	190°

Notes

- The number after "con." indicates the approximate 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).

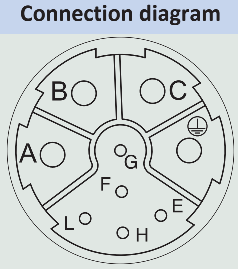
20.6.9.3 Terminal assignment for plug connectors (One Cable Solution)

In the One Cable Solution design, the power and encoder lines are connected using a shared plug connector.

The temperature sensor of the motor is connected to the encoder internally. The measured values from the temperature sensor are transmitted via the EnDat 3 protocol of the encoder.

The colors of the connecting wires inside the motor are specified in accordance with IEC 60757.

Plug connector size con.23

Connection diagram	Pin	Connection	Color
	A	U phase	BK
	B	V phase	BU
	C	W phase	RD
	E	P_SD –	YE
	F		
	G	Brake +	
	H	P_SD +	VT
	L	Brake –	
	⏚	Grounding conductor	GNYE

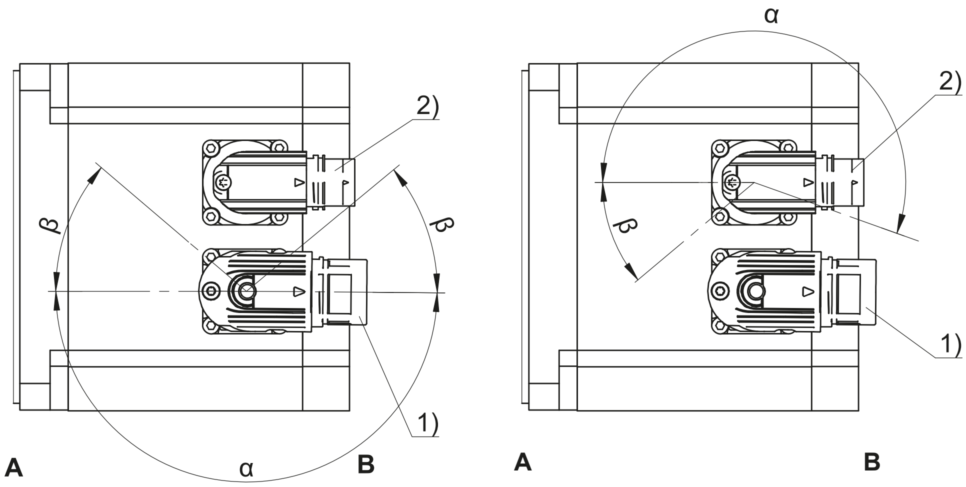
20.6.9.4 Plug connectors

STOBER synchronous servo motors are equipped with rotatable quick-lock plug connectors in the standard version. Details can be found in this chapter.

For motors with forced ventilation, avoid collisions between the motor connection cables and the plug connector of the forced ventilation unit. In the event of a collision, turn the motor plug connectors accordingly. Details regarding the position of the plug connector for the forced ventilation unit can be found in the "Dimensional drawings" chapter.

The figures represent the position of the plug connectors upon delivery.

Turning ranges of plug connectors



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

Power plug connector features

Motor type	Size	Connection	Turning range	
			α	β
EZS	con.23	Quick lock	180°	40°

Encoder plug connector features

Motor type	Size	Connection	Turning range	
			α	β
EZS	con.17	Quick lock	195°	35°

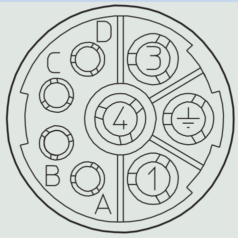
Notes

- The number after "con." indicates the approximate 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 or encoder plug connectors can be turned only if doing so does not cause them to collide.

20.6.9.5 Connection assignment of the power plug connector

The colors of the connecting wires inside the motor are specified in accordance with IEC 60757.

Plug connector size con.23

Connection diagram	Pin	Connection	Color
	1	U phase	BK
	3	V phase	BU
	4	W phase	RD
	A	Brake +	RD
	B	Brake –	BK
	C	Temperature sensor +	
	D	Temperature sensor –	
	⏚	Grounding conductor	GNYE

20.6.9.6 Connection assignment of the encoder plug connector

The size and connection assignment of the encoder plug connectors depend on the model of encoder installed and the size of the motor. The colors of the connecting wires inside the motor are specified in accordance with IEC 60757.

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

Connection diagram	Pin	Connection	Color
	1	Clock +	VT
	2	Up sense	BNGN
	3		
	4		
	5	Data –	PK
	6	Data +	GY
	7		
	8	Clock –	YE
	9		
	10	0 V GND	WHGN
	11		
	12	Up +	BNGN

EnDat 2.2 digital encoder 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	WHGN
	11		
	12	Up +	BNGN
	UBatt+ = DC 3.6 V for encoder model EBI in combination with the AES option of STOBER drive controllers		

EnDat 2.1 encoder 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 +	BNGN
	8	Clock +	VT
	9	Clock –	YE
	10	0 V GND	WHGN
	11		
	12	B + (Sin +)	BUBK
	13	B – (Sin –)	RDBK
	14	Data +	GY
	15	A + (Cos +)	GNBK
	16	A – (Cos –)	YEBK
	17	Data –	PK

Resolver, plug connector size con.17

Connection diagram	Pin	Connection	Color
	1	S3 Cos +	BK
	2	S1 Cos –	RD
	3	S4 Sin +	BU
	4	S2 Sin –	YE
	5		
	6		
	7	R2 Ref +	YEWH/BKWH[5]
	8	R1 Ref –	RDWH
	9		
	10		
	11		
	12		

20.7 Project configuration

Project your drives using our SERVOsoft designing software. Download SERVOsoft for free at https://www.stoeber.de/en/ServoSoft.

It is the most convenient and reliable method of drive selection, as the entire torque/speed curve of the application is displayed and evaluated here in the curve of the geared motor.

In this chapter, only limit values for specific operating points can be taken into consideration for manual drive selection.

An explanation of the formula symbols can be found in Chapter [▷ 23.1].

The formula symbols for values actually present in the application are marked with *.

20.7.1 Design of the screw drive

You can use the information below to select a suitable synchronous servo motor for your screw drive. For detailed design information on the screw drive, please contact the screw drive manufacturer.

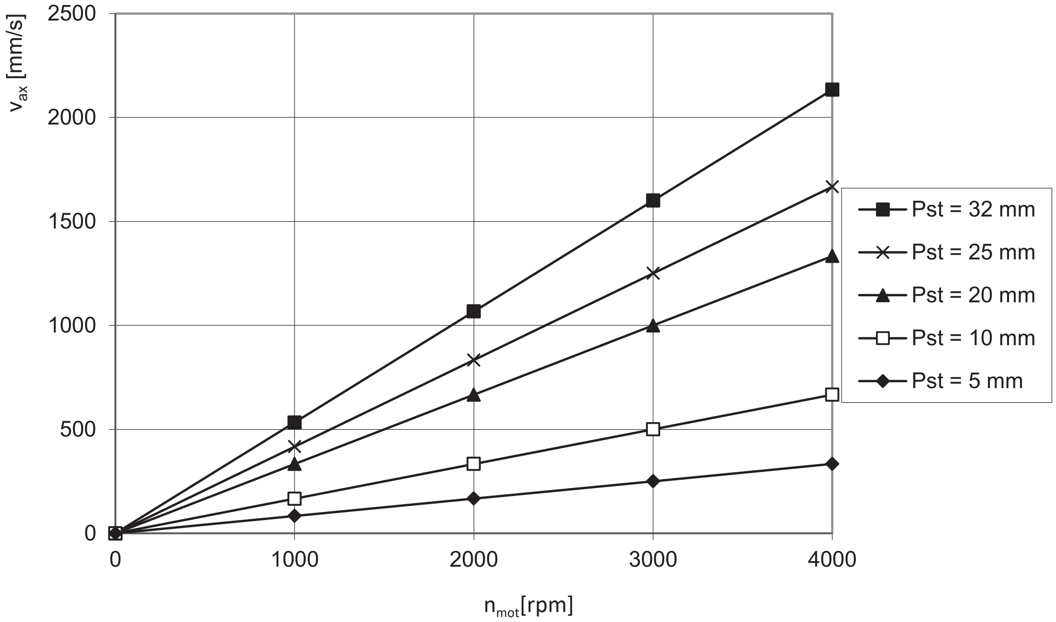
Axial velocity

The axial velocity of a screw drive can be calculated as follows:

$$v_{ax} = \frac{n_{mot} \cdot P_{st}}{60}$$

[5] (depending on the brand of the resolver)

The following diagram represents the characteristic curves of screw drives with common pitches that can be implemented with STOBER synchronous servo motors for screw drives.



Axial force

The axial force of a screw drive can be calculated as follows:

$$F_{ax} = \frac{2000 \cdot M \cdot \pi \cdot \eta_{gt}}{P_{st}}$$

With a spindle pitch P_{st} = 5, the shrink ring connection between the motor shaft and threaded spindle can be overloaded when using the maximum torque of EZS502, EZS503, EZS702 or EZS703 motors. To prevent this, the following condition for the maximum permitted axial force F_{ax} must be observed in these application cases. Values for $F_{ax,ss}$ and dh1 can be found in the chapter General features. For more details on the shrink ring, contact the manufacturer Ringfeder.

$$F_{ax} \leq \frac{F_{ax,ss}}{1 + \frac{P_{st}}{\pi \cdot \eta_{gt} \cdot dh1}}$$

You can use the following table to select a motor type / screw drive pitch combination. The axial forces in the table are calculated for M_0 and η_{gt} = 0.9.

	M_0 [Nm]	F_{ax0} P_{st}=5 [N]	F_{ax0} P_{st}=10 [N]	F_{ax0} P_{st}=15 [N]	F_{ax0} P_{st}=20 [N]	F_{ax0} P_{st}=25 [N]	F_{ax0} P_{st}=32 [N]
EZS501U	4.3	4863	2432	1621	1216	973	760
EZS501B	5.5	6164	3082	2055	1541	1233	963
EZS502U	7.6	8539	4269	2846	2135	1708	1334
EZS502B	10.9	12271	6136	4090	3068	2454	1917
EZS503U	10.7	12045	6022	4015	3011	2409	1882
EZS503B	15.6	17587	8793	5862	4397	3517	2748
EZS701U	7.7	8652	4326	2884	2163	1730	1352
EZS701B	10.2	11479	5740	3826	2870	2296	1794
EZS702U	13.5	15268	7634	5089	3817	3054	2386
EZS702B	19.0	21432	10716	7144	5358	4286	3349
EZS703U	19.7	22280	11140	7427	5570	4456	3481
EZS703B	27.7	31271	15636	10424	7818	6254	4886

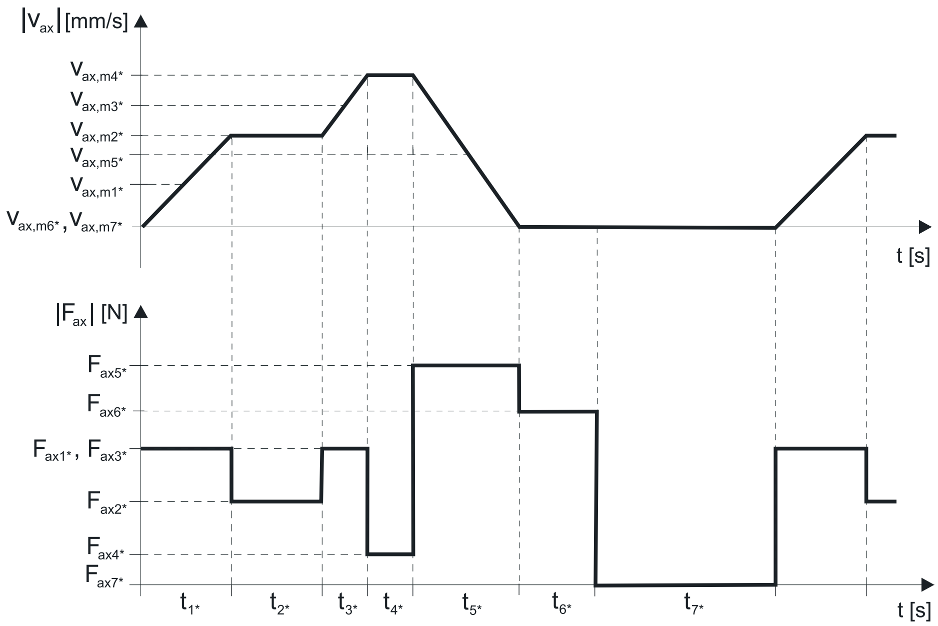
If the synchronous servo motor at absolute standstill (n_{mot}=0) must hold the load using its torque, the following formula defines the permitted axial force:

$$F_{ax0,abs} \leq 0.6 \cdot \frac{2000 \cdot M_0 \cdot \pi \cdot \eta_{gt}}{P_{st}}$$

20.7.2 Calculation of the operating point

In this chapter, you can find information needed to calculate the operating point.

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



Calculation of the actual average axial velocity

$$v_{ax,m^*} = \frac{|v_{ax,m1^*}| \cdot t_{1^*} + \ldots + |v_{ax,mn^*}| \cdot t_{n^*}}{t_{1^*} + \ldots + t_{n^*}}$$

If t_{1*} + ... + t_{6*} ≥ 6 min, determine $v_{ax,m*}$ without the rest phase t_{7*}.

Calculation of the actual average speed

$$n_{m^*} = \frac{v_{ax,m^*} \cdot 60}{P_{st}}$$

Check the condition $n_{m*} \leq n_N$ and adjust the parameters as needed.

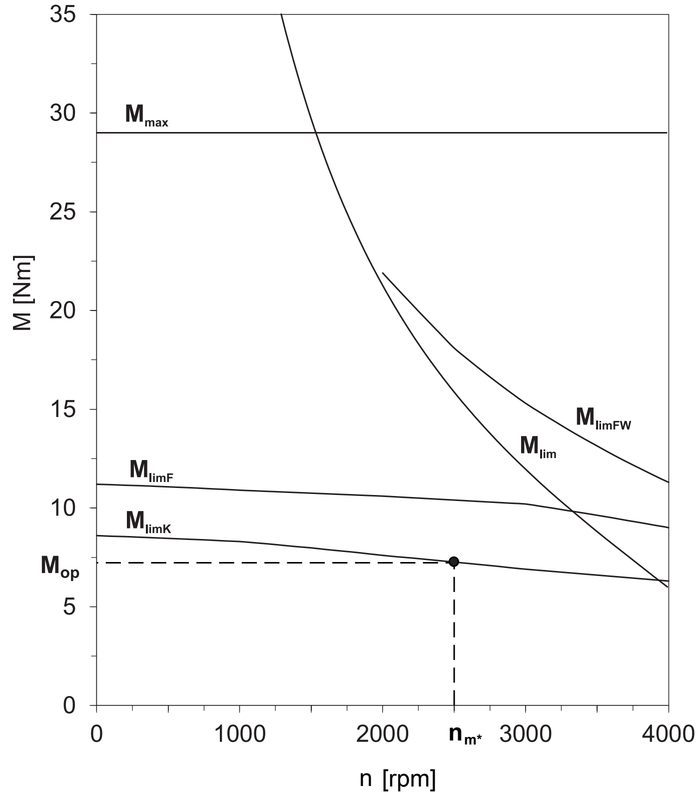
Calculation of the actual effective axial force

$$F_{ax,eff^*} = \sqrt{\frac{t_{1^*} \cdot F_{ax1^*}{}^2 + \ldots + t_{n^*} \cdot F_{ax,n^*}{}^2}{t_{1^*} + \ldots + t_{n^*}}}$$

Calculation of the actual effective torque

$$M_{eff^*} = \frac{F_{ax,eff^*} \cdot P_{st}}{2000 \cdot \pi \cdot \eta_{gt}}$$

You can find the value for the torque of the motor at operating point M_{op} with the determined average input speed n_{m*} in the motor characteristic curve in the chapter [▶ 19.3]. In doing so, keep the size and cooling type of the motor in mind. The figure below shows an example of reading the torque M_{op} of a motor with convection cooling at the operating point.



Check the condition: $M_{eff*} \leq M_{op}$ and adjust the parameters as needed.

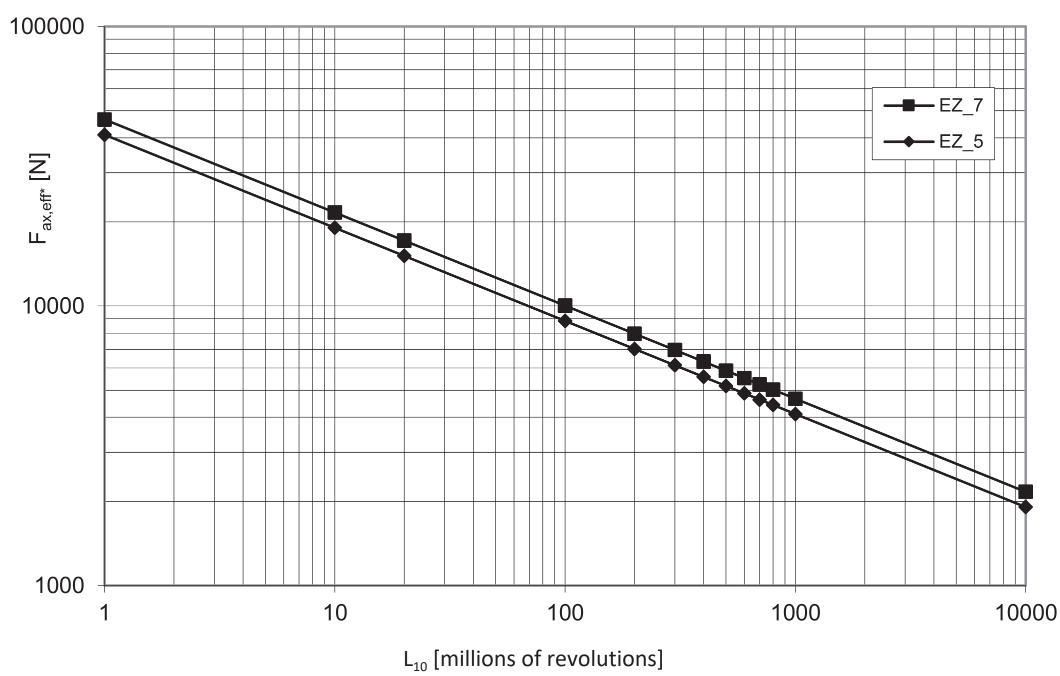
20.7.3 Calculation of the bearing service life

The service life of the axial angular contact ball bearing of a STOBER synchronous servo motor for screw drives is generally longer than the service life of the screw drive bearing.

You can calculate the service life of the axial angular contact ball bearing as follows (the value for C_{dyn} can be found in the "General features" chapter):

$$L_{10} = \left(\frac{C_{dyn}}{F_{ax,eff*}} \right)^3 \cdot 10^6$$

The following diagram shows the bearing service life L_{10}.



$$L_{10h} = \frac{L_{10}}{n_{m*} \cdot 60}$$

20.8 Further information

20.8.1 Directives and standards

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

- (Low Voltage) Directive 2014/35/EU
- EN 60034-1:2010 + Cor.:2010
- EN 60034-5:2001 + A1:2007
- EN 60034-6:1993

20.8.2 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.

UKCA mark: The product meets the requirements of UK directives.

cURus test symbol "Servo and Stepper Motors – Component"; registered under UL number E488992 with Underwriters Laboratories USA (optional).

20.8.3 Additional documentation

Additional documentation related to the product can be found at http://www.stoeber.de/en/downloads/

Enter the ID of the documentation in the Search field.

Documentation	ID
Operating manual for EZ synchronous servo motors	443032_en