STÖBER

Drives and automation

Motion controllers

Drive controllers

Motors

Product catalog

Drives and automation

STOBER, decades of innovative drive technology

STÖBER Antriebstechnik has a long drive-related tradition. The family company was founded in 1934 in Pforzheim.

As a service-oriented and worldwide system provider, STOBER is one of the innovators of digital drive technology.

STOBER IN MOTION

That very special spirit

STOBER

The top level production strategy gives rise to a the highest level of product reliability

For demanding applications, it must be possible to rely on stiffness, smooth running, repeatability and maximum stability.

The well-known product quality is ensured by the highly qualified employees at STOBER who are provided with the latest machines and workstations.

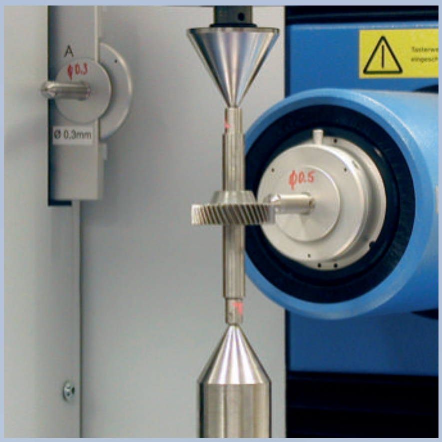

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Table of contents

1 Overview

1.1 Electronics

		
Product section	**MC6**	
Chapter number	[▶ 2]	

MC6 motion controller

Hardware version	**0**	**1**	**5**
Processor	Intel Atom Z530, 1.6 GHz	Intel Atom Dual-Core E3825, 2 × 1.33 GHz	Intel Core i3-3120ME, 2 × 2.4 GHz
L2 Cache	512 kB	1 MB	3 MB
Main memory	DDR2-RAM, 1 GB	DDR3-RAM, 2 GB	DDR3-RAM, 2 GB
Mass memory	Internal SSD, 4 GB	CFast card, 8 GB	CFast card, 8 GB
Remanent memory	128 kB nvSRAM	128 kB nvRAM	128 kB MRAM
USB	3 USB 2.0 interfaces	3 USB 2.0 interfaces	4 USB 3.0 interfaces
EtherCAT	✓	✓	✓
Ethernet	✓	✓	✓
RS-232	✓	✓	✓
CANopen	✓	✓	✓
Video (DVI-D)	✓	✓	✓
Version as control cabinet PC	✓	✓	✓
Version with touch panel	✓	✓	✓
Surrounding temperature (operation)	0 – 50 °C	0 – 45 °C	0 – 45 °C
Storage temperature	-20 – 75 °C	-20 – 75 °C	-20 – 75 °C

				
Product section	**SI6**	**SD6**	**SDS 5000**	**MDS 5000**
Chapter number	[▷ 3]	[▷ 4]	[▷ 5]	[▷ 6]

Drive controller

Technical data				
Nominal output current (4 kHz)	5 – 22 A	2.3 – 85 A	2.3 – 85 A	2.3 – 85 A
Maximum current (4 kHz)	10.5 – 46.2	4.14 – 153 A	4.14 – 153 A	4.14 – 153 A
Nominal output current (8 kHz)	4.5 – 20 A	1.7 – 60 A	1.7 – 60 A	1.7 – 60 A
Maximum current (8 kHz)	9.45 – 22.1 A	4.25 – 150 A	4.25 – 150 A	4.25 – 150 A

Motor types				
Asynchronous motors	✓	✓	✓	✓
Synchronous servo motors	✓	✓	✓	✓
Linear motors		✓		
Torque motors	✓	✓		

Encoder interfaces				
EnDat 2.1/2.2 digital	✓	✓	✓	✓
Incremental	✓	✓	✓	✓
SSI	✓	✓	✓	✓
Resolver	✓	(✓)	(✓)	(✓)
Pulse/direction signals		(✓)	(✓)	(✓)
EnDat 2.1 sin/cos		(✓)	(✓)	(✓)
Sin/cos		(✓)		
HIPERFACE DSL	✓			
(✓): Terminal module required				

Motor temperature evaluation				
PTC thermistor	✓	✓	✓	✓
KTY temperature sensor	✓	✓	✓	✓
Pt1000 temperature sensor	✓	✓	✓	✓

Communication				
Isochronic system bus (IGB)		✓	✓	
CANopen		(✓)	(✓)	(✓)
EtherCAT	✓	(✓)	(✓)	(✓)
PROFINET	✓	(✓)	(✓)	(✓)
PROFIBUS DP			(✓)	(✓)
(✓): Communication module required				

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Product section	**SI6**	**SD6**	**SDS 5000**	**MDS 5000**
Chapter number	[▶ 3]	[▶ 4]	[▶ 5]	[▶ 6]
Safety functions				
STO, SS1 (SIL 3, PL e, category 3)			(✓)	(✓)
STO, SS1 (SIL 3, PL e, category 4)	(✓)	(✓)		
(✓): Safety module required				
Terminals				
I/O	✓	(✓)	(✓)	(✓)
Expanded I/O		(✓)	(✓)	(✓)
I/O with exp. encoder support		(✓)	(✓)	(✓)
(✓): Terminal module required				
Features				
Multi-axis drive system	✓			
Single cable solution	✓			
Live firmware update	✓	✓	✓	
Display & keyboard		✓	✓	✓
Removable data storage	✓	✓	✓	✓
DC link connection	✓	✓	✓	✓
Applications				
Torque/force mode	✓	✓	✓	✓
Velocity mode	✓	✓	✓	✓
Positioning mode	✓	✓	✓	✓
Master/slave mode			✓	✓
Electronic cam disk			✓	✓
Interpolating mode	✓	✓		
Conformity				
cULus	✓	✓	✓	✓
CE	✓	✓	✓	✓

		
Product section	**Cable**	
Chapter number	[▷ 7]	

Power cable

Design	con.15	con.23	con.40	con.58
SpringTec quick lock	✓			
SpeedTec quick lock		✓	✓	
Screw technology		✓		✓

Power wires	Brake	Temperature sensor	∅ Cable	Min. bending radius 1	Min. bending radius 2
4 × 1.0 mm²	2 × 0.5 mm²	2 × 0.34 mm²	Max. 10.5 mm	105 mm	52.5 mm
4 × 1.5 mm²	2 × 1.0 mm²	2 × 0.5 mm²	Max. 12.7 mm	127 mm	63.5 mm
4 × 2.5 mm²	2 × 1.0 mm²	2 × 1.0 mm²	Max. 15.3 mm	153 mm	76.5 mm
4 × 4.0 mm²	2 × 1.0 mm²	2 × 0.75 mm²	Max. 16.0 mm	160 mm	80.0 mm
4 × 6.0 mm²	2 × 1.5 mm²	2 × 1.0 mm²	Max. 19.4 mm	194 mm	97.0 mm
4 × 10.0 mm²	2 × 1.5 mm²	2 × 1.0 mm²	Max. 23.5 mm	235 mm	117.5 mm
4 × 16.0 mm²	2 × 1.5 mm²	2 × 1.5 mm²	Max. 25.5 mm	255 mm	191 mm
4 × 25.0 mm²	2 × 1.5 mm²	2 × 1.5 mm²	Max. 28.8 mm	288 mm	216 mm
Bending radius: 1 = free to move, 2 = permanently installed					

Other	
Torsional stress	± 30°/m
Resistant to bending	✓
Resistant to oil, chemicals	✓

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Product section	**Cable**	
Chapter number	[▹ 7]	

Encoder cable

Encoder	**con.15**	**con.17**
Encoder Endat 2.1/2.2 digital	✓	✓
Encoder Endat 2.1 sin/cos	✓	✓
Resolver	✓	✓

Encoder	**∅ Cable**	**Bending radius 1**	**Bending radius 2**
Encoder Endat 2.1/2.2 digital	Max. 8.5 mm	85 mm	42.5 mm
Encoder Endat 2.1 sin/cos	Max. 13.0 mm	130 mm	65.0 mm
Resolver	Max. 11.4 mm	114 mm	57.0 mm
Bending radius: 1 = free to move, 2 = permanently installed			

Other	
Max. torsion stress	± 30°/m
Resistant to bending	✓
Resistant to oil, chemicals	✓

1.2 Synchronous servo motors

			
Product section	**EZ**	**EZHD**	**EZHP**
Chapter number	[▷ 8]	[▷ 9]	[▷ 10]

Technical data for motors with convection cooling

M_N	0.89 – 43.7 Nm	1.9 – 24.6 Nm	
M_0	1 – 66.1 Nm	2.6 – 31.1 Nm	
i			3 – 27
M_{2acc}			47 – 500 Nm

Technical data for motors with forced ventilation

M_N	2.9 – 77.2 Nm		
M_0	3.5 – 94 Nm		

Technical data for motors with water cooling

M_N	2.6 – 72.1 Nm		
M_0	3.4 – 90.1 Nm		

Shaft design			
Solid shaft without feather key	✓		
Flange hollow shaft		✓	✓
Encoder			
EnDat 2.2	✓	✓	✓
EnDat 2.1	✓	✓	✓
Resolver	✓		
Cooling			
Convection cooling	✓	✓	✓
Forced ventilation	✓		
Water cooling	✓		✓
Holding brake			
Permanent magnetic brake	✓	✓	✓
Identifiers and test symbols			
CE	✓	✓	✓
cURus	✓	✓	✓

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Product section	**EZM**	**EZS**
Chapter number	[▸ 11]	[▸ 12]

Technical data for motors with convection cooling

F_{ax}	751 – 21375 N	760 – 22280 N

Technical data for motors with forced ventilation

F_{ax}		963 – 31271 N

Technical data for motors with water cooling

F_{ax}	919 – 30649 N	937 – 30649 N
Shaft design		
Direct drive of the threaded nut	✓	
Direct drive of the threaded spindle		✓
Encoder		
EnDat 2.2	✓	✓
EnDat 2.1	✓	✓
Resolver		✓
Cooling		
Convection cooling	✓	✓
Forced ventilation		✓
Water cooling	✓	✓
Holding brake		
Permanent magnetic brake	✓	✓
Identifiers and test symbols		
CE	✓	✓
cURus	✓	✓

2 MC6 motion controller

2.1 Overview

MC6 and AS6 – highest level of flexibility for industrial automation

- Motion controller MC6 based on CODESYS V3
- AutomationControlSuite AS6 is a convenient way to create programs
- Up to 100 axes in synchronous operation mode
- IEC 61131-3 compliant programming with ST, AS, CFC, FUP, KOP, AWL
- Very compact design
- Communication: CANopen or EtherCAT
- Cam disk and cam functionality
- For demanding CNC applications
- 3D CNC editor (dynamic G-code)
- Robotics and transformations
- EtherCAT, CANopen, serial RS-232,TCP/IP, USB
- Different hardware versions
- Optional with touch panel
- CFast socket
- Two freely programmable LEDs

MC6

2.1.1 Features

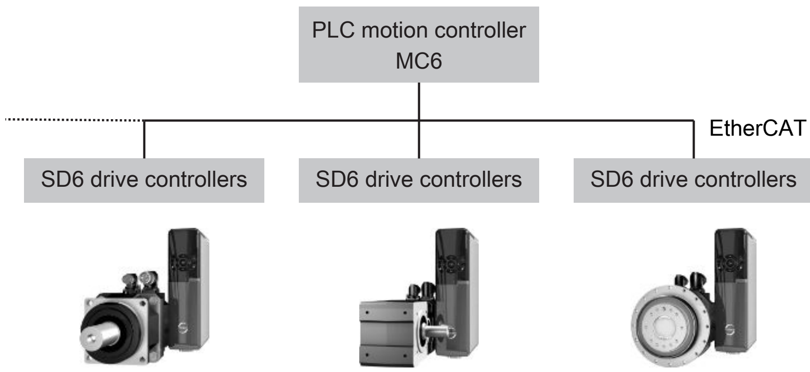
MC6 – complex motion sequences, high dynamics and precision

All control-related drive functions are grouped together centrally in a program sequence. This makes it easier to program multiple axes in many cases.
Use of one or more motion controllers is a precondition for complex interlinked processes with high positioning and adjustment accuracy.
Especially with complex functions, the Motion Control architecture makes commissioning easier as well as service, if problems occur.
Program upkeep can be done centrally on the motion controller.

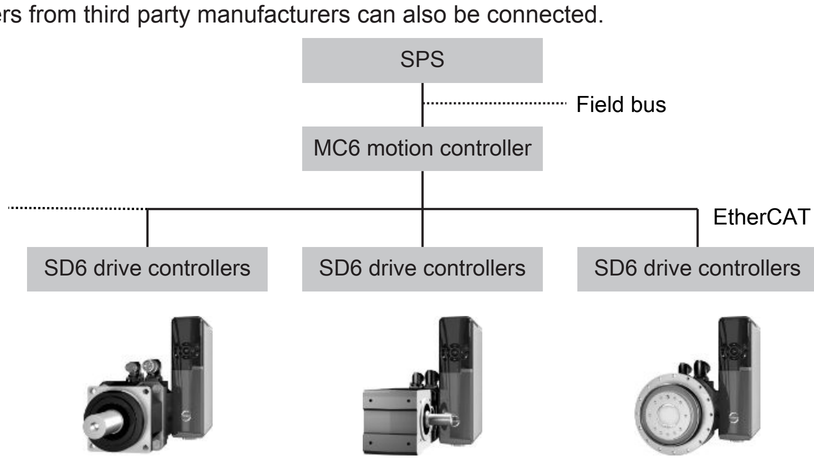
No special user interface (HMI) is required in the MC6 motion controller version with touch panel.

Also suitable for PLC solutions

The motion controller is suitable for use as a programmable logic controller (PLC).



Controllers from third party manufacturers can also be connected.



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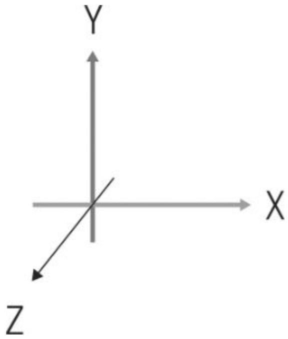
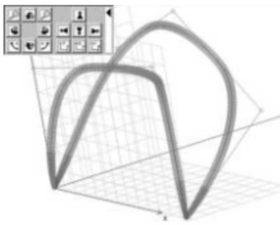
Track travel and robot function

Motion controllers are capable of interpolating the track travels of multiple axes and performing robotic functions.
The robotic function consists of coordinate transformations, which are required if the motor axes do not correspond to spatial axes.



Track travel with interpolation of several axes



CNC function: easy creation of 3D trajectories

Scara robot: coordination transformation (spatial axes)

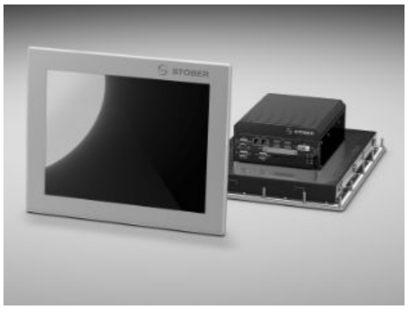
MC6 in the switch cabinet PC design

This compact and powerful motion controller is optimized for operation with the AutomationControl-Suite development environment.
The system features impressive technical details: Thanks to the efficient convection cooling, no fan is required. A Solid State Drive (SSD) is used as storage medium. This feature made it possible to dispense with rotating elements entirely.
No data will be lost if the 24 vdc power supply fails.
The Windows operating system can be used for installation of internally produced software. If service is required, the program can quickly be transferred via CFast card (optional).
HMI panels from third party manufacturers can be connected.

Motion controller MC6 in the switch cabinet PC design for easy top-hat rail mounting

MC6 with touch panel for installation in the operating area

The controller in the version with touch panel is ideal for use as a master controller.
For applications that require parameterization, the panel design is especially advantageous as a visually sensitive interface. The interaction is presented in a convenient and contemporary manner.
The other technical functions are the same as for the motion controller in the switch cabinet PC design.



MC6 motion controller with touch panel for installation in the operating area

Communication interfaces

- EtherCAT, CANopen, serial RS-232, TCP/IP, USB
- Open for all other bus systems

Computing power

- Up to 20 axes with extensive robotic functions (track control)
- Up to 100 axes for cyclic cam discs

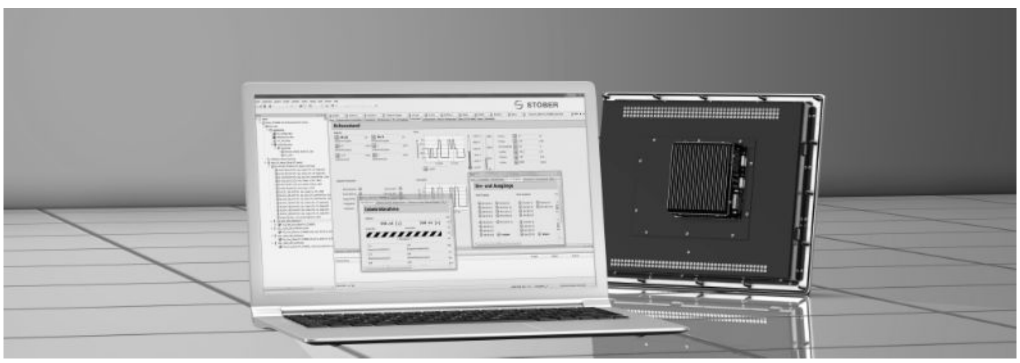
User interface (HMI)

- Large selection of ready-made visualization elements
- Control masks can be generated in the integrated visualization editor
- Complete control masks can be reused as an individual visualization element
- Complex visualization elements can be instantiated by an interface for the parameter transfer
- Multi-lingual visualization capability with integrated editor for text lists
- Access to machine visualization via web browser

2.1.2 Development environment

AS6 – the multi-axis controller for the MC6 motion controller

The AutomationControlSuite development environment covers all functions included in CODESYS 3.5 for Motion Control (PLCopen, DIN 66025) and for PLCs (Programmable Logic Controllers) (IEC 61131-3).
Additional function blocks were specially developed by STOBER from drive-related practice and are identified as such.
High performance Drive&Motion libraries are available for creating programs. Furthermore the convenient quick start-up was the focus – without programing effort and within a few minutes.



Advantageous for CODESYS users

If you are familiar with CODESYS, you can readily program an application for the motion controller MC6 yourself.

Integrated system solutions

The topic of control and drive technology is nearly always the focus of the desired solution for modern machines and automation systems. Here it is helpful to know a partner with extensive expertise and a complete product program to be able to realize new projects. As a system manufacturer with detailed drive-related experience, STOBER can offer solutions without system interruptions.

Program languages

The following programming languages are supported:

- Structured text (ST)
- Sequential language (AS)
- Graphical function plan (CFC)
- Function plan diagram (FUP)
- Contact plan (KOP)
- Instruction list (AWL)

Extensive simulation options are possible on the programming level on a PC.

Simulation mode

Using virtual axes, it is possible to check the complete functionality even without the available machine in simulation mode.

Software Development Kit MC6-Data-Link

Convenient software interface (API) for communication between a motion controller MC6 and client systems such as external visualizations, operating devices, service devices or diagnostics devices. Access via client to IEC 61131-3 variables and the online services of the controller. MC6-Data-Link is realized as C-, C++- and C# class and is delivered in a Software Development Kit (SDK). The scope of delivery of the SDK includes an additional C-interface, platform-specific files for Windows and demo clients in source code.

Scope of functions:

- Connection set-up and disconnection for controller; automatic connection set-up after connection termination
- Synchronous / cyclic exchange of variable values with the controller (read / write)
- Instantiation capability for simultaneous communication with several controllers
- Transfer of files to and from the controller

2.1.3 Application training

Establish specific CODESYS expertise. STOBER offers a multi-level training program that focuses essentially on application programming of the MC6 motion controller and SD6 or SDS 5000 drive controller.

MC6 Basic

Training content: PLC programming acc. to IEC 61131-3. Data types, operators, instructions and pointers. The programming languages ST, CFC, AS, AWL, FUP and KOP. Creation of programs. function blocks and functions with transfer parameters. Simple remote diagnosis via Trace, Debug, Watchlists and Force. Create a visualization for operation. General basic knowledge about SoftMotion. Parameterization of drives. Configuration of STOBER drives. Using real and virtual axes and encoders with PLCopen blocks. Using a master/slave coupling. Disc cam applications with cam function. Practical exercises for the training structure. Application of STOBER Drive&Motion library blocks.

Software used: AutomationControlSuite.

MC6 Advanced

Training content: General basic knowledge about CNC track control. Creation of CNC programs in the editor according to DIN 66025 in G-code. Integration of NC decoders and CNC interpolator blocks. Application of objects of track preprocessing. 15 different transformation blocks with the associated visualization elements. Practical exercises for the training structure. Application of STOBER Drive&Motion library blocks.

2.2 Technical data

Technical specifications for the MC6 motion controller can be found in the following sections.

2.2.1 Type designation

MC	**6**	**A**	**0**	**0**	**C**	**T**

Tab. 1: Example code for the MC6 type designation

Code	Designation	Design
MC	Series	MotionControl
6	Generation	6. Generation
A, B, C	Software version	Version of the image
0	Design	As control cabinet PC
1		With touch panel
0...9	Hardware version	0: Atom Single-Core
		1: Atom Dual-Core
		5: Core i3 Dual-Core
N	"Motion" software option	Control
S		SoftMotion
C		SoftMotion CNC
N	"Visualization" software option	Without
T		Target visualization
W		Web visualization
A		Target visualization and web visualization

Tab. 2: Meaning of the MC6 example code

2.2.2 Versions

The following MC6 versions are currently available.

Type	ID no.	Description
MC6A00CN	56444	MC6 motion controller MC6 with software option 3.5: SoftMotion CNC (without visualization) (use: only for service purposes)
MC6A00CT	56445	MC6 motion controller with the software options: • SoftMotion CNC • Target visualization (Application: only for service purposes)
MC6A10CT	56446	MC6 motion controller with 15" touch panel and software options: • SoftMotion CNC • Target visualization (Application: only for service purposes)

Tab. 3: MC6 versions, software version A

Type	ID no.	Description
MC6B00CN	56524	MC6 motion controller with software option 3.5.5.0: SoftMotion CNC (without visualization)
MC6B00CT	56525	MC6 motion controller with the software options 3.5.5.0: • SoftMotion CNC • Target visualization
MC6B10CT	56526	MC6 motion controller with 15" touch panel and software options 3.5.5.0: • SoftMotion CNC • Target visualization
MC6B00NT	56527	MC6 motion controller with the software options 3.5.5.0: • CODESYS Control • Target visualization

Tab. 4: MC6 versions, software version B

Type	ID no.	Description
MC6C01CT	56564	MC6 motion controller Dual Core with the software options 3.5.6.40: • SoftMotion CNC • Target visualization
MC6C11CT	56565	MC6 motion controller Dual Core with the software options 3.5.6.40: • SoftMotion CNC • Target visualization
MC6C05CA	56566	MC6 motion controller Core i3 with the software options 3.5.6.40: • SoftMotion CNC • Target and web visualization
MC6C15CA	56567	MC6 motion controller Core i3 with touch panel and software options 3.5.6.40: • SoftMotion CNC • Target and web visualization

Tab. 5: MC6 versions, software version C

Note the possible restrictions for using and selling the MC6 motion controllers within the United States of America (USA).

If you require a US version or another version that is not included in the list but corresponds to the type designation, please contact the sales team of
STÖBER ANTRIEBSTECHNIK GmbH & Co. KG:
Tel: + 49 7231 582-1165
Fax: + 49 7231 582-4165
sales@stoeber.de

2.2.3 Licenses

Three versions of the "Motion" controller software are available with different functionalities.

"Control (N)" license

The Control license (key "N") is a basic license that is included in the scope of delivery of the MC6 as standard. "Control" enables flexible programming according to IEC 61131-3 and supports the following languages:

- Structured text (ST)
- Sequential language (AS, SFC)
- Graphical function plan (CFC)
- Function plan diagram (FUP)
- Contact plan (KOP)
- Instruction list (AWL)

"SoftMotion (S)" license

The SoftMotion license (key "S") is based on the Control license and also enables motion programming with PLCopen-compliant blocks.
The integrated disk cam editor can either be used online in the target system or offline in the programming system. Cams can be directly connected to cam disks. In addition any number of couplings is possible between virtual and real axes using a cam disk or electronic gear units. This license also supports a cam disk change on the fly. Cam data can be an integral part of the project.

"SoftMotion CNC (C)" license

The SoftMotion CNC license (key "C") is based on the SoftMotion license and also enables numerous coordinate transformations for commonly used mechanical processes, for example:

- 6 different Gantry drives
- H portal (wrap-around belt)
- T portal (wrap-around belt)
- SCARA drive, 2 articulation points
- SCARA drive, 3 articulation points
- Bipod drive
- 2 different tripods
- 5-axes pelletizing robot
- 6-axes articulated robot

The creation of your own transformations is also supported.
The SoftMotion CNC license also makes a 3D CNC editor as defined by DIN 66025 (G code, dynamic) available. Cam and CNC data can be an integral part of the project. The PLC program can influence the CNC trajectory dynamically at runtime.
You also have the option to transfer CNC data from 3D design programs. Furthermore, complex 3D trajectories can be created independently by the mechanics.

2.2.4 Device features

Feature	MC6xx0
Processor	• Intel Atom Processor Z530, 1.6 GHz • Front Side Bus, 533 MHz • L2 Cache, 512 kB
Memory	• DDR2-RAM, 1 GB • Internal SSD with 4 GB • 128 kB nvSRAM (no battery backup necessary) • Internal cFast socket for SATA-based SSD modules
Power supply	• MC6x00: 9 – 32 V_{DC} • MC6x10: 14 – 32 V_{DC}
Power consumption	• MC6x00: max. 12 W • MC6x10: max. 25 W
Front connections	• Realtek RTL8111 Ethernet controller,10/100/1000 Mbit/s • Single Chip fast Ethernet NIC controller, 10/100 Mbit/s • 3 USB 2.0 interfaces, type A, 480 Mbit/s, with 500 mA current carrying capacity per output • Reset button and power LED • Serial RS-232 interface (RTS/CTS only): D-sub connector, 9-pin • CANopen interface: D-sub connector, 9-pin • 2 freely programmable front panel LEDs
Protection class	• IP20
Other	• CODESYS IEC61131-3 runtime for SoftMotion CNC environment (note the functional differences between the software licenses) • Windows XP Embedded operating system • Battery-supported real-time clock (internal watchdog)

Tab. 6: Device features MC6xx0, Atom Single-Core

Feature	MC6xx1
Processor	• Intel Atom Dual-Core E3825, 2x 1.33 GHz • L2 Cache, 1 MB
Memory	• DDR3-RAM, 2 GB • 128 kB nvRAM (no battery backup necessary) • CFast card, 8 GB
Power supply	• MC6x01: 9 – 32 V_{DC} • MC6x11: 14 – 32 V_{DC}
Power consumption	• MC6x01: max. 10 W • MC6x11: max. 23 W
Front connections	• Realtek RTL8111 Ethernet controller,10/100/1000 Mbit/s • Single Chip fast Ethernet DM9102D controller, 10/100 Mbit/s • 3 USB 2.0 interfaces, type A, 480 Mbit/s, with 500 mA current carrying capacity per output • Reset button and power LED • Serial RS-232 interface (RTS/CTS only): D-sub connector, 9-pin • CANopen interface: D-sub connector, 9-pin • 2 freely programmable front panel LEDs
Protection class	• IP20
Other	• CODESYS IEC61131-3 runtime for SoftMotion CNC environment (note the functional differences between the software licenses) • Windows 7 Embedded operating system • Battery-supported real-time clock (internal watchdog)

Tab. 7: Device features MC6xx1, Atom Single-Core

Feature	MC6xx5
Processor	• Intel Core i3-3120ME, 2x 2.4 GHz • L2 Cache, 3 MB
Memory	• DDR3-RAM, 2 GB • 128 kB MRAM (no battery backup necessary) • CFast card, 8 GB
Power supply	• MC6x05: 9 – 32 V_{DC} • MC6x15: 14 – 32 V_{DC}
Power consumption	• MC6x05: on request • MC6x15: on request
Front connections	• 2x Realtek RTL8111 Ethernet controller,10/100/1000 Mbit/s • 4 USB 3.0 interfaces, type A, 480 Mbit/s, with 500 mA current carrying capacity per output • Reset button and power LED • Serial RS-232 interface (RTS/CTS only): D-sub connector, 9-pin or CANopen DVI monitor connection
Protection class	• IP20
Other	• CODESYS IEC61131-3 runtime for SoftMotion CNC environment (note the functional differences between the software licenses) • Windows 7 Embedded operating system • Battery-supported real-time clock (internal watchdog)

Tab. 8: Device features MC6xx5 Core i3 Dual-Core

Feature	Version with touch panel
Display	• 15.0" (38.1 cm) XGA TFT LCD • CCFL backlight • Pixel Pitch 0.297 0.297 • Display mode: normal white • Resolution 1,024 768 • 16.7 million colors • Contrast rate 700:1 (typical), at least 480:1 • Brightness 450 cd/m² (typical) • Viewing angle horizontal 160°, vertical 160° • MTBF 50,000 h
Touch screen	• Resistive 4-line touch screen • Protection class IP65

Tab. 9: Additional device features for design with touch panel

2.2.5 Storage and operating conditions

Condition	MC6xx0	MC6xx1, MC6xx5
Operating temperature	0 – 50 °C	0 – 45 °C
Storage temperature	-20 – 75 °C	
Relative humidity	0 – 80 %, non condensing	

Tab. 10: MC6 storage and operating conditions

2.2.6 Electrical data

Electrical data	MC6x0[1]	MC6x1[2]
Power supply	9 – 32 V_{DC}	14 – 32 V_{DC}
Maximum power consumption	12 W	25 W

Tab. 11: Electrical data MC6

2.2.7 Dimensions

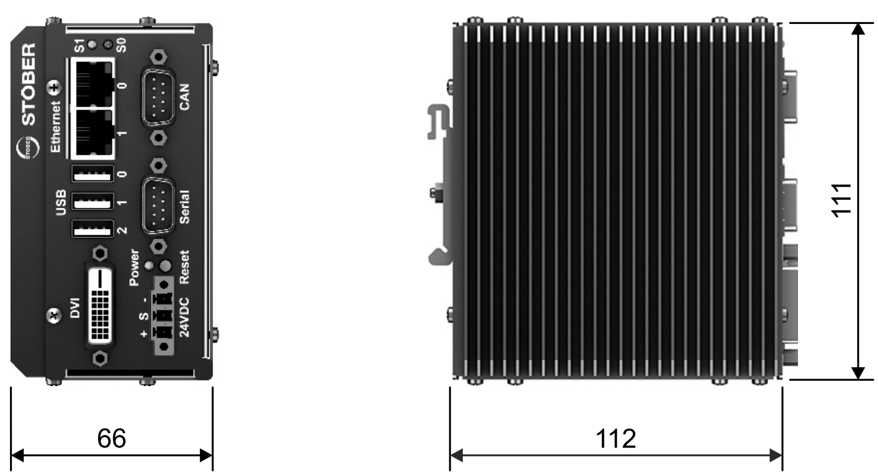


Fig. 1: Dimensions MC6x00 and MC6x01

[1] Version as control cabinet PC
[2] Version as touch panel

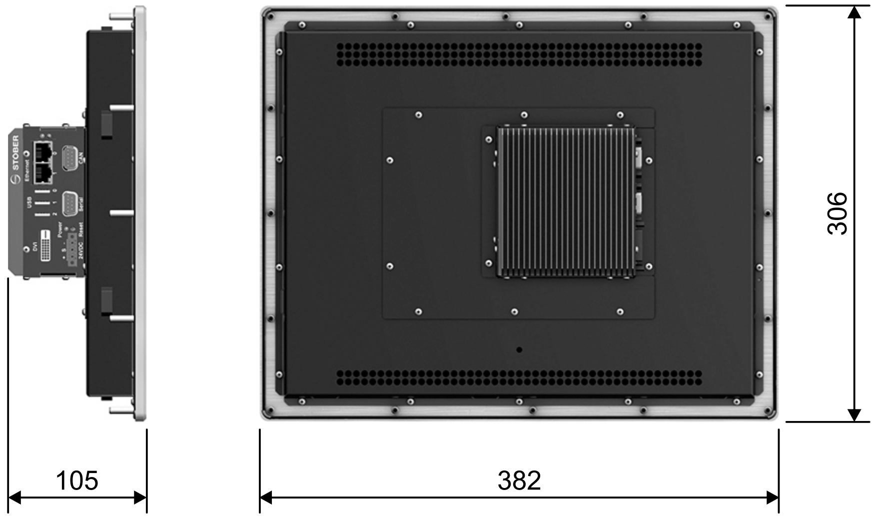


Fig. 2: Dimensions MC6x10 and MC6x11

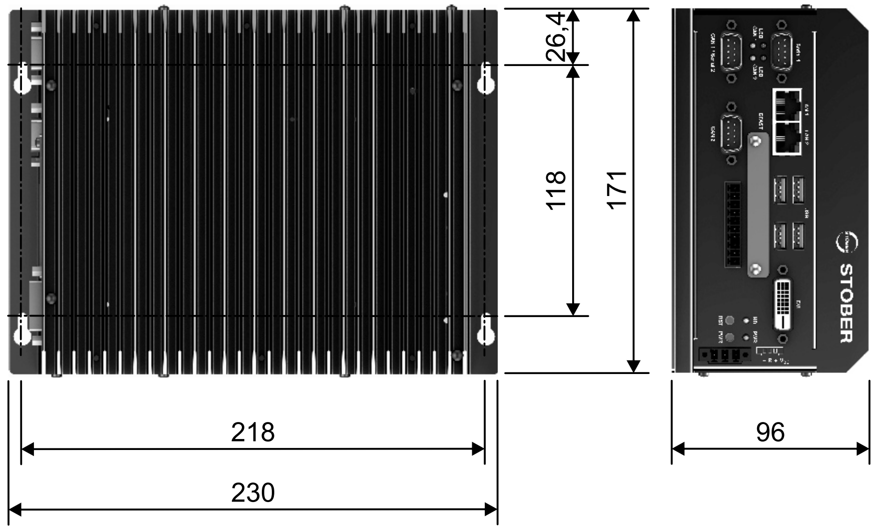


Fig. 3: Dimensions MC6x05

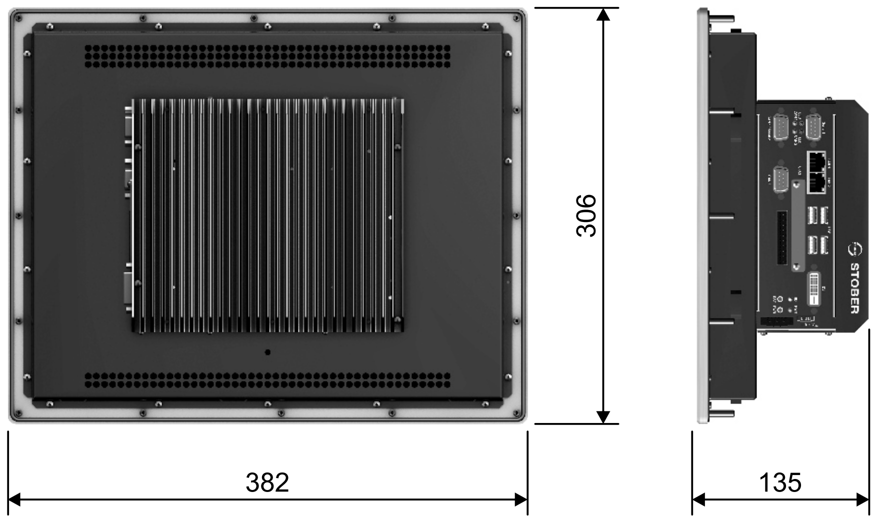


Fig. 4: Dimensions MC6x15

Type	Height [mm]	Width [mm]	Depth [mm]
MC6x00, MC6x01	111	66	112
MC6x05	171	230	96
MC6x10, MC6x11	306	382	100
MC6x15	306	382	128

Tab. 12: Dimensions MC6 [mm]

2.2.8 Weight

Type	Total weight [kg]
MC6x00	0.8
MC6x01	0.8
MC6x05	1.95
MC6x10	4.8
MC6x11	4.8
MC6x15	5.95

Tab. 13: Total weights of the individual MC6 versions

2.3 Accessories

AutomationControlSuite development environment

ID no. AS6_3580
A 30 day test version of the AutomationControlSuite can be found at http://www.stoeber.de/ajax_dt/ajax/produkte.phpwww.stoeber.de.
Please contact us if you are interested: You can get advice, offers and further information from our sales staff.

Software Development Kit MC6-Data-Link

ID no. MC6DL_3579
Please contact us if you are interested: You can get advice, offers and further information from our sales staff.

Product CD "ELECTRONICS 6"

Included in the standard design.

ID no. 442538
The CD-ROM contains the DriveControlSuite project configuration and commissioning software, documentation as well as the device description files for the drive controller – controller connection.

3 SI6 drive controller

3.1 Overview

SI6 – drive control in multi-axis drive systems

- Control of rotary synchronous and asynchronous motors
- Single or double axis controller with a nominal output current up to 22 A
- Supply modules in two sizes with 10 or 20 kW nominal output
- HIPERFACE DSL single cable solution
- STO safety technology via terminals or STO and SS1 via FSoE (Safety over EtherCAT): PL e / SIL 3
- Integrated EtherCAT fieldbus
- Integrated holding brake controller
- Energy supply via Quick DC-Link connection
- Variable feed-in power using supply modules that can be connected in parallel

SI6

3.1.1 Features

The completely new designed STOBER multi-axis drive system consists of the SI6 drive controller and PS6 supply module combination. The SI6 drive controller is available in three sizes as a single or double axis controller with a nominal output current of up to 22 A. The PS6 supply module is available in two sizes with a nominal output of 10 kW or 20 kW. As an economically attractive system with a minimized device width, the SI6 opens a new dimension in multi-axis applications.

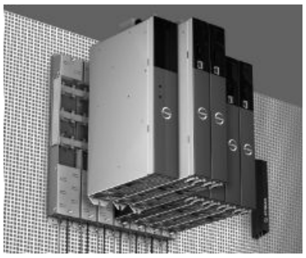
Drive controller in multi-axis drive system with SI6 and PS6

Booksize? Pocket book!

You save valuable space in the control cabinet as with a width of just 45 mm, the SI6 drive controller is the most compact solution on the market. It provides all the features that a designer requires.

Dimension capacities precisely

4 axes, 16 or 97? A single SI6 drive controller can control up to two axes. Thanks to the multi-axis drive system, the number of motors or axes to be controlled can be freely scaled. If required, SI6 drive controllers can be combined with stand-alone units from the STOBER SD6 series. For the general energy supply, the drive controllers from the SI6 and SD6 series can be connected to each other via Quick DC-Link modules.



Tailored energy yield

The SI6 drive controllers are connected to a central supply module. Decentralized supply units as well as fuses and cabling for each axis are dispensed with. When using double axis modules, unused power reserves of an axis can be used for other axes. A significant reduction of space and costs!

Precise dynamics

The SI6 provides acceleration literally as fast as lightning. For example, in conjunction with the STOBER synchronous servo motor EZ401: in 10 ms from 0 to 3000 rpm.

Less clicks, less wiring

Installation is exceptionally simple. No difficult wiring. The patented Quick DC-Link modules allow for a simple “click” into the standard copper rails as well as simple mounting and connection of the SI6 drive controller. The encoder communication and power connection of the motor takes place via a common cable connection: with the encoder system HIPERFACE DSL, the electronic motor nameplate is available that simply and safely takes care of the parameterization of motor data. The alternative interface: EnDat 2.2 digital, also with an electronic nameplate function.

Safety immediately

The safety concept of the SI6 drive controller is based on the STO (Safe Torque Off) function that can be controlled via terminals as well as via Fail Safe over EtherCAT (FSoE). The SI6 is categorized in the highest Performance Level e (category 4) according to EN 13849-1.

Heavy Duty

The SI6 looks elegant. However an extremely robust design is concealed behind the delicate exterior. All components – from the stable, well shielded sheet steel housing to the motor connectors – exceed the reference values of industry standards by far. Even the inside is anything but small format: generously designed computer capacities, high-quality components, careful workmanship.

3.1.2 Software components

Projecting and commissioning

The DriveControlSuite project planning and commissioning software of the 6th generation has all the functions for the efficient use of drive controllers in single-axis and multi-axis applications. The program guides you step by step through the complete project planning and parameterization process using wizards.

Open communication

The Ethernet-based filed bus systems EtherCAT and PROFINET are available in the SI6 drive controller as standard. The fieldbus communication can be specified and replaced via the firmware.

Applications

Using the **CiA 402 Controller Based** application in the drive controller, you can implement applications with synchronized, cyclic assignment of reference values (csp, csv, cst, ip) by a motion controller, type MC6, for example. In addition the drive controller can also independently apply motion tasks, for example referencing and jog when commissioning.

The drive-based operation modes of the CiA 402 with complete movement calculation and design due to the drive controller are also available. Using the **CiA 402 Drive Based** application, the reference values for position, velocity and torque/force (pp, pv, pt) are converted accurately and precisely to movements. Referencing and jog are performed with jerk limitation during commissioning.

Whenever universal and flexible solutions are necessary, the drive-based application package from STOBER is the appropriate choice. For the **STOBER Drive Based** application, a drive-based movement controller for positioning, velocity and torque/force is provided with the PLCopen Motion Control command set. These standard commands were combined into operation modes for different applications and supplemented with additional functions such as jerk limit, motion block linking, cams and much more. For the Command operation mode, all properties of the movements are specified directly by the controller. The properties of the movements in the drive are predefined in the Motion block operation mode so that only a start signal for the execution of the movement is necessary. Complete motion sequences can be defined by linking. There is a separate operation mode available for applications controlled by velocity or torque/force such as pumps, fans or conveyor belts. This also allows for operation without a controller.

3.1.3 Application training

STOBER offers a multi-level training program that focuses essentially on application programming of the motion controller and drive controller.

G6 Basic

Training content: system overview, assembly and commissioning of the drive controller. Use of option modules. Parameterization, commissioning and diagnostics via the commissioning software. Remote maintenance. Basics of controller optimization. Configuration of the drive train. Integrated software functions. Software applications. Connection to a higher-level controller. Basics of safety technology. Practical exercises for the training structure.

Software used: DriveControlSuite.

G6 Advanced

Training content: special knowledge for regulating, control and safety technology. Practical exercises for the training structure.

3.2 Technical data

Technical data for drive controllers and supply modules can be found in the following sections.

3.2.1 Formula symbol

Formula symbols	Unit	Explanation
C_{maxPU}	F	Charging capacity of the power unit
C_{PU}	F	Self-capacitance of the power unit
D_{IA}	%	Reduction of the nominal current depending on the installation height
D_T	%	Reduction of the nominal current depending on the surrounding temperature
f_{2PU}	Hz	Output frequency of the power unit
$f_{PWM,PU}$	Hz	Internal pulse clock frequency of the power unit
I_{1maxCU}	A	Maximum input current of the control board
I_0	A	Standstill current: RMS value of the line-to-line current with standstill torque M_0 generated (Tolerance ±5 %)
$I_{1N,PU}$	A	Nominal input current of the power unit
I_{2maxPU}	A	Maximum output current of the power unit
$I_{2N,PU}$	A	Nominal output current of the power unit
I_N	A	Nominal current
$I_{N,MOT}$	A	Nominal current of the motor
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 %)
M_0	Nm	Standstill torque: the torque the motor is able to deliver long term at a speed of 10 rpm (tolerance ±5 %)
M_N	Nm	Nominal torque: the maximum torque of a motor in S1 mode at nominal speed n_N (tolerance ±5 %)
n_N	rpm	Nominal speed: the speed for which the nominal torque M_N is specified
p		Number of pole pairs
$P_{N,PU}$	W	Nominal power of the power unit
P_{maxRB}	W	Maximum power at the external braking resistor
P_V	W	Power loss
$P_{V,CU}$	W	Power loss of the control board
R_{2minRB}	Ω	Minimum resistance of the external braking resistor
$\vartheta_{amb,max}$	°C	Maximum surrounding temperature
τ_{th}	°C	Thermal time constant
U_{1CU}	V	Input voltage of the control board
U_{1PU}	V	Input voltage of the power unit
U_{2PU}	V	Output voltage of the power unit
U_{max}	V	Maximum voltage
U_{offCH}	V	Off limit of the brake chopper
U_{onCH}	V	On limit of the brake chopper

3.2.2 General technical data

The following specifications apply equally for the SI6 drive controller and the PS6 supply module.

Device features	
Protection class of the device	IP20
Protection class of the control cabinet	At least IP54
Radio interference suppression	Integrated line filter according to EN 61800-3:2012, interference emission class C3
Overvoltage category	III according to EN 61800-5-1:2008

Tab. 1: Device features

Transport and storage conditions	
Storage/ transport temperature	-20 °C to +70 °C Maximum change: 20 °C/h
Relative humidity	Maximum relative humidity 85 %, non-condensing
Vibration (transport) to DIN EN 60068-2-6	5 Hz ≤ f ≤ 9 Hz: 3.5 mm 9 Hz ≤ f ≤ 200 Hz: 10 m/s² 200 Hz ≤ f ≤ 500 Hz: 15 m/s²

Tab. 2: Transport and storage conditions

Operating conditions	
Surrounding operating temperature	0 °C to 45 °C for nominal data 45 °C to 55 °C with derating −2.5 % / °C
Relative humidity	Maximum relative humidity 85 %, non-condensing
Installation altitude	0 m to 1000 m above sea level without restrictions 1000 m to 2000 m above seal level with derating −1.5 % / 100 m
Pollution degree	Pollution degree level 2 as per EN 50178
Ventilated	Installed fan
Vibration (operation) to DIN EN 60068-2-6	5 Hz ≤ f ≤ 9 Hz: 0.35 mm 9 Hz ≤ f ≤ 200 Hz: 1 m/s²

Tab. 3: Operating conditions

Discharge times	
Self-discharge	15 minutes
Fast discharge	Due to PS6 supply module in conjunction with a braking resistor: < 1 minute.

Tab. 4: Discharge times of the DC link circuit

3.2.3 Supply module

The following section contains specifications for the electrical data, dimensions and weight of the PS6 supply module.

3.2.3.1 Type designation

PS	6	A	2	4

Tab. 5: Example code for the PS6 type designation

Code	Designation	Design
PS	Series	PowerSupply
6	Generation	6. Generation
A	Version	
2 – 3	Size	
4	Power output stage	

Tab. 6: Meaning of the PS6 example code

3.2.3.2 Sizes

Type	ID no.	Size
PS6A24	56650	Size 2
PS6A34	56651	Size 3

Tab. 7: Available PS6 types and sizes

Fig. 1: PS6 in sizes 2 and 3

Note that the basic device is delivered without terminals. Suitable terminal strips are available separately for each size.

3.2.3.3 Electrical data

The electrical data of the available PS6 sizes as well as the properties of the brake chopper can be found in the following sections.

3.2.3.3.1 Control board

Electrical data	All types
U_{1CU}	24 V_{DC}, +20 % / -15 %
I_{1maxCU}	0.5 A

Tab. 8: Electrical data control board

3.2.3.3.2 Power unit: size 2

Electrical data	PS6A24
U_{1PU}	3 × 400 V_{AC}, +32 % / -50 %, 50/60 Hz; 3 × 480 V_{AC}, +10 % / -58 %, 50/60 Hz
U_{2PU}	√2 × U_{1PU}
$P_{N,PU}$	10 kW
$I_{1N,PU}$	25 A
I_{1maxPU}	$I_{1N,PU}$ × 180 % for 5 s; $I_{1N,PU}$ × 150 % for 30 s
C_{maxPU}	5000 µF

Tab. 9: Electrical data PS6, size 2

3.2.3.3.3 Power unit: size 3

Electrical data	PS6A34
U_{1PU}	3 × 400 V_{AC}, +32 % / -50 %, 50/60 Hz; 3 × 480 V_{AC}, +10 % / -58 %, 50/60 Hz
U_{2PU}	√2 × U_{1PU}
$P_{N,PU}$	20 kW
$I_{1N,PU}$	50 A
I_{1maxPU}	$I_{1N,PU}$ × 180 % for 5 s; $I_{1N,PU}$ × 150 % for 30 s
C_{maxPU}	10000 µF

Tab. 10: Electrical data PS6, size 3

3.2.3.3.4 Parallel operation

Information

For parallel operation of supply modules, the power increases but not the charging capacity.

Electrical data	2 x PS6A24	3 x PS6A24	2 x PS6A34	3 x PS6A34
$P_{N,PU}$	16 kW	24 kW	32 kW	48 kW
$I_{1N,PU}$	40 A	60 A	80 A	120 A
Charging capacity	5000 µF	5000 µF	10000 µF	10000 µF

Tab. 11: Electrical data in parallel operation: example combinations

The following general conditions apply for the parallel connection of several PS6 supply modules:

- Only the same sizes may be connected in parallel.
- You can operate a maximum of 6 PS6A24 units in parallel.
- You can operate a maximum of 3 PS6A34 units in parallel.
- Note the derating factor of 0.8 for the supply module for the nominal output in parallel operation.

3.2.3.3.5 Brake chopper

Electrical data	All types
U_{onCH}	780 – 800 V_{DC}
U_{offCH}	740 – 760 V_{DC}
R_{2minRB}	22 Ω
P_{maxRB}	29.1 kW

Tab. 12: Electrical data brake chopper

3.2.3.3.6 Fast discharge

The fast discharge is activated when no power supply is present for 20 s and the DC link voltage has reduced over this time. For active fast discharge, the DC link is discharged via the brake chopper and the braking resistor. No fast discharge takes place for constant or increasing DC link voltage as this behavior indicates a second supply module in the DC link system. If the temperature sensor of the braking resistor is active, the fast discharge also remains off.

3.2.3.4 Dimensions

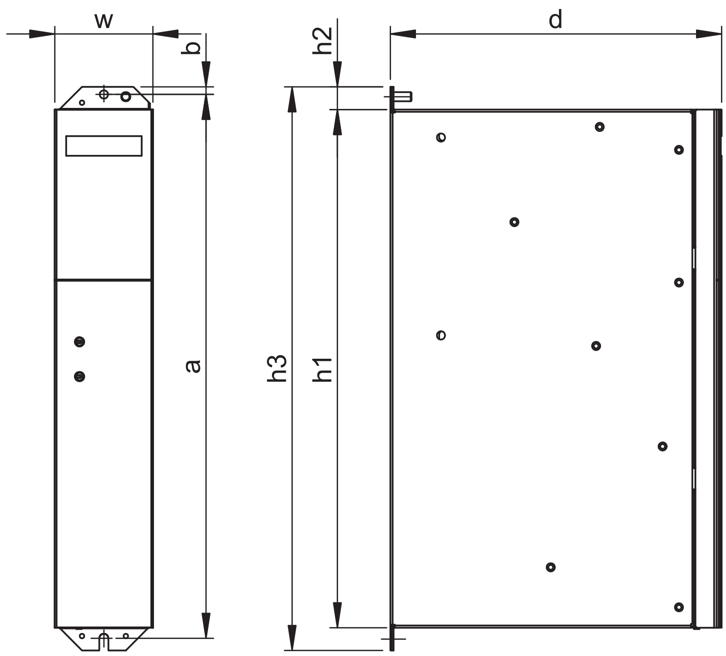


Fig. 2: PS6 dimensional drawing

Dimension			Size 2	Size 3
Supply module	Body height	h1	343	
	Fastening clip height	h2	15	
	Height incl. fastening clips	h3	373	
	Width	w	45	65
	Depth	d	204	219
Fastening holes (M5)	Vertical distance	a	360+2	
	Vertical distance to upper edge	b	5	

Tab. 13: Dimensions PS6 [mm]

3.2.3.5 Weight

Weight	PS6A24	PS6A34
Without packaging	2.7 kg	3.9 kg
With packaging	4.2 kg	5.0 kg

Tab. 14: Weight PS6

3.2.4 Drive controller

The following section contains specifications for the electrical data, dimensions and weight of the SI6 drive controller.

3.2.4.1 Type designation

SI	6	A	0	6	1	Z

Tab. 15: Example code for the SI6 type designation

Code	Designation	Design
SI	Series	ServoInverter
6	Generation	6. Generation
A	Version	
0 – 2	Size	
6	Power output stage	Power output stage within the size
1 2	Axis controller	Single axis controller Double axis controller
Z R Y	Safety technology	SZ6: without safety technology SR6: STO and SS1 via terminals SY6: STO via FSoE

Tab. 16: Meaning of the SI6 example code

3.2.4.2 Sizes

Type	ID no.	Size
SI6A061	56645	Size 0
SI6A062	56646	Size 0
SI6A161	56647	Size 1
SI6A162	56648	Size 1
SI6A261	56649	Size 2

Tab. 17: Available SI6 types and sizes

Fig. 3: SI6 in sizes 0, 1 and 2

Note that the basic device is delivered without terminals. Suitable terminal strips are available separately for each size.

3.2.4.3 Electrical data

The electrical data of the available SI6 sizes can be found in the following sections.

3.2.4.3.1 Power unit: size 0

Electrical data	SI6A061	SI6A062
U_{1PU}	280 – 800 V_{DC}	
f_{2PU}	0 – 700 Hz	
U_{2PU}	0 – max. $\frac{U_{1PU}}{\sqrt{2}}$	
C_{PU}	180 µF	270 µF

Tab. 18: Electrical data SI6, size 0

Nominal currents up to +45 °C (in the control cabinet)

Electrical data	SI6A061	SI6A062
$f_{PWM,PU}$	4 kHz	
$I_{2N,PU}$	5 A	2 × 5 A
I_{2maxPU}	210 % for 2 s	

Tab. 19: Electrical data SI6, size 0, for 4 kHz clock frequency

Electrical data	SI6A061	SI6A062
$f_{PWM,PU}$	8 kHz	
$I_{2N,PU}$	4.5 A	2 × 4.5 A
I_{2maxPU}	250 % for 2 s	

Tab. 20: Electrical data SI6, size 0, for 8 kHz clock frequency

3.2.4.3.2 Power unit: size 1

Electrical data	SI6A161	SI6A162
U_{1PU}	$280 – 800\ V_{DC}$	
f_{2PU}	0 – 700 Hz	
U_{2PU}	$0 – \text{max.}\ \frac{U_{1PU}}{\sqrt{2}}$	
C_{PU}	470 µF	940 µF

Tab. 21: Electrical data SI6, size 1

Nominal currents up to +45 °C (in the control cabinet)

Electrical data	SI6A161	SI6A162
$f_{PWM,PU}$	4 kHz	
$I_{2N,PU}$	12 A	2 × 12 A
I_{2maxPU}	210 % for 2 s	

Tab. 22: Electrical data SI6, size 1, for 4 kHz clock frequency

Electrical data	SI6A161	SI6A162
$f_{PWM,PU}$	8 kHz	
$I_{2N,PU}$	10 A	2 × 10 A
I_{2maxPU}	250 % for 2 s	

Tab. 23: Electrical data SI6, size 1, for 8 kHz clock frequency

3.2.4.3.3 Power unit: size 2

Electrical data	SI6A261
U_{1PU}	$280 – 800\ V_{DC}$
f_{2PU}	0 – 700 Hz
U_{2PU}	$0 – \text{max.}\ \frac{U_{1PU}}{\sqrt{2}}$
C_{PU}	940 µF

Tab. 24: Electrical data SI6, size 2

Nominal currents up to +45 °C (in the control cabinet)

Electrical data	SI6A261
$f_{PWM,PU}$	4 kHz
$I_{2N,PU}$	22 A
I_{2maxPU}	210 % for 2 s

Tab. 25: Electrical data SI6, size 2, for 4 kHz clock frequency

Electrical data	SI6A261
$f_{PWM,PU}$	8 kHz
$I_{2N,PU}$	20 A
I_{2maxPU}	250 % for 2 s

Tab. 26: Electrical data SI6, size 2, for 8 kHz clock frequency

3.2.4.3.4 Asymmetrical load on double axis controllers

When operating 2 motors with different power at a SI6 double axis controller, it is possible to operate one of the motors with a nominal current above the drive controller nominal current if the nominal current of the second connected motor is significantly less than the drive controller nominal current. A simply adaptation of the motors at the double axis controller is therefore available and additional cost-effective combinations of double axis controllers and motors can be used.

The nominal output current for axis B can be determined using the following formula if the nominal output current for axis A is defined:

$$I_{2N,PU(B)} = I_{2N,PU} - \left(I_{2N,PU(A)} - I_{2N,PU}\right) \times \frac{5}{3}$$

for

$$I_{2N,PU} \leq I_{2N,PU(A)} \leq 1{,}6 \times I_{2N,PU}$$

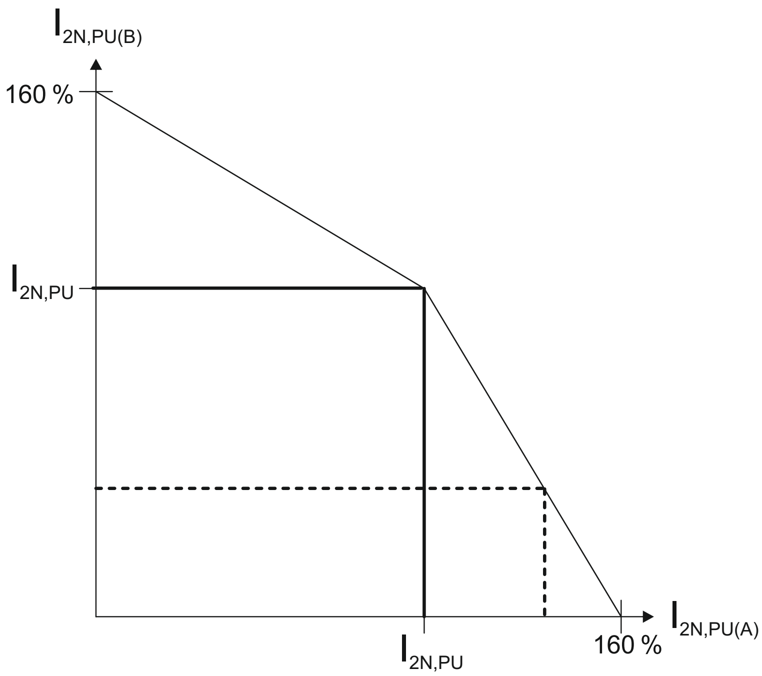


Fig. 4: Asymmetrical load on SI6 double axis controllers

Information

Note that the available maximum currents $I_{2max,PU}$ of the axis controller also refer to the nominal output current $I_{2N,PU}$ for an asymmetrical load.

3.2.4.3.5 Power loss data according to EN 50598

Type	Nominal current $I_{2N,PU}$	Apparent power	Absolute losses $P_{V,CU}$[1]	Working points[2]								IE class[3]	Comparison[4]
				(0/25)	(0/50)	(0/100)	(50/25)	(50/50)	(50/100)	(90/50)	(90/100)		
				Relative losses									
	[A]	[kVA]	[W]	[%]									
SI6A06x	5	3.5	Max. 10	0.71	0.86	1.33	0.76	0.97	1.61	1.13	2.13	IE2	
SI6A16x	12	8.3	Max. 10	0.55	0.71	1.19	0.59	0.80	1.44	0.94	1.87	IE2	
SI6A261	22	16.6	Max. 10	0.55	0.71	1.19	0.59	0.80	1.44	0.94	1.87	IE2	
				Absolute losses P_V									
		[kVA]	[W]	[W]									[%]
SI6A06x	5	3.5	Max. 10	25	30.2	46.5	26.5	33.8	56.5	39.5	74.4	IE2	24.9
SI6A16x	12	8.3	Max. 10	45.7	58.7	98.7	49.1	66.3	119.6	78.1	155.4	IE2	26.7
SI6A261	22	16.6	Max. 10	91.5	117.4	197.3	98.2	132.6	239.2	156.2	310.8	IE2	30.8

Tab. 27: Power loss data according to EN 50598 for an axis of a SI6 drive controller

General conditions

The specified losses apply for an axis of a drive controller and take into account the proportionate losses of the PS6 supply module for this axis.

For a group with a total of x axes, the values are to be multiplied by the number of the axis controllers (x), e.g. x = 4 for 1 × PS6 and 2 × SI6A062.

The loss data applies to drive controllers without accessories.

The power loss calculation based on a three-phase supply voltage with 400 V_{AC} / 50 Hz.

The calculated data includes a supplement of 10 % according to EN 50598.

The power loss specifications refer to a clock frequency of 4 kHz.

The absolute losses for a power stage that is switched off refer to the 24 vdc power supply of the control electronics.

3.2.4.4 Derating

When dimensioning the drive controller, observe the derating of the nominal output current depending on the clock frequency, surrounding temperature, and installation altitude. There is no restriction for a surrounding temperature from 0 °C to 45 °C and an installation altitude of 0 m to 1000 m. The details given below apply to values outside these ranges.

3.2.4.4.1 Effect of the clock frequency

Changing the clock frequency f_{PWM} affects the amount of noise produced by the drive amongst other things. However, increasing the clock frequency results in increased losses. During project configuration, define the highest clock frequency and use it to determine the nominal output current $I_{2N,PU}$ for dimensioning the drive controller.

[1] Absolute losses for a power stage that is switched off
[2] Operating points for relative motor stator frequency in % and relative torque current in %
[3] IE class according to EN 50598
[4] Comparison of the losses for the reference drive controller related to IE2 in the nominal point (90, 100)

Type	$I_{2N,PU}$ 4 kHz	$I_{2N,PU}$ 8 kHz
SI6A061	5 A	4.5 A
SI6A062	2 × 5 A	2 × 4.5 A
SI6A161	12 A	10 A
SI6A162	2 × 12 A	2 × 10 A
SI6A261	22 A	20 A

Tab. 28: Nominal output current $I_{2N,PU}$ depending on the clock frequency

3.2.4.4.2 Effect of surrounding temperature

Derating depending on the surrounding temperature is determined as follows:

- 0 °C to 45 °C: no restrictions (D_T = 100 %)
- 45 °C to 55 °C: derating −2.5 % / °C

Example

The drive controller will be operated at 50 °C.

The derating factor D_T is calculated as follows
D_T= 100 % − 5 × 2.5 % = 87.5 %

3.2.4.4.3 Effect of installation altitude

Derating depending on the installation altitude is determined as follows:

- 0 m to 1000 m: no restriction (D_{IA} = 100 %)
- 1000 m to 2000 m: derating −1.5 % / 100 m

Example

The drive controller will be installed at an altitude of 1500 m above sea level.

The derating factor D_{IA} is calculated as follows:
D_{IA} = 100 % − 5 × 1.5 % = 92.5 %

3.2.4.4.4 Calculating the derating

Follow these steps for the calculation:

1. Determine the highest clock frequency (f_{PWM}) that will be used during operation and use it to determine the nominal current $I_{2N,PU}$.
2. Determine the derating factors for installation altitude and surrounding temperature.
3. Calculate the reduced nominal current $I_{2N,PU}$ according to the following formula:
   $I_{2N,PU} = I_{2N,PU} \times D_T \times D_{IA}$

A drive controller of type SI6A061 will be operated at a clock frequency of 8 kHz at an altitude of 1500 m above sea level and an surrounding temperature of 50 °C.

The nominal current of the SI6A061 at 8 kHz is 4.5 A. The derating factor D_T is calculated as follows:
D_T = 100 % − 5 × 2.5 % = 87.5 %

The derating factor D_{IA} is calculated as follows:
D_{IA} = 100 % − 5 × 1.5 % = 92.5 %

The output current to be observed for the project configuration is:
$I_{2N,PU}$ = 4.5 A × 0.875 × 0.925 = 3.64 A

3.2.4.5 Dimensions

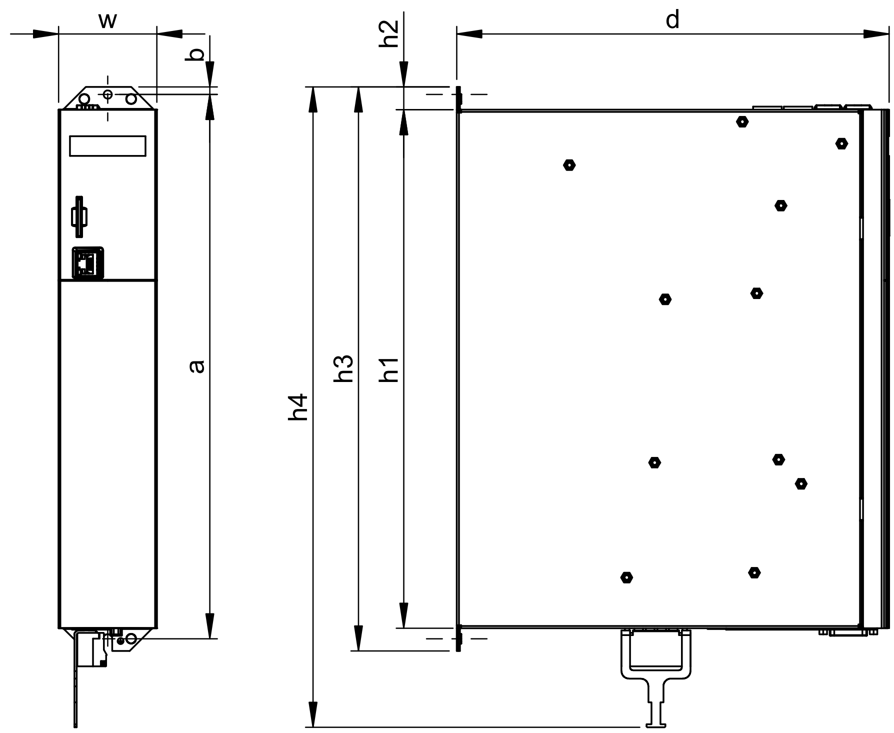


Fig. 5: SI6 dimensional drawing

<table>
<tr><th colspan="3">Dimension</th><th>Size 0</th><th>Size 1</th><th>Size 2</th></tr>
<tr><td rowspan="6">Drive controller</td><td>Body height</td><td>h1</td><td colspan="3">343</td></tr>
<tr><td>Fastening clip height</td><td>h2</td><td colspan="3">15</td></tr>
<tr><td>Height incl. fastening clips</td><td>h3</td><td colspan="3">373</td></tr>
<tr><td>Total height incl. shield connection</td><td>h4</td><td colspan="3">423</td></tr>
<tr><td>Width</td><td>w</td><td>45</td><td colspan="2">65</td></tr>
<tr><td>Depth</td><td>d</td><td>265</td><td colspan="2">286</td></tr>
<tr><td rowspan="2">Fastening holes (M5)</td><td>Vertical distance</td><td>a</td><td colspan="3">360+2</td></tr>
<tr><td>Vertical distance to upper edge</td><td>b</td><td colspan="3">5</td></tr>
</table>

Tab. 29: Dimensions SI6 [mm]

3.2.4.6 Weight

Weight	SI6A061	SI6A062	SI6A161	SI6A162	SI6A261
Without packaging	3.0 kg	3.5 kg	3.9 kg	4.9 kg	4.8 kg
With packaging	4.6 kg	5.1 kg	5.3 kg	6.3 kg	6.2 kg

Tab. 30: Weight SI6

3.2.5 DC link connection

The following section contains specifications for the electrical data, dimensions and weight of the DL6B Quick DC-Link modules.

DL6B is available in the following designs suitable for the individual drive controller and supply module types:

Type	DL6B10	DL6B11	DL6B20	DL6B21
ID no.	56655	56656	56657	56658
SI6A061	X	—	—	—
SI6A062	X	—	—	—
SI6A161	—	X	—	—
SI6A162	—	X	—	—
SI6A261	—	X	—	
PS6A24	—	—	X	—
PS6A34	—	—	—	X

Tab. 31: Assignment DL6B for SI6 and PS6

3.2.5.1 Electrical data

When designing and operating the Quick DC-Link, always observe the electrical data of the individual drive controller and supply module types. The maximum DC link voltage is 750 V_{DC} and the maximum permitted total current is 200 A.

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3.2.5.2 Dimensions

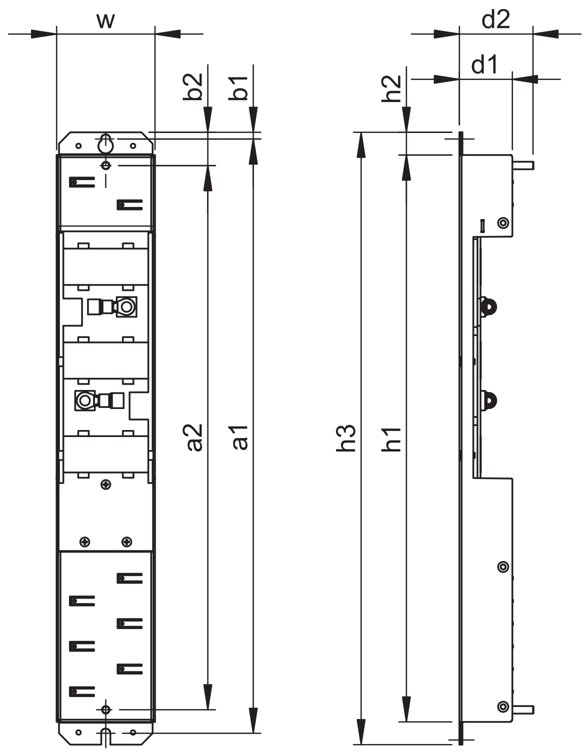


Fig. 6: DL6B dimensional drawing

Dimension			DL6B10 DL6B20	DL6B11 DL6B21
Quick DC-Link	Height	h1	375	
	Fastening clip height	h2	15	
	Height incl. fastening clips	h3	405	
	Width	w	45	65
	Depth	d1	35	
	Depth incl. attachment bolts	d2	49	
Fastening holes	Vertical distance (wall mounting)	a1	393+2	
	Vertical distance (module mounting)	a2	360	
	Vertical distance to upper edge	b1	4.5	
	Vertical distance to upper edge	b2	22	

Tab. 32: Dimensions DL6B [mm]

3.2.5.3 Weight

Weight	DL6B10	DL6B11	DL6B20	DL6B21
With / without packaging	0.5 kg	0.6 kg	0.6 kg	0.8 kg

Tab. 33: Weight DL6B

3.2.6 Minimum clearances

The specified dimensions refer to the outside edges of the drive controller or supply module.

Fig. 7: Minimum clearances

Minimum clearance	A (above)	B (below)	C (on the side)
All sizes	100	200	5

Tab. 34: Minimum clearances for the multi-axis drive system [mm]

3.3 Drive controller/motor combinations

EZ Synchronous servo motor (n_N = 3000 rpm) – SI6

						SI6A061 SI6A062	SI6A161 SI6A162	SI6A261	SI6A061 SI6A062	SI6A161 SI6A162	SI6A261
$f_{PWM,PU}$						4 kHz			8 kHz		
	K_{EM} [V/1000 rpm]	M_N [Nm]	$I_{N,MOT}$ [A]	M_0 [Nm]	I_0 [A]	$I_{2N,PU}$= 5 A	$I_{2N,PU}$= 12 A	$I_{2N,PU}$= 22 A	$I_{2N,PU}$= 4.5 A	$I_{2N,PU}$= 10 A	$I_{2N,PU}$= 20 A
Convection cooling of IC 410						$I_{2N,PU}$ / I_0					
EZ301U	40	0.93	1.99	0.95	2.02	2.5			2.2		
EZ302U	86	1.59	1.6	1.68	1.67	3.0			2.7		
EZ303U	109	2.07	1.63	2.19	1.71	2.9			2.6		
EZ401U	96	2.8	2.74	3	2.88	1.7			1.6		
EZ402U	94	4.7	4.4	5.2	4.8	1.0				2.1	
EZ404U	116	6.9	5.8	8.6	6.6		1.8			1.5	
EZ501U	97	4.3	3.74	4.7	4	1.3			1.1		
EZ502U	121	7.4	5.46	8	5.76		2.1			1.7	
EZ503U	119	9.7	6.9	11.1	7.67		1.6			1.3	
EZ505U	141	13.5	8.8	16	10		1.2	2.0		1.0	2.0
EZ701U	95	7.4	7.2	8.3	8		1.5			1.3	
EZ702U	133	12	8.2	14.4	9.6		1.3			1.0	2.1
EZ703U	122	16.5	11.4	20.8	14			1.6			1.4
EZ705U	140	21.3	14.2	30.2	19.5			1.1			1.0
Forced ventilation IC 416						$I_{2N,PU}$ / I_0					
EZ401B	96	3.4	3.4	3.7	3.6	1.4			1.3		
EZ402B	94	5.9	5.5	6.3	5.8		2.1			1.7	
EZ404B	116	10.2	8.2	11.2	8.7		1.4			1.1	
EZ501B	97	5.4	4.7	5.8	5	1.0				2.0	
EZ502B	121	10.3	7.8	11.2	8.16		1.5			1.2	
EZ503B	119	14.4	10.9	15.9	11.8		1.0	1.9			1.7
EZ505B	141	20.2	13.7	23.4	14.7			1.5			1.4
EZ701B	95	9.7	9.5	10.5	10		1.2	2.2		1.0	2.0
EZ702B	133	16.6	11.8	19.3	12.9			1.7			1.6
EZ703B	122	24	18.2	28	20			1.1			1.0
Water cooling						$I_{2N,PU}$ / I_0					
EZ401W	96	3.3	3.7	3.55	3.9	1.3			1.2		
EZ402W	94	5.85	5.5	6.35	6		2.0			1.7	
EZ404W	116	10.4	8.3	11.3	8.9		1.3			1.1	
EZ501W	97	5.4	4.75	5.65	4.85	1.0				2.1	
EZ502W	121	10.2	7.7	11	7.85		1.5			1.3	
EZ503W	119	13.5	10.2	15.2	11.3		1.1	1.9			1.8
EZ505W	141	17.9	11.4	21.5	13.1			1.7			1.5
EZ701W	95	10.2	9.95	10.4	10		1.2	2.2		1.0	2.0
EZ702W	133	17.1	12.2	19.3	13.1			1.7			1.5
EZ703W	122	22.5	17	27.5	19.6			1.1			1.0

EZ Synchronous servo motor (n_N = 4500 rpm) – SI6

						SI6A061 SI6A062	SI6A161 SI6A162	SI6A261	SI6A061 SI6A062	SI6A161 SI6A162	SI6A261
$f_{PWM,PU}$							4 kHz			8 kHz	
	K_{EM} [V/1000 rpm]	M_N [Nm]	$I_{N,MOT}$ [A]	M_0 [Nm]	I_0 [A]	$I_{2N,PU}$= 5 A	$I_{2N,PU}$= 12 A	$I_{2N,PU}$= 22 A	$I_{2N,PU}$= 4.5 A	$I_{2N,PU}$= 10 A	$I_{2N,PU}$= 20 A
Convection cooling of IC 410						$I_{2N,PU}$ / I_0					
EZ505U	103	9.5	8.9	15.3	13.4			1.6			1.5
EZ703U	99	12.1	11.5	20	17.8			1.2			1.1
Forced ventilation IC 416						$I_{2N,PU}$ / I_0					
EZ505B	103	16.4	16.4	22	19.4			1.1			1.0
Water cooling						$I_{2N,PU}$ / I_0					
EZ505W	103	14.2	13	20.2	17.2			1.3			1.2

EZ Synchronous servo motor (n_N = 6000 rpm) – SI6

						SI6A061 SI6A062	SI6A161 SI6A162	SI6A261	SI6A061 SI6A062	SI6A161 SI6A162	SI6A261
$f_{PWM,PU}$							4 kHz			8 kHz	
	K_{EM} [V/1000 rpm]	M_N [Nm]	$I_{N,MOT}$ [A]	M_0 [Nm]	I_0 [A]	$I_{2N,PU}$= 5 A	$I_{2N,PU}$= 12 A	$I_{2N,PU}$= 22 A	$I_{2N,PU}$= 4.5 A	$I_{2N,PU}$= 10 A	$I_{2N,PU}$= 20 A
Convection cooling of IC 410						$I_{2N,PU}$ / I_0					
EZ301U	40	0.89	1.93	0.95	2.02	2.5			2.2		
EZ302U	42	1.5	3.18	1.68	3.48	1.4			1.3		
EZ303U	55	1.96	3.17	2.25	3.55	1.4			1.3		
EZ401U	47	2.3	4.56	2.8	5.36		2.2			1.9	
EZ402U	60	3.5	5.65	4.9	7.43		1.6			1.3	
EZ404U	78	5.8	7.18	8.4	9.78		1.2			1.0	2.0
EZ501U	68	3.4	4.77	4.4	5.8		2.1			1.7	
EZ502U	72	5.2	7.35	7.8	9.8		1.2			1.0	2.0
EZ503U	84	6.2	7.64	10.6	11.6		1.0	1.9			1.7
EZ701U	76	5.2	6.68	7.9	9.38		1.3			1.1	2.1
EZ702U	82	7.2	8.96	14.3	16.5			1.3			1.2
Forced ventilation IC 416						$I_{2N,PU}$ / I_0					
EZ401B	47	2.9	5.62	3.5	6.83		1.8			1.5	
EZ402B	60	5.1	7.88	6.4	9.34		1.3			1.1	2.1
EZ404B	78	8	9.98	10.5	12		1.0	1.8			1.7
EZ501B	68	4.5	6.7	5.7	7.5		1.6			1.3	
EZ502B	72	8.2	11.4	10.5	13.4			1.6			1.5
EZ503B	84	10.4	13.5	14.8	15.9			1.4			1.3
EZ701B	76	7.5	10.6	10.2	12.4			1.8			1.6
Water cooling						$I_{2N,PU}$ / I_0					
EZ401W	47	2.55	5.2	3.35	6.95		1.7			1.4	
EZ402W	60	5	8	6.45	9.7		1.2			1.0	2.1
EZ404W	78	7.7	10.5	10.6	12.3			1.8		1.4	1.6
EZ501W	68	4.3	6.4	5.55	7.25		1.7				
EZ502W	72	8.1	11.2	10.3	12.9			1.7			1.6
EZ503W	84	9.95	12.6	14.2	15.2			1.4			1.3
EZ701W	76	7	10.2	10.4	12.7			1.7			1.6

EZHD synchronous servo motor with hollow shaft and direct drive (n_N = 3000 rpm) – SI6

						SI6A061 SI6A062	SI6A161 SI6A162	SI6A261	SI6A061 SI6A062	SI6A161 SI6A162	SI6A261
$f_{PWM,PU}$							4 kHz			8 kHz	
	K_{EM} [V/1000 rpm]	M_N [Nm]	$I_{N,MOT}$ [A]	M_0 [Nm]	I_0 [A]	$I_{2N,PU}$= 5 A	$I_{2N,PU}$= 12 A	$I_{2N,PU}$= 22 A	$I_{2N,PU}$= 4.5 A	$I_{2N,PU}$= 10 A	$I_{2N,PU}$= 20 A
Convection cooling of IC 410						$I_{2N,PU}$ / I_0					
EZHD0411U	96	1.9	2.36	2.6	2.89	1.7			1.6		
EZHD0412U	94	4.2	4.29	5.1	4.94	1.0				2.0	
EZHD0414U	116	7.7	6.3	8.5	6.88		1.7			1.5	
EZHD0511U	97	3	3.32	4.1	4.06	1.2			1.1		
EZHD0512U	121	7.0	5.59	7.8	6.13		2.0			1.6	
EZHD0513U	119	8.3	7.04	10.9	8.76		1.4			1.1	
EZHD0515U	141	14	9.46	16.4	11		1.1	2.0			1.8
EZHD0711U	95	7.3	7.53	7.9	7.98		1.5			1.3	
EZHD0712U	133	11.6	8.18	14.4	9.99		1.2			1.0	2.0
EZHD0713U	122	17.8	13.4	20.4	15.1			1.5			1.3
EZHD0715U	140	24.6	17.2	31.1	21.1			1.0			

EZHP synchronous servo motor with hollow shaft and attached planetary gear unit (n_N = 3000 rpm) – SI6

						SI6A061 SI6A062	SI6A161 SI6A162	SI6A261	SI6A061 SI6A062	SI6A161 SI6A162	SI6A261
$f_{PWM,PU}$							4 kHz			8 kHz	
	K_{EM} [V/1000 rpm]	M_N [Nm]	$I_{N,MOT}$ [A]	M_0 [Nm]	I_0 [A]	$I_{2N,PU}$= 5 A	$I_{2N,PU}$= 12 A	$I_{2N,PU}$= 22 A	$I_{2N,PU}$= 4.5 A	$I_{2N,PU}$= 10 A	$I_{2N,PU}$= 20 A
Convection cooling of IC 410						$I_{2N,PU}$ / I_0					
EZHP_511U	97	3	3.32	4.1	4.06	1.2			1.1		
EZHP_512U	121	7.0	5.59	7.8	6.13		2.0			1.6	
EZHP_513U	119	8.3	7.04	10.9	8.76		1.4			1.1	
EZHP_515U	141	14	9.46	16.4	11		1.1	2.0			1.8
EZHP_711U	95	7.3	7.53	7.9	7.98		1.5			1.3	
EZHP_712U	133	11.6	8.18	14.4	9.99		1.2			1.0	2.0
EZHP_713U	122	17.8	13.4	20.4	15.1			1.5			1.3
EZHP_715U	140	24.6	17.2	31.1	21.1			1.0			
Water cooling						$I_{2N,PU}$ / I_0					
EZHP_511W	97	4.1	4.5	4.8	4.79	1.0				2.1	
EZHP_512W	121	8.15	6.54	9	7.07		1.7			1.4	
EZHP_513W	119	9.7	8.23	12.3	9.89		1.2			1.0	2.0
EZHP_515W	141	16.2	11	18.6	12.5			1.8			1.6
EZHP_711W	95	8.3	8.58	9.1	9.18		1.3			1.1	2.2
EZHP_712W	133	13.6	9.6	16.6	11.5		1.0	1.9			1.7
EZHP_713W	122	20.8	15.7	23.7	17.5			1.3			1.1

EZS synchronous servo motor for screw drive (driven threaded spindle) (n_N = 3000 rpm) – SI6

						SI6A061 SI6A062	SI6A161 SI6A162	SI6A261	SI6A061 SI6A062	SI6A161 SI6A162	SI6A261
$f_{PWM,PU}$						4 kHz			8 kHz		
	K_{EM} [V/1000 rpm]	M_N [Nm]	$I_{N,MOT}$ [A]	M_0 [Nm]	I_0 [A]	$I_{2N,PU}$= 5 A	$I_{2N,PU}$= 12 A	$I_{2N,PU}$= 22 A	$I_{2N,PU}$= 4.5 A	$I_{2N,PU}$= 10 A	$I_{2N,PU}$= 20 A
Convection cooling of IC 410						$I_{2N,PU}$ / I_0					
EZS501U	97	3.85	3.65	4.3	3.95	1.3					
EZS502U	121	6.9	5.3	7.55	5.7		2.1			1.8	
EZS503U	119	9.1	6.7	10.7	7.6		1.6			1.3	
EZS701U	95	6.65	6.8	7.65	7.7		1.6			1.3	
EZS702U	133	11	7.75	13.5	9.25		1.3			1.1	2.2
EZS703U	122	15.3	10.8	19.7	13.5			1.6			1.5
Forced ventilation IC 416						$I_{2N,PU}$ / I_0					
EZS501B	97	5.1	4.7	5.45	5	1.0				2.0	
EZS502B	121	10	7.8	10.9	8.16		1.5			1.2	
EZS503B	119	14.1	10.9	15.6	11.8		1.0	1.9			1.7
EZS701B	95	9.35	9.5	10.2	10		1.2	2.2		1.0	2.0
EZS702B	133	16.3	11.8	19	12.9			1.7			1.6
EZS703B	122	23.7	18.2	27.7	20			1.1			1.0
Water cooling						$I_{2N,PU}$ / I_0					
EZS501W	97	5.1	4.75	5.3	4.85	1.0				2.1	
EZS502W	121	9.9	7.7	10.7	7.85		1.5			1.3	
EZS503W	119	13.2	10.2	14.9	11.3		1.1	1.9			1.8
EZS701W	95	9.85	9.95	10	10		1.2	2.2		1.0	2.0
EZS702W	133	16.8	12.2	18.9	13.1			1.7			1.5
EZS703W	122	22.1	17	27.1	19.6			1.1			1.0

EZM synchronous servo motor for screw drive (driven spindle nut) (n_N = 3000 rpm) – SI6

						SI6A061 SI6A062	SI6A161 SI6A162	SI6A261	SI6A061 SI6A062	SI6A161 SI6A162	SI6A261
$f_{PWM,PU}$						4 kHz			8 kHz		
	K_{EM} [V/1000 rpm]	M_N [Nm]	$I_{N,MOT}$ [A]	M_0 [Nm]	I_0 [A]	$I_{2N,PU}$= 5 A	$I_{2N,PU}$= 12 A	$I_{2N,PU}$= 22 A	$I_{2N,PU}$= 4.5 A	$I_{2N,PU}$= 10 A	$I_{2N,PU}$= 20 A
Convection cooling of IC 410						$I_{2N,PU}$ / I_0					
EZM511U	97	3.65	3.55	4.25	4	1.3			1.1		
EZM512U	121	6.6	5.2	7.55	5.75		2.1			1.7	
EZM513U	119	8.8	6.55	10.6	7.6		1.6			1.3	
EZM711U	95	6.35	6.6	7.3	7.4		1.6			1.4	
EZM712U	133	10.6	7.5	13	8.9		1.3			1.1	
EZM713U	122	14.7	10.4	18.9	13			1.7			1.5
Water cooling						$I_{2N,PU}$ / I_0					
EZM511W	97	4.95	4.75	5.2	4.85	1.0				2.1	
EZM512W	121	9.75	7.7	10.6	7.85		1.5			1.3	
EZM513W	119	13.1	10.2	14.8	11.3		1.1	1.9			1.8
EZM711W	95	9.8	9.95	10	10		1.2	2.2		1.0	2.0
EZM712W	133	16.7	12.2	18.8	13.1			1.7			1.5
EZM713W	122	22	17	27.1	19.6			1.1			1.0

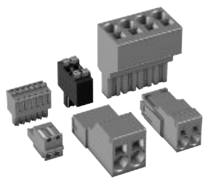
3.4 Accessories

Information about the available accessories can be found in the following sections.

3.4.1 Terminal strip

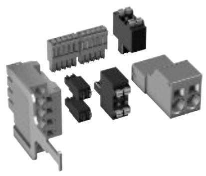
You need suitable terminal strips for the connection for each PS6 supply module and for each SI6 drive controller.

Terminal strip for supply module



The following versions are available:
ID no. 138660
Terminal strip for PS6A24.
ID no. 138661
Terminal strip for PS6A34.

Terminal strip for drive controller



The following versions are available:
ID no. 138655
Terminal strip for SI6A061Z/Y.
ID no. 138656
Terminal strip for SI6A062Z/Y.
ID no. 138657
Terminal strip for SI6A161Z/Y.
ID no. 138658
Terminal strip for SI6A162Z/Y.
ID no. 138659
Terminal strip for SI6A261Z/Y.

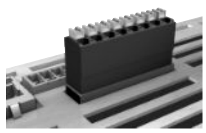
3.4.2 Safety technology

Note: the SI6 drive controller is delivered as a standard version without safety technology. If you want a SI6 drive controller with integrated safety technology, you must order it together with the drive controller. The safety modules are an integrated part of the drive controllers and must not be modified.

Option SZ6 – without safety technology

ID no. 56660
Standard version.

Safety module SR6 – STO via terminals



ID no. 56661
Optional accessories for using the Safe Torque Off (STO) safety function in safety-relevant applications (PL e / SIL 3) according to DIN EN ISO 13849-1 and DIN EN 61800-5-2. Connection to higher-level safety circuit via terminal X12 (included in the scope of delivery, ID no. 56531).

Safety module SY6 – STO and SS1 via FSoE

Safety over EtherCAT

ID no. 56662
Optional accessory for using the Safe Torque Off (STO) and Safe Stop 1 (SS1) safety functions in safety-relevant applications (PL e / SIL 3) according to DIN EN ISO 13849-1 and DIN EN 61800-5-2. Connection to the higher-level safety circuit via Fail Save over EtherCAT (FSoE).

3.4.3 Communication

The SI6 drive controller has two interfaces for the EtherCAT connection on the top of the device as well as via an Ethernet service interface on the front of the device. Cables for the connection are available separately.

EtherCAT cable

Ethernet patch cable, CAT5e, yellow.
The following versions are available:
ID no. 49313: length approx. 0.2 m.
ID no. 49314: length approx. 0.35 m.

PC connecting cable

ID no. 49857
Cable for connecting the service interface X9 with the PC, CAT5e, blue, 5m.

Hi-speed USB 2.0 Ethernet adapter

ID no. 49940
Adapter for connecting Ethernet to a USB connection.

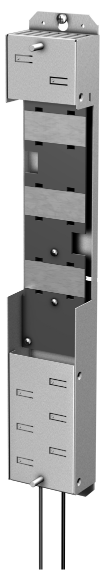
3.4.4 DC link connection

For the energy supply of the existing drive controllers in the group, you need suitable Quick DC-Link modules of type DL6B for each PS6 supply module and for each SI6 drive controller.

For the horizontal connection, you receive the DL6B substructures in different designs, suitable for the size of the drive controller or supply module.

The quick fastening clamps for attaching the copper rails are included in the scope of delivery. The copper rails are not included in the scope of delivery. These must have a cross-section of 5 x 12 mm. Insulation end sections are available separately.

Quick DC-Link DL6B for drive controller



The following versions are available:
DL6B10
ID no. 56655
Substructure element for drive controllers of size 0.
DL6B11
ID no. 56656
Substructure element for drive controller of size 1 or 2.

Quick DC-Link DL6B for supply module

The following versions are available:

DL6B20

ID no. 56657

Substructure element for supply module of size 2.

DL6B21

ID no. 56658

Substructure element for supply module of size 3.

Quick DC-Link DL6B insulation end section

ID no. 56659

Insulation end sections for the left and right termination of the group, 2 pcs.

3.4.5 Braking resistor

In addition to the supply modules, STOBER offers braking resistors in different sizes and performance classes described in the following. When selecting, note the minimum permitted braking resistances specified in the technical data of the supply modules.

3.4.5.1 Flat resistor KWADQU 420×91

Properties

Specification	KWADQU 420×91
ID no.	56634
Type	Flat resistor with temperature switch (incl. mounting bracket)
Resistance [Ω]	100
Power [W]	600
Thermal time constant τ_{th} [s]	60
Pulse power for < 1 s [kW]	13
U_{max} [V]	848
Cable design	FEP
Cable length [mm]	500
Cable cross-section [AWG]	14/19 (1.9 mm²)
Weight [kg]	Approx. 2.6
Protection class	IP54
Test marks	c UL us

Tab. 35: Specification KWADQU 420×91

Dimensions

Dimension	KWADQU 420×91
A	420

Tab. 36: Dimensions KWADQU 420×91 [mm]

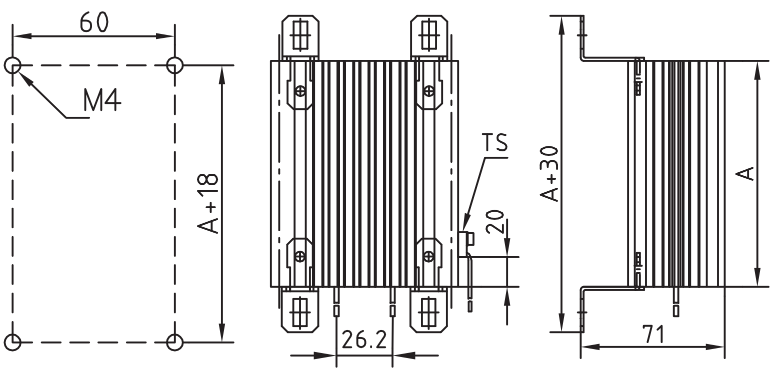


Fig. 8: Dimensional drawing KWADQU 420×91

3.4.5.2 Tubular fixed resistor FZZMQU 400×65

Properties

Specification	FZZMQU 400×65
ID no.	56635
Type	Tubular fixed resistor with temperature switch
Resistance [Ω]	47
Power [W]	1200
Thermal time constant τ_{th} [s]	40
Pulse power for < 1 s [kW]	36
U_{max} [V]	848
Weight [kg]	Approx. 4.2
Protection class	IP20
Test marks	cULus

Tab. 37: Specification FZZMQU 400×65

Dimensions

Dimension	FZZMQU 400×65
L × D	400 × 65
H	120
K	6.5 × 12
M	426
O	475
R	185
U	150

Tab. 38: Dimensions FZZMQU 400×65 [mm]

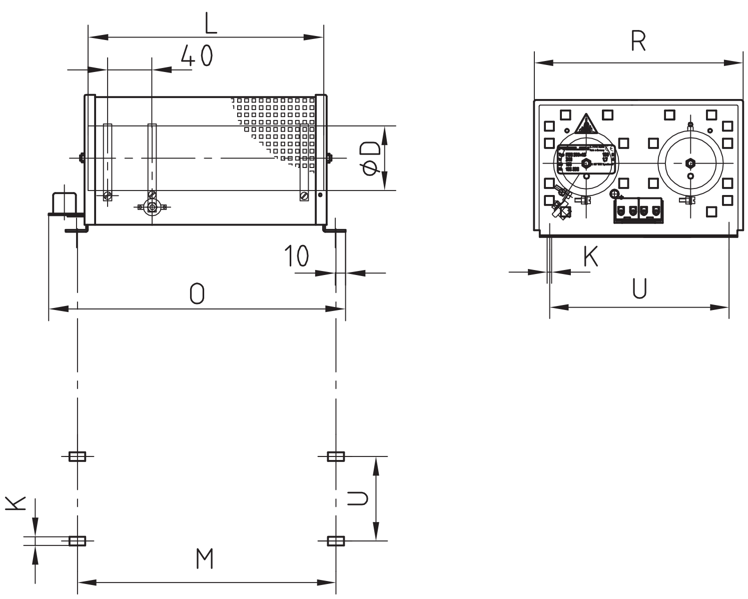


Fig. 9: Dimensional drawing FZZMQU 400×65

3.4.5.3 Steel-grid fixed resistor FGFKQU 31005

Properties

Specification	FGFKQU 31005
ID no.	56636
Type	Steel-grid fixed resistor with temperature switch
Resistance [Ω]	22
Power [W]	2500
Thermal time constant τ_{th} [s]	30
Pulse power for < 1 s [kW]	50
U_{max} [V]	848
Weight [kg]	Approx. 7.5
Protection class	IP20
Test marks	cULus

Tab. 39: Specification FGFKQU 31005

Dimensions

Dimension	FGFKQU 31005
A	270
B	295
C	355

Tab. 40: Dimensions FGFKQU 31005 [mm]

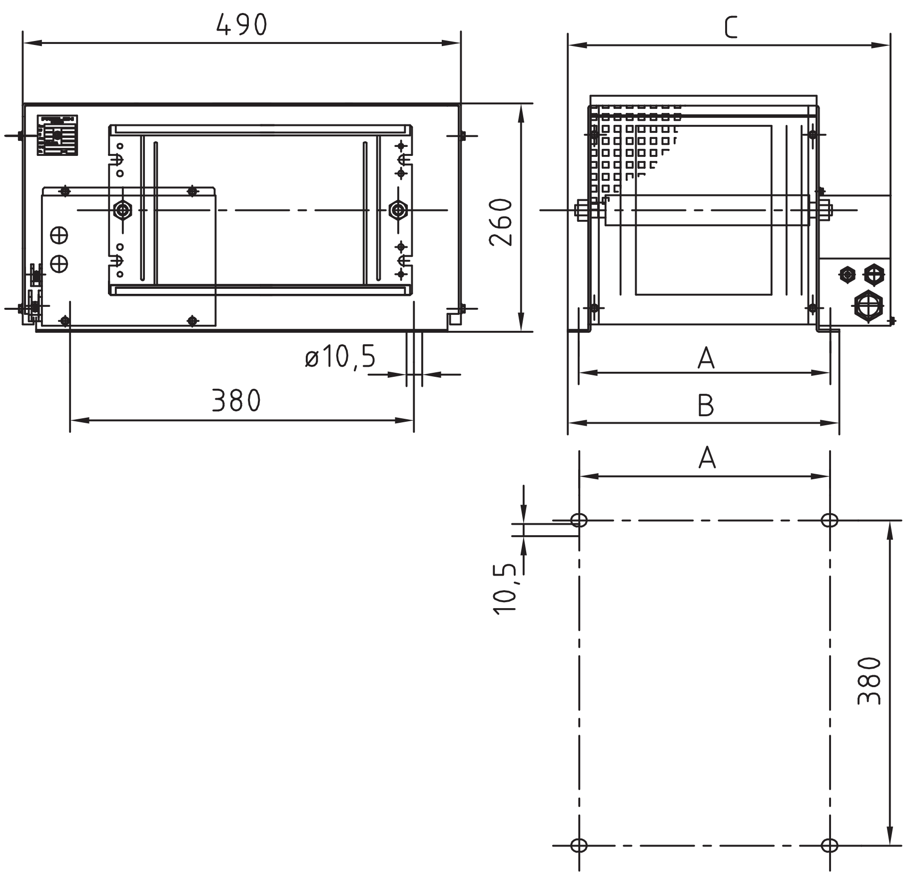


Fig. 10: Dimensional drawing FGFKQU 31005

3.4.6 Output choke

Technical specifications for suitable output chokes can be found in the following sections. Output choke are required with a cable length > 50 m.

3.4.6.1 Output choke TEP

Information

The following technical data applies for a rotary field frequency of 200 Hz. For example, this rotary field frequency is achieved with a motor with 4 pole pairs and a nominal speed of 3000 rpm. Always observe the specified derating for higher rotary field frequencies. Also observe the dependency of the cycle frequency.

Properties

Specification	TEP3720-0ES41	TEP3820-0CS41	TEP4020-0RS41
ID no.	53188	53189	53190
Voltage range	3 × 0 bis 480 V		
Frequency range	0 – 200 Hz		
I_N at 4 kHz	4 A	17.5 A	38 A
I_N at 8 kHz	3.3 A	15.2 A	30.4 A
Max. permitted motor cable length with output choke	100 m		
Max. surrounding temperature $\vartheta_{amb,max}$	40 °C		
Design	Open		
Winding losses	11 W	29 W	61 W
Iron losses	25 W	16 W	33 W
Connections	Screw terminals		
Max. conductor cross-section	10 mm²		
UL Recognized Component (CAN; USA)	Yes		
Test marks	cURus		

Tab. 41: Specification TEP

Projecting

Select the output chokes according to the rated currents of the motor and output chokes. In particular, observe the derating of the output choke for rotary field frequencies higher than 200 Hz. You can calculate the rotary field frequency for your drive with the following formula:

$$f = n_N \times \frac{p}{60}$$

f	Rotary field frequency in Hz
n	Speed in rpm
N	Nominal value
p	Number of pole pairs

Derating

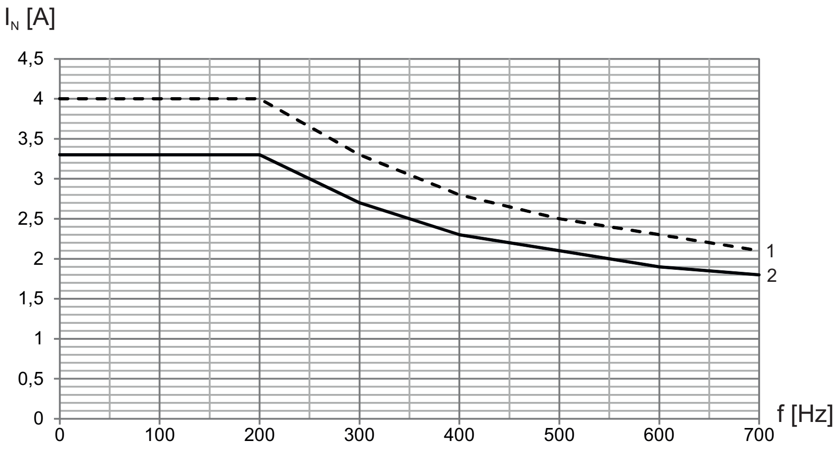


Fig. 11: Derating TEP3720-0ES41

1	Clock frequency 4 kHz
2	Clock frequency 8 kHz

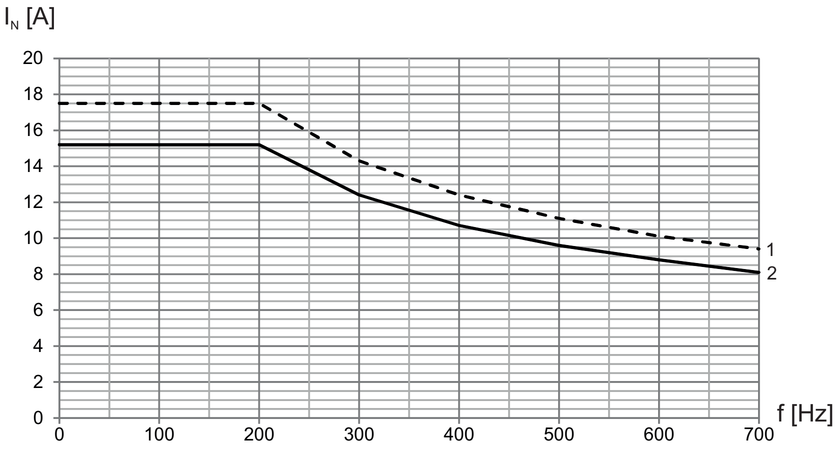


Fig. 12: Derating TEP3820-0CS41

1	Clock frequency 4 kHz
2	Clock frequency 8 kHz

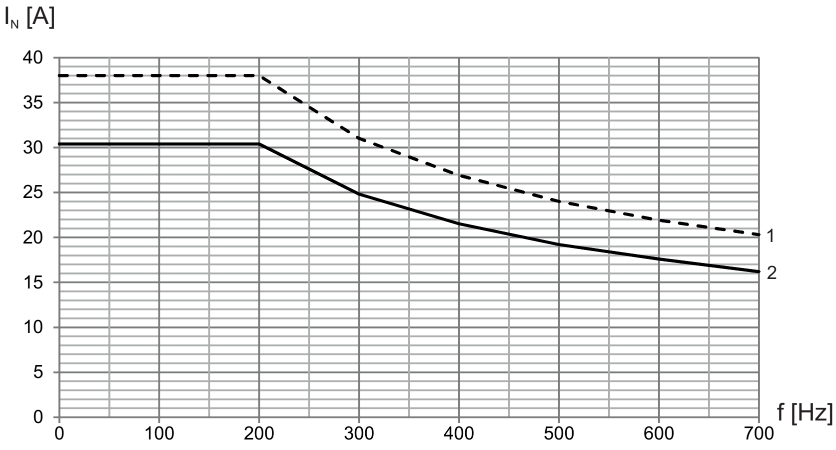


Fig. 13: Derating TEP4020-0RS41

1	Clock frequency 4 kHz
2	Clock frequency 8 kHz

Dimensions and weight

Dimension	TEP3720-0ES41	TEP3820-0CS41	TEP4020-0RS41
Height h [mm]	Max. 153	Max. 153	Max. 180
Width w [mm]	178	178	219
Depth d [mm]	73	88	119
Vertical distance – fastening holes a1 [mm]	166	166	201
Vertical distance – fastening holes a2 [mm]	113	113	136
Horizontal distance – fastening holes b1 [mm]	53	68	89
Horizontal distance – fastening holes b2 [mm]	49	64	76
Drill holes – depth e [mm]	5.8	5.8	7
Drill holes – width f [mm]	11	11	13
Screw connection – M	M5	M5	M6
Weight [kg]	2.9	5.9	8.8

Tab. 42: Dimensions and weight TEP

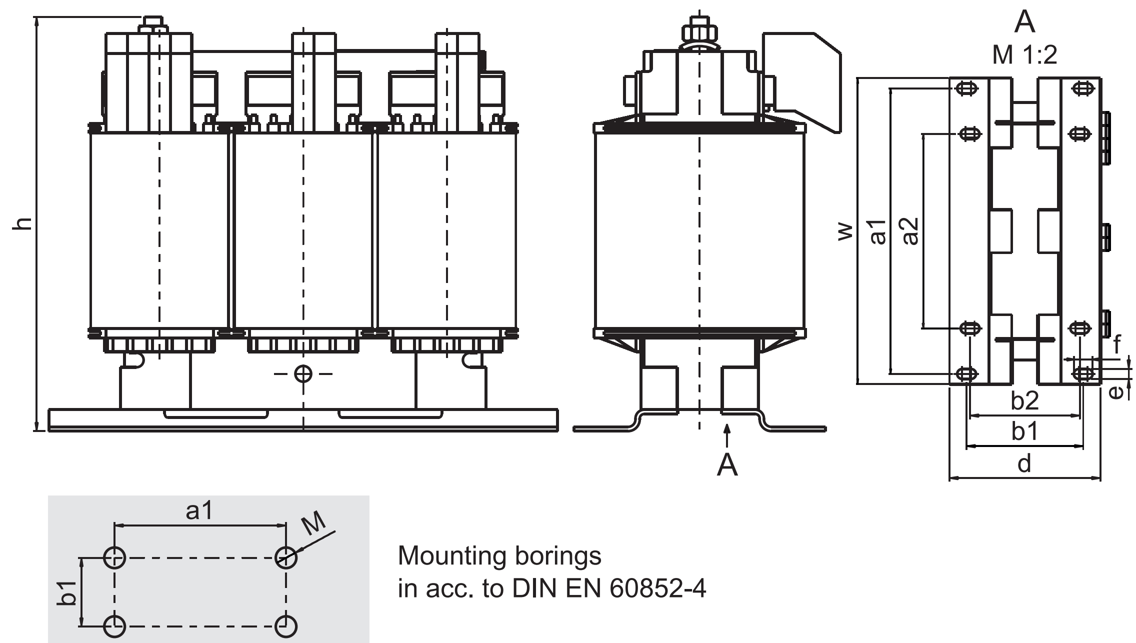


Fig. 14: Dimensional drawing TEP

3.5 Further information

3.5.1 Symbols, identifiers and test symbols

Grounding symbol
according to IEC 60417-5019 (DB:2002-10).

Lead-free identifier RoHS
according to RoHS directive 2011-65-EU.

CE mark
Manufacturer's self declaration: The product meets the requirements of EU directives.

UL-test mark
This product is listed by UL for the USA and Canada. Representative samples of this product have been evaluated by UL and meet the requirements of applicable standards.

UL test marks for recognized components
This component or material is recognized by UL. Representative samples of this product have been evaluated by UL and meet applicable requirements.

4 SD6 drive controller

Table of contents

4.1 Overview

SD6 – high performance and flexibility

- Control of linear and rotary synchronous and asynchronous motors
- Nominal output current up to 85 A
- 250 % overload capacity
- Communication via CANopen, EtherCAT or PROFINET
- Isochronic system bus (IGB) for parameterization and multi-axis applications
- Multi-functional encoder interfaces
- Digital and analog inputs and outputs
- Automatic motor parameterization from the electronic motor nameplate
- Integrated brake chopper
- Integrated holding brake controller
- Integrated line filter
- Flexible DC link connection for multi-axis applications
- Safe Torque Off (STO) in the standard version (SIL 3/PL e)
- Fast commissioning with DriveControlSuite software
- Convenient control unit consisting of graphical display and sensor keys
- One-Touch-Save-Taste
- Removable data storage Paramodule for commissioning and service
- Secured remote maintenance concept

SD6

4.1.1 Features

The SD6 drive controller from the 6th generation of STOBER drive controllers is available in four sizes with a nominal output current up to 85 A. The SD6 offers maximum precision and productivity for automation technology and machine manufacturing despite ever more complex functions. Highly dynamic drives ensure the shortest recovery times from fast changes in reference value and load jumps. There is also an option of connecting the drive controllers in a DC intermediate circuit for multi-axis applications, which improves the energy footprint of the entire system.

SD6 drive controllers

32-bit Dual-Core

The control unit of the SD6 with a 32-bit dual-core processor opens up new dimensions in terms of precise movements and dynamics. The position, speed and torque control of the servo axes are calculated at a cycle time of 62.5 µs (16 kHz). This ensures the shortest recovery times from fast changes in reference value and load jumps.

Fully electronic STO as a standard feature

There is already a wear-free, fully electronic interface for the Safe Torque Off (STO) safety function available in the standard series version.
The technologically innovative solution works without any system tests interrupting production. In practical terms this means an impressive increase in the availability of machines and systems.
Time-consuming planning and documentation of tests are also eliminated. In multi-axis applications with SD6 drive controllers, the STO safety function can simply be looped through.
The safety-relevant functions were developed together with Pilz GmbH & Co. KG.

pilz
the spirit of safety
Safety in Motion

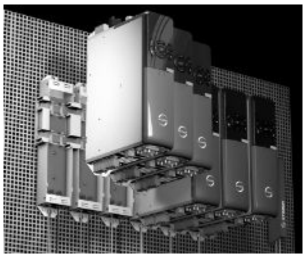
TÜV certification makes it possible to use SD6 drive controllers even in applications with challenging safety requirements.

- SIL 3, HFT 1 according to EN 61800-5-2
- PL e, category 4 according to EN ISO 13849

TÜV SÜD
No. Z10 13 04 84451 001

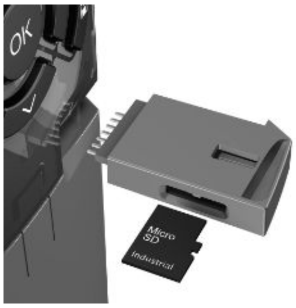
Quick DC-Link

All the product types of the SD6 drive controller have the option for DC link connection. This technology makes it possible for the regeneratively produced energy of one drive to be used as motor energy by another drive. The Quick DC-Link rear structure element was developed to set up a reliable and efficient rail connection to the DC link connection. This optionally available accessory connects the DC links of the individual drive controllers by means of copper rails that can carry a load of up to 200 A. The rails can be attached without a tool using quick fastening clamps.



Paramodule removable data storage

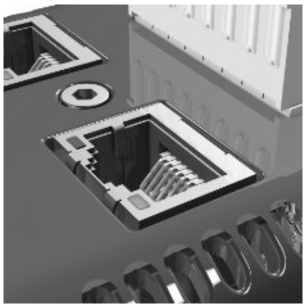
Removable data storage with integrated microSD card is available for fast series commissioning by copying and for easy service when replacing devices. It represents the ideal medium for saving additional project data and documentation and can be used for direct editing on the PC.



Integrated bus (IGB)

SD6 drive controllers have two interfaces for the integrated bus in the standard version. The integrated bus is used for easy project planning via Ethernet and isochronic data exchange for the following functions:

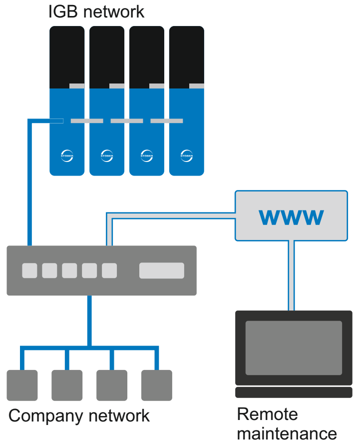
- Direct connection for remote maintenance of individual and multiple drive controllers
- Direct connection between one or more drive controllers and a PC



Interface for Integrated Bus

STOBER remote maintenance

STOBER remote maintenance using the commissioning software can be used to perform all processes and sequence just as for on-site service operations. The concept guides users through a controlled and protected procedure. This ensures that the responsible employee is at the machine on site to pay attention to special features and personal safety. On the other end, the remote maintenance specialist is ensured that he is communicating with a responsible employee on site who is controlling the situation on the machine.



Remote maintenance can be used to perform all processes and sequence just as for on-site service operations.

Brake management

The drive controller SD6 can control a 24 V brake via the integrated brake controller. Brake management provides both functions for the brake system:

- Cyclic brake test
- Grind brake

4.1.2 Software components

Projecting and commissioning

The DriveControlSuite project planning and commissioning software of the 6th generation has all the functions for the efficient use of drive controllers in single-axis and multi-axis applications. The program guides you step by step through the complete project planning and parameterization process using wizards.

Open communication

Device communication via EtherCAT, CANopen or PROFINET is possible.

Applications

Using the **CiA 402 Controller Based** application in the drive controller, you can implement applications with synchronized, cyclic assignment of reference values (csp, csv, cst, ip) by a motion controller, type MC6, for example. In addition the drive controller can also independently apply motion tasks, for example referencing and jog when commissioning.

The drive-based operation modes of the CiA 402 with complete movement calculation and design due to the drive controller are also available. Using the **CiA 402 Drive Based** application, the reference values for position, velocity and torque/force (pp, pv, pt) are converted accurately and precisely to movements. Referencing and jog are performed with jerk limitation during commissioning.

Whenever universal and flexible solutions are necessary, the drive-based application package from STOBER is the appropriate choice. For the **STOBER Drive Based** application, a drive-based movement controller for positioning, velocity and torque/force is provided with the PLCopen Motion Control command set. These standard commands were combined into operation modes for different applications and supplemented with additional functions such as jerk limit, motion block linking, cams and much more. For the Command operation mode, all properties of the movements are specified directly by the controller. The properties of the movements in the drive are predefined in the Motion block operation mode so that only a start signal for the execution of the movement is necessary. Complete motion sequences can be defined by linking. There is a separate operation mode available for applications controlled by velocity or torque/force such as pumps, fans or conveyor belts. This also allows for operation without a controller.

4.1.3 Application training

STOBER offers a multi-level training program that focuses essentially on application programming of the motion controller and drive controller.

G6 Basic

Training content: system overview, assembly and commissioning of the drive controller. Use of option modules. Parameterization, commissioning and diagnostics via the commissioning software. Remote maintenance. Basics of controller optimization. Configuration of the drive train. Integrated software functions. Software applications. Connection to a higher-level controller. Basics of safety technology. Practical exercises for the training structure.

Software used: DriveControlSuite.

G6 Advanced

Training content: special knowledge for regulating, control and safety technology. Practical exercises for the training structure.

4.2 Technical Data

Technical data for drive controllers can be found in the following sections.

4.2.1 Formula symbol

Formula symbols	Unit	Explanation
D_{IA}	%	Reduction of the nominal current depending on the installation height
D_T	%	Reduction of the nominal current depending on the surrounding temperature
f_{2PU}	Hz	Output frequency of the power unit
$f_{PWM,PU}$	Hz	Internal pulse clock frequency of the power unit
I_{1maxCU}	A	Maximum input current of the control board
I_0	A	Standstill current: RMS value of the line-to-line current with standstill torque M_0 generated (Tolerance ±5 %)
$I_{1N,PU}$	A	Nominal input current of the power unit
I_{2maxPU}	A	Maximum output current of the power unit
$I_{2N,PU}$	A	Nominal output current of the power unit
I_N	A	Nominal current
$I_{N,MOT}$	A	Nominal current of the motor
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 %)
M_0	Nm	Standstill torque: the torque the motor is able to deliver long term at a speed of 10 rpm (tolerance ±5 %)
M_N	Nm	Nominal torque: the maximum torque of a motor in S1 mode at nominal speed n_N (tolerance ±5 %)
n_N	rpm	Nominal speed: the speed for which the nominal torque M_N is specified
p		Number of pole pairs
P_{maxRB}	W	Maximum power at the external braking resistor
P_V	W	Power loss
$P_{V,CU}$	W	Power loss of the control board
R_{2minRB}	Ω	Minimum resistance of the external braking resistor
$\vartheta_{amb,max}$	°C	Maximum surrounding temperature
τ_{th}	°C	Thermal time constant
U_{1CU}	V	Input voltage of the control board
U_{1PU}	V	Input voltage of the power unit
U_{2PU}	V	Output voltage of the power unit
U_{max}	V	Maximum voltage
U_{offCH}	V	Off limit of the brake chopper
U_{onCH}	V	On limit of the brake chopper

4.2.2 Type designation

SD	6	A	0	6	T	E	X

Tab. 1: Sample code

Code	Designation	Design
SD	Series	ServoDrive
6	Generation	6. Generation
A, B	Version	
0 – 3	Size	
0 – 9	Power output stage	(within the size)
T	Safety module	ST6: Safe Torque Off (STO)
N	Communication module	Empty
E		EC6: EtherCAT
C		CA6: CANopen
P		PN6: PROFINET
N	Terminal module	Empty
X		XI6: Extended I/O
I		IO6: Standard I/O
R		RI6: Resolver I/O

Tab. 2: Explanation

4.2.3 Sizes

Type	Size
SD6A02	Size 0
SD6A04	Size 0
SD6A06	Size 0
SD6A14	Size 1
SD6A16	Size 1
SD6A24	Size 2
SD6A26	Size 2
SD6A34	Size 3
SD6A36	Size 3
SD6A38	Size 3

Tab. 3: Available SD6 types and sizes

Fig. 1: SD6 in sizes 0, 1, 2 and 3

4.2.4 General technical data

Device features	
Protection class of the device	IP20
Protection class of the control cabinet	At least IP54
Radio interference suppression	Integrated line filter according to EN 61800-3:2012, interference emission class C3
Overvoltage category	III according to EN 61800-5-1:2008

Tab. 4: Device features

Transport and storage conditions	
Storage/ transport temperature	-20 °C to +70 °C Maximum change: 20 °C/h
Relative humidity	Maximum relative humidity 85 %, non-condensing
Vibration (transport) to DIN EN 60068-2-6	5 Hz ≤ f ≤ 9 Hz: 3.5 mm 9 Hz ≤ f ≤ 200 Hz: 10 m/s² 200 Hz ≤ f ≤ 500 Hz: 15 m/s²

Tab. 5: Transport and storage conditions

Operating conditions	
Surrounding operating temperature	0 °C to 45 °C for nominal data 45 °C to 55 °C with derating −2.5 % / °C
Relative humidity	Maximum relative humidity 85 %, non-condensing
Installation altitude	0 m to 1000 m above sea level without restrictions 1000 m to 2000 m above seal level with derating −1.5 % / 100 m
Pollution degree	Pollution degree level 2 as per EN 50178
Ventilated	Installed fan
Vibration (operation) to DIN EN 60068-2-6	5 Hz ≤ f ≤ 9 Hz: 0.35 mm 9 Hz ≤ f ≤ 200 Hz: 1 m/s²

Tab. 6: Operating conditions

Discharge times	
Self-discharge	5 minutes

Tab. 7: Discharge times of the DC link circuit

4.2.5 Electrical data

The electrical data of the available SD6 sizes as well as the properties of the brake chopper can be found in the following sections.

4.2.5.1 Control unit

Electrical data	All types
U_{1CU}	24 V_{DC}, +20 % / -15 %
I_{1maxCU}	1.5 A

Tab. 8: Control unit electrical data

4.2.5.2 Power unit: size 0

Electrical data	SD6A02	SD6A04	SD6A06
U_{1PU}	1 × 230 V, +20 % / -40 %, 50/60 Hz	3 × 400 V, +32 % / -50 %, 50/60 Hz; 3 × 480 V, +10 % / -58 %, 50/60 Hz	
f_{2PU}	0 – 700 Hz		
U_{2PU}	0 – max. U_1		

Tab. 9: Electrical data SD6, size 0

Nominal currents up to +45 °C (in the control cabinet)

Electrical data	SD6A02	SD6A04	SD6A06
$f_{PWM,PU}$	4 kHz		
$I_{1N,PU}$	8.3 A	2.8 A	5.4 A
$I_{2N,PU}$	4 A	2.3 A	4.5 A
I_{2maxPU}	180 % for 5 s; 150 % for 30 s		

Tab. 10: Electrical data SD6, size 0, for 4 kHz clock frequency

Electrical data	SD6A02	SD6A04	SD6A06
$f_{PWM,PU}$	8 kHz		
$I_{1N,PU}$	6 A	2.2 A	4 A
$I_{2N,PU}$	3 A	1.7 A	3.4 A
I_{2maxPU}	250 % for 2 s; 200 % for 5 s		

Tab. 11: Electrical data SD6, size 0, for 8 kHz clock frequency

Electrical data	SD6A02	SD6A04	SD6A06
U_{onCH}	400 – 420 V	780 – 800 V	
U_{offCH}	360 – 380 V	740 – 760 V	
R_{2minRB}	100 Ω		
P_{maxRB}	1.8 kW	6.4 kW	

Tab. 12: Brake chopper electrical data, size 0

4.2.5.3 Power unit: size 1

Electrical data	SD6A14	SD6A16
U_{1PU}	3 × 400 V, +32 % / -50 %, 50/60 Hz; 3 × 480 V, +10 % / -58 %, 50/60 Hz	
f_{2PU}	0 – 700 Hz	
U_{2PU}	0 – max. U_1	

Tab. 13: Electrical data SD6, size 1

Nominal currents up to +45 °C (in the control cabinet)

Electrical data	SD6A14	SD6A16
$f_{PWM,PU}$	4 kHz	
$I_{1N,PU}$	12 A	19.2 A
$I_{2N,PU}$	10 A	16 A
I_{2maxPU}	180 % for 5 s; 150 % for 30 s	

Tab. 14: Electrical data SD6, size 1, for 4 kHz clock frequency

Electrical data	SD6A14	SD6A16
$f_{PWM,PU}$	8 kHz	
$I_{1N,PU}$	9.3 A	15.8 A
$I_{2N,PU}$	6 A	10 A
I_{2maxPU}	250 % for 2 s; 200 % for 5 s	

Tab. 15: Electrical data SD6, size 1, for 8 kHz clock frequency

Electrical data	SD6A14	SD6A16
U_{onCH}	780 – 800 V	
U_{offCH}	740 – 760 V	
R_{2minRB}	47 Ω	
P_{maxRB}	13.6 kW	13.6 kW

Tab. 16: Brake chopper electrical data, size 1

4.2.5.4 Power unit: size 2

Electrical data	SD6A24	SD6A26
U_{1PU}	3 × 400 V, +32 % / -50 %, 50/60 Hz; 3 × 480 V, +10 % / -58 %, 50/60 Hz	
f_{2PU}	0 – 700 Hz	
U_{2PU}	0 – max. U_1	

Tab. 17: Electrical data SD6, size 2

Nominal currents up to +45 °C (in the control cabinet)

Electrical data	SD6A24	SD6A26
$f_{PWM,PU}$	4 kHz	
$I_{1N,PU}$	26.4 A	38.4 A
$I_{2N,PU}$	22 A	32 A
I_{2maxPU}	180 % for 5 s; 150 % for 30 s	

Tab. 18: Electrical data SD6, size 2, for 4 kHz clock frequency

Electrical data	SD6A24	SD6A26
$f_{PWM,PU}$	8 kHz	
$I_{1N,PU}$	24.5 A	32.6 A
$I_{2N,PU}$	14 A	20 A
I_{2maxPU}	250 % for 2 s; 200 % for 5 s	

Tab. 19: Electrical data SD6, size 2, for 8 kHz clock frequency

Electrical data	SD6A24	SD6A26
U_{onCH}	780 – 800 V	
U_{offCH}	740 – 760 V	
R_{2minRB}	22 Ω	
P_{maxRB}	29.1 kW	29.1 kW

Tab. 20: Brake chopper electrical data, size 2

4.2.5.5 Power unit: size 3

Electrical data	SD6A34	SD6A36	SD6A38
U_{1PU}	3 × 400 V, +32 % / -50 %, 50/60 Hz; 3 × 480 V, +10 % / -58 %, 50/60 Hz		
f_{2PU}	0 – 700 Hz		
U_{2PU}	0 – max. U_1		

Tab. 21: Electrical data SD6, size 3

Nominal currents up to +45 °C (in the control cabinet)

Electrical data	SD6A34	SD6A36	SD6A38
$f_{PWM,PU}$	4 kHz		
$I_{1N,PU}$	45.3 A	76 A	76 A
$I_{2N,PU}$	44 A	70 A	85 A[1]
I_{2maxPU}	180 % for 5 s; 150 % for 30 s		

Tab. 22: Electrical data SD6, size 3, for 4 kHz clock frequency

Electrical data	SD6A34	SD6A36	SD6A38
$f_{PWM,PU}$	8 kHz		
$I_{1N,PU}$	37 A	62 A	76 A
$I_{2N,PU}$	30 A	50 A	60 A
I_{2maxPU}	250 % for 2 s; 200 % for 5 s		

Tab. 23: Electrical data SD6, size 3, for 8 kHz clock frequency

Electrical data	SD6A34	SD6A36	SD6A38
U_{onCH}	780 – 800 V		
U_{offCH}	740 – 760 V		
R_{2minRB}	15 Ω		
P_{maxRB}	42 kW		

Tab. 24: Brake chopper electrical data, size 3

[1] Specification applies for the default setting of the field weakening voltage limit: B92 = 80 %.

4.2.5.6 Power loss data according to EN 50598

Type	Nominal current $I_{2N,PU}$	Apparent power	Absolute losses $P_{V,CU}$ [2]	Working points[3] (0/25)	(0/50)	(0/100)	(50/25)	(50/50)	(50/100)	(90/50)	(90/100)	IE class[4]	Comparison[5]
				Relative losses									
	[A]	[kVA]	[W]	[%]									
SD6A02	4	0.9	10	5.01	5.07	5.68	5.20	5.37	6.30	5.88	7.43	IE2	
SD6A04	2.3	1.6	10	2.98	3.13	3.49	3.02	3.22	3.71	3.36	4.09	IE2	
SD6A06	4.5	3.1	12	1.71	1.86	2.24	1.75	1.97	2.51	2.16	3.04	IE2	
SD6A14	10	6.9	12	1.38	1.54	1.93	1.43	1.64	2.17	1.80	2.57	IE2	
SD6A24	22	15.2	15	0.80	0.97	1.49	0.84	1.06	1.75	1.21	2.19	IE2	
SD6A26	32	22.2	15	0.70	0.87	1.40	0.74	0.97	1.66	1.11	2.08	IE2	
SD6A34	44	30.5	35	0.61	0.76	1.21	0.68	0.90	1.53	1.06	1.96	IE2	
SD6A36	70	48.5	35	0.53	0.69	1.18	0.59	0.82	1.49	0.97	1.89	IE2	
SD6A38	85	58.9	35	0.47	0.64	1.18	0.54	0.78	1.50	0.94	1.94	IE2	
				Absolute losses P_V									
	[A]	[kVA]	[W]	[W]									[%]
SD6A02	4	0.9	10	45.1	45.6	51.1	46.8	48.3	56.7	52.9	66.9	IE2	51.8
SD6A04	2.3	1.6	10	47.7	50.1	55.8	48.3	51.5	59.3	53.8	65.4	IE2	40.2
SD6A06	4.5	3.1	12	52.9	57.6	69.3	54.4	61.0	77.9	67.1	94.1	IE2	39.6
SD6A14	10	6.9	12	95.3	106.1	133.3	98.6	113.2	149.9	123.9	177.0	IE2	37.1
SD6A24	22	15.2	15	121.5	146.9	226.1	128.1	161.6	266.0	183.7	332.7	IE2	32.9
SD6A26	32	22.2	15	154.7	192.8	311.3	164.6	214.6	369.3	245.9	462.1	IE2	38.3
SD6A34	44	30.5	35	187.5	232.2	368.7	207.7	273.9	466.8	323.0	597.8	IE2	32.1
SD6A36	70	48.5	35	256.6	332.3	570.8	287.9	397.0	721.5	471.0	915.9	IE2	33.9
SD6A38	85	58.9	35	277.8	376.9	692.3	317.4	459.0	886.1	554.6	1143.1	IE2	35.3

Tab. 25: Power loss data of the SD6 drive controller according to EN 50598

General conditions

The loss data applies to drive controllers without accessories.

The power loss calculation based on a three-phase supply voltage with 400 V_{AC} / 50 Hz.

The calculated data includes a supplement of 10 % according to EN 50598.

The power loss specifications refer to a clock frequency of 4 kHz.

The absolute losses for a power stage that is switched off refer to the 24 vdc power supply of the control electronics.

[2] Absolute losses for a power stage that is switched off
[3] Operating points for relative motor stator frequency in % and relative torque current in %
[4] IE class according to EN 50598
[5] Comparison of the losses for the reference drive controller related to IE2 in the nominal point (90, 100)

4.2.5.7 Power loss data of accessories

Type	Absolute losses P_V [W]
ST6 safety module	1
Terminal module IO6	< 2
Terminal module XI6	< 5
Terminal module RI6	< 5
CA6 fieldbus module	1
EC6 fieldbus module	< 2
PN6 fieldbus module	< 4

Tab. 26: Absolute losses of the accessories

Information

Also observe the absolute power loss of the encoder (usually < 3 W as well as the brake for the design.

4.2.6 Derating

When dimensioning the drive controller, observe the derating of the nominal output current depending on the clock frequency, surrounding temperature, and installation altitude. There is no restriction for a surrounding temperature from 0 °C to 45 °C and an installation altitude of 0 m to 1000 m. The details given below apply to values outside these ranges.

4.2.6.1 Effect of the clock frequency

Changing the clock frequency f_{PWM} affects the amount of noise produced by the drive amongst other things. However, increasing the clock frequency results in increased losses. During project configuration, define the highest clock frequency and use it to determine the nominal output current $I_{2N,PU}$ for dimensioning the drive controller.

Type	$I_{2N,PU}$ 4 kHz	$I_{2N,PU}$ 8 kHz	$I_{2N,PU}$ 16 kHz
SD6A02	4 A	3 A	2 A
SD6A04	2.3 A	1.7 A	1.1 A
SD6A06	4.5 A	3.4 A	2.3 A
SD6A14	10 A	6 A	4 A
SD6A16	16 A	10 A	5.7 A
SD6A24	22 A	14 A	8.1 A
SD6A26	32 A	20 A	12 A
SD6A34	44 A	30 A	18 A
SD6A36	70 A	50 A	31 A
SD6A38	85 A[6]	60 A	37.8 A

Tab. 27: Nominal output current $I_{2N,PU}$ depending on the clock frequency

[6] Specification applies for the default setting of the field weakening voltage limit: B92 = 80 %.

4.2.6.2 Effect of installation altitude

Derating depending on the installation altitude is determined as follows:

- 0 m to 1000 m: no restriction (D_{IA} = 100 %)
- 1000 m to 2000 m: derating −1.5 % / 100 m

Example

The drive controller will be installed at an altitude of 1500 m above sea level.

The derating factor D_{IA} is calculated as follows:
D_{IA} = 100 % − 5 × 1.5 % = 92.5 %

4.2.6.3 Effect of surrounding temperature

Derating depending on the surrounding temperature is determined as follows:

- 0 °C to 45 °C: no restrictions (D_T = 100 %)
- 45 °C to 55 °C: derating −2.5 % / °C

Example

The drive controller will be operated at 50 °C.

The derating factor D_T is calculated as follows
D_T= 100 % − 5 × 2.5 % = 87.5 %

4.2.6.4 Calculating the derating

Follow these steps for the calculation:

1. Determine the highest clock frequency (f_{PWM}) that will be used during operation and use it to determine the nominal current $I_{2N,PU}$.
2. Determine the derating factors for installation altitude and surrounding temperature.
3. Calculate the reduced nominal current $I_{2N,PU}$ according to the following formula:
   $I_{2N,PU} = I_{2N,PU} \text{ x } D_T \text{ x } D_{IA}$

A drive controller of type SD6A06 will be operated at a clock frequency of 8 kHz at an altitude of 1500 m above sea level and an surrounding temperature of 50 °C.

The nominal current of the SD6A06 at 8 kHz is 3.4 A. The derating factor D_T is calculated as follows:
D_T = 100 % − 5 × 2.5 % = 87.5 %

The derating factor D_{IA} is calculated as follows:
D_{IA} = 100 % − 5 × 1.5 % = 92.5 %

The output current to be observed for the project configuration is:
$I_{2N,PU}$ = 3.4 A × 0.875 × 0.925 = 2.75 A

4.2.7 Dimensions

The dimensions of the available SD6 sizes can be found in the following sections.

4.2.7.1 Dimensions: sizes 0 to 2

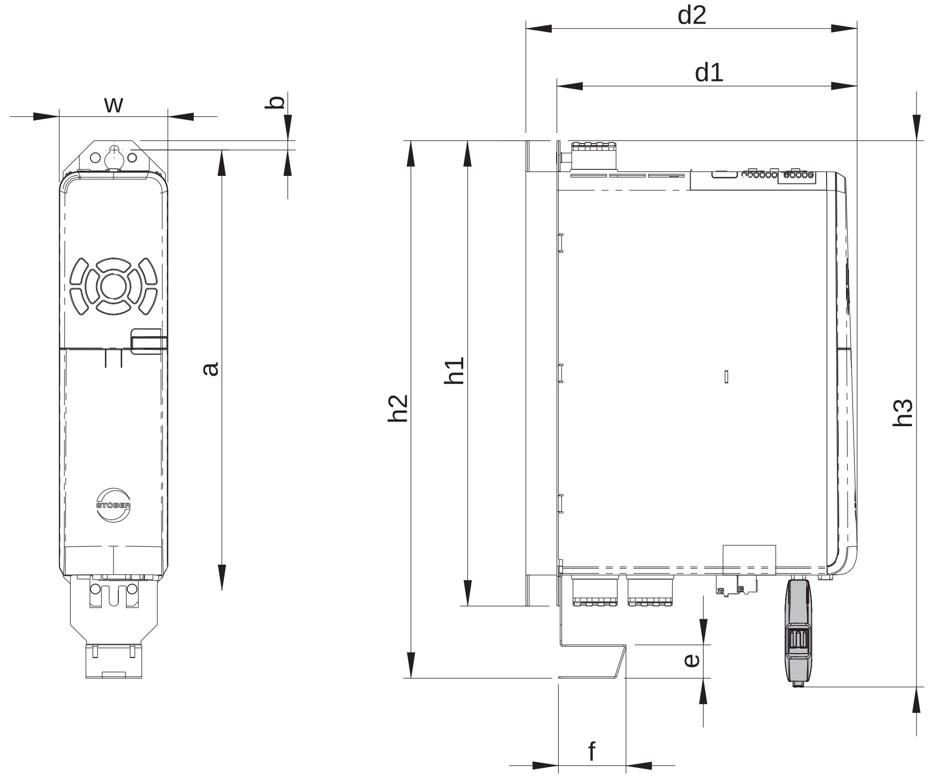


Fig. 2: SD6 dimension drawing, size 0 to 2

<table>
<tr><th colspan="3">Dimension</th><th>Size 0</th><th>Size 1</th><th>Size 2</th></tr>
<tr><td rowspan="6">Drive controller</td><td>Height</td><td>h1</td><td colspan="3">300</td></tr>
<tr><td>Height incl. EMC shroud</td><td>h2</td><td colspan="3">355</td></tr>
<tr><td>Height incl. AES</td><td>h3</td><td colspan="3">367</td></tr>
<tr><td>Width</td><td>w</td><td>70</td><td colspan="2">105</td></tr>
<tr><td>Depth</td><td>d1</td><td>194</td><td colspan="2">284</td></tr>
<tr><td>Depth incl. braking resistor RB 5000</td><td>d2</td><td>212</td><td colspan="2">302</td></tr>
<tr><td rowspan="2">EMC shroud</td><td>Height</td><td>e</td><td colspan="3">27</td></tr>
<tr><td>Depth</td><td>f</td><td colspan="3">40</td></tr>
<tr><td rowspan="2">Fastening holes</td><td>Vertical distance</td><td>a</td><td colspan="3">283+2</td></tr>
<tr><td>Vertical distance to upper edge</td><td>b</td><td colspan="3">6</td></tr>
</table>

Tab. 28: SD6 dimensions, size 0 to 2 [mm]

4.2.7.2 Dimensions: size 3

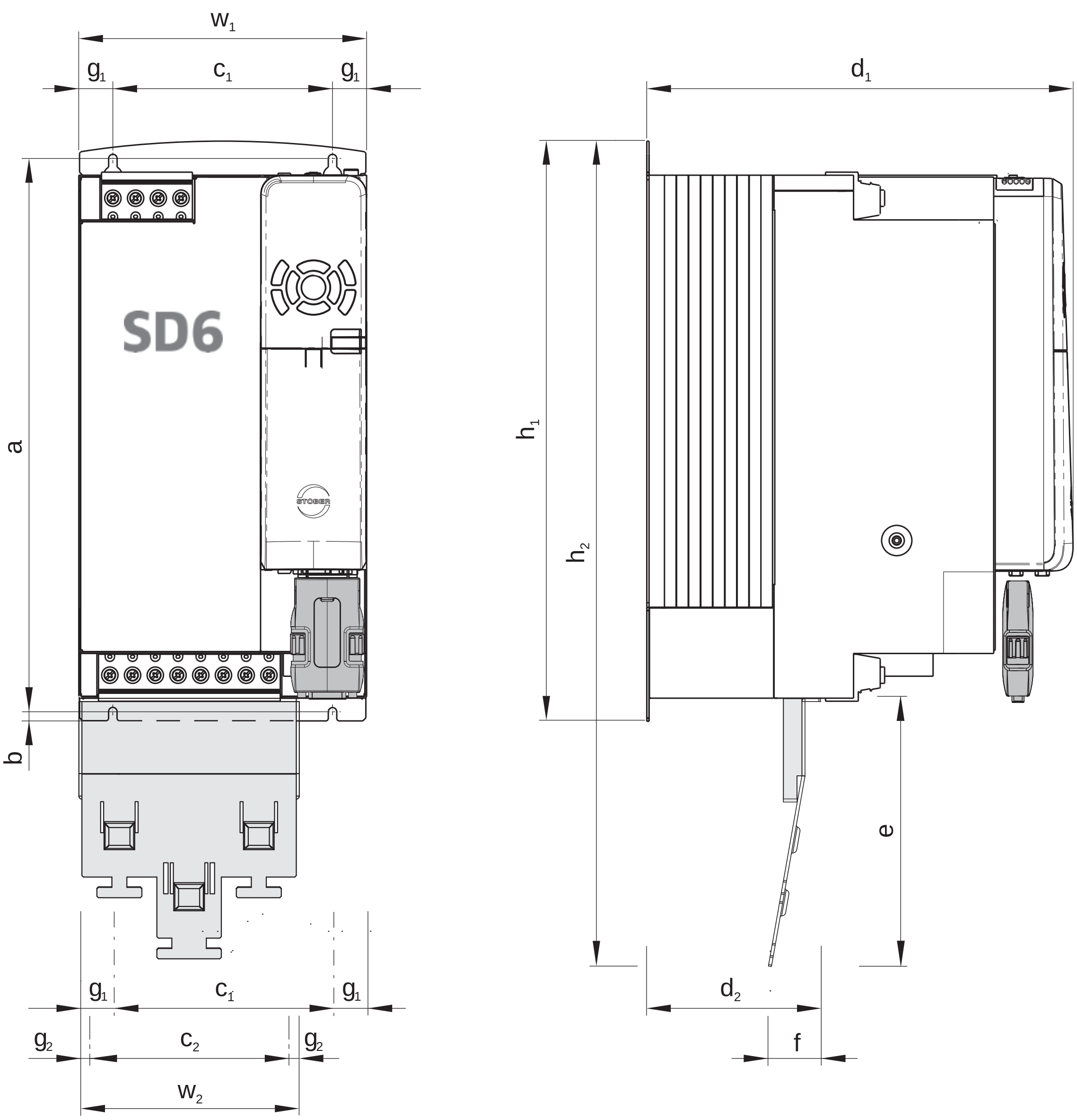


Fig. 3: Dimension drawing SD6, size 3

Dimension			Size 3
Drive controller	Height	h1	382.5
	Height incl. EMC shroud	h2	540
	Width	w1	194
	Depth	d1	305
EMC shroud	Height	e	174
	Width	w2	147
	Depth	f	34
		d2	113
Fastening holes	Vertical distance	a	365+2
	Vertical distance to upper edge	b	6
	Horizontal distance from the fastening holes of the drive controller	c1	150+0.2/-0.2
	Horizontal distance from the side edge of the drive controller	g1	20
	Horizontal distance from the fastening holes of the EMC shroud	c2	132
	Horizontal distance from the side edge of the EMC shroud	g2	7.5

Tab. 29: SD6 dimensions, size 3 [mm]

4.2.8 Minimum clearances

The specified dimensions refer to the outside edges of the drive controller or supply module.

Minimum clearance	Up	Down	to the side[7]
Size 0 – Size 2	100	100	5
... with EMC shroud	100	120	5
Size 3	100	100	5
... with EMC shroud	100	220	5

Tab. 30: Minimum clearances [mm]

[7] Installation without Quick DC-Link module

4.3 Drive controller/motor combinations

EZ synchronous servo motor (n_N = 2000 rpm) – SD6

	K_{EM} [V/1000 rpm]	M_N [Nm]	$I_{N,MOT}$ [A]	M_0 [Nm]	I_0 [A]	SD6A04 $I_{2N,PU}$= 1.7 A	SD6A06 $I_{2N,PU}$= 3.4 A	SD6A14 $I_{2N,PU}$= 6 A	SD6A16 $I_{2N,PU}$= 10 A	SD6A24 $I_{2N,PU}$= 14 A	SD6A26 $I_{2N,PU}$= 20 A	SD6A34 $I_{2N,PU}$= 30 A	SD6A36 $I_{2N,PU}$= 50 A	SD6A38 $I_{2N,PU}$= 60 A
Convection cooling of IC 410										$I_{2N,PU}$ / I_0				
EZ805U	142	43.7	25.9	66.1	37.9								1.3	1.6
Forced ventilation IC 416										$I_{2N,PU}$ / I_0				
EZ805B	142	77.2	45.2	94	53.9									1.1
Water cooling										$I_{2N,PU}$ / I_0				
EZ805W	142	72.1	42.1	90.1	51.9									1.2

EZ Synchronous servo motor (n_N = 3000 rpm) – SD6

	K_{EM} [V/1000 rpm]	M_N [Nm]	$I_{N,MOT}$ [A]	M_0 [Nm]	I_0 [A]	SD6A04 $I_{2N,PU}$= 1.7 A	SD6A06 $I_{2N,PU}$= 3.4 A	SD6A14 $I_{2N,PU}$= 6 A	SD6A16 $I_{2N,PU}$= 10 A	SD6A24 $I_{2N,PU}$= 14 A	SD6A26 $I_{2N,PU}$= 20 A	SD6A34 $I_{2N,PU}$= 30 A	SD6A36 $I_{2N,PU}$= 50 A	SD6A38 $I_{2N,PU}$= 60 A
Convection cooling of IC 410										$I_{2N,PU}$ / I_0				
EZ301U	40	0.93	1.99	0.95	2.02		1.7							
EZ302U	86	1.59	1.6	1.68	1.67	1.0	2.0							
EZ303U	109	2.07	1.63	2.19	1.71	1.0	2.0							
EZ401U	96	2.8	2.74	3	2.88		1.2							
EZ402U	94	4.7	4.4	5.2	4.8			1.3						
EZ404U	116	6.9	5.8	8.6	6.6				1.5					
EZ501U	97	4.3	3.74	4.7	4			1.5						
EZ502U	121	7.4	5.46	8	5.76			1.0	1.7					
EZ503U	119	9.7	6.9	11.1	7.67				1.3	1.8				
EZ505U	141	13.5	8.8	16	10				1.0	1.4	2.0			
EZ701U	95	7.4	7.2	8.3	8				1.3	1.8				
EZ702U	133	12	8.2	14.4	9.6				1.0	1.5				
EZ703U	122	16.5	11.4	20.8	14					1.0	1.4			
EZ705U	140	21.3	14.2	30.2	19.5						1.0	1.5		
EZ802U	136	22.3	13.9	37.1	22.3							1.3		
EZ803U	131	26.6	17.7	48.2	31.1								1.6	1.9
Forced ventilation IC 416										$I_{2N,PU}$ / I_0				
EZ401B	96	3.4	3.4	3.7	3.6			1.7						
EZ402B	94	5.9	5.5	6.3	5.8			1.0	1.7					
EZ404B	116	10.2	8.2	11.2	8.7				1.1	1.6				
EZ501B	97	5.4	4.7	5.8	5			1.2	2.0					
EZ502B	121	10.3	7.8	11.2	8.16				1.2	1.7				
EZ503B	119	14.4	10.9	15.9	11.8					1.2	1.7			
EZ505B	141	20.2	13.7	23.4	14.7					1.0	1.4			
EZ701B	95	9.7	9.5	10.5	10				1.0	1.4	2.0			
EZ702B	133	16.6	11.8	19.3	12.9					1.1	1.6			
EZ703B	122	24	18.2	28	20						1.0	1.5		
EZ705B	140	33.8	22.9	41.8	26.5							1.1	1.9	
EZ802B	136	34.3	26.5	47.9	28.9							1.0	1.7	
EZ803B	131	49	35.9	66.7	42.3								1.2	1.4

Water cooling										$I_{2N,PU} / I_0$				
EZ401W	96	3.3	3.7	3.55	3.9			1.5						
EZ402W	94	5.85	5.5	6.35	6			1.0	1.7					
EZ404W	116	10.4	8.3	11.3	8.9				1.1	1.6				
EZ501W	97	5.4	4.75	5.65	4.85			1.2						
EZ502W	121	10.2	7.7	11	7.85				1.3	1.8				
EZ503W	119	13.5	10.2	15.2	11.3					1.2	1.8			
EZ505W	141	17.9	11.4	21.5	13.1					1.1	1.5			
EZ701W	95	10.2	9.95	10.4	10					1.4	2.0			
EZ702W	133	17.1	12.2	19.3	13.1					1.1	1.5			
EZ703W	122	22.5	17	27.5	19.6						1.0	1.5		
EZ705W	140	30.3	20.5	39.4	25.4							1.2	2.0	
EZ802W	136	32.2	26.6	48.9	29.6							1.0	1.7	
EZ803W	131	46.7	34.1	65.7	41.7								1.2	1.4

EZ Synchronous servo motor (n_N = 4500 rpm) – SD6

	K_{EM} [V/1000 rpm]	M_N [Nm]	$I_{N,MOT}$ [A]	M_0 [Nm]	I_0 [A]	SD6A04 $I_{2N,PU}$= 1.7 A	SD6A06 $I_{2N,PU}$= 3.4 A	SD6A14 $I_{2N,PU}$= 6 A	SD6A16 $I_{2N,PU}$= 10 A	SD6A24 $I_{2N,PU}$= 14 A	SD6A26 $I_{2N,PU}$= 20 A	SD6A34 $I_{2N,PU}$= 30 A	SD6A36 $I_{2N,PU}$= 50 A	SD6A38 $I_{2N,PU}$= 60 A
Convection cooling of IC 410										$I_{2N,PU} / I_0$				
EZ505U	103	9.5	8.94	15.3	13.4					1.0	1.5			
EZ703U	99	12.1	11.5	20	17.8						1.1	1.7		
EZ705U	106	16.4	14.8	30	25.2							1.2	2.0	
EZ802U	90	10.5	11.2	34.5	33.3								1.5	1.8
Forced ventilation IC 416										$I_{2N,PU} / I_0$				
EZ505B	103	16.4	16.4	22	19.4						1.0	1.5		
EZ703B	99	19.8	20.3	27.2	24.2							1.2		
EZ705B	106	27.7	25.4	39.4	32.8								1.5	1.8
EZ802B	90	30.6	30.5	47.4	45.1								1.1	1.3
Water cooling										$I_{2N,PU} / I_0$				
EZ505W	103	14.2	13	20.2	17.2						1.2	1.7		
EZ703W	99	19.1	18.1	26.7	23.7							1.3		
EZ705W	106	24.1	22	37.2	31.6								1.6	1.9
EZ802W	90	30.7	30.3	46.9	44.6								1.1	1.3

EZ Synchronous servo motor (n_N = 6000 rpm) – SD6

	K_{EM} [V/1000 rpm]	M_N [Nm]	$I_{N,MOT}$ [A]	M_0 [Nm]	I_0 [A]	SD6A04 $I_{2N,PU}$= 1.7 A	SD6A06 $I_{2N,PU}$= 3.4 A	SD6A14 $I_{2N,PU}$= 6 A	SD6A16 $I_{2N,PU}$= 10 A	SD6A24 $I_{2N,PU}$= 14 A	SD6A26 $I_{2N,PU}$= 20 A	SD6A34 $I_{2N,PU}$= 30 A	SD6A36 $I_{2N,PU}$= 50 A	SD6A38 $I_{2N,PU}$= 60 A
Convection cooling of IC 410										$I_{2N,PU} / I_0$				
EZ301U	40	0.89	1.93	0.95	2.02		1.7							
EZ302U	42	1.5	3.18	1.68	3.48			1.7						
EZ303U	55	1.96	3.17	2.25	3.55			1.7						
EZ401U	47	2.3	4.56	2.8	5.36			1.1	1.9					
EZ402U	60	3.5	5.65	4.9	7.43				1.3	1.9				
EZ404U	78	5.8	7.18	8.4	9.78				1.0	1.4	2.0			
EZ501U	68	3.4	4.77	4.4	5.8			1.0	1.7	2.4				
EZ502U	72	5.2	7.35	7.8	9.8				1.0	1.4	2.0			
EZ503U	84	6.2	7.64	10.6	11.6					1.2	1.7			
EZ701U	76	5.2	6.68	7.9	9.38				1.1	1.5				
EZ702U	82	7.2	8.96	14.3	16.5						1.2	1.8		
Forced ventilation IC 416										$I_{2N,PU} / I_0$				
EZ401B	47	2.9	5.62	3.5	6.83				1.5	2.0				
EZ402B	60	5.1	7.88	6.4	9.34				1.1	1.5				
EZ404B	78	8	9.98	10.5	12					1.2	1.7			
EZ501B	68	4.5	6.7	5.7	7.5				1.3	1.9				
EZ502B	72	8.2	11.4	10.5	13.4					1.0	1.5			
EZ503B	84	10.4	13.5	14.8	15.9						1.3	1.9		
EZ701B	76	7.5	10.6	10.2	12.4					1.1	1.6			
EZ702B	82	12.5	16.7	19.3	22.1							1.4		

Water cooling										$I_{2N,PU}$ / I_0				
EZ401W	47	2.55	5.2	3.35	6.95				1.4	2.0				
EZ402W	60	5	8	6.45	9.7				1.0	1.4				
EZ404W	78	7.7	10.5	10.6	12.3					1.1	1.6			
EZ501W	68	4.3	6.4	5.55	7.25				1.4	1.9				
EZ502W	72	8.1	11.2	10.3	12.9					1.1	1.6			
EZ503W	84	9.95	12.6	14.2	15.2						1.3	2.0		
EZ701W	76	7	10.2	10.4	12.7					1.1	1.6			
EZ702W	82	12	17.5	19.3	22.5							1.3		

EZHD synchronous servo motor with hollow shaft and direct drive (n_N = 3000 rpm) – SD6

						SD6A04	SD6A06	SD6A14	SD6A16	SD6A24	SD6A26	SD6A34	SD6A36	SD6A38
	K_{EM} [V/1000 rpm]	M_N [Nm]	$I_{N,MOT}$ [A]	M_0 [Nm]	I_0 [A]	$I_{2N,PU}$= 1.7 A	$I_{2N,PU}$= 3.4 A	$I_{2N,PU}$= 6 A	$I_{2N,PU}$= 10 A	$I_{2N,PU}$= 14 A	$I_{2N,PU}$= 20 A	$I_{2N,PU}$= 30 A	$I_{2N,PU}$= 50 A	$I_{2N,PU}$= 60 A
Convection cooling of IC 410										$I_{2N,PU}$ / I_0				
EZHD0411U	96	1.9	2.36	2.6	2.89		1.2							
EZHD0412U	94	4.2	4.29	5.1	4.94			1.2						
EZHD0414U	116	7.7	6.3	8.5	6.88				1.5					
EZHD0511U	97	3	3.32	4.1	4.06			1.5						
EZHD0512U	121	7.0	5.59	7.8	6.13				1.6					
EZHD0513U	119	8.3	7.04	10.9	8.76				1.1	1.6				
EZHD0515U	141	14	9.46	16.4	11					1.3	1.8			
EZHD0711U	95	7.3	7.53	7.9	7.98				1.3	1.8				
EZHD0712U	133	11.6	8.18	14.4	9.99				1.0	1.4				
EZHD0713U	122	17.8	13.4	20.4	15.1						1.3	2.0		
EZHD0715U	140	24.6	17.2	31.1	21.1							1.4		

EZHP synchronous servo motor with hollow shaft and attached planetary gear unit (n_N = 3000 rpm) – SD6

						SD6A04	SD6A06	SD6A14	SD6A16	SD6A24	SD6A26	SD6A34	SD6A36	SD6A38
	K_{EM} [V/1000 rpm]	M_N [Nm]	$I_{N,MOT}$ [A]	M_0 [Nm]	I_0 [A]	$I_{2N,PU}$= 1.7 A	$I_{2N,PU}$= 3.4 A	$I_{2N,PU}$= 6 A	$I_{2N,PU}$= 10 A	$I_{2N,PU}$= 14 A	$I_{2N,PU}$= 20 A	$I_{2N,PU}$= 30 A	$I_{2N,PU}$= 50 A	$I_{2N,PU}$= 60 A
Convection cooling of IC 410										$I_{2N,PU}$ / I_0				
EZHP_511U	97	3	3.32	4.1	4.06			1.5						
EZHP_512U	121	7.0	5.59	7.8	6.13				1.6					
EZHP_513U	119	8.3	7.04	10.9	8.76				1.1	1.6				
EZHP_515U	141	14	9.46	16.4	11					1.3	1.8			
EZHP_711U	95	7.3	7.53	7.9	7.98				1.3	1.8				
EZHP_712U	133	11.6	8.18	14.4	9.99				1.0	1.4				
EZHP_713U	122	17.8	13.4	20.4	15.1						1.3	2.0		
EZHP_715U	140	24.6	17.2	31.1	21.1							1.4		
Water cooling										$I_{2N,PU}$ / I_0				
EZHP_511W	97	4.1	4.5	4.8	4.79			1.3						
EZHP_512W	121	8.15	6.54	9	7.07				1.4	2.0				
EZHP_513W	119	9.7	8.23	12.3	9.89				1.0	1.4				
EZHP_515W	141	16.2	11	18.6	12.5					1.1	1.6			
EZHP_711W	95	8.3	8.58	9.1	9.18				1.1	1.5				
EZHP_712W	133	13.6	9.6	16.6	11.5					1.2	1.7			
EZHP_713W	122	20.8	15.7	23.7	17.5						1.1	1.7		
EZHP_715W	140	29	20.3	35.7	24.2							1.2		

EZS synchronous servo motor for screw drive (driven threaded spindle) (n_N = 3000 rpm) – SD6

	K_{EM} [V/1000 rpm]	M_N [Nm]	$I_{N,MOT}$ [A]	M_0 [Nm]	I_0 [A]	SD6A04 $I_{2N,PU}$= 1.7 A	SD6A06 $I_{2N,PU}$= 3.4 A	SD6A14 $I_{2N,PU}$= 6 A	SD6A16 $I_{2N,PU}$= 10 A	SD6A24 $I_{2N,PU}$= 14 A	SD6A26 $I_{2N,PU}$= 20 A	SD6A34 $I_{2N,PU}$= 30 A	SD6A36 $I_{2N,PU}$= 50 A	SD6A38 $I_{2N,PU}$= 60 A
Convection cooling of IC 410										$I_{2N,PU}$ / I_0				
EZS501U	97	3.85	3.65	4.3	3.95			1.5						
EZS502U	121	6.9	5.3	7.55	5.7			1.1	1.8					
EZS503U	119	9.1	6.7	10.7	7.6				1.3	1.8				
EZS701U	95	6.65	6.8	7.65	7.7				1.3	1.8				
EZS702U	133	11	7.75	13.5	9.25				1.1	1.5				
EZS703U	122	15.3	10.8	19.7	13.5					1.0	1.5			
Forced ventilation IC 416										$I_{2N,PU}$ / I_0				
EZS501B	97	5.1	4.7	5.45	5			1.2	2.0					
EZS502B	121	10	7.8	10.9	8.16				1.2	1.7				
EZS503B	119	14.1	10.9	15.6	11.8					1.2	1.7			
EZS701B	95	9.35	9.5	10.2	10				1.0	1.4	2.0			
EZS702B	133	16.3	11.8	19	12.9					1.1	1.6			
EZS703B	122	23.7	18.2	27.7	20						1.0	1.5		
Water cooling										$I_{2N,PU}$ / I_0				
EZS501W	97	5.1	4.75	5.3	4.85			1.2						
EZS502W	121	9.9	7.7	10.7	7.85				1.3	1.8				
EZS503W	119	13.2	10.2	14.9	11.3					1.2	1.8			
EZS701W	95	9.85	9.95	10	10				1.0	1.4	2.0			
EZS702W	133	16.8	12.2	18.9	13.1					1.1	1.5			
EZS703W	122	22.1	17	27.1	19.6						1.0	1.5		

EZM synchronous servo motor for screw drive (driven spindle nut) (n_N = 3000 rpm) – SD6

	K_{EM} [V/1000 rpm]	M_N [Nm]	$I_{N,MOT}$ [A]	M_0 [Nm]	I_0 [A]	SD6A04 $I_{2N,PU}$= 1.7 A	SD6A06 $I_{2N,PU}$= 3.4 A	SD6A14 $I_{2N,PU}$= 6 A	SD6A16 $I_{2N,PU}$= 10 A	SD6A24 $I_{2N,PU}$= 14 A	SD6A26 $I_{2N,PU}$= 20 A	SD6A34 $I_{2N,PU}$= 30 A	SD6A36 $I_{2N,PU}$= 50 A	SD6A38 $I_{2N,PU}$= 60 A
Convection cooling of IC 410										$I_{2N,PU}$ / I_0				
EZM511U	97	3.65	3.55	4.25	4			1.5						
EZM512U	121	6.6	5.2	7.55	5.75			1.0	1.7					
EZM513U	119	8.8	6.55	10.6	7.6				1.3	1.8				
EZM711U	95	6.35	6.6	7.3	7.4				1.4	1.9				
EZM712U	133	10.6	7.5	13	8.9				1.1	1.6				
EZM713U	122	14.7	10.4	18.9	13					1.1	1.5			
Water cooling										$I_{2N,PU}$ / I_0				
EZM511W	97	4.95	4.75	5.2	4.85			1.2						
EZM512W	121	9.75	7.7	10.6	7.85				1.3	1.8				
EZM513W	119	13.1	10.2	14.8	11.3					1.2	1.8			
EZM711W	95	9.8	9.95	10	10				1.0	1.4	2.0			
EZM712W	133	16.7	12.2	18.8	13.1					1.1	1.5			
EZM713W	122	22	17	27.1	19.6						1.0	1.5		

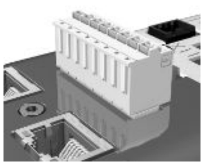
4.4 Accessories

Information about the available accessories can be found in the following sections.

4.4.1 Safety technology

Safe Torque Off – ST6

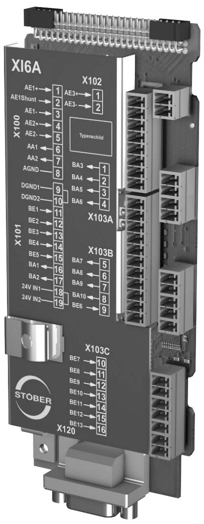
Included in the standard design.



The ST6 accessory makes it possible to use the "Safe Torque Off" (STO) safety function in the SD6 drive controller in safety-relevant applications according to EN ISO 13849-1.

4.4.2 Terminal module

Terminal module XI6



ID no. 138421
Terminal module for connecting analog and binary signals as well as encoders.
Supported inputs and outputs:

- 13 binary inputs (24 V)
- 10 binary outputs (24 V)
- 3 analog inputs (±10 V, 1 x 0 – 20 mA, 16 bits)
- 2 analog outputs (±10 V, 12 Bit)

Supported encoders / interfaces:

- SSI encoder (simulation and evaluation)
- TTL incremental encoder, differential (simulation and evaluation)
- HTL incremental encoder, single-ended (simulation and evaluation)
- TTL pulse train, differential (simulation and evaluation)
- HTL pulse train, single-ended (simulation and evaluation)

Terminal module RI6

ID no. 138422
Terminal module for connecting analog and binary signals as well as encoders.
Supported inputs and outputs:

- 5 binary inputs (24 V)
- 2 binary outputs (24 V)
- 2 analog inputs (±10 V, 1 x 0 – 20 mA, 16 bits)
- 2 analog outputs (±10 V, ±20 mA, 12 Bit)

Supported encoders / interfaces:

- Resolver (evaluation)
- Encoder EnDat 2.1 sin/cos (evaluation)
- Encoder EnDat 2.1/2.2 digital (evaluation)
- Sin/cos encoder (evaluation)
- SSI encoder (simulation and evaluation)
- TTL incremental encoder, differential (simulation and evaluation)
- TTL incremental encoder, single-ended (evaluation)
- HTL incremental encoder, single-ended (simulation and evaluation)
- TTL pulse train, differential (simulation and evaluation)
- TTL pulse train, single-ended (evaluation)
- HTL pulse train, single-ended (simulation and evaluation)

Note:
For connection to synchronous servo motors via a resolver encoder cable with plug connector con.23, you also require the interface adapter AP6A00 (ID no. 56498, 9-pin to 15-pin) that is available separately.

Interface adapter AP6

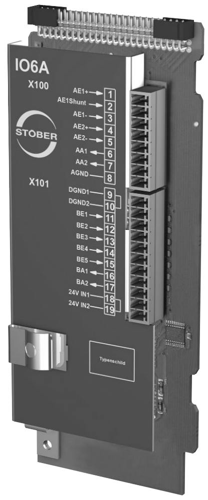
Encoder cables that were connected to a POSIDYN SDS 4000 can be connected via the AP6 interface adapter to the X140 encoder interface of the RI6 terminal module.
The following versions are available:

AP6A00
ID no. 56498
Adapter X140 resolver, 9/15-pin.

AP6A01
ID no. 56522
Adapter X140 resolver, 9/15-pin with motor temperature sensor - lead through.

AP6A02
ID no. 56523
Adapter X140 EnDat 2.1 sin/cos, 15/15-pin with motor temperature sensor - lead through.

Terminal module IO6



ID no. 138420
Terminal module for connecting analog and binary signals as well as encoders.
Supported inputs and outputs:

- 5 binary inputs (24 V)
- 2 binary outputs (24 V)
- 2 analog inputs (±10 V, 1 x 0 – 20 mA, 12 bits)
- 2 analog outputs (±10 V, ±20 mA)

Supported encoders / interfaces:

- HTL incremental encoder, single-ended (simulation and evaluation)
- HTL pulse train, single-ended (simulation and evaluation)

4.4.3 Communication

The SD6 drive controller has two interfaces for IGB communication on the top of the device as standard.
The communication module is installed in the shaft at the top and the drive controller is connected to the field bus system via it.
The following communication modules are available:

- CA6 for the CANopen connection
- EC6 for the EtherCAT connection
- PN6 for the PROFINET connection

IGB connecting cable

Cable for connecting the X3A or X3B interface for IGB, CAT5e, magenta.
The following versions are available:
ID no. 56489: 0.4 m.
ID no. 56490: 2 m.

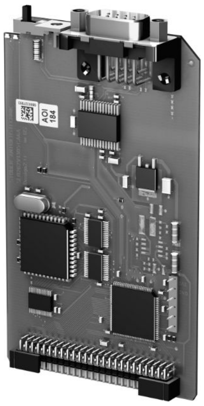
PC connecting cable

ID no. 49857
Cable for connecting the X3A or X3B interface with the PC, CAT5e, blue, 5 m.

Hi-speed USB 2.0 Ethernet adapter

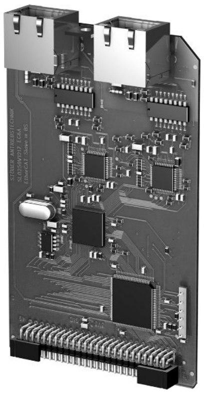
ID no. 49940
Adapter for connecting Ethernet to a USB connection.

CA6 communication module



ID no. 138427
Communication module for the CANopen connection.

EC6 communication module

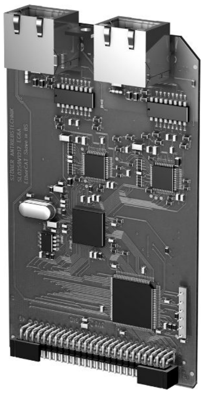


ID no. 138425
Communication module for the EtherCAT connection.

EtherCAT cable

Ethernet patch cable, CAT5e, yellow.
The following versions are available:
ID no. 49313: length approx. 0.2 m.
ID no. 49314: length approx. 0.35 m.

PN6 communication module



ID no. 56426
Communication module for the PROFINET connection.

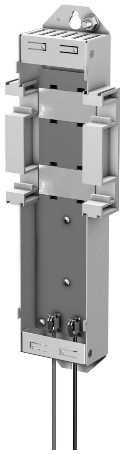
4.4.4 DC link connection

If you want to connect SD6 drive controllers in the DC-Link system, you will need the Quick DC-Link module of type DL6A.

For the horizontal connection, you receive the DL6A substructures in different designs, suitable for the size of the drive controller.

The quick tension clamps for attaching the copper rails as well as the insulation connection pieces are included in the scope of delivery. The copper rails are not included in the scope of delivery. These must have a cross-section of 5 x 12 mm. Insulation end sections are available separately.

Quick DC-Link DL6A for drive controller



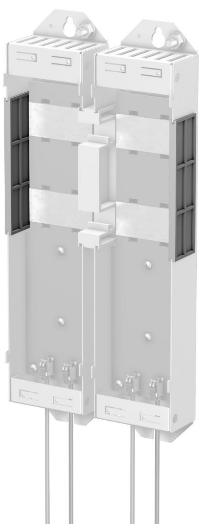
The following versions are available:

DL6A1
ID no. 56441
Substructure element for drive controller of size 0 or 1.

DL6A2
ID no. 56442
Substructure element for drive controllers of size 2.

DL6A3
ID no. 56443
Substructure element for drive controllers of size 3.

Quick DC-Link DL6A insulation end section



ID no. 56494
Insulation end sections for the left and right termination of the group, 2 pcs.

4.4.5 Braking resistor

In addition to the drive controllers, STOBER offers braking resistors in different sizes and performance classes described in the following. When selecting, note the minimum permitted braking resistances specified in the technical data of the individual drive controller types.

4.4.5.1 Tubular fixed resistor FZMU, FZZMU 400×65

Type	FZMU 400×65		FZZMU 400×65	
ID no.	49010	55445	53895	55447
SD6A02	X	—	—	—
SD6A04	X	—	—	—
SD6A06	X	—	—	—
SD6A14	(X)	—	X	—
SD6A16	(X)	—	X	—
SD6A24	—	X	(X)	X
SD6A26	—	X	(X)	X
SD6A34	—	(X)	—	(X)
SD6A36	—	(X)	—	(X)
SD6A38	—	(X)	—	(X)

Tab. 31: Assignment of braking resistor FZMU, FZZMU 400×65 – drive controller SD6

X	Recommended	—	Not possible
(X)	Possible		

Properties

Specification	FZMU 400×65		FZMU 400×65	
ID no.	49010	55445	53895	55447
Type	Tubular fixed resistor		Tubular fixed resistor	
Resistance [Ω]	100	22	47	22
Power [W]	600		1200	
Therm. time const. th [s]	40		40	
Pulse power for < 1 s [kW]	18		36	
U_{max} [V]	848		848	
Weight [kg]	Approx. 2.2		Approx. 4.2	
Protection class	IP20		IP20	
Test marks	cULus		cULus	

Tab. 32: Specification FZMU, FZZMU 400×65

Dimensions

Dimension	FZMU 400×65		FZZMU 400×65	
ID no.	49010	55445	53895	55447
L x D	400 × 65		400 × 65	
H	120		120	
K	6.5 × 12		6.5 × 12	
M	430		426	
O	485		450	
R	92		185	
U	64		150	
X	10		10	

Tab. 33: Dimensions FZMU, FZZMU 400×65 [mm]

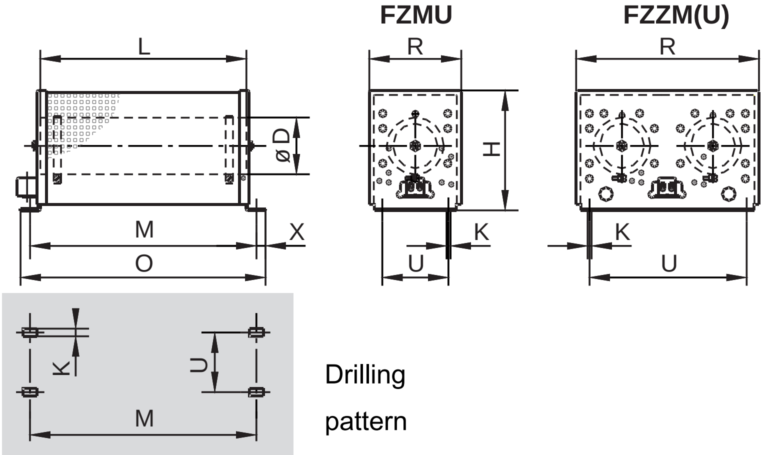


Fig. 4: Dimensional drawing FZMU, FZZMU 400×65

4.4.5.2 Flat resistor GVADU, GBADU

Type	GVADU 210×20	GBADU 265×30	GBADU 405×30	GBADU 335×30	GBADU 265×30
ID no.	55441	55442	55499	55443	55444
SD6A02	X	X	X	—	—
SD6A04	X	X	X	—	—
SD6A06	X	X	X	—	—
SD6A14	(X)	(X)	(X)	X	—
SD6A16	(X)	(X)	(X)	X	—
SD6A24	—	—	—	(X)	X
SD6A26	—	—	—	(X)	X
SD6A34	—	—	—	—	(X)
SD6A36	—	—	—	—	(X)
SD6A38	—	—	—	—	(X)

Tab. 34: Assignment of braking resistor GVADU, GBADU – drive controller SD6

X	Recommended	—	Not possible
(X)	Possible		

Properties

Specification	GVADU 210×20	GBADU 265×30		GBADU 335×30	GBADU 405×30
ID no.	55441	55442	55444	55443	55499
Type	Flat resis-tor	Flat resistor			
Resistance [Ω]	100	100	22	47	100
Power [W]	150	300	300	400	500
Therm. time const. th [s]	60	60			
Pulse power for < 1 s [kW]	3.3	6.6	6.6	8.8	11
U_{max} [V]	848	848			
Cable design	Radox	FEP			
Cable length [mm]	500	500			
Cable cross-section [AWG]	18/19 (0.82 mm²)	14/19 (1.9 mm²)			
Weight [g]	300	950	950	1200	1450
Protection class	IP54	IP54			
Test marks	c UL us	c UL us			

Tab. 35: Specification GVADU, GBADU

Dimensions

Dimension	GVADU 210×20	GBADU 265×30		GBADU 335×30	GBADU 405×30
ID no.	55441	55442	55444	55443	55499
A	210	265		335	405
H	192	246		316	386
C	20	30		30	30
D	40	60		60	60
E	18.2	28.8		28.8	28.8
F	6.2	10.8		10.8	10.8
G	2	3		3	3
K	2.5	4		4	4
J	4.3	5.3		5.3	5.3
β	65°	73°		73°	73°

Tab. 36: Dimensions GVADU, GBADU [mm]

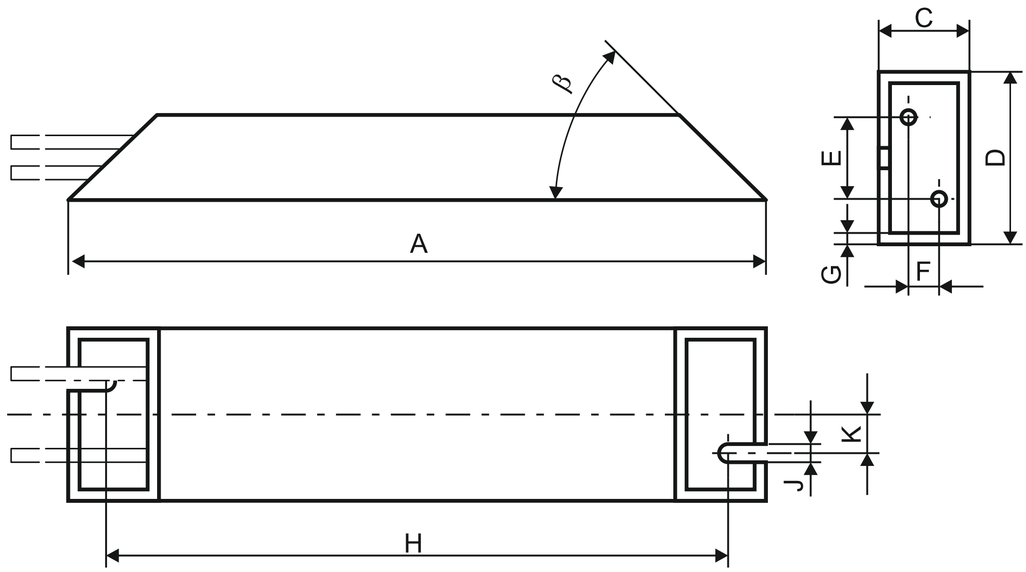


Fig. 5: Dimensional drawing GVADU, GBADU

4.4.5.3 Steel-grid fixed resistor FGFKU

Type	FGFKU			
ID no.	55449	55450	55451	53897
SD6A24	X	—	—	—
SD6A26	X	—	—	—
SD6A34	(X)	X	X	X
SD6A36	(X)	X	X	X
SD6A38	(X)	X	X	X

Tab. 37: Assignment of braking resistor FGFKU – drive controller SD6

—	Not possible	X	Recommended
(X)	Possible		

Properties

Specification	FGFKU			
ID no.	55449	55450	55451	53897
Type	Steel-grid fixed resistor		Steel-grid fixed resistor	Steel-grid fixed resistor
Resistance [Ω]	22	15	15	15
Power [W]	2500		6000	8000
Therm. time const. th [s]	30		20	20
Pulse power for < 1 s [kW]	50		120	160
U_{max} [V]	848		848	848
Weight [kg]	Approx. 7.5		12	18
Protection class	IP20		IP20	IP20
Test marks	cURus		cURus	cURus

Tab. 38: Specification FGFKU

STÖBER

SD6

Dimensions

Dimension	FGFKU			
ID no.	55449	55450	55451	53897
A	270		370	570
B	295		395	595
C	355		455	655

Tab. 39: Dimensions FGFKU [mm]

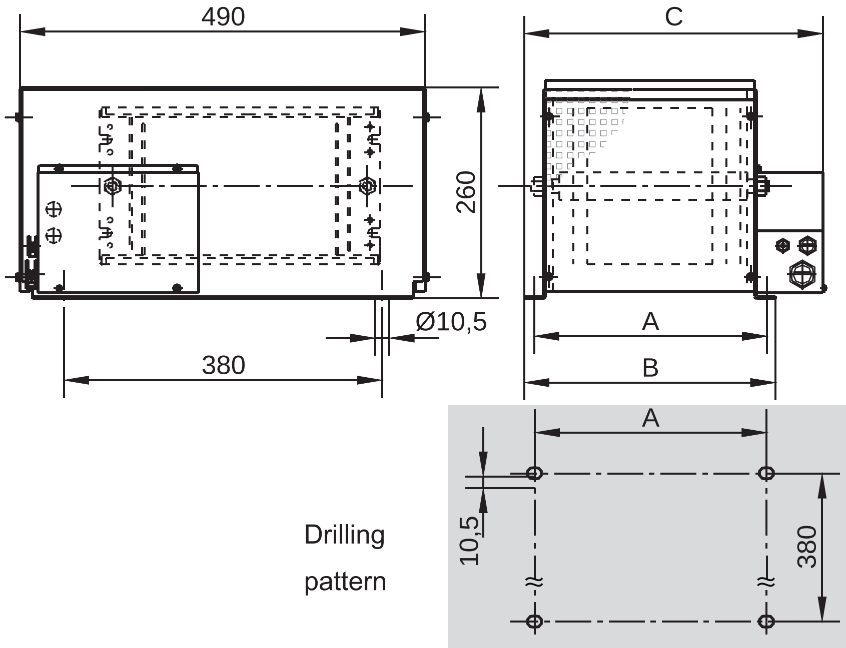


Fig. 6: Dimensional drawing FGFKU

4.4.5.4 Bottom brake resistor RB 5000

Type	RB 5022	RB 5047	RB 5100
ID no.	45618	44966	44965
SD6A04	—	—	X
SD6A06	—	—	X
SD6A14	—	X	(X)
SD6A16	—	X	(X)
SD6A24	X	—	—
SD6A26	X	—	—
SD6A34	—	—	—
SD6A36	—	—	—
SD6A38	—	—	—

Tab. 40: Assignment of braking resistor RB 5000 – drive controller SD6

—	Not possible	X	Recommended
(X)	Possible		

Properties

Specification	RB 5022	RB 5047	RB 5100
ID no.	45618	44966	44965
Resistance [Ω]	22	47	100
Power [W]	100	60	60
Therm. time const. th [s]	8		
Pulse power for < 1 s [kW]	1.5	1.0	1.0
U_{max} [V]	800		
Weight [g]	about 640	about 460	about 440
Cable design	Radox		
Cable length [mm]	250		
Cable cross-section [AWG]	18/19 (0.82 mm²)		
Maximum torque of M5 threaded bolts [Nm]	5		
Protection class	IP40		
Test marks	cULus		

Tab. 41: Specification RB 5000

Dimensions

Dimension	RB 5022	RB 5047	RB 5100
ID no.	45618	44966	44965
Height	300	300	
Width	94	62	
Depth	18	18	
Drilling pattern corresponds to size	Size 2	Size 1	Size 0 and size 1

Tab. 42: Dimensions RB 5000 [mm]

4.4.6 Chokes

4.4.6.1 Power choke

Properties

Specification	TEP4010-2US00
ID no.	56528
Phases	3
Permitted thermal continuous current	100 A
Rated current	90 A
Rated inductance	0.14 mH
Mains voltage	480 V
Voltage drop (Uk)	2 %
Frequency	60 Hz
Protection class	IP 00
Max. surrounding temperature $\vartheta_{amb,max}$	40° C
Insulation class	B
Connection	Flange connection
Mounting	Screws
Specification	EN 61558-2-20
UL Recognized Component (CAN; USA)	Yes
CE mark	Yes
Identification/test mark, symbol	CE, c UL US,

Dimensions and weight

Dimensions	TEP4010-2US00
Height [mm]	235
Width [mm]	219
Depth [mm]	118
Vertical distance 1 – fastening holes [mm]	201
Vertical distance 2 – fastening holes [mm]	136
Horizontal distance 1 – fastening holes [mm]	88
Horizontal distance 2 – fastening holes [mm]	75
Drill holes – depth [mm]	7
Drill holes – width [mm]	12
Screw connection – M	M6
Weight [kg]	10

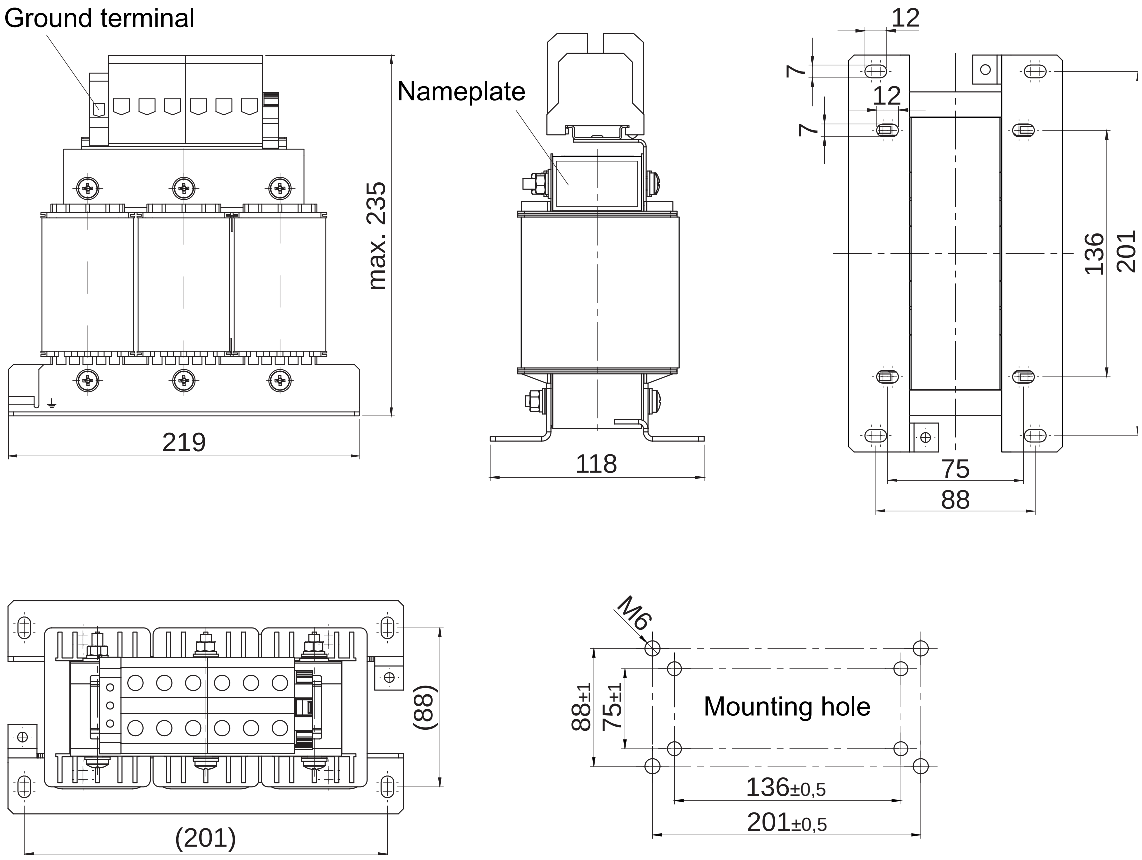


Fig. 7: Dimensional drawing power choke

4.4.6.2 Output choke TEP

Information

The following technical data applies for a rotary field frequency of 200 Hz. For example, this rotary field frequency is achieved with a motor with 4 pole pairs and a nominal speed of 3000 rpm. Always observe the specified derating for higher rotary field frequencies. Also observe the dependency of the cycle frequency.

Properties

Specification	TEP3720-0ES41	TEP3820-0CS41	TEP4020-0RS41
ID no.	53188	53189	53190
Voltage range	3 × 0 bis 480 V		
Frequency range	0 – 200 Hz		
I_N at 4 kHz	4 A	17.5 A	38 A
I_N at 8 kHz	3.3 A	15.2 A	30.4 A
Max. permitted motor cable length with output choke	100 m		
Max. surrounding temperature $\vartheta_{amb,max}$	40 °C		
Design	Open		
Winding losses	11 W	29 W	61 W
Iron losses	25 W	16 W	33 W
Connections	Screw terminals		
Max. conductor cross-section	10 mm²		
UL Recognized Component (CAN; USA)	Yes		
Test marks	cRUus		

Tab. 43: Specification TEP

Projecting

Select the output chokes according to the rated currents of the motor and output chokes. In particular, observe the derating of the output choke for rotary field frequencies higher than 200 Hz. You can calculate the rotary field frequency for your drive with the following formula:

$$f = n_N \times \frac{p}{60}$$

f	Rotary field frequency in Hz
n	Speed in rpm
N	Nominal value
p	Number of pole pairs

Derating

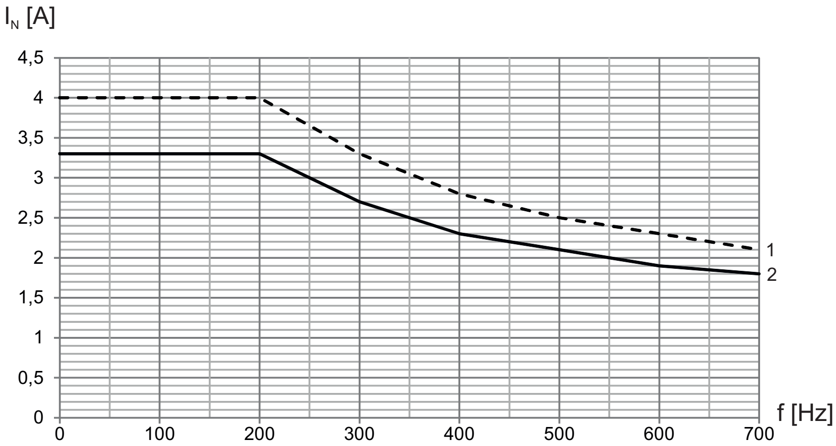


Fig. 8: Derating TEP3720-0ES41

1	Clock frequency 4 kHz
2	Clock frequency 8 kHz

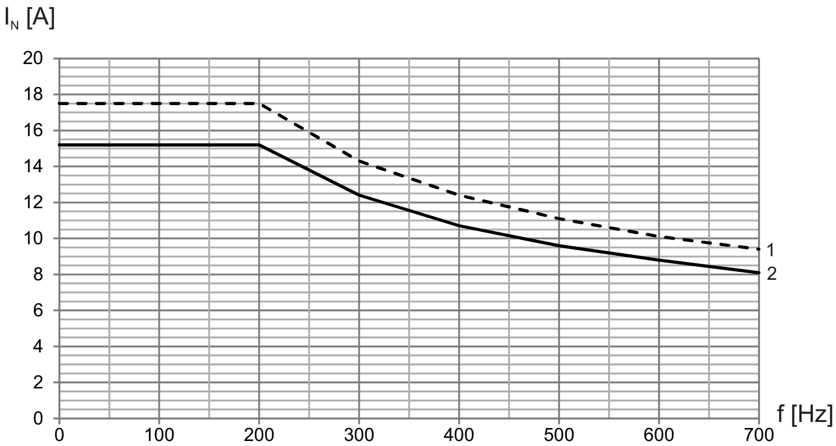


Fig. 9: Derating TEP3820-0CS41

1	Clock frequency 4 kHz
2	Clock frequency 8 kHz

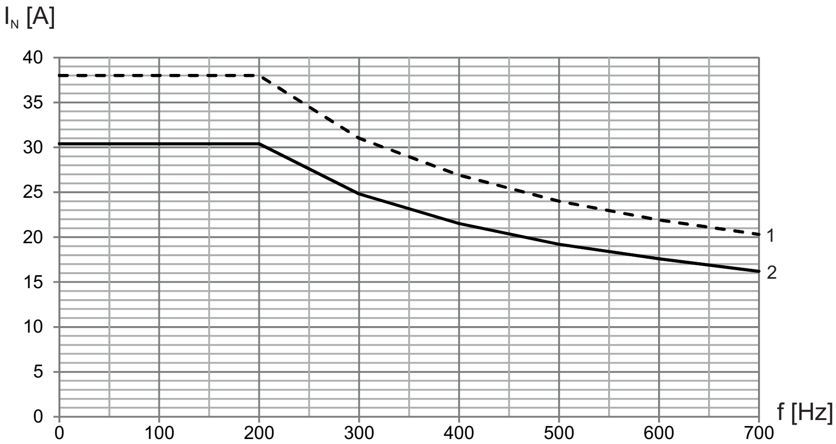


Fig. 10: Derating TEP4020-0RS41

1	Clock frequency 4 kHz
2	Clock frequency 8 kHz

Dimensions and weight

Dimension	TEP3720-0ES41	TEP3820-0CS41	TEP4020-0RS41
Height h [mm]	Max. 153	Max. 153	Max. 180
Width w [mm]	178	178	219
Depth d [mm]	73	88	119
Vertical distance – fastening holes a1 [mm]	166	166	201
Vertical distance – fastening holes a2 [mm]	113	113	136
Horizontal distance – fastening holes b1 [mm]	53	68	89
Horizontal distance – fastening holes b2 [mm]	49	64	76
Drill holes – depth e [mm]	5.8	5.8	7
Drill holes – width f [mm]	11	11	13
Screw connection – M	M5	M5	M6
Weight [kg]	2.9	5.9	8.8

Tab. 44: Dimensions and weight TEP

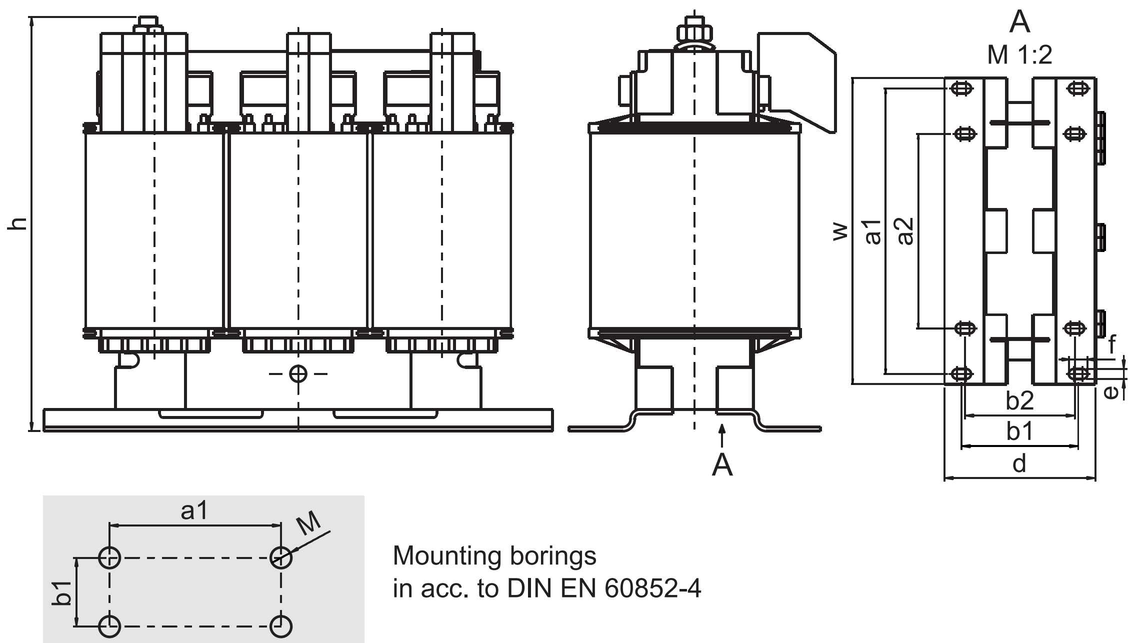


Fig. 11: Dimensional drawing TEP

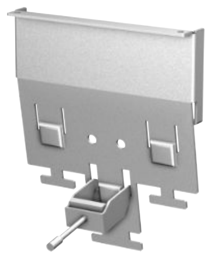
4.4.7 EMC shroud

You can use the EM6 EMC shroud to connect the cable shield of the power cable. Two different designs are available.

EMC shroud EM6A0

ID no. 135115
EMC shroud for sizes 0 to 2.
Accessory part for shield connection of the motor line.
Attachable to the basic housing including shield connection terminal.

EMC shroud EM6A3



ID no. 135120
EMC shroud for size 3.
Accessory part for shield connection of the motor line.
Attachable on the basic housing.
Including shield connection terminal.
If necessary you can also connect the cable shield of the braking resistor and DC link connection on the shroud. Additional shield connection terminals are available as accessories for this purpose (ID no. 56521).

4.4.8 Encoder adapter box

Encoder adapter box LA6A00

ID no. 56510
LA6 for connection HIWIN-TTL.
Encoder adapter box for transferring TTL and Hall sensor signals from HIWIN synchronous linear motors to the SD6 drive controller.
LA6 for the adaptation of additional linear motors on request.

SSI/TTL connection cable X120

ID no. 49482
Cable for connecting the TTL interface X120 to the SD6 drive controller (on terminal module RI6 or XI6) with the X301 interface on the LA6 adapter box for transferring Hall sensor signals. 0.3 m.

Connection cable LA6 / AX 5000

Cable for connecting connections X4 to the SD6 drive controller and X300 on the LA6 adapter box for transferring incremental encoder signals.
The following versions are available:
ID no. 45405: 0.5 m.
ID no. 45386: 2.5 m.

4.4.9 Battery module for encoder buffering

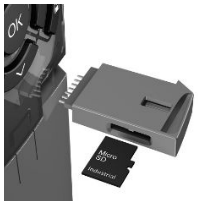
Replaceable battery AES

ID no. 55453
replacement battery for the battery module AES.

4.4.10 Removable data storage

Paramodule removable data storage

Included in the standard design.



ID no. 56403
The plug-in ParaModule with integrated microSD card (128 MB, industrial) is available as a storage medium.
The microSD card is also available separately as a spare part (ID no. 56436).

4.4.11 Product CD

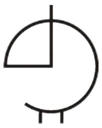
Product CD "ELECTRONICS 6"

Included in the standard design.

ID no. 442538
The CD-ROM contains the DriveControlSuite project configuration and commissioning software, documentation as well as the device description files for the drive controller – controller connection.

4.5 Further information

4.5.1 Symbols, identifiers and test symbols



EN 61558-2-20
Choke without overload protection.

Grounding symbol
according to IEC 60417-5019 (DB:2002-10).

Lead-free identifier RoHS
according to RoHS directive 2011-65-EU.

CE mark
Manufacturer's self declaration: The product meets the requirements of EU directives.

UL-test mark
This product is listed by UL for the USA and Canada. Representative samples of this product have been evaluated by UL and meet the requirements of applicable standards.

UL test marks for recognized components
This component or material is recognized by UL. Representative samples of this product have been evaluated by UL and meet applicable requirements.

5 POSIDYN SDS 5000 servo inverter

5.1 Overview

SDS 5000 – high dynamics for fully digital servo axes

- Control of rotary synchronous and asynchronous motors
- Nominal output current up to 60 A (at 8 kHz clock frequency)
- 250 % overload capacity
- Power range: 0.75 kW to 45 kW
- Communication via PROFIBUS DP, PROFINET, CANopen, EtherCAT
- Isochronic system bus (IGB) for parameterization and multi-axis applications
- Encoder interfaces EnDat 2.1/2.2 digital, SSI, incremental (HTL/TTL) or resolver
- Digital and analog inputs and outputs
- Automatic motor parameterization from the electronic motor nameplate
- Integrated brake chopper
- Brake management for two 24 V holding brakes
- Integrated line filter
- Motor temperature evaluation via PTC thermistors, KTY or Pt temperature sensors
- Standard applications with speed, torque, positioning and master/slave functionality
- Programming based on IEC 61131-3 with CFC for creating applications
- Safe Torque Off and Safe Stop 1 safety functions in accordance with DIN EN ISO 13849-1 and DIN EN 61800-5-2
- Fast commissioning with POSITool software
- Convenient control unit consisting of plain text display and keyboard
- Removable data storage Paramodule for commissioning and service
- Secured remote maintenance concept

SDS 5000

5.1.1 Features

The 5th generation series of STOBER inverters work entirely digitally as modular inverter systems for operating rotary synchronous and asynchronous motors. It includes product types for direct operation on a one or three-phase network in a voltage range from 200 V_{AC} to 528 V_{AC}. An EMC line filter is integrated. EnDat 2.1/2.2 digital, SSI and Incremental (HTL/TTL) are available as encoder interfaces in the standard version. Resolver evaluation is possible as an option. STOBER synchronous servo motors are designed for operation preferably with encoder EnDat 2.1/2.2 digital. The highest control quality can be achieved with these encoder systems. Motor parameterization can be derived automatically from the electronic motor nameplate. The inverter can be adapted to the requirements of individual applications using different option modules. The ASP 5001 safety module makes it possible to implement the Safe Torque Off (STO) and Safe Stop 1 (SS1) safety functions in accordance with DIN EN ISO 13849-1 and DIN EN 61800-5-2 for safety-relevant applications. The communication modules are used to connect to a control unit using PROFIBUS DP, PROFINET, CANopen or EtherCAT fieldbuses. Terminal modules offer the option of connecting analog and binary signals as well as additional encoder signals. A plain text display and the keyboard simplify diagnostics if a fault is present and enable fast access to parameters. The removable data storage Paramodule can be used to transfer all application-relevant data from one inverter to another.

POSIDYN SDS 5000

POSIDRIVE MDS 5000

Sequential axis switching with POSISwitch AX 5000

With the POSISwitch AX 5000 accessory, up to four synchronous servo motors can be operated on one inverter sequentially with absolute value encoder EnDat 2.1/2.2 digital. The POSISwitch AX 5000 module is used to switch absolute value encoder signals and control signals for brake and motor line switching. Entirely digital encoder signals with EnDat protocol allow for easy switching with EMC immunity.

Integrated bus (IGB) for performance, convenience and safety

POSIDYN 5000 servo inverters have two interfaces for the integrated bus in the standard version. The integrated bus is used for easy project planning via Ethernet and isochronic data exchange for the following functions:

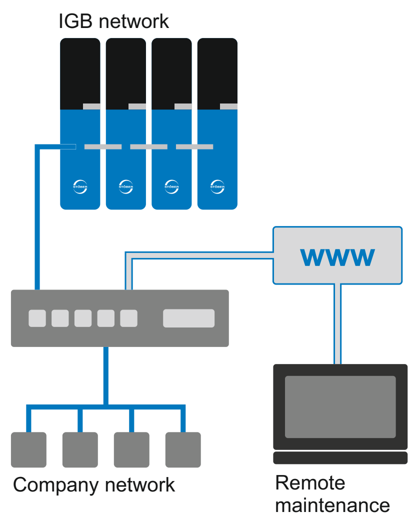
- Multi-axis synchronization between the servo inverters (IGB motion bus)
- Internet connection for remote maintenance of individual and multiple inverters
- Direct connection between servo inverter and PC

IGB motion bus

The IGB motion bus allows for cyclic, isochronic data exchange between multiple POSIDYN SDS 5000 units integrated into the IGB network. In addition to transferring guide values for master/slave operation, any other data items can also be exchanged, for example tailor-made applications.

STOBER remote maintenance

STOBER remote maintenance using the commissioning software can be used to perform all processes and sequence just as for on-site service operations. The concept guides users through a controlled and protected procedure. This ensures that the responsible employee is at the machine on site to pay attention to special features and personal safety. On the other end, the remote maintenance specialist is ensured that he is communicating with a responsible employee on site who is controlling the situation on the machine.



Remote maintenance can be used to perform all processes and sequence just as for on-site service operations.

Brake management

The POSIDYN SDS 5000 servo inverter can control one or two 24 V brake systems with the optional BRS 5001 brake module. Brake management provides the following functions for both brake systems:

- Cyclic brake test
- Grind brake

Optionally available: brake module BRS 5001

POSITool

The 5th generation of POSITool project planning and commissioning software has all the functions needed for efficient use of inverters in single and multi-axis applications.

Paramodule removable data storage

Removable data storage for fast series commissioning by copying and easy service when replacing devices.

5.1.2 Software components

Modular application software

Different standard applications can be loaded on the devices of the 5th generation of STOBER inverters with the POSITool commissioning software as required. Programming based on IEC 61131-3 can also be used with CFC to create new applications or expand existing ones. The inverter operating system is multi-axis capable. It supports up to four axes with separate application and parameter ranges.

Velocity mode (standard application)

- **Fast reference value**
  Simple speed application for lean applications. The speed reference value and torque limiting can be assigned via analog inputs and also digitally.

Torque and velocity mode (standard application)

- **Comfort reference value**
  Expanded torque and speed reference value application. Reference values and limits can be assigned with the fast reference value and also using fixed values, motor potentiometers and other functions.
- **Technology controller**
  PID controller for torque or speed controlled applications.

Positioning mode (standard application)

- **Command positioning, synchronous command positioning**
  High-performance positioning application with a command interface based on PLCopen. The data for a motion task including target position, velocity and acceleration are transferred together via fieldbus to the inverter, which then processes them independently. The functional scope is rounded out by an electrical cam, motion block switching point and Posi-Latch.
- **Motion block positioning**
  Extensive positioning application with up to 256 motion blocks based on PLCopen. The motion blocks can be selected individually via fieldbus or with binary inputs. They can also be started chained. The functional scope is rounded out by an electrical cam, motion block switching point and Posi-Latch.

Electronic cam disk with PLCopen interface (tailor-made applications)

The electronic cam disk application makes it possible to implement complex motion tasks such as:

- Flying saw
- Synchronizer (clock in/clock out)
- Cross cutter
- Welding bar/embossing stamp
- Print mark control

These applications can be implemented quickly and easily using the readily understandable free graphical programming based on IEC 61131-3 CFC. This also allows for customer-specific adaptations for special system features. Function blocks based on PLCopen Motion Control are available for this purpose for trained users.

5.1.3 Application training

STOBER offers a multi-level training program that focuses essentially on application programming of the motion controller and inverter.

SDS 5000 Basic

Training content: system overview, assembly and commissioning of the inverter. Use of option modules. Parameterization, commissioning and diagnostics using the integrated display and commissioning software. Remote maintenance. Basics of controller optimization. Configuration of the drive train. Integrated software functions. Software applications. Connection to a higher-level controller. Basics of safety technology. Practical exercises for the training structure.

Software used: POSITool.

SDS 5000 Advanced

Training content: Graphical programming with CFC. Special knowledge for regulating, control and safety technology. Practical exercises for the training structure.

SDS 5000 CAM

Training content: special knowledge of electronic cam disks. Practical exercises for the training structure.

5.2 Technical data

Technical data for inverters can be found in the following sections.

5.2.1 Formula symbol

Formula symbols	Unit	Explanation
D_{IA}	%	Reduction of the nominal current depending on the installation height
D_T	%	Reduction of the nominal current depending on the surrounding temperature
f_{2PU}	Hz	Output frequency of the power unit
$f_{PWM,PU}$	Hz	Internal pulse clock frequency of the power unit
I_0	A	Standstill current: RMS value of the line-to-line current with standstill torque M_0 generated (Tolerance ±5 %)
$I_{1N,PU}$	A	Nominal input current of the power unit
I_{2maxPU}	A	Maximum output current of the power unit
$I_{2N,PU}$	A	Nominal output current of the power unit
$I_{N,MOT}$	A	Nominal current of the motor
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 %)
M_0	Nm	Standstill torque: the torque the motor is able to deliver long term at a speed of 10 rpm (tolerance ±5 %)
M_N	Nm	Nominal torque: the maximum torque of a motor in S1 mode at nominal speed n_N (tolerance ±5 %)
n_N	rpm	Nominal speed: the speed for which the nominal torque M_N is specified
P_{maxRB}	W	Maximum power at the external braking resistor
P_V	W	Power loss
$P_{V,CU}$	W	Power loss of the control board
R_{2minRB}	Ω	Minimum resistance of the external braking resistor
R_{intRB}	Ω	Resistance of the internal braking resistor
$\vartheta_{amb,max}$	°C	Maximum surrounding temperature
τ_{th}	°C	Thermal time constant
U_{1CU}	V	Input voltage of the control board
U_{1PU}	V	Input voltage of the power unit
U_{2PU}	V	Output voltage of the power unit
U_{max}	V	Maximum voltage
U_{maxPU}	V	Maximum voltage of the power unit
U_{offCH}	V	Off limit of the brake chopper
U_{onCH}	V	On limit of the brake chopper

5.2.2 Type designation

SDS	5	075	A

Tab. 1: Sample code

Code	Designation	Design
SDS	Series	
5	Generation	5. Generation
075	Power	075 = 7.5 kW
– **A**	Hardware variants	No identification: HW 199 or lower A: HW 200 or higher

Tab. 2: Explanation

5.2.3 Sizes

Type	ID no.	Size
SDS 5007A	55428	Size 0
SDS 5008A	55429	Size 0
SDS 5015A	55430	Size 0
SDS 5040A	55431	Size 1
SDS 5075A	55432	Size 1
SDS 5110A	55433	Size 2
SDS 5150A	55434	Size 2
SDS 5220A	55435	Size 3
SDS 5370A	55436	Size 3
SDS 5450A	55437	Size 3

Tab. 3: Available SDS 5000 types and sizes

Fig. 1: SDS 5000 in sizes 3, 2, 1 and 0

5.2.4 General technical data

Device features	
Protection class of the device	IP20
Protection class of the control cabinet	At least IP54
Radio interference suppression	Integrated line filter according to EN 61800-3:2012, interference emission class C3
Overvoltage category	III according to EN 61800-5-1:2008

Tab. 4: Device features

Transport and storage conditions	
Storage/ transport temperature	-20 °C to +70 °C Maximum change: 20 °C/h
Relative humidity	Maximum relative humidity 85 %, non-condensing
Vibration (transport) to DIN EN 60068-2-6	5 Hz ≤ f ≤ 9 Hz: 3.5 mm 9 Hz ≤ f ≤ 200 Hz: 10 m/s² 200 Hz ≤ f ≤ 500 Hz: 15 m/s²

Tab. 5: Transport and storage conditions

Operating conditions	
Surrounding operating temperature	0 °C to 45 °C for nominal data 45 °C to 55 °C with derating −2.5 % / °C
Relative humidity	Maximum relative humidity 85 %, non-condensing
Installation altitude	0 m to 1000 m above sea level without restrictions 1000 m to 2000 m above seal level with derating −1.5 % / 100 m
Pollution degree	Pollution degree level 2 as per EN 50178
Ventilated	Installed fan
Vibration (operation) to DIN EN 60068-2-6	5 Hz ≤ f ≤ 9 Hz: 0.35 mm 9 Hz ≤ f ≤ 200 Hz: 1 m/s²

Tab. 6: Operating conditions

Discharge times	
Self-discharge	5 minutes

Tab. 7: Discharge times of the DC link circuit

5.2.5 Electrical data

The electrical data of the available sizes as well as the properties of the brake chopper can be found in the following sections.

5.2.5.1 Size 0: SDS 5007A to SDS 5015A

Electrical data	SDS 5007A	SDS 5008A	SDS 5015A
ID no.	55428	55429	55430
Recommended motor rating	0.75 kW	0.75 kW	1.5 kW
U_{1PU}	1 × 230 V, +20 % / -40 %, 50/60 Hz	3 × 400 V, +32 % / -50 %, 50 Hz; 3 × 480 V, +10 % / -58 %, 60 Hz	
$I_{1N,PU}$	1 × 5.9 A	3 × 2.2 A	3 × 4 A
f_{2PU}	0 – 700 Hz		
U_{2PU}	0 – 230 V	0 – 400 V	
U_{maxPU}	440 V	830 V	

Tab. 8: Electrical data SDS 5000, size 0

Nominal currents up to +45 °C (in the control cabinet)

Operation with asynchronous motor

Electrical data	SDS 5007A	SDS 5008A	SDS 5015A
$I_{2N,PU}$	3 × 4 A	3 × 2.3 A	3 × 4.5 A
I_{2maxPU}	180 % for 5 s; 150 % for 30 s		
$f_{PWM,PU}$	4 kHz[1]		

Tab. 9: Electrical data SDS 5000, size 0, for 4 kHz clock frequency

Operation with synchronous servo motor

Electrical data	SDS 5007A	SDS 5008A	SDS 5015A
$I_{2N,PU}$	3 × 3 A	3 × 1.7 A	3 × 3.4 A
I_{2maxPU}	250 % for 2 s; 200 % for 5 s		
$f_{PWM,PU}$	8 kHz[2]		

Tab. 10: Electrical data SDS 5000, size 0, for 8 kHz clock frequency

Electrical data	SDS 5007A	SDS 5008A	SDS 5015A
U_{onCH}	400 – 420 V	780 – 800 V	
U_{offCH}	360 – 380 V	740 – 760 V	
R_{2minRB}	100 Ω	100 Ω	
P_{maxRB}	1.8 kW	6.4 kW	

Tab. 11: Brake chopper electrical data, size 0

[1] Clock frequency adjustable from 4 to 16 kHz (see derating section)
[2] Clock frequency adjustable from 4 to 16 kHz (see derating section)

5.2.5.2 Size 1: SDS 5040A to SDS 5075A

Electrical data	SDS 5040A	SDS 5075A
ID no.	55431	55432
Recommended motor rating	4.0 kW	7.5 kW
U_{1PU}	3 × 400 V, +32 % / -50 %, 50 Hz; 3 × 480 V, +10 % / -58 %, 60 Hz	
$I_{1N,PU}$	3 × 9.3A	3 × 15.8 A
f_{2PU}	0 – 700 Hz	
U_{2PU}	0 – 400 V	
U_{maxPU}	830 V	

Tab. 12: Electrical data SDS 5000, size 1

Nominal currents up to +45 °C (in the control cabinet)

Operation with asynchronous motor

Electrical data	SDS 5040A	SDS 5075A
$I_{2N,PU}$	3 × 10 A	3 × 16 A
I_{2maxPU}	180 % for 5 s; 150 % for 30 s	
$f_{PWM,PU}$	4 kHz[3]	

Tab. 13: Electrical data SDS 5000, size 1, for 4 kHz clock frequency

Operation with synchronous servo motor

Electrical data	SDS 5040A	SDS 5075A
$I_{2N,PU}$	3 × 6 A	3 × 10 A
I_{2maxPU}	250 % for 2 s; 200 % for 5 s	
$f_{PWM,PU}$	8 kHz[4]	

Tab. 14: Electrical data SDS 5000, size 1, for 8 kHz clock frequency

Electrical data	SDS 5040A	SDS 5075A
U_{maxPU}	830 V	
U_{onCH}	780 – 800 V	
U_{offCH}	740 – 760 V	
R_{2minRB}	47 Ω	47 Ω
P_{maxRB}	13.6 kW	13.6 kW

Tab. 15: Brake chopper electrical data, size 1

[3] Clock frequency adjustable from 4 to 16 kHz (see derating section)
[4] Clock frequency adjustable from 4 to 16 kHz (see derating section)

5.2.5.3 Size 2: SDS 5110A to SDS 5150A

Electrical data	SDS 5110A	SDS 5150A
ID no.	55433	55434
Recommended motor rating	11 kW	15 kW
U_{1PU}	3 × 400 V, +32 % / -50 %, 50 Hz; 3 × 480 V, +10 % / -58 %, 60 Hz	
$I_{1N,PU}$	3 × 24.5 A	3 × 32.6 A
f_{2PU}	0 – 700 Hz	
U_{2PU}	0 – 400 V	
U_{maxPU}	830 V	

Tab. 16: Electrical data SDS 5000, size 2

Nominal currents up to +45 °C (in the control cabinet)

Operation with asynchronous motor

Electrical data	SDS 5110A	SDS 5150A
$I_{2N,PU}$	3 × 22 A	3 × 32 A
I_{2maxPU}	180 % for 5 s; 150 % for 30 s	
$f_{PWM,PU}$	4 kHz[5]	

Tab. 17: Electrical data SDS 5000, size 2, for 4 kHz clock frequency

Operation with synchronous servo motor

Electrical data	SDS 5110A	SDS 5150A
$I_{2N,PU}$	3 × 14 A	3 × 20 A
I_{2maxPU}	250 % for 2 s; 200 % for 5 s	
$f_{PWM,PU}$	8 kHz[6]	

Tab. 18: Electrical data SDS 5000, size 2, for 8 kHz clock frequency

Electrical data	SDS 5110A	SDS 5150A
U_{onCH}	780 – 800 V	
U_{offCH}	740 – 760 V	
R_{2minRB}	22 Ω	
P_{maxRB}	29.1 kW	

Tab. 19: Brake chopper electrical data, size 2

[5] Clock frequency adjustable from 4 to 16 kHz (see derating section)
[6] Clock frequency adjustable from 4 to 16 kHz (see derating section)

5.2.5.4 Size 3: SDS 5220A to SDS 5450A

Electrical data	SDS 5220A	SDS 5370A	SDS 5450A
ID no.	55435	55436	55437
Recommended motor rating	22 kW	37 kW	45 kW
U_{1PU}	3 × 400 V, +32 % / -50 %, 50 Hz; 3 × 480 V, +10 % / -58 %, 60 Hz		
$I_{1N,PU}$	1 × 37 A	3 × 62 A	3 × 76 A
f_{2PU}	0 – 700 Hz		
U_{2PU}	0 – 400 V		
U_{maxPU}	830 V		

Tab. 20: Electrical data SDS 5000, size 3

Nominal currents up to +45 °C (in the control cabinet)

Operation with asynchronous motor

Electrical data	SDS 5220A	SDS 5370A	SDS 5450A
$I_{2N,PU}$	3 × 44 A	3 × 70 A	3 × 85 A
I_{2maxPU}	180 % for 5 s; 150 % for 30 s		
$f_{PWM,PU}$	4 kHz[7]		

Tab. 21: Electrical data SDS 5000, size 3, for 4 kHz clock frequency

Operation with synchronous servo motor

Electrical data	SDS 5220A	SDS 5370A	SDS 5450A
$I_{2N,PU}$	3 × 30 A	3 × 50 A	3 × 60 A
I_{2maxPU}	250 % for 2 s; 200 % for 5 s		
$f_{PWM,PU}$	8 kHz[8]		

Tab. 22: Electrical data SDS 5000, size 3, for 8 kHz clock frequency

Electrical data	SDS 5220A	SDS 5370A	SDS 5450A
U_{onCH}	780 – 800 V		
U_{offCH}	740 – 760 V		
R_{intRB}	30 Ω (PTC resistance; 100 W; max. 1 kW for 1 s; τ = 40 s)		
R_{2minRB}	15 Ω		
P_{maxRB}	42 kW		

Tab. 23: Brake chopper electrical data, size 3

[7] Clock frequency adjustable from 4 to 16 kHz (see derating section)
[8] Clock frequency adjustable from 4 to 16 kHz (see derating section)

5.2.5.5 Power loss data according to EN 50598

Type	Nominal current $I_{2N,PU}$	Apparent power	Absolute losses $P_{V,CU}$[9]	Working points[10]								IE class[11]
				(0/25)	(0/50)	(0/100)	(50/25)	(50/50)	(50/100)	(90/50)	(90/100)	
				Relative losses								
	[A]	[kVA]	[W]	[%]								
SDS 5007A	4	0.9	10	5.01	5.07	5.68	5.20	5.37	6.30	5.88	7.43	IE2
SDS 5008A	2.3	1.6	10	2.98	3.13	3.49	3.02	3.22	3.71	3.36	4.09	IE2
SDS 5015A	4.5	3.1	12	1.71	1.86	2.24	1.75	1.97	2.51	2.16	3.04	IE2
SDS 5040A	10	6.9	12	1.38	1.54	1.93	1.43	1.64	2.17	1.80	2.57	IE2
SDS 5075A	16	11.1	12	0.95	1.12	1.66	0.99	1.23	1.98	1.41	2.52	IE2
SDS 5110A	22	15.2	15	0.80	0.97	1.49	0.84	1.06	1.75	1.21	2.19	IE2
SDS 5150A	32	22.2	15	0.70	0.87	1.40	0.74	0.97	1.66	1.11	2.08	IE2
SDS 5220A	44	30.5	35	0.61	0.76	1.21	0.68	0.90	1.53	1.06	1.96	IE2
SDS 5370A	70	48.5	35	0.53	0.69	1.18	0.59	0.82	1.49	0.97	1.89	IE2
SDS 5450A	85	58.9	35	0.47	0.64	1.18	0.54	0.78	1.50	0.94	1.94	IE2

Tab. 24: Relative losses of inverter SDS 5000 according to EN 50598

[9] Absolute losses for a power stage that is switched off
[10] Operating points for relative motor stator frequency in % and relative torque current in %
[11] IE class according to EN 50598

Type	Nominal current $I_{2N,PU}$	Apparent power	Absolute losses $P_{V,CU}$[12]	Working points[13]								IE class[14]	Comparison[15]
				(0/25)	(0/50)	(0/100)	(50/25)	(50/50)	(50/100)	(90/50)	(90/100)		
				Absolute losses P_V									
	[A]	[kVA]	[W]	[W]									[%]
SDS 5007A	4	0.9	10	45.1	45.6	51.1	46.8	48.3	56.7	52.9	66.9	IE2	51.8
SDS 5008A	2.3	1.6	10	47.7	50.1	55.8	48.3	51.5	59.3	53.8	65.4	IE2	40.2
SDS 5015A	4.5	3.1	12	52.9	57.6	69.3	54.4	61.0	77.9	67.1	94.1	IE2	39.6
SDS 5040A	10	6.9	12	95.3	106.1	133.3	98.6	113.2	149.9	123.9	177.0	IE2	37.1
SDS 5075A	16	11.1	12	104.9	124.0	184.6	110.3	136.6	219.8	156.0	279.8	IE2	35.8
SDS 5110A	22	15.2	15	121.5	146.9	226.1	128.1	161.6	266.0	183.7	332.7	IE2	32.9
SDS 5150A	32	22.2	15	154.7	192.8	311.3	164.6	214.6	369.3	245.9	462.1	IE2	38.3
SDS 5220A	44	30.5	35	187.5	232.2	368.7	207.7	273.9	466.8	323.0	597.8	IE2	32.1
SDS 5370A	70	48.5	35	256.6	332.3	570.8	287.9	397.0	721.5	471.0	915.9	IE2	33.9
SDS 5450A	85	58.9	35	277.8	376.9	692.3	317.4	459.0	886.1	554.6	1143.1	IE2	35.3

Tab. 25: Power loss data of inverter SDS 5000 according to EN 50598

General conditions

The loss data applies to inverters without accessories.

The power loss calculation based on a three-phase supply voltage with 400 V_{AC} / 50 Hz.

The calculated data includes a supplement of 10 % according to EN 50598.

The power loss specifications refer to a clock frequency of 4 kHz.

The absolute losses for a power stage that is switched off refer to the 24 vdc power supply of the control electronics.

[12] Absolute losses for a power stage that is switched off
[13] Operating points for relative motor stator frequency in % and relative torque current in %
[14] IE class according to EN 50598
[15] Comparison of the losses for the reference inverter related to IE2 in the nominal point (90, 100)

5.2.5.6 Power loss data of accessories

Type	Absolute losses P_V [W]
Safety module ASP 5001	1
Terminal module SEA 5001	< 2
Terminal module XEA 5001	< 5
Terminal module REA 5001	< 5
Fieldbus module CAN 5000	1
Fieldbus module DP 5000	< 2
Fieldbus module ECS 5000	< 2
Fieldbus module PN 5000	< 4
Brake module BRS 5001	< 1

Tab. 26: Absolute losses of the accessories

Information

Also observe the absolute power loss of the encoder (usually < 3 W as well as the brake for the design.

5.2.6 Derating by increasing the clock frequency

Depending on the clock frequency $f_{PWM,PU}$, the following values of the nominal output currents $I_{2N,PU}$ arise. Note that only 8 kHz and 16 kHz can be set for the servo control type.

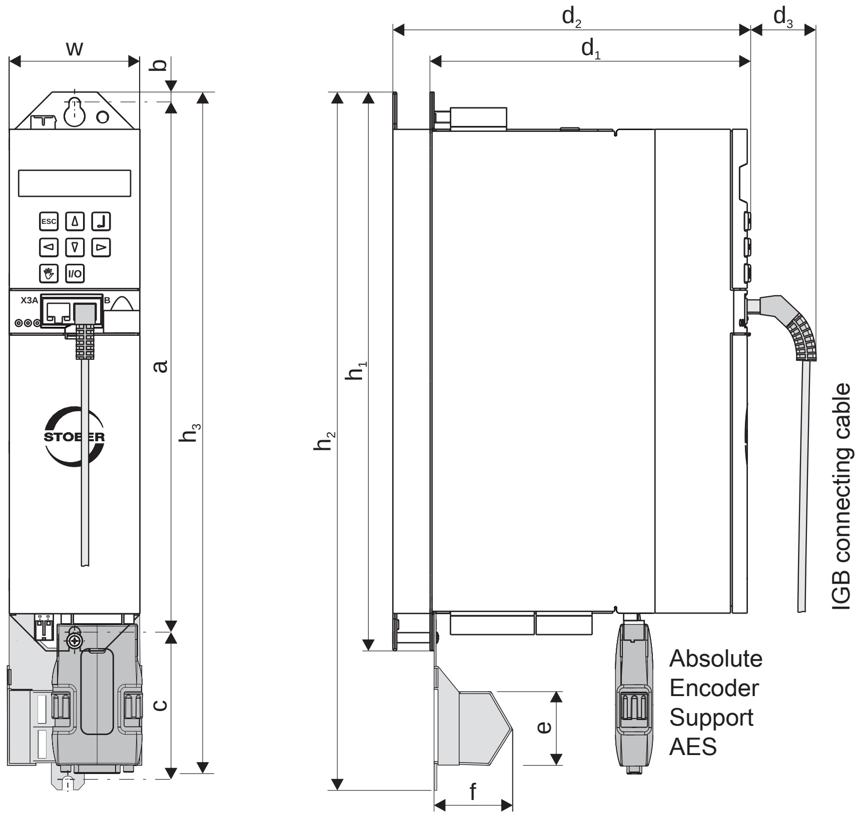
Type	$I_{2N,PU}$ 4 kHz	$I_{2N,PU}$ 8 kHz	$I_{2N,PU}$ 16 kHz
SDS 5007A	4 A	3 A	2 A
SDS 5008A	2.3 A	1.7 A	1.2 A
SDS 5015A	4.5 A	3.4 A	2.2 A
SDS 5040A	10 A	6 A	3.3 A
SDS 5075A	16 A	10 A	5.7 A
SDS 5110A	22 A	14 A	8.1 A
SDS 5150A	32 A	20 A	11.4 A
SDS 5220A	44 A	30 A	18.3 A
SDS 5370A	70 A	50 A	31.8 A
SDS 5450A	85 A	60 A	37.8 A

Tab. 27: Nominal output current $I_{2N,PU}$ depending on the clock frequency

5.2.7 Dimensions

The dimensions of the available SDS 5000 sizes can be found in the following sections.

5.2.7.1 Dimensions: sizes 0 to 2

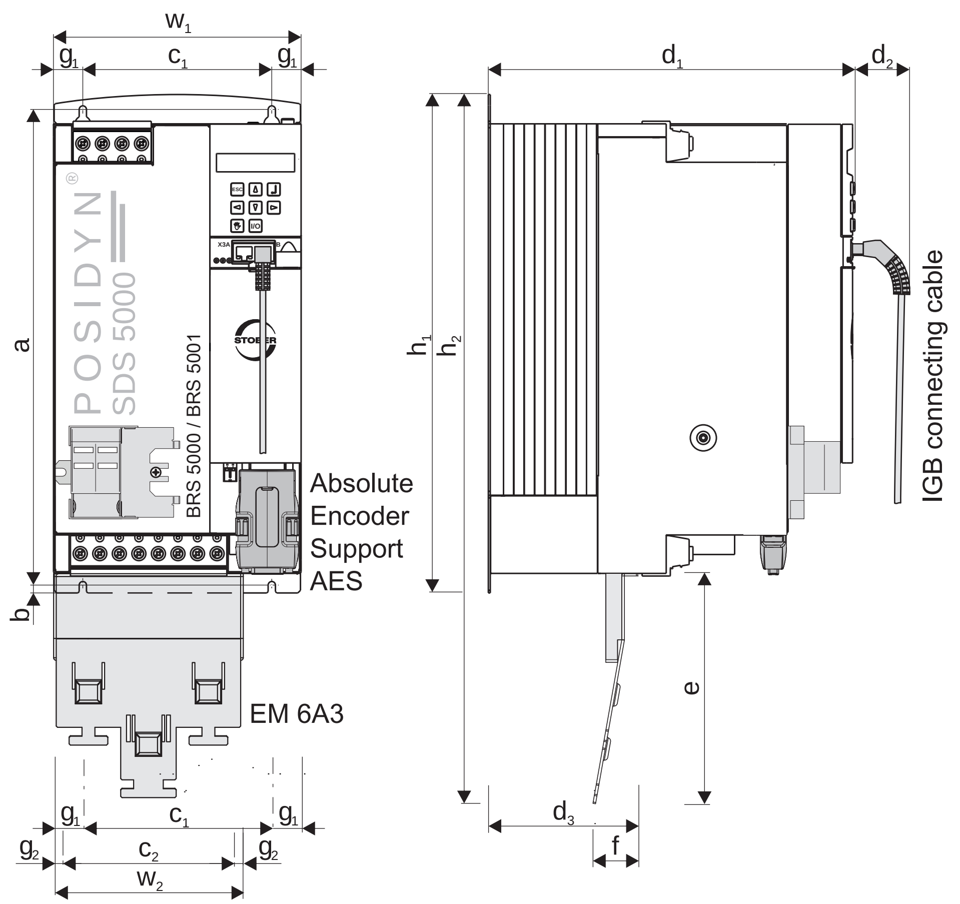


EM 5000 /
BRS 5000 / BRS 5001

<table>
<tr><th colspan="3">Dimensions [mm]</th><th>Size 0</th><th>Size 1</th><th>Size 2</th></tr>
<tr><td rowspan="7">Inverter</td><td rowspan="3">Height</td><td>h_1</td><td colspan="3">300</td></tr>
<tr><td>h_2</td><td colspan="3">360[16] / 373[17]</td></tr>
<tr><td>h_3[18]</td><td colspan="3">365</td></tr>
<tr><td>Width</td><td>w</td><td colspan="2">70</td><td>105</td></tr>
<tr><td rowspan="3">Depth</td><td>d_1</td><td>175</td><td>260</td><td>260</td></tr>
<tr><td>d_2[19]</td><td>193</td><td>278</td><td>278</td></tr>
<tr><td>d_3</td><td colspan="3">40</td></tr>
<tr><td rowspan="2">EMC shroud</td><td>Height</td><td>e</td><td colspan="3">37.5[20] / 44[21]</td></tr>
<tr><td>Depth</td><td>f</td><td colspan="3">40</td></tr>
<tr><td rowspan="3">Fastening holes</td><td>Vertical distance to upper edge</td><td>b</td><td colspan="3">6</td></tr>
<tr><td>Vertical distance</td><td>a</td><td colspan="3">283+2</td></tr>
<tr><td>Vertical distance</td><td>c[22]</td><td colspan="3">79</td></tr>
</table>

[16] h2 = height incl. EMC shroud EM 5000
[17] h2 = height incl. brake module BRS 5001
[18] h3 = Height incl. AES
[19] d2 = Depth including brake resistor RB 5000
[20] e = height of EMC shroud EM 5000
[21] e = height of brake module BRS 5001
[22] c = vertical distance with brake module BRS 5001

5.2.7.2 Dimensions: size 3



Dimensions [mm]			Size 3
Inverter	Height	h_1	382.5
		h_2[23]	540
	Width	w_1	194
	Depth	d_1	276
		d_2	40
EMC shroud	Height	e	174
	Width	w_2	147
	Depth	f	34
	Depth	d_3	113
Fastening holes	Vertical distance	a	365+2
	Vertical distance to bottom edge	b	6
	Horizontal distance	c_1[24]	150+0.2/-0.2
	Horizontal distance from the side edge	g_1[25]	20
	Horizontal distance	c_2[26]	132
	Horizontal distance from the side edge	g_2[27]	7.5

[23] h2 = Height incl. EMC shroud EM6A3
[24] c1 = Horizontal distance from the fastening holes of the inverter
[25] g1 = Horizontal distance from the side edge of the inverter
[26] c2 = Horizontal distance from the fastening holes of the EMC shroud EM6A3
[27] g2 = Horizontal distance from the side edge of the EMC shroud EM6A3

5.2.8 Minimum clearances

The specified dimensions refer to the outside edges of the inverter.

Minimum clearance	Up	Down	on the side
Size 0 – Size 2	100	100	5
... with EMC shroud or brake module	100	120	5
Size 3	100	100	5
... with EMC shroud	100	220	5

Tab. 28: Minimum clearances [mm]

5.3 Inverter/motor combination

EZ synchronous servo motor (n_N = 2000 rpm) – SDS/MDS 5000

						5007A	5008A	5015A	5040A	5075A	5110A	5150A	5220A	5370A	5450A
	K_{EM} [V/1000 rpm]	M_N [Nm]	$I_{N,MOT}$ [A]	M_0 [Nm]	I_0 [A]	$I_{2N,PU}$= 3 A	$I_{2N,PU}$= 1.7 A	$I_{2N,PU}$= 3.4 A	$I_{2N,PU}$= 6 A	$I_{2N,PU}$= 10 A	$I_{2N,PU}$= 14 A	$I_{2N,PU}$= 20 A	$I_{2N,PU}$= 30 A	$I_{2N,PU}$= 50 A	$I_{2N,PU}$= 60 A
Convection cooling of IC 410						$I_{2N,PU} / I_0$									
EZ805U	142	43.7	25.9	66.1	37.9									1.3	1.6
Forced ventilation IC 416						$I_{2N,PU} / I_0$									
EZ805B	142	77.2	45.2	94	53.9										1.1
Water cooling						$I_{2N,PU} / I_0$									
EZ805W	142	72.1	42.1	90.1	51.9										1.2

SDS

EZ synchronous servo motor (n_N = 3000 rpm) – SDS/MDS 5000

	K_{EM} [V/1000 rpm]	M_N [Nm]	$I_{N,MOT}$ [A]	M_0 [Nm]	I_0 [A]	5007A $I_{2N,PU}$= 3 A	5008A $I_{2N,PU}$= 1.7 A	5015A $I_{2N,PU}$= 3.4 A	5040A $I_{2N,PU}$= 6 A	5075A $I_{2N,PU}$= 10 A	5110A $I_{2N,PU}$= 14 A	5150A $I_{2N,PU}$= 20 A	5220A $I_{2N,PU}$= 30 A	5370A $I_{2N,PU}$= 50 A	5450A $I_{2N,PU}$= 60 A
Convection cooling of IC 410						$I_{2N,PU}$ / I_0									
EZ301U	40	0.93	1.99	0.95	2.02	1.5		1.7							
EZ302U	86	1.59	1.6	1.68	1.67		1.0	2.0							
EZ303U	109	2.07	1.63	2.19	1.71		1.0	2.0							
EZ401U	96	2.8	2.74	3	2.88			1.2							
EZ402U	94	4.7	4.4	5.2	4.8				1.3						
EZ404U	116	6.9	5.8	8.6	6.6					1.5					
EZ501U	97	4.3	3.74	4.7	4				1.5						
EZ502U	121	7.4	5.46	8	5.76				1.0	1.7					
EZ503U	119	9.7	6.9	11.1	7.67					1.3	1.8				
EZ505U	141	13.5	8.8	16	10					1.0	1.4	2.0			
EZ701U	95	7.4	7.2	8.3	8					1.3	1.8				
EZ702U	133	12	8.2	14.4	9.6					1.0	1.5				
EZ703U	122	16.5	11.4	20.8	14						1.0	1.4			
EZ705U	140	21.3	14.2	30.2	19.5							1.0	1.5		
EZ802U	136	22.3	13.9	37.1	22.3								1.3		
EZ803U	131	26.6	17.7	48.2	31.1									1.6	1.9
Forced ventilation IC 416						$I_{2N,PU}$ / I_0									
EZ401B	96	3.4	3.4	3.7	3.6				1.7						
EZ402B	94	5.9	5.5	6.3	5.8				1.0	1.7					
EZ404B	116	10.2	8.2	11.2	8.7					1.1	1.6				
EZ501B	97	5.4	4.7	5.8	5				1.2	2.0					
EZ502B	121	10.3	7.8	11.2	8.16					1.2	1.7				
EZ503B	119	14.4	10.9	15.9	11.8						1.2	1.7			
EZ505B	141	20.2	13.7	23.4	14.7						1.0	1.4			
EZ701B	95	9.7	9.5	10.5	10					1.0	1.4	2.0			
EZ702B	133	16.6	11.8	19.3	12.9						1.1	1.6			
EZ703B	122	24	18.2	28	20							1.0	1.5		
EZ705B	140	33.8	22.9	41.8	26.5								1.1	1.9	
EZ802B	136	34.3	26.5	47.9	28.9								1.0	1.7	
EZ803B	131	49	35.9	66.7	42.3									1.2	1.4
Water cooling						$I_{2N,PU}$ / I_0									
EZ401W	96	3.3	3.7	3.55	3.9				1.5						
EZ402W	94	5.85	5.5	6.35	6				1.0	1.7					
EZ404W	116	10.4	8.3	11.3	8.9					1.1	1.6				
EZ501W	97	5.4	4.75	5.65	4.85				1.2						
EZ502W	121	10.2	7.7	11	7.85					1.3	1.8				
EZ503W	119	13.5	10.2	15.2	11.3						1.2	1.8			
EZ505W	141	17.9	11.4	21.5	13.1						1.1	1.5			
EZ701W	95	10.2	9.95	10.4	10						1.4	2.0			
EZ702W	133	17.1	12.2	19.3	13.1						1.1	1.5			
EZ703W	122	22.5	17	27.5	19.6							1.0	1.5		
EZ705W	140	30.3	20.5	39.4	25.4								1.2	2.0	
EZ802W	136	32.2	26.6	48.9	29.6								1.0	1.7	
EZ803W	131	46.7	34.1	65.7	41.7									1.2	1.4

EZ synchronous servo motor (n_N = 4500 rpm) – SDS/MDS 5000

	K_{EM} [V/1000 rpm]	M_N [Nm]	$I_{N,MOT}$ [A]	M_0 [Nm]	I_0 [A]	5007A $I_{2N,PU}$= 3 A	5008A $I_{2N,PU}$= 1.7 A	5015A $I_{2N,PU}$= 3.4 A	5040A $I_{2N,PU}$= 6 A	5075A $I_{2N,PU}$= 10 A	5110A $I_{2N,PU}$= 14 A	5150A $I_{2N,PU}$= 20 A	5220A $I_{2N,PU}$= 30 A	5370A $I_{2N,PU}$= 50 A	5450A $I_{2N,PU}$= 60 A
Convection cooling of IC 410						$I_{2N,PU}$ / I_0									
EZ505U	103	9.5	8.94	15.3	13.4						1.0	1.5			
EZ703U	99	12.1	11.5	20	17.8							1.1	1.7		
EZ705U	106	16.4	14.8	30	25.2								1.2	2.0	
EZ802U	90	10.5	11.2	34.5	33.3									1.5	1.8
Forced ventilation IC 416						$I_{2N,PU}$ / I_0									
EZ505B	103	16.4	16.4	22	19.4							1.0	1.5		
EZ703B	99	19.8	20.3	27.2	24.2								1.2		
EZ705B	106	27.7	25.4	39.4	32.8									1.5	1.8
EZ802B	90	30.6	30.5	47.4	45.1									1.1	1.3
Water cooling						$I_{2N,PU}$ / I_0									
EZ505W	103	14.2	13	20.2	17.2							1.2	1.7		
EZ703W	99	19.1	18.1	26.7	23.7								1.3		
EZ705W	106	24.1	22	37.2	31.6									1.6	1.9
EZ802W	90	30.7	30.3	46.9	44.6									1.1	1.3

EZ synchronous servo motor (n_N = 6000 rpm) – SDS/MDS 5000

	K_{EM} [V/1000 rpm]	M_N [Nm]	$I_{N,MOT}$ [A]	M_0 [Nm]	I_0 [A]	5007A $I_{2N,PU}$= 3 A	5008A $I_{2N,PU}$= 1.7 A	5015A $I_{2N,PU}$= 3.4 A	5040A $I_{2N,PU}$= 6 A	5075A $I_{2N,PU}$= 10 A	5110A $I_{2N,PU}$= 14 A	5150A $I_{2N,PU}$= 20 A	5220A $I_{2N,PU}$= 30 A	5370A $I_{2N,PU}$= 50 A	5450A $I_{2N,PU}$= 60 A
Convection cooling of IC 410						$I_{2N,PU}$ / I_0									
EZ301U	40	0.89	1.93	0.95	2.02			1.7							
EZ302U	42	1.5	3.18	1.68	3.48				1.7						
EZ303U	55	1.96	3.17	2.25	3.55				1.7						
EZ401U	47	2.3	4.56	2.8	5.36				1.1	1.9					
EZ402U	60	3.5	5.65	4.9	7.43					1.3	1.9				
EZ404U	78	5.8	7.18	8.4	9.78					1.0	1.4	2.0			
EZ501U	68	3.4	4.77	4.4	5.8				1.0	1.7	2.4				
EZ502U	72	5.2	7.35	7.8	9.8					1.0	1.4	2.0			
EZ503U	84	6.2	7.64	10.6	11.6						1.2	1.7			
EZ701U	76	5.2	6.68	7.9	9.38					1.1	1.5				
EZ702U	82	7.2	8.96	14.3	16.5							1.2	1.8		
Forced ventilation IC 416						$I_{2N,PU}$ / I_0									
EZ401B	47	2.9	5.62	3.5	6.83					1.5	2.0				
EZ402B	60	5.1	7.88	6.4	9.34					1.1	1.5				
EZ404B	78	8	9.98	10.5	12						1.2	1.7			
EZ501B	68	4.5	6.7	5.7	7.5					1.3	1.9				
EZ502B	72	8.2	11.4	10.5	13.4						1.0	1.5			
EZ503B	84	10.4	13.5	14.8	15.9							1.3	1.9		
EZ701B	76	7.5	10.6	10.2	12.4						1.1	1.6			
EZ702B	82	12.5	16.7	19.3	22.1								1.4		
Water cooling						$I_{2N,PU}$ / I_0									
EZ401W	47	2.55	5.2	3.35	6.95					1.4	2.0				
EZ402W	60	5	8	6.45	9.7					1.0	1.4				
EZ404W	78	7.7	10.5	10.6	12.3						1.1	1.6			
EZ501W	68	4.3	6.4	5.55	7.25					1.4	1.9				
EZ502W	72	8.1	11.2	10.3	12.9						1.1	1.6			
EZ503W	84	9.95	12.6	14.2	15.2							1.3	2.0		
EZ701W	76	7	10.2	10.4	12.7						1.1	1.6			
EZ702W	82	12	17.5	19.3	22.5								1.3		

EZHD synchronous servo motor with hollow shaft and direct drive (n_N = 3000 rpm) – SDS/MDS 5000

						5007A	5008A	5015A	5040A	5075A	5110A	5150A	5220A	5370A	5450A
	K_{EM} [V/1000 rpm]	M_N [Nm]	$I_{N,MOT}$ [A]	M_0 [Nm]	I_0 [A]	$I_{2N,PU}$= 3 A	$I_{2N,PU}$= 1.7 A	$I_{2N,PU}$= 3.4 A	$I_{2N,PU}$= 6 A	$I_{2N,PU}$= 10 A	$I_{2N,PU}$= 14 A	$I_{2N,PU}$= 20 A	$I_{2N,PU}$= 30 A	$I_{2N,PU}$= 50 A	$I_{2N,PU}$= 60 A
Convection cooling of IC 410						$I_{2N,PU}$ / I_0									
EZHD0411U	96	1.9	2.36	2.6	2.89	1.0		1.2							
EZHD0412U	94	4.2	4.29	5.1	4.94				1.2						
EZHD0414U	116	7.7	6.3	8.5	6.88					1.5					
EZHD0511U	97	3	3.32	4.1	4.06				1.5						
EZHD0512U	121	7.0	5.59	7.8	6.13					1.6					
EZHD0513U	119	8.3	7.04	10.9	8.76					1.1	1.6				
EZHD0515U	141	14	9.46	16.4	11						1.3	1.8			
EZHD0711U	95	7.3	7.53	7.9	7.98					1.3	1.8				
EZHD0712U	133	11.6	8.18	14.4	9.99					1.0	1.4				
EZHD0713U	122	17.8	13.4	20.4	15.1							1.3	2.0		
EZHD0715U	140	24.6	17.2	31.1	21.1								1.4		

EZHP synchronous servo motor with hollow shaft and attached planetary gear unit (n_N = 3000 rpm) – SDS/MDS 5000

						5007A	5008A	5015A	5040A	5075A	5110A	5150A	5220A	5370A	5450A
	K_{EM} [V/1000 rpm]	M_N [Nm]	$I_{N,MOT}$ [A]	M_0 [Nm]	I_0 [A]	$I_{2N,PU}$= 3 A	$I_{2N,PU}$= 1.7 A	$I_{2N,PU}$= 3.4 A	$I_{2N,PU}$= 6 A	$I_{2N,PU}$= 10 A	$I_{2N,PU}$= 14 A	$I_{2N,PU}$= 20 A	$I_{2N,PU}$= 30 A	$I_{2N,PU}$= 50 A	$I_{2N,PU}$= 60 A
Convection cooling of IC 410						$I_{2N,PU}$ / I_0									
EZHP_511U	97	3	3.32	4.1	4.06				1.5						
EZHP_512U	121	7.0	5.59	7.8	6.13					1.6					
EZHP_513U	119	8.3	7.04	10.9	8.76					1.1	1.6				
EZHP_515U	141	14	9.46	16.4	11						1.3	1.8			
EZHP_711U	95	7.3	7.53	7.9	7.98					1.3	1.8				
EZHP_712U	133	11.6	8.18	14.4	9.99					1.0	1.4				
EZHP_713U	122	17.8	13.4	20.4	15.1							1.3	2.0		
EZHP_715U	140	24.6	17.2	31.1	21.1								1.4		
Water cooling						$I_{2N,PU}$ / I_0									
EZHP_511W	97	4.1	4.5	4.8	4.79				1.3						
EZHP_512W	121	8.15	6.54	9	7.07					1.4	2.0				
EZHP_513W	119	9.7	8.23	12.3	9.89					1.0	1.4				
EZHP_515W	141	16.2	11	18.6	12.5						1.1	1.6			
EZHP_711W	95	8.3	8.58	9.1	9.18					1.1	1.5				
EZHP_712W	133	13.6	9.6	16.6	11.5						1.2	1.7			
EZHP_713W	122	20.8	15.7	23.7	17.5							1.1	1.7		
EZHP_715W	140	29	20.3	35.7	24.2								1.2		

EZS synchronous servo motor for screw drive (driven threaded spindle) (n_N = 3000 rpm) – SDS/MDS 5000

						5007A	5008A	5015A	5040A	5075A	5110A	5150A	5220A	5370A	5450A
	K_{EM} [V/1000 rpm]	M_N [Nm]	$I_{N,MOT}$ [A]	M_0 [Nm]	I_0 [A]	$I_{2N,PU}$= 3 A	$I_{2N,PU}$= 1.7 A	$I_{2N,PU}$= 3.4 A	$I_{2N,PU}$= 6 A	$I_{2N,PU}$= 10 A	$I_{2N,PU}$= 14 A	$I_{2N,PU}$= 20 A	$I_{2N,PU}$= 30 A	$I_{2N,PU}$= 50 A	$I_{2N,PU}$= 60 A
Convection cooling of IC 410						$I_{2N,PU}$ / I_0									
EZS501U	97	3.85	3.65	4.3	3.95				1.5						
EZS502U	121	6.9	5.3	7.55	5.7				1.1	1.8					
EZS503U	119	9.1	6.7	10.7	7.6					1.3	1.8				
EZS701U	95	6.65	6.8	7.65	7.7					1.3	1.8				
EZS702U	133	11	7.75	13.5	9.25					1.1	1.5				
EZS703U	122	15.3	10.8	19.7	13.5						1.0	1.5			
Forced ventilation IC 416						$I_{2N,PU}$ / I_0									
EZS501B	97	5.1	4.7	5.45	5				1.2	2.0					
EZS502B	121	10	7.8	10.9	8.16					1.2	1.7				
EZS503B	119	14.1	10.9	15.6	11.8						1.2	1.7			
EZS701B	95	9.35	9.5	10.2	10					1.0	1.4	2.0			
EZS702B	133	16.3	11.8	19	12.9						1.1	1.6			
EZS703B	122	23.7	18.2	27.7	20							1.0	1.5		

Water cooling						$I_{2N,PU} / I_0$									
EZS501W	97	5.1	4.75	5.3	4.85				1.2						
EZS502W	121	9.9	7.7	10.7	7.85					1.3	1.8				
EZS503W	119	13.2	10.2	14.9	11.3						1.2	1.8			
EZS701W	95	9.85	9.95	10	10					1.0	1.4	2.0			
EZS702W	133	16.8	12.2	18.9	13.1						1.1	1.5			
EZS703W	122	22.1	17	27.1	19.6							1.0	1.5		

EZM synchronous servo motor for screw drive (driven spindle nut) (n_N = 3000 rpm) – SDS/MDS 5000

						5007A	5008A	5015A	5040A	5075A	5110A	5150A	5220A	5370A	5450A
	K_{EM} [V/1000 rpm]	M_N [Nm]	$I_{N,MOT}$ [A]	M_0 [Nm]	I_0 [A]	$I_{2N,PU}$= 3 A	$I_{2N,PU}$= 1.7 A	$I_{2N,PU}$= 3.4 A	$I_{2N,PU}$= 6 A	$I_{2N,PU}$= 10 A	$I_{2N,PU}$= 14 A	$I_{2N,PU}$= 20 A	$I_{2N,PU}$= 30 A	$I_{2N,PU}$= 50 A	$I_{2N,PU}$= 60 A
Convection cooling of IC 410						$I_{2N,PU} / I_0$									
EZM511U	97	3.65	3.55	4.25	4				1.5						
EZM512U	121	6.6	5.2	7.55	5.75				1.0	1.7					
EZM513U	119	8.8	6.55	10.6	7.6					1.3	1.8				
EZM711U	95	6.35	6.6	7.3	7.4					1.4	1.9				
EZM712U	133	10.6	7.5	13	8.9					1.1	1.6				
EZM713U	122	14.7	10.4	18.9	13						1.1	1.5			
Water cooling						$I_{2N,PU} / I_0$									
EZM511W	97	4.95	4.75	5.2	4.85				1.2						
EZM512W	121	9.75	7.7	10.6	7.85					1.3	1.8				
EZM513W	119	13.1	10.2	14.8	11.3						1.2	1.8			
EZM711W	95	9.8	9.95	10	10					1.0	1.4	2.0			
EZM712W	133	16.7	12.2	18.8	13.1						1.1	1.5			
EZM713W	122	22	17	27.1	19.6							1.0	1.5		

5.4 Accessories

Information about the available accessories can be found in the following sections.

5.4.1 Safety technology

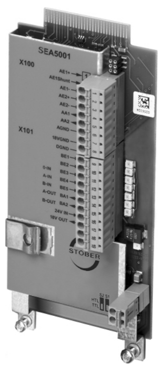
ASP 5001 – Safe Torque Off

Available with the standard version.

Option module for implementation of integrated safety function Safe Torque Off (STO).
The ASP 5001 may only be installed by STÖBER Antriebstechnik GmbH & Co. KG!
The ASP 5001 must be ordered with the basic device.

5.4.2 Terminal module

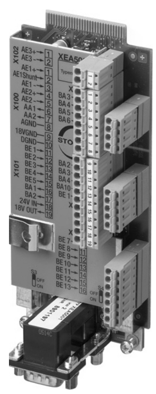
Terminal module standard SEA 5001



ID no. 49576
Terminals:

- 2 analog inputs
- 2 analog outputs
- 5 binary inputs
- 2 binary outputs

Terminal module extended XEA 5001



ID no. 49015
Terminals:

- 3 analog inputs
- 2 analog outputs
- 13 binary inputs
- 10 binary outputs

Encoder / interfaces:

- TTL incremental encoder (simulation and evaluation)
- Pulse train (simulation and evaluation)
- SSI encoder (simulation and evaluation)

SSI/TTL connection cable X120

ID no. 49482
Cable for connecting the TTL interface X120 to the SD6 drive controller (on terminal module RI6 or XI6) with the X301 interface on the LA6 adapter box for transferring Hall sensor signals. 0.3 m.

Terminal module resolver REA 5001

ID no. 49854
Terminals:

- 2 analog inputs
- 2 analog outputs
- 5 binary inputs
- 2 binary outputs

Encoder / interfaces:

- Resolver
- Encoder EnDat 2.1 sin/cos
- TTL incremental encoder (simulation and evaluation)
- SSI encoder (simulation and evaluation)
- Pulse train (simulation and evaluation)

Resolver cables that were connected to an POSIDYN SDS 4000 can be connected via the resolver adapter (9-pin to 15-pin) included in the scope of delivery to terminal X140 of REA 5001.

5.4.3 Communication

IGB connecting cable

To connect the interface X3A or X3B on the inverter front for IGB, CAT5e, magenta, connector angled at 45°.
The following versions are available:
ID no. 49855: 0.4 m.
ID no. 49856: 2 m.

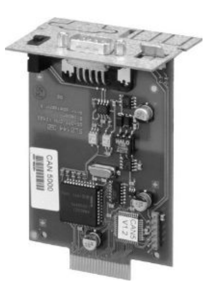
PC connecting cable

ID no. 49857
Cable for connecting the X3A or X3B interface with the PC, CAT5e, blue, 5 m.

Hi-speed USB 2.0 Ethernet adapter

ID no. 49940
Adapter for connecting Ethernet to a USB connection.

Communication module CANopen DS-301 CAN 5000



ID no. 44574
Accessory part for connecting CAN bus.

Communication module PROFIBUS DP-V1 DP 5000

ID no. 44575
Accessory module for connecting PROFIBUS DP-V1.

Communication module EtherCAT ECS 5000

ID no. 49014
Accessory part for connecting EtherCAT (CANopen over EtherCAT).

EtherCAT cable

Ethernet patch cable, CAT5e, yellow.
The following versions are available:
ID no. 49313: length approx. 0.2 m.
ID no. 49314: length approx. 0.35 m.

Communication module PROFINET PN 5000

ID no. 53893
Accessory part for connecting PROFINET.

5.4.4 Braking resistor

In addition to the inverters, STOBER offers braking resistors in different sizes and performance classes described in the following. When selecting, note the minimum permitted braking resistances specified in the technical data of the individual inverter types.

5.4.4.1 Tubular fixed resistor FZMU, FZZMU 400×65

Type	FZMU 400×65			FZZMU 400×65		
ID no.	49010	55445	55446	53895	55447	55448
SDS 5007A	X	—	—	—	—	—
SDS 5008A	X	—	—	—	—	—
SDS 5015A	X	—	—	—	—	—
SDS 5040A	—	—	—	X	—	—
SDS 5075A	—	—	—	X	—	—
SDS 5110A	—	X	—	—	X	—
SDS 5150A	—	X	—	—	X	—
SDS 5220A	—	—	X	—	—	X
SDS 5370A	—	—	X	—	—	X
SDS 5450A	—	—	X	—	—	X

Tab. 29: Assignment of braking resistor FZMU, FZZMU 400×65 – inverter SDS 5000

Properties

Specification	FZMU 400×65			FZZMU 400×65		
ID no.	49010	55445	55446	53895	55447	55448
Type	Tubular fixed resistor			Tubular fixed resistor		
Resistance [Ω]	100	22	15	47	22	15
Power [W]	600			1200		
Therm. time const. th [s]	40			40		
Pulse power for < 1 s [kW]	18			36		
U_{max} [V]	848			848		
Weight [kg]	Approx. 2.2			Approx. 4.2		
Protection class	IP20			IP20		
Test marks	cULus			cULus		

Tab. 30: Specification FZMU, FZZMU 400×65

Dimensions

Dimension	FZMU 400×65			FZZMU 400×65		
ID no.	49010	55445	55446	53895	55447	55448
L x D	400 × 65			400 × 65		
H	120			120		
K	6.5 × 12			6.5 × 12		
M	430			426		
O	485			450		
R	92			185		
U	64			150		
X	10			10		

Tab. 31: Dimensions FZMU, FZZMU 400×65 [mm]

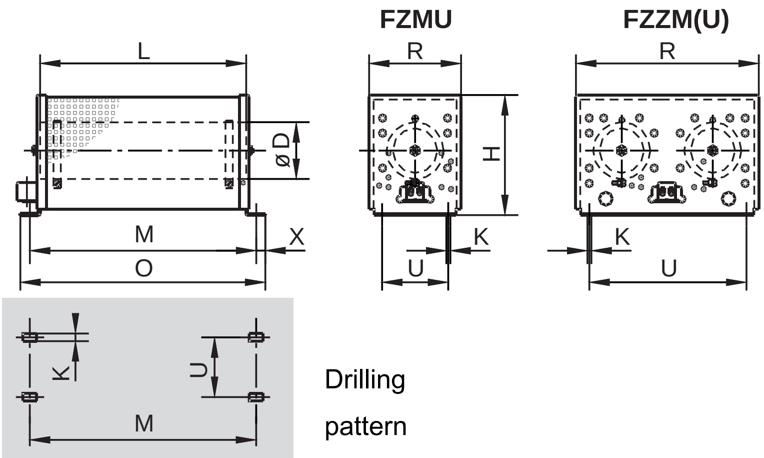


Fig. 2: Dimensional drawing FZMU, FZZMU 400×65

5.4.4.2 Flat resistor GVADU, GBADU

Type	GVADU 210×20	GBADU 265×30	GBADU 405×30	GBADU 335×30	GBADU 265×30
ID no.	55441	55442	55499	55443	55444
SDS 5007A	X	X	X	—	—
SDS 5008A	X	X	X	—	—
SDS 5015A	X	X	X	—	—
SDS 5040A	X	X	X	X	—
SDS 5075A	—	—	—	X	—
SDS 5110A	—	—	—	—	X
SDS 5150A	—	—	—	—	X
SDS 5220A	—	—	—	—	X
SDS 5370A	—	—	—	—	X
SDS 5450A	—	—	—	—	X

Tab. 32: Assignment of braking resistor GVADU, GBADU – inverter SDS 5000

Properties

Specification	GVADU 210×20	GBADU 265×30		GBADU 335×30	GBADU 405×30
ID no.	55441	55442	55444	55443	55499
Type	Flat resis-tor	Flat resistor			
Resistance [Ω]	100	100	22	47	100
Power [W]	150	300	300	400	500
Therm. time const. th [s]	60	60			
Pulse power for < 1 s [kW]	3.3	6.6	6.6	8.8	11
U_{max} [V]	848	848			
Cable design	Radox	FEP			
Cable length [mm]	500	500			
Cable cross-section [AWG]	18/19 (0.82 mm²)	14/19 (1.9 mm²)			
Weight [g]	300	950	950	1200	1450
Protection class	IP54	IP54			
Test marks	cULus	cULus			

Tab. 33: Specification GVADU, GBADU

Dimensions

Dimension	GVADU 210×20	GBADU 265×30		GBADU 335×30	GBADU 405×30
ID no.	55441	55442	55444	55443	55499
A	210	265		335	405
H	192	246		316	386
C	20	30		30	30
D	40	60		60	60
E	18.2	28.8		28.8	28.8
F	6.2	10.8		10.8	10.8
G	2	3		3	3
K	2.5	4		4	4
J	4.3	5.3		5.3	5.3
β	65°	73°		73°	73°

Tab. 34: Dimensions GVADU, GBADU [mm]

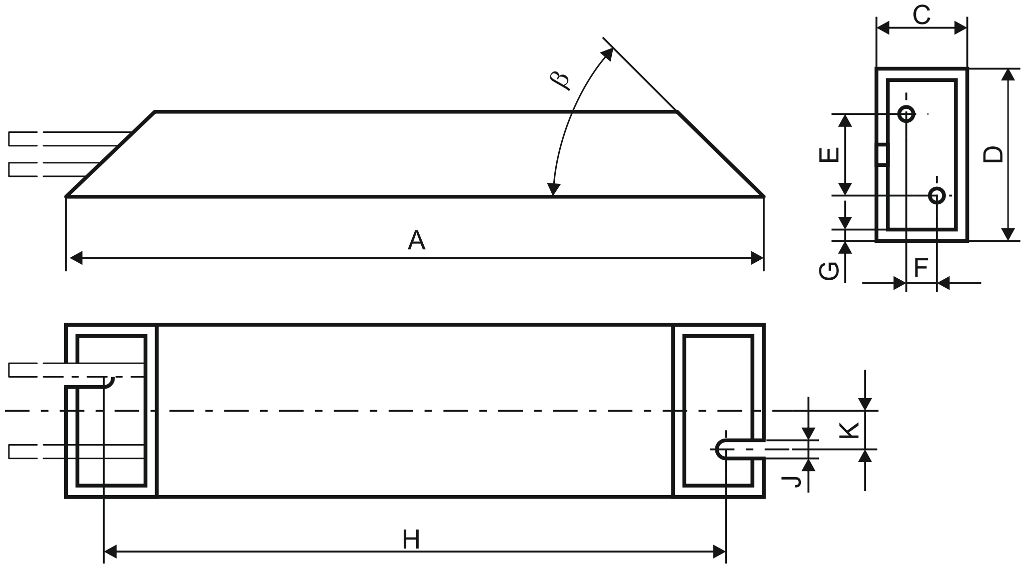


Fig. 3: Dimensional drawing GVADU, GBADU

5.4.4.3 Steel-grid fixed resistor FGFKU

Type	FGFKU			
ID no.	55449	55450	55451	53897
SDS 5110A	X	—	—	—
SDS 5150A	X	—	—	—
SDS 5220A	—	X	X	X
SDS 5370A	—	X	X	X
SDS 5450A	—	X	X	X

Tab. 35: Assignment of braking resistor FGFKU – inverter SDS 5000

Properties

Specification	FGFKU			
ID no.	55449	55450	55451	53897
Type	Steel-grid fixed resistor		Steel-grid fixed resistor	Steel-grid fixed resistor
Resistance [Ω]	22	15	15	15
Power [W]	2500		6000	8000
Therm. time const. th [s]	30		20	20
Pulse power for < 1 s [kW]	50		120	160
U_{max} [V]	848		848	848
Weight [kg]	Approx. 7.5		12	18
Protection class	IP20		IP20	IP20
Test marks				

Tab. 36: Specification FGFKU

Dimensions

Dimension	FGFKU			
ID no.	55449	55450	55451	53897
A	270		370	570
B	295		395	595
C	355		455	655

Tab. 37: Dimensions FGFKU [mm]

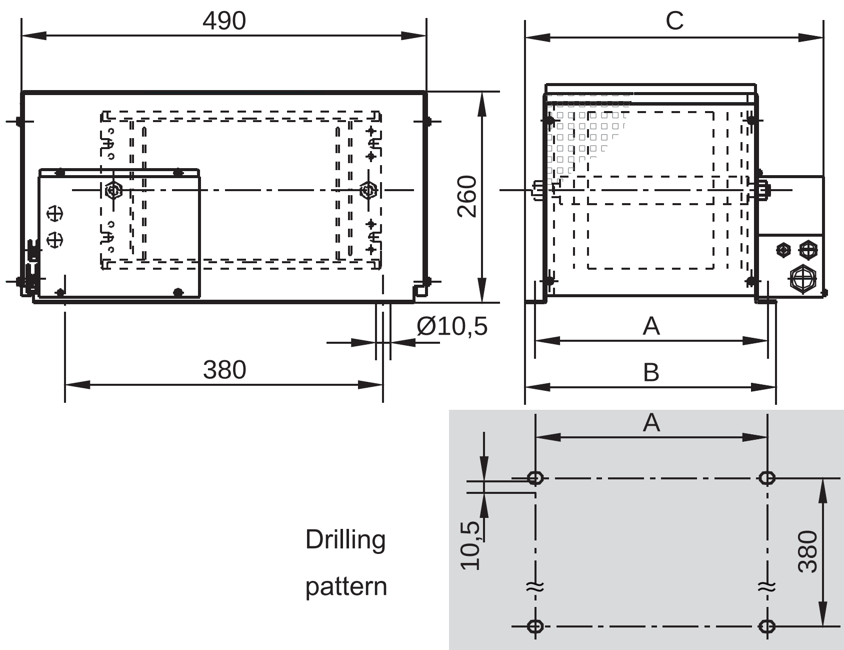


Fig. 4: Dimensional drawing FGFKU

5.4.4.4 Bottom brake resistor RB 5000

Type	RB 5022	RB 5047	RB 5100
ID no.	45618	44966	44965
SDS 5007A	—	—	X
SDS 5008A	—	—	X
SDS 5015A	—	—	X
SDS 5040A	—	X	X
SDS 5075A	—	X	—
SDS 5110A	X	—	—
SDS 5150A	X	—	—

Tab. 38: Assignment of braking resistor RB 5000 – inverter SDS 5000

Properties

Specification	RB 5022	RB 5047	RB 5100
ID no.	45618	44966	44965
Resistance [Ω]	22	47	100
Power [W]	100	60	60
Therm. time const. th [s]		8	
Pulse power for < 1 s [kW]	1.5	1.0	1.0
U_{max} [V]		800	
Weight [g]	about 640	about 460	about 440
Cable design		Radox	
Cable length [mm]		250	
Cable cross-section [AWG]		18/19 (0.82 mm²)	
Maximum torque of M5 threaded bolts [Nm]		5	
Protection class		IP40	
Test marks		cULus	

Tab. 39: Specification RB 5000

Dimensions

Dimension	RB 5022	RB 5047	RB 5100
ID no.	45618	44966	44965
Height	300	300	
Width	94	62	
Depth	18	18	
Drilling pattern corresponds to size	Size 2	Size 1	Size 0 and size 1

Tab. 40: Dimensions RB 5000 [mm]

5.4.5 Output choke TEP

Information

The following technical data applies for a rotary field frequency of 200 Hz. For example, this rotary field frequency is achieved with a motor with 4 pole pairs and a nominal speed of 3000 rpm. Always observe the specified derating for higher rotary field frequencies. Also observe the dependency of the cycle frequency.

Properties

Specification	TEP3720-0ES41	TEP3820-0CS41	TEP4020-0RS41
ID no.	53188	53189	53190
Voltage range	3 × 0 bis 480 V		
Frequency range	0 – 200 Hz		
I_N at 4 kHz	4 A	17.5 A	38 A
I_N at 8 kHz	3.3 A	15.2 A	30.4 A
Max. permitted motor cable length with output choke	100 m		
Max. surrounding temperature $\vartheta_{amb,max}$	40 °C		
Design	Open		
Winding losses	11 W	29 W	61 W
Iron losses	25 W	16 W	33 W
Connections	Screw terminals		
Max. conductor cross-section	10 mm²		
UL Recognized Component (CAN; USA)	Yes		
Test marks	c UL us		

Tab. 41: Specification TEP

Projecting

Select the output chokes according to the rated currents of the motor and output chokes. In particular, observe the derating of the output choke for rotary field frequencies higher than 200 Hz. You can calculate the rotary field frequency for your drive with the following formula:

$$f = n_N \times \frac{p}{60}$$

f	Rotary field frequency in Hz
n	Speed in rpm
N	Nominal value
p	Number of pole pairs

Derating

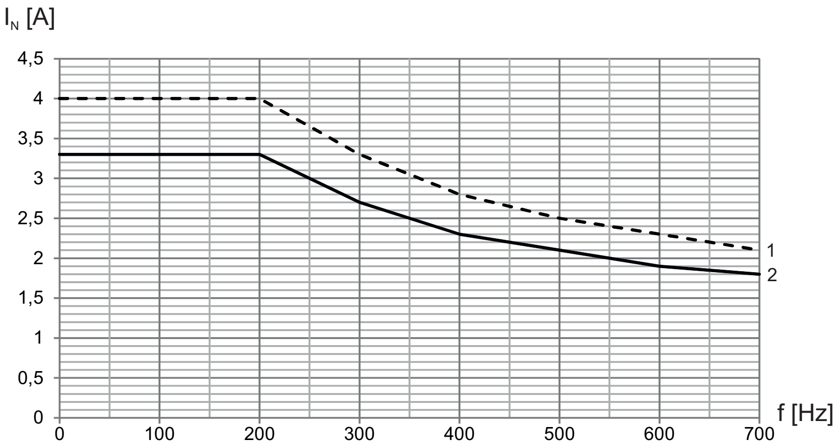


Fig. 5: Derating TEP3720-0ES41

1	Clock frequency 4 kHz
2	Clock frequency 8 kHz

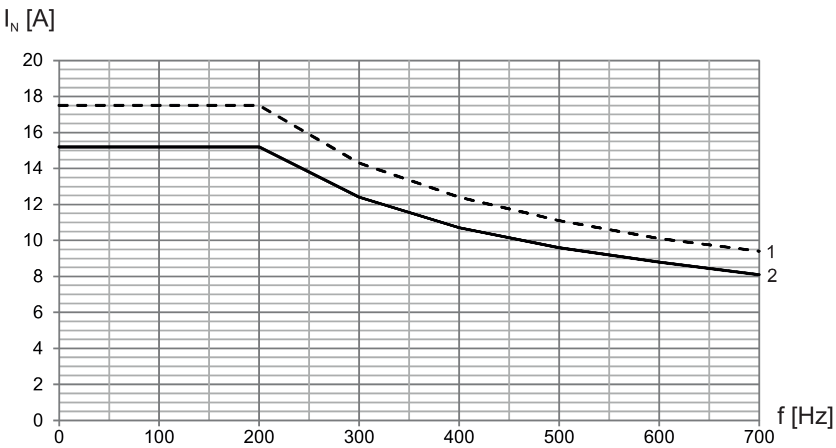


Fig. 6: Derating TEP3820-0CS41

1	Clock frequency 4 kHz
2	Clock frequency 8 kHz

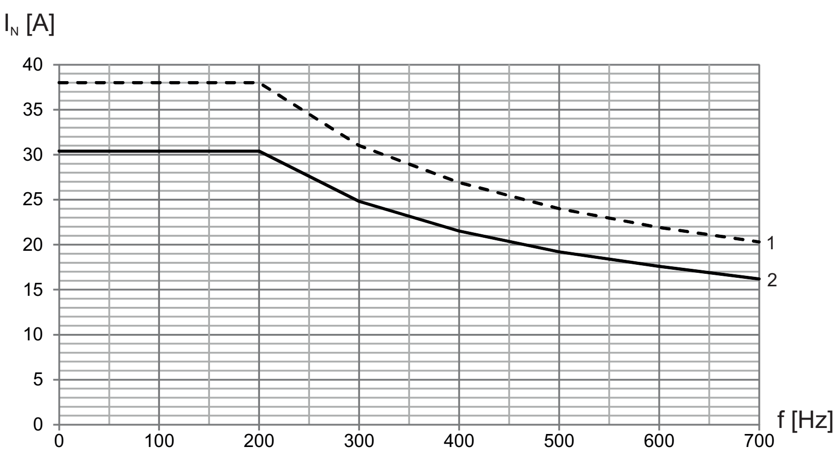


Fig. 7: Derating TEP4020-0RS41

1	Clock frequency 4 kHz
2	Clock frequency 8 kHz

Dimensions and weight

Dimension	TEP3720-0ES41	TEP3820-0CS41	TEP4020-0RS41
Height h [mm]	Max. 153	Max. 153	Max. 180
Width w [mm]	178	178	219
Depth d [mm]	73	88	119
Vertical distance – fastening holes a1 [mm]	166	166	201
Vertical distance – fastening holes a2 [mm]	113	113	136
Horizontal distance – fastening holes b1 [mm]	53	68	89
Horizontal distance – fastening holes b2 [mm]	49	64	76
Drill holes – depth e [mm]	5.8	5.8	7
Drill holes – width f [mm]	11	11	13
Screw connection – M	M5	M5	M6
Weight [kg]	2.9	5.9	8.8

Tab. 42: Dimensions and weight TEP

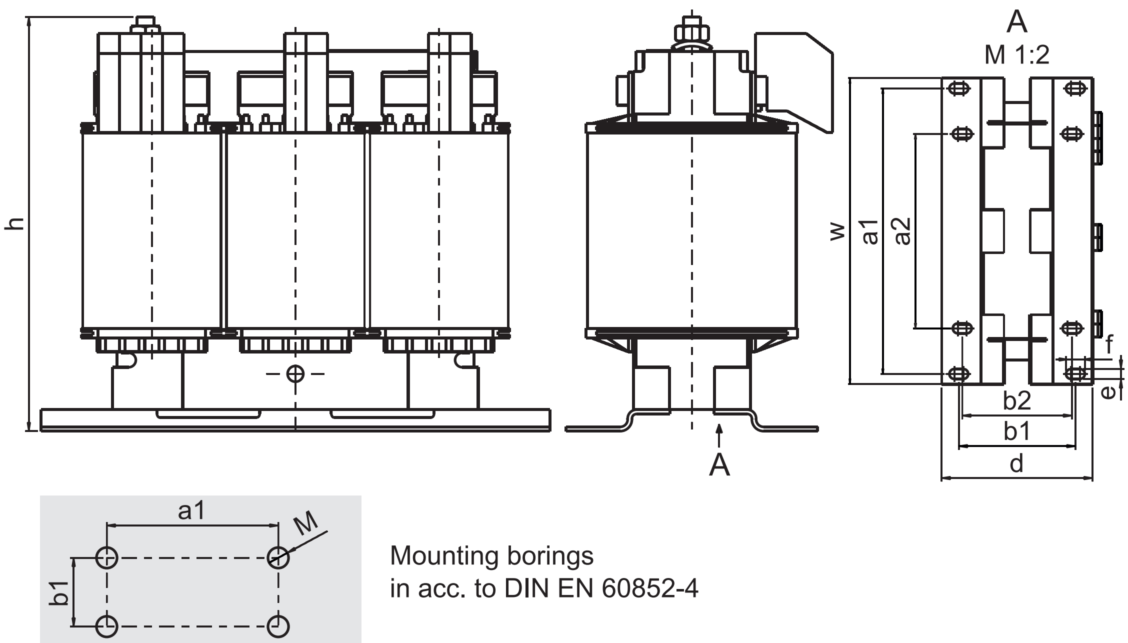


Fig. 8: Dimensional drawing TEP

5.4.6 Brake module and EMC shroud

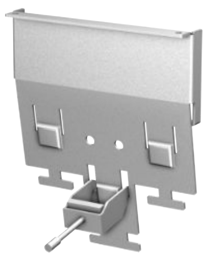
Brake module BRS 5001

ID no. 56519
Brake module for inverters of series SDS 5000.
Accessory part for direct control of up to two motor holding brakes (24 V_{DC}) and (for inverters up to size 2) for connecting to the shield of the power cable.
Attachable on the basic housing.
Including connection cable for basic device and shield connection terminal.

EMC shroud EM 5000

ID no. 44959
EMC shroud for sizes 0 to 2.
Accessory part for shield connection of the motor line. Attachable on the basic housing.
Including shield connection terminal.

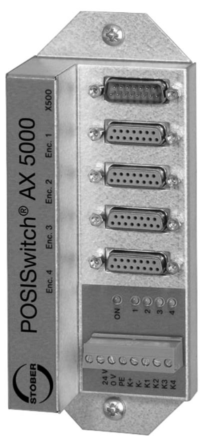
EMC shroud EM6A3



ID no. 135120
EMC shroud for size 3.
Accessory part for shield connection of the motor line.
Attachable on the basic housing.
Including shield connection terminal.
If necessary you can also connect the cable shield of the braking resistor and DC link connection on the shroud. Additional shield connection terminals are available as accessories for this purpose (ID no. 56521).

5.4.7 Axis switcher

4-way axis switcher POSISwitch AX 5000



ID no. 49578
Enables the operation of up to four servo motors on one inverter.

Connection cable LA6 / AX 5000

Cable to connect inverter and axis switcher POSISwitch AX 5000. The following versions are available:
ID no. 45405: 0.5 m.
ID no. 45386: 2.5 m.

5.4.8 Battery module for encoder buffering

Absolute Encoder Support AES

ID no. 55452
For buffering the power supply when using the inductive absolute value encoder EnDat 2.2 digital with battery-buffered multiturn power stage, for example EBI1135, EBI135.
A battery is included.

Replaceable battery AES

ID no. 55453
replacement battery for the battery module AES.

5.4.9 Removable data storage

Paramodule removable data storage

Included in the standard design.

ID no. 55464
Memory module for configuration and parameters.

5.4.10 Product CD

Product CD "ELECTRONICS 5000"

Included in the standard design.

ID no. 441852
The CD-ROM contains the POSITool project configuration and commissioning software, documentation as well as the device description files for the inverter – controller connection.

5.5 Further information

5.5.1 Symbols, identifiers and test symbols

Grounding symbol
according to IEC 60417-5019 (DB:2002-10).

Lead-free identifier RoHS
according to RoHS directive 2011-65-EU.

CE mark
Manufacturer's self declaration: The product meets the requirements of EU directives.

UL-test mark
This product is listed by UL for the USA and Canada. Representative samples of this product have been evaluated by UL and meet the requirements of applicable standards.

UL test marks for recognized components
This component or material is recognized by UL. Representative samples of this product have been evaluated by UL and meet applicable requirements.

6 POSIDRIVE MDS 5000 servo inverter

6.1 Overview

MDS 5000 – the universal servo inverter for fully digital servo axes

- Control of rotary synchronous and asynchronous motors
- Nominal output current up to 60 A (at 8 kHz clock frequency)
- 250 % overload capacity
- Power range: 0.75 kW to 45 kW
- Communication via PROFIBUS DP, PROFINET, CANopen or EtherCAT
- Encoder interfaces EnDat 2.1/2.2 digital, SSI, incremental (HTL/TTL) or resolver
- Digital and analog inputs and outputs
- Automatic motor parameterization from the electronic motor nameplate
- Integrated brake chopper
- Integrated line filter
- Motor temperature evaluation via PTC thermistors, KTY or Pt temperature sensors
- Standard applications with speed, torque, positioning and master/slave functionality
- Programming based on IEC 61131-3 with CFC for creating applications
- Safe Torque Off and Safe Stop 1 safety functions in accordance with DIN EN ISO 13849-1 and DIN EN 61800-5-2
- Fast commissioning with POSITool software
- Convenient control unit consisting of plain text display and keyboard
- Removable data storage Paramodule for commissioning and service

MDS 5000

6.1.1 Features

The 5th generation series of STOBER inverters work entirely digitally as modular inverter systems for operating rotary synchronous and asynchronous motors. It includes product types for direct operation on a one or three-phase network in a voltage range from 200 V_{AC} to 528 V_{AC}. An EMC line filter is integrated. EnDat 2.1/2.2 digital, SSI and Incremental (HTL/TTL) are available as encoder interfaces in the standard version. Resolver evaluation is possible as an option. STOBER synchronous servo motors are designed for operation preferably with encoder EnDat 2.1/2.2 digital. The highest control quality can be achieved with these encoder systems. Motor parameterization can be derived automatically from the electronic motor nameplate. The inverter can be adapted to the requirements of individual applications using different option modules. The ASP 5001 safety module makes it possible to implement the Safe Torque Off (STO) and Safe Stop 1 (SS1) safety functions in accordance with DIN EN ISO 13849-1 and DIN EN 61800-5-2 for safety-relevant applications. The communication modules are used to connect to a control unit using PROFIBUS DP, PROFINET, CANopen or EtherCAT fieldbuses. Terminal modules offer the option of connecting analog and binary signals as well as additional encoder signals. A plain text display and the keyboard simplify diagnostics if a fault is present and enable fast access to parameters. The removable data storage Paramodule can be used to transfer all application-relevant data from one inverter to another.

POSIDYN SDS 5000

POSIDRIVE MDS 5000

Sequential axis switching with POSISwitch AX 5000

With the POSISwitch AX 5000 accessory, up to four synchronous servo motors can be operated on one inverter sequentially with absolute value encoder EnDat 2.1/2.2 digital. The POSISwitch AX 5000 module is used to switch absolute value encoder signals and control signals for brake and motor line switching. Entirely digital encoder signals with EnDat protocol allow for easy switching with EMC immunity.

POSITool

The 5th generation of POSITool project planning and commissioning software has all the functions needed for efficient use of inverters in single and multi-axis applications.

Paramodule removable data storage

Removable data storage for fast series commissioning by copying and easy service when replacing devices.

6.1.2 Software components

Modular application software

Different standard applications can be loaded on the devices of the 5th generation of STOBER inverters with the POSITool commissioning software as required. Programming based on IEC 61131-3 can also be used with CFC to create new applications or expand existing ones. The inverter operating system is multi-axis capable. It supports up to four axes with separate application and parameter ranges.

Velocity mode (standard application)

- **Fast reference value**
  Simple speed application for lean applications. The speed reference value and torque limiting can be assigned via analog inputs and also digitally.

Torque and velocity mode (standard application)

- **Comfort reference value**
  Expanded torque and speed reference value application. Reference values and limits can be assigned with the fast reference value and also using fixed values, motor potentiometers and other functions.
- **Technology controller**
  PID controller for torque or speed controlled applications.

Positioning mode (standard application)

- **Command positioning, synchronous command positioning**
  High-performance positioning application with a command interface based on PLCopen. The data for a motion task including target position, velocity and acceleration are transferred together via fieldbus to the inverter, which then processes them independently. The functional scope is rounded out by an electrical cam, motion block switching point and Posi-Latch.
- **Motion block positioning**
  Extensive positioning application with up to 256 motion blocks based on PLCopen. The motion blocks can be selected individually via fieldbus or with binary inputs. They can also be started chained. The functional scope is rounded out by an electrical cam, motion block switching point and Posi-Latch.

Electronic cam disk with PLCopen interface (tailor-made applications)

The electronic cam disk application makes it possible to implement complex motion tasks such as:

- Flying saw
- Synchronizer (clock in/clock out)
- Cross cutter
- Welding bar/embossing stamp
- Print mark control

These applications can be implemented quickly and easily using the readily understandable free graphical programming based on IEC 61131-3 CFC. This also allows for customer-specific adaptations for special system features. Function blocks based on PLCopen Motion Control are available for this purpose for trained users.

6.1.3 Application training

STOBER offers a multi-level training program that focuses essentially on application programming of the motion controller and inverter.

The application training is performed on the SDS 5000 series. However this is compatible with the MDS 5000 series to a great extent.

SDS 5000 Basic

Training content: system overview, assembly and commissioning of the inverter. Use of option modules. Parameterization, commissioning and diagnostics using the integrated display and commissioning software. Remote maintenance. Basics of controller optimization. Configuration of the drive train. Integrated software functions. Software applications. Connection to a higher-level controller. Basics of safety technology. Practical exercises for the training structure.

Software used: POSITool.

SDS 5000 Advanced

Training content: Graphical programming with CFC. Special knowledge for regulating, control and safety technology. Practical exercises for the training structure.

SDS 5000 CAM

Training content: special knowledge of electronic cam disks. Practical exercises for the training structure.

6.2 Technical data

Technical data for inverters can be found in the following sections.

6.2.1 Formula symbol

Formula symbols	Unit	Explanation
D_{IA}	%	Reduction of the nominal current depending on the installation height
D_T	%	Reduction of the nominal current depending on the surrounding temperature
f_{2PU}	Hz	Output frequency of the power unit
$f_{PWM,PU}$	Hz	Internal pulse clock frequency of the power unit
I_0	A	Standstill current: RMS value of the line-to-line current with standstill torque M_0 generated (Tolerance ±5 %)
$I_{1N,PU}$	A	Nominal input current of the power unit
I_{2maxPU}	A	Maximum output current of the power unit
$I_{2N,PU}$	A	Nominal output current of the power unit
$I_{N,MOT}$	A	Nominal current of the motor
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 %)
M_0	Nm	Standstill torque: the torque the motor is able to deliver long term at a speed of 10 rpm (tolerance ±5 %)
M_N	Nm	Nominal torque: the maximum torque of a motor in S1 mode at nominal speed n_N (tolerance ±5 %)
n_N	rpm	Nominal speed: the speed for which the nominal torque M_N is specified
P_{maxRB}	W	Maximum power at the external braking resistor
P_V	W	Power loss
$P_{V,CU}$	W	Power loss of the control board
R_{2minRB}	Ω	Minimum resistance of the external braking resistor
R_{intRB}	Ω	Resistance of the internal braking resistor
$\vartheta_{amb,max}$	°C	Maximum surrounding temperature
τ_{th}	°C	Thermal time constant
U_{1CU}	V	Input voltage of the control board
U_{1PU}	V	Input voltage of the power unit
U_{2PU}	V	Output voltage of the power unit
U_{max}	V	Maximum voltage
U_{maxPU}	V	Maximum voltage of the power unit
U_{offCH}	V	Off limit of the brake chopper
U_{onCH}	V	On limit of the brake chopper

6.2.2 Type designation

MDS	5	075	A

Tab. 1: Sample code

Code	Designation	Design
MDS	Series	
5	Generation	5. Generation
075	Power	075 = 7.5 kW
– **A**	Hardware variants	No identification: HW 199 or lower A: HW 200 or higher

Tab. 2: Explanation

6.2.3 Sizes

Type	ID no.	Size
MDS 5007A	55401	Size 0
MDS 5008A	55402	Size 0
MDS 5015A	55403	Size 0
MDS 5040A	55404	Size 1
MDS 5075A	55405	Size 1
MDS 5110A	55406	Size 2
MDS 5150A	55407	Size 2
MDS 5220A	55408	Size 3
MDS 5370A	55409	Size 3
MDS 5450A	55410	Size 3

Tab. 3: Available MDS 5000 types and sizes

Fig. 1: MDS 5000 in sizes 3, 2, 1 and 0

6.2.4 General technical data

Device features	
Protection class of the device	IP20
Protection class of the control cabinet	At least IP54
Radio interference suppression	Integrated line filter according to EN 61800-3:2012, interference emission class C3
Overvoltage category	III according to EN 61800-5-1:2008

Tab. 4: Device features

Transport and storage conditions	
Storage/ transport temperature	-20 °C to +70 °C Maximum change: 20 °C/h
Relative humidity	Maximum relative humidity 85 %, non-condensing
Vibration (transport) to DIN EN 60068-2-6	5 Hz ≤ f ≤ 9 Hz: 3.5 mm 9 Hz ≤ f ≤ 200 Hz: 10 m/s² 200 Hz ≤ f ≤ 500 Hz: 15 m/s²

Tab. 5: Transport and storage conditions

Operating conditions	
Surrounding operating temperature	0 °C to 45 °C for nominal data 45 °C to 55 °C with derating −2.5 % / °C
Relative humidity	Maximum relative humidity 85 %, non-condensing
Installation altitude	0 m to 1000 m above sea level without restrictions 1000 m to 2000 m above seal level with derating −1.5 % / 100 m
Pollution degree	Pollution degree level 2 as per EN 50178
Ventilated	Installed fan
Vibration (operation) to DIN EN 60068-2-6	5 Hz ≤ f ≤ 9 Hz: 0.35 mm 9 Hz ≤ f ≤ 200 Hz: 1 m/s²

Tab. 6: Operating conditions

Discharge times	
Self-discharge	5 minutes

Tab. 7: Discharge times of the DC link circuit

6.2.5 Electrical data

The electrical data of the available sizes as well as the properties of the brake chopper can be found in the following sections.

6.2.5.1 Size 0: MDS 5007A to MDS 5015A

Electrical data	MDS 5007A	MDS 5008A	MDS 5015A
ID no.	55401	55402	55403
Recommended motor rating	0.75 kW	0.75 kW	1.5 kW
U_{1PU}	1 × 230 V, +20 % / -40 %, 50/60 Hz	3 × 400 V, +32 % / -50 %, 50 Hz; 3 × 480 V, +10 % / -58 %, 60 Hz	
$I_{1N,PU}$	1 × 6 A	3 × 2.2 A	3 × 4 A
f_{2PU}	0 – 700 Hz		
U_{2PU}	0 – 230 V	0 – 400 V	
U_{maxPU}	440 V	830 V	

Tab. 8: Electrical data MDS 5000, size 0

Nominal currents up to +45 °C (in the control cabinet)

Operation with asynchronous motor

Electrical data	MDS 5007A	MDS 5008A	MDS 5015A
$I_{2N,PU}$	3 × 4 A	3 × 2.3 A	3 × 4.5 A
I_{2maxPU}	180 % for 5 s; 150 % for 30 s		
$f_{PWM,PU}$	4 kHz[1]		

Tab. 9: Electrical data MDS 5000, size 0, for 4 kHz clock frequency

Operation with synchronous servo motor

Electrical data	MDS 5007A	MDS 5008A	MDS 5015A
$I_{2N,PU}$	3 × 3 A	3 × 1.7 A	3 × 3.4 A
I_{2maxPU}	250 % for 2 s; 200 % for 5 s		
$f_{PWM,PU}$	8 kHz[2]		

Tab. 10: Electrical data MDS 5000, size 0, for 8 kHz clock frequency

Electrical data	MDS 5007A	MDS 5008A	MDS 5015A
U_{onCH}	400 – 420 V	780 – 800 V	
U_{offCH}	360 – 380 V	740 – 760 V	
R_{2minRB}	100 Ω	100 Ω	
P_{maxRB}	1.6 kW	3.2 kW	

Tab. 11: Brake chopper electrical data, size 0

[1] Clock frequency adjustable from 4 to 16 kHz (see derating section)
[2] Clock frequency adjustable from 4 to 16 kHz (see derating section)

6.2.5.2 Size 1: MDS 5040A to MDS 5075A

Electrical data	MDS 5040A	MDS 5075A
ID no.	55404	55405
Recommended motor rating	4.0 kW	7.5 kW
U_{1PU}	3 × 400 V, +32 % / -50 %, 50 Hz; 3 × 480 V, +10 % / -58 %, 60 Hz	
$I_{1N,PU}$	3 × 9.3A	3 × 15.8 A
f_{2PU}	0 – 700 Hz	
U_{2PU}	0 – 400 V	
U_{maxPU}	830 V	

Tab. 12: Electrical data MDS 5000, size 1

Nominal currents up to +45 °C (in the control cabinet)

Operation with asynchronous motor

Electrical data	MDS 5040A	MDS 5075A
$I_{2N,PU}$	3 × 10 A	3 × 16 A
I_{2maxPU}	180 % for 5 s; 150 % for 30 s	
$f_{PWM,PU}$	4 kHz[3]	

Tab. 13: Electrical data MDS 5000, size 1, for 4 kHz clock frequency

Operation with synchronous servo motor

Electrical data	MDS 5040A	MDS 5075A
$I_{2N,PU}$	3 × 6 A	3 × 10 A
I_{2maxPU}	250 % for 2 s; 200 % for 5 s	
$f_{PWM,PU}$	8 kHz[4]	

Tab. 14: Electrical data MDS 5000, size 1, for 8 kHz clock frequency

Electrical data	MDS 5040A	MDS 5075A
U_{onCH}	780 – 800 V	
U_{offCH}	740 – 760 V	
R_{2minRB}	47 Ω	47 Ω
P_{maxRB}	6.4 kW	13.6 kW

Tab. 15: Brake chopper electrical data, size 1

[3] Clock frequency adjustable from 4 to 16 kHz (see derating section)
[4] Clock frequency adjustable from 4 to 16 kHz (see derating section)

6.2.5.3 Size 2: MDS 5110A to MDS 5150A

Electrical data	MDS 5110A	MDS 5150A
ID no.	55406	55407
Recommended motor rating	11 kW	15 kW
U_{1PU}	3 × 400 V, +32 % / -50 %, 50 Hz; 3 × 480 V, +10 % / -58 %, 60 Hz	
$I_{1N,PU}$	3 × 24.5 A	3 × 32.6 A
f_{2PU}	0 – 700 Hz	
U_{2PU}	0 – 400 V	
U_{maxPU}	830 V	

Tab. 16: Electrical data MDS 5000, size 2

Nominal currents up to +45 °C (in the control cabinet)

Operation with asynchronous motor

Electrical data	MDS 5110A	MDS 5150A
$I_{2N,PU}$	3 × 22 A	3 × 32 A
I_{2maxPU}	180 % for 5 s; 150 % for 30 s	
$f_{PWM,PU}$	4 kHz[5]	

Tab. 17: Electrical data MDS 5000, size 2, for 4 kHz clock frequency

Operation with synchronous servo motor

Electrical data	MDS 5110A	MDS 5150A
$I_{2N,PU}$	3 × 14 A	3 × 20 A
I_{2maxPU}	250 % for 2 s; 200 % for 5 s	
$f_{PWM,PU}$	8 kHz[6]	

Tab. 18: Electrical data MDS 5000, size 2, for 8 kHz clock frequency

Electrical data	MDS 5110A	MDS 5150A
U_{onCH}	780 – 800 V	
U_{offCH}	740 – 760 V	
R_{2minRB}	22 Ω	
P_{maxRB}	29.1 kW	

Tab. 19: Brake chopper electrical data, size 2

[5] Clock frequency adjustable from 4 to 16 kHz (see derating section)
[6] Clock frequency adjustable from 4 to 16 kHz (see derating section)

6.2.5.4 Size 3: MDS 5220A to MDS 5450A

Electrical data	MDS 5220A	MDS 5370A	MDS 5450A
ID no.	55408	55409	55410
Recommended motor rating	22 kW	37 kW	45 kW
U_{1PU}	3 × 400 V, +32 % / -50 %, 50 Hz; 3 × 480 V, +10 % / -58 %, 60 Hz		
$I_{1N,PU}$	1 × 37 A	3 × 62 A	3 × 76 A
f_{2PU}	0 – 700 Hz		
U_{2PU}	0 – 400 V		
U_{maxPU}	830 V		

Tab. 20: Electrical data MDS 5000, size 3

Nominal currents up to +45 °C (in the control cabinet)

Operation with asynchronous motor

Electrical data	MDS 5220A	MDS 5370A	MDS 5450A
$I_{2N,PU}$	3 × 44 A	3 × 70 A	3 × 85 A
I_{2maxPU}	180 % for 5 s; 150 % for 30 s		
$f_{PWM,PU}$	4 kHz[7]		

Tab. 21: Electrical data MDS 5000, size 3, for 4 kHz clock frequency

Operation with synchronous servo motor

Electrical data	MDS 5220A	MDS 5370A	MDS 5450A
$I_{2N,PU}$	3 × 30 A	3 × 50 A	3 × 60 A
I_{2maxPU}	250 % for 2 s; 200 % for 5 s		
$f_{PWM,PU}$	8 kHz[8]		

Tab. 22: Electrical data MDS 5000, size 3, for 8 kHz clock frequency

Electrical data	MDS 5220A	MDS 5370A	MDS 5450A
U_{onCH}	780 – 800 V		
U_{offCH}	740 – 760 V		
R_{intRB}	30 Ω (PTC resistance; 100 W; max. 1 kW for 1 s)		
R_{2minRB}	15 Ω		
P_{maxRB}	42 kW		

Tab. 23: Brake chopper electrical data, size 3

[7] Clock frequency adjustable from 4 to 16 kHz (see derating section)
[8] Clock frequency adjustable from 4 to 16 kHz (see derating section)

6.2.5.5 Power loss data according to EN 50598

Type	Nominal current $I_{2N,PU}$	Apparent power	Absolute losses $P_{V,CU}$[9]	Working points[10]								IE class[11]
				(0/25)	(0/50)	(0/100)	(50/25)	(50/50)	(50/100)	(90/50)	(90/100)	
				Relative losses								
	[A]	[kVA]	[W]	[%]								
MDS 5007A	4	0.9	8	5.01	5.07	5.68	5.20	5.37	6.30	5.88	7.43	IE2
MDS 5008A	2.3	1.6	8	2.98	3.13	3.49	3.02	3.22	3.71	3.36	4.09	IE2
MDS 5015A	4.5	3.1	10	1.71	1.86	2.24	1.75	1.97	2.51	2.16	3.04	IE2
MDS 5040A	10	6.9	10	1.38	1.54	1.93	1.43	1.64	2.17	1.80	2.57	IE2
MDS 5075A	16	11.1	10	0.95	1.12	1.66	0.99	1.23	1.98	1.41	2.52	IE2
MDS 5110A	22	15.2	12	0.80	0.97	1.49	0.84	1.06	1.75	1.21	2.19	IE2
MDS 5150A	32	22.2	12	0.70	0.87	1.40	0.74	0.97	1.66	1.11	2.08	IE2
MDS 5220A	44	30.5	32	0.61	0.76	1.21	0.68	0.90	1.53	1.06	1.96	IE2
MDS 5370A	70	48.5	32	0.53	0.69	1.18	0.59	0.82	1.49	0.97	1.89	IE2
MDS 5450A	85	58.9	32	0.47	0.64	1.18	0.54	0.78	1.50	0.94	1.94	IE2

Tab. 24: Relative losses of inverter MDS 5000 according to EN 50598

[9] Absolute losses for a power stage that is switched off
[10] Operating points for relative motor stator frequency in % and relative torque current in %
[11] IE class according to EN 50598

Type	Nominal current $I_{2N,PU}$	Apparent power	Absolute losses $P_{V,CU}$[12]	Working points[13]								IE class[14]	Comparison[15]
				(0/25)	(0/50)	(0/100)	(50/25)	(50/50)	(50/100)	(90/50)	(90/100)		
				Absolute losses P_V									
	[A]	[kVA]	[W]	[W]									[%]
MDS 5007A	4	0.9	8	45.1	45.6	51.1	46.8	48.3	56.7	52.9	66.9	IE2	51.8
MDS 5008A	2.3	1.6	8	47.7	50.1	55.8	48.3	51.5	59.3	53.8	65.4	IE2	40.2
MDS 5015A	4.5	3.1	10	52.9	57.6	69.3	54.4	61.0	77.9	67.1	94.1	IE2	39.6
MDS 5040A	10	6.9	10	95.3	106.1	133.3	98.6	113.2	149.9	123.9	177.0	IE2	37.1
MDS 5075A	16	11.1	10	104.9	124.0	184.6	110.3	136.6	219.8	156.0	279.8	IE2	35.8
MDS 5110A	22	15.2	12	121.5	146.9	226.1	128.1	161.6	266.0	183.7	332.7	IE2	32.9
MDS 5150A	32	22.2	12	154.7	192.8	311.3	164.6	214.6	369.3	245.9	462.1	IE2	38.3
MDS 5220A	44	30.5	32	187.5	232.2	368.7	207.7	273.9	466.8	323.0	597.8	IE2	32.1
MDS 5370A	70	48.5	32	256.6	332.3	570.8	287.9	397.0	721.5	471.0	915.9	IE2	33.9
MDS 5450A	85	58.9	32	277.8	376.9	692.3	317.4	459.0	886.1	554.6	1143.1	IE2	35.3

Tab. 25: Absolute losses of inverter MDS 5000 according to EN 50598

General conditions

The loss data applies to inverters without accessories.

The power loss calculation based on a three-phase supply voltage with 400 V_{AC} / 50 Hz.

The calculated data includes a supplement of 10 % according to EN 50598.

The power loss specifications refer to a clock frequency of 4 kHz.

The absolute losses for a power stage that is switched off refer to the 24 vdc power supply of the control electronics.

[12] Absolute losses for a power stage that is switched off
[13] Operating points for relative motor stator frequency in % and relative torque current in %
[14] IE class according to EN 50598
[15] Comparison of the losses for the reference inverter related to IE2 in the nominal point (90, 100)

6.2.5.6 Power loss data of accessories

Type	Absolute losses P_V [W]
Safety module ASP 5001	1
Terminal module SEA 5001	< 2
Terminal module XEA 5001	< 5
Terminal module REA 5001	< 5
Fieldbus module CAN 5000	1
Fieldbus module DP 5000	< 2
Fieldbus module ECS 5000	< 2
Fieldbus module PN 5000	< 4
Brake module BRS 5001	< 1

Tab. 26: Absolute losses of the accessories

Information

Also observe the absolute power loss of the encoder (usually < 3 W as well as the brake for the design.

6.2.6 Derating by increasing the clock frequency

Depending on the clock frequency $f_{PWM,PU}$, the following values of the nominal output currents $I_{2N,PU}$ arise. Note that only 8 kHz and 16 kHz can be set for the servo control type.

Type	$I_{2N,PU}$ 4 kHz	$I_{2N,PU}$ 8 kHz	$I_{2N,PU}$ 16 kHz
MDS 5007A	4 A	3 A	2 A
MDS 5008A	2.3 A	1.7 A	1.2 A
MDS 5015A	4.5 A	3.4 A	2.2 A
MDS 5040A	10 A	6 A	3.3 A
MDS 5075A	16 A	10 A	5.7 A
MDS 5110A	22 A	14 A	8.1 A
MDS 5150A	32 A	20 A	11.4 A
MDS 5220A	44 A	30 A	18.3 A
MDS 5370A	70 A	50 A	31.8 A
MDS 5450A	85 A	60 A	37.8 A

Tab. 27: Nominal output current $I_{2N,PU}$ depending on the clock frequency

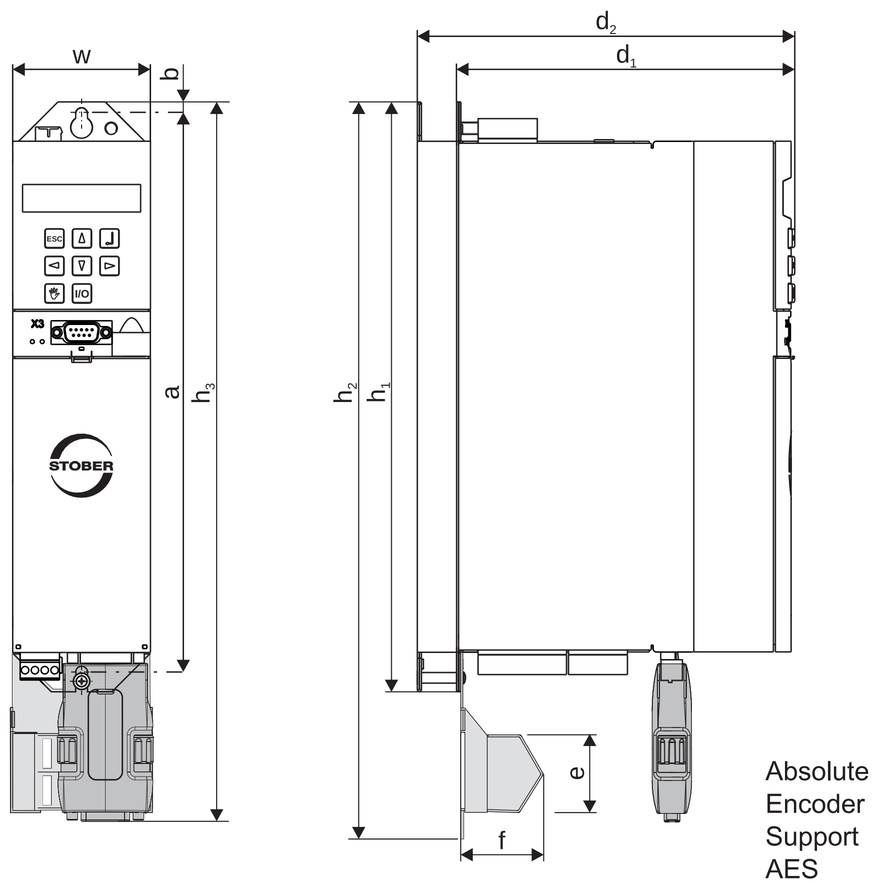
STOBER

MDS

6.2.7 Dimensions

The dimensions of the available MDS 5000 sizes can be found in the following sections.

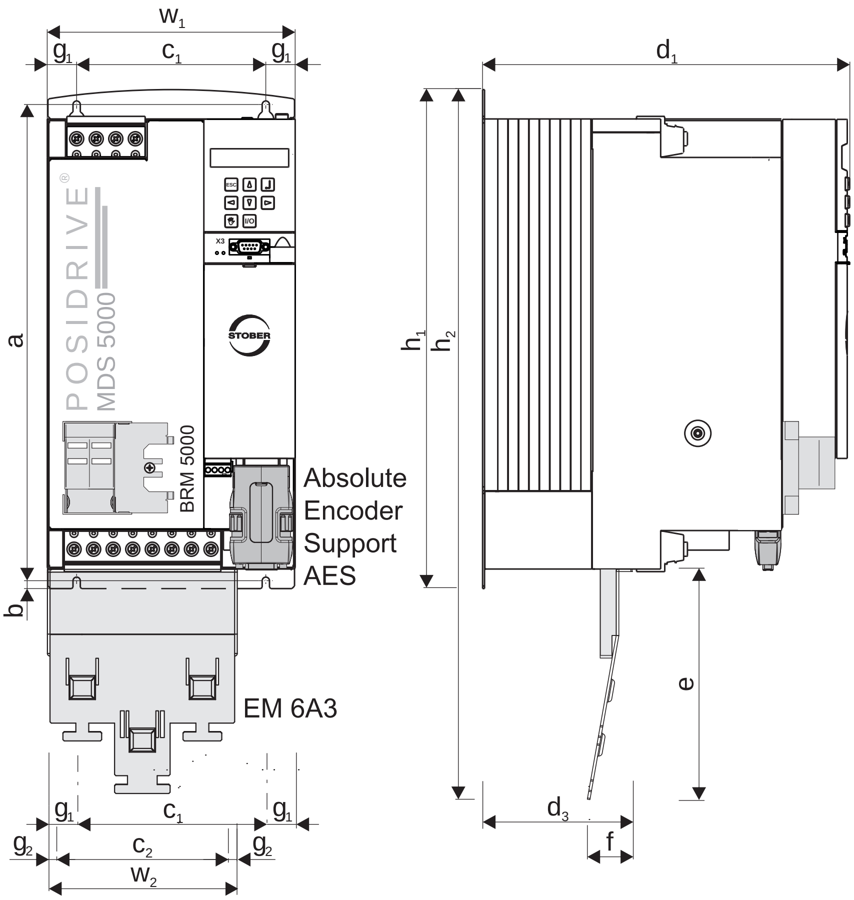
6.2.7.1 Dimensions: size 0 to 2



Dimensions [mm]			Size 0	Size 1	Size 2
Inverter	Height	h_1		300	
		h_2[16]		360	
		h_3[17]		365	
	Width	w	70		105
	Depth	d_1	175	260	260
		d_2[18]	193	278	278
EMC shroud	Height	e		37.5	
	Depth	f		40	
Fastening holes	Vertical distance	a		283	
	Vertical distance to upper edge	b		6	

[16] h2 = height incl. EMC shroud EM 5000 or brake module BRM 5000
[17] h3 = Height incl. AES
[18] d2 = Depth including brake resistor RB 5000

6.2.7.2 Dimensions: size 3



Dimensions [mm]			Size 3
Inverter	Height	h_1	382.5
		h_2[19]	540
	Width	w_1	194
	Depth	d_1	276
EMC shroud	Height	e	174
	Width	w_2	147
	Depth	f	34
	Depth	d_3	113
Fastening holes	Vertical distance	a	365+2
	Vertical distance to bottom edge	b	6
	Horizontal distance	c_1[20]	150+0.2/-0.2
	Horizontal distance from the side edge	g_1[21]	20
	Horizontal distance	c_2[22]	132
	Horizontal distance from the side edge	g_2[23]	7.5

[19] h2 = Height incl. EMC shroud EM6A3
[20] c1 = Horizontal distance from the fastening holes of the inverter
[21] g1 = Horizontal distance from the side edge of the inverter
[22] c2 = Horizontal distance from the fastening holes of the EMC shroud EM6A3
[23] g2 = Horizontal distance from the side edge of the EMC shroud EM6A3

MDS

6.2.8 Minimum clearances

The specified dimensions refer to the outside edges of the inverter.

Minimum clearance	Up	Down	on the side
Size 0 – Size 2	100	100	5
... with EMC shroud or brake module	100	120	5
Size 3	100	100	5
... with EMC shroud	100	220	5

Tab. 28: Minimum clearances [mm]

6.3 Inverter/motor combination

EZ synchronous servo motor (n_N = 2000 rpm) – SDS/MDS 5000

						5007A	5008A	5015A	5040A	5075A	5110A	5150A	5220A	5370A	5450A
	K_{EM} [V/1000 rpm]	M_N [Nm]	$I_{N,MOT}$ [A]	M_0 [Nm]	I_0 [A]	$I_{2N,PU}$= 3 A	$I_{2N,PU}$= 1.7 A	$I_{2N,PU}$= 3.4 A	$I_{2N,PU}$= 6 A	$I_{2N,PU}$= 10 A	$I_{2N,PU}$= 14 A	$I_{2N,PU}$= 20 A	$I_{2N,PU}$= 30 A	$I_{2N,PU}$= 50 A	$I_{2N,PU}$= 60 A
Convection cooling of IC 410						$I_{2N,PU}$ / I_0									
EZ805U	142	43.7	25.9	66.1	37.9									1.3	1.6
Forced ventilation IC 416						$I_{2N,PU}$ / I_0									
EZ805B	142	77.2	45.2	94	53.9										1.1
Water cooling						$I_{2N,PU}$ / I_0									
EZ805W	142	72.1	42.1	90.1	51.9										1.2

EZ synchronous servo motor (n_N = 3000 rpm) – SDS/MDS 5000

	K_{EM} [V/1000 rpm]	M_N [Nm]	$I_{N,MOT}$ [A]	M_0 [Nm]	I_0 [A]	5007A $I_{2N,PU}$= 3 A	5008A $I_{2N,PU}$= 1.7 A	5015A $I_{2N,PU}$= 3.4 A	5040A $I_{2N,PU}$= 6 A	5075A $I_{2N,PU}$= 10 A	5110A $I_{2N,PU}$= 14 A	5150A $I_{2N,PU}$= 20 A	5220A $I_{2N,PU}$= 30 A	5370A $I_{2N,PU}$= 50 A	5450A $I_{2N,PU}$= 60 A
Convection cooling of IC 410											$I_{2N,PU}$ / I_0				
EZ301U	40	0.93	1.99	0.95	2.02	1.5		1.7							
EZ302U	86	1.59	1.6	1.68	1.67		1.0	2.0							
EZ303U	109	2.07	1.63	2.19	1.71		1.0	2.0							
EZ401U	96	2.8	2.74	3	2.88			1.2							
EZ402U	94	4.7	4.4	5.2	4.8				1.3						
EZ404U	116	6.9	5.8	8.6	6.6					1.5					
EZ501U	97	4.3	3.74	4.7	4				1.5						
EZ502U	121	7.4	5.46	8	5.76				1.0	1.7					
EZ503U	119	9.7	6.9	11.1	7.67					1.3	1.8				
EZ505U	141	13.5	8.8	16	10					1.0	1.4	2.0			
EZ701U	95	7.4	7.2	8.3	8					1.3	1.8				
EZ702U	133	12	8.2	14.4	9.6					1.0	1.5				
EZ703U	122	16.5	11.4	20.8	14						1.0	1.4			
EZ705U	140	21.3	14.2	30.2	19.5							1.0	1.5		
EZ802U	136	22.3	13.9	37.1	22.3								1.3		
EZ803U	131	26.6	17.7	48.2	31.1									1.6	1.9
Forced ventilation IC 416										$I_{2N,PU}$ / I_0					
EZ401B	96	3.4	3.4	3.7	3.6				1.7						
EZ402B	94	5.9	5.5	6.3	5.8				1.0	1.7					
EZ404B	116	10.2	8.2	11.2	8.7					1.1	1.6				
EZ501B	97	5.4	4.7	5.8	5				1.2	2.0					
EZ502B	121	10.3	7.8	11.2	8.16					1.2	1.7				
EZ503B	119	14.4	10.9	15.9	11.8						1.2	1.7			
EZ505B	141	20.2	13.7	23.4	14.7						1.0	1.4			
EZ701B	95	9.7	9.5	10.5	10					1.0	1.4	2.0			
EZ702B	133	16.6	11.8	19.3	12.9						1.1	1.6			
EZ703B	122	24	18.2	28	20							1.0	1.5		
EZ705B	140	33.8	22.9	41.8	26.5								1.1	1.9	
EZ802B	136	34.3	26.5	47.9	28.9								1.0	1.7	
EZ803B	131	49	35.9	66.7	42.3									1.2	1.4
Water cooling											$I_{2N,PU}$ / I_0				
EZ401W	96	3.3	3.7	3.55	3.9				1.5						
EZ402W	94	5.85	5.5	6.35	6				1.0	1.7					
EZ404W	116	10.4	8.3	11.3	8.9					1.1	1.6				
EZ501W	97	5.4	4.75	5.65	4.85				1.2						
EZ502W	121	10.2	7.7	11	7.85					1.3	1.8				
EZ503W	119	13.5	10.2	15.2	11.3						1.2	1.8			
EZ505W	141	17.9	11.4	21.5	13.1						1.1	1.5			
EZ701W	95	10.2	9.95	10.4	10						1.4	2.0			
EZ702W	133	17.1	12.2	19.3	13.1						1.1	1.5			
EZ703W	122	22.5	17	27.5	19.6							1.0	1.5		
EZ705W	140	30.3	20.5	39.4	25.4								1.2	2.0	
EZ802W	136	32.2	26.6	48.9	29.6								1.0	1.7	
EZ803W	131	46.7	34.1	65.7	41.7									1.2	1.4

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EZ synchronous servo motor (n_N = 4500 rpm) – SDS/MDS 5000

	K_{EM} [V/1000 rpm]	M_N [Nm]	$I_{N,MOT}$ [A]	M_0 [Nm]	I_0 [A]	5007A $I_{2N,PU}$= 3 A	5008A $I_{2N,PU}$= 1.7 A	5015A $I_{2N,PU}$= 3.4 A	5040A $I_{2N,PU}$= 6 A	5075A $I_{2N,PU}$= 10 A	5110A $I_{2N,PU}$= 14 A	5150A $I_{2N,PU}$= 20 A	5220A $I_{2N,PU}$= 30 A	5370A $I_{2N,PU}$= 50 A	5450A $I_{2N,PU}$= 60 A
Convection cooling of IC 410										$I_{2N,PU}$ / I_0					
EZ505U	103	9.5	8.94	15.3	13.4						1.0	1.5			
EZ703U	99	12.1	11.5	20	17.8							1.1	1.7		
EZ705U	106	16.4	14.8	30	25.2								1.2	2.0	
EZ802U	90	10.5	11.2	34.5	33.3									1.5	1.8
Forced ventilation IC 416										$I_{2N,PU}$ / I_0					
EZ505B	103	16.4	16.4	22	19.4							1.0	1.5		
EZ703B	99	19.8	20.3	27.2	24.2								1.2		
EZ705B	106	27.7	25.4	39.4	32.8									1.5	1.8
EZ802B	90	30.6	30.5	47.4	45.1									1.1	1.3
Water cooling										$I_{2N,PU}$ / I_0					
EZ505W	103	14.2	13	20.2	17.2							1.2	1.7		
EZ703W	99	19.1	18.1	26.7	23.7								1.3		
EZ705W	106	24.1	22	37.2	31.6									1.6	1.9
EZ802W	90	30.7	30.3	46.9	44.6									1.1	1.3

EZ synchronous servo motor (n_N = 6000 rpm) – SDS/MDS 5000

	K_{EM} [V/1000 rpm]	M_N [Nm]	$I_{N,MOT}$ [A]	M_0 [Nm]	I_0 [A]	5007A $I_{2N,PU}$= 3 A	5008A $I_{2N,PU}$= 1.7 A	5015A $I_{2N,PU}$= 3.4 A	5040A $I_{2N,PU}$= 6 A	5075A $I_{2N,PU}$= 10 A	5110A $I_{2N,PU}$= 14 A	5150A $I_{2N,PU}$= 20 A	5220A $I_{2N,PU}$= 30 A	5370A $I_{2N,PU}$= 50 A	5450A $I_{2N,PU}$= 60 A
Convection cooling of IC 410										$I_{2N,PU}$ / I_0					
EZ301U	40	0.89	1.93	0.95	2.02			1.7							
EZ302U	42	1.5	3.18	1.68	3.48				1.7						
EZ303U	55	1.96	3.17	2.25	3.55				1.7						
EZ401U	47	2.3	4.56	2.8	5.36				1.1	1.9					
EZ402U	60	3.5	5.65	4.9	7.43					1.3	1.9				
EZ404U	78	5.8	7.18	8.4	9.78					1.0	1.4	2.0			
EZ501U	68	3.4	4.77	4.4	5.8				1.0	1.7	2.4				
EZ502U	72	5.2	7.35	7.8	9.8					1.0	1.4	2.0			
EZ503U	84	6.2	7.64	10.6	11.6						1.2	1.7			
EZ701U	76	5.2	6.68	7.9	9.38					1.1	1.5				
EZ702U	82	7.2	8.96	14.3	16.5							1.2	1.8		
Forced ventilation IC 416										$I_{2N,PU}$ / I_0					
EZ401B	47	2.9	5.62	3.5	6.83					1.5	2.0				
EZ402B	60	5.1	7.88	6.4	9.34					1.1	1.5				
EZ404B	78	8	9.98	10.5	12						1.2	1.7			
EZ501B	68	4.5	6.7	5.7	7.5					1.3	1.9				
EZ502B	72	8.2	11.4	10.5	13.4						1.0	1.5			
EZ503B	84	10.4	13.5	14.8	15.9							1.3	1.9		
EZ701B	76	7.5	10.6	10.2	12.4						1.1	1.6			
EZ702B	82	12.5	16.7	19.3	22.1								1.4		
Water cooling										$I_{2N,PU}$ / I_0					
EZ401W	47	2.55	5.2	3.35	6.95					1.4	2.0				
EZ402W	60	5	8	6.45	9.7					1.0	1.4				
EZ404W	78	7.7	10.5	10.6	12.3						1.1	1.6			
EZ501W	68	4.3	6.4	5.55	7.25					1.4	1.9				
EZ502W	72	8.1	11.2	10.3	12.9						1.1	1.6			
EZ503W	84	9.95	12.6	14.2	15.2							1.3	2.0		
EZ701W	76	7	10.2	10.4	12.7						1.1	1.6			
EZ702W	82	12	17.5	19.3	22.5								1.3		

EZHD synchronous servo motor with hollow shaft and direct drive (n_N = 3000 rpm) – SDS/MDS 5000

	K_{EM} [V/1000 rpm]	M_N [Nm]	$I_{N,MOT}$ [A]	M_0 [Nm]	I_0 [A]	5007A $I_{2N,PU}$= 3 A	5008A $I_{2N,PU}$= 1.7 A	5015A $I_{2N,PU}$= 3.4 A	5040A $I_{2N,PU}$= 6 A	5075A $I_{2N,PU}$= 10 A	5110A $I_{2N,PU}$= 14 A	5150A $I_{2N,PU}$= 20 A	5220A $I_{2N,PU}$= 30 A	5370A $I_{2N,PU}$= 50 A	5450A $I_{2N,PU}$= 60 A
Convection cooling of IC 410						$I_{2N,PU} / I_0$									
EZHD0411U	96	1.9	2.36	2.6	2.89	1.0		1.2							
EZHD0412U	94	4.2	4.29	5.1	4.94				1.2						
EZHD0414U	116	7.7	6.3	8.5	6.88					1.5					
EZHD0511U	97	3	3.32	4.1	4.06				1.5						
EZHD0512U	121	7.0	5.59	7.8	6.13					1.6					
EZHD0513U	119	8.3	7.04	10.9	8.76					1.1	1.6				
EZHD0515U	141	14	9.46	16.4	11						1.3	1.8			
EZHD0711U	95	7.3	7.53	7.9	7.98					1.3	1.8				
EZHD0712U	133	11.6	8.18	14.4	9.99					1.0	1.4				
EZHD0713U	122	17.8	13.4	20.4	15.1							1.3	2.0		
EZHD0715U	140	24.6	17.2	31.1	21.1								1.4		

EZHP synchronous servo motor with hollow shaft and attached planetary gear unit (n_N = 3000 rpm) – SDS/MDS 5000

	K_{EM} [V/1000 rpm]	M_N [Nm]	$I_{N,MOT}$ [A]	M_0 [Nm]	I_0 [A]	5007A $I_{2N,PU}$= 3 A	5008A $I_{2N,PU}$= 1.7 A	5015A $I_{2N,PU}$= 3.4 A	5040A $I_{2N,PU}$= 6 A	5075A $I_{2N,PU}$= 10 A	5110A $I_{2N,PU}$= 14 A	5150A $I_{2N,PU}$= 20 A	5220A $I_{2N,PU}$= 30 A	5370A $I_{2N,PU}$= 50 A	5450A $I_{2N,PU}$= 60 A
Convection cooling of IC 410						$I_{2N,PU} / I_0$									
EZHP_511U	97	3	3.32	4.1	4.06				1.5						
EZHP_512U	121	7.0	5.59	7.8	6.13					1.6					
EZHP_513U	119	8.3	7.04	10.9	8.76					1.1	1.6				
EZHP_515U	141	14	9.46	16.4	11						1.3	1.8			
EZHP_711U	95	7.3	7.53	7.9	7.98					1.3	1.8				
EZHP_712U	133	11.6	8.18	14.4	9.99					1.0	1.4				
EZHP_713U	122	17.8	13.4	20.4	15.1							1.3	2.0		
EZHP_715U	140	24.6	17.2	31.1	21.1								1.4		
Water cooling						$I_{2N,PU} / I_0$									
EZHP_511W	97	4.1	4.5	4.8	4.79				1.3						
EZHP_512W	121	8.15	6.54	9	7.07					1.4	2.0				
EZHP_513W	119	9.7	8.23	12.3	9.89					1.0	1.4				
EZHP_515W	141	16.2	11	18.6	12.5						1.1	1.6			
EZHP_711W	95	8.3	8.58	9.1	9.18					1.1	1.5				
EZHP_712W	133	13.6	9.6	16.6	11.5						1.2	1.7			
EZHP_713W	122	20.8	15.7	23.7	17.5							1.1	1.7		
EZHP_715W	140	29	20.3	35.7	24.2								1.2		

EZS synchronous servo motor for screw drive (driven threaded spindle) (n_N = 3000 rpm) – SDS/MDS 5000

	K_{EM} [V/1000 rpm]	M_N [Nm]	$I_{N,MOT}$ [A]	M_0 [Nm]	I_0 [A]	5007A $I_{2N,PU}$= 3 A	5008A $I_{2N,PU}$= 1.7 A	5015A $I_{2N,PU}$= 3.4 A	5040A $I_{2N,PU}$= 6 A	5075A $I_{2N,PU}$= 10 A	5110A $I_{2N,PU}$= 14 A	5150A $I_{2N,PU}$= 20 A	5220A $I_{2N,PU}$= 30 A	5370A $I_{2N,PU}$= 50 A	5450A $I_{2N,PU}$= 60 A
Convection cooling of IC 410						$I_{2N,PU} / I_0$									
EZS501U	97	3.85	3.65	4.3	3.95				1.5						
EZS502U	121	6.9	5.3	7.55	5.7				1.1	1.8					
EZS503U	119	9.1	6.7	10.7	7.6					1.3	1.8				
EZS701U	95	6.65	6.8	7.65	7.7					1.3	1.8				
EZS702U	133	11	7.75	13.5	9.25					1.1	1.5				
EZS703U	122	15.3	10.8	19.7	13.5						1.0	1.5			
Forced ventilation IC 416						$I_{2N,PU} / I_0$									
EZS501B	97	5.1	4.7	5.45	5				1.2	2.0					
EZS502B	121	10	7.8	10.9	8.16					1.2	1.7				
EZS503B	119	14.1	10.9	15.6	11.8						1.2	1.7			
EZS701B	95	9.35	9.5	10.2	10					1.0	1.4	2.0			
EZS702B	133	16.3	11.8	19	12.9						1.1	1.6			
EZS703B	122	23.7	18.2	27.7	20							1.0	1.5		

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Water cooling						$I_{2N,PU}$ / I_0									
EZS501W	97	5.1	4.75	5.3	4.85				1.2						
EZS502W	121	9.9	7.7	10.7	7.85					1.3	1.8				
EZS503W	119	13.2	10.2	14.9	11.3						1.2	1.8			
EZS701W	95	9.85	9.95	10	10					1.0	1.4	2.0			
EZS702W	133	16.8	12.2	18.9	13.1						1.1	1.5			
EZS703W	122	22.1	17	27.1	19.6							1.0	1.5		

EZM synchronous servo motor for screw drive (driven spindle nut) (n_N = 3000 rpm) – SDS/MDS 5000

						5007A	5008A	5015A	5040A	5075A	5110A	5150A	5220A	5370A	5450A
	K_{EM} [V/1000 rpm]	M_N [Nm]	$I_{N,MOT}$ [A]	M_0 [Nm]	I_0 [A]	$I_{2N,PU}$= 3 A	$I_{2N,PU}$= 1.7 A	$I_{2N,PU}$= 3.4 A	$I_{2N,PU}$= 6 A	$I_{2N,PU}$= 10 A	$I_{2N,PU}$= 14 A	$I_{2N,PU}$= 20 A	$I_{2N,PU}$= 30 A	$I_{2N,PU}$= 50 A	$I_{2N,PU}$= 60 A
Convection cooling of IC 410						$I_{2N,PU}$ / I_0									
EZM511U	97	3.65	3.55	4.25	4				1.5						
EZM512U	121	6.6	5.2	7.55	5.75				1.0	1.7					
EZM513U	119	8.8	6.55	10.6	7.6					1.3	1.8				
EZM711U	95	6.35	6.6	7.3	7.4					1.4	1.9				
EZM712U	133	10.6	7.5	13	8.9					1.1	1.6				
EZM713U	122	14.7	10.4	18.9	13						1.1	1.5			
Water cooling						$I_{2N,PU}$ / I_0									
EZM511W	97	4.95	4.75	5.2	4.85				1.2						
EZM512W	121	9.75	7.7	10.6	7.85					1.3	1.8				
EZM513W	119	13.1	10.2	14.8	11.3						1.2	1.8			
EZM711W	95	9.8	9.95	10	10					1.0	1.4	2.0			
EZM712W	133	16.7	12.2	18.8	13.1						1.1	1.5			
EZM713W	122	22	17	27.1	19.6							1.0	1.5		

6.4 Accessories

Information about the available accessories can be found in the following sections.

6.4.1 Safety technology

ASP 5001 – Safe Torque Off

Available with the standard version.

Option module for implementation of integrated safety function Safe Torque Off (STO).
The ASP 5001 may only be installed by STÖBER Antriebstechnik GmbH & Co. KG!
The ASP 5001 must be ordered with the basic device.

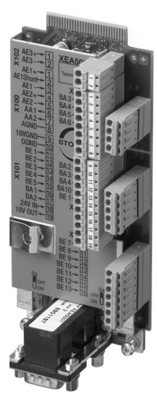
6.4.2 Terminal module

Terminal module standard SEA 5001

ID no. 49576
Terminals:

- 2 analog inputs
- 2 analog outputs
- 5 binary inputs
- 2 binary outputs

Terminal module extended XEA 5001



ID no. 49015
Terminals:

- 3 analog inputs
- 2 analog outputs
- 13 binary inputs
- 10 binary outputs

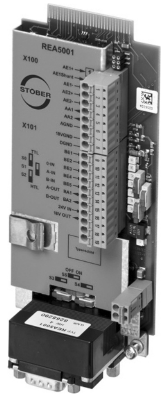
Encoder / interfaces:

- TTL incremental encoder (simulation and evaluation)
- Pulse train (simulation and evaluation)
- SSI encoder (simulation and evaluation)

SSI/TTL connection cable X120

ID no. 49482
Cable for connecting the TTL interface X120 to the SD6 drive controller (on terminal module RI6 or XI6) with the X301 interface on the LA6 adapter box for transferring Hall sensor signals. 0.3 m.

Terminal module resolver REA 5001



ID no. 49854
Terminals:

- 2 analog inputs
- 2 analog outputs
- 5 binary inputs
- 2 binary outputs

Encoder / interfaces:

- Resolver
- Encoder EnDat 2.1 sin/cos
- TTL incremental encoder (simulation and evaluation)
- SSI encoder (simulation and evaluation)
- Pulse train (simulation and evaluation)

Resolver cables that were connected to an POSIDYN SDS 4000 can be connected via the resolver adapter (9-pin to 15-pin) included in the scope of delivery to terminal X140 of REA 5001.

6.4.3 Communication

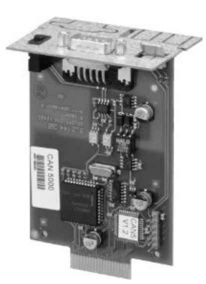
Connection cable G3

ID no. 41488
Cable for the connection of the inverter to terminal X3 with the PC , Sub-D connector, 9-pin, socket/socket, approx. 5 m.

USB adapter on RS232

ID no. 45616
Adapter for connecting RS232 to a USB connection.

Communication module CANopen DS-301 CAN 5000



ID no. 44574
Accessory part for connecting CAN bus.

Communication module PROFIBUS DP-V1 DP 5000

ID no. 44575
Accessory module for connecting PROFIBUS DP-V1.

Communication module EtherCAT ECS 5000

ID no. 49014
Accessory part for connecting EtherCAT (CANopen over Ether-CAT).

EtherCAT cable

Ethernet patch cable, CAT5e, yellow.
The following versions are available:
ID no. 49313: length approx. 0.2 m.
ID no. 49314: length approx. 0.35 m.

Communication module PROFINET PN 5000

ID no. 53893
Accessory part for connecting PROFINET.

6.4.4 Braking resistor

In addition to the inverters, STOBER offers braking resistors in different sizes and performance classes described in the following. When selecting, note the minimum permitted braking resistances specified in the technical data of the individual inverter types.

6.4.4.1 Tubular fixed resistor FZMU, FZZMU 400×65

Type	FZMU 400×65			FZZMU 400×65		
ID no.	49010	55445	55446	53895	55447	55448
MDS 5007A	X	—	—	—	—	—
MDS 5008A	X	—	—	—	—	—
MDS 5015A	X	—	—	—	—	—
MDS 5040A	—	—	—	X	—	—
MDS 5075A	—	—	—	X	—	—
MDS 5110A	—	X	—	—	X	—
MDS 5150A	—	X	—	—	X	—
MDS 5220A	—	—	X	—	—	X
MDS 5370A	—	—	X	—	—	X
MDS 5450A	—	—	X	—	—	X

Tab. 29: Assignment of braking resistor FZMU, FZZMU 400×65 – inverter MDS 5000

Properties

Specification	FZMU 400×65			FZZMU 400×65		
ID no.	49010	55445	55446	53895	55447	55448
Type	Tubular fixed resistor			Tubular fixed resistor		
Resistance [Ω]	100	22	15	47	22	15
Power [W]	600			1200		
Therm. time const. th [s]	40			40		
Pulse power for < 1 s [kW]	18			36		
U_{max} [V]	848			848		
Weight [kg]	Approx. 2.2			Approx. 4.2		
Protection class	IP20			IP20		
Test marks	cULus			cULus		

Tab. 30: Specification FZMU, FZZMU 400×65

Dimensions

Dimension	FZMU 400×65			FZZMU 400×65		
ID no.	49010	55445	55446	53895	55447	55448
L x D	400 × 65			400 × 65		
H	120			120		
K	6.5 × 12			6.5 × 12		
M	430			426		
O	485			450		
R	92			185		
U	64			150		
X	10			10		

Tab. 31: Dimensions FZMU, FZZMU 400×65 [mm]

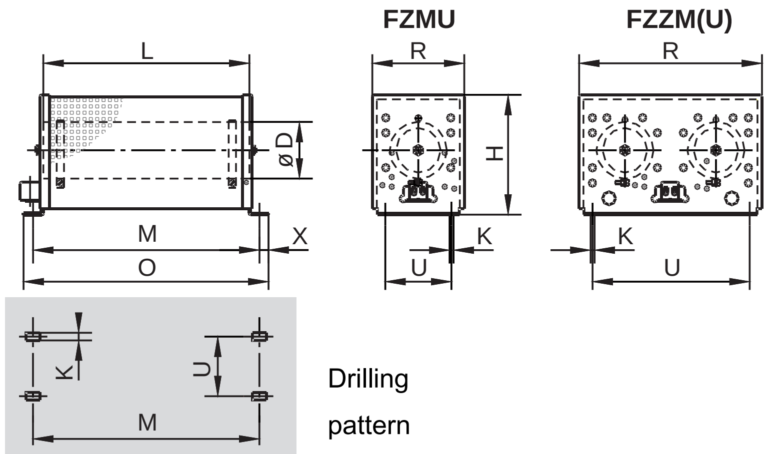


Fig. 2: Dimensional drawing FZMU, FZZMU 400×65

6.4.4.2 Flat resistor GVADU, GBADU

Type	GVADU 210×20	GBADU 265×30	GBADU 405×30	GBADU 335×30	GBADU 265×30
ID no.	55441	55442	55499	55443	55444
MDS 5007A	X	X	X	—	—
MDS 5008A	X	X	X	—	—
MDS 5015A	X	X	X	—	—
MDS 5040A	X	X	X	X	—
MDS 5075A	—	—	—	X	—
MDS 5110A	—	—	—	—	X
MDS 5150A	—	—	—	—	X
MDS 5220A	—	—	—	—	X
MDS 5370A	—	—	—	—	X
MDS 5450A	—	—	—	—	X

Tab. 32: Assignment of braking resistor GVADU, GBADU – inverter MDS 5000

STÖBER

MDS

Properties

Specification	GVADU 210×20	GBADU 265×30		GBADU 335×30	GBADU 405×30
ID no.	55441	55442	55444	55443	55499
Type	Flat resis-tor	Flat resistor			
Resistance [Ω]	100	100	22	47	100
Power [W]	150	300	300	400	500
Therm. time const. th [s]	60	60			
Pulse power for < 1 s [kW]	3.3	6.6	6.6	8.8	11
U_{max} [V]	848	848			
Cable design	Radox	FEP			
Cable length [mm]	500	500			
Cable cross-section [AWG]	18/19 (0.82 mm²)	14/19 (1.9 mm²)			
Weight [g]	300	950	950	1200	1450
Protection class	IP54	IP54			
Test marks	cULus	cULus			

Tab. 33: Specification GVADU, GBADU

Dimensions

Dimension	GVADU 210×20	GBADU 265×30		GBADU 335×30	GBADU 405×30
ID no.	55441	55442	55444	55443	55499
A	210	265		335	405
H	192	246		316	386
C	20	30		30	30
D	40	60		60	60
E	18.2	28.8		28.8	28.8
F	6.2	10.8		10.8	10.8
G	2	3		3	3
K	2.5	4		4	4
J	4.3	5.3		5.3	5.3
β	65°	73°		73°	73°

Tab. 34: Dimensions GVADU, GBADU [mm]

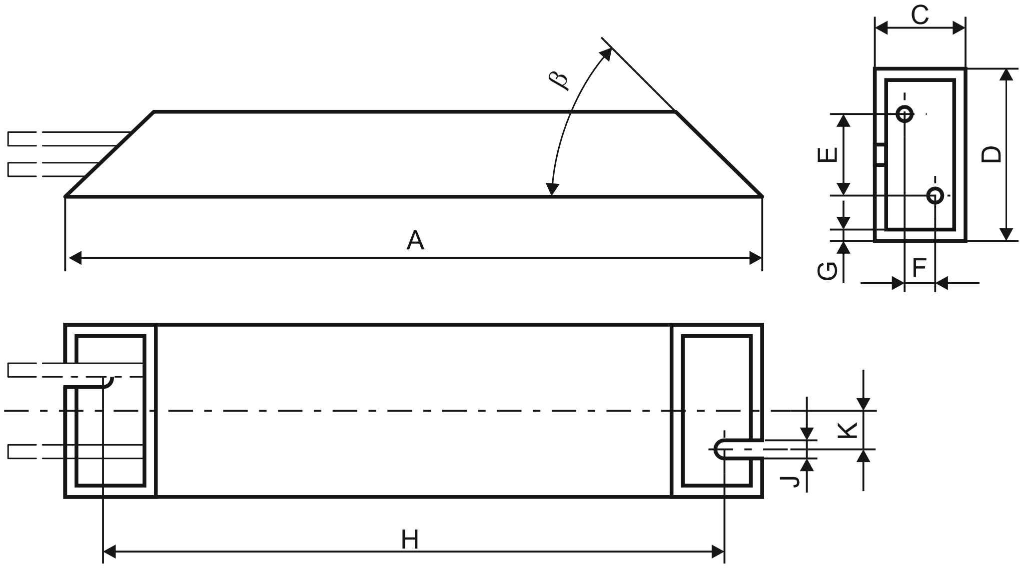


Fig. 3: Dimensional drawing GVADU, GBADU

6.4.4.3 Steel-grid fixed resistor FGFKU

Type	**FGFKU**			
ID no.	55449	55450	55451	53897
MDS 5110A	X	—	—	—
MDS 5150A	X	—	—	—
MDS 5220A	—	X	X	X
MDS 5370A	—	X	X	X
MDS 5450A	—	X	X	X

Tab. 35: Assignment of braking resistor FGFKU – inverter MDS 5000

Properties

Specification	**FGFKU**			
ID no.	55449	55450	55451	53897
Type	Steel-grid fixed resistor		Steel-grid fixed resistor	Steel-grid fixed resistor
Resistance [Ω]	22	15	15	15
Power [W]	2500		6000	8000
Therm. time const. th [s]	30		20	20
Pulse power for < 1 s [kW]	50		120	160
U_{max} [V]	848		848	848
Weight [kg]	Approx. 7.5		12	18
Protection class	IP20		IP20	IP20
Test marks	cULus		cULus	cULus

Tab. 36: Specification FGFKU

Dimensions

Dimension	FGFKU			
ID no.	55449	55450	55451	53897
A	270		370	570
B	295		395	595
C	355		455	655

Tab. 37: Dimensions FGFKU [mm]

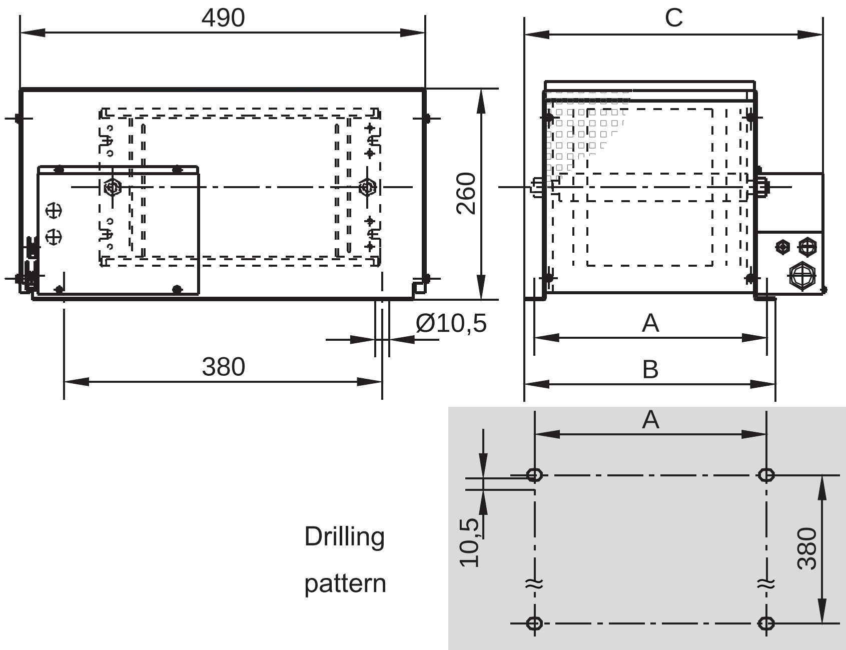


Fig. 4: Dimensional drawing FGFKU

6.4.4.4 Bottom brake resistor RB 5000

Type	RB 5022	RB 5047	RB 5100
ID no.	45618	44966	44965
MDS 5007A	—	—	X
MDS 5008A	—	—	X
MDS 5015A	—	—	X
MDS 5040A	—	X	X
MDS 5075A	—	X	—
MDS 5110A	X	—	—
MDS 5150A	X	—	—

Tab. 38: Assignment of braking resistor RB 5000 – inverter MDS 5000

Properties

Specification	RB 5022	RB 5047	RB 5100
ID no.	45618	44966	44965
Resistance [Ω]	22	47	100
Power [W]	100	60	60
Therm. time const. th [s]		8	
Pulse power for < 1 s [kW]	1.5	1.0	1.0
U_{max} [V]		800	
Weight [g]	about 640	about 460	about 440
Cable design		Radox	
Cable length [mm]		250	
Cable cross-section [AWG]		18/19 (0.82 mm²)	
Maximum torque of M5 threaded bolts [Nm]		5	
Protection class		IP40	
Test marks		cULus	

Tab. 39: Specification RB 5000

Dimensions

Dimension	RB 5022	RB 5047	RB 5100
ID no.	45618	44966	44965
Height	300	300	
Width	94	62	
Depth	18	18	
Drilling pattern corresponds to size	Size 2	Size 1	Size 0 and size 1

Tab. 40: Dimensions RB 5000 [mm]

6.4.5 Output choke TEP

Information

The following technical data applies for a rotary field frequency of 200 Hz. For example, this rotary field frequency is achieved with a motor with 4 pole pairs and a nominal speed of 3000 rpm. Always observe the specified derating for higher rotary field frequencies. Also observe the dependency of the cycle frequency.

Properties

Specification	TEP3720-0ES41	TEP3820-0CS41	TEP4020-0RS41
ID no.	53188	53189	53190
Voltage range	3 × 0 bis 480 V		
Frequency range	0 – 200 Hz		
I_N at 4 kHz	4 A	17.5 A	38 A
I_N at 8 kHz	3.3 A	15.2 A	30.4 A
Max. permitted motor cable length with output choke	100 m		
Max. surrounding temperature $\vartheta_{amb,max}$	40 °C		
Design	Open		
Winding losses	11 W	29 W	61 W
Iron losses	25 W	16 W	33 W
Connections	Screw terminals		
Max. conductor cross-section	10 mm²		
UL Recognized Component (CAN; USA)	Yes		
Test marks	c RU us		

Tab. 41: Specification TEP

Projecting

Select the output chokes according to the rated currents of the motor and output chokes. In particular, observe the derating of the output choke for rotary field frequencies higher than 200 Hz. You can calculate the rotary field frequency for your drive with the following formula:

$$f = n_N \times \frac{p}{60}$$

f	Rotary field frequency in Hz
n	Speed in rpm
N	Nominal value
p	Number of pole pairs

Derating

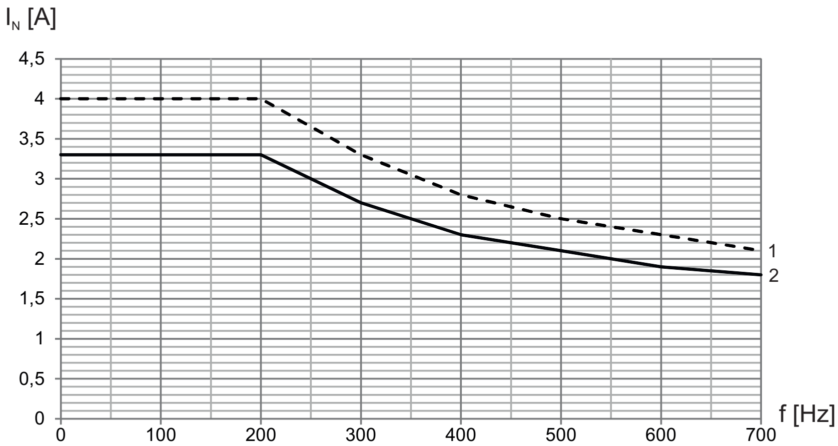


Fig. 5: Derating TEP3720-0ES41

1	Clock frequency 4 kHz
2	Clock frequency 8 kHz

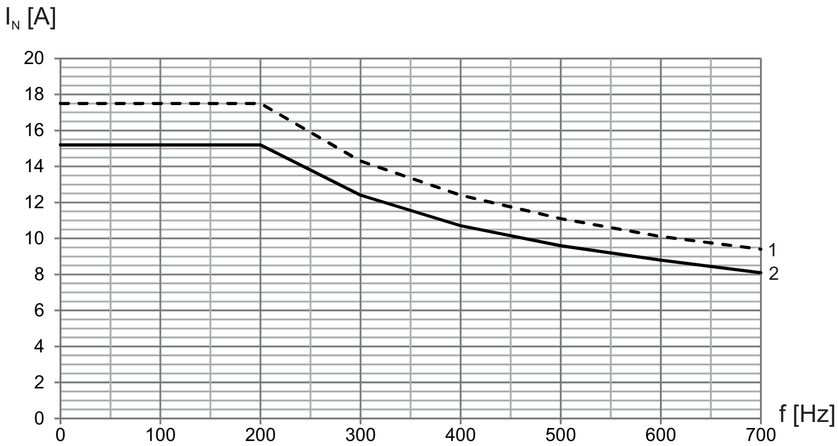


Fig. 6: Derating TEP3820-0CS41

1	Clock frequency 4 kHz
2	Clock frequency 8 kHz

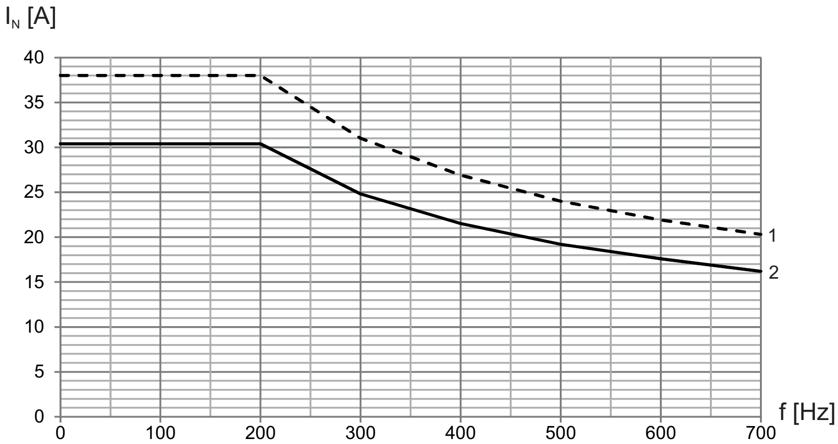


Fig. 7: Derating TEP4020-0RS41

1	Clock frequency 4 kHz
2	Clock frequency 8 kHz

Dimensions and weight

Dimension	TEP3720-0ES41	TEP3820-0CS41	TEP4020-0RS41
Height h [mm]	Max. 153	Max. 153	Max. 180
Width w [mm]	178	178	219
Depth d [mm]	73	88	119
Vertical distance – fastening holes a1 [mm]	166	166	201
Vertical distance – fastening holes a2 [mm]	113	113	136
Horizontal distance – fastening holes b1 [mm]	53	68	89
Horizontal distance – fastening holes b2 [mm]	49	64	76
Drill holes – depth e [mm]	5.8	5.8	7
Drill holes – width f [mm]	11	11	13
Screw connection – M	M5	M5	M6
Weight [kg]	2.9	5.9	8.8

Tab. 42: Dimensions and weight TEP

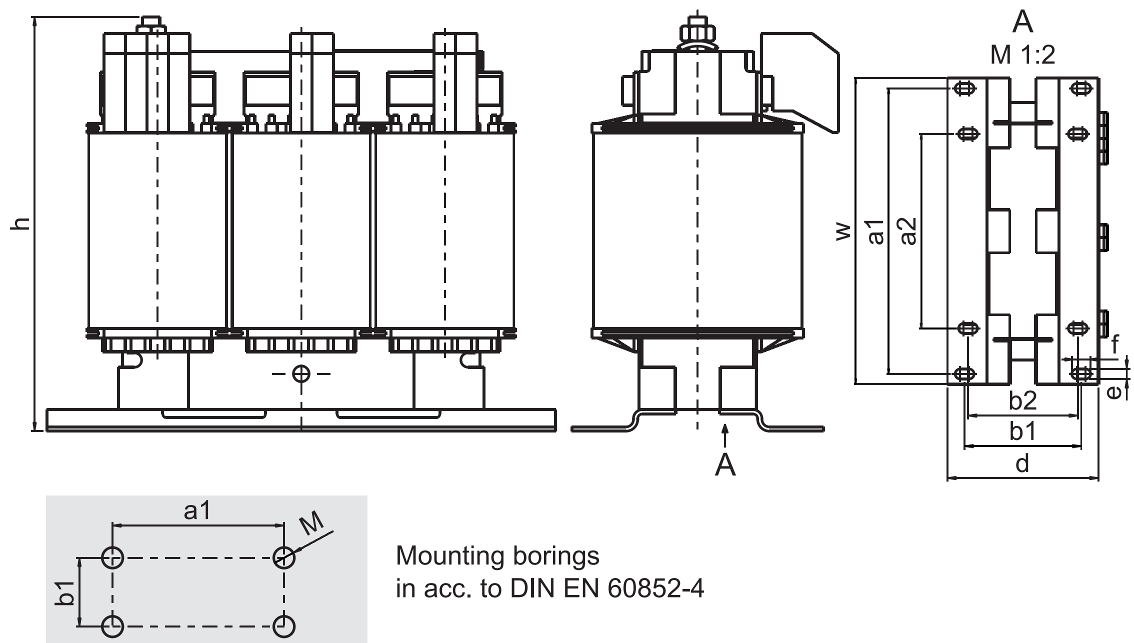


Fig. 8: Dimensional drawing TEP

6.4.6 Brake module and EMC shroud

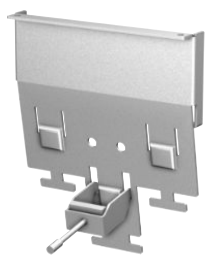
Brake module for 24 V brake BRM 5000

ID no. 44571
Brake module for inverters of series FDS 5000 and MDS 5000.
Accessory part for control of a motor holding brake (24 VDC) and (for inverters up to size 2) for connecting to the shield of the power cable.
Attachable on the basic housing.
Including shield connection terminal.

EMC shroud EM 5000

ID no. 44959
EMC shroud for sizes 0 to 2.
Accessory part for shield connection of the motor line. Attachable on the basic housing.
Including shield connection terminal.

EMC shroud EM6A3



ID no. 135120
EMC shroud for size 3.
Accessory part for shield connection of the motor line.
Attachable on the basic housing.
Including shield connection terminal.
If necessary you can also connect the cable shield of the braking resistor and DC link connection on the shroud. Additional shield connection terminals are available as accessories for this purpose (ID no. 56521).

6.4.7 Control box

Control box

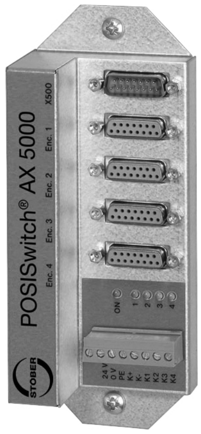
Operating device for parameterization and configuration of the inverter.
The connection cable with a length of 1.5 m is included in the scope of delivery.
The following versions are available:
ID no. 42224: service versions.
ID no. 42225: installation DIN housing 96 x 96 mm, protection class IP54.

Control box cable

Connection cable from control box to inverter.
The following versions are available:
ID no. 43216: 5 m.
ID no. 43217: 10 m.

6.4.8 Axis switcher

4-way axis switcher POSISwitch AX 5000



ID no. 49578
Enables the operation of up to four servo motors on one inverter.

Connection cable LA6 / AX 5000

Cable to connect inverter and axis switcher POSISwitch AX 5000.
The following versions are available:
ID no. 45405: 0.5 m.
ID no. 45386: 2.5 m.

6.4.9 Battery module for encoder buffering

Absolute Encoder Support AES

ID no. 55452
Battery module for buffering the power supply when using the inductive absolute value encoder EnDat 2.2 digital with battery-buffered multiturn power stage, for example EBI1135, EBI135.
A battery is included.

Replaceable battery AES

ID no. 55453
replacement battery for the battery module AES.

6.4.10 Removable data storage

Paramodule removable data storage

Included in the standard design.

ID no. 55464
Memory module for configuration and parameters.

6.4.11 Product CD

Product CD "ELECTRONICS 5000"

Included in the standard design.

ID no. 441852
The CD-ROM contains the POSITool project configuration and commissioning software, documentation as well as the device description files for the inverter – controller connection.

6.5 Further information

6.5.1 Symbols, identifiers and test symbols

Grounding symbol
according to IEC 60417-5019 (DB:2002-10).

Lead-free identifier RoHS
according to RoHS directive 2011-65-EU.

CE mark
Manufacturer's self declaration: The product meets the requirements of EU directives.

UL-test mark
This product is listed by UL for the USA and Canada. Representative samples of this product have been evaluated by UL and meet the requirements of applicable standards.

UL test marks for recognized components
This component or material is recognized by UL. Representative samples of this product have been evaluated by UL and meet applicable requirements.

CAB

7 Connection method

7.1 Overview

Coordinated connection systems for STOBER drive controllers

The interaction between drive controller, cable and synchronous servo motor is often underestimated. Every product has its own unique leakage capacitances and inductances. Unsuitable matches can therefore result in impermissibly high voltage peaks on the motor or drive controller, which could destroy the motor and cause other damage. Legal requirements for EMC (electromagnetic compatibility) must also be observed. STOBER offers a product line of matching cables to ensure this, both for the power connection and for the various encoder systems. The combination of STOBER motors, STOBER cables and STOBER drive controllers ensures safety and reliability for the system and compliance with legal requirements. Using unsuitable connection cables may result in voiding of any claims made under the warranty. Cables are available in different lengths and are ready-made on both sides. They simply have to be connected or clamped to the motor or drive controller.

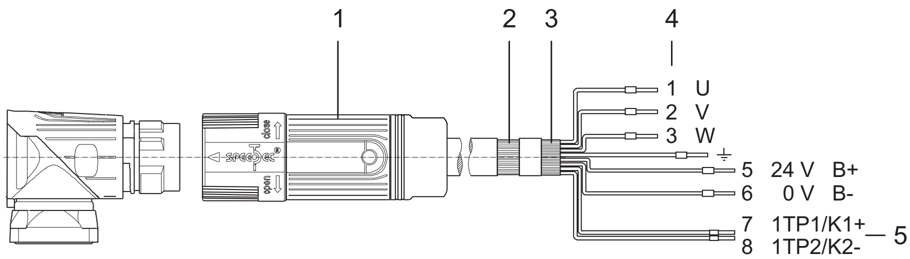
Connection technology

7.2 Power cable

Please observe the motor connection diagram that is delivered with every synchronous servo motor.

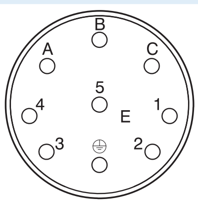
Power cables are available depending on the plug size in the following designs:

- SpringTec quick lock for con.15
- SpeedTec quick lock for con.23 and con.40
- Screw technology for con.58



1	Plug connector (quick/screw lock)
2	Cable shield
3	Junction of all shields
4	Wire no.
5	Motor, brake temperature sensor

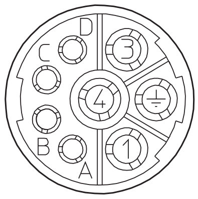
Synchronous servo motors from STOBER are equipped with circular plugs as a standard features. They can be connected to drive controllers with the following power cables. The color specifications refer to the connection wires and are only significant for the motor-internal wiring.

Bracket flange socket – Motor	Pin	Designation	Motor int. Wire colors	Wire no.
	A	1U1	BK	1
	B	1V1	BU	2
	C	1W1	RD	3
	1	1TP1/1K1	BK/BN	7
	2	1TP2/1K2	WH/WH	8
	3	1BD1	RD	5
	4	1BD2	BK	6
	5	—	—	—
	⏚	PE	GN/YE	⏚
	Housing	Shield	—	—

Tab. 1: Power cable pin assignment con.15

Length [mm]	Diameter [mm]
42	18.7

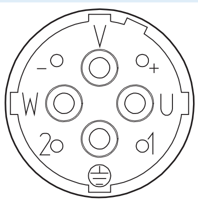
Tab. 2: Dimensions con. 15

Bracket flange socket – Motor	Pin	Designation	Motor int. Wire colors	Wire no.
	1	1U1	BK	1
	3	1V1	BU	2
	4	1W1	RD	3
	A	1BD1	RD	5
	B	1BD2	BK	6
	C	1TP1/1K1	BK/BN	7
	D	1TP2/1K2	WH/WH	8
	⏚	PE	GN/YE	⏚
	Housing	Shield	—	—

Tab. 3: Power cable pin assignment con.23

Length [mm]	Diameter [mm]
78	26

Tab. 4: Dimensions con. 23

Bracket flange socket – Motor	Pin	Designation	Motor int. Wire colors	Wire no.
	U	1U1	BK	1
	V	1V1	BU	2
	W	1W1	RD	3
	+	1BD1	RD	5
	–	1BD2	BK	6
	1	1TP1/1K1	BK/BN	7
	2	1TP2/1K2	WH/WH	8
	⏚	PE	GN/YE	⏚
	Housing	Shield	—	—

Tab. 5: Power cable pin assignment con.40, con.58

Length [mm]	Diameter [mm]
99	46

Tab. 6: Dimensions con.40

Length [mm]	Diameter [mm]
146	63.5

Tab. 7: Dimensions con.58

BK	BLACK	PK	PINK
BN	BROWN	RD	RED
BU	BLUE	VT	VIOLET
GN	GREEN	WH	WHITE
GY	GREY	YE	YELLOW
OG	ORANGE		

Tab. 8: Cable color – key

7.2.1 Technical data

Conductor material

Ultra-fine conductor made of bare Cu wires as per VDE 0295 class 6, table 4, column 3;
Internal structure stranded tension-free;
The wire structure for conductors with 0.34 mm² is based on DIN VDE 0812

Voltage

For cable 4 × 1.0 mm² + ...

- Nominal voltage (DIN VDE): supply wires U_o/U = 0.6/1.0 kV
- Voltage (UL/CSA): supply wires 1000 V
- Voltage (UL): control conductors max. 300 V
- Voltage (CSA): control conductors max. 1000 V

For cable 4 × 1.5 mm² +... and 4 × 2.5 mm² +...

- Nominal voltage (DIN VDE): supply wires U_o/U = 0.6/1.0 kV
- Voltage (UL/CSA): supply wires 1000 V
- Voltage (UL): control conductors max. 300 V
- Voltage (CSA): control conductors max. 1000 V

For cable 4 × 4.0 mm² + ...

- Nominal voltage (DIN VDE): supply wires U_o/U = 0.6/1.0 kV
- Voltage (UL/CSA): supply wires 1000 V
- Voltage (UL): control conductors max. 300 V
- Voltage (CSA): control conductors max. 1000 V

For cable 4 × 6.0 mm² + ...

- Nominal voltage (DIN VDE): supply wires U_o/U = 0.6/1.0 kV
- Voltage (UL/CSA): supply wires 1000 V
- Voltage (UL/CSA): control conductors max. 1000 V

For cable 4 × 10.0 mm² + ...

- Nominal voltage (DIN VDE): supply wires U_o/U = 0.6/1.0 kV
- Voltage (UL/CSA): supply wires 1000 V
- Voltage (UL/CSA): control conductors max. 1000 V

For cable 4 × 16.0 mm² + ...

- Nominal voltage (DIN VDE): supply wires U_o/U = 0.6/1.0 kV
- Voltage (UL/CSA): supply wires 1000 V
- Voltage (UL/CSA): control conductors max. 1000 V

For cable 4 × 25.0 mm² + ...

- Nominal voltage (DIN VDE): supply wires U_o/U = 0.6/1.0 kV
- Voltage (UL/CSA): supply wires 1000 V
- Voltage (UL/CSA): control conductors max. 1000 V

Power wires

A [mm²]	Conductor cross-section	1.0	1.5	2.5	4.0	6.0	10.0	16.0	25.0
I_N [A]	Nominal current	12.5	15.0	20.0	28.3	35.8	49.2	66.7	90.0

Current carrying capacity

In accordance with DIN VDE 0298, part 4, 2013-06, table 9, 17, 15 and 20; 0.34 mm² in accordance with DIN VDE 0891, part 1

Control wires – brake lines and temperature sensors

A [mm²]	Conductor cross-section	0.34	0.5	0.75	1.0
I_N [A]	Nominal current	1.5	5.0	9.0	12.5

Test voltage

Conductor/conductor 4.0 kV_{eff} ≥ 1.5 mm²
Conductor/conductor 1.5 kV_{eff} ≤ 1.0 mm²
Conductor/conductor 0.5 kV_{eff} ≤ 0.5 mm²
Conductor/shield 1.2 kV ≥ 1.0 mm²
Conductor/shield 0.5 kV ≤ 0.5 mm²

Insulation resistance at 20 °C

Min. 100 MΩ × km

Limit temperature

Temperature range/operation mode	DIN VDE	UL / CSA
Not specified	—	Up to +80 °C
Not in motion	-50 °C to +90 °C	—
In motion	-40 °C to +90 °C	—
Briefly on the conductor	120 °C	—

Max. tensile stress when being laid

50 N for each mm² of conductor cross-section

Smallest permissible bending radius

Free to move 10 x d_{out}
Permanently installed 5 × d_{out}; from 16 mm² = 7.5 × d_{out}

Torsional stress

± 30°/m

Bending resistance

Trailable with 5 million bending cycles up to 120 m/min travel speed and 5 m/s² acceleration under optimum ambient conditions

Resistance

Oil resistant: very good as per VDE 0282, part 10+HD 22.10
Chemical: good against acids, bases, solvents, hydraulic fluids, etc.;
For more detailed information see the cable manufacturer's lists of materials

Outer sheath

PUR (TMPU as per DIN VDE 0282, part 10)

Banding

Fleece tape with overlapping

Conductor insulation

TPE-E

Identification

Conductors: black with numbers printed in white (1; 2; 3; yellow/green for PE; (5; 6 thick pair); (7; 8 thin pair));
Sheath: color based on Desina, similar to RAL 2003 with additional imprinted “STOBER 44214” for 1.0 mm^2; “STOBER 44211”for 1.5 mm^2;
From 4 × 2.5 +...mm^2 with cable manufacturer’

Shield coverage factor

Braiding min. 80 % (Cu, tinned); control pairs with shielding film and braiding

Insulation material

Halogen-free, silicone-free, PWIS non-critical (PWIS = free of paint-wetting impairment substances)

Flammability

Combustion behavior: flame retarding and self-extinguishing in accordance with IEC 60322-1, CSA FT1 and UL FT1

Conductor cross-sections

Cable diameter	Description
Max. 10.5 mm	(4 × 1.0 + (2 × 0.5) + (2 × 0.34)) mm^2
Max. 12.7 mm	(4 × 1.5 + (2 × 1.0) + (2 × 0.50)) mm^2
Max. 15.3 mm	(4 × 2.5 + 2 × (2 × 1.0)) mm^2
Max. 16 mm	(4 × 4.0 + (2 × 1.0) + (2 × 0.75)) mm^2
Max. 19.4 mm	(4 × 6.0 + (2 × 1.5) + (2 × 1.0)) mm^2
Max. 23.5 mm	(4 × 10.0 + (2 × 1.5) + (2 × 1.0)) mm^2
Max. 25.5 mm	(4 × 16.0 + 2 × (2 × 1.5)) mm^2
Max. 28.8 mm	(4 × 25.0 + 2 x (2 × 1.5)) mm^2

Tab. 9: Conductor cross-section

”(...)” = shield; other cross-sections on request

Design

UL/CSA (E172204)

Capacitance, inductance

Capacitance as per VDE 0472 part 504 test type A; conductor/conductor[1]	
Conductor cross-section 1.0 mm²:	
Conductors 1.0 mm²	Max. 45 nF/km
Pair 0.5 mm²	Max. 110 nF/km
Pair 0.34 mm²	Max. 70 nF/km
Conductor cross-section 1.5 mm²:	
Conductors 1.5 mm²	Max. 55 nF/km
Pair 1.0 mm²	Max. 70 nF/km
Pair 0.5 mm²	Max. 50 nF / km
Conductor cross-section 2.5 mm²:	
Conductors 2.5 mm²	Max. 65 nF/km
Pair 1.0 mm²	Max. 60 nF/km
Conductor cross-section 4.0 mm²:	
Conductors 4.0 mm²	Max. 60 nF/km
Pair 0.75 mm²	Max. 40 nF/km
Pair 1.0 mm²	Max. 45 nF/km
Conductor cross-section 6.0 mm²:	
Conductors 6.0 mm²	Max. 70 nF/km
Pair 1.0 mm²	Max. 35 nF/km
Pair 1.5 mm²	Max. 45 nF/km
Conductor cross-section 10.0 mm²:	
Conductors 10.0 mm²	Max. 75 nF/km
Pair 1.0 mm²	Max. 34 nF / km
Pair 1.5 mm²	Max. 45 nF/km
Conductor cross-section 16.0 mm²:	
Conductors 16.0 mm²	Max. 75 nF/km
Pair 1.5 mm²	Max. 35 nF/km
Conductor cross-section 25.0 mm²:	
Conductors 25.0 mm²	Values on request
Pair 1.5 mm²	Values on request

[1] Details as per EN 50289-1-5:2001 in preparation

Capacitance as per VDE 0472 part 504 test type B; conductor/remainder[2]	
Conductor cross-section 1.0 mm²:	
Conductors 1.0 mm²	Max. 250 nF/km
Pair 0.5 mm²	Max. 650 nF/km
Pair 0.34 mm²	Max. 600 nF/km
Conductor cross-section 1.5 mm²:	
Conductors 1.5 mm²	Max. 300 nF/km
Pair 1.0 mm²	Max. 550 nF/km
Pair 0.5 mm²	Max. 450 nF/km
Conductor cross-section 2.5 mm²:	
Conductors 2.5 mm²	Max. 325 nF/km
Pair 1.0 mm²	Max. 600 nF/km
Conductor cross-section 4.0 mm²:	
Conductors 4.0 mm²	Max. 260 nF/km
Pair 0.75 mm²	Max. 400 nF/km
Pair 1.0 mm²	Max. 550 nF/km
Conductor cross-section 6.0 mm²:	
Conductors 6.0 mm²	Max. 300 nF/km
Pair 1.0 mm²	Max. 350 nF/km
Pair 1.5 mm²	Max. 400 nF/km
Conductor cross-section 10.0 mm²:	
Conductors 10.0 mm²	Max. 350 nF/km
Pair 1.0 mm²	Max. 350 nF/km
Pair 1.5 mm²	Max. 400 nF/km
Conductor cross-section 16.0 mm²:	
Conductors 16.0 mm²	Max. 360 nF/km
Pair 1.5 mm²	Max. 350 nF/km
Conductor cross-section 25.0 mm²:	
Conductors 25.0 mm²	Values on request
Pair 1.5 mm²	Values on request

[2] Details as per EN 50289-1-5:2001 in preparation

CAB

Inductance as per EN 50289-1-12:2005; conductor/conductor[3]	
Conductor cross-section 1.0 mm²:	
Conductors 1.0 mm²	Max. 800 µH/km
Pair 0.5 mm²	Max. 600 µH/km
Pair 0.34 mm²	Max. 650 µH/km
Conductor cross-section 1.5 mm²:	
Conductors 1.5 mm²	Max. 700 µH/km
Pair 1.0 mm²	Max. 700 µH/km
Pair 0.5 mm²	Max. 650 µH/km
Conductor cross-section 2.5 mm²:	
Conductors 2.5 mm²	Max. 700 µH/km
Pair 1.0 mm²	Max. 650 µH/km
Conductor cross-section 4.0 mm²:	
Conductors 4.0 mm²	Max. 600 µH/km
Pair 0.75 mm²	Max. 650 µH / km
Pair 1.0 mm²	Max. 600 µH / km
Conductor cross-section 6.0 mm²:	
Conductors 6.0 mm²	Max. 650 µH/km
Pair 1.0 mm²	Max. 700 µH/km
Pair 1.5 mm²	Max. 650 µH/km
Conductor cross-section 10.0 mm²:	
Conductors 10.0 mm²	Max. 600 µH/km
Pair 1.0 mm²	Max. 700 µH/km
Pair 1.5 mm²	Max. 650 µH/km
Conductor cross-section 16.0 mm²:	
Conductors 16.0 mm²	Max. 570 µH/km
Pair 1.5 mm²	Max. 500 µH/km
Conductor cross-section 25.0 mm²:	
Conductors 25.0 mm²	Values on request
Pair 1.5 mm²	Values on request

[3] Details as per EN 50289-1-5:2001 in preparation

7.2.2 Assignment of motors to power cable

The assigned cable cross-sections are relative to a max. cable length of 100 m.
Cross-sections of longer cables assigned on request.
Power cable and encoder cable are available ready-made in lengths of 2.5 m, 5.0 m, 7.5 m, 10.0 m, 12.5 m, 15.0 m, 18.0 m, 20.0 m, 25.0 m, 30.0 m.
Other lengths on request.

The following formula symbols are used in the following sections.

Formula symbols	Unit	Explanation
K_{EM}	V/rpm	Voltage constant: peak value of the induced motor voltage at a speed of 1000 rpm and a winding temperature Δϑ = 100 K (tolerance ±10 %)
n_N	rpm	Nominal speed: the speed for which the nominal torque M_N is specified

Motors EZ – convection cooling IC 410

	n_N 2000 min^{-1}			n_N 3000 min^{-1}			n_N 4500 min^{-1}			n_N 6000 min^{-1}		
	K_{EM} V/1000 min^{-1}	Connector size	Cable-cross section mm²	K_{EM} V/1000 min^{-1}	Connector size	Cable-cross section mm²	K_{EM} V/1000 min^{-1}	Connector size	Cable-cross section mm²	K_{EM} V/1000 min^{-1}	Connector size	Cable-cross section mm²
EZ301U	—	—	—	40	con.15	1.0	—	—	—	40	con.15	1.0
EZ302U	—	—	—	86	con.15	1.0	—	—	—	42	con.15	1.0
EZ303U	—	—	—	109	con.15	1.0	—	—	—	55	con.15	1.0
EZ401U	—	—	—	96	con.23	1.5	—	—	—	47	con.23	1.5
EZ402U	—	—	—	94	con.23	1.5	—	—	—	60	con.23	1.5
EZ404U	—	—	—	116	con.23	1.5	—	—	—	78	con.23	1.5
EZ501U	—	—	—	97	con.23	1.5	—	—	—	68	con.23	1.5
EZ502U	—	—	—	121	con.23	1.5	—	—	—	72	con.23	1.5
EZ503U	—	—	—	119	con.23	1.5	—	—	—	84	con.23	1.5
EZ505U	—	—	—	141	con.23	1.5	103	con.23	1.5	—	—	—
EZ701U	—	—	—	95	con.23	1.5	—	—	—	76	con.23	1.5
EZ702U	—	—	—	133	con.23	1.5	—	—	—	82	con.23	2.5
EZ703U	—	—	—	122	con.23	1.5	99	con.23	2.5	—	—	—
EZ705U	—	—	—	140	con.40	2.5	106	con.40	4.0	—	—	—
EZ802U	—	—	—	136	con.40	4.0	90	con.40	6.0	—	—	—
EZ803U	—	—	—	131	con.40	6.0	—	—	—	—	—	—
EZ805U	142	con.40	10.0	—	—	—	—	—	—	—	—	—

Motors EZ – forced ventilation IC 416

	n_N 2000 min^{-1}			n_N 3000 min^{-1}			n_N 4500 min^{-1}			n_N 6000 min^{-1}		
	K_{EM} V/1000 min^{-1}	Connector size	Cable-cross section mm²	K_{EM} V/1000 min^{-1}	Connector size	Cable-cross section mm²	K_{EM} V/1000 min^{-1}	Connector size	Cable-cross section mm²	K_{EM} V/1000 min^{-1}	Connector size	Cable-cross section mm²
EZ401B	—	—	—	96	con.23	1.5	—	—	—	47	con.23	1.5
EZ402B	—	—	—	94	con.23	1.5	—	—	—	60	con.23	1.5
EZ404B	—	—	—	116	con.23	1.5	—	—	—	78	con.23	1.5
EZ501B	—	—	—	97	con.23	1.5	—	—	—	68	con.23	1.5
EZ502B	—	—	—	121	con.23	1.5	—	—	—	72	con.23	1.5
EZ503B	—	—	—	119	con.23	1.5	—	—	—	84	con.23	2.5
EZ505B	—	—	—	141	con.23	1.5	103	con.23	1.5	—	—	—
EZ701B	—	—	—	95	con.23	1.5	—	—	—	76	con.23	1.5
EZ702B	—	—	—	133	con.23	1.5	—	—	—	82	con.23	4.0
EZ703B	—	—	—	122	con.23	2.5	99	con.23	4.0	—	—	—
EZ705B	—	—	—	140	con.40	4.0	106	con.40	6.0	—	—	—
EZ802B	—	—	—	136	con.40	6.0	90	con.40	10.0	—	—	—
EZ803B	—	—	—	131	con.40	10.0	—	—	—	—	—	—
EZ805B	142	con.58	16.0	—	—	—	—	—	—	—	—	—

Motors EZ – water cooling

	n_N 2000 min^{-1}			n_N 3000 min^{-1}			n_N 4500 min^{-1}			n_N 6000 min^{-1}		
	K_{EM} V/1000 min^{-1}	Connector size	Cable-cross section mm²	K_{EM} V/1000 min^{-1}	Connector size	Cable-cross section mm²	K_{EM} V/1000 min^{-1}	Connector size	Cable-cross section mm²	K_{EM} V/1000 min^{-1}	Connector size	Cable-cross section mm²
EZ401W	—	—	—	96	con.23	1.5	—	—	—	47	con.23	1.5
EZ402W	—	—	—	94	con.23	1.5	—	—	—	60	con.23	1.5
EZ404W	—	—	—	116	con.23	1.5	—	—	—	78	con.23	1.5
EZ501W	—	—	—	97	con.23	1.5	—	—	—	68	con.23	1.5
EZ502W	—	—	—	121	con.23	1.5	—	—	—	72	con.23	1.5
EZ503W	—	—	—	119	con.23	1.5	—	—	—	84	con.23	2.5
EZ505W	—	—	—	141	con.23	1.5	103	con.23	1.5	—	—	—
EZ701W	—	—	—	95	con.23	1.5	—	—	—	76	con.23	1.5
EZ702W	—	—	—	133	con.23	1.5	—	—	—	82	con.23	4.0
EZ703W	—	—	—	122	con.23	2.5	99	con.23	4.0	—	—	—
EZ705W	—	—	—	140	con.40	4.0	106	con.40	6.0	—	—	—
EZ802W	—	—	—	136	con.40	6.0	90	con.40	10.0	—	—	—
EZ803W	—	—	—	131	con.40	10.0	—	—	—	—	—	—
EZ805W	142	con.58	16.0	—	—	—	—	—	—	—	—	—

Motors EZHD – convection cooling IC 410

	n_N 3000 min^{-1}		
	K_{EM} V/1000 min^{-1}	Connector size	Cable-cross section mm²
EZHD0411U	96	con.23	1.5
EZHD0412U	94	con.23	1.5
EZHD0414U	116	con.23	1.5
EZHD0511U	97	con.23	1.5
EZHD0512U	121	con.23	1.5
EZHD0513U	119	con.23	1.5
EZHD0515U	141	con.23	1.5
EZHD0711U	95	con.23	1.5
EZHD0712U	133	con.23	1.5
EZHD0713U	122	con.23	1.5
EZHD0715U	140	con.40	2.5

Assignment of Motors EZHD – convection cooling IC 410

	n_N 3000 min^{-1}		
	K_{EM} V/1000 min^{-1}	Connector size	Cable-cross section mm²
EZHP_511U	97	con.23	1.5
EZHP_512U	121	con.23	1.5
EZHP_513U	119	con.23	1.5
EZHP_515U	141	con.23	1.5
EZHP_711U	95	con.23	1.5
EZHP_712U	133	con.23	1.5
EZHP_713U	122	con.23	1.5
EZHP_715U	140	con.40	2.5

Assignment of motors EZHP – water cooling

	n_N 3000 min^{-1}		
	K_{EM} V/1000 min^{-1}	Connector size	Cable-cross section mm²
EZHP_511W	97	con.23	1.5
EZHP_512W	121	con.23	1.5
EZHP_513W	119	con.23	1.5
EZHP_515W	141	con.23	1.5
EZHP_711W	95	con.23	1.5
EZHP_712W	133	con.23	1.5
EZHP_713W	122	con.23	2.5
EZHP_715W	140	con.40	4.0

Assignment of Motors EZS – convection cooling IC 410

	n_N 3000 min^{-1}		
	K_{EM} V/1000 min^{-1}	Connector size	Cable-cross section mm²
EZS501U	97	con.23	1.5
EZS502U	121	con.23	1.5
EZS503U	119	con.23	1.5
EZS701U	95	con.23	1.5
EZS702U	133	con.23	1.5
EZS703U	122	con.23	1.5

Assignment of Motors EZS – forced ventilation IC 416

	n_N 3000 min^{-1}		
	K_{EM} V/1000 min^{-1}	Connector size	Cable-cross section mm²
EZS501B	97	con.23	1.5
EZS502B	121	con.23	1.5
EZS503B	119	con.23	1.5
EZS701B	95	con.23	1.5
EZS702B	133	con.23	1.5
EZS703B	122	con.23	2.5

Assignment of motors EZS – water cooling

	n_N 3000 min^{-1}		
	K_{EM} V/1000 min^{-1}	Connector size	Cable-cross section mm²
EZS501W	97	con.23	1.5
EZS502W	121	con.23	1.5
EZS503W	119	con.23	1.5
EZS701W	95	con.23	1.5
EZS702W	133	con.23	1.5
EZS703W	122	con.23	2.5

Assignment of Motors EZM – convection cooling IC 410

	n_N 3000 min^{-1}		
	K_{EM} V/1000 min^{-1}	Connector size	Cable-cross section mm²
EZM511U	97	con.23	1.5
EZM512U	121	con.23	1.5
EZM513U	119	con.23	1.5
EZM711U	95	con.23	1.5
EZM712U	133	con.23	1.5
EZM713U	122	con.23	1.5

Assignment of motors EZM – water cooling

	n_N 3000 min^{-1}		
	K_{EM} V/1000 min^{-1}	Connector size	Cable-cross section mm²
EZM511W	97	con.23	1.5
EZM512W	121	con.23	1.5
EZM513W	119	con.23	1.5
EZM711W	95	con.23	1.5
EZM712W	133	con.23	1.5
EZM713W	122	con.23	2.5

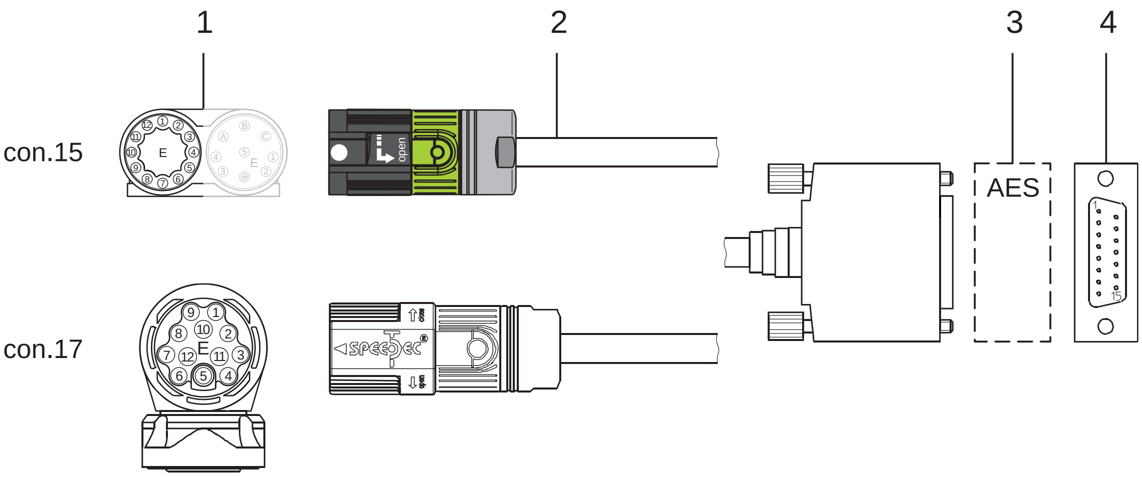
7.3 Encoder cable

STOBER motors are equipped with encoder systems as standard.

The following sections describe the individual encoder systems, plug connectors and signal assignments for connecting to STOBER drive controllers.

7.3.1 Encoder EnDat 2.1/2.2 digital

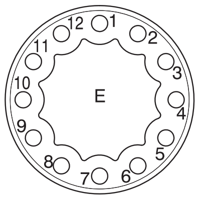
Suitable encoder cables are described below.



1	Bracket flange socket motor
2	STOBER encoder cable
3	Absolute Encoder Support (AES)
4	Sub-D (X4)

Encoder cable – plug connector con.15

The voltage supply is buffered for the inductive EnDat 2.2 digital encoders "EBI 1135" and "EBI 135" with multiturn function. In this case, pin 2 and pin 3 are assigned to the backup battery $U_{2\text{-}BAT}$. Note that the encoder cable must not be connected to X4 of the drive controller but to the battery module AES for these encoders.

Bracket flange socket – Motor	Pin	Designation	Wire colors		Sub-D (X4)
			Motor int.	Encoder	Pin
	1	Clock+	VT	YE	8
	2	Sense	BU	PK	12
		U_{2BAT+}[4]			
	3	—	WH	GY	3
		U_{2BAT-}[5]			
	4	—	—	—	—
	5	Data-	PK	BN	13
	6	Data+	GY	WH	5
	7	—	—	—	—
	8	Clock-	YE	GN	15
	9	—	—	—	—
	10	GND	WH/GN	BU	2
	11	—	—	—	—
	12	U_2	BN/GN	RD	4
	Housing	Shield			

Tab. 10: Encoder cable pin assignment con.15

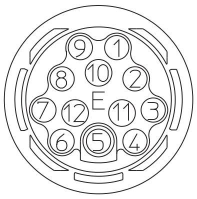
Length [mm]	Diameter [mm]
42	18.7

Tab. 11: Dimensions con. 15

[4] Only relevant for EBI encoders.
[5] Only relevant for EBI encoders.

Encoder cable – plug connector con.17

The voltage supply is buffered for the inductive EnDat 2.2 digital encoders "EBI 1135" and "EBI 135" with multiturn function. In this case, pin 2 and pin 3 are assigned to the backup battery $U_{2\text{-}BAT}$. Note that the encoder cable must not be connected to X4 of the drive controller but to the battery module AES for these encoders.

Bracket flange socket – Motor	Pin	Designation	Wire colors		Sub-D (X4)
			Motor int.	Encoder	Pin
	1	Clock+	VT	YE	8
	2	Sense	BU	PK	12
		U_{2BAT+}[6]			
	3	—	WH	GY	3
		U_{2BAT-}[7]			
	4	—	—	—	—
	5	Data-	PK	BN	13
	6	Data+	GY	WH	5
	7	—	—	—	—
	8	Clock-	YE	GN	15
	9	—	—	—	—
	10	GND	WH/GN	BU	2
	11	—	—	—	—
	12	U_2	BN/GN	RD	4
	Housing	Shield			

Tab. 12: Encoder cable pin assignment con.17

Length [mm]	Diameter [mm]
56	22

Tab. 13: Dimensions – connector size con.17

BK	BLACK	PK	PINK
BN	BROWN	RD	RED
BU	BLUE	VT	VIOLET
GN	GREEN	WH	WHITE
GY	GREY	YE	YELLOW
OG	ORANGE		

Tab. 14: Cable color – key

[6] Only relevant for EBI encoders.
[7] Only relevant for EBI encoders.

7.3.1.1 Technical data

Conductor material

Ultra-fine conductor made of bare Cu wires based on DIN VDE 0812;
Single wire 0.11 mm with nominal cross-section of 0.14 and 0.25 mm²;
Internal structure stranded tension-free

Peak operating voltage

Peak operating voltage (DIN VDE): control conductors max. 350 V
Voltage (UL / CSA): control conductors max. 300 V

Test voltage

Conductor/conductor 2000 V_{eff}
Conductor/shield 1200 V_{eff}

Current carrying capacity

As per DIN VDE 0891, part 1

Insulation resistance at 20 °C

Min. 100 MΩ × km

Limit temperature

Temperature range / operation mode	DIN VDE
Not in motion	-30 °C to +90 °C
In motion	-30 °C to +90 °C

Max. tensile stress when being laid

50 N for each mm² of conductor cross-section

Smallest permissible bending radius

Free to move 10 x d_{out}
Permanently installed 5 × d_{out}

Torsional stress

± 30°/m

Bending resistance

Trailable with 5 million bending cycles up to 180 m/min travel speed and 5 m/s² acceleration under optimum ambient conditions

Resistance

Oil resistant: very good as per VDE 0282, part 10+HD 22.10
Chemical: good against acids, bases, solvents, hydraulic fluids, etc.;
For more detailed information see the cable manufacturer's lists of materials

Outer sheath

PUR (TMPU as per DIN VDE 0282, part 10)

Banding

Fleece tape with overlapping

Conductor insulation

PP, thermoplastic plastic based on polypropylene, fulfills 9YI1 in accordance with DIN VDE 0207 part 7

Conductor identification

Pair	Colors	
2 × 0.14	YE	GN
2 × 0.14	BN	WH
2 × 0.14	PK	GY
2 × 0.25	BU	RD

Sheath: color: Desina GREEN similar to RAL 6018, imprinted with "STOBER 49484"

Shield structure

Shield: copper braiding, tinned
Cover: ≥ 90 %

Insulation material

Halogen-free, silicone-free, PWIS non-critical (PWIS = free of paint-wetting impairment substances)

Flammability

Combustion behavior: flame retarding and self-extinguishing in accordance with IEC 60322-1, CSA FT1 and UL FT1

Conductor cross-sections

Cable diameter	Description
Max. 8.5 mm	(3 x 2 x 0.14 mm^2 + 2 x 0.25 mm^3)

"(...)" = shield

Design

UL/CSA (E172204)

Capacitance, inductance

Capacitance as per VDE 0472 part 504 test type A; conductor/conductor[8]	
Pair 0.14 mm^2	Max. 30 nF/km
Pair 0.25 mm^2	Max. 35 nF/km

Capacitance as per VDE 0472 part 504 test type B; conductor/remainder[9]	
Pair 0.14 mm^2	Max. 110 nF/km
Pair 0.25 mm^2	Max. 130 nF/km

Inductance as per EN 50289-1-12:2005; conductor/conductor	
Pair 0.14 mm^2	Max. 800 µH/km
Pair 0.25 mm^2	Max. 800 µH/km

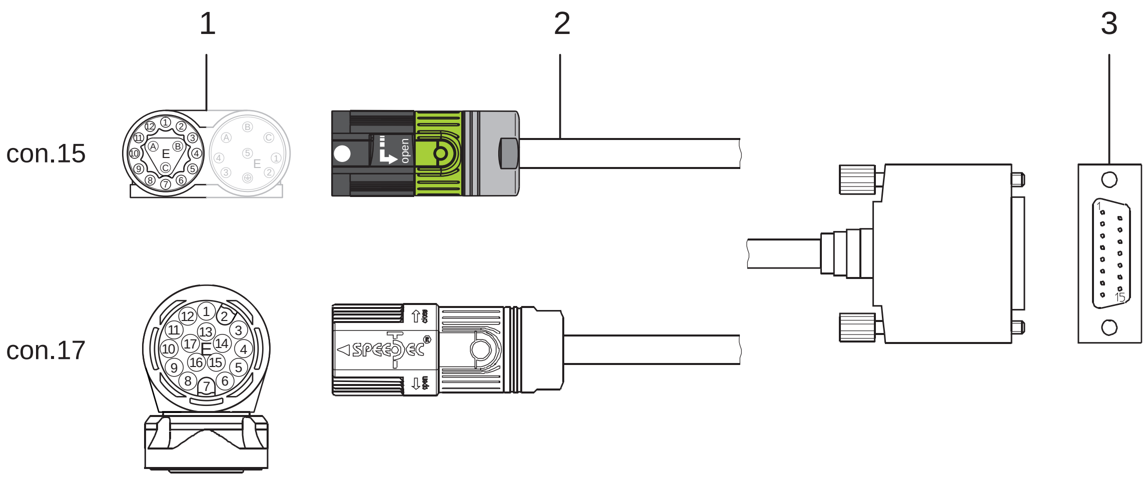
[8] Details as per EN 50289-1-5:2001 in preparation
[9] Details as per EN 50289-1-5:2001 in preparation

STOBER

7.3.2 Encoder EnDat 2.1 sin/cos

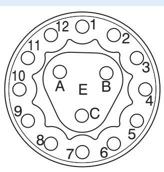
CAB

Suitable encoder cables are described below.



1:	Bracket flange socket motor
2:	STOBER encoder cable
4:	Sub-D (X140)

Encoder cable – plug connector con.15

Motor Angle flange socket	Pin	Designation	Wire colors Motor int.	Wire colors Encoder	Sub-D (X140) Pin
	1	Sense+	BU	GN/RD	12
	2	Sense-	WH	GN/BK	10
	3	U_2	BN/GN	BN/RD	4
	4	Clock+	VT	WH/BK	8
	5	Clock-	YE	WH/YE	15
	6	GND	WH/GN	BN/BU	2
	7	B+ (Sin+)	BU/BK	RD	9
	8	B- (Sin-)	RD/BK	OG	1
	9	Data+	GY	GY	5
	10	A+ (Cos+)	GN/BK	GN	11
	11	A- (Cos-)	YE/BK	YE	3
	12	Data-	PK	BU	13
	A	—	—	—	—
	B	—	—	—	—
	C	—	—	—	—
	Housing	Shield			

Tab. 15: Encoder cable pin assignment con.15

Length [mm]	Diameter [mm]
42	18.7

Tab. 16: Dimensions con. 15

Encoder cable – plug connector con.17

Motor Angle flange socket	Pin	Designation	Wire colors Motor int.	 Encoder	Sub-D (X140) Pin
	1	Sense+	BU	GN/RD	12
	2	—	—	—	—
	3	—	—	—	—
	4	Sense-	WH	GN/BK	10
	5	—	—	—	—
	6	—	—	—	—
	7	U_2	BN/GN	BN/RD	4
	8	Clock+	VT	WH/BK	8
	9	Clock-	YE	WH/YE	15
	10	GND	WH/GN	BN/BU	2
	11	—	—	—	—
	12	B+ (Sin+)	BU/BK	RD	9
	13	B- (Sin-)	RD/BK	OG	1
	14	Data+	GY	GY	5
	15	A+ (Cos+)	GN/BK	GN	11
	16	A- (Cos-)	YE/BK	YE	3
	17	Data-	PK	BU	13
	Housing	Shield			

Tab. 17: Encoder cable pin assignment con.17

Length [mm]	Diameter [mm]
56	22

Tab. 18: Dimensions – connector size con.17

BK	BLACK	PK	PINK
BN	BROWN	RD	RED
BU	BLUE	VT	VIOLET
GN	GREEN	WH	WHITE
GY	GREY	YE	YELLOW
OG	ORANGE		

Tab. 19: Cable color – key

7.3.2.1 Technical data

Conductor material

Ultra-fine conductor made of bare Cu wires based on DIN VDE 0812;
Single wire Ø ≤ 0.11 mm with nominal cross-section of 0.14 and 0.25 mm²;
Single wire Ø ≤ 0.16 mm with nominal cross-section of 0.34 mm²;
Internal structure stranded tension-free

Peak operating voltage

Peak operating voltage (DIN VDE): control conductors max. 100 V
Voltage (UL / CSA): control conductors max. 30 V

Test voltage

Conductor/conductor 500 V_{eff}
Conductor/shield 500 V_{eff}

Current carrying capacity

As per DIN VDE 0891, part 1

Insulation resistance at 20 °C

Min. 100 MΩ × km

Limit temperature

Temperature range/operation mode	DIN VDE	UL/CSA
Not in motion	-50 °C to +90 °C	up to +80 °C
In motion	-40 °C to +90 °C	up to +80 °C
Briefly on the conductor	120 °C	

Max. tensile stress when being laid

50 N for each mm² of conductor cross-section

Smallest permissible bending radius

Free to move 10 x d_{out}
Permanently installed 5 × d_{out}

Torsional stress

± 30°/m

Bending resistance

Trailable with 5 million bending cycles up to 180 m/min travel speed and 5 m/s² acceleration under optimum ambient conditions

Resistance

Oil resistant: very good as per VDE 0282, part 10+HD 22.10
Chemical: good against acids, bases, solvents, hydraulic fluids, etc.;
For more detailed information see the cable manufacturer's lists of materials

Outer sheath

PUR (TMPU as per DIN VDE 0282, part 10)

Banding

Fleece tape with overlapping

Conductor insulation

TPE-E

Conductor identification

Pair	Colors	
2 × 0.14	GN	YE
2 × 0.14	RD	OG
2 × 0.14	BU	GY
2 × 0.14	WH/BK	WH/YE
2 × 0.25	GN/RD	GN/BK
2 × 0.25	BN/GN	BN/YE
2 × 0.34	BN/RD	BN/BU

Sheath: color Desina GREEN, similar to RAL 6018, imprinted with "STOBER 44207" without supplier article number

Shield structure

Shield: copper braiding, tinned
Pairs: copper braiding, tinned
Cover: ≥ 80 %

Insulation material

Halogen-free, silicone-free, PWIS non-critical (PWIS = free of paint-wetting impairment substances)

Flammability

Combustion behavior: flame retarding and self-extinguishing in accordance with IEC 60322-1, CSA FT1 and UL FT1

Conductor cross-sections

Cable diameter	Description
Max. 13.0 mm	(2 x 2 x 0.25 mm² + 2 x 2 x 0.14 mm² + 2 x (2 x 0.14 mm²) + 2 x 0.34 mm²)

"(...)" = shield

Design

UL/CSA (E172204)

Capacitance, inductance

Capacitance as per VDE 0472 part 504 test type A; conductor/conductor[10]	
Pair 0.14 mm²	Max. 60 nF/km
Pair 0.25 mm²	Max. 110 nF/km
Pair 0.37 mm²	Max. 130 nF/km

[10] Details as per EN 50289-1-5:2001 in preparation

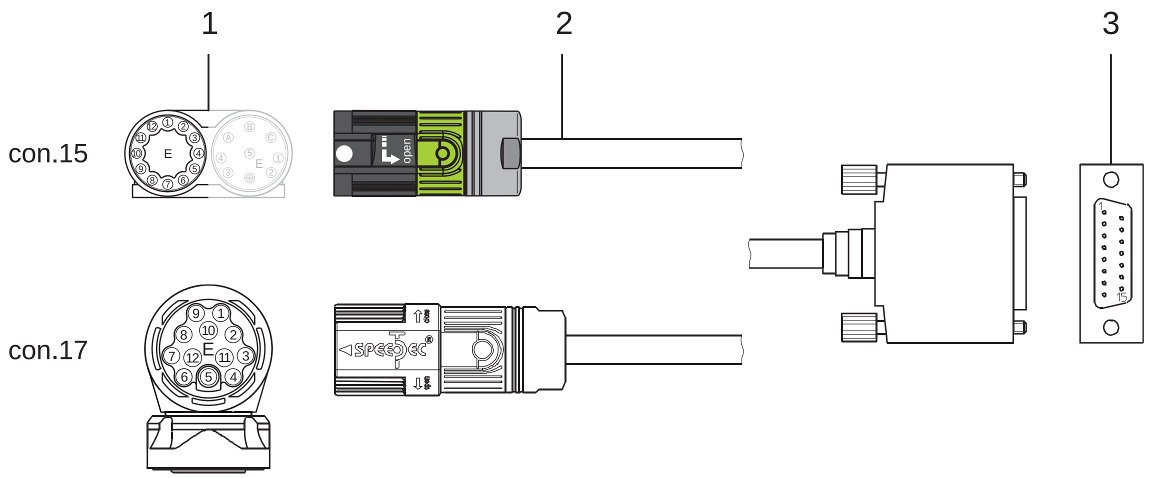
Capacitance as per VDE 0472 part 504 test type B; conductor/remainder[11]	
Pair 0.14 mm²	Max. 300 nF/km
Pair 0.25 mm²	Max. 300 nF/km
Pair 0.37 mm²	Max. 325 nF/km

Inductance based on EN 50289-1-12:2005; conductor/conductor	
Pair 0.14 mm²	Max. 650 µH/km
Pair 0.25 mm²	Max. 700 µH/km
Pair 0.37 mm²	Max. 700 µH/km

[11] Details as per EN 50289-1-5:2001 in preparation

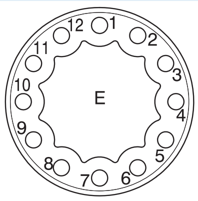
7.3.3 Resolver

Suitable resolver cables are described below.



1	Bracket flange socket motor
2	STOBER encoder cable
3	Sub-D (X4/X140)

Encoder cable – plug connector con.15

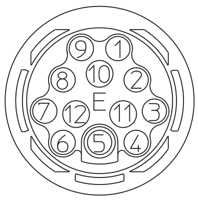
Bracket flange socket – Motor	Pin	Designation	Wire colors		Sub-D (X4/ X140)
			Motor int.	Encoder	Pin
	1	S3 Cos+	VT	YE	3
	2	S1 Cos-	BU	GN	11
	3	S2 Sin+	WH	WH	1
	4	S2 Sin-	YE	BN	9
	5	—	—	—	Do not con- nect
	6	—	—	—	Do not con- nect
	7	R1 Ref+	YE/WH	GY	6
	8	R1 Ref-	RD/WH	PK	2
	9	—	—	—	—
	10	—	—	—	—
	11	—	—	—	—
	12	—	—	—	—
	Housing	Shield			

Tab. 20: Encoder cable pin assignment con.15

Length [mm]	Diameter [mm]
42	18.7

Tab. 21: Dimensions con. 15

Encoder cable – plug connector con.17

Bracket flange socket – Motor	Pin	Designation	Wire colors		Sub-D (X4/ X140)
			Motor int.	Encoder	Pin
	1	S3 Cos+	BK	YE	3
	2	S1 Cos-	RD	GN	11
	3	S4 Sin+	BU	WH	1
	4	S2 Sin-	YE	BN	9
	5	—	—	—	Do not connect
	6	—	—	—	Do not connect
	7	R2 Ref+	YE/WH	GY	6
	8	R1 Ref-	RD/WH	PK	2
	9	—	—	—	—
	10	—	—	—	—
	11	—	—	—	—
	12	—	—	—	—
	Housing	Shield			

Tab. 22: Encoder cable pin assignment con.17

Length [mm]	Diameter [mm]
56	22

Tab. 23: Dimensions – connector size con.17

BK	BLACK	PK	PINK
BN	BROWN	RD	RED
BU	BLUE	VT	VIOLET
GN	GREEN	WH	WHITE
GY	GREY	YE	YELLOW
OG	ORANGE		

Tab. 24: Cable color – key

7.3.3.1 Technical data

Conductor material

Ultra-fine conductor made of bare Cu wires based on DIN VDE 0812;
Single wire 0.11 mm with nominal cross-section of 0.14 and 0.25 mm²;
Internal structure stranded tension-free

Peak operating voltage

Peak operating voltage (DIN VDE): control conductors max. 350 V;
Voltage (UL / CSA): control conductors max. 300 V

Test voltage

Conductor/conductor 2000 V_{eff}
Conductor/shield 1200 V_{eff}

Current carrying capacity

As per DIN VDE 0891, part 1

Insulation resistance at 20 °C

Min. 100 MΩ × km

Limit temperature

Temperature range/operation mode	DIN VDE	UL / CSA
Not specified	—	Up to +80 °C
Not in motion	-50 °C to +90 °C	—
In motion	-40 °C to +90 °C	—
Briefly on the conductor	120 °C	—

Max. tensile stress when being laid

50 N for each mm² of conductor cross-section

Smallest permissible bending radius

Free to move 10 x d_{out}
Permanently installed 5 × d_{out}

Torsional stress

± 30°/m

Bending resistance

Trailable with 5 million bending cycles up to 180 m/min travel speed and 5 m/s² acceleration under optimum ambient conditions

Resistance

Oil resistant: very good as per VDE 0282, part 10+HD 22.10
Chemical: good against acids, bases, solvents, hydraulic fluids, etc.;
For more detailed information see the cable manufacturer's lists of materials

Outer sheath

PUR (TMPU as per DIN VDE 0282, part 10)

CAB

Banding

Fleece tape with overlapping

Conductor insulation

TPE-E

Conductor identification

Pair	Colors	
2 × 0.14	YE	GN
2 × 0.14	BN	WH
2 × 0.14	PK	GY
2 × 0.25	BU	RD

Sheath: color: Desina GREEN similar to RAL 6018, imprinted with "STOBER 44206"

Shield structure

Shield: copper braiding, tinned
Cover: ≥ 80 %
Pairs: with shielding film and braiding

Insulation material

Halogen-free, silicone-free, PWIS non-critical (PWIS = free of paint-wetting impairment substances)

Flammability

Combustion behavior: flame retarding and self-extinguishing in accordance with IEC 60322-1, CSA FT1 and UL FT1

Conductor cross-sections

Cable diameter	Description
Max. 11.4 mm	(3 × (2 × 0.14 mm²) + (2 × 0.25 mm²))

”(...)” = shield

Design

UL/CSA (E172204)

Capacitance, inductance

Capacitance as per VDE 0472 part 504 test type A; conductor/conductor[12]	
Pair 0.14 mm²	Max. 40 nF/km
Pair 0.25 mm²	Max. 50 nF/km

Capacitance as per VDE 0472 part 504 test type B; conductor/remainder[13]	
Pair 0.14 mm²	Max. 300 nF/km
Pair 0.25 mm²	Max. 300 nF/km

Inductance based on EN 50289-1-12:2005; conductor/conductor	
Pair 0.14 mm²	Max. 800 µH/km
Pair 0.25 mm²	Max. 800 µH/km

[12] Details as per EN 50289-1-5:2001 in preparation
[13] Details as per EN 50289-1-5:2001 in preparation

8 EZ synchronous servo motors

Table of contents

8.1 Overview

Synchronous servo motors with single tooth winding

Torques of motors with convection cooling

M_N	0.89 – 43.7 Nm
M_0	1 – 66.1 Nm

Torques of motors with forced ventilation

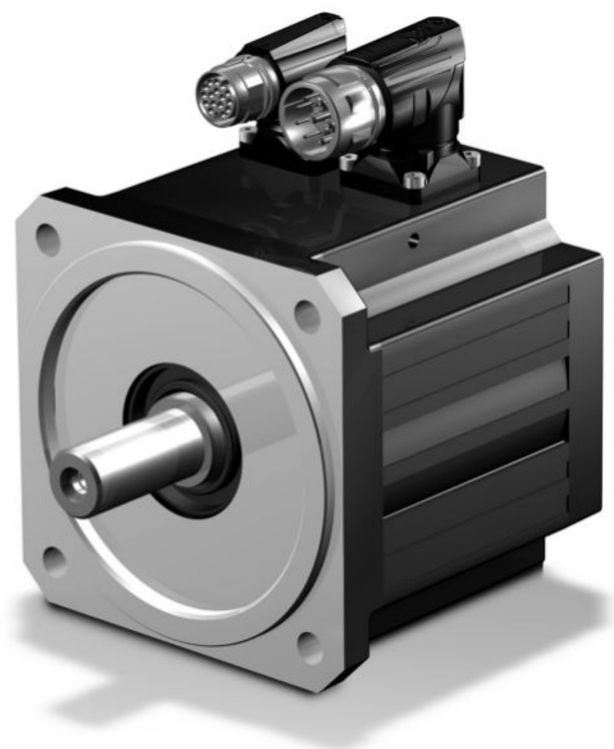
M_N	2.9 – 77.2 Nm
M_0	3.5 – 94 Nm

Torques of motors with water cooling

M_N	2.6 – 72.1 Nm
M_0	3.4 – 90.1 Nm

Features

Highly dynamic (increased mass moment of inertia optionally available)	✓
Short length	✓
Super compact due to tooth winding technology with the highest possible copper fill factor	✓
Backlash-free holding brake (optional)	✓
Electronic nameplate for fast and reliable commissioning	✓
Convection cooling, forced ventilation (optional) or water cooling (optional)	✓
Optical, inductive EnDat absolute value encoder or resolver	✓
Multiturn absolute value encoders (optional) eliminate the need for referencing	✓
Rotating plug connectors with quick lock	✓



8.2 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
EZ3 − EZ5	23 x 210 x 275 mm	0.16 m^2
EZ7 − EZ8	28 x 300 x 400 mm	0.3 m^2

Note the differing ambient conditions in section [▷ 8.7.3]

Formula symbols	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_{dyn}	10^{-4}kgm^2	Mass moment of inertia of a motor in the dynamic version
ΔJ	kgm^2	Additive mass moment of inertia of a motor with increased 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_{dyn}	kg	Weight of a motor in the dynamic version
Δm	kg	Additive weight of a motor with increased mass moment of inertia
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

STOBER

Formula symbols	Unit	Explanation
n_N	rpm	Nominal speed: the speed for which the nominal torque M_N is specified
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

EZ

8.2.1 EZ motors with convection cooling

Type	K_{EM} [V/1000 min⁻¹]	n_N [min⁻¹]	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_{dyn} [10^{-4} kgm²]	m_{dyn} [kg]
EZ301U	40	6000	0.89	1.93	0.46	0.56	0.95	2.02	0.49	0.04	2.80	12.7	11.70	39.80	3.40	0.19	1.50
EZ301U	40	3000	0.93	1.99	0.47	0.29	0.95	2.02	0.49	0.04	2.80	12.7	11.70	39.80	3.40	0.19	1.50
EZ302U	42	6000	1.50	3.18	0.47	0.94	1.68	3.48	0.49	0.04	5.00	17.8	4.50	18.70	4.16	0.29	2.10
EZ302U	86	3000	1.59	1.60	0.99	0.50	1.68	1.67	1.03	0.04	5.00	8.55	17.80	75.00	4.21	0.29	2.10
EZ303U	55	6000	1.96	3.17	0.62	1.2	2.25	3.55	0.65	0.04	7.00	16.9	4.90	21.10	4.31	0.40	2.60
EZ303U	109	3000	2.07	1.63	1.27	0.65	2.19	1.71	1.30	0.04	7.00	8.25	13.10	68.70	5.24	0.40	2.60
EZ401U	47	6000	2.30	4.56	0.50	1.4	2.80	5.36	0.53	0.04	8.50	33.0	1.94	11.52	5.94	0.93	4.00
EZ401U	96	3000	2.80	2.74	1.02	0.88	3.00	2.88	1.06	0.04	8.50	16.5	6.70	37.70	5.63	0.93	4.00
EZ402U	60	6000	3.50	5.65	0.62	2.2	4.90	7.43	0.66	0.04	16.0	43.5	1.20	8.88	7.40	1.63	5.10
EZ402U	94	3000	4.70	4.40	1.07	1.5	5.20	4.80	1.09	0.04	16.0	26.5	3.00	21.80	7.26	1.63	5.10
EZ404U	78	6000	5.80	7.18	0.81	3.6	8.40	9.78	0.86	0.04	29.0	51.0	0.89	7.07	7.94	2.98	7.20
EZ404U	116	3000	6.90	5.80	1.19	2.2	8.60	6.60	1.31	0.04	29.0	35.0	1.85	15.00	8.11	2.98	7.20
EZ501U	68	6000	3.40	4.77	0.71	2.1	4.40	5.80	0.77	0.06	16.0	31.0	2.10	12.10	5.76	2.90	5.00
EZ501U	97	3000	4.30	3.74	1.15	1.4	4.70	4.00	1.19	0.06	16.0	22.0	3.80	23.50	6.18	2.90	5.00
EZ502U	72	6000	5.20	7.35	0.71	3.3	7.80	9.80	0.80	0.06	31.0	59.0	0.76	5.60	7.37	5.20	6.50
EZ502U	121	3000	7.40	5.46	1.36	2.3	8.00	5.76	1.40	0.06	31.0	33.0	2.32	16.80	7.24	5.20	6.50
EZ503U	84	6000	6.20	7.64	0.81	3.9	10.6	11.6	0.92	0.06	43.0	63.5	0.62	5.00	8.06	7.58	8.00
EZ503U	119	3000	9.70	6.90	1.41	3.1	11.1	7.67	1.46	0.06	43.0	41.0	1.25	10.00	8.00	7.58	8.00
EZ505U	103	4500	9.50	8.94	1.06	4.5	15.3	13.4	1.15	0.06	67.0	73.0	0.50	4.47	8.94	12.2	10.9
EZ505U	141	3000	13.5	8.80	1.53	4.2	16.0	10.0	1.61	0.06	67.0	52.0	0.93	8.33	8.96	12.2	10.9
EZ701U	76	6000	5.20	6.68	0.78	3.3	7.90	9.38	0.87	0.24	20.0	31.0	0.87	8.13	9.34	8.50	8.30
EZ701U	95	3000	7.40	7.20	1.03	2.3	8.30	8.00	1.07	0.24	20.0	25.0	1.30	12.83	9.87	8.50	8.30
EZ702U	82	6000	7.20	8.96	0.80	4.5	14.3	16.5	0.88	0.24	41.0	60.5	0.34	3.90	11.47	13.7	10.8
EZ702U	133	3000	12.0	8.20	1.46	3.8	14.4	9.60	1.53	0.24	41.0	36.0	1.00	11.73	11.73	13.7	10.8
EZ703U	99	4500	12.1	11.5	1.05	5.7	20.0	17.8	1.14	0.24	65.0	78.0	0.36	4.42	12.28	21.6	12.8
EZ703U	122	3000	16.5	11.4	1.45	5.2	20.8	14.0	1.50	0.24	65.0	62.0	0.52	6.80	13.08	21.6	12.8
EZ705U	106	4500	16.4	14.8	1.11	7.7	30.0	25.2	1.20	0.24	104	114	0.22	2.76	12.55	34.0	18.3
EZ705U	140	3000	21.3	14.2	1.50	6.7	30.2	19.5	1.56	0.24	104	87.0	0.33	4.80	14.55	34.0	18.3
EZ802U	90	4500	10.5	11.2	0.94	5.0	34.5	33.3	1.05	0.30	100	135	0.13	1.90	14.60	58.0	26.6
EZ802U	136	3000	22.3	13.9	1.60	7.0	37.1	22.3	1.68	0.30	100	84.0	0.30	5.00	16.66	58.0	26.6
EZ803U	131	3000	26.6	17.7	1.50	8.4	48.2	31.1	1.56	0.30	145	124	0.18	2.79	15.50	83.5	32.7
EZ805U	142	2000	43.7	25.9	1.69	9.2	66.1	37.9	1.75	0.30	205	155	0.13	2.22	17.08	133	45.8

Additional values in the version with increased mass moment of inertia

Type	ΔJ [10^{-4} kgm²]	Δm [kg]
EZ301	–	–
EZ302	–	–
EZ303	–	–
EZ401	0.2	0.08
EZ402	0.4	0.15
EZ404	0.8	0.31
EZ501	–	–
EZ502	1.1	0.22
EZ503	2.0	0.43
EZ505	4.1	0.87
EZ701	–	–
EZ702	4.4	0.41
EZ703	6.3	0.81
EZ705	13.6	1.6
EZ802	14.9	1.3
EZ803	22.3	1.9
EZ805	37.2	3.2

8.2.2 EZ motors with forced ventilation

Type	K_{EM} [V/1000 min⁻¹]	n_N [min⁻¹]	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_{dyn} [10⁻⁴ kgm²]	m_{dyn} [kg]
EZ401B	47	6000	2.90	5.62	0.52	1.8	3.50	6.83	0.52	0.04	8.50	33.0	1.94	11.52	5.94	0.93	5.40
EZ401B	96	3000	3.40	3.40	1.00	1.1	3.70	3.60	1.04	0.04	8.50	16.5	6.70	37.70	5.63	0.93	5.40
EZ402B	60	6000	5.10	7.88	0.65	3.2	6.40	9.34	0.69	0.04	16.0	43.5	1.20	8.88	7.40	1.63	6.50
EZ402B	94	3000	5.90	5.50	1.07	1.9	6.30	5.80	1.09	0.04	16.0	26.5	3.00	21.80	7.26	1.63	6.50
EZ404B	78	6000	8.00	9.98	0.80	5.0	10.5	12.0	0.88	0.04	29.0	51.0	0.89	7.07	7.94	2.98	8.60
EZ404B	116	3000	10.2	8.20	1.24	3.2	11.2	8.70	1.29	0.04	29.0	35.0	1.85	15.00	8.11	2.98	8.60
EZ501B	68	6000	4.50	6.70	0.67	2.8	5.70	7.50	0.77	0.06	16.0	31.0	2.10	12.10	5.76	2.90	7.00
EZ501B	97	3000	5.40	4.70	1.15	1.7	5.80	5.00	1.17	0.06	16.0	22.0	3.80	23.50	6.18	2.90	7.00
EZ502B	72	6000	8.20	11.4	0.72	5.2	10.5	13.4	0.79	0.06	31.0	59.0	0.76	5.60	7.37	5.20	8.50
EZ502B	121	3000	10.3	7.80	1.32	3.2	11.2	8.16	1.38	0.06	31.0	33.0	2.32	16.80	7.24	5.20	8.50
EZ503B	84	6000	10.4	13.5	0.77	6.5	14.8	15.9	1.07	0.06	43.0	63.5	0.62	5.00	8.06	7.58	10.0
EZ503B	119	3000	14.4	10.9	1.32	4.5	15.9	11.8	1.35	0.06	43.0	41.0	1.25	10.00	8.00	7.58	10.0
EZ505B	103	4500	16.4	16.4	1.00	7.7	22.0	19.4	1.14	0.06	67.0	73.0	0.50	4.47	8.94	12.2	12.9
EZ505B	141	3000	20.2	13.7	1.47	6.4	23.4	14.7	1.60	0.06	67.0	52.0	0.93	8.33	8.96	12.2	12.9
EZ701B	76	6000	7.50	10.6	0.71	4.7	10.2	12.4	0.84	0.24	20.0	31.0	0.87	8.13	9.34	8.50	13.3
EZ701B	95	3000	9.70	9.50	1.02	3.1	10.5	10.0	1.07	0.24	20.0	25.0	1.30	12.83	9.87	8.50	13.3
EZ702B	82	6000	12.5	16.7	0.75	7.9	19.3	22.1	0.89	0.24	41.0	60.5	0.34	3.90	11.47	13.7	15.8
EZ702B	133	3000	16.6	11.8	1.41	5.2	19.3	12.9	1.51	0.24	41.0	36.0	1.00	11.73	11.73	13.7	15.8
EZ703B	99	4500	19.8	20.3	0.98	9.3	27.2	24.2	1.13	0.24	65.0	78.0	0.36	4.42	12.28	21.6	17.8
EZ703B	122	3000	24.0	18.2	1.32	7.5	28.0	20.0	1.41	0.24	65.0	62.0	0.52	6.80	13.08	21.6	17.8
EZ705B	106	4500	27.7	25.4	1.09	13	39.4	32.8	1.21	0.24	104	114	0.22	2.76	12.55	34.0	23.3
EZ705B	140	3000	33.8	22.9	1.48	11	41.8	26.5	1.59	0.24	104	87.0	0.33	4.80	14.55	34.0	23.3
EZ802B	90	4500	30.6	30.5	1.00	14	47.4	45.1	1.06	0.30	100	135	0.13	1.90	14.60	58.0	31.6
EZ802B	136	3000	34.3	26.5	1.29	11	47.9	28.9	1.67	0.30	100	84.0	0.30	5.00	16.66	58.0	31.6
EZ803B	131	3000	49.0	35.9	1.37	15	66.7	42.3	1.58	0.30	145	124	0.18	2.79	15.50	83.5	37.7
EZ805B	142	2000	77.2	45.2	1.71	16	94.0	53.9	1.75	0.30	205	155	0.13	2.22	17.08	133	51.8

Additional values in the version with increased mass moment of inertia

Type	ΔJ [10⁻⁴ kgm²]	Δm [kg]
EZ301	–	–
EZ302	–	–
EZ303	–	–
EZ401	0.2	0.08
EZ402	0.4	0.15
EZ404	0.8	0.31
EZ501	–	–
EZ502	1.1	0.22
EZ503	2.0	0.43
EZ505	4.1	0.87
EZ701	–	–
EZ702	4.4	0.41
EZ703	6.3	0.81
EZ705	13.6	1.6
EZ802	14.9	1.3
EZ803	22.3	1.9
EZ805	37.2	3.2

8.2.3 EZ motors with water cooling

Type	K_{EM} [V/1000 min^{-1}]	n_N [min^{-1}]	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_{dyn} [10^{-4} kgm^2]	m_{dyn} [kg]
EZ401W	47	6000	2.55	5.20	0.49	1.6	3.35	6.95	0.49	0.04	8.50	33.0	1.94	11.52	5.94	0.93	4.00
EZ401W	96	3000	3.30	3.70	0.89	1.0	3.55	3.90	0.92	0.04	8.50	16.5	6.70	37.70	5.63	0.93	4.00
EZ402W	60	6000	5.00	8.00	0.63	3.1	6.45	9.70	0.67	0.04	16.0	43.5	1.20	8.88	7.40	1.63	5.10
EZ402W	94	3000	5.85	5.50	1.06	1.8	6.35	6.00	1.07	0.04	16.0	26.5	3.00	21.80	7.26	1.63	5.10
EZ404W	78	6000	7.70	10.5	0.73	4.8	10.6	12.3	0.87	0.04	29.0	51.0	0.89	7.07	7.94	2.98	7.20
EZ404W	116	3000	10.4	8.30	1.25	3.3	11.3	8.90	1.27	0.04	29.0	35.0	1.85	15.00	8.11	2.98	7.20
EZ501W	68	6000	4.30	6.40	0.67	2.7	5.55	7.25	0.77	0.06	16.0	31.0	2.10	12.10	5.76	2.90	5.00
EZ501W	97	3000	5.40	4.75	1.14	1.7	5.65	4.85	1.18	0.06	16.0	22.0	3.80	23.50	6.18	2.90	5.00
EZ502W	72	6000	8.10	11.2	0.72	5.1	10.3	12.9	0.80	0.06	31.0	59.0	0.76	5.60	7.37	5.20	6.50
EZ502W	121	3000	10.2	7.70	1.32	3.2	11.0	7.85	1.41	0.06	31.0	33.0	2.32	16.80	7.24	5.20	6.50
EZ503W	84	6000	9.95	12.6	0.79	6.3	14.2	15.2	0.94	0.06	43.0	63.5	0.62	5.00	8.06	7.58	8.00
EZ503W	119	3000	13.5	10.2	1.32	4.2	15.2	11.3	1.35	0.06	43.0	41.0	1.25	10.00	8.00	7.58	8.00
EZ505W	103	4500	14.2	13.0	1.09	6.7	20.2	17.2	1.18	0.06	67.0	73.0	0.50	4.47	8.94	12.2	10.9
EZ505W	141	3000	17.9	11.4	1.57	5.6	21.5	13.1	1.65	0.06	67.0	52.0	0.93	8.33	8.96	12.2	10.9
EZ701W	76	6000	7.00	10.2	0.69	4.4	10.4	12.7	0.83	0.24	20.0	31.0	0.87	8.13	9.34	8.50	8.30
EZ701W	95	3000	10.2	9.95	1.03	3.2	10.4	10.0	1.06	0.24	20.0	25.0	1.30	12.83	9.87	8.50	8.30
EZ702W	82	6000	12.0	17.5	0.69	7.5	19.3	22.5	0.86	0.24	41.0	60.5	0.34	3.90	11.47	13.7	10.8
EZ702W	133	3000	17.1	12.2	1.40	5.4	19.3	13.1	1.47	0.24	41.0	36.0	1.00	11.73	11.73	13.7	10.8
EZ703W	99	4500	19.1	18.1	1.06	9.0	26.7	23.7	1.14	0.24	65.0	78.0	0.36	4.42	12.28	21.6	12.8
EZ703W	122	3000	22.5	17.0	1.32	7.1	27.5	19.6	1.42	0.24	65.0	62.0	0.52	6.80	13.08	21.6	12.8
EZ705W	106	4500	24.1	22.0	1.10	11	37.2	31.6	1.18	0.24	104	114	0.22	2.76	12.55	34.0	18.3
EZ705W	140	3000	30.3	20.5	1.48	9.5	39.4	25.4	1.56	0.24	104	87.0	0.33	4.80	14.55	34.0	18.3
EZ802W	90	4500	30.7	30.3	1.01	15	46.9	44.6	1.06	0.30	100	135	0.13	1.90	14.60	58.0	26.6
EZ802W	136	3000	32.2	26.6	1.21	10	48.9	29.6	1.66	0.30	100	84.0	0.30	5.00	16.66	58.0	26.6
EZ803W	131	3000	46.7	34.1	1.37	15	65.7	41.7	1.58	0.30	145	124	0.18	2.79	15.50	83.5	32.7
EZ805W	142	2000	72.1	42.1	1.71	15	90.1	51.9	1.74	0.30	205	155	0.13	2.22	17.08	133	46.8

Additional values in the version with increased mass moment of inertia

Type	ΔJ [10^{-4} kgm^2]	Δm [kg]
EZ301	–	–
EZ302	–	–
EZ303	–	–
EZ401	0.2	0.08
EZ402	0.4	0.15
EZ404	0.8	0.31
EZ501	–	–
EZ502	1.1	0.22
EZ503	2.0	0.43
EZ505	4.1	0.87
EZ701	–	–
EZ702	4.4	0.41
EZ703	6.3	0.81
EZ705	13.6	1.6
EZ802	14.9	1.3
EZ803	22.3	1.9
EZ805	37.2	3.2

8.3 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 symbols	Unit	Explanation
ED	%	Duty cycle relative to 10 minutes
M_{lim}	Nm	Torque limit without compensating for field weakening
M_{limF}	Nm	Torque limit of the motor with forced ventilation
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_{limW}	Nm	Torque limit of the motor with water 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

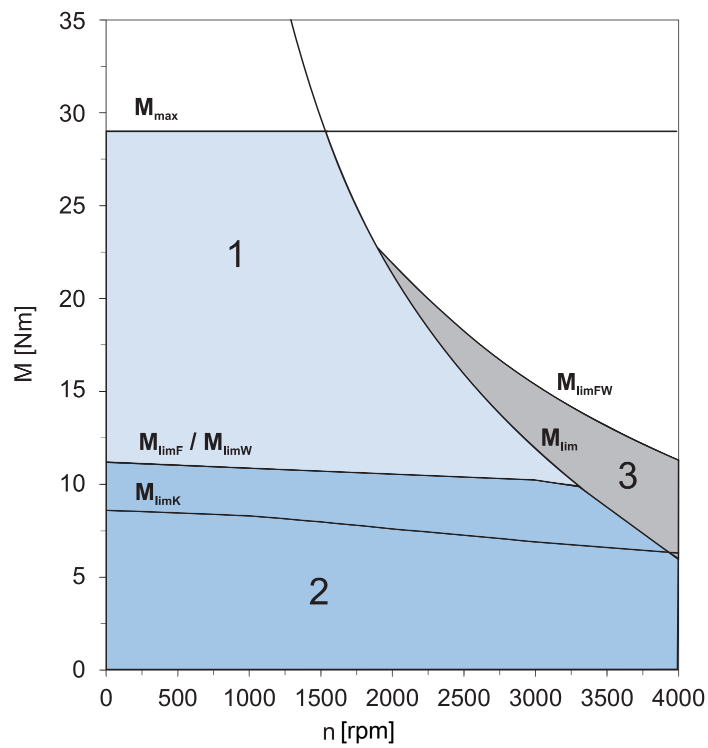
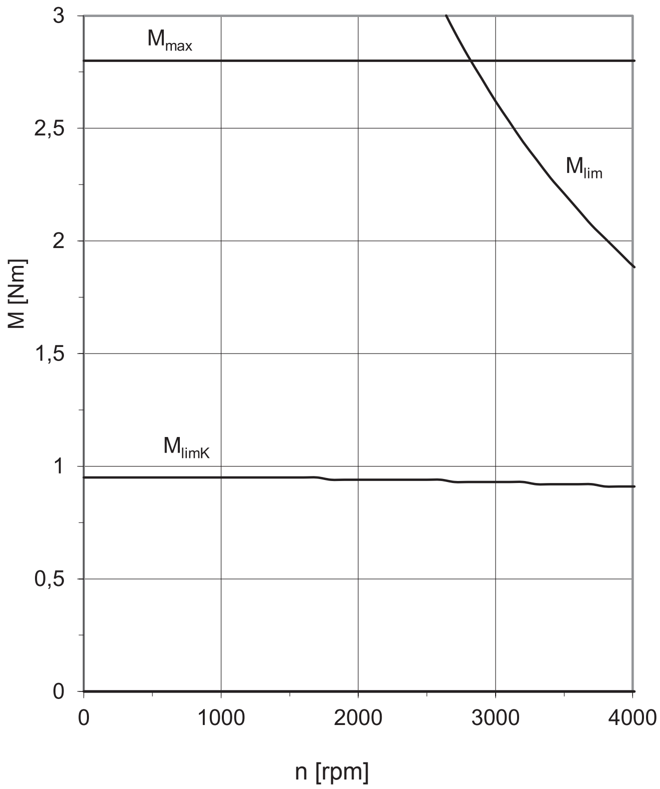


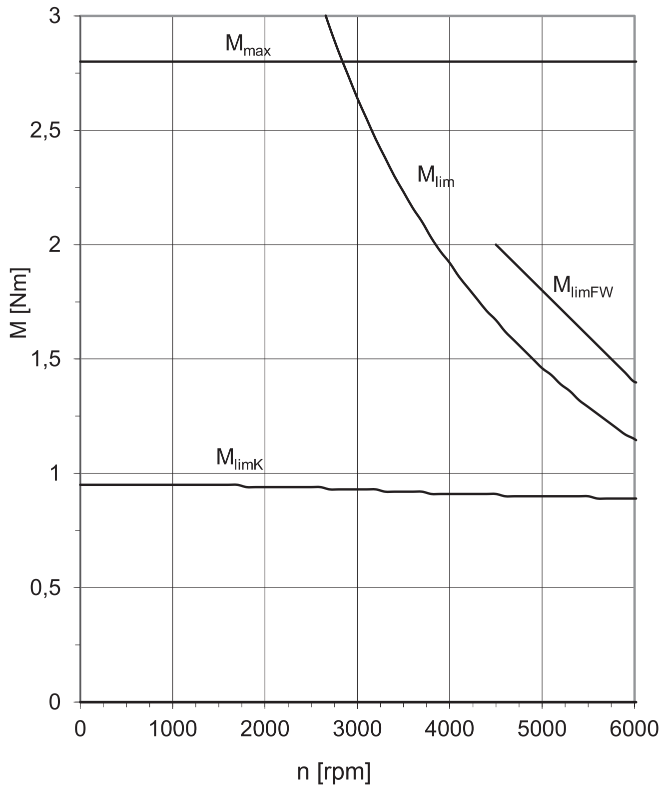
Fig. 1: Explanation of a torque/speed characteristic curve

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)		

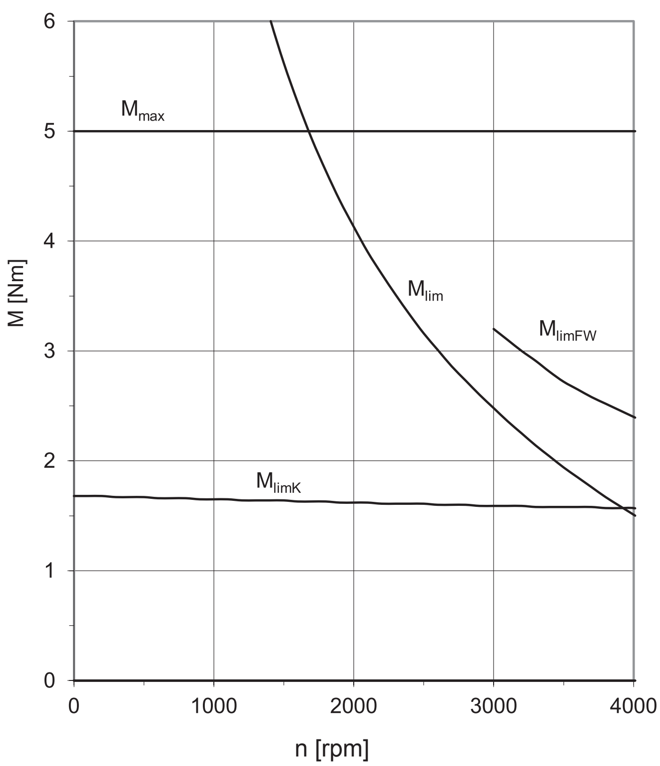
EZ301 (n_N=3000 rpm)



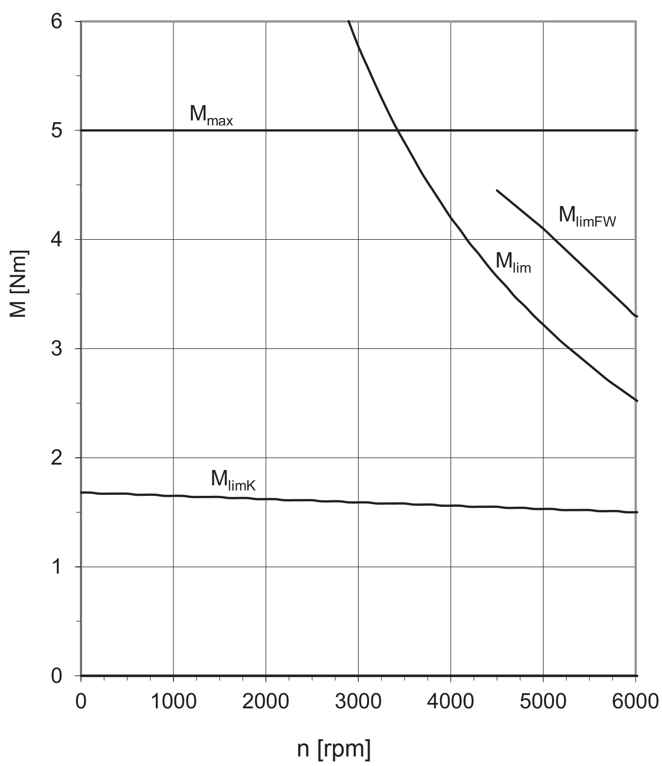
EZ301 (n_N=6000 rpm)



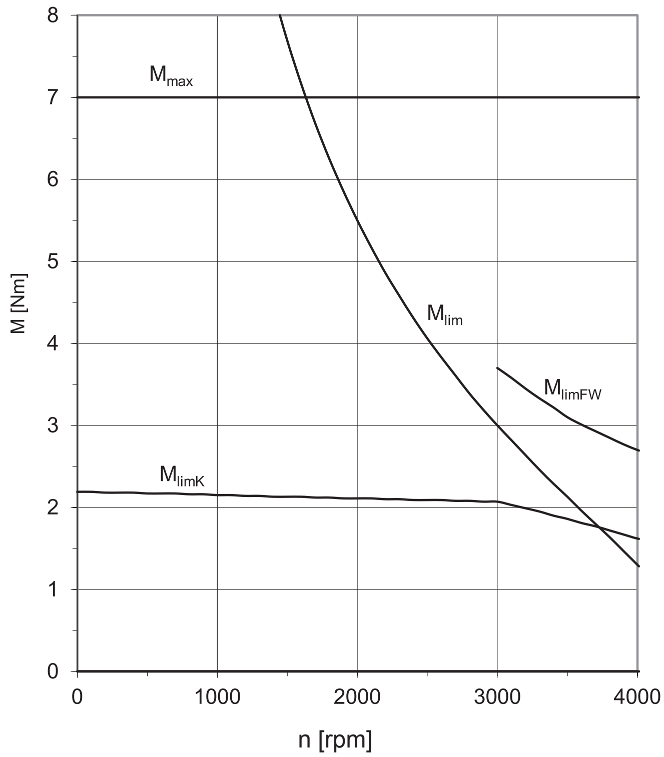
EZ302 (n_N=3000 rpm)



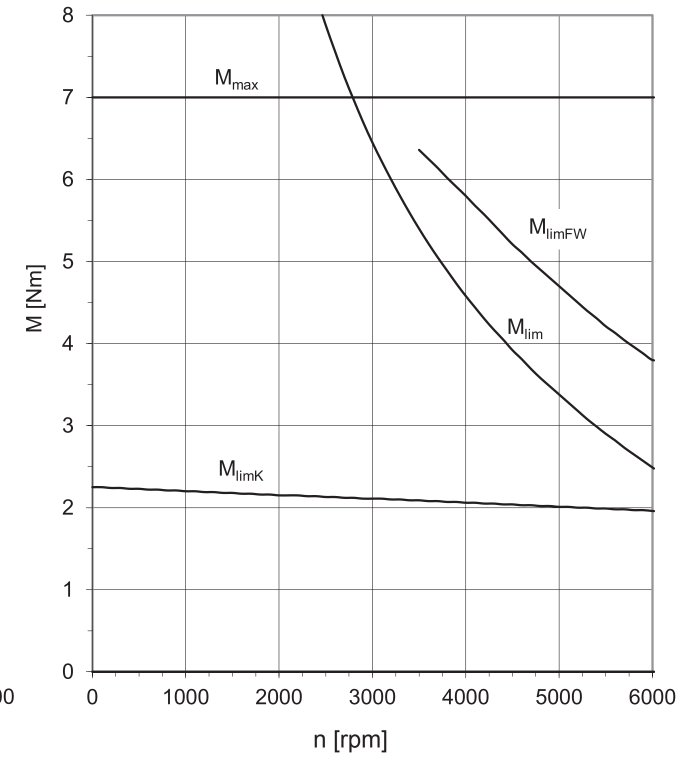
EZ302 (n_N=6000 rpm)



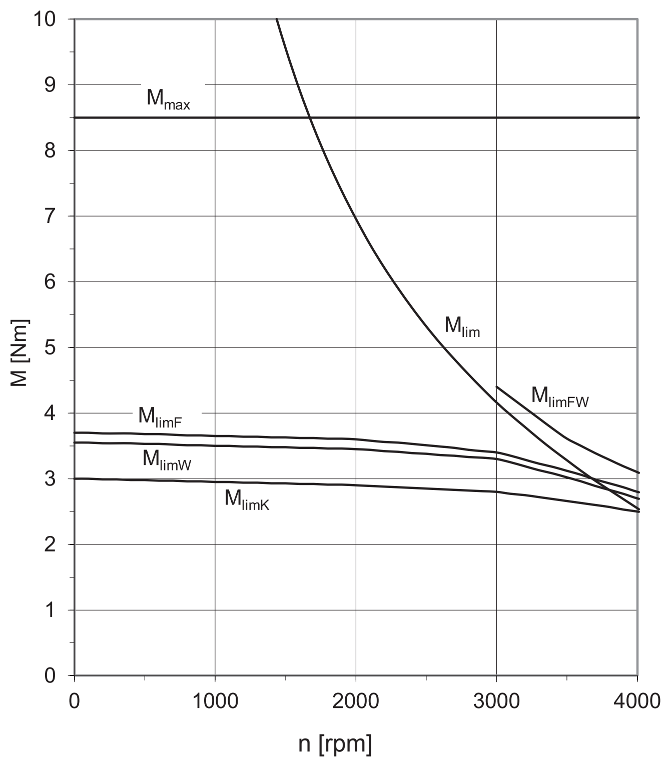
EZ303 (n_N=3000 rpm)



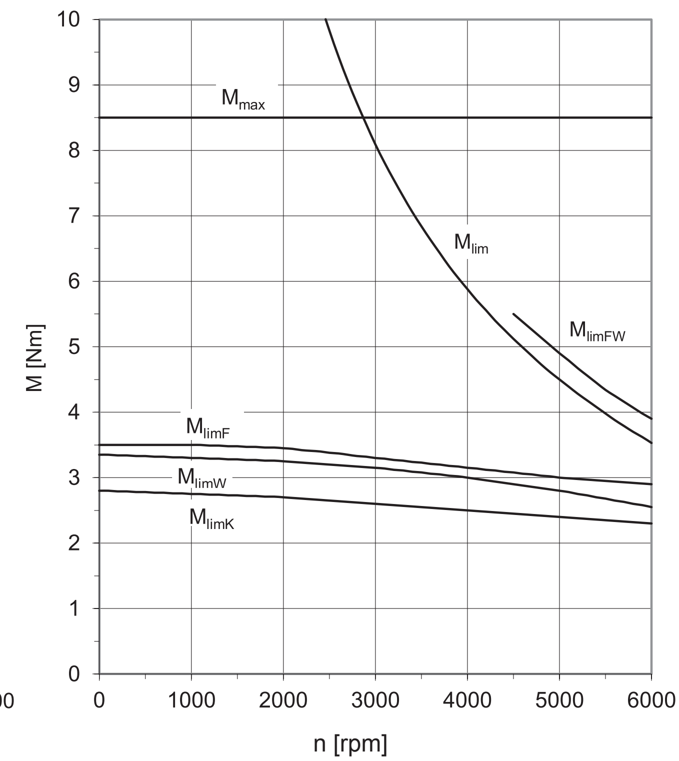
EZ303 (n_N=6000 rpm)



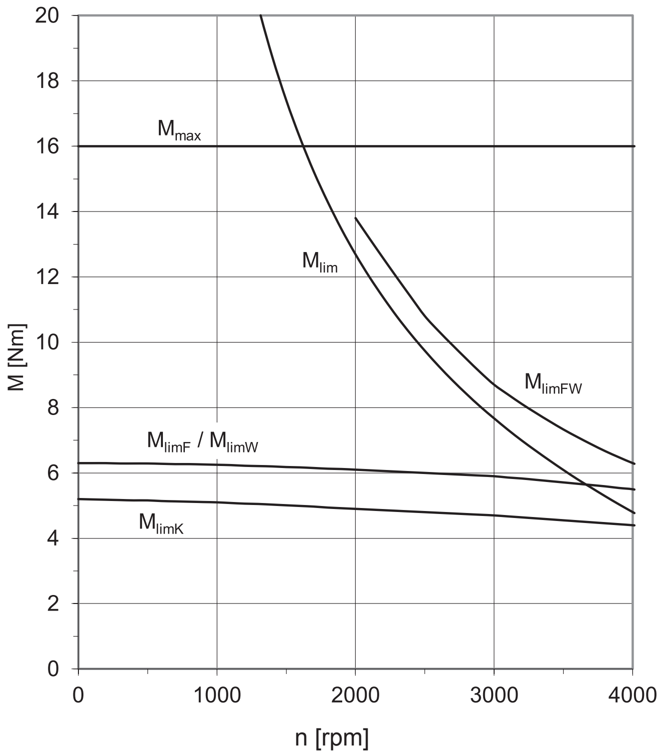
EZ401 (n_N=3000 rpm)



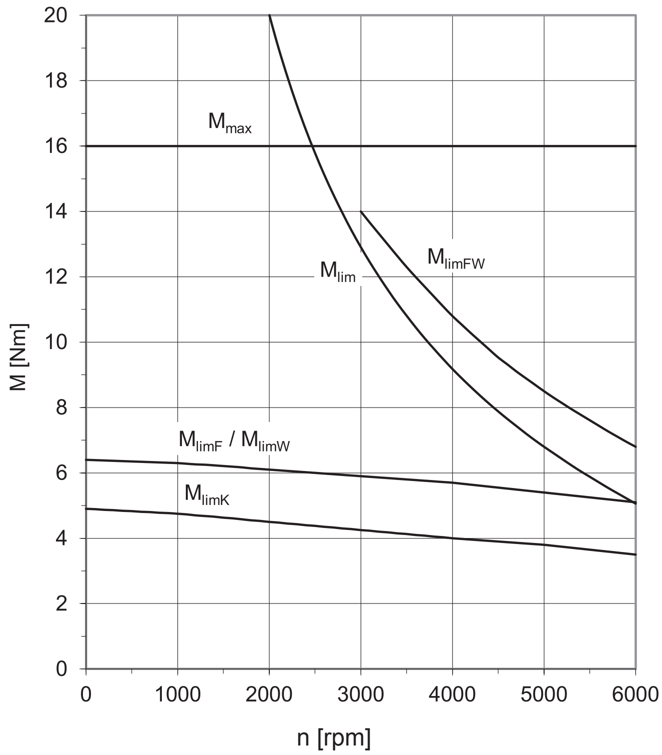
EZ401 (n_N=6000 rpm)



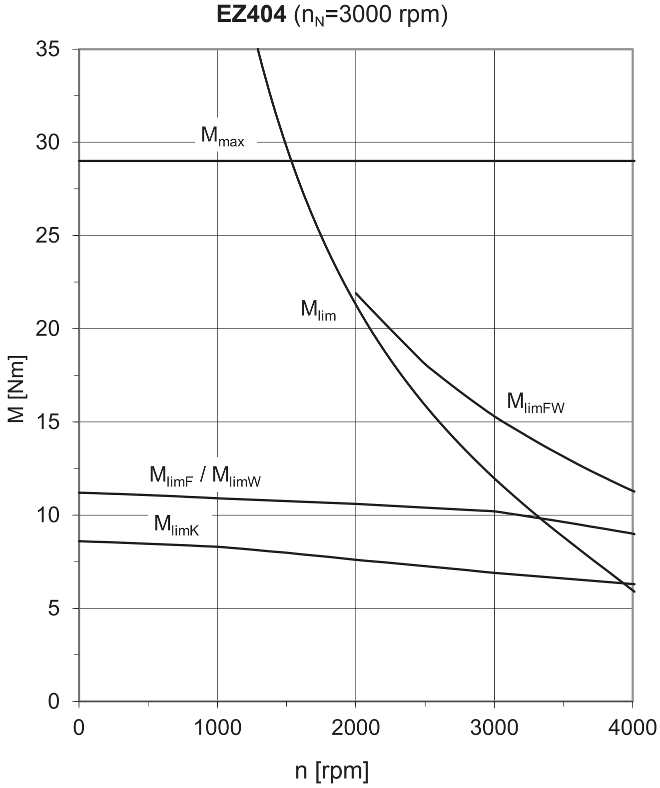
EZ402 (n_N=3000 rpm)



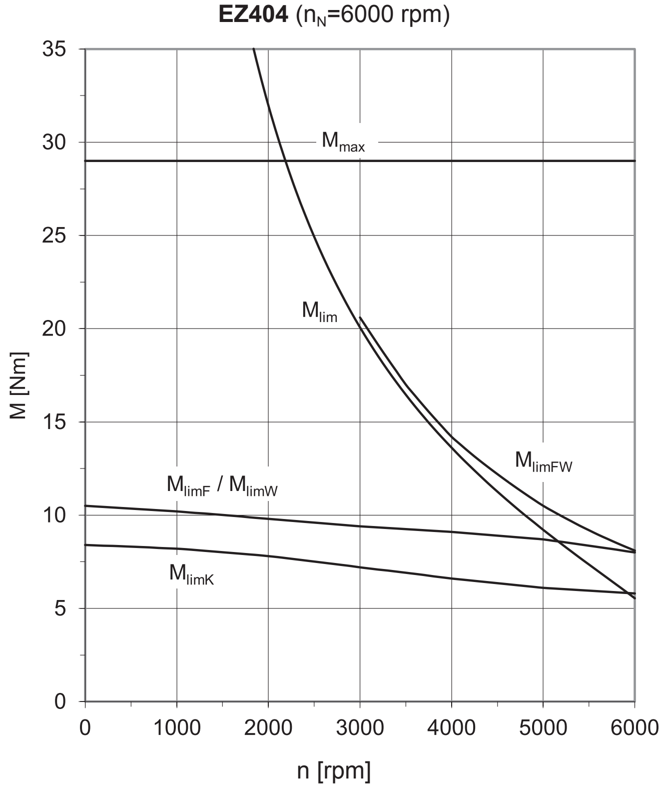
EZ402 (n_N=6000 rpm)



EZ404 (n_N=3000 rpm)



EZ404 (n_N=6000 rpm)



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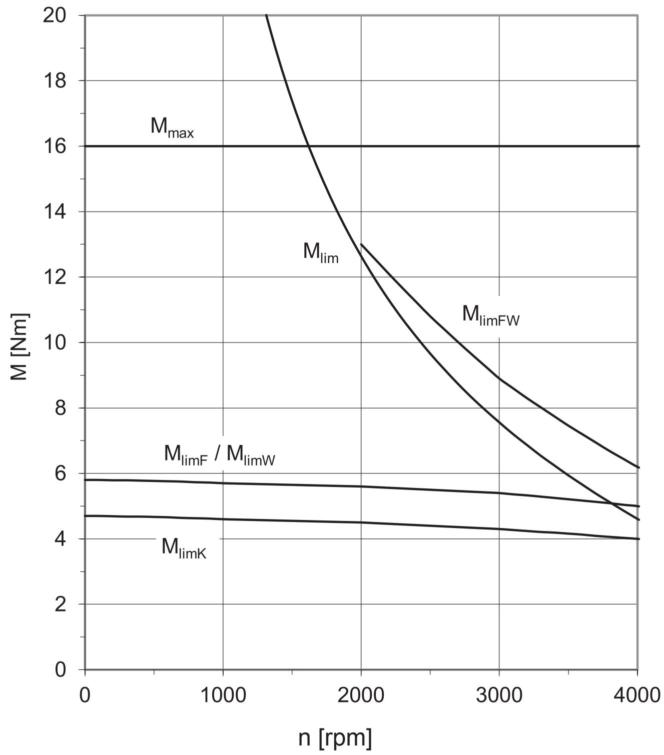
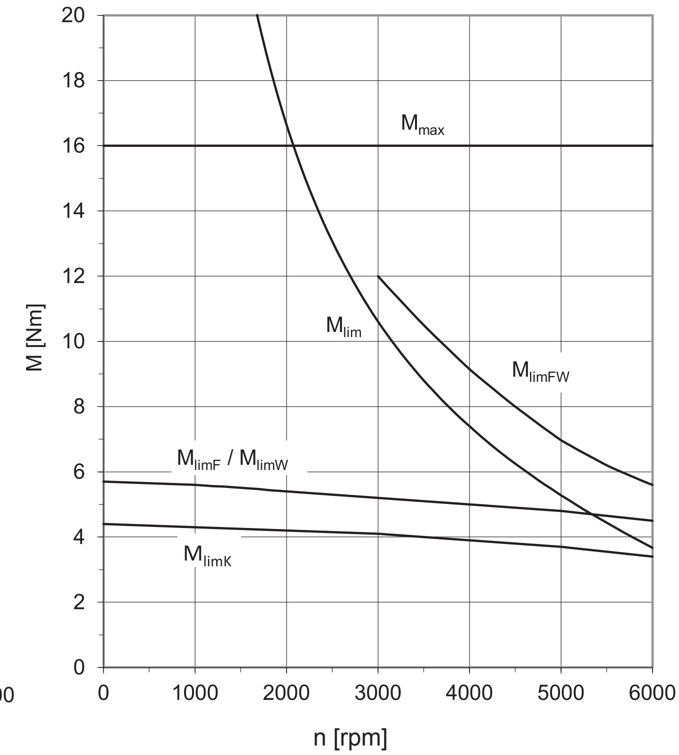
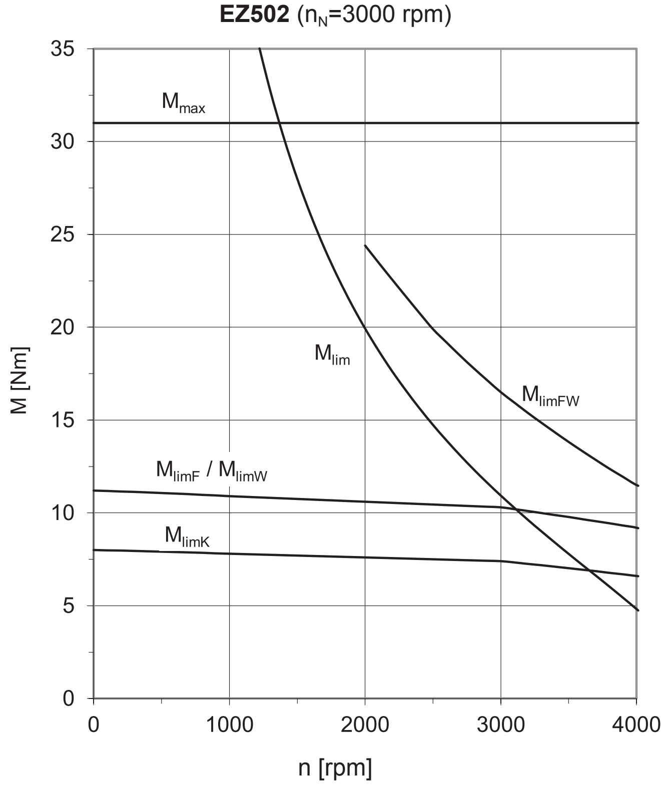
EZ501 (n_N=3000 rpm)



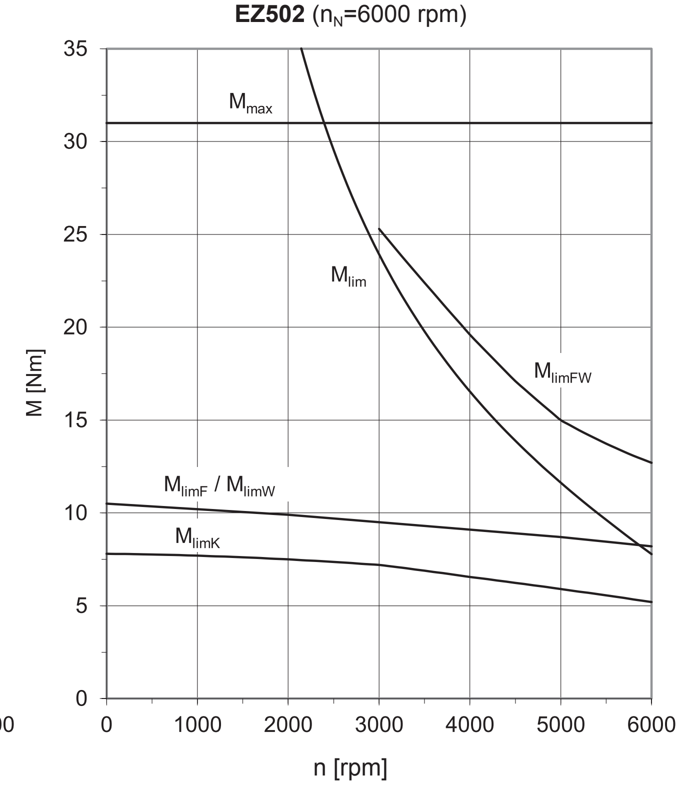
EZ501 (n_N=6000 rpm)

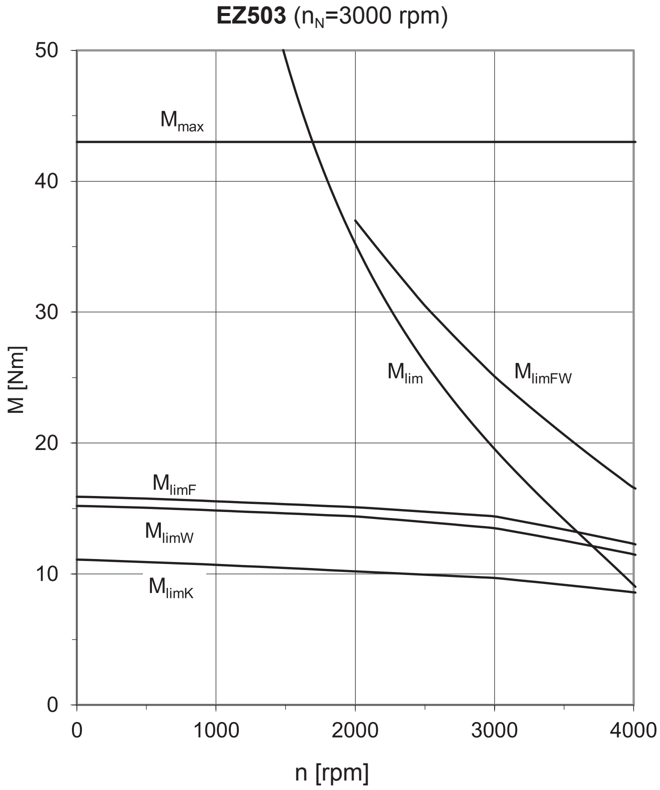


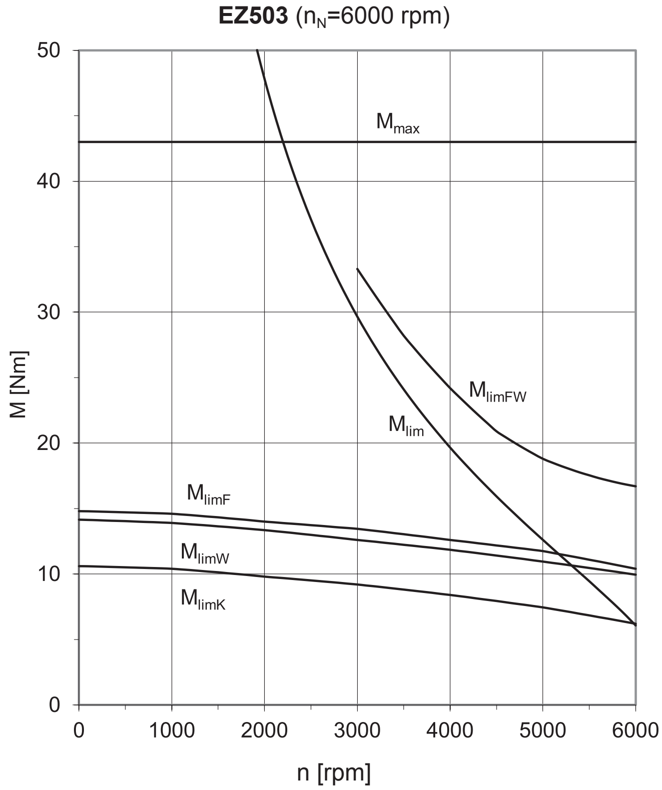
EZ502 (n_N=3000 rpm)

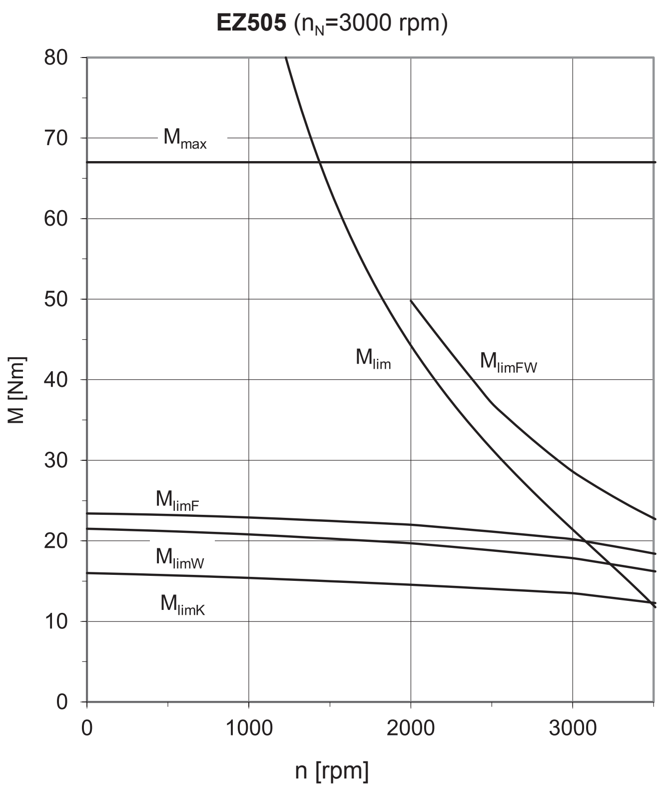


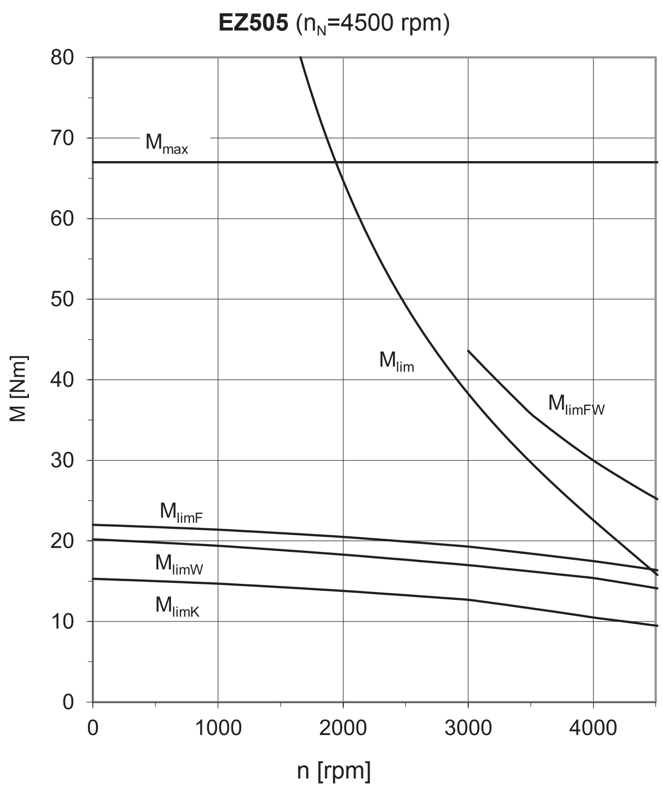
EZ502 (n_N=6000 rpm)



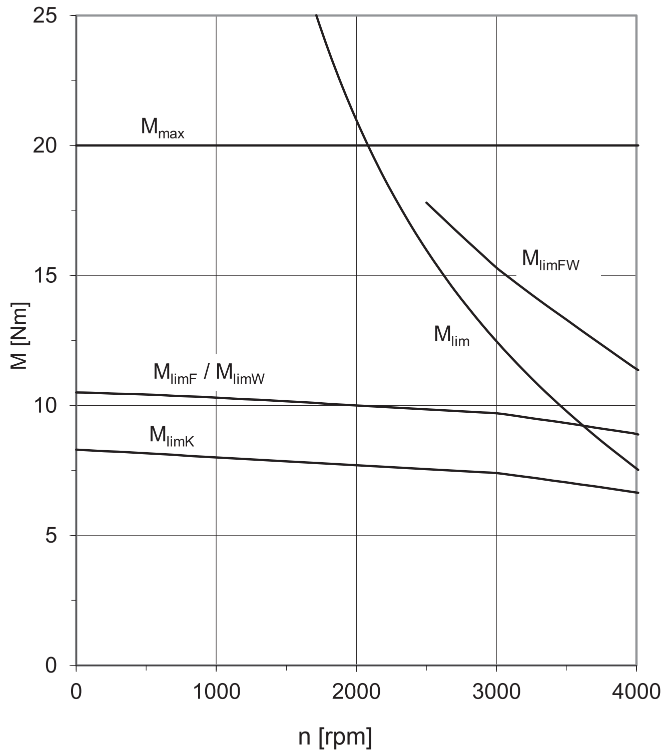

EZ503 (nN=3000 rpm)
Mmax
Mlim
MlimFW
MlimF
MlimW
MlimK
M [Nm]
n [rpm]
0
10
20
30
40
50
1000
2000
3000
4000


EZ503 (nN=6000 rpm)
Mmax
MlimFW
Mlim
MlimF
MlimW
MlimK
M [Nm]
n [rpm]
0
10
20
30
40
50
1000
2000
3000
4000
5000
6000

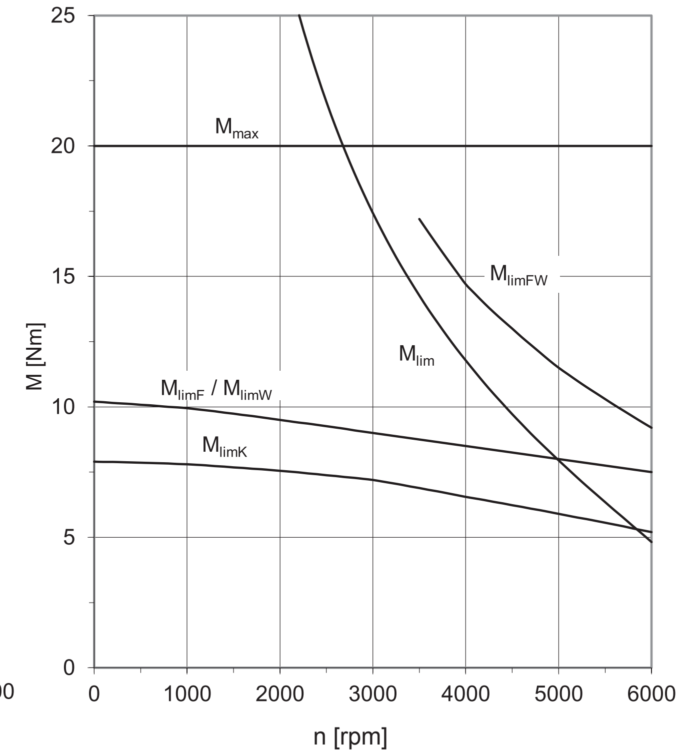

EZ505 (nN=3000 rpm)
Mmax
Mlim
MlimFW
MlimF
MlimW
MlimK
M [Nm]
n [rpm]
0
10
20
30
40
50
60
70
80
1000
2000
3000


EZ505 (nN=4500 rpm)
Mmax
Mlim
MlimFW
MlimF
MlimW
MlimK
M [Nm]
n [rpm]
0
10
20
30
40
50
60
70
80
1000
2000
3000
4000

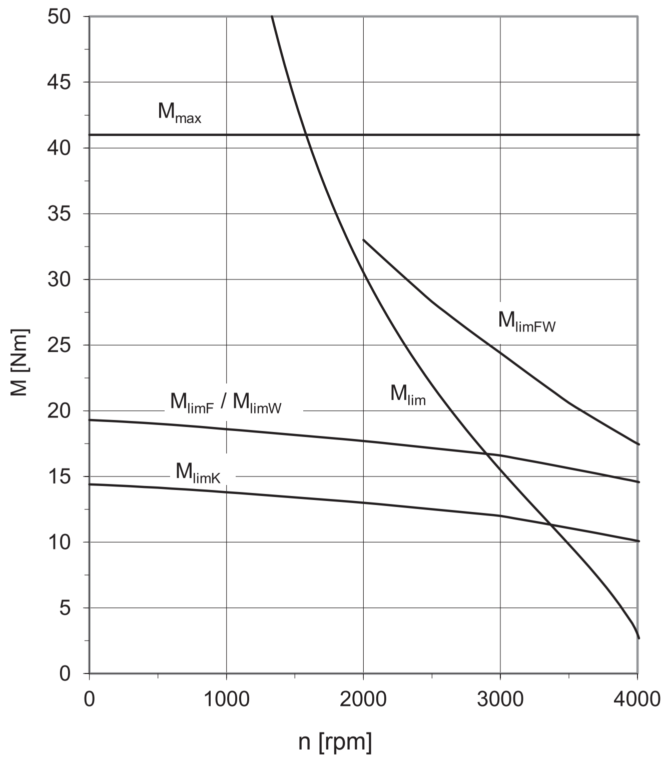
EZ701 (n_N=3000 rpm)



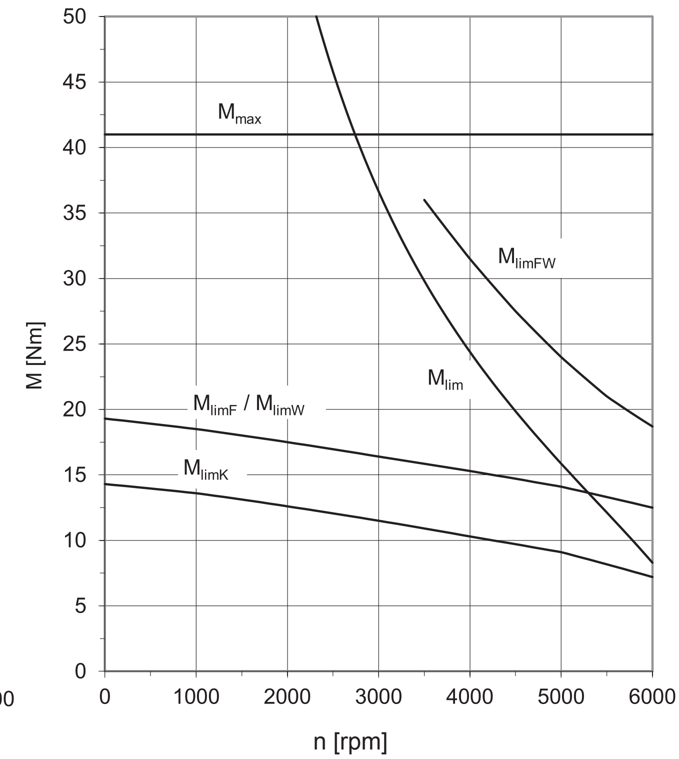
EZ701 (n_N=6000 rpm)

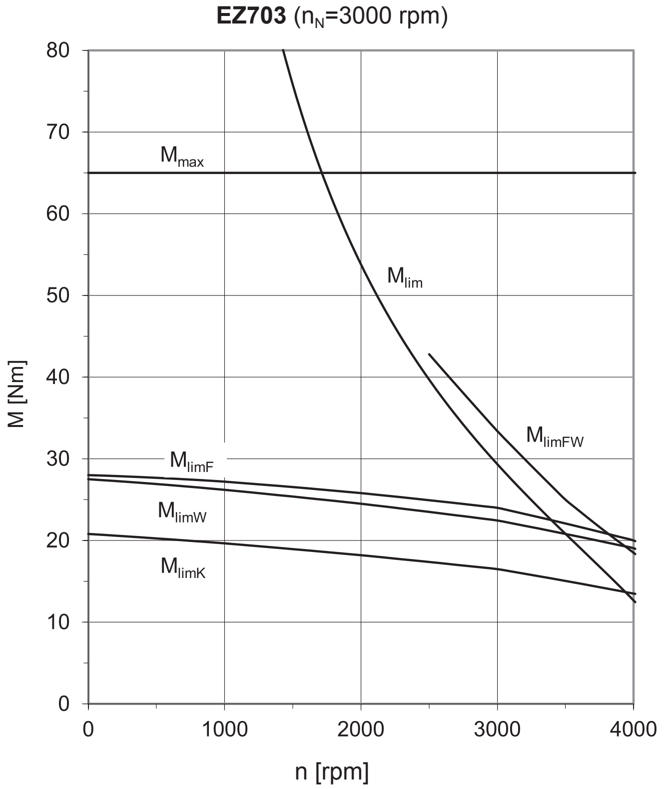


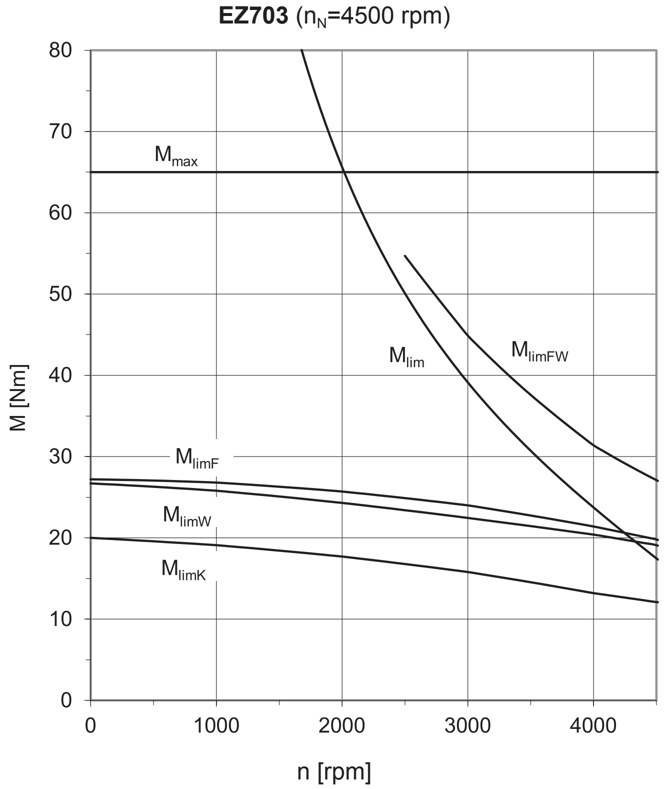
EZ702 (n_N=3000 rpm)

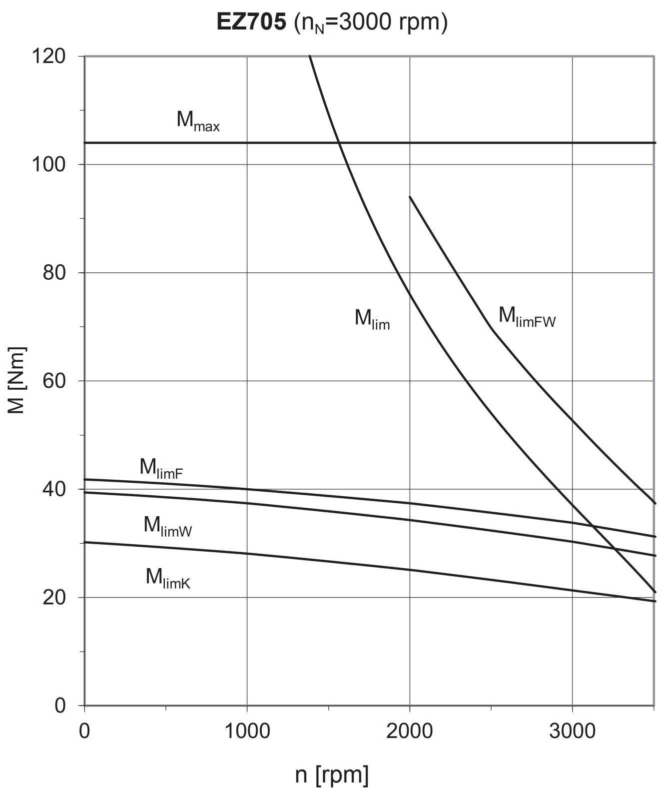


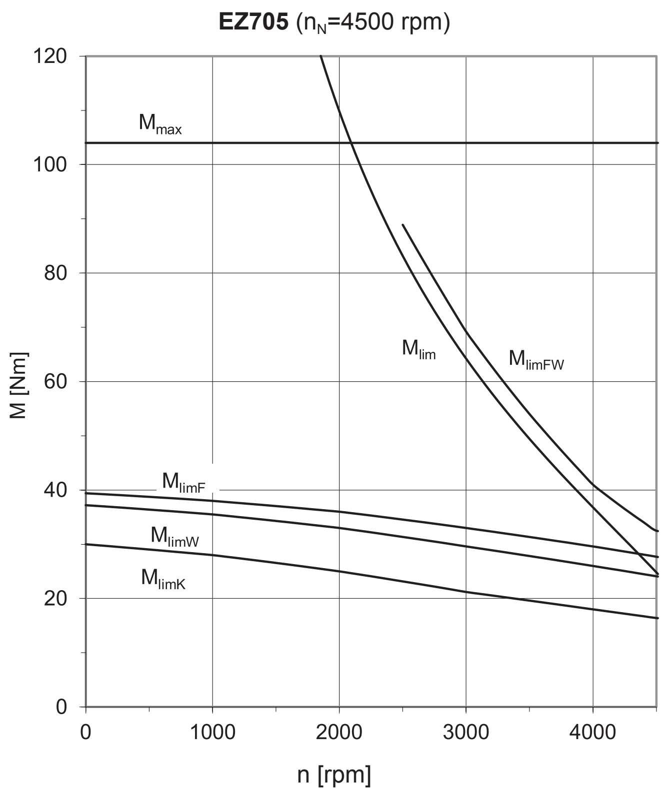
EZ702 (n_N=6000 rpm)




EZ703 (n_N=3000 rpm)
M [Nm]
n [rpm]
M_{max}
M_{lim}
M_{limFW}
M_{limF}
M_{limW}
M_{limK}
0
10
20
30
40
50
60
70
80
1000
2000
3000
4000


EZ703 (n_N=4500 rpm)
M [Nm]
n [rpm]
M_{max}
M_{lim}
M_{limFW}
M_{limF}
M_{limW}
M_{limK}
0
10
20
30
40
50
60
70
80
1000
2000
3000
4000

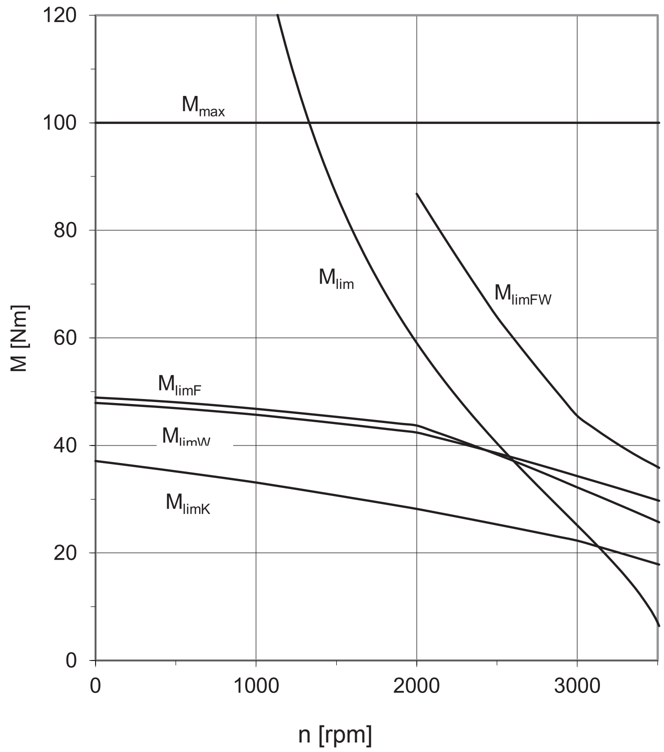

EZ705 (n_N=3000 rpm)
M [Nm]
n [rpm]
M_{max}
M_{lim}
M_{limFW}
M_{limF}
M_{limW}
M_{limK}
0
20
40
60
80
100
120
1000
2000
3000


EZ705 (n_N=4500 rpm)
M [Nm]
n [rpm]
M_{max}
M_{lim}
M_{limFW}
M_{limF}
M_{limW}
M_{limK}
0
20
40
60
80
100
120
1000
2000
3000
4000

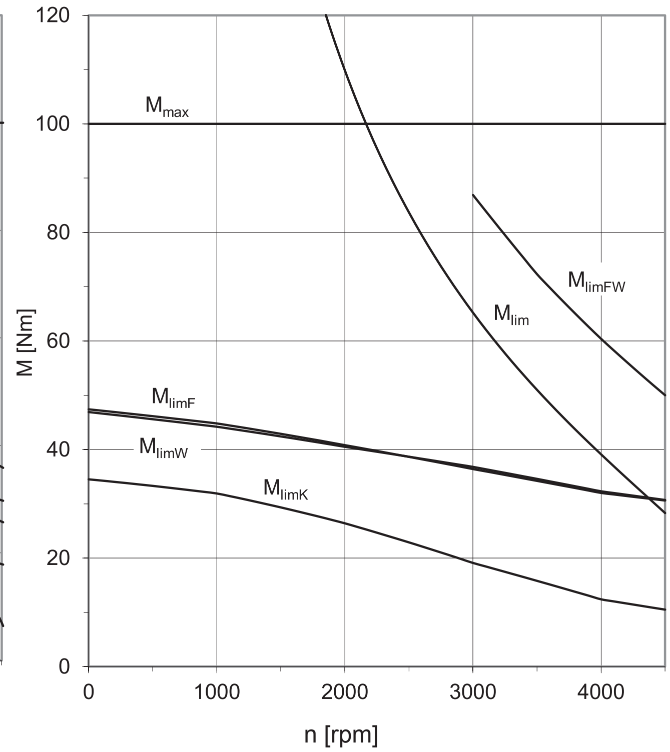
STÖBER

EZ

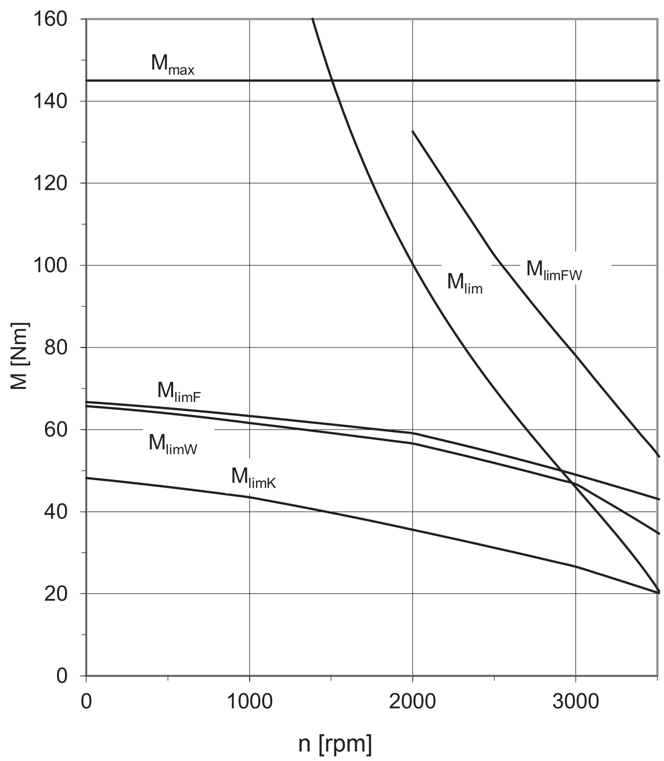
EZ802 (n_N=3000 rpm)



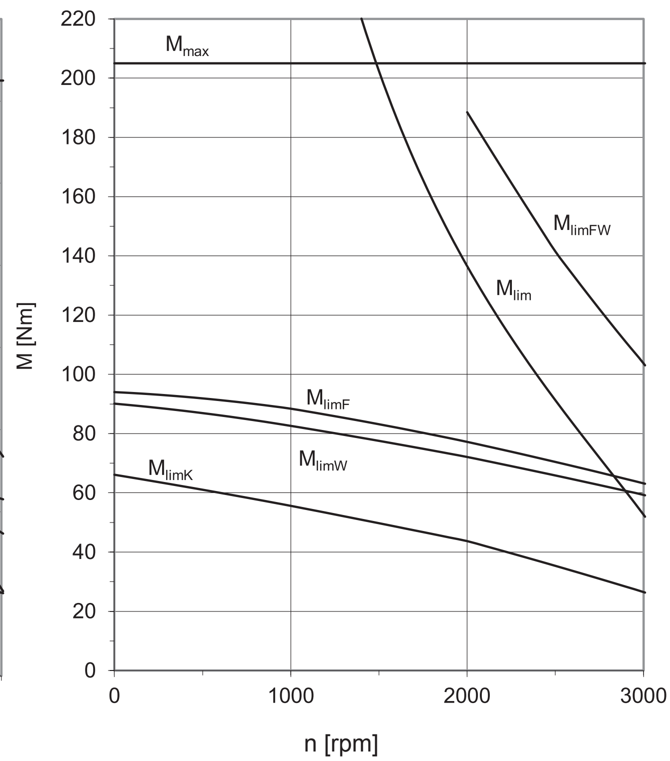
EZ802 (n_N=4500 rpm)



EZ803 (n_N=3000 rpm)



EZ805 (n_N=2000 rpm)



8.4 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.

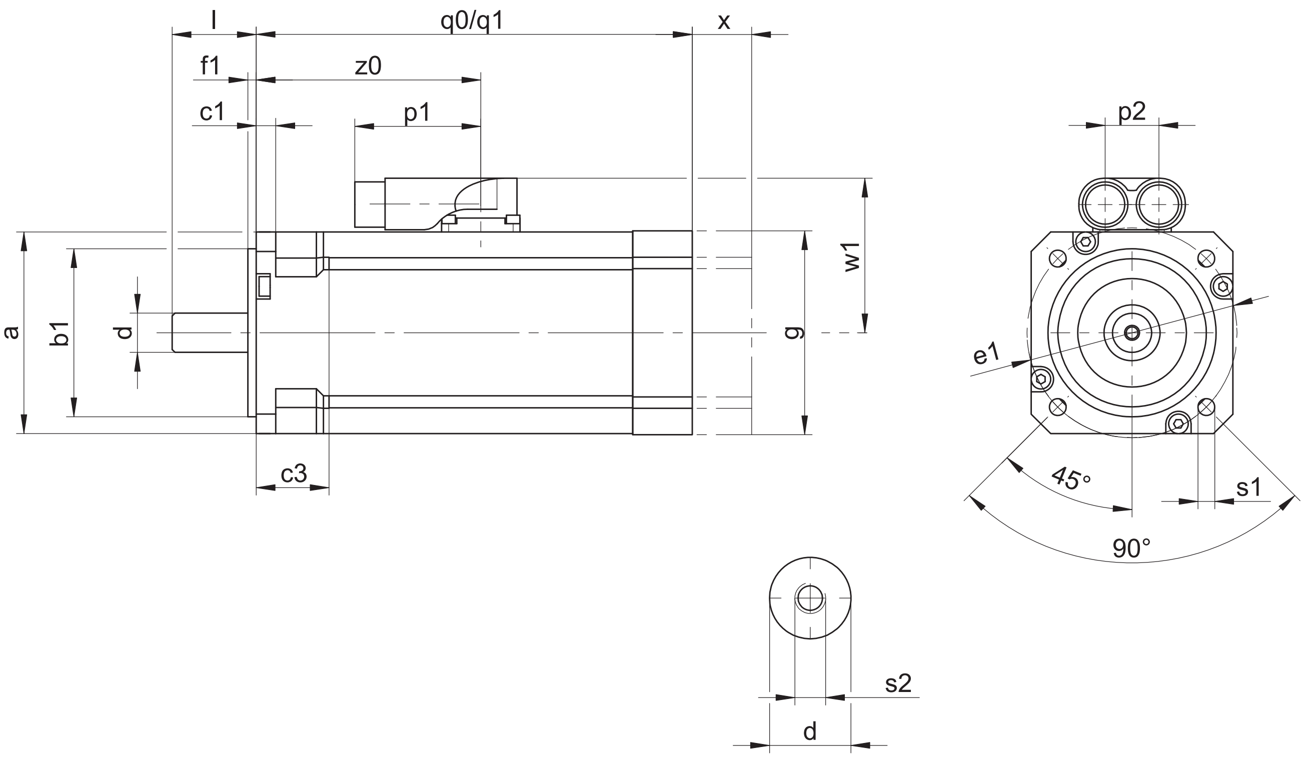
Tolerances

Solid shaft	Tolerance
Shaft end fit ∅ ≤ 50 mm	DIN 748-1, ISO k6
Shaft end fit ∅ > 50 mm	DIN 748-1, ISO m6

Centering holes in solid shafts according to DIN 332-2, shape DR

Thread size	M4	M5	M6	M8	M10	M12	M16	M20	M24
Thread depth	10	12.5	16	19	22	28	36	42	50

8.4.1 EZ3 motors



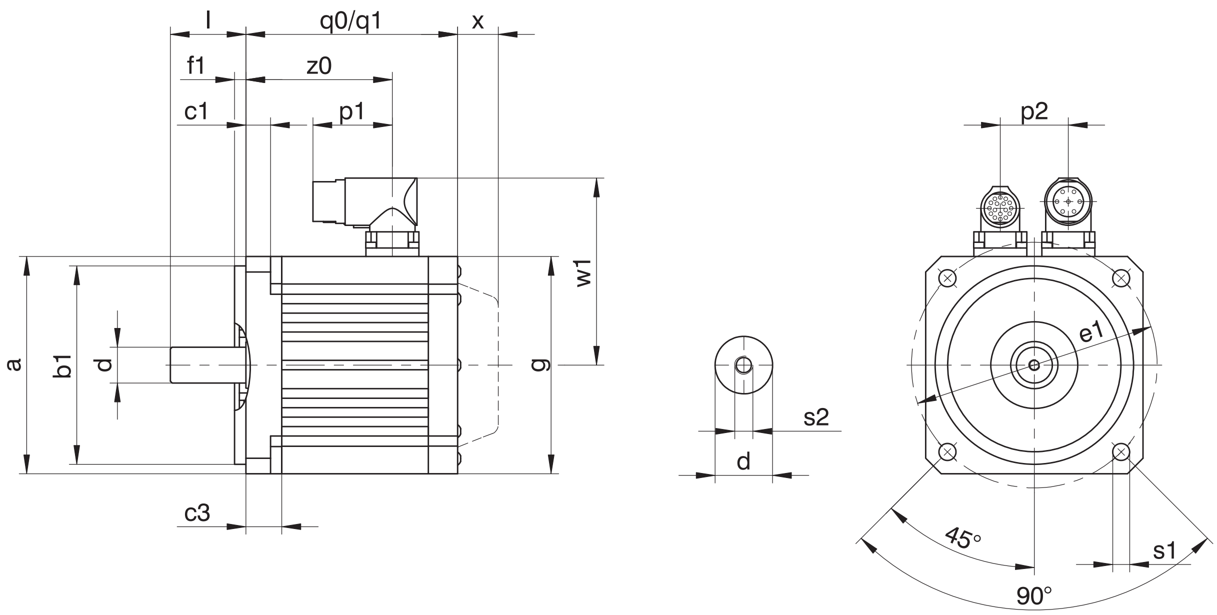
q0	Applies to motors without holding brake.	q1	Applies to motors with holding brake.
x	Applies to encoders based on optical measuring principle.		

Type	□a	∅b1	c1	c3	∅d	∅e1	f1	□g	l	p1	p2	q0	q1	∅s1	s2	w1	x	z0
EZ301U	72	60_{j6}	7	26	14_{k6}	75	3	72	30	45	19	116	156	6	M5	55.5	21	80.5
EZ302U	72	60_{j6}	7	26	14_{k6}	75	3	72	30	45	19	138	178	6	M5	55.5	21	102.5
EZ303U	72	60_{j6}	7	26	14_{k6}	75	3	72	30	45	19	160	200	6	M5	55.5	21	124.5

STOBER

EZ

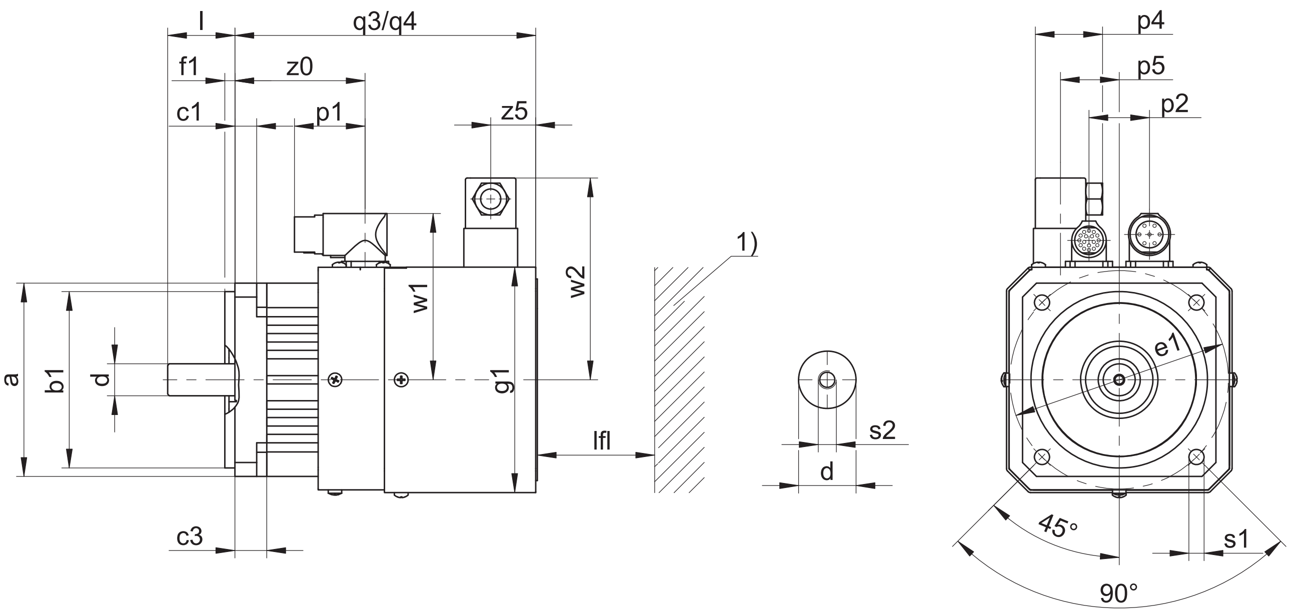
8.4.2 EZ4 – EZ8 motors with convection cooling



q0	Applies to motors without holding brake.	q1	Applies to motors with holding brake.
x	Applies to encoders based on optical measuring principle.		

Type	□a	∅b1	c1	c3	∅d	∅e1	f1	□g	l	p1	p2	q0	q1	∅s1	s2	w1	x	z0
EZ401U	98	95_{j6}	9.5	20.5	14_{k6}	115	3.5	98	30	40	32	118.5	167.0	9	M5	91.0	22	76.5
EZ402U	98	95_{j6}	9.5	20.5	19_{k6}	115	3.5	98	40	40	32	143.5	192.0	9	M6	91.0	22	101.5
EZ404U	98	95_{j6}	9.5	20.5	19_{k6}	115	3.5	98	40	40	32	193.5	242.0	9	M6	91.0	22	151.5
EZ501U	115	110_{j6}	10.0	16.0	19_{k6}	130	3.5	115	40	40	36	109.0	163.5	9	M6	100.0	22	74.5
EZ502U	115	110_{j6}	10.0	16.0	19_{k6}	130	3.5	115	40	40	36	134.0	188.5	9	M6	100.0	22	99.5
EZ503U	115	110_{j6}	10.0	16.0	24_{k6}	130	3.5	115	50	40	36	159.0	213.5	9	M8	100.0	22	124.5
EZ505U	115	110_{j6}	10.0	16.0	24_{k6}	130	3.5	115	50	40	36	209.0	263.5	9	M8	100.0	22	174.5
EZ701U	145	130_{j6}	10.0	19.0	24_{k6}	165	3.5	145	50	40	42	121.0	180.0	11	M8	115.0	22	83.0
EZ702U	145	130_{j6}	10.0	19.0	24_{k6}	165	3.5	145	50	40	42	146.0	205.0	11	M8	115.0	22	108.0
EZ703U	145	130_{j6}	10.0	19.0	24_{k6}	165	3.5	145	50	40	42	171.0	230.0	11	M8	115.0	22	133.0
EZ705U	145	130_{j6}	10.0	19.0	32_{k6}	165	3.5	145	58	71	42	226.0	285.0	11	M12	134.0	22	184.0
EZ802U	190	180_{j6}	15.0	25.0	32_{k6}	215	3.5	190	58	71	60	222.0	299.0	13.5	M12	156.5	22	168.0
EZ803U	190	180_{j6}	15.0	25.0	38_{k6}	215	3.5	190	80	71	60	263.0	340.0	13.5	M12	156.5	22	209.0
EZ805U	190	180_{j6}	15.0	25.0	38_{k6}	215	3.5	190	80	71	60	345.0	422.0	13.5	M12	156.5	22	277.0

8.4.3 EZ4 – EZ8 motors with forced ventilation



q3	Applies to motors without holding brake.	q4	Applies to motors with holding brake.
1)	Machine wall		

Type	□a	∅b1	c1	c3	∅d	∅e1	f1	□g1	l	lfl_{min}	p1	p2	p4	p5	q3	q4	∅s1	s2	w1	w2	z0	z5
EZ401B	98	95_{j6}	9.5	20.5	14_{k6}	115	3.5	118	30	20	40	32	37.5	0	175	224	9.0	M5	91.0	111	76.5	25
EZ402B	98	95_{j6}	9.5	20.5	19_{k6}	115	3.5	118	40	20	40	32	37.5	0	200	249	9.0	M6	91.0	111	101.5	25
EZ404B	98	95_{j6}	9.5	20.5	19_{k6}	115	3.5	118	40	20	40	32	37.5	0	250	299	9.0	M6	91.0	111	151.5	25
EZ501B	115	110_{j6}	10.0	16.0	19_{k6}	130	3.5	135	40	20	40	36	37.5	0	179	234	9.0	M6	100.0	120	74.5	25
EZ502B	115	110_{j6}	10.0	16.0	19_{k6}	130	3.5	135	40	20	40	36	37.5	0	204	259	9.0	M6	100.0	120	99.5	25
EZ503B	115	110_{j6}	10.0	16.0	24_{k6}	130	3.5	135	50	20	40	36	37.5	0	229	284	9.0	M8	100.0	120	124.5	25
EZ505B	115	110_{j6}	10.0	16.0	24_{k6}	130	3.5	135	50	20	40	36	37.5	0	279	334	9.0	M8	100.0	120	174.5	25
EZ701B	145	130_{j6}	10.0	19.0	24_{k6}	165	3.5	165	50	30	40	42	37.5	0	213	272	11.0	M8	115.0	134	83.0	40
EZ702B	145	130_{j6}	10.0	19.0	24_{k6}	165	3.5	165	50	30	40	42	37.5	0	238	297	11.0	M8	115.0	134	108.0	40
EZ703B	145	130_{j6}	10.0	19.0	24_{k6}	165	3.5	165	50	30	40	42	37.5	0	263	322	11.0	M8	115.0	134	133.0	40
EZ705B	145	130_{j6}	10.0	19.0	32_{k6}	165	3.5	165	58	30	71	42	37.5	0	318	377	11.0	M12	134.0	134	184.0	40
EZ802B	190	180_{j6}	15.0	25.0	32_{k6}	215	3.5	215	58	30	71	60	37.5	62	322	399	13.5	M12	156.5	160	168.0	40
EZ803B	190	180_{j6}	15.0	25.0	38_{k6}	215	3.5	215	80	30	71	60	37.5	62	363	440	13.5	M12	156.5	160	209.0	40
EZ805B	190	180_{j6}	15.0	25.0	38_{k6}	215	3.5	215	80	30	71	60	37.5	62	445	522	13.5	M12	178.0	160	277.0	40

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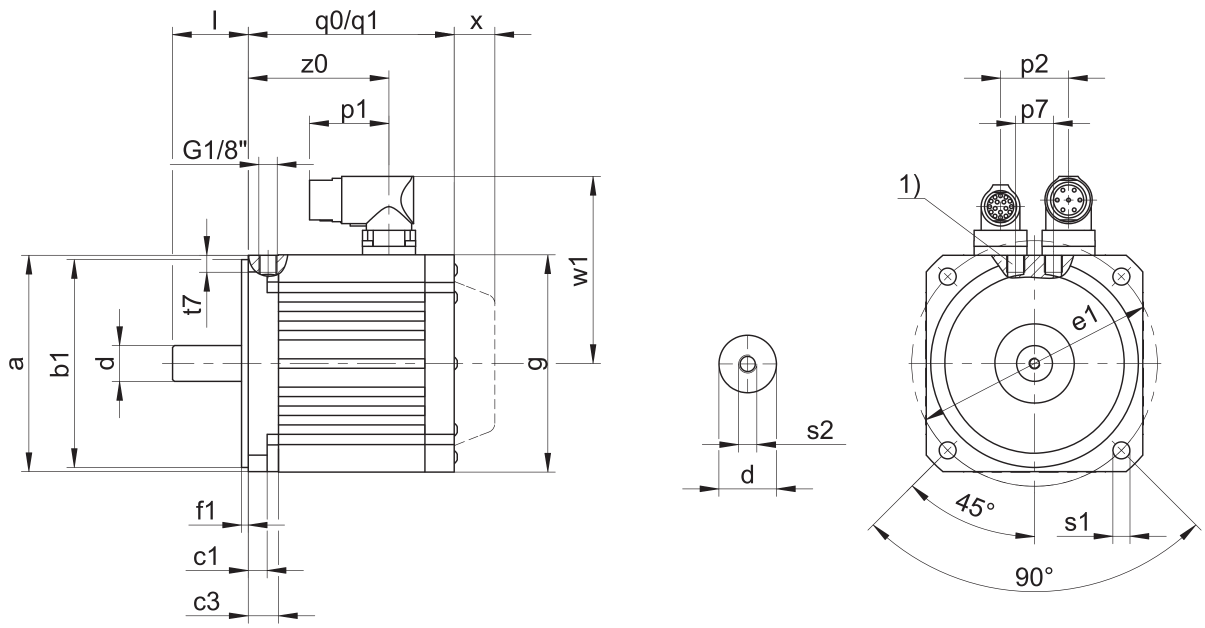
8.4.4 EZ4 – EZ8 motors with water cooling

EZ4
EZ7
EZ8



EZ5

1)	The supply or return line of the cooling system can be connected to both connections for water cooling. The flange with the connections for water cooling can be rotated 180°.
q0	Applies to motors without holding brake.
q1	Applies to motors with holding brake.
x	Applies to encoders based on optical measuring principle.

Type	□a	∅b1	c1	c3	∅d	∅e1	f1	□g	l	p1	p2	p7	q0	q1	∅s1	s2	t7	w1	x	z0
EZ401W	98	95_{j6}	9.5	20.5	14_{k6}	115	3.5	98	30	40	32	20	118.5	167.0	9	M5	9	91.0	22	76.5
EZ402W	98	95_{j6}	9.5	20.5	19_{k6}	115	3.5	98	40	40	32	20	143.5	192.0	9	M6	9	91.0	22	101.5
EZ404W	98	95_{j6}	9.5	20.5	19_{k6}	115	3.5	98	40	40	32	20	193.5	242.0	9	M6	9	91.0	22	151.5
EZ501W	115	110_{j6}	10.0	16.0	19_{k6}	130	3.5	115	40	40	36	20	109.0	163.5	9	M6	8	100.0	22	74.5
EZ502W	115	110_{j6}	10.0	16.0	19_{k6}	130	3.5	115	40	40	36	20	134.0	188.5	9	M6	8	100.0	22	99.5
EZ503W	115	110_{j6}	10.0	16.0	24_{k6}	130	3.5	115	50	40	36	20	159.0	213.5	9	M8	8	100.0	22	124.5
EZ505W	115	110_{j6}	10.0	16.0	24_{k6}	130	3.5	115	50	40	36	20	209.0	263.5	9	M8	8	100.0	22	174.5
EZ701W	145	130_{j6}	10.0	19.0	24_{k6}	165	3.5	145	50	40	42	20	121.0	180.0	11	M8	9	115.0	22	83.0
EZ702W	145	130_{j6}	10.0	19.0	24_{k6}	165	3.5	145	50	40	42	20	146.0	205.0	11	M8	9	115.0	22	108.0
EZ703W	145	130_{j6}	10.0	19.0	24_{k6}	165	3.5	145	50	40	42	20	171.0	230.0	11	M8	9	115.0	22	133.0
EZ705W	145	130_{j6}	10.0	19.0	32_{k6}	165	3.5	145	58	71	42	20	226.0	285.0	11	M12	9	134.0	22	184.0
EZ802W	190	180_{j6}	15.0	25.0	32_{k6}	215	3.5	190	58	71	60	25	222.0	299.0	13.5	M12	12	156.5	22	168.0
EZ803W	190	180_{j6}	15.0	25.0	38_{k6}	215	3.5	190	80	71	60	25	263.0	340.0	13.5	M12	12	156.5	22	209.0
EZ805W	190	180_{j6}	15.0	25.0	38_{k6}	215	3.5	190	80	71	60	25	345.0	422.0	13.5	M12	12	156.5	22	291.0

8.5 Type designation

Sample code

EZ	4	0	1	U	D	AD	M4	O	096

Explanation

Code	Designation	Design
EZ	Type	Synchronous servo motor
4	Size	4 (example)
0	Generation	0
1	Length	1 (example)
U B W	Cooling[1]	Convection cooling Forced ventilation Water cooling
D M	Mass moment of inertia	Dynamic performance With increased mass moment of inertia[2]
AD	Drive controller	SD6 (example)
M4	Encoder	EQI 1131 FMA EnDat 2.2 (example)
O P	Brake	Without holding brake Permanent magnet holding brake
096	Electromagnetic constant (EMC) K_{EM}	96 V/1000 rpm (example)

Instructions

- You can find information about available encoders in section [▸ 8.6.4].
- In section [▸ 8.6.4.5], you can find information about connecting synchronous servo motors to other STOBER drive controllers.

8.6 Product description

8.6.1 General features

Feature	Description
Design	IM B5, IM V1, IM V3 in accordance with EN 60034-7/A1
Protection class	IP56 / IP66 (option)
Thermal class	155 (F) as per EN 60034-1 (155 °C, heating $\Delta\vartheta$ = 100 K)
Surface[3]	Black matte as per RAL 9005
Cooling	IC 410 convection cooling (IC 416 convection cooling with forced ventilation or optionally water cooling in the A-side flange)
Bearing	Ball bearing with lifetime lubrication and non-contact sealing
Sealing	Radial shaft seal rings made of FKM (A side)
Shaft end	Shaft without feather key, diameter quality k6
Concentricity	Normal tolerance class in accordance with IEC 60072-1
Coaxiality	Normal tolerance class in accordance with IEC 60072-1
Axial runout	Normal tolerance class in accordance with IEC 60072-1

[1] Only convection cooling available for EZ3 motors
[2] Not available for EZ3, EZ501 and EZ701 motors.
[3] Repainting will change the thermal properties and therefore the performance limits of the motor.

Feature	Description
Vibration intensity	A as per EN 60034-14/A1
Noise level	Limit values as per EN 60034-9/A1

8.6.2 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	5 (EZ3) 7 (EZ4/EZ5/EZ7) 8 (EZ8)

8.6.3 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 [▸ 8.7.3].

Feature	Description
Transport/storage surrounding temperature[4]	-30 °C to +85 °C
Surrounding operating temperature	−15 °C to +40 °C (without water cooling) +10 °C to +40 °C (with water cooling)
Installation altitude	≤ 1000 m above sea level
Shock load	≤ 50 m/s^2 (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.

[4] If you will be storing or transporting the system in which a motor with water cooling is installed below +3 °C, drain the water completely out of the cooling circuit in advance.

8.6.4 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.

8.6.4.1 Encoder measuring principle selection tool

The following table provides you with a selection tool for an encoder measuring principle that is optimally suited for your application.

Feature	Absolute value encoder		Resolver
Measuring principle	Optical	Inductive	Electromag-netic
Temperature resistance	★★☆	★★★	★★★
Vibration strength and shock resistance	★★☆	★★★	★★★
System accuracy	★★★	★★☆	★☆☆
Version with fault elimination for mechanical mount-ing FMA (option with EnDat interface)	✓	✓	–
The multiturn version (optional) eliminate the need for referencing	✓	✓	–
- Electronic nameplate ensures easy commission-ing	✓	✓	–
Key: ★☆☆ = satisfactory, ★★☆ = good, ★★★ = very good			

8.6.4.2 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		

8.6.4.3 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 rev-olutions	Resolution	Position values per revolution
EQI 1131 FMA	M4	Inductive	4096	19 bits	524288
EQI 1131	Q6	Inductive	4096	19 bits	524288
EBI 1135	B0	Inductive	65536	18 bits	262144
EQN 1135 FMA	M3	Optical	4096	23 bits	8388608
EQN 1135	Q5	Optical	4096	23 bits	8388608
ECN 1123 FMA	M1	Optical	–	23 bits	8388608
ECN 1123	C7	Optical	–	23 bits	8388608
ECI 1118-G2	C5	Inductive	–	18 bits	262144

Encoder with EnDat 2.1 interface

Encoder type	Type code	Measuring principle	Recordable revolutions	Resolution	Position values per revolution	Periods per revolution
EQN 1125 FMA	M2	Optical	4096	13 bits	8192	Sin/cos 512
EQN 1125	Q4	Optical	4096	13 bits	8192	Sin/cos 512
ECN 1113 FMA	M0	Optical	–	13 bits	8192	Sin/cos 512
ECN 1113	C6	Optical	–	13 bits	8192	Sin/cos 512

Instructions

- The type code of the encoder is a part of the type designation of the motor.
- FMA = Version with fault elimination for mechanical mounting.
- The encoder EBI 1135 requires an external buffer battery so that the absolute position information will be retained after the power supply is turned off.
- Several revolutions of the motor shaft can only be recorded with multiturn encoders.

8.6.4.4 Resolver

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

Feature	Description
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

8.6.4.5 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
Drive controller type code		AA	AB	AC	AD	AE
ID connection plan		442305	442306	442307	442450	442451
Encoder	**Encoder type code**					
EQI 1131 FMA	M4	✓	–	–	✓	–
EQI 1131	Q6	✓	✓	–	✓	–
EBI 1135	B0	✓	✓	–	✓	–
EQN 1135 FMA	M3	✓	–	–	✓	–
EQN 1135	Q5	✓	✓	–	✓	–
ECN 1123 FMA	M1	✓	–	–	✓	–
ECN 1123	C7	✓	✓	–	✓	–
ECI 1118-G2	C5	✓	✓	–	✓	–
EQN 1125 FMA	M2	✓	✓	✓	✓	✓
EQN 1125	Q4	✓	✓	✓	✓	✓
ECN 1113 FMA	M0	✓	✓	✓	✓	✓

Drive controller		SDS 5000	MDS 5000	SDS 5000 sin/cos MDS 5000 sin/cos	SD6	SD6 sin/cos
Drive controller type code		AA	AB	AC	AD	AE
ID connection plan		442305	442306	442307	442450	442451
Encoder	**Encoder type code**					
ECN 1113	C6	✓	✓	✓	✓	✓
Resolver	R0	✓	✓	–	–	✓

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).

8.6.5 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.

8.6.5.1 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)

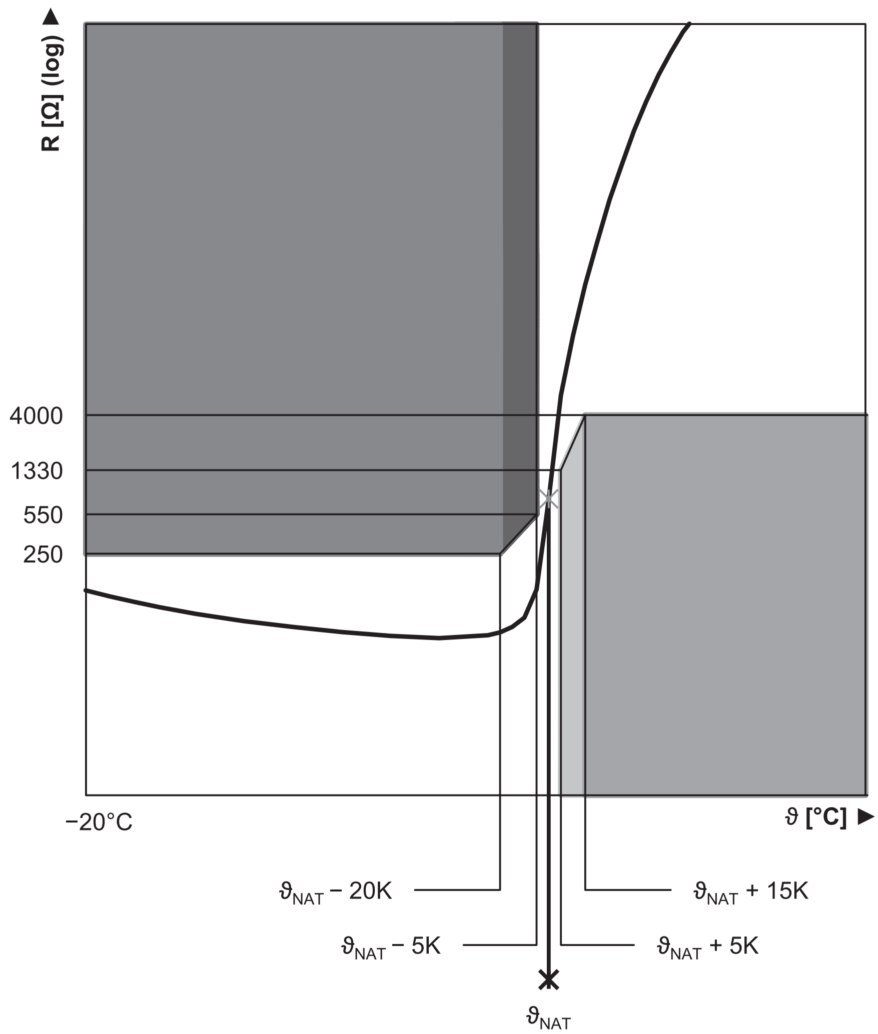


Fig. 2: Characteristic curve of PTC thermistor (single thermistor)

8.6.6 Cooling

A synchronous servo motor in the standard version is cooled by convection cooling (IC 410 in accordance with EN 60034-6). The air flowing around the motor is heated by the radiated motor heat and rises. The motor can optionally be cooled by an forced-cooling fan or with water.

8.6.6.1 Forced ventilation

STOBER synchronous servo motors can optionally be cooled with a forced-cooling fan to increase the performance data for the same size. Retrofitting with a forced-cooling fan is also possible to optimize the drive at a later date. When retrofitting, check whether the core cross-section of the power cable of the motor must be increased. Also take into account the dimensions of the forced-cooling fan.

The performance data of the motors with forced ventilation can be found in section [8.2.2], the dimensional drawings in section [8.4.3].

Formula symbols	Unit	Explanation
$I_{N,F}$	A	Nominal current of the forced-cooling fan
$L_{pA,F}$	dBA	Noise level of the forced-cooling fan in the optimum operating range
m_F	kg	Weight of the forced-cooling fan
$P_{N,F}$	W	Nominal output of the forced-cooling fan

Formula symbols	Unit	Explanation
q_{vF}	m³/h	Delivery capacity of the forced-cooling fan in open air
$U_{N,F}$	V	Nominal voltage of the forced-cooling fan

Technical Data

Motor	Forced-cooling fan	$U_{N,F}$ [V]	$I_{N,F}$ [V]	$P_{N,F}$ [W]	$q_{v,F}$ [m³/h]	$L_{p(A)}$ [dBA]	m_F [kg]	Protection class
EZ4_B	FL4	230 V ± 5 %, 50/60 Hz	0.07	10	59	41	1.4	IP44
EZ5_B	FL5		0.10	14	160	45	1.9	IP54
EZ7_B	FL7		0.10	14	160	45	2.9	IP54
EZ8_B	FL8		0.20	26	420	54	5.0	IP55

Connection assignment for forced-cooling fan plug connectors

Connection diagram	Pin	Connection
	1	L1 (phase)
	2	N (neutral conductor)
	3	
	⏚	PE (protective ground)

8.6.6.2 Water cooling

STOBER synchronous servo motors can optionally be cooled with water to increase the performance data for the same size. Water cooling represents an alternative to forced ventilation if it is not possible due to the surrounding area or space considerations. Water cooling cannot be retrofitted. It must be specified in the purchase order. Water cooling can not be combined with forced ventilation.

The performance data of the motors with water cooling can be found in section [▹ 8.2.3], the dimensional drawings in section [▹ 8.4.4].

Cooling circuit specification

Feature	Description
Coolant	Water
Temperature at inlet	+5 °C to +40 °C (max. 5 K below the surrounding temperature)
Cooling circuit	Closed, with recooling unit
Cleanliness	Clear, with no suspended matter or dirt, use particle filter ≤ 100 µm if necessary
pH value	6.5 – 7.5
Hardness	1.43 – 2.5 mmol/l
Salinity	NaCl < 100 ppm, demineralized
Anticorrosive	Maximum percentage 25 %, neutral relative to AlCuMgPb F38, GG-220HB
Operating pressure	≤ 3.5 bar (provide a pressure relief valve in the supply line if necessary)
Flow rate	Optimum 6 l/min, minimum 4.5 l/min (EZ4/EZ5)
	Optimum 7.5 l/min, minimum 5 l/min (EZ7/EZ8)

Instructions

- The nominal data for synchronous servo motors with water cooling refers to water as a coolant. If another coolant is used, the nominal data must be determined again.
- For detailed information about the cooling system or coolants and coolant additives, please contact the manufacturer of your cooling system.
- Coolant with fresh water from the public supply grid with coolants, lubricants or cutting agents from the machining process is not permitted.
- If the temperature of the coolant is lower than the surrounding temperature, interrupt the supply of coolant when the motor is stopped for extended times to prevent condensation water from forming.
- If you will be storing or transporting the system in which a motor is installed below +3 °C, drain the water completely out of the cooling circuit in advance.
- Further information on water cooling can be found in the operating manual for the motor.

8.6.7 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.

Observe the following for the configuration:

- The holding brake can be used for braking from full speed (following a power failure or when setting up the machine). 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 symbols	Unit	Explanation
$I_{N,B}$	A	Nominal current of the brake at 20 °C
ΔJ_B	10^{-4}kgm^2	Additive mass moment of inertia of a motor with holding brake
J_{Bstop}	10^{-4}kgm^2	Reference mass moment of inertia with braking from full speed: $J_{Bstop} = J_{dyn} \times 2$
J_{dyn}	10^{-4}kgm^2	Mass moment of inertia of a motor in the dynamic version
J_{tot}	10^{-4}kgm^2	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 %)

Formula symbols	Unit	Explanation
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
$W_{B,Rmax/h}$	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

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

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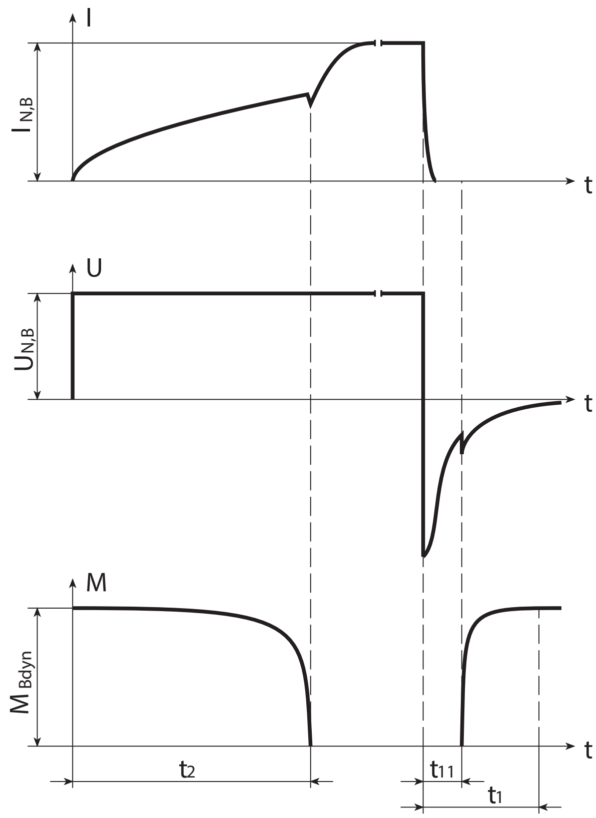
Switching characteristics



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]
EZ301	2.5	2.3	0.51	6.0	48000	0.752	180	25	3.0	20	0.2	0.186	0.55
EZ302	4.0	3.8	0.75	8.5	38000	0.952	180	44	4.0	26	0.3	0.186	0.55
EZ303	4.0	3.8	0.75	8.5	30000	1.17	180	44	4.0	26	0.3	0.186	0.55
EZ401	4.0	3.8	0.75	8.5	16000	2.24	180	44	4.0	26	0.3	0.192	0.76
EZ402	8.0	7.0	0.75	8.5	13500	4.39	300	40	2.0	20	0.3	0.566	0.97
EZ404	8.0	7.0	0.75	8.5	8500	7.09	300	40	2.0	20	0.3	0.566	0.97
EZ501	8.0	7.0	0.75	8.5	8700	6.94	300	40	2.0	20	0.3	0.571	1.19
EZ502	8.0	7.0	0.75	8.5	5200	11.5	300	40	2.0	20	0.3	0.571	1.19
EZ503	15	12	1.0	11.0	5900	18.6	550	60	5.0	30	0.3	1.721	1.62
EZ505	15	12	1.0	11.0	4000	27.8	550	60	5.0	30	0.3	1.721	1.62
EZ701	15	12	1.0	11.0	5400	20.5	550	60	5.0	30	0.3	1.743	1.94
EZ702	15	12	1.0	11.0	3600	30.9	550	60	5.0	30	0.3	1.743	1.94
EZ703	32	28	1.1	25.0	5200	54.6	1400	100	5.0	25	0.4	5.680	2.81
EZ705	32	28	1.1	25.0	3500	79.4	1400	100	5.0	25	0.4	5.680	2.81
EZ802	65	35	1.7	45.0	6000	149	2250	200	10	50	0.4	16.460	5.40
EZ803	65	35	1.7	45.0	4500	200	2250	200	10	50	0.4	16.460	5.40
EZ805	115	70	2.1	65.0	7000	376	6500	190	12	65	0.5	55.460	8.40

8.6.8 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.

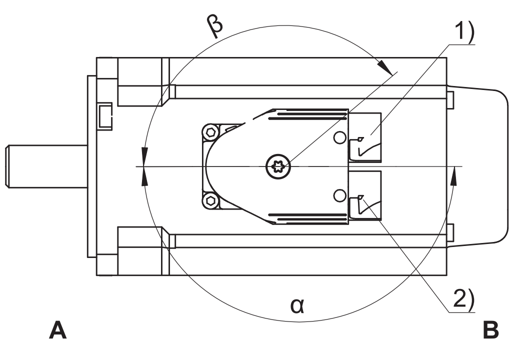
8.6.8.1 Plug connector

STOBER synchronous servo motors are equipped with twistable quick lock plug connectors in the standard version (external plug connector size con.58). For details see this section.

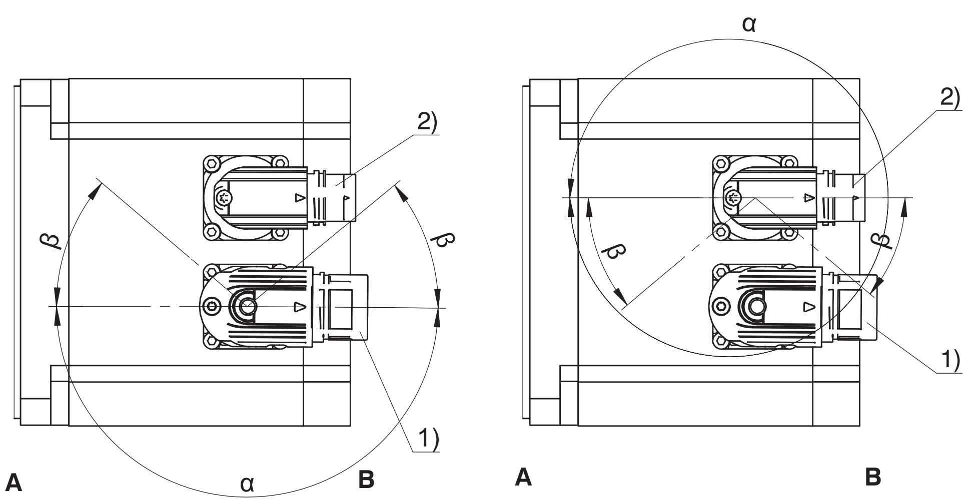
In motors with forced ventilation or water cooling, prevent collisions between the motor connection cables and the plug connector of the forced-cooling fan or the connecting lines of the cooling system. In the event of a collision, turn the motor plug connectors appropriately. For details on the position of the forced-cooling fan plug connector or the connections for water cooling, see the dimensional drawings section.

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

Turning ranges of plug connectors (EZ3 motors)



Turning ranges of plug connectors (EZ4 – EZ8 motors)



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	Turning range β
EZ3	con.15	Quick lock	180°	120°
EZ4, EZ5, EZ701, EZ703	con.23	Quick lock	180°	40°
EZ705, EZ802, EZ803, EZ805U	con.40	Quick lock	180°	40°
EZ805B, EZ805W	con.58	Screw thread[5]	0°	0°

Encoder plug connector features

Motor type	Size	Connection	Turning range α	Turning range β
EZ3	con.15	Quick lock	180°	120°
EZ4, EZ5, EZ7, EZ802, EZ803, EZ805U	con.17	Quick lock	180°	20°
EZ805B, EZ805W	con.17	Quick lock	180°	0°

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.
- For the EZ3 motor, the power and encoder plug connectors are mechanically connected and can only be turned together.

8.6.8.2 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.

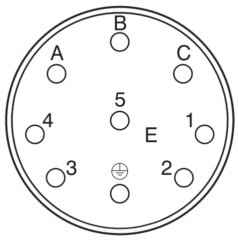
Cross-section of the copper protective grounding in the power cable (A)	Cross-section of the copper protective ground for motor housing (A_E)
A < 10 mm²	$A_E = A$
A ≥ 10 mm²	$A_E \geq 10$ mm²

[5] Specify the alignment to side A or B in the purchase order.

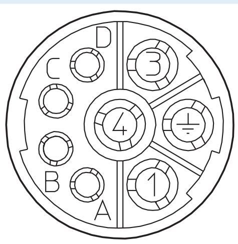
8.6.8.3 Connection assignment of the power plug connector

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.

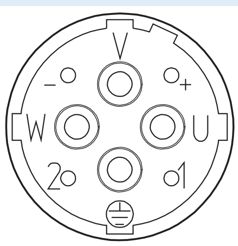
Plug connector size con.15

Connection diagram	Pin	Connection	Color
	A	1U1 (phase U)	BK
	B	1V1 (phase V)	BU
	C	1W1 (phase W)	RD
	1	1TP1/1K1 (temperature sensor)	
	2	1TP2/1K2 (temperature sensor)	
	3	1BD1 (brake +)	RD
	4	1BD2 (brake −)	BK
	⏚	PE (protective ground)	GNYE

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

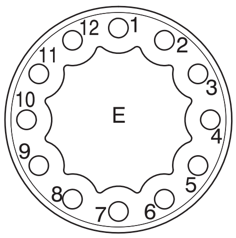
Plug connector size con.40 (1.5)/con.58 (3)

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

8.6.8.4 Connection assignment of encoder plug connector

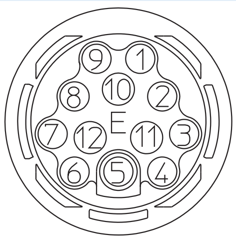
The size and connection assignment of the encoder plug connector depend on the type of the installed encoder and the size of the motor.

Encoder EnDat 2.1/2.2 digital, plug connector size con.15



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		

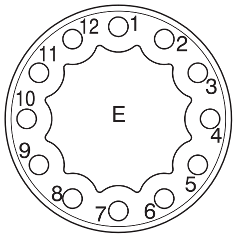
Encoder EnDat 2.1/2.2 digital, plug connector size con.17



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		

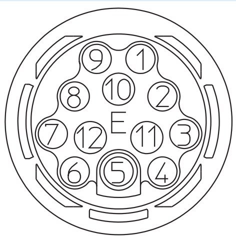
EZ

Encoder EnDat 2.2 digital with battery buffering, plug connector size con.15



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 2.2 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		

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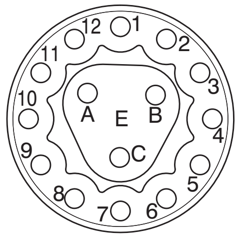
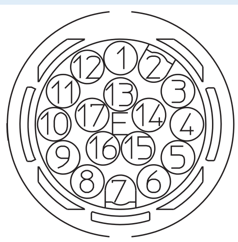
Encoder EnDat 2.1 with sin/cos incremental signals, plug connector size con.15



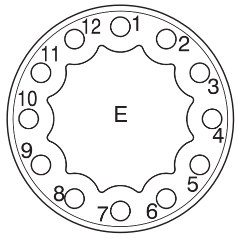
Connection diagram	Pin	Connection	Color
	1	Up sense	BU
	2	0 V sense	WH
	3	Up +	BN GN
	4	Clock +	VT
	5	Clock −	YE
	6	0 V GND	WH GN
	7	B + (sin +)	BU BK
	8	B − (sin −)	RD BK
	9	Data +	GY
	10	A + (cos +)	GN BK
	11	A − (cos −)	YE BK
	12	Data −	PK
	A		
	B		
	C		

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

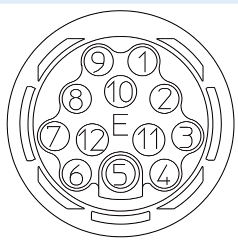


Connection diagram	Pin	Connection	Color
	1	Up sense	BU
	2		
	3		
	4	0 V sense	WH
	5		
	6		
	7	Up +	BN GN
	8	Clock +	VT
	9	Clock −	YE
	10	0 V GND	WH GN
	11		
	12	B + (sin +)	BU BK
	13	B − (sin −)	RD BK
	14	Data +	GY
	15	A + (cos +)	GN BK
	16	A − (cos −)	YE BK
	17	Data −	PK

Resolver, plug connector size con.15

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 +	YE WH
	8	R1 ref −	RD WH
	9		
	10		
	11		
	12		

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 +	YE WH
	8	R1 ref −	RD WH
	9		
	10		
	11		
	12		

8.7 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.

8.7.1 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 symbols	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_{limF}	Nm	Torque limit of the motor with forced ventilation
M_{limK}	Nm	Torque limit of the motor with convection cooling
M_{limW}	Nm	Torque limit of the motor with water 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
$n_{m,1*} – n_{m,6*}$	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:

$n_{m*} \leq n_N$

$M_{eff*} \leq M_{limK}$ or $M_{eff*} \leq M_{limF}$ or $M_{eff*} \leq M_{limW}$

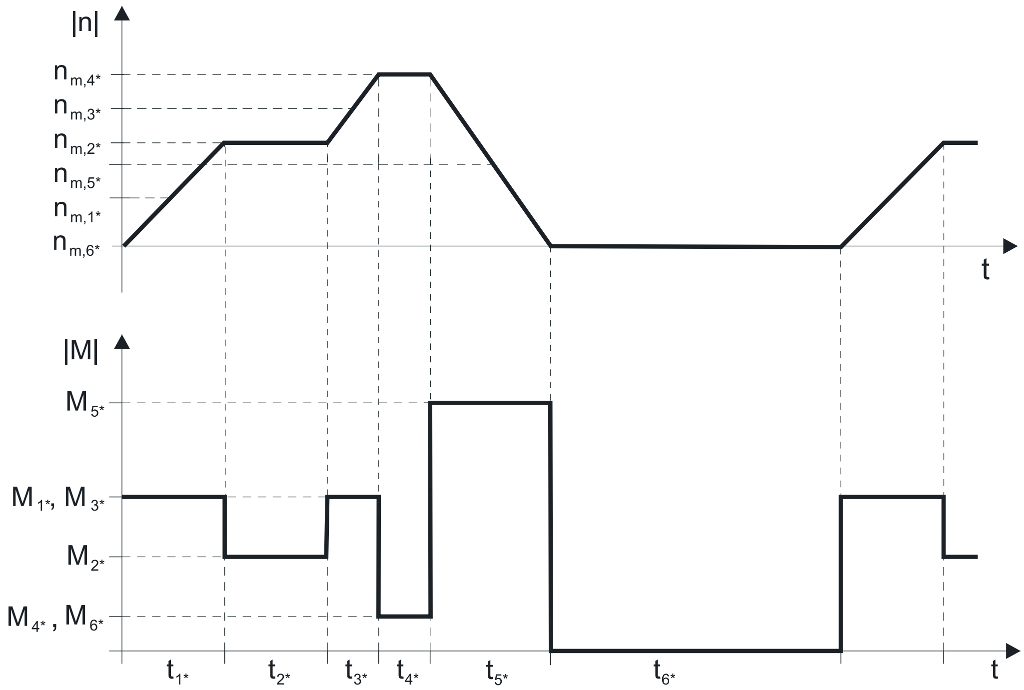
$M_{max*} < M_{max}$

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

The values for M_{limK} or M_{limF} or M_{limW} 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

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

If t_{1^*} + ... + $t_{5^*} \geq 10$ min, determine n_{m^*} without pause t_{6^*}.

Calculation of the existing effective torque

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

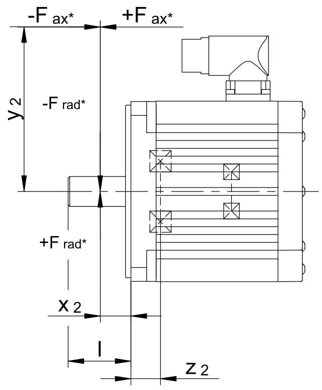
8.7.2 Permissible shaft loads

Formula symbols	Unit	Explanation
F_{ax^*}	N	Existing axial force on the output
F_{ax100}	N	Permitted axial force on the output for $n_{m^*} \leq 100$ rpm
F_{ax}	N	Permitted axial force on the output
F_{rad^*}	N	Existing radial force on the output
F_{rad100}	N	Permitted radial force on the output for $n_{m^*} \leq 100$ rpm
F_{rad}	N	Permitted radial force on the output
l	mm	Length of the output shaft
M_{k^*}	Nm	Existing breakdown torque on the output
M_{k100}	Nm	Permitted breakdown torque on the output for $n_{m^*} \leq 100$ rpm
M_k	Nm	Permitted breakdown torque on the output
n_{m^*}	rpm	Existing average motor speed

STOBER

EZ

Formula symbols	Unit	Explanation
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_{ax100} [N]	F_{rad100} [N]	M_{k100} [Nm]
EZ301	24,0	350	1000	39
EZ302	24,0	350	1000	39
EZ303	24,0	350	1000	39
EZ401	19,5	550	1800	62
EZ402	19,5	550	1800	71
EZ404	19,5	550	1800	71
EZ501	19,5	750	2000	79
EZ502	19,5	750	2400	95
EZ503	19,5	750	2400	107
EZ505	19,5	750	2400	107
EZ701	24,5	1300	3500	173
EZ702	24,5	1300	4200	208
EZ703	24,5	1300	4200	208
EZ705	24,5	1300	4200	225
EZ802	28,5	1750	5600	384
EZ803	28,5	1750	5600	384
EZ805	28,5	1750	5600	384

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

- For shaft dimensions according to the catalog
- If force is applied at the center of the output shaft: $x_2 = l / 2$ (shaft dimensions can be found in section [▸ 8.4]).
- Output speed $n_{m^*} \leq 100$ rpm ($F_{ax} = F_{ax100}$; $F_{rad} = F_{rad100}$; $M_k = M_{k100}$)

The following applies for output speeds n_{m*} > 100 rpm:

$$F_{ax} = \frac{F_{ax100}}{\sqrt[3]{\frac{n_{m*}}{100\ \text{rpm}}}} \qquad F_{rad} = \frac{F_{rad100}}{\sqrt[3]{\frac{n_{m*}}{100\ \text{rpm}}}} \qquad M_k = \frac{M_{k100}}{\sqrt[3]{\frac{n_{m*}}{100\ \text{rpm}}}}$$

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

$$M_{k*} = \frac{2 \cdot F_{ax*} \cdot y_2 + F_{rad*} \cdot (x_2 + z_2)}{1000} \leq M_{k100}$$

$$F_{rad*} \leq F_{rad100}$$

$$F_{ax*} \leq F_{ax100}$$

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

8.7.3 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 symbols	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

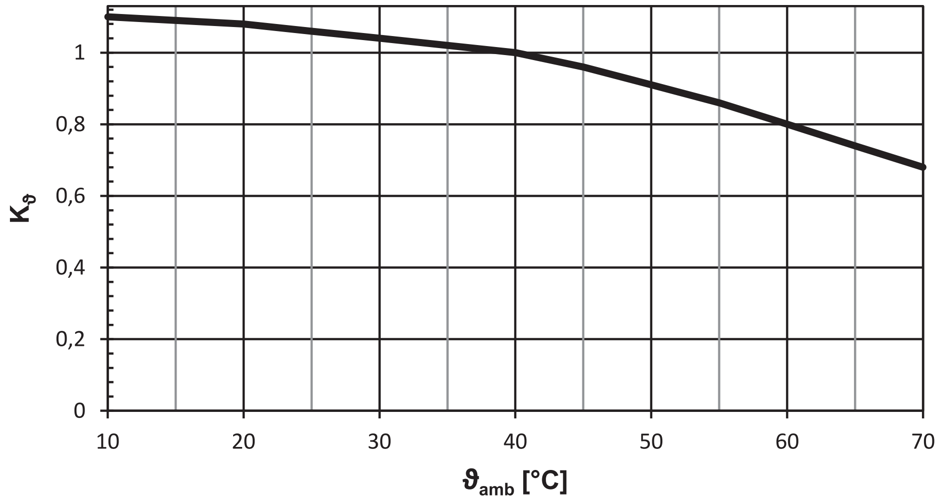


Fig. 3: Derating depending on the surrounding temperature

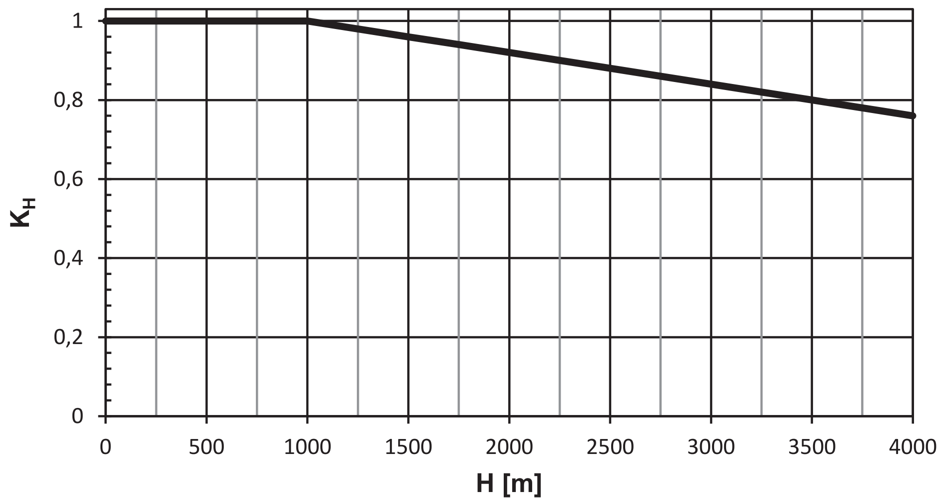


Fig. 4: Derating depending on the installation height

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:

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

8.8 Further information

8.8.1 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

8.8.2 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).

8.8.3 More documentation

More documentation concerning the product can be found at http://www.stoeber.de/en/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

9 EZHD synchronous servo motors with hollow shaft

Table of contents

STOBER

EZHD

9.1 Overview

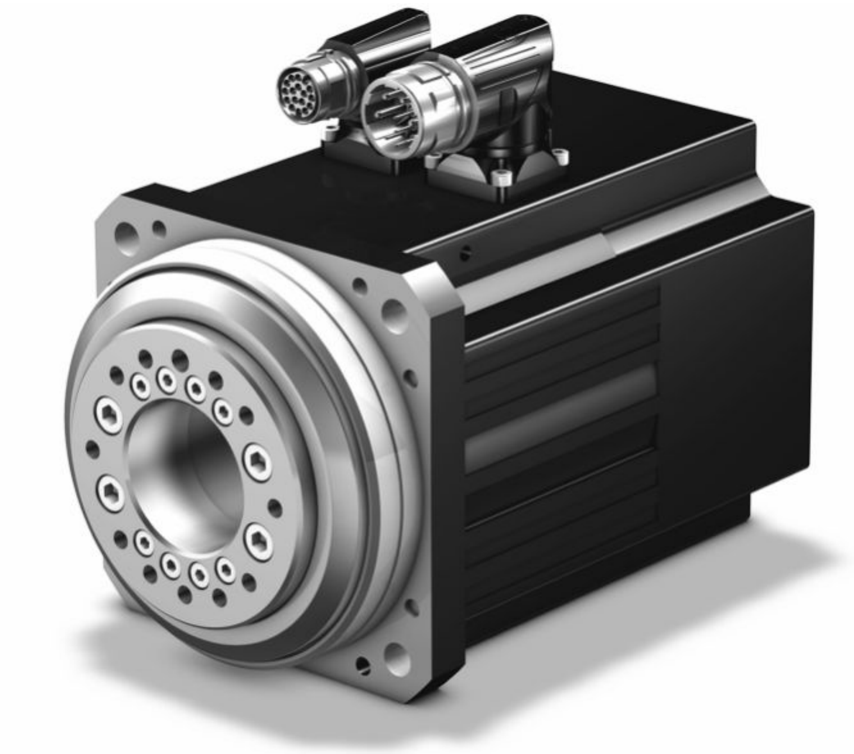
Synchronous servo motors with hollow shaft

Torques of motors with convection cooling

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)	✓
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	✓



9.2 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 m²
EZHD07	28 x 300 x 400 mm	0.3 m²

Note the differing ambient conditions in section [▸ 9.7.3]

Formula symbols	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}kgm²	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 symbols	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 min⁻¹]	n_N [min⁻¹]	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

9.3 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 symbols	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

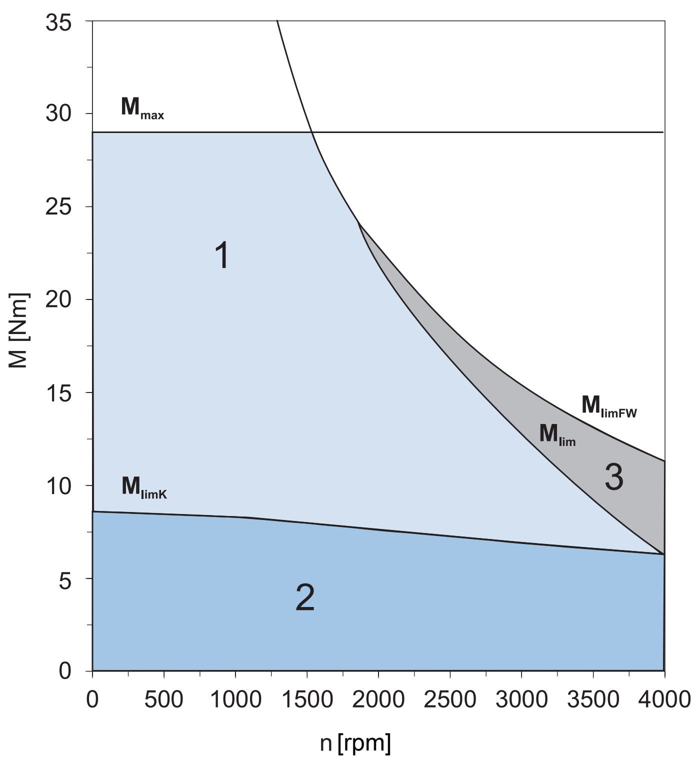


Fig. 1: Explanation of a torque/speed characteristic curve

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)		

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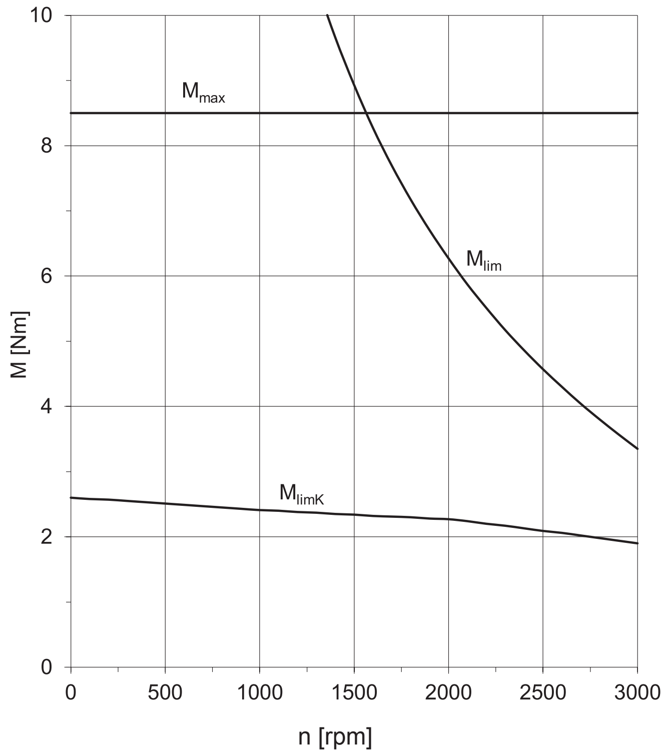
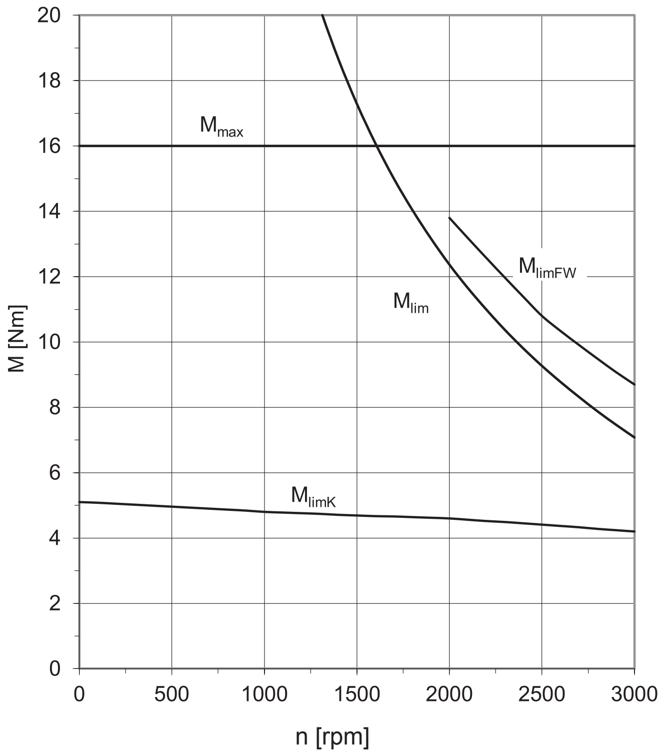
EZHD

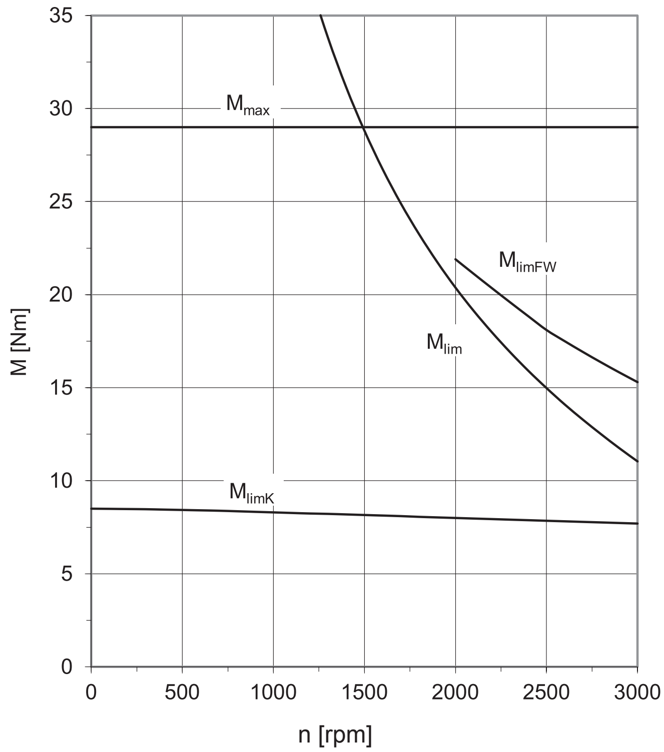
EZHD0411U (n_N=3000 rpm)



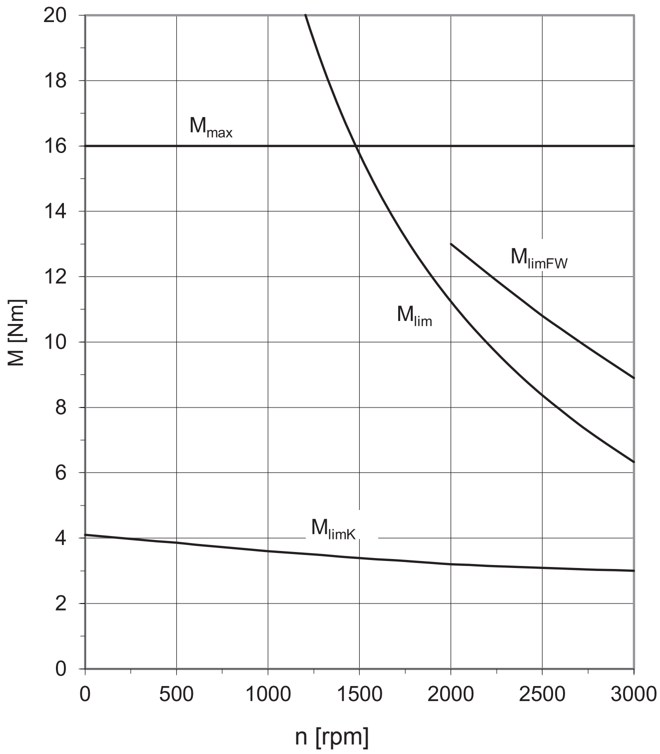
EZHD0412U (n_N=3000 rpm)



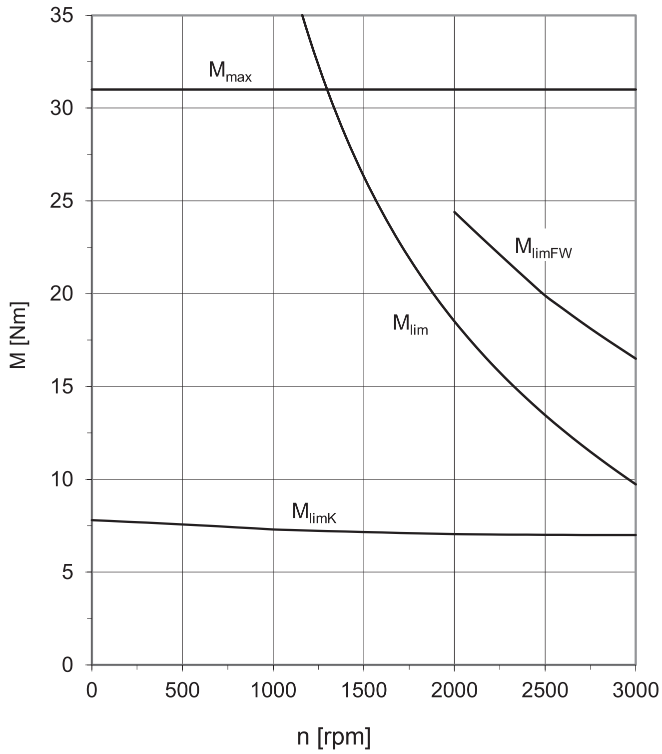
EZHD0414U (n_N=3000 rpm)



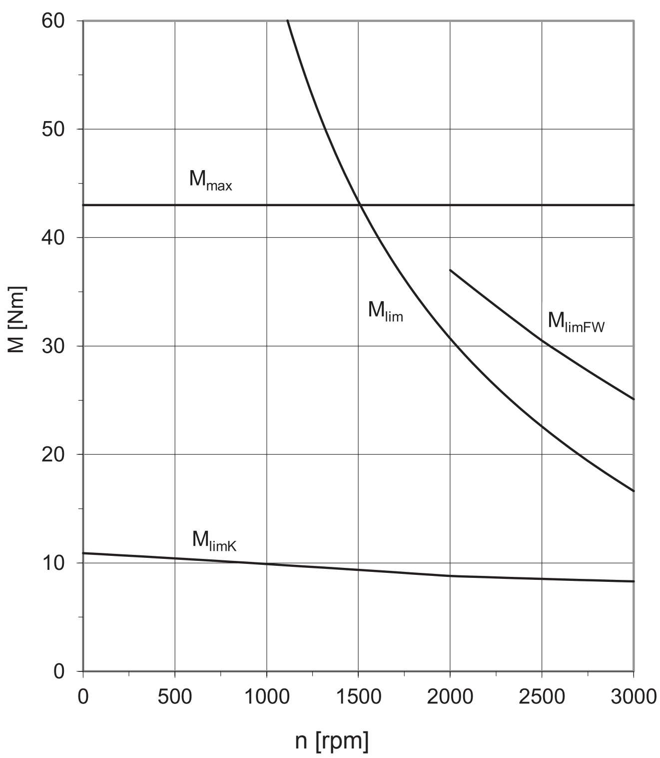
EZHD0511U (n_N=3000 rpm)



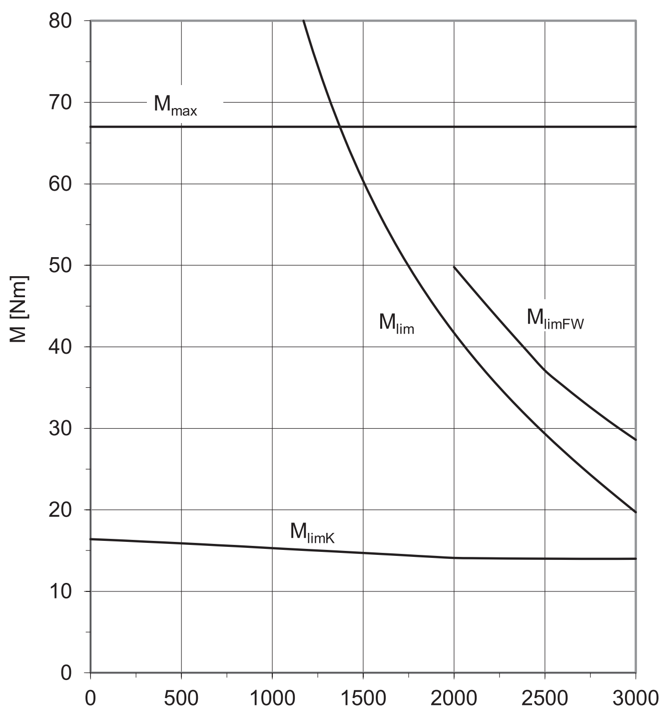
EZHD0512U (n_N=3000 rpm)



EZHD0513U (n_N=3000 rpm)



EZHD0515U (n_N=3000 rpm)



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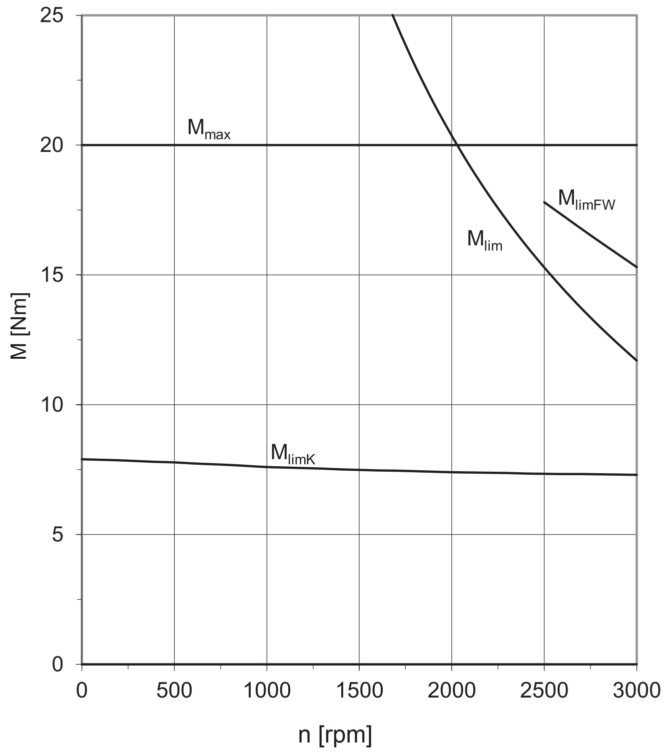
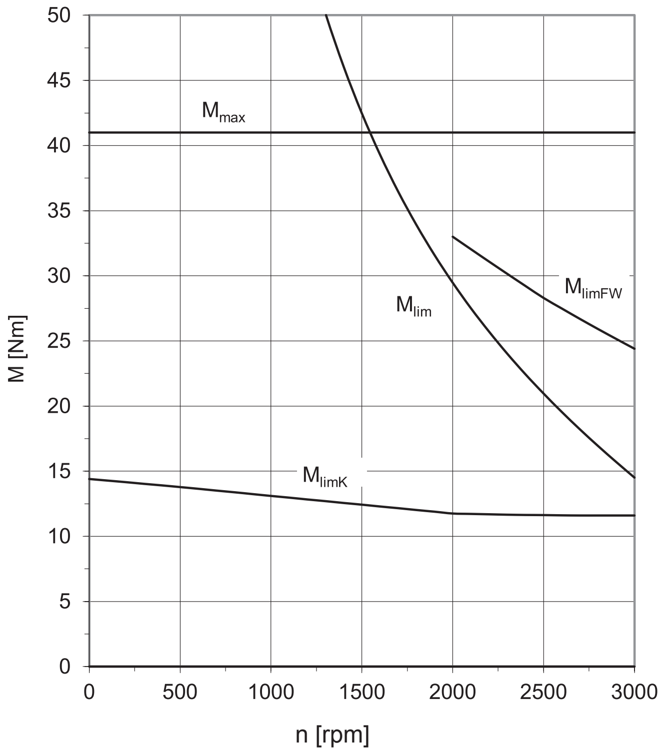
EZHD

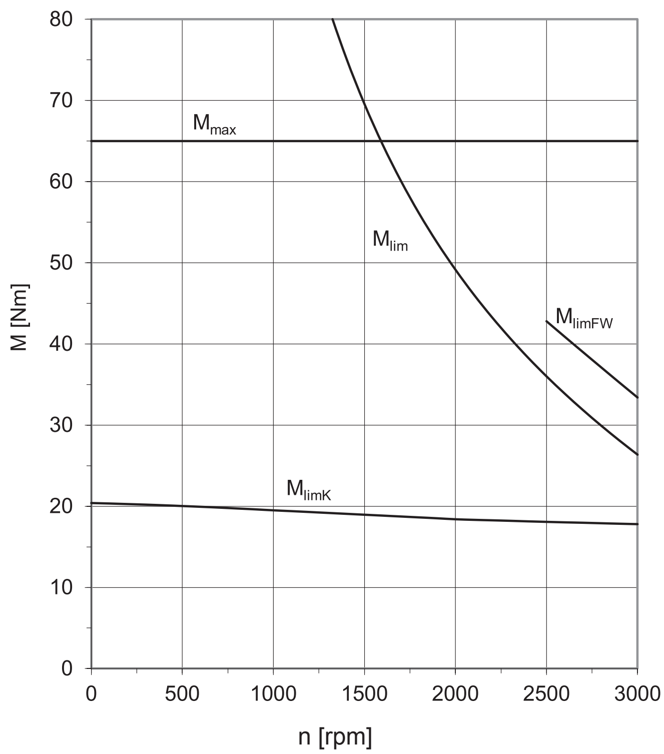
EZHD0711U (n_N=3000 rpm)



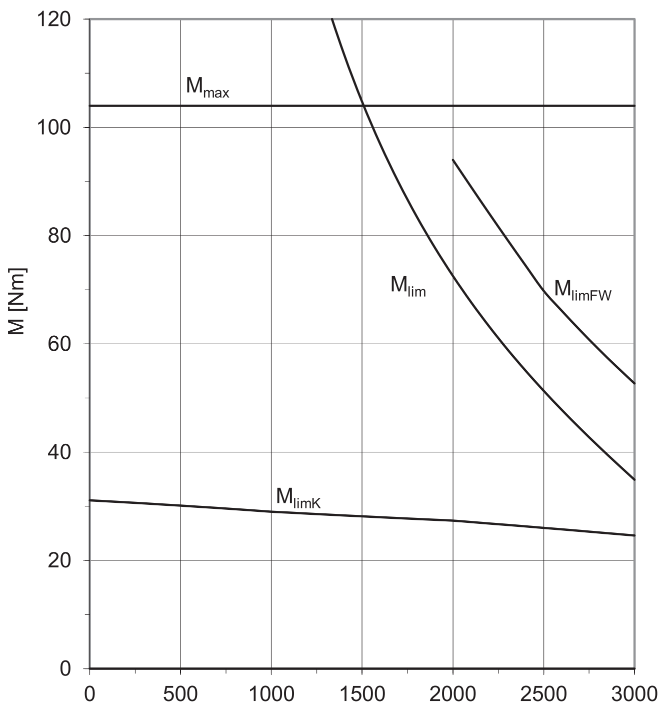
EZHD0712U (n_N=3000 rpm)



EZHD0713U (n_N=3000 rpm)



EZHD0715U (n_N=3000 rpm)



9.4 Dimensional drawings

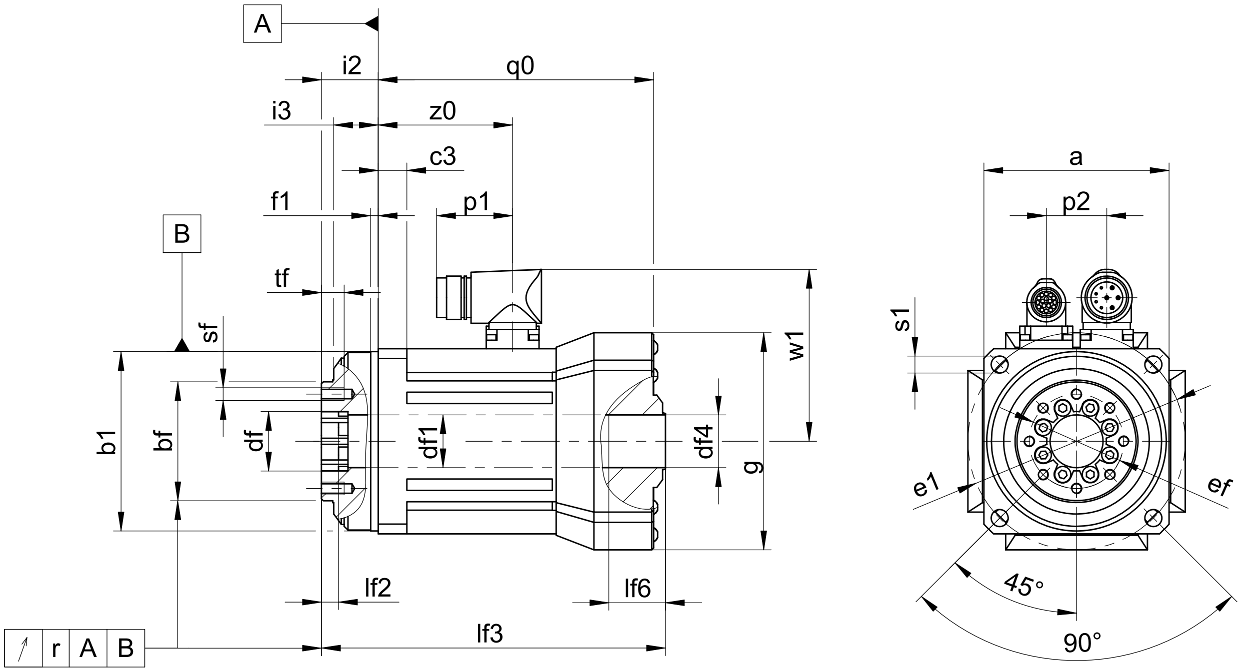
In this chapter you can find the dimensions of the motors.

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.

9.4.1 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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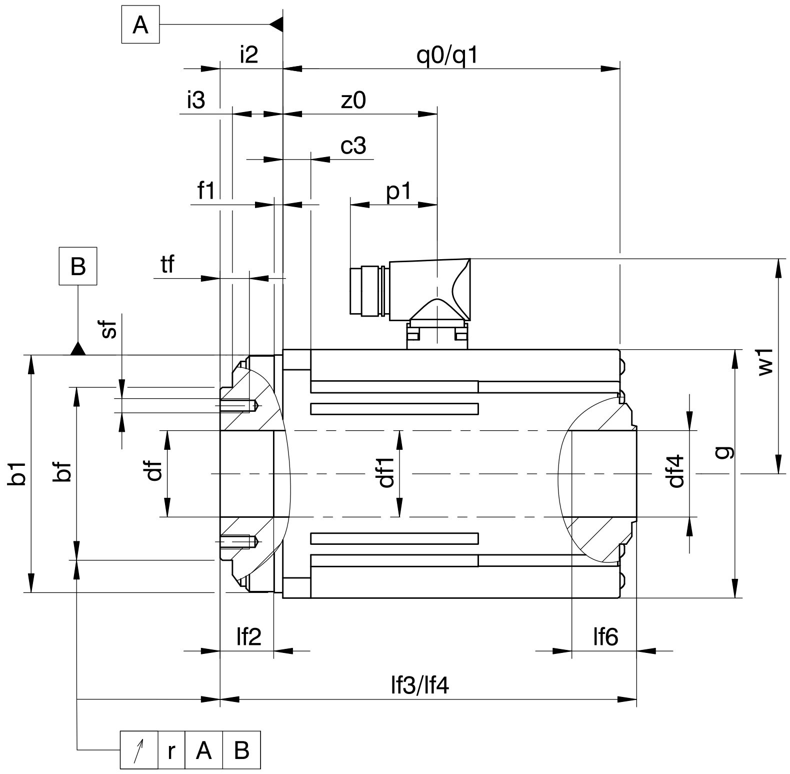
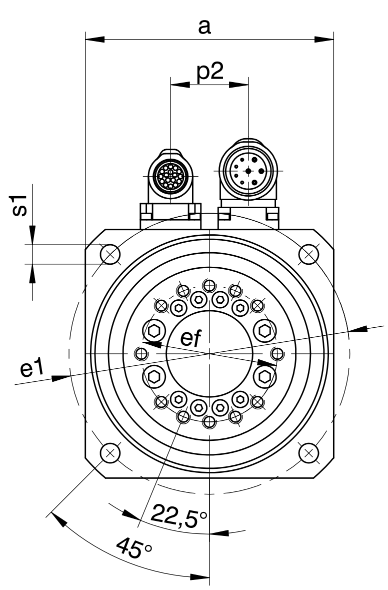
EZHD

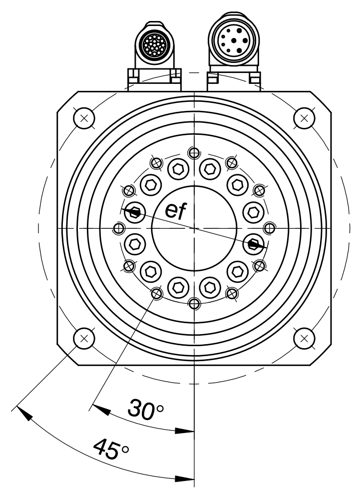
9.4.2 EZHD05 – EZHD07 motors



EZHD05



EZHD07



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

Type	□a	∅b1	∅bf	c3	∅df	∅df1	∅df4	∅e1	∅ef	f1	□g	i2	i3	lf2	lf3	lf6	p1	p2	q0	q1	r	∅s1	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

9.5 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 [▸ 9.6.4].
- In section [▸ 9.6.4.3], you can find information about connecting synchronous servo motors to other STOBER drive controllers.

9.6 Product description

9.6.1 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.

9.6.2 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

9.6.3 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 [▸ 9.7.3].

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.

9.6.4 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.

9.6.4.1 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		

9.6.4.2 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.

9.6.4.3 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**
Drive controller type code		AA	AB	AC	AD	AE
ID connection plan		442305	442306	442307	442450	442451
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).

9.6.5 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.

9.6.5.1 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 Δϑ = 100 K)

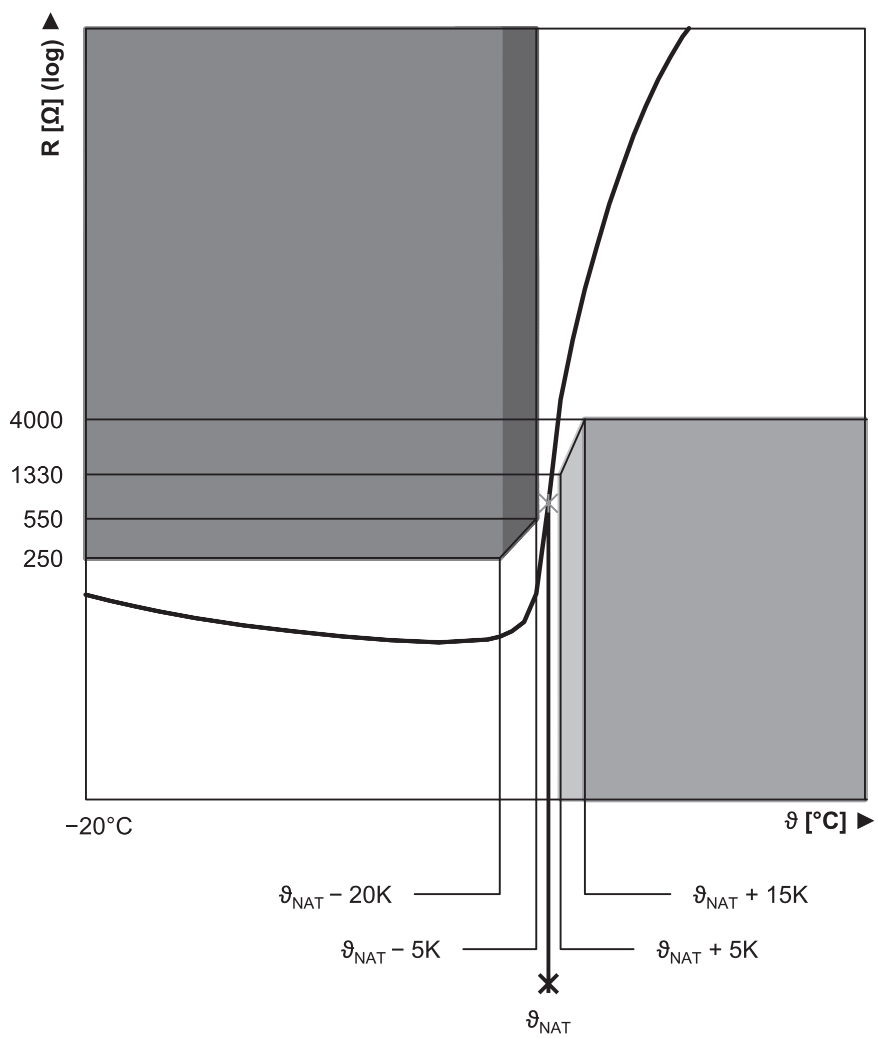


Fig. 2: Characteristic curve of PTC thermistor (single thermistor)

9.6.6 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.

9.6.7 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.

Observe the following for the configuration:

- The holding brake can be used for braking from full speed (following a power failure or when setting up the machine). 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 symbols	Unit	Explanation
$I_{N,B}$	A	Nominal current of the brake at 20 °C
ΔJ_B	10^{-4}kgm^2	Additive mass moment of inertia of a motor with holding brake
J	10^{-4}kgm^2	Mass moment of inertia
J_{Bstop}	10^{-4}kgm^2	Reference mass moment of inertia with braking from full speed: $J_{Bstop} = J \times 2$
J_{tot}	10^{-4}kgm^2	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

Formula symbols	Unit	Explanation
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
$W_{B,Rmax/h}$	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

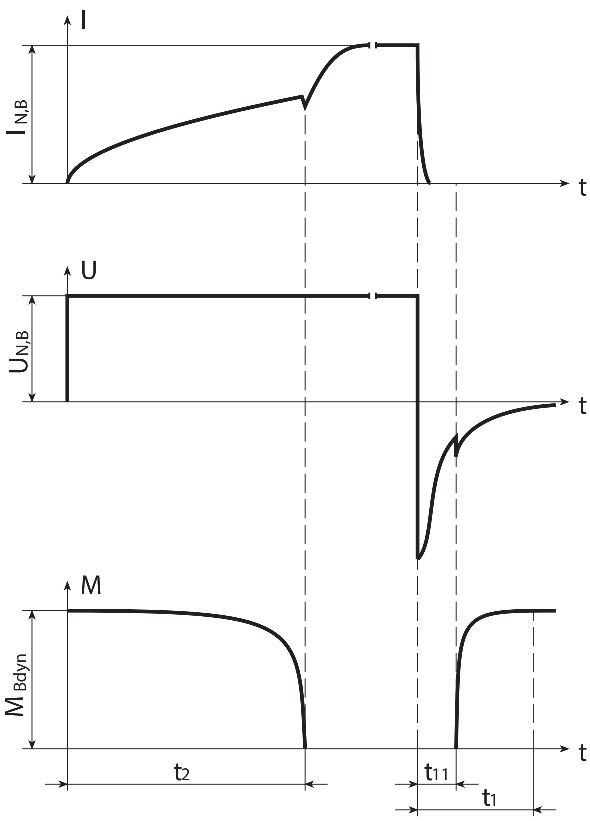
$$W_{B,R/B} = \frac{J_{tot} \cdot n^2}{182.4} \cdot \frac{M_{Bdyn}}{M_{Bdyn} \pm M_L}$$

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

9.6.8 Connection method

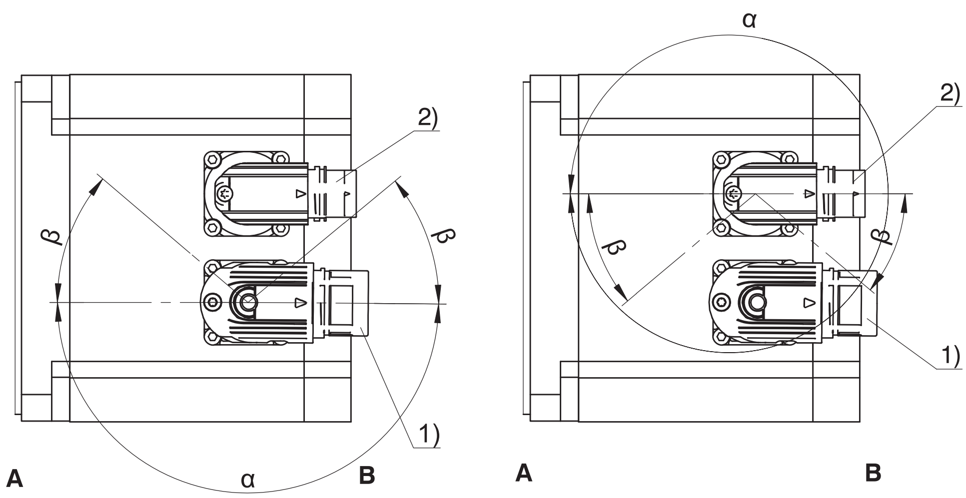
The following sections describe the connection technology of STOBER synchronous servo motors in the standard version of STOBER drive controllers. You can find further information relating to the drive controller type that was specified in your order in the connection plan that is delivered with every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

9.6.8.1 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	Turning range 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

9.6.8.2 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.

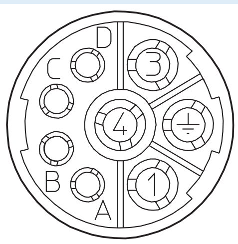
All attachment parts required for the connection of the protective ground to the motor housing are delivered with the motor. The grounding screw of the motor is identified with the symbol ⏚ as per IEC 60417-DB. The minimum cross-section of the protective ground is specified in the following table.

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

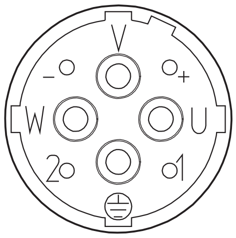
9.6.8.3 Connection assignment of the power plug connector

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

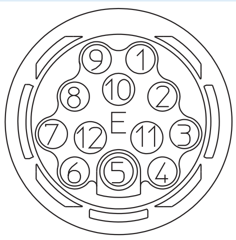
Plug connector size con.40 (1.5)

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

9.6.8.4 Connection assignment of encoder plug connector

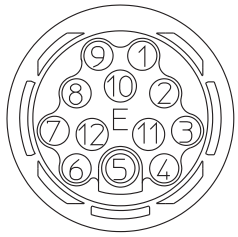
The size and connection assignment of the encoder plug connector depend on the type of the installed encoder and the size of the motor. The colors of the connection strands inside the motor and specified according to IEC 60757.

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		

EZHD

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

9.7 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.

9.7.1 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 symbols	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
$n_{m,1*} – n_{m,6*}$	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:

$n_{m*} \leq n_N$

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

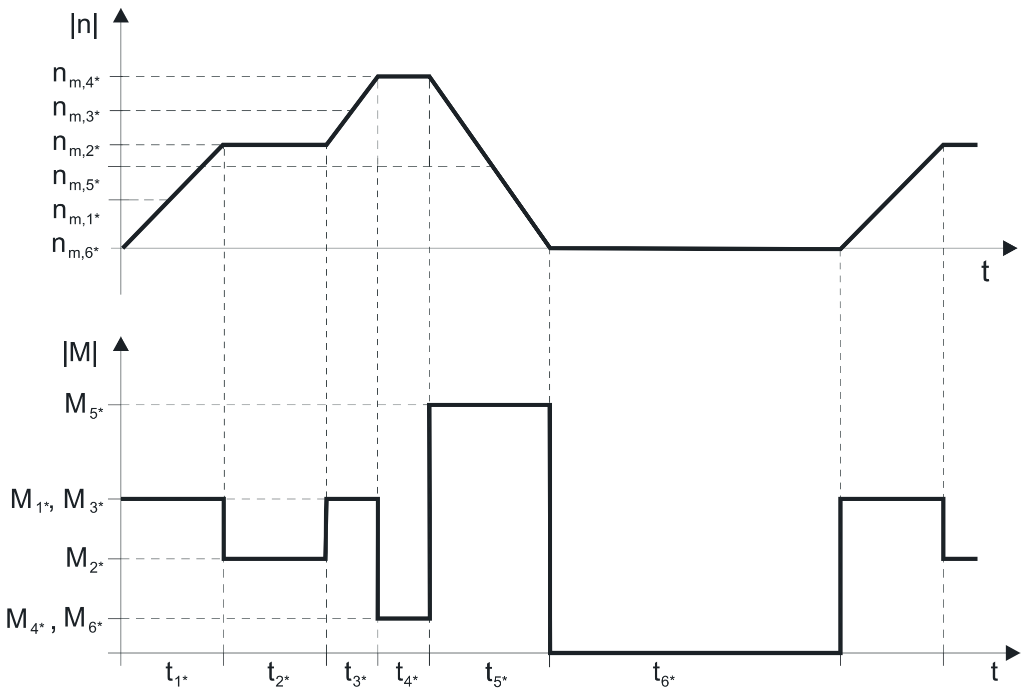
$M_{max*} < M_{max}$

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

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

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

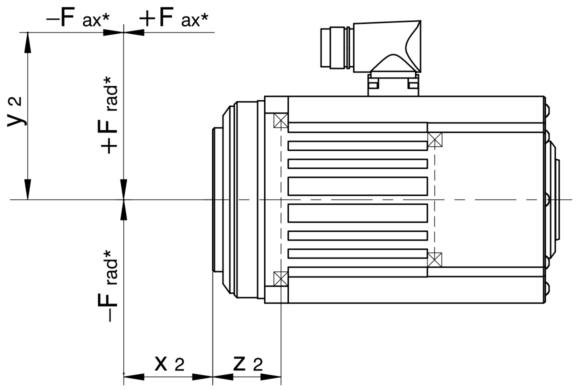
Calculation of the existing effective torque

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

9.7.2 Permissible shaft loads

Formula symbols	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^*} ≤ 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^*} ≤ 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^*} ≤ 300 rpm
n_{m^*}	rpm	Existing average motor speed
x_2	mm	Distance from shaft shoulder to the point of application of force

Formula symbols	Unit	Explanation
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
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:

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

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.

9.7.3 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 symbols	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

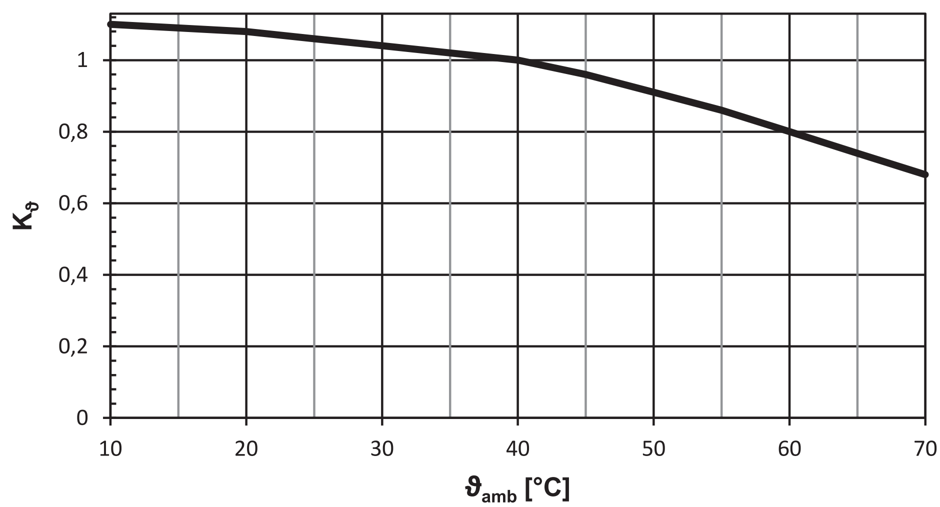


Fig. 3: Derating depending on the surrounding temperature

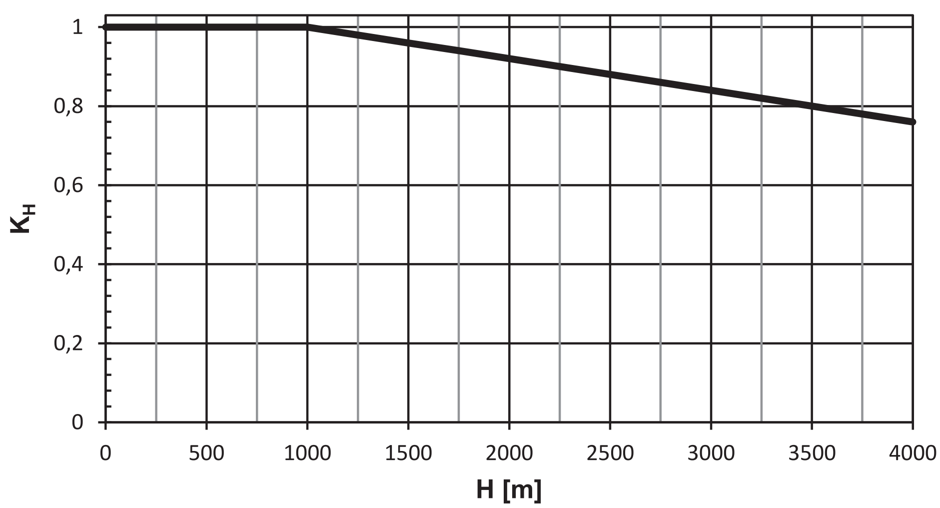


Fig. 4: Derating depending on the installation height

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:

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

9.8 Further information

9.8.1 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

9.8.2 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).

9.8.3 More documentation

More documentation concerning the product can be found at http://www.stoeber.de/en/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

10 EZHP synchronous servo geared motors with hollow shaft

Table of contents

10.1 Overview

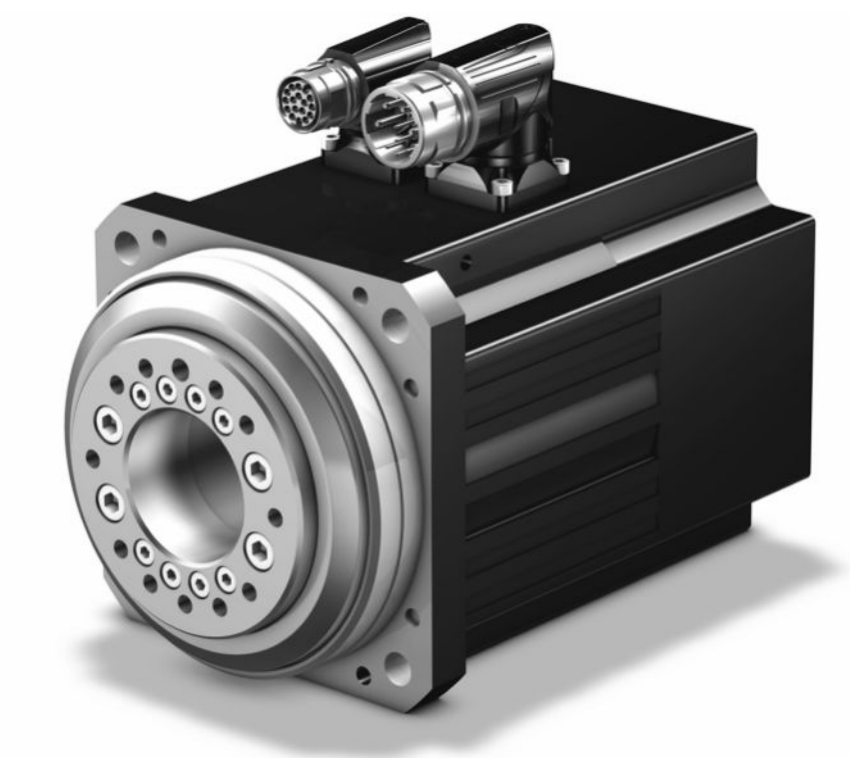
Synchronous servo geared motors with hollow shaft

Technical Data

i	3 – 27
M_{2acc}	47 – 500 Nm

Features

Continuous flange hollow shaft for conveying media	✓
Attached compact planetary gear unit with i = 3, 9 or 27	✓
Maintenance-free	✓
Any installation position	✓
Continuous operation without cooling (FKM sealing ring on the output)	✓
Backlash-free holding brake (optional)	✓
Convection cooling or water cooling (optional)	✓
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	✓



10.2 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

Formula symbols	Unit	Explanation
a_{th}	–	Parameter for calculating $K_{mot,th}$
C_2	Nm/ arcmin	Torsional stiffness of gear unit (final stiffness) relative to the gear unit output
$\Delta\varphi_2$	arcmin	Backlash on the output shaft with the input blocked
i	–	Gear ratio
i_{exakt}	–	Mathematically accurate gear transmission ratio
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_1	10^{-4}kgm^2	Mass moment of inertia relative to the gear unit input
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 %)
$M_{2.0}$	Nm	Standstill torque on the gear unit output
M_{2acc}	Nm	Maximum permitted acceleration torque on the gear unit output
$M_{2acc,max}$	Nm	Maximum permitted acceleration torque of a group of geared motor having the same size and nominal speed n_{1N}
M_{max}	Nm	Maximum torque: the maximum permitted torque the motor is able to deliver briefly (when accelerating or decelerating) (tolerance ±10 %)
M_{2N}	Nm	Nominal torque on the gear unit output (relative to n_{1N})
M_{2NOT}	Nm	Emergency off torque of the gear unit at gear unit output for max. 1000 load changes
M_N	Nm	Nominal torque: the maximum torque of a motor in S1 mode at nominal speed n_N (tolerance ±5 %)

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Formula symbols	Unit	Explanation
		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
n_{1N}	rpm	Nominal speed on the gear unit input
n_{2N}	rpm	Nominal speed on the gear unit output
n_{1maxDB}	rpm	Maximum permitted input speed of the gear unit in continuous operation
n_{1maxZB}	rpm	Maximum permitted input speed of the gear unit in cyclic operation
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
S	–	Characteristic load value: quotient of nominal gear unit and motor torque without taking the thermal output limit into consideration. Represents a dimension for the reserve of the geared motor.
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

10.2.1 Technical data for synchronous servo motor

The following tables show the technical data for the motor component of EZHP synchronous servo geared motors. You will need this technical data to calculate the operating point, among other things (see section [▷ 10.7.1])

EZHP motors with convection cooling

Type	K_{EM} [V/1000 min⁻¹]	n_N [min⁻¹]	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]
EZHP_511U	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
EZHP_512U	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
EZHP_513U	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
EZHP_515U	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
EZHP_711U	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
EZHP_712U	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
EZHP_713U	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
EZHP_715U	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

EZHP

EZHP motors with water cooling

Type	K_{EM} [V/1000 min⁻¹]	n_N [min⁻¹]	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]
EZHP_511W	97	3000	4.10	4.50	0.91	1.3	4.80	4.79	1.09	0.44	16.0	22.0	3.80	23.50	6.18
EZHP_512W	121	3000	8.15	6.54	1.25	2.6	9.00	7.07	1.33	0.44	31.0	33.0	2.32	16.80	7.24
EZHP_513W	119	3000	9.70	8.23	1.18	3.1	12.3	9.89	1.29	0.44	43.0	41.0	1.25	10.00	8.00
EZHP_515W	141	3000	16.2	11.0	1.48	5.1	18.6	12.5	1.53	0.44	67.0	52.0	0.93	8.33	8.96
EZHP_711W	95	3000	8.30	8.58	0.97	2.6	9.10	9.18	1.06	0.63	20.0	25.0	1.30	12.83	9.87
EZHP_712W	133	3000	13.6	9.60	1.42	4.3	16.6	11.5	1.50	0.63	41.0	36.0	1.00	11.73	11.73
EZHP_713W	122	3000	20.8	15.7	1.32	6.5	23.7	17.5	1.39	0.63	65.0	62.0	0.52	6.80	13.08
EZHP_715W	140	3000	29.0	20.3	1.43	9.1	35.7	24.2	1.50	0.63	104	87.0	0.33	4.80	14.55

10.2.2 Selection tables for synchronous servo geared motor

See the selection table below for the technical data of EZHP synchronous servo geared motors with convection cooling. For technical data of EZHP synchronous servo geared motors with water cooling go to http://products.stoeber.de.

n_{2N} [min⁻¹]	M_{2N} [Nm]	$M_{2,0}$ [Nm]	a_{th}	S	Type	M_{2acc} [Nm]	M_{2NOT} [Nm]	i	i_{exakt}	n_{1max} DB [min⁻¹]	n_{1max} ZB [min⁻¹]	J_1 [10⁻⁴ kgm²]	$Δφ_2$ [arcmin]	C_2 [Nm/ arcmin]	m [kg]
EZHP_5 (n_{1N} = 3000min⁻¹, $M_{2acc,max}$ = 200 Nm)															
111	75	103	9.4	1.6	EZHP3511U	200	400	27.00	27/1	3500	4500	13	4	81	12
333	26	35	17	3.2	EZHP2511U	140	400	9.000	9/1	2700	4500	13	4	84	11
333	60	67	40	1.4	EZHP2512U	200	400	9.000	9/1	2700	4500	16	4	84	13
333	71	93	47	1.2	EZHP2513U	200	400	9.000	9/1	2700	4500	19	4	84	15
1000	8.7	12	23	6.6	EZHP1511U	47	400	3.000	3/1	2000	4500	14	3	101	9.2
1000	20	23	53	2.8	EZHP1512U	90	400	3.000	3/1	2000	4500	17	3	101	11
1000	24	32	63	2.4	EZHP1513U	130	400	3.000	3/1	2000	4500	20	3	101	13
1000	41	48	106	1.4	EZHP1515U	190	400	3.000	3/1	2000	4500	26	3	101	16
EZHP_7 (n_{1N} = 3000min⁻¹, $M_{2acc,max}$ = 500 Nm)															
111	183	198	9.5	1.7	EZHP3711U	500	1000	27.00	27/1	3000	3500	36	4	215	23
111	291	362	15	1.1	EZHP3712U	500	1000	27.00	27/1	3000	3500	45	4	215	25
333	62	68	20	3.4	EZHP2711U	170	1000	9.000	9/1	2000	3500	36	4	217	20
333	99	123	32	2.2	EZHP2712U	350	1000	9.000	9/1	2000	3500	45	4	217	23
333	152	174	50	1.4	EZHP2713U	500	1000	9.000	9/1	2000	3500	54	4	217	26
333	210	266	69	1.0	EZHP2715U	500	1000	9.000	9/1	2000	3500	73	4	217	32
1000	21	23	23	7.0	EZHP1711U	58	1000	3.000	3/1	1600	3500	39	3	259	17
1000	34	42	36	4.4	EZHP1712U	120	1000	3.000	3/1	1600	3500	48	3	259	20
1000	52	59	56	2.9	EZHP1713U	190	1000	3.000	3/1	1600	3500	57	3	259	23
1000	72	91	77	2.1	EZHP1715U	300	1000	3.000	3/1	1600	3500	76	3	259	29

10.3 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.

The following torque/speed characteristic curves apply to EZHP synchronous servo geared motors without gear unit component. The torque/speed characteristic curves of the complete EZHP synchronous servo geared motor can be found at http://products.stoeber.de.

Formula symbols	Unit	Explanation
ED	%	Duty cycle relative to 20 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_{limW}	Nm	Torque limit of the motor with water 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

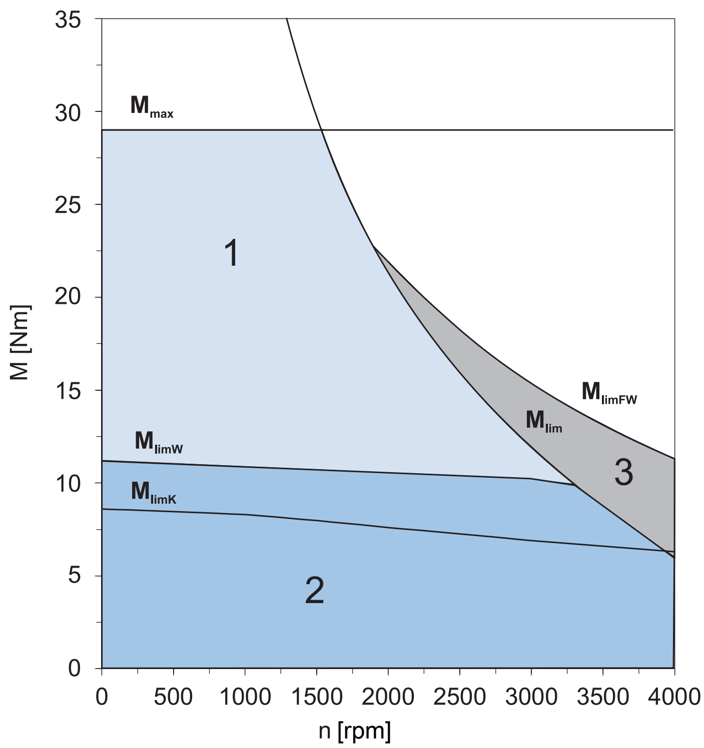
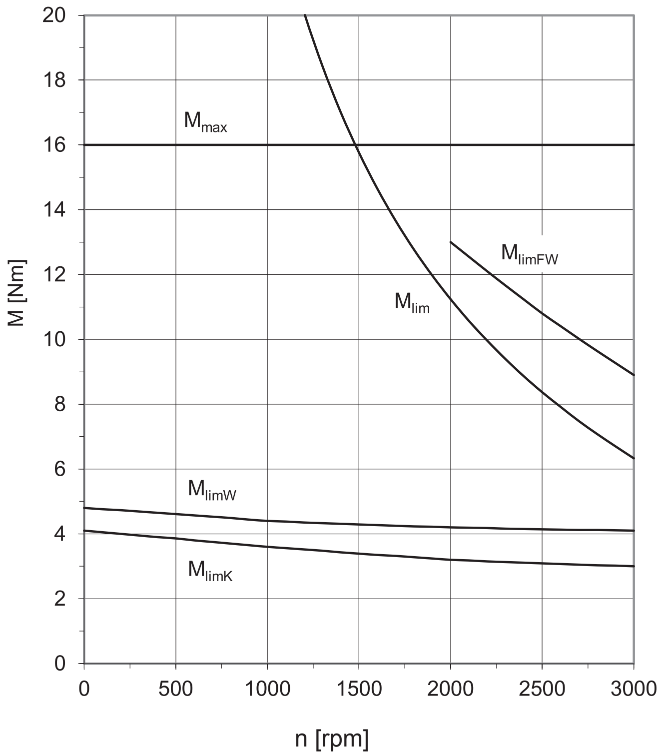


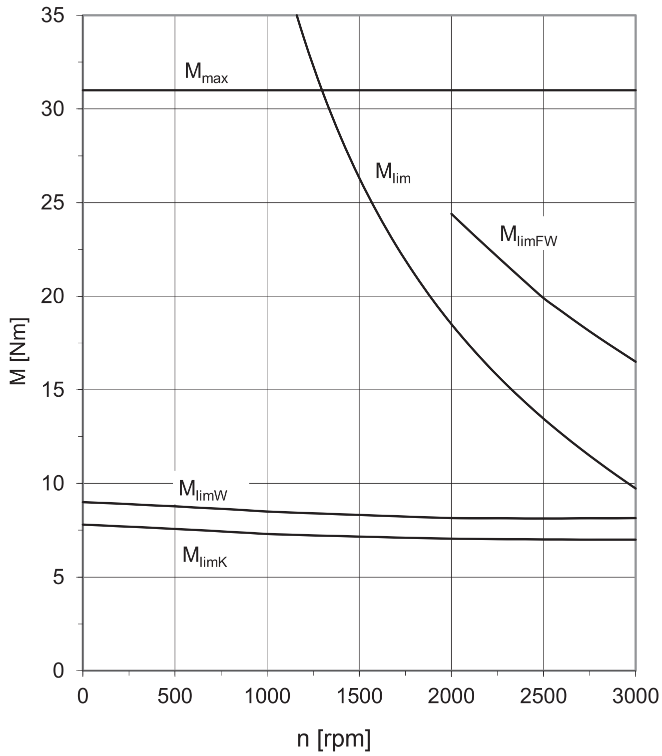
Fig. 1: Explanation of a torque/speed characteristic curve

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)		

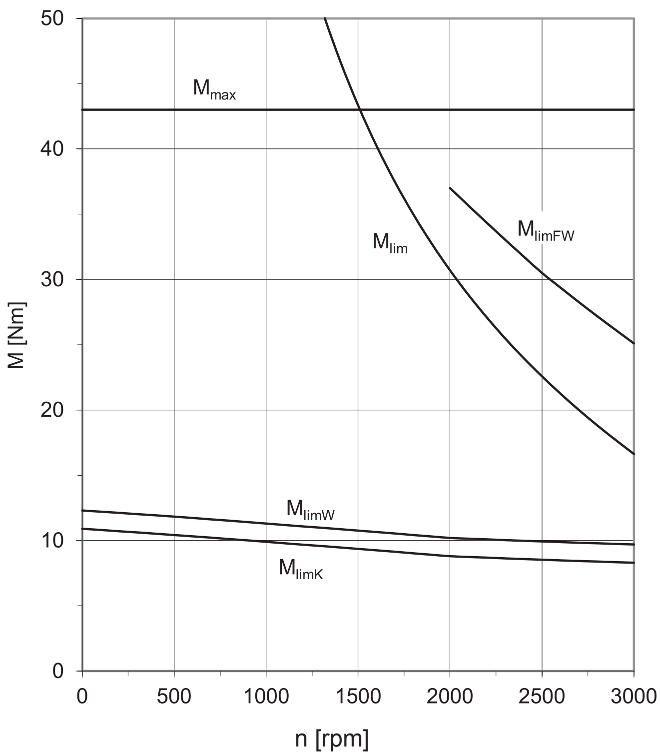
EZHP_511 (n_N=3000 rpm)



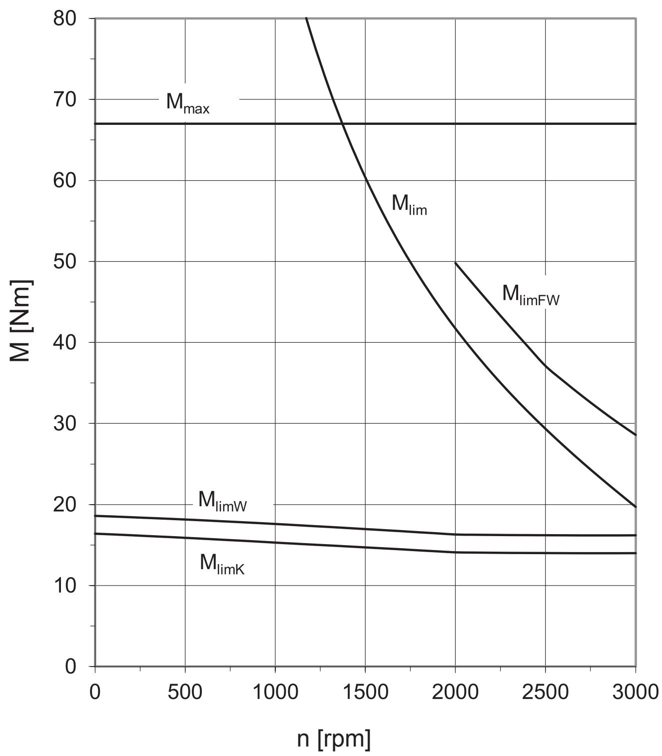
EZHP_512 (n_N=3000 rpm)



EZHP_513 (n_N=3000 rpm)

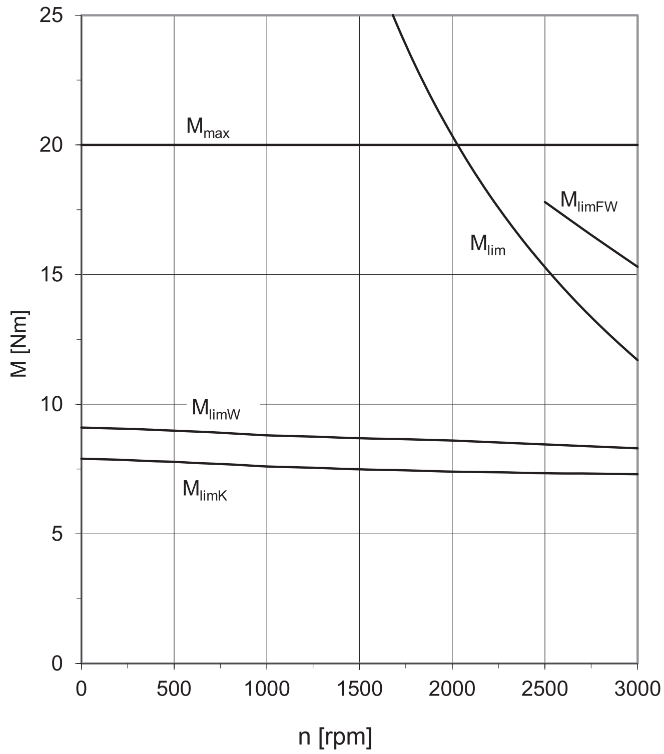


EZHP_515 (n_N=3000 rpm)

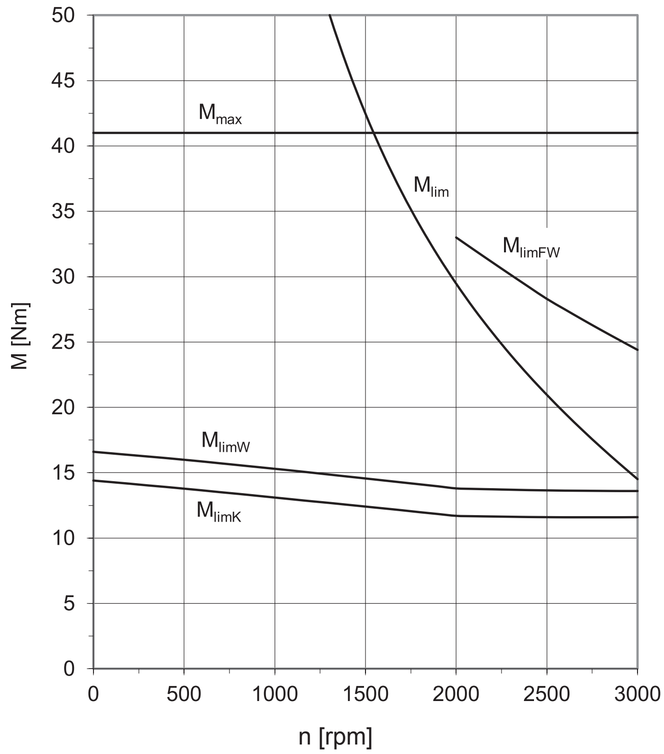


EZHP

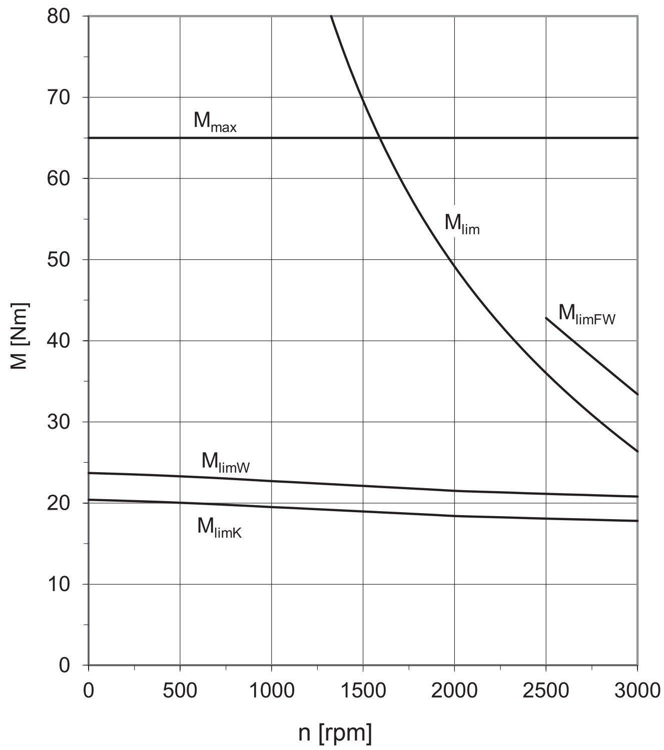
EZHP_711 (n_N=3000 rpm)



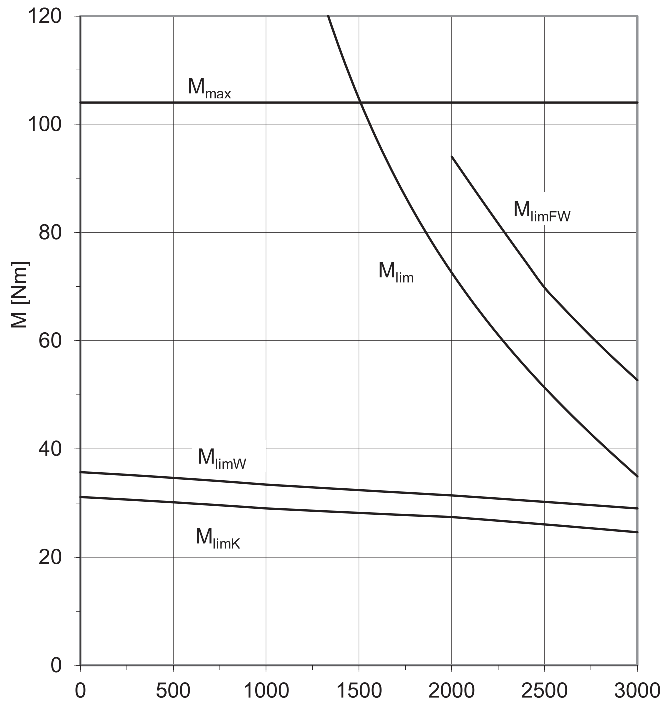
EZHP_712 (n_N=3000 rpm)



EZHP_713 (n_N=3000 rpm)



EZHP_715 (n_N=3000 rpm)



10.4 Dimensional drawings

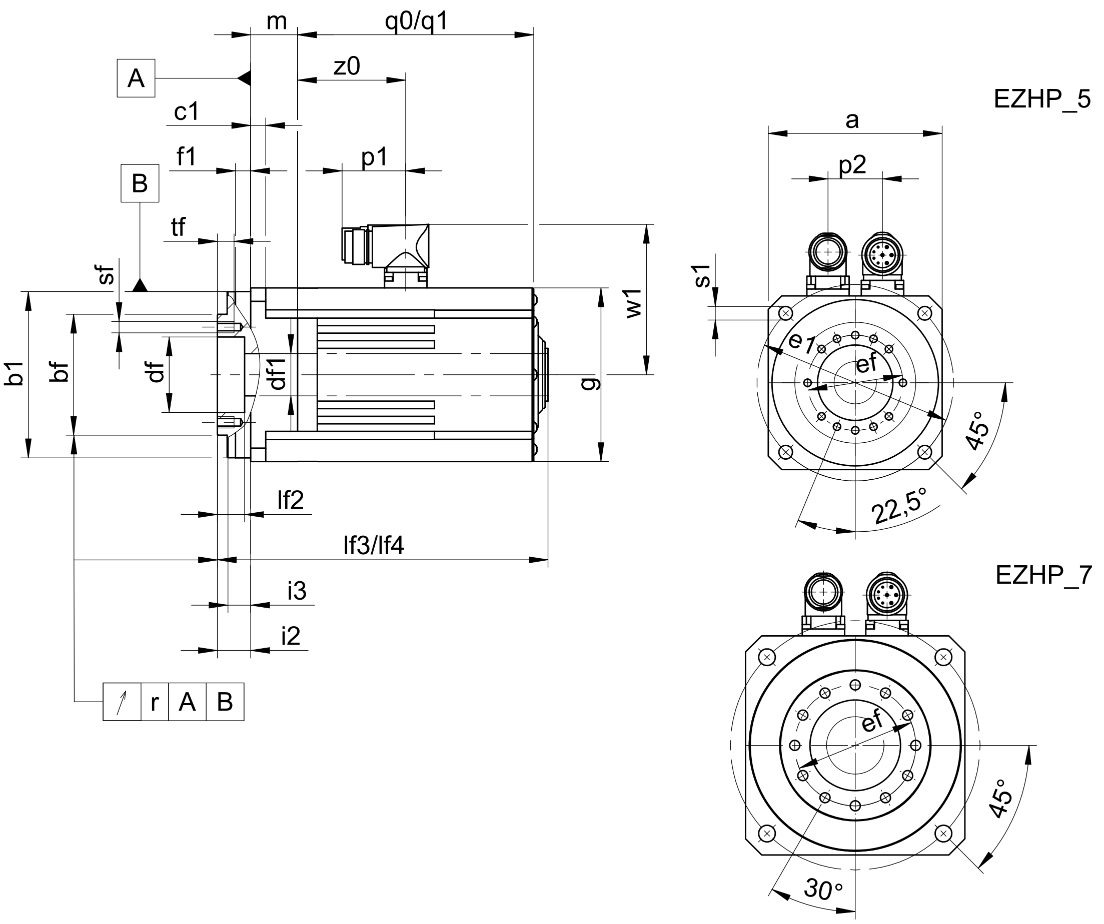
In this chapter you can find the dimensions of the motors.

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.

10.4.1 EZHP geared motors with convection cooling



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

Type	□a	Øb1	Øbf	c1	Ødf	Ødf1	Øe1	Øef	f1	□g	i2	i3	lf2	lf3	lf4	m	p1	p2	q0	q1	r	Øs1	sf	tf	w1	z0
EZHP1511U	115	110_{h7}	80_{h7}	10	50^{H7}	28	130	63	10	115	29	22.5	18	218.6	273.9	24.0	40	36	156.1	211.4	0.020	9	M6	11	100	71.5
EZHP1512U	115	110_{h7}	80_{h7}	10	50^{H7}	28	130	63	10	115	29	22.5	18	243.6	298.9	24.0	40	36	181.1	236.4	0.020	9	M6	11	100	96.5
EZHP1513U	115	110_{h7}	80_{h7}	10	50^{H7}	28	130	63	10	115	29	22.5	18	268.6	323.9	24.0	40	36	206.1	261.4	0.020	9	M6	11	100	121.5
EZHP1515U	115	110_{h7}	80_{h7}	10	50^{H7}	28	130	63	10	115	29	22.5	18	318.6	373.9	24.0	40	36	256.1	311.4	0.020	9	M6	11	100	171.5
EZHP1711U	145	140_{h7}	100_{h7}	15	60^{H7}	38	165	80	10	145	38	31.0	20	247.7	307.7	29.5	40	42	170.7	230.7	0.025	11	M8	14	115	77.2
EZHP1712U	145	140_{h7}	100_{h7}	15	60^{H7}	38	165	80	10	145	38	31.0	20	272.7	332.7	29.5	40	42	195.7	255.7	0.025	11	M8	14	115	102.2
EZHP1713U	145	140_{h7}	100_{h7}	15	60^{H7}	38	165	80	10	145	38	31.0	20	297.7	357.7	29.5	40	42	220.7	280.7	0.025	11	M8	14	115	127.2
EZHP1715U	145	140_{h7}	100_{h7}	15	60^{H7}	38	165	80	10	145	38	31.0	20	352.7	412.7	29.5	71	42	275.7	335.7	0.025	11	M8	14	134	178.2
EZHP2511U	115	110_{h7}	80_{h7}	10	50^{H7}	28	130	63	10	115	29	22.5	18	243.1	298.4	48.5	40	36	156.1	211.4	0.020	9	M6	11	100	71.5
EZHP2512U	115	110_{h7}	80_{h7}	10	50^{H7}	28	130	63	10	115	29	22.5	18	268.1	323.4	48.5	40	36	181.1	236.4	0.020	9	M6	11	100	96.5
EZHP2513U	115	110_{h7}	80_{h7}	10	50^{H7}	28	130	63	10	115	29	22.5	18	293.1	348.4	48.5	40	36	206.1	261.4	0.020	9	M6	11	100	121.5
EZHP2711U	145	140_{h7}	100_{h7}	15	60^{H7}	38	165	80	10	145	38	31.0	20	275.2	335.2	57.0	40	42	170.7	230.7	0.025	11	M8	14	115	77.2
EZHP2712U	145	140_{h7}	100_{h7}	15	60^{H7}	38	165	80	10	145	38	31.0	20	300.2	360.2	57.0	40	42	195.7	255.7	0.025	11	M8	14	115	102.2
EZHP2713U	145	140_{h7}	100_{h7}	15	60^{H7}	38	165	80	10	145	38	31.0	20	325.2	385.2	57.0	40	42	220.7	280.7	0.025	11	M8	14	115	127.2
EZHP2715U	145	140_{h7}	100_{h7}	15	60^{H7}	38	165	80	10	145	38	31.0	20	380.2	440.2	57.0	71	42	275.7	335.7	0.025	11	M8	14	134	178.2
EZHP3511U	115	110_{h7}	80_{h7}	10	50^{H7}	28	130	63	10	115	29	22.5	18	267.6	322.9	73.0	40	36	156.1	211.4	0.020	9	M6	11	100	71.5
EZHP3711U	145	140_{h7}	100_{h7}	15	60^{H7}	38	165	80	10	145	38	31.0	20	302.7	362.7	84.5	40	42	170.7	230.7	0.025	11	M8	14	115	77.2
EZHP3712U	145	140_{h7}	100_{h7}	15	60^{H7}	38	165	80	10	145	38	31.0	20	327.7	387.7	84.5	40	42	195.7	255.7	0.025	11	M8	14	115	102.2

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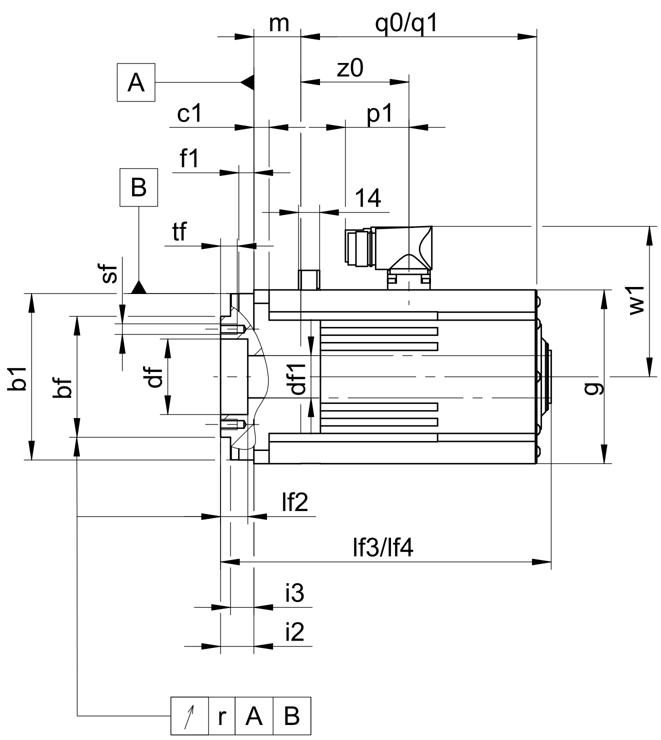
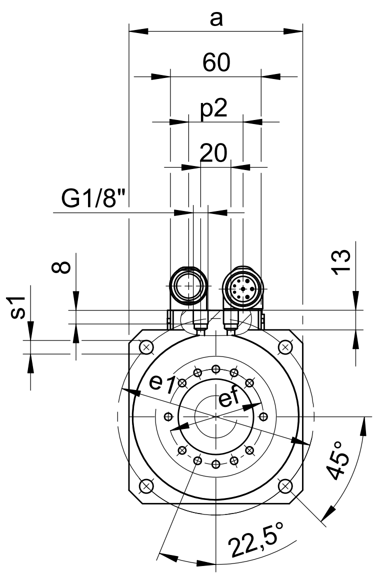
EZHP

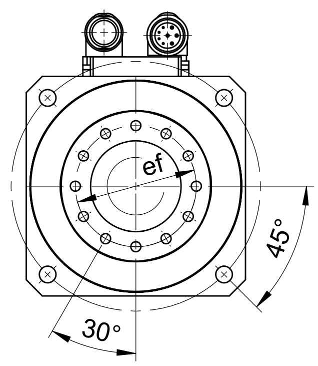
10.4.2 EZHP geared motors with water cooling



EZHP_5



EZHP_7



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

Type	□a	∅b1	∅bf	c1	∅df	∅df1	∅e1	∅ef	f1	□g	i2	i3	lf2	lf3	lf4	m	p1	p2	q0	q1	r	∅s1	sf	tf	w1	z0
EZHP1511W	115	110_{h7}	80_{h7}	10	50^{H7}	28	130	63	10	115	29	22.5	18	218.6	273.9	24.0	40	36	156.1	211.4	0.020	9	M6	11	100	71.5
EZHP1512W	115	110_{h7}	80_{h7}	10	50^{H7}	28	130	63	10	115	29	22.5	18	243.6	298.9	24.0	40	36	181.1	236.4	0.020	9	M6	11	100	96.5
EZHP1513W	115	110_{h7}	80_{h7}	10	50^{H7}	28	130	63	10	115	29	22.5	18	268.6	323.9	24.0	40	36	206.1	261.4	0.020	9	M6	11	100	121.5
EZHP1515W	115	110_{h7}	80_{h7}	10	50^{H7}	28	130	63	10	115	29	22.5	18	318.6	373.9	24.0	40	36	256.1	311.4	0.020	9	M6	11	100	171.5
EZHP1711W	145	140_{h7}	100_{h7}	15	60^{H7}	38	165	80	10	145	38	31.0	20	247.7	307.7	29.5	40	42	170.7	230.7	0.025	11	M8	14	115	77.2
EZHP1712W	145	140_{h7}	100_{h7}	15	60^{H7}	38	165	80	10	145	38	31.0	20	272.7	332.7	29.5	40	42	195.7	255.7	0.025	11	M8	14	115	102.2
EZHP1713W	145	140_{h7}	100_{h7}	15	60^{H7}	38	165	80	10	145	38	31.0	20	297.7	357.7	29.5	40	42	220.7	280.7	0.025	11	M8	14	115	127.2
EZHP1715W	145	140_{h7}	100_{h7}	15	60^{H7}	38	165	80	10	145	38	31.0	20	352.7	412.7	29.5	71	42	275.7	335.7	0.025	11	M8	14	134	178.2
EZHP2511W	115	110_{h7}	80_{h7}	10	50^{H7}	28	130	63	10	115	29	22.5	18	243.1	298.4	48.5	40	36	156.1	211.4	0.020	9	M6	11	100	71.5
EZHP2512W	115	110_{h7}	80_{h7}	10	50^{H7}	28	130	63	10	115	29	22.5	18	268.1	323.4	48.5	40	36	181.1	236.4	0.020	9	M6	11	100	96.5
EZHP2513W	115	110_{h7}	80_{h7}	10	50^{H7}	28	130	63	10	115	29	22.5	18	293.1	348.4	48.5	40	36	206.1	261.4	0.020	9	M6	11	100	121.5
EZHP2711W	145	140_{h7}	100_{h7}	15	60^{H7}	38	165	80	10	145	38	31.0	20	275.2	335.2	57.0	40	42	170.7	230.7	0.025	11	M8	14	115	77.2
EZHP2712W	145	140_{h7}	100_{h7}	15	60^{H7}	38	165	80	10	145	38	31.0	20	300.2	360.2	57.0	40	42	195.7	255.7	0.025	11	M8	14	115	102.2
EZHP2713W	145	140_{h7}	100_{h7}	15	60^{H7}	38	165	80	10	145	38	31.0	20	325.2	385.2	57.0	40	42	220.7	280.7	0.025	11	M8	14	115	127.2
EZHP3511W	115	110_{h7}	80_{h7}	10	50^{H7}	28	130	63	10	115	29	22.5	18	267.6	322.9	73.0	40	36	156.1	211.4	0.020	9	M6	11	100	71.5
EZHP3711W	145	140_{h7}	100_{h7}	15	60^{H7}	38	165	80	10	145	38	31.0	20	302.7	362.7	84.5	40	42	170.7	230.7	0.025	11	M8	14	115	77.2

10.5 Type designation

Sample code

EZH	P	2	5	1	1	U	F	AD	B1	O	097

Explanation

Code	Designation	Design
EZH	Type	Synchronous servo motor with hollow shaft
P	Drive	Attached planetary gear unit
1 **2** 3	Stages	1-stage (i=3) 2-stage (i=9) 3-stage (i=27)
5	Motor size	5 (example)
1	Generation	1
1	Length	1 (example)
U W	Cooling	Convection cooling Water 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
097	Electromagnetic constant (EMC) K_{EM}	97 V/1000 rpm (example)

Instructions

- You can find information about available encoders in section [▸ 10.6.7].
- In section [▸ 10.6.7.3], you can find information about connecting synchronous servo geared motors to other STOBER drive controllers.

10.6 Product description

10.6.1 General features

Feature	Description
Design	IM B5, IM V1, IM V3 in accordance with EN 60034-7/A1
Protection class	IP56 / IP66 (option)
Thermal class	155 (F) as per EN 60034-1 (155 °C, heating $\Delta\vartheta$ = 100 K)
Maximum permitted temperature at the surface of the geared motor	≤ 80 °C
Surface[1]	Black matte as per RAL 9005
Cooling	IC 410 convection cooling (Water cooling in the A-side flange optional)
Sealing	Gamma ring (on B side), shaft seal ring (on A side)
Shaft	Flange hollow shaft

[1] Repainting will change the thermal properties and therefore the performance limits of the motor.

Feature	Description
Vibration intensity	A as per EN 60034-14/A1
Noise level	Limit values according to EN 60034-9/A1 (motor components) Limit values according to VDI 2159 (geared component)

10.6.2 Electrical features

General electrical features of the motor component of the geared 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

10.6.3 Installation conditions

The torques and forces specified only apply for the attachment of gear units on the machine side using screws of quality 10.9. In addition, the gear housing must be adjusted at the pilot (H7).

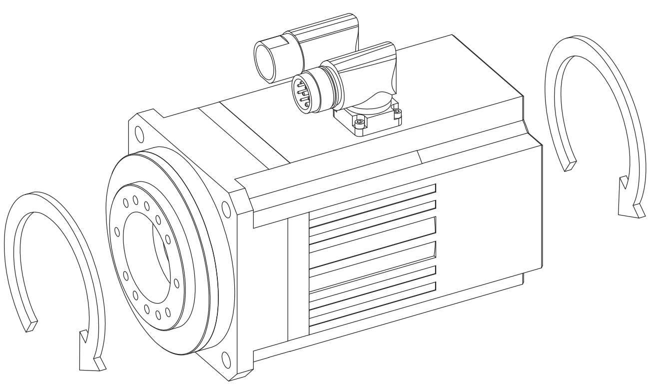
10.6.4 Lubricants

STOBER fills the gear units with the amount and type of lubricant specified on the nameplate.

The Quantity of lubricant for gear units, document ID 441871, can be found online at http://www.stoeber.de

10.6.5 Direction of rotation

The input and output turn in the same direction.



10.6.6 Ambient conditions

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

Feature	Description
Transport/storage surrounding temperature[2]	-30 °C to +85 °C
Surrounding operating temperature	−15 °C to +40 °C (without water cooling) +10 °C to +40 °C (with water cooling)
Installation altitude	≤ 1000 m above sea level
Shock load	≤ 50 m/s^2 (5 g), 6 ms as per EN 60068-2-27

Instructions

- EHZP synchronous servo geared motors are not suitable for use in potentially explosive atmospheres according to ATEX Directive.
- 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 geared motor with output units to which the geared motor is connected.

10.6.7 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.

10.6.7.1 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		

10.6.7.2 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

[2] If you will be storing or transporting the system in which a geared motor with water cooling is installed below +3 °C, drain the water completely out of the cooling circuit in advance.

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.

10.6.7.3 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
Drive controller type code		AA	AB	AC	AD	AE
ID connection plan		442305	442306	442307	442450	442451
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).

10.6.8 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.

10.6.8.1 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)

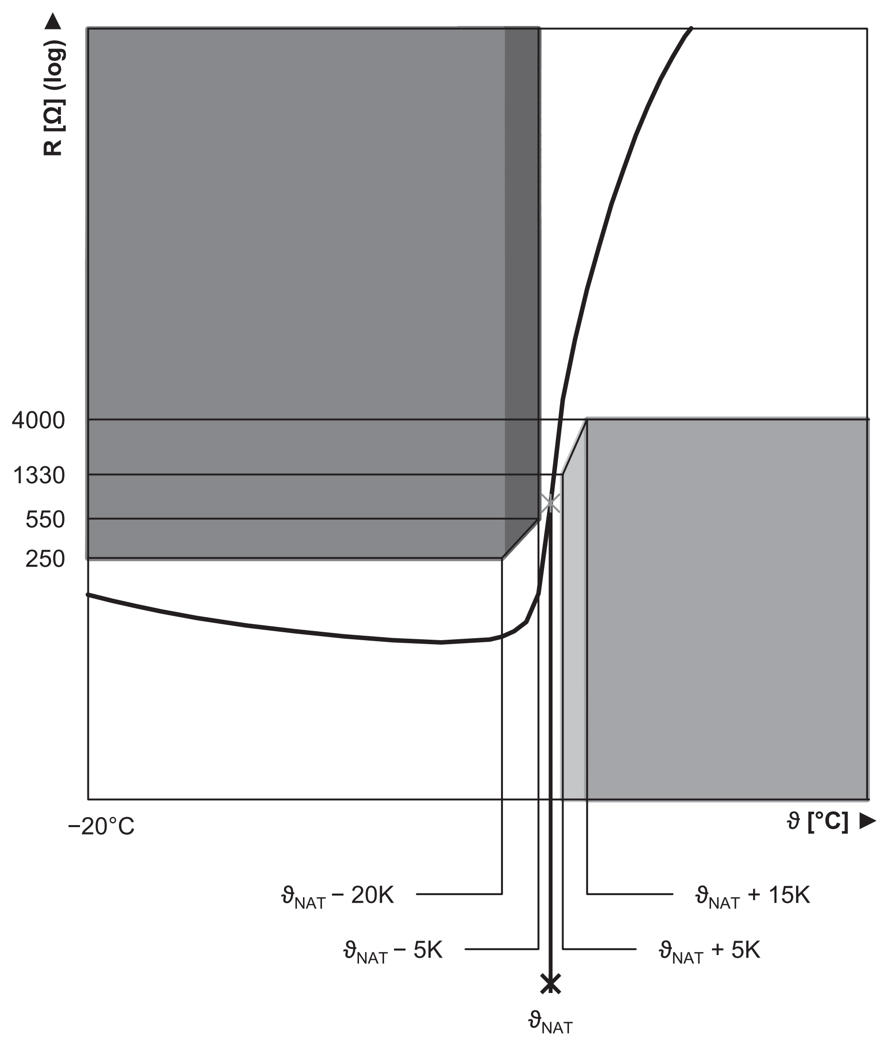


Fig. 2: Characteristic curve of PTC thermistor (single thermistor)

10.6.9 Cooling

An EZHP synchronous servo geared motor in the standard version is cooled by convection cooling (IC 410 in accordance with EN 60034-6). The air flowing around the geared motor is heated by the radiated motor heat and rises. The geared motor can optionally be cooled with water.

10.6.9.1 Water cooling

The EZHP synchronous servo geared motors can optionally be cooled with water to increase the performance data for the same size. Water cooling cannot be retrofitted. It must be specified in the purchase order.

The performance data of the geared motors with water cooling can be found in section [▸ 10.2], the dimensional drawings in section [▸ 10.4.2].

EZHP

Cooling circuit specification

Feature	Description
Coolant	Water
Temperature at inlet	+5 °C to +40 °C (max. 5 K below the surrounding temperature)
Cooling circuit	Closed, with recooling unit
Cleanliness	Clear, with no suspended matter or dirt, use particle filter ≤ 100 µm if necessary
pH value	6.5 – 7.5
Hardness	1.43 – 2.5 mmol/l
Salinity	NaCl < 100 ppm, demineralized
Anticorrosive	Maximum percentage 25 %, neutral relative to AlCuMgPb F38, GG-220HB
Operating pressure	≤ 3.5 bar (provide a pressure relief valve in the supply line if necessary)
Flow rate	Optimum 6 l/min, minimum 4.5 l/min (EZHP_5)
	Optimum 7.5 l/min, minimum 5 l/min (EZHP_7)

Instructions

- The nominal data for EZHP synchronous servo geared motors with water cooling refers to water as a coolant. If another coolant is used, the nominal data must be determined again.
- For detailed information about the cooling system or coolants and coolant additives, please contact the manufacturer of your cooling system.
- Coolant with fresh water from the public supply grid with coolants, lubricants or cutting agents from the machining process is not permitted.
- If the temperature of the coolant is lower than the surrounding temperature, interrupt the supply of coolant when the geared motor is stopped for extended times to prevent condensation water from forming.
- If you will be storing or transporting the system in which the geared motor is installed below +3 °C, drain the water completely out of the cooling circuit in advance.
- Further information on water cooling can be found in the operating manual for the geared motor.

10.6.10 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.

Observe the following for the configuration:

- The holding brake can be used for braking from full speed (following a power failure or when setting up the machine). 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 symbols	Unit	Explanation
$I_{N,B}$	A	Nominal current of the brake at 20 °C
ΔJ_B	10^{-4}kgm^2	Additive mass moment of inertia of a motor with holding brake
J	10^{-4}kgm^2	Mass moment of inertia
J_{Bstop}	10^{-4}kgm^2	Reference mass moment of inertia with braking from full speed: $J_{Bstop} = J \times 2$
J_{tot}	10^{-4}kgm^2	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

Formula symbols	Unit	Explanation
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
$W_{B,Rmax/h}$	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

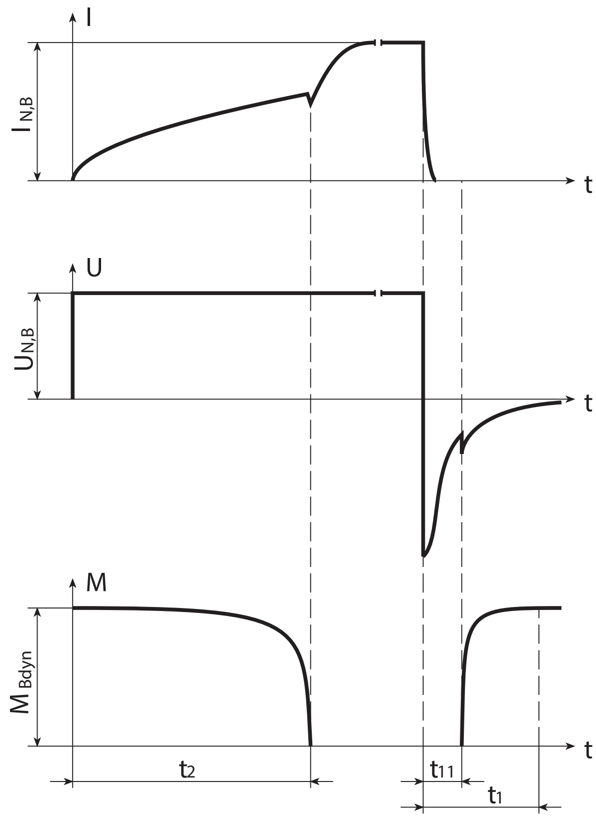
$$W_{B,R/B} = \frac{J_{tot} \cdot n^2}{182.4} \cdot \frac{M_{Bdyn}}{M_{Bdyn} \pm M_L}$$

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]
EZHP_511	18	15	1.1	11.0	3250	34.1	550	55	3.0	30	0.3	5.450	2.32
EZHP_512	18	15	1.1	11.0	2750	40.2	550	55	3.0	30	0.3	5.450	2.32
EZHP_513	18	15	1.1	11.0	2400	46.3	550	55	3.0	30	0.3	5.450	2.32
EZHP_515	18	15	1.1	11.0	1850	58.8	550	55	3.0	30	0.3	5.450	2.32
EZHP_711	28	25	1.1	25.0	3200	88.6	1400	120	4.0	40	0.4	12.620	3.91
EZHP_712	28	25	1.1	25.0	2650	107	1400	120	4.0	40	0.4	12.620	3.91
EZHP_713	28	25	1.1	25.0	2250	125	1400	120	4.0	40	0.4	12.620	3.91
EZHP_715	28	25	1.1	25.0	1700	162	1400	120	4.0	40	0.4	12.620	3.91

10.6.11 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.

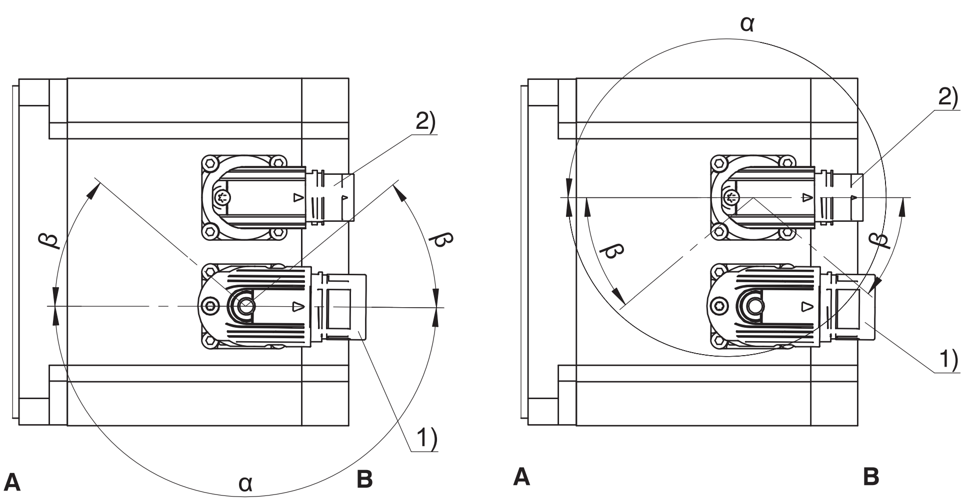
10.6.11.1 Plug connector

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

In motors with water cooling, prevent collisions between the motor connection cables and the connecting lines of the cooling system. In the event of a collision, turn the motor plug connectors appropriately. Details regarding the position of the connections for water cooling can be found in the dimensional drawings 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	Turning range β
EZHP_5, EZHP_711 – EZHP_713	con.23	Quick lock	180°	40°
EZHP_715	con.40	Quick lock	180°	40°

Encoder plug connector features

Motor type	Size	Connection	Turning range	
			α	β
EZHP	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.

10.6.11.2 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.

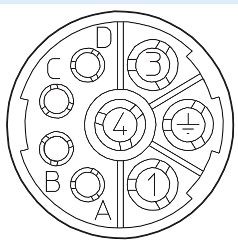
All attachment parts required for the connection of the protective ground to the motor housing are delivered with the motor. The grounding screw of the motor is identified with the symbol ⏚ as per IEC 60417-DB. The minimum cross-section of the protective ground is specified in the following table.

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

10.6.11.3 Connection assignment of the power plug connector

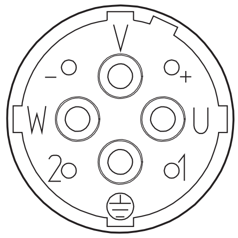
The size and connection plan of the power plug connector depend on the size of the motor. The colors of the connection strands inside the motor and specified according to IEC 60757.

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

STÖBER

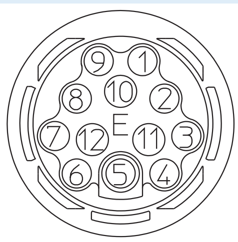
Plug connector size con.40 (1.5)

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

10.6.11.4 Connection assignment of encoder plug connector

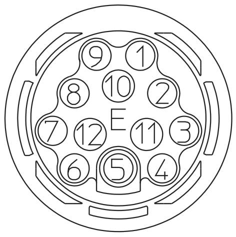
The size and connection assignment of the encoder plug connector depend on the type of the installed encoder and the size of the motor. The colors of the connection strands inside the motor and specified according to IEC 60757.

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		

EZHP

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

10.7 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.

10.7.1 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 symbols	Unit	Explanation
a_{th}	–	Parameter for calculating $K_{mot,th}$
ED	%	Duty cycle relative to 20 minutes
fB_{op}	–	Operational factor – operation mode
fB_t	–	Operational factor – runtime
fB_T	–	Operational factor – temperature
i	–	Gear ratio
$K_{mot,th}$	–	Factor for determining the thermal limit torque
$\|M_2\|$	Nm	Amount of the torque on the output
$M_{2.1*}$ – $M_{2.6*}$	Nm	Existing torque in the relevant time segment (1 to 6)
M_{2acc}	Nm	Maximum permitted acceleration torque on the gear unit output
M_{2acc*}	Nm	Existing acceleration torque on the gear unit output
M_{2eff*}	Nm	Existing effective torque on the gear unit output
M_{2eq*}	Nm	Existing equivalent torque on the gear unit output
M_{2N}	Nm	Nominal torque on the gear unit output (relative to n_{1N})
M_{2NOT}	Nm	Emergency off torque of the gear unit at gear unit output for max. 1000 load changes
M_{2NOT*}	Nm	Existing emergency off torque for the gear unit on the gear unit output
M_{2th}	Nm	Thermal limit torque on the gear unit output
M_{op}	Nm	Torque of motor in the operating point from the motor characteristics for n_{1m*}
n_{1m*}	rpm	Existing average input speed
n_{1max*}	rpm	Existing maximum input speed
n_{1maxDB}	rpm	Maximum permitted input speed of the gear unit in continuous operation
n_{1maxZB}	rpm	Maximum permitted input speed of the gear unit in cyclic operation
$\|n_2\|$	rpm	Amount of the output speed
$n_{2m,1*}$ – $n_{2m,6*}$	rpm	Existing average output speed in the respective time segment (1 bis 6)
n_{2m*}	rpm	Existing average output speed
n_N	rpm	Nominal speed: the speed for which the nominal torque M_N is specified
S	–	Characteristic load value: quotient of nominal gear unit and motor torque without taking the thermal output limit into consideration. Represents a dimension for the reserve of the geared motor.

Formula symbols	Unit	Explanation
t	s	Time
$t_{1*} – t_{6*}$	s	Duration of the relevant time segment (1 to 6)

Check the following conditions for operating points other than the nominal point specified in the selection tables M_{2N}.

$$n_{1m*} \leq \frac{n_{1maxDB}}{fB_T}$$

$$n_{1max*} \leq \frac{n_{1maxZB}}{fB_T}$$

$$M_{2eff*} \leq M_{2th}$$

$$M_{2acc*} \leq M_{2acc}$$

$$M_{2NOT*} \leq M_{2NOT}$$

$$M_{2eq*} \leq M_{2N} \cdot \frac{S}{fB_{op} \cdot fB_t}$$

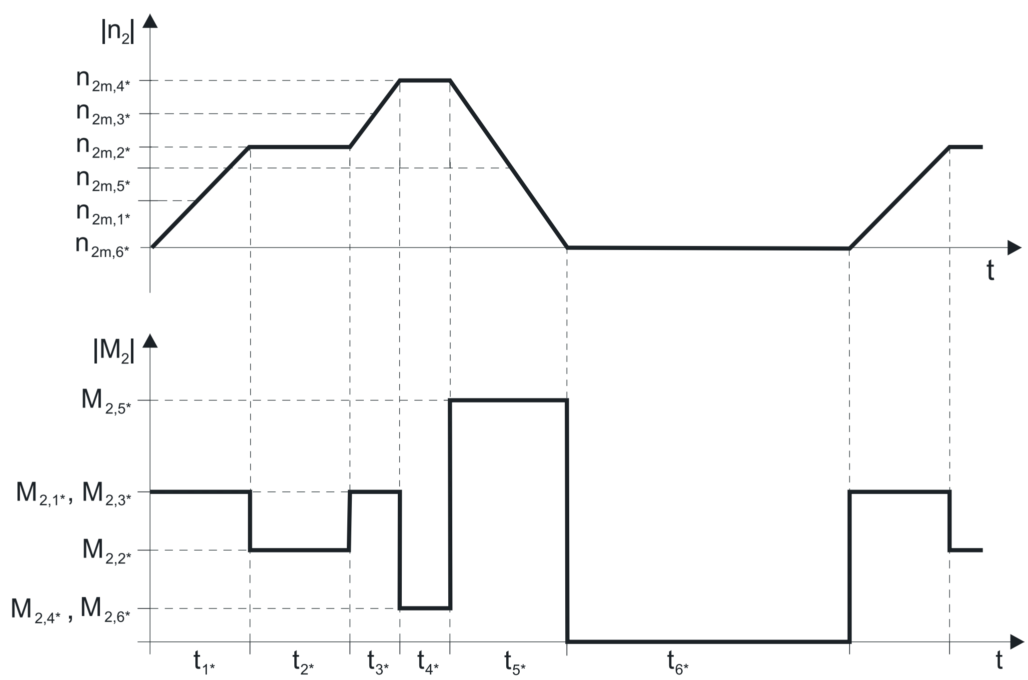
The values for n_{1maxDB}, n_{1maxZB}, M_{2acc}, M_{2NOT}, M_{2N} and S can be found in the selection tables.

The values for fB_T, fB_{op} and fB_t can be found in the relevant tables in this section.

Calculate the thermal limit torque M_{2th} for a duty cycle > 50 %.

Example of cycle sequence

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



Calculation of the existing average input speed

$$n_{1m^*} = n_{2m^*} \cdot i$$

$$n_{2m^*} = \frac{|n_{2m,1^*}| \cdot t_{1^*} + \ldots + |n_{2m,n^*}| \cdot t_{n^*}}{t_{1^*} + \ldots + t_{n^*}}$$

If t_{1^*} + ... + t_{5^*} ≥ 20 min, determine n_{2m^*} without pause t_{6^*}.

For the values for the gear ratio i, see the selection tables.

Calculation of the existing effective torque

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

Calculation of the existing equivalent torque

$$M_{2eq^*} = \sqrt[3]{\frac{|n_{2m,1^*}| \cdot t_{1^*} \cdot |M_{2,1^*}^{\;3}| + \ldots + |n_{2m,n^*}| \cdot t_{n^*} \cdot |M_{2,n^*}^{\;3}|}{|n_{2m,1^*}| \cdot t_{1^*} + \ldots + |n_{2m,n^*}| \cdot t_{n^*}}}$$

Calculation of the thermal limit torque

For a duty cycle ED > 50%, calculate the thermal limit torque M_{2th} for the existing average input speed n_{1m^*}. (With $K_{mot,th}$ ≤ 0 you must reduce the average input speed n_{1m^*} accordingly or select a different size for the geared motor.)

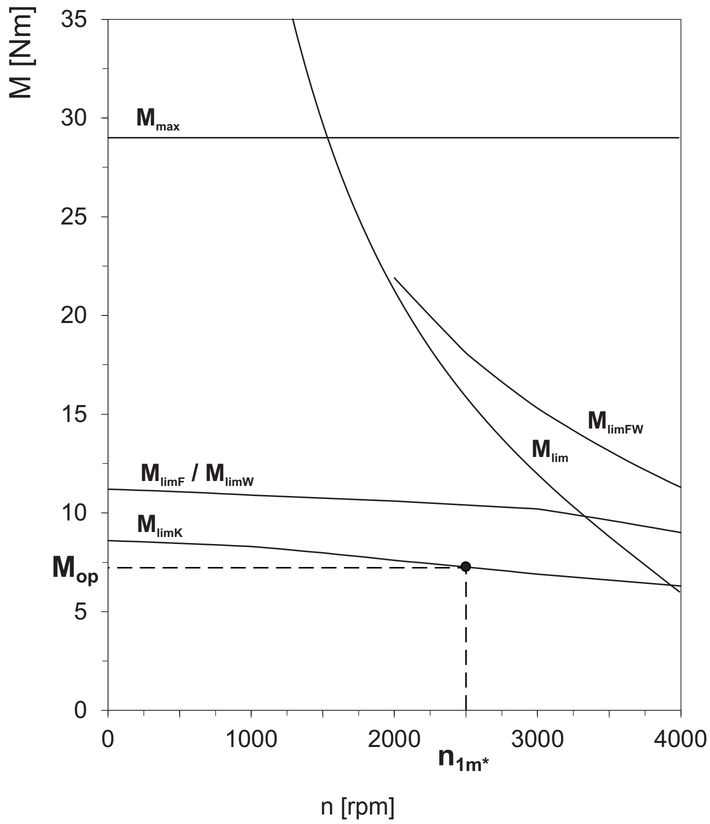
$$M_{2th} = M_{op} \cdot i \cdot K_{mot,th}$$

$$K_{mot,th} = 0{,}93 - \frac{a_{th}}{1000} \cdot fB_T \cdot \left(\frac{n_{1m^*}}{1000}\right)^3$$

For the values for i and a_{th}, see the selection tables.

The values for fB_T can be found in the relevant tables in this section.

The motor characteristics can found in section [▸ 10.3], including the value for the torque of the motor in the operating point M_{op} at the determined average input speed n_{1m^*}. Note the size, nominal speed n_N and cooling type of the motor. The illustration below shows an example of reading the torque M_{op} of a motor with convection cooling in the operating point.



Operating factors

Operation mode	fB_{op}
Consistent continuous operation	1.00
Cyclic operation	1.00
Cyclic operation - reversing load	1.00

Runtime	fB_t
Daily runtime ≤ 8 h	1.00
Daily runtime ≤ 16 h	1.15
Daily runtime ≤ 24 h	1.20

Temperature		fB_T
Motor cooling	**Surrounding temperature**	
EZHP_U (with convection cooling)	≤ 20 °C ≤ 30 °C ≤ 40 °C	1.0 1.1 1.25
EZHP_W (with water cooling)	≤ 20 °C ≤ 30 °C ≤ 40 °C	0.9 1.0 1.15

Instructions

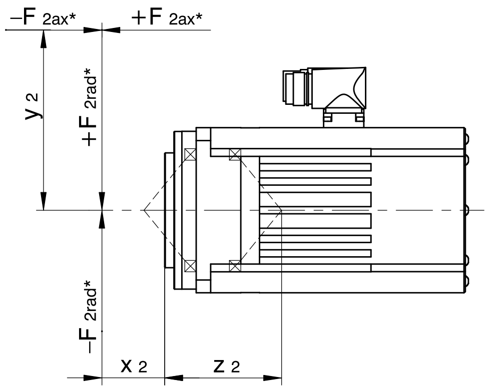
- The maximum permitted gear unit temperature (see General product features sections) must not be exceeded. Doing so may result in damage to the geared motor.
- When braking from full speed (for example when the power fails or when setting up the machine), note the permissible gear unit torques (M_{2acc}, M_{2NOT}) in the selection tables.

10.7.2 Permissible shaft loads

Formula symbols	Unit	Explanation
C_{2k}	Nm/ar-cmin	Tilting stiffness
ED	%	Duty cycle relative to 20 minutes
F_{ax}	N	Permitted axial force on the output
F_{2ax*}	N	Existing axial force on the gear unit output
F_{2ax100}	N	Permitted axial force on the gear unit output for $n_{2m*} \leq 100$ rpm
$F_{2ax,eq*}$	N	Actual equivalent axial force on the gear unit output
F_{2axN}	N	Permitted nominal axial force on the gear unit output
F_{2rad*}	N	Existing radial force on the gear unit output
$F_{2rad100}$	N	Permitted radial force on the gear unit output for $n_{2m*} \leq 100$ rpm
F_{2radN}	N	Permitted nominal axial force on the gear unit output
$F_{2rad,acc*}$	N	Actual radial acceleration force on the gear unit output
$F_{2rad,acc}$	N	Permitted radial acceleration force on the gear unit output
$F_{2rad,acc,n*}$	N	Actual radial acceleration force on the gear unit output in the n-th time segment
$F_{2rad,eq*}$	N	Existing equivalent force on the gear unit output
L_{10h}	h	Bearing service life
M_{2k*}	Nm	Existing breakdown torque on the gear unit output
M_{2k100}	Nm	Permitted breakdown torque on the gear unit output for $n_{2m*} \leq 100$ rpm
$M_{2k,acc}$	Nm	Permitted acceleration breakdown torque on the gear unit output
$M_{2k,acc*}$	Nm	Actual acceleration breakdown torque on the gear unit output
$M_{2k,acc,n*}$	Nm	Actual acceleration breakdown torque on the gear unit output in the n-th time segment
$M_{2k,eq*}$	Nm	Existing equivalent breakdown torque on the gear unit output
M_{2kN}	Nm	Permitted nominal breakdown torque on the gear unit output
n_{2m*}	rpm	Existing average output speed
$n_{2m,n*}$	rpm	Existing average output speed in the n-th time segment
t_{n*}	s	Duration of the n-th time segment
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

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

- For shaft dimensions according to the catalog
- For output speeds $n_{2m*} \leq 100$ rpm ($F_{2axN} = F_{2ax100}$; $F_{2radN} = F_{2rad100}$; $M_{2kN} = M_{2k100}$)
- Only if pilots are used (housing, flange hollow shaft)



You can download the diagrams for other output speeds at http://products.stoeber.de.

EZHP

The following applies for output speeds n_{2m^*} > 100 rpm:

$$F_{2axN} = \frac{F_{2ax100}}{\sqrt[3]{\frac{n_{2m^*}}{100\ \text{rpm}}}} \qquad F_{2radN} = \frac{F_{2rad100}}{\sqrt[3]{\frac{n_{2m^*}}{100\ \text{rpm}}}} \qquad M_{2kN} = \frac{M_{2k100}}{\sqrt[3]{\frac{n_{2m^*}}{100\ \text{rpm}}}}$$

The values for F_{2ax100}, $F_{2rad100}$ and M_{2k100} can be found in the following table.

Type	z_2 [mm]	F_{2ax} [N]	F_{2radN} [N]	$F_{2rad,acc}$ [N]	M_{2kN} [Nm]	$M_{2k,acc}$ [Nm]	C_{2k} [Nm/arcmin]
EZHP_5	88.0	4150	5029	5429	440	475	340
EZHP_7	110.0	5000	9070	13605	1000	1500	700

The permitted lateral forces can be determined from the permissible breakdown torque M_{2kN} and $M_{2k,acc}$. The existing lateral forces must not exceed the permissible lateral forces. The permitted lateral forces refer to the end of the hollow shaft (x2 = 0).

$$M_{2k,acc^*} = \frac{2 \cdot F_{2ax^*} \cdot y_2 + F_{2rad,acc^*} \cdot (x_2 + z_2)}{1000} \leq M_{2k,acc}$$

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

In EMERGENCY OFF mode (max. 1000 load changes) you can multiply the permissible forces and torques for F_{2ax100}, $F_{2rad100}$ and M_{2k100} by a factor of 2.

Note also the calculation for equivalent values:

$$M_{2k,eq^*} = \sqrt[3]{\frac{|n_{2m,1^*}| \cdot t_{1^*} \cdot |M_{2k,acc,1^*}{}^3| + \ldots + |n_{2m,n^*}| \cdot t_{n^*} \cdot |M_{2k,acc,n^*}{}^3|}{|n_{2m,1^*}| \cdot t_{1^*} + \ldots + |n_{2m,n^*}| \cdot t_{n^*}}} \leq M_{2kN}$$

$$F_{2rad,eq^*} = \sqrt[3]{\frac{|n_{2m,1^*}| \cdot t_{1^*} \cdot |F_{2rad,acc,1^*}{}^3| + \ldots + |n_{2m,n^*}| \cdot t_{n^*} \cdot |F_{2rad,acc,n^*}{}^3|}{|n_{2m,1^*}| \cdot t_{1^*} + \ldots + |n_{2m,n^*}| \cdot t_{n^*}}} \leq F_{2radN}$$

$$F_{2ax,eq^*} \leq F_{2axN}$$

The following apply to the bearing service life L_{10h} (duty cycle ≤ 40 %):

L_{10h} > 10000 h with 1 < M_{2kN}/M_{2k^*} < 1.25

L_{10h} > 20000 h with 1.25 < M_{2kN}/M_{2k^*} < 1.5

L_{10h} > 30000 h with 1.5 < M_{2kN}/M_{2k^*}

With a different duty cycle:

$$L_{10h} > L_{10h(ED=40\%)} \cdot \frac{40\%}{ED}$$

10.8 Further information

10.8.1 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

10.8.2 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).

10.8.3 More documentation

More documentation concerning the product can be found at http://www.stoeber.de/en/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

11 EZM synchronous servo motor for screw drive

Table of contents

11.1 Overview

Synchronous servo motor for screw drive (direct drive for threaded nut)

Axial forces of motors with convection cooling

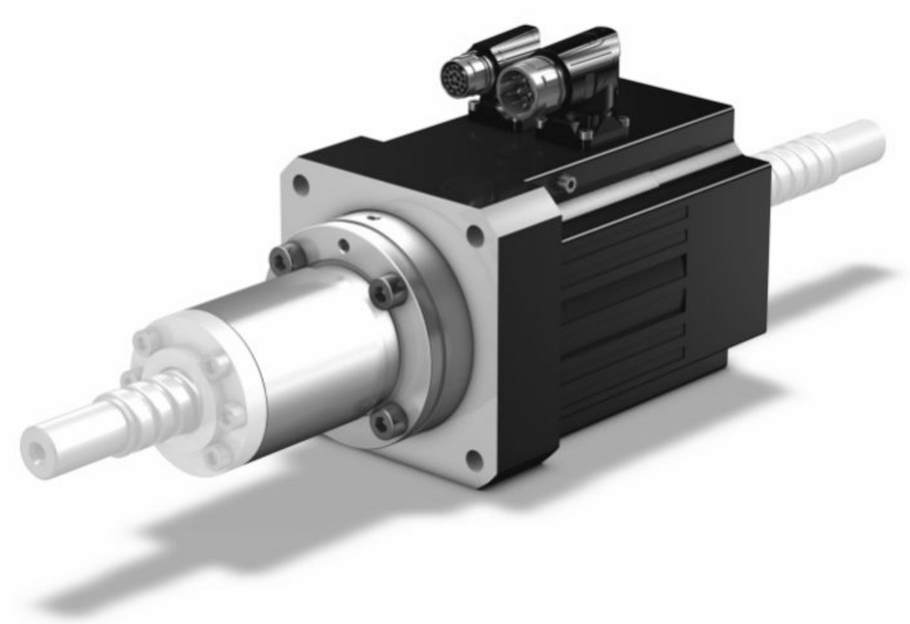
F_{ax}	751 – 21375 N

Axial forces of motors with water cooling

F_{ax}	919 – 30649 N

Features

Designed for ball threaded nut drive of ball screws in accordance with DIN 69051-2.	✓
Axial angular ball bearing acting on two sides for direct absorption of the threaded spindle forces	✓
Super compact due to tooth winding technology with the highest possible copper fill factor	✓
Backlash-free holding brake (optional)	✓
Convection cooling or water cooling (optional)	✓
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	✓



11.2 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
EZM5	23 x 210 x 275 mm	0.16 m^2
EZM7	28 x 300 x 400 mm	0.3 m^2

Formula symbols	Unit	Explanation
F_{ax}	N	Permitted axial force on the output
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}kgm²	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

STOBER

Formula symbols	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

EZM

11.2.1 EZM motors with convection cooling

Type	K_{EM} [V/1000 min⁻¹]	n_N [min⁻¹]	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]
EZM511U	97	3000	3.65	3.55	1.03	1.2	4.25	4.00	1.19	0.49	16.0	22.0	3.80	23.50	6.18
EZM512U	121	3000	6.60	5.20	1.27	2.1	7.55	5.75	1.40	0.49	31.0	33.0	2.32	16.80	7.24
EZM513U	119	3000	8.80	6.55	1.34	2.8	10.6	7.60	1.46	0.49	43.0	41.0	1.25	10.00	8.00
EZM711U	95	3000	6.35	6.60	0.96	2.0	7.30	7.40	1.07	0.65	20.0	25.0	1.30	12.83	9.87
EZM712U	133	3000	10.6	7.50	1.41	3.3	13.0	8.90	1.53	0.65	41.0	36.0	1.00	11.73	11.73
EZM713U	122	3000	14.7	10.4	1.41	4.6	18.9	13.0	1.50	0.65	65.0	62.0	0.52	6.80	13.08

11.2.2 EZM motors with water cooling

Type	K_{EM} [V/1000 min⁻¹]	n_N [min⁻¹]	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]
EZM511W	97	3000	4.95	4.75	1.04	1.6	5.20	4.85	1.18	0.49	16.0	22.0	3.80	23.50	6.18
EZM512W	121	3000	9.75	7.70	1.27	3.1	10.6	7.85	1.41	0.49	31.0	33.0	2.32	16.80	7.24
EZM513W	119	3000	13.1	10.2	1.28	4.1	14.8	11.3	1.35	0.49	43.0	41.0	1.25	10.00	8.00
EZM711W	95	3000	9.80	9.95	0.98	3.1	10.0	10.0	1.06	0.65	20.0	25.0	1.30	12.83	9.87
EZM712W	133	3000	16.7	12.2	1.37	5.3	18.8	13.1	1.49	0.65	41.0	36.0	1.00	11.73	11.73
EZM713W	122	3000	22.0	17.0	1.29	6.9	27.1	19.6	1.42	0.65	65.0	62.0	0.52	6.80	13.08

11.2.3 Mass moments of inertia and weights

	df [mm]	ef [mm]	ef2 [mm]	J [10⁻⁴ kgm²]	m [kg]
EZM511	40	51	65	20,3	9,9
EZM512	40	51	65	23,6	11,5
EZM513	40	51	65	26,8	13,1
EZM711	50	65	78	53,7	17,4
EZM711	56	71	78	60,3	17,6
EZM712	50	65	78	63,1	19,9
EZM712	56	71	78	69,7	20,1
EZM713	50	65	78	72,4	22,5
EZM713	56	71	78	79,0	22,7

11.3 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 symbols	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_{limW}	Nm	Torque limit of the motor with water 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

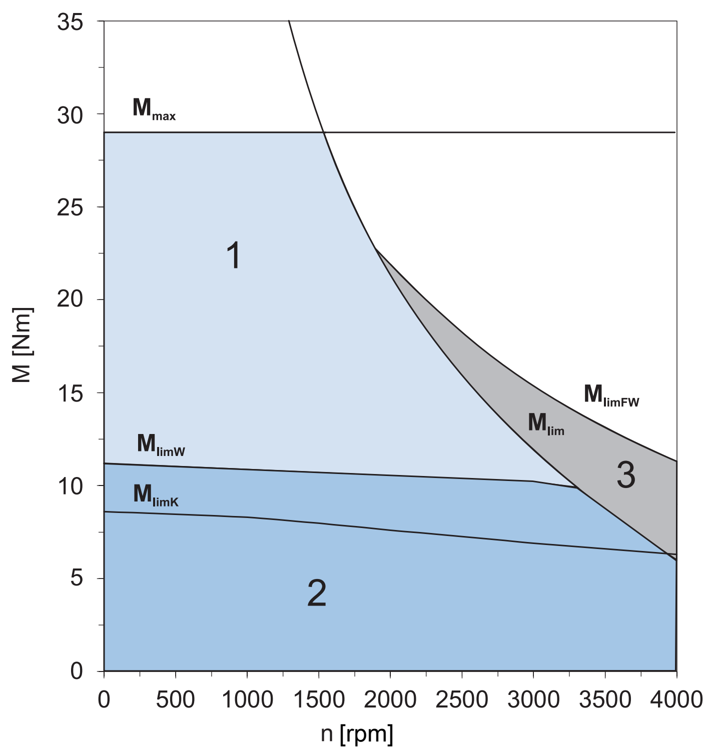
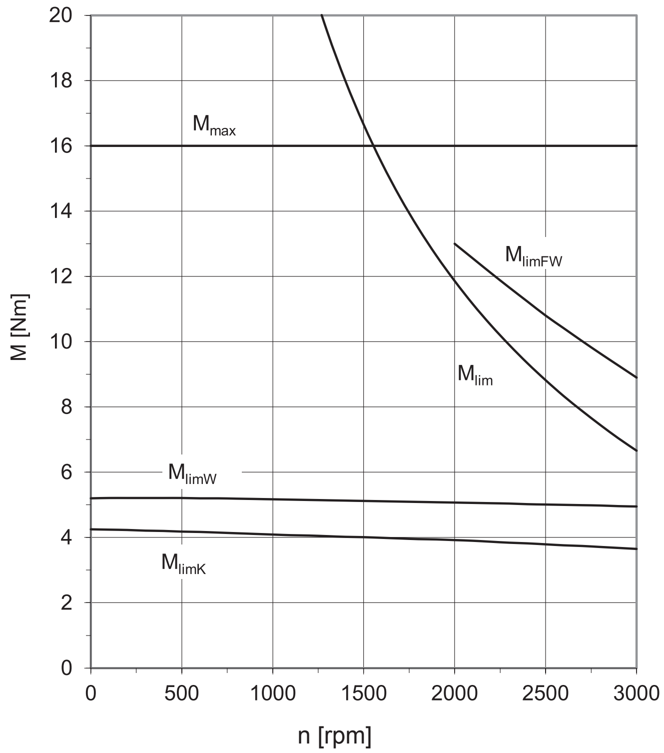


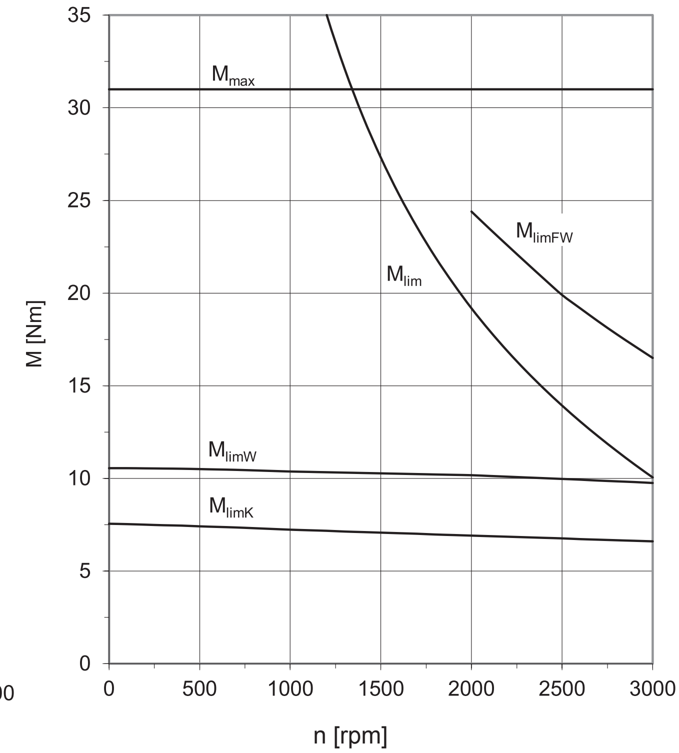
Fig. 1: Explanation of a torque/speed characteristic curve

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)		

EZM511 (n_N=3000 rpm)

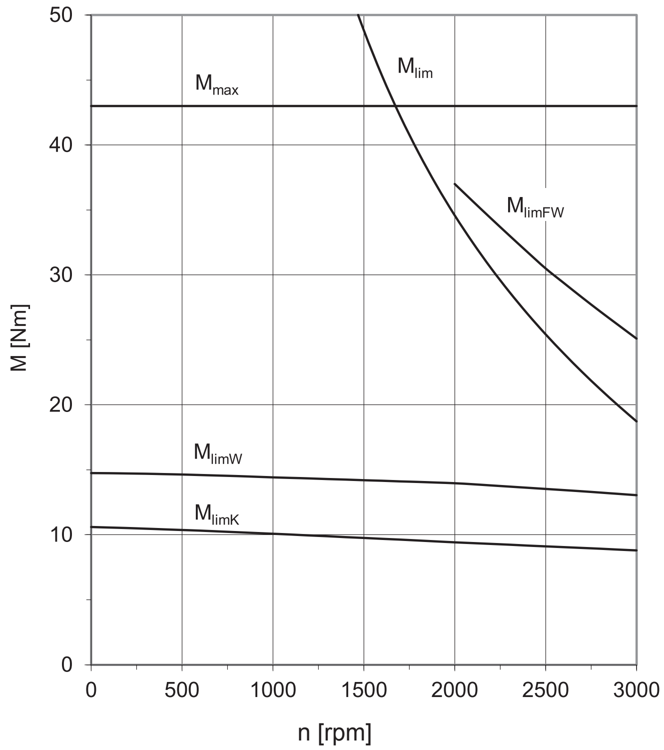


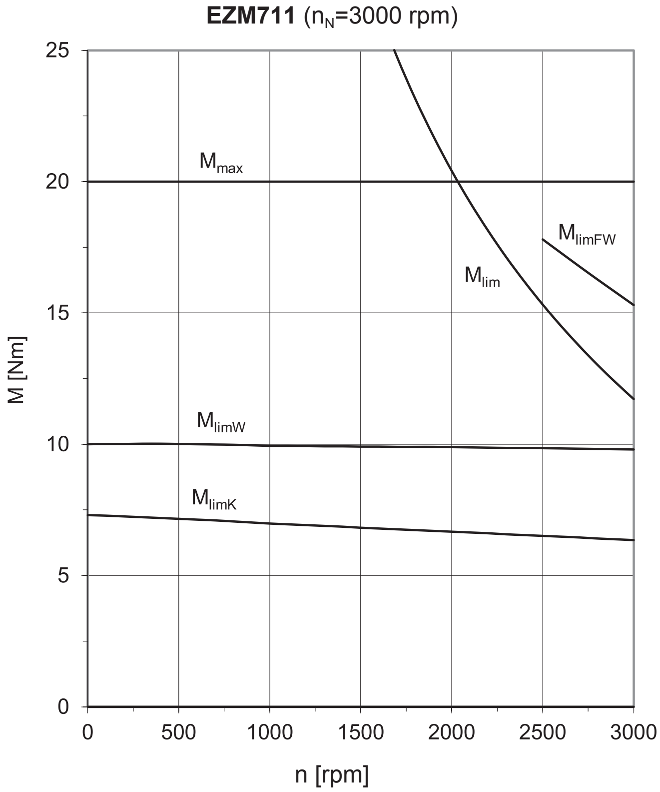
EZM512 (n_N=3000 rpm)

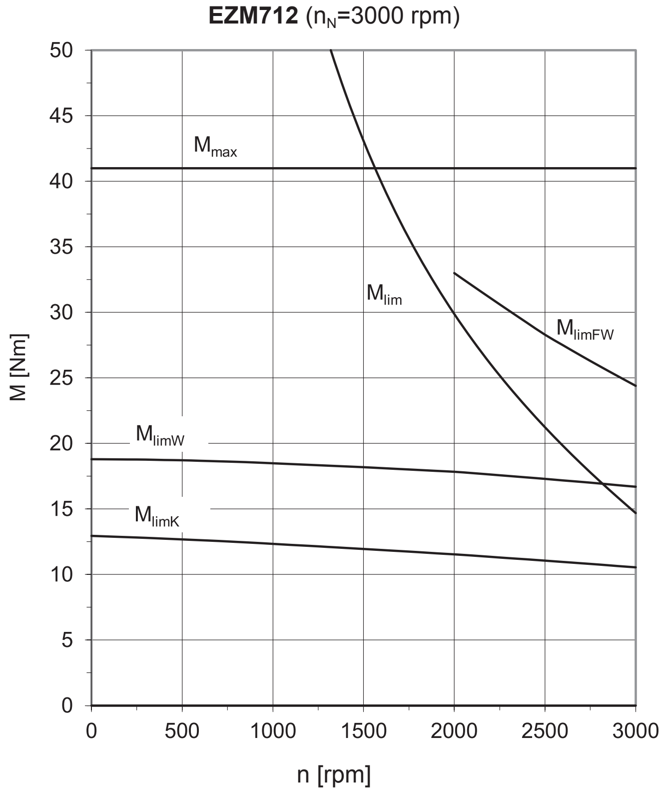


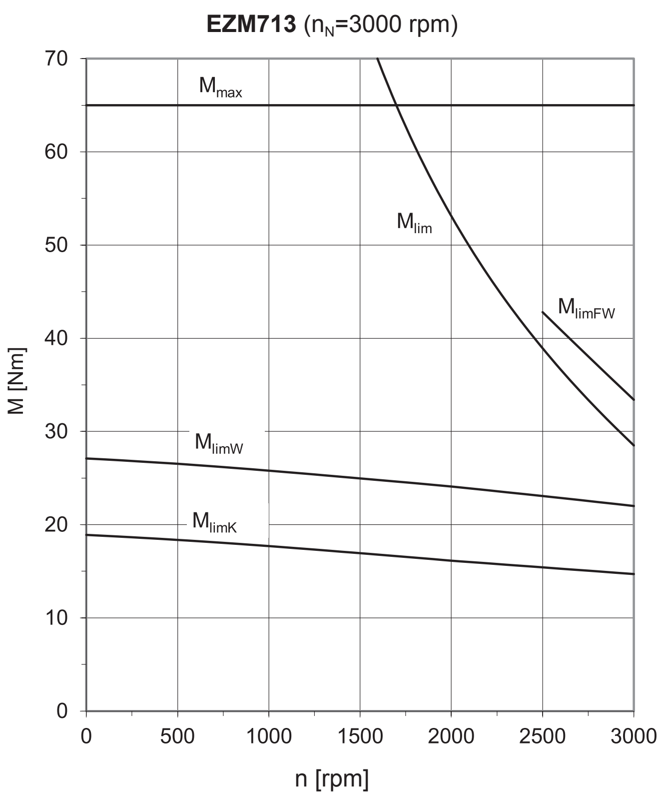
EZM

EZM513 (n_N=3000 rpm)




EZM711 (nN=3000 rpm)
Mmax
MlimFW
Mlim
MlimW
MlimK
M [Nm]
n [rpm]
0
5
10
15
20
25
0
500
1000
1500
2000
2500
3000


EZM712 (nN=3000 rpm)
Mmax
Mlim
MlimFW
MlimW
MlimK
M [Nm]
n [rpm]
0
5
10
15
20
25
30
35
40
45
50
0
500
1000
1500
2000
2500
3000


EZM713 (nN=3000 rpm)
Mmax
Mlim
MlimFW
MlimW
MlimK
M [Nm]
n [rpm]
0
10
20
30
40
50
60
70
0
500
1000
1500
2000
2500
3000

EZM

11.4 Dimensional drawings

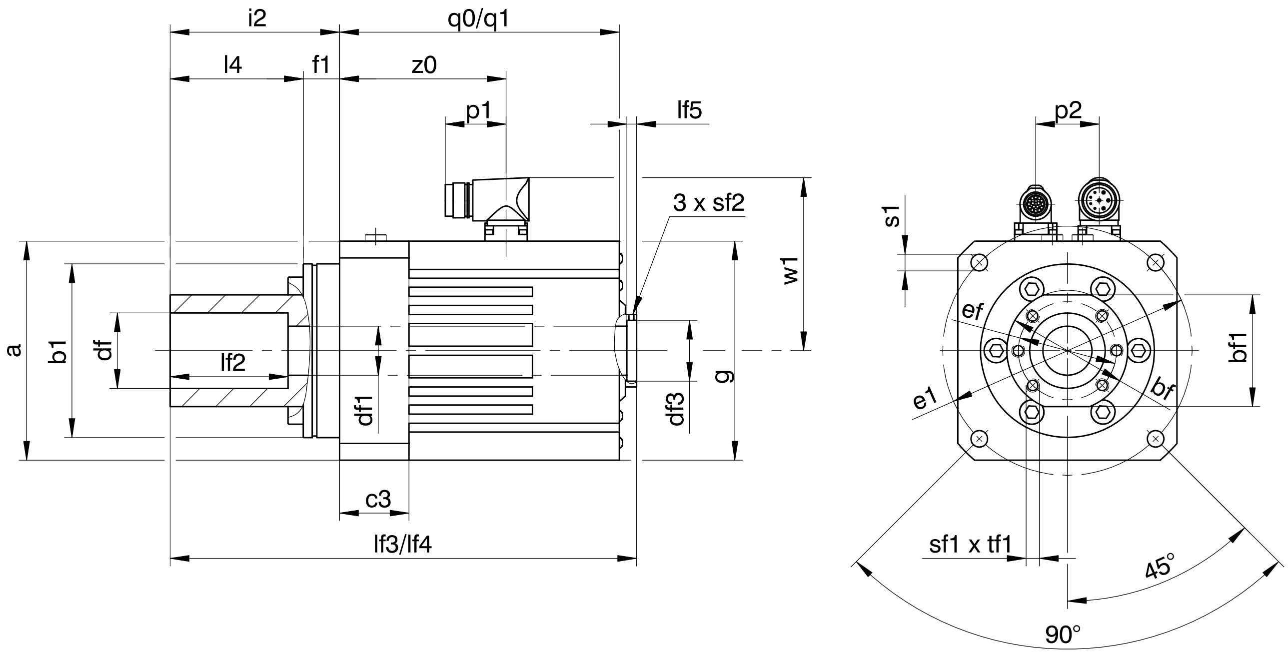
In this chapter you can find the dimensions of the motors.

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.

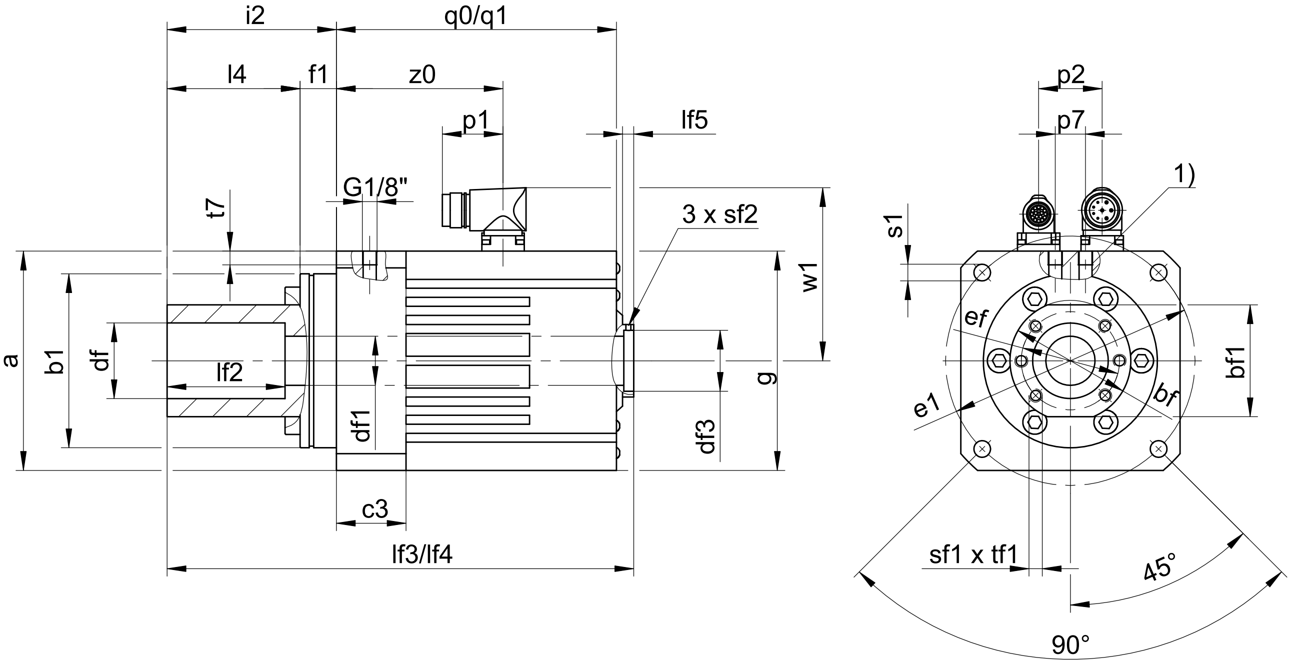
11.4.1 EZM motors with convection cooling



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

Type	□a	∅b1	∅bf	bf1	c3	∅df	∅df1	∅df3	∅e1	∅ef	f1	□g	i2	l4	lf2	lf3	lf4	lf5	p1	p2	q0	q1	∅s1	sf1	sf2	tf1	w1	z0
EZM511U	115	$90_{-0,01}$	62	59	37	40^{JS6}	25.5	32.3	130	51	24	115	98	74	66	279.0	333.0	4.4	40	36	170.1	225.4	9	M6	M3	12	100	95.5
EZM512U	115	$90_{-0,01}$	62	59	37	40^{JS6}	25.5	32.3	130	51	24	115	98	74	66	304.0	358.3	4.4	40	36	195.1	250.4	9	M6	M3	12	100	120.5
EZM513U	115	$90_{-0,01}$	62	59	37	40^{JS6}	25.5	32.3	130	51	24	115	98	74	66	329.0	383.3	4.4	40	36	220.1	275.4	9	M6	M3	12	100	145.5
EZM711U	145	$115_{-0,01}$	80	74	46	50^{JS6}	32.5	40.3	165	65	24	145	112	88	79	308.6	368.6	5.2	40	42	185.2	245.2	11	M8	M4	14	115	110.2
EZM712U	145	$115_{-0,01}$	80	74	46	50^{JS6}	32.5	40.3	165	65	24	145	112	88	79	333.6	393.6	5.2	40	42	210.2	270.2	11	M8	M4	14	115	135.2
EZM713U	145	$115_{-0,01}$	80	74	46	50^{JS6}	32.5	40.3	165	65	24	145	112	88	79	358.6	418.6	5.2	40	42	235.2	295.2	11	M8	M4	14	115	160.2
EZM711U	145	$115_{-0,01}$	86	80	46	56^{JS6}	32.5	40.3	165	71	24	145	112	88	79	308.6	368.6	5.2	40	42	185.2	245.2	11	M8	M4	14	115	110.2
EZM712U	145	$115_{-0,01}$	86	80	46	56^{JS6}	32.5	40.3	165	71	24	145	112	88	79	333.6	393.6	5.2	40	42	210.2	270.2	11	M8	M4	14	115	135.2
EZM713U	145	$115_{-0,01}$	86	80	46	56^{JS6}	32.5	40.3	165	71	24	145	112	88	79	358.6	418.6	5.2	40	42	235.2	295.2	11	M8	M4	14	115	160.2

11.4.2 EZM motors with water cooling



1)	The supply or return line of the cooling system can be connected to both connections for water cooling. The flange with the connections for water cooling can be rotated 180°.
q0, lf3	Applies to motors without holding brake.
q1, lf4	Applies to motors with holding brake.

Type	□a	∅b1	∅bf	bf1	c3	∅df	∅df1	∅df3	∅e1	∅ef	f1	□g	i2	l4	lf2	lf3	lf4	lf5	p1	p2	p7	q0	q1	∅s1	sf1	sf2	t7	tf1	w1	z0
EZM511W	115	$90_{-0,01}$	62	59	37	40^{JS6}	25.5	32.3	130	51	24	115	98	74	66	279.0	333.0	4.4	40	36	20	170.1	225.4	9	M6	M3	8	12	100	95.5
EZM512W	115	$90_{-0,01}$	62	59	37	40^{JS6}	25.5	32.3	130	51	24	115	98	74	66	304.0	358.3	4.4	40	36	20	195.1	250.4	9	M6	M3	8	12	100	120.5
EZM513W	115	$90_{-0,01}$	62	59	37	40^{JS6}	25.5	32.3	130	51	24	115	98	74	66	329.0	383.3	4.4	40	36	20	220.1	275.4	9	M6	M3	8	12	100	145.5
EZM711W	145	$115_{-0,01}$	80	74	46	50^{JS6}	32.5	40.3	165	65	24	145	112	88	79	308.6	368.6	5.2	40	42	20	185.2	245.2	11	M8	M4	9	14	115	110.2
EZM712W	145	$115_{-0,01}$	80	74	46	50^{JS6}	32.5	40.3	165	65	24	145	112	88	79	333.6	393.6	5.2	40	42	20	210.2	270.2	11	M8	M4	9	14	115	135.2
EZM713W	145	$115_{-0,01}$	80	74	46	50^{JS6}	32.5	40.3	165	65	24	145	112	88	79	358.6	418.6	5.2	40	42	20	235.2	295.2	11	M8	M4	9	14	115	160.2
EZM711W	145	$115_{-0,01}$	86	80	46	56^{JS6}	32.5	40.3	165	71	24	145	112	88	79	308.6	368.6	5.2	40	42	20	185.2	245.2	11	M8	M4	9	14	115	110.2
EZM712W	145	$115_{-0,01}$	86	80	46	56^{JS6}	32.5	40.3	165	71	24	145	112	88	79	333.6	393.6	5.2	40	42	20	210.2	270.2	11	M8	M4	9	14	115	135.2
EZM713W	145	$115_{-0,01}$	86	80	46	56^{JS6}	32.5	40.3	165	71	24	145	112	88	79	358.6	418.6	5.2	40	42	20	235.2	295.2	11	M8	M4	9	14	115	160.2

STOBER

11.5 Type designation

Sample code

EZM	5	1	1	U	S	AD	B1	O	097

Explanation

Code	Designation	Design
EZM	Type	Synchronous servo motor for screw drive
5	Motor size	5 (example)
1	Generation	1
1	Length	1 (example)
U W	Cooling	Convection cooling Water cooling
S	Design	Standard
AD	Drive controller	SD6 (example)
B1	Encoder	EBI 135 EnDat 2.2 (example)
O P	Brake	Without holding brake Permanent magnet holding brake
097	Electromagnetic constant (EMC) K_{EM}	97 V/1000 rpm (example)

Instructions

- You can find information about available encoders in section [▸ 11.6.6].
- In section [▸ 11.6.6.3], you can find information about connecting synchronous servo motors to other STOBER drive controllers.

11.6 Product description

11.6.1 General features

Feature	EZM5	EZM7
Maximum threaded spindle diameter ∅kg [mm]	25.00	32.00
Pitch of threaded spindle P_{st}	5 – 25	5 – 32
Pilot ∅kg [mm]	40	50/56
Pitch circle ∅ekg [mm]	51	65/71
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) as per EN 60034-1 (155°C, heating $\Delta\vartheta$ = 100 K)	

[1] Axial angular ball bearing for screw drives, grease lubricated, can be relubricated
[2] Or comparable products of other providers
[3] Or comparable products of other providers

EZM

Feature	EZM5	EZM7
Surface[4]	Black matte as per RAL 9005	
Noise level	Limit values as per EN 60034-9/A1	
Cooling	IC 410 convection cooling or water cooling in the A-side flange (optional)	

11.6.2 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

11.6.3 Ambient conditions

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

Feature	Description
Transport/storage surrounding temperature[5]	-30 °C to +85 °C
Surrounding operating temperature	−15 °C to +40 °C (without water cooling) +10 °C to +40 °C (with water cooling)
Installation altitude	≤ 1000 m above sea level
Shock load	≤ 50 m/s^2 (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.

11.6.4 Threaded nut

The driven threaded nut (threaded spindle mounted stationary) has the following advantages compared to the driven threaded spindle (threaded nut mounted stationary):

- Higher axial velocity can be achieved with long threaded spindles because swinging of the threaded spindle is less problematic.
- Drastic reduction in the power loss of the threaded spindle bearing because the stretching forces do not have to be directed through the bearing.
- Liquid cooling of the threaded spindle is easier.
- Increased axial rigidity and torsional rigidity of the threaded spindle (especially with a high pitch/diameter ratio) because the \axial forces and torques at both ends of the threaded spindle can be channeled to the surrounding structure.

[4] Repainting will change the thermal properties and therefore the performance limits of the motor.
[5] If you will be storing or transporting the system in which a motor with water cooling is installed below +3 °C, drain the water completely out of the cooling circuit in advance.

11.6.4.1 Lubrication of the threaded nut

Because lubricant supply to the driven threaded nut is made difficult due to the system, it should be lubricated via the threaded spindle. The following options are available.

- For threaded nut with axial motion: Through a lubrication channel in the threaded spindle, which is arranged axially parallel up to the tool change position of the threaded nut. Lubricant can be injected into the threaded nut through a cross-hole if it is exactly in that position. As a rule, the amount of lubricant is adequate without problem until the next tool change.
- For threaded spindle with axial motion: By lubrication brushes attached on the machine, which are connected to the lubrication supply and dispense the lubricant to the threaded spindle as it moves axially.

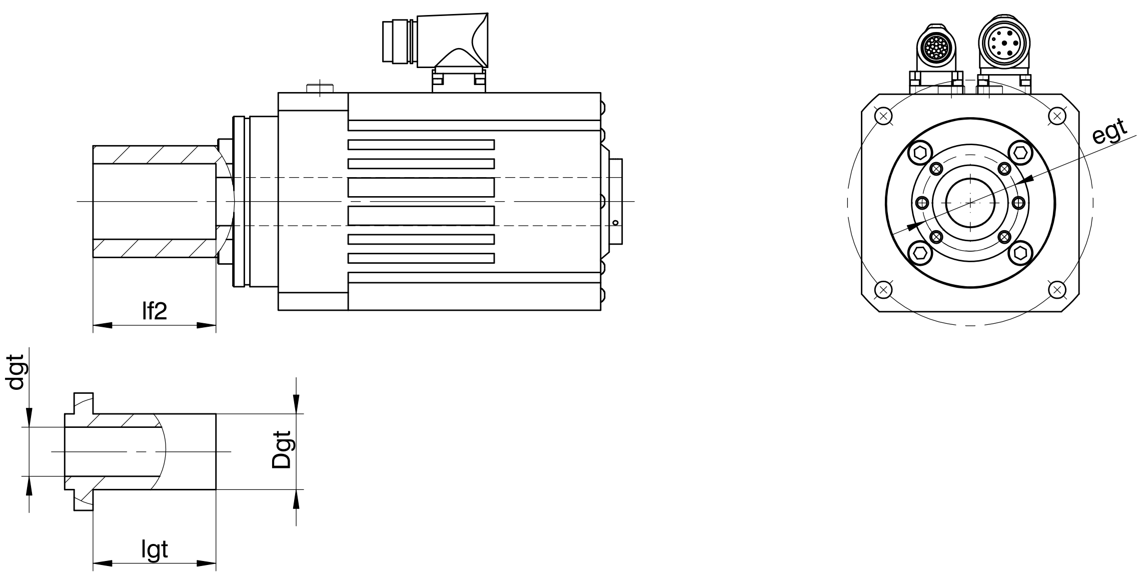
Lubricants that penetrate into the inside of the motor can impair the function of the holding brake and encoder. Therefore take into consideration the protection class of the synchronous servo motor during projecting planning for your screw drive, especially for vertical installation of the synchronous servo motor with the A side on top. For detailed information about lubrication of the screw drive, contact the manufacturer of your screw drive.

11.6.4.2 Possible combinations with ball screw nuts in accordance with DIN 69051-5

As the screw drive is not included in the scope of delivery from STOBER, you can find information in the following sections about possible combinations of the EZM motor with ball screw nuts in accordance with DIN 69051-5 from a few well known manufacturers. Information about EZM motors for other types of threaded nuts is available on request.

Formula symbols	Unit	Explanation
P_{st}	mm	Pitch of the screw drive

Dimensions of the ball screw nut



Manufacturer	Type	∅dgt	P_{st}	∅Dgt	∅egt	lgt	Motor type	lf2
HIWIN	FSC/DEB	25	10	40	51	51/55	EZM5	66
HIWIN	FSC/DEB	25	25	40	51	60	EZM5	66
HIWIN	FSC/DEB	32	10	50	65	65	EZM7	79
HIWIN	FSC/DEB	32	20	50	65	76	EZM7	79
HIWIN	FSC/DEB	32	32	50	65	68	EZM7	79

Manufac-turer	Type	∅dgt	P_{st}	∅Dgt	∅egt	lgt	Motor type	lf2
Steinmeyer	Series 2426	25	10	40	51	52	EZM5	66
Steinmeyer	Series 2426	25	20	40	51	40	EZM5	66
Steinmeyer	Series 2426	25	20	40	51	60	EZM5	66
Steinmeyer	Series 2426	25	25	40	51	49	EZM5	66
Steinmeyer	Series 3426	32	10	50	65	65	EZM7	79
Steinmeyer	Series 3426	32	10	50	65	76	EZM7	79
Steinmeyer	Series 3426	32	20	56	71	47	EZM7	79
Steinmeyer	Series 3426	32	20	56	71	67	EZM7	79
Steinmeyer	Series 3426	32	30	56	71	67	EZM7	79
THK	EBA	25	10	40	51	65	EZM5	66
THK	EBA	32	10	50	65	65	EZM7	79
THK	EBA	32	10	50	65	77	EZM7	79
Kammerer	FM	25	10	40	51	50	EZM5	66
Kammerer	FM	25	20	40	51	60	EZM5	66
Kammerer	FM	32	10	50	65	68	EZM7	79
Kammerer	FM	32	10	56	71	66	EZM7	79
NSK	PR	25	10	40	51	48	EZM5	66
NSK	LPR	25	25	40	51	51	EZM5	66
NSK	PR	32	10	50	65	47	EZM7	79
NSK	LPR	32	32	50	65	78	EZM7	79
Neff	KGF-D	25	10	40	51	45	EZM5	66
Neff	KGF-D	25	20	40	51	25	EZM5	66
Neff	KGF-D	25	25	40	51	45	EZM5	66
Neff	KGF-D	32	5	50	65	43	EZM7	79
Neff	KGF-D	32	10	50	65	57	EZM7	79
Rodriguez	SFU	25	5	40	51	40	EZM5	66
Rodriguez	SFS*	25	6	40	51	50	EZM5	66
Rodriguez	SFS*	25	6	40	51	50	EZM5	66
Rodriguez	SFS*	32	6	50	65	39	EZM7	79
Rodriguez	SFS*	31	8	50	65	50	EZM7	79
Rodriguez	FK*	25	5	40	51	33	EZM5	66
Rodriguez	FK*	32	5	50	65	39	EZM7	79
Rodriguez	FK*	32	10	50	65	55	EZM7	79
Rodriguez	FH*	25	10	40	51	25	EZM5	66
Rodriguez	FH*	25	25	40	51	45.5	EZM5	66
Rodriguez	FH*	32	20	56	71	52	EZM7	79
Rodriguez	FH*	32	32	56	71	57.5	EZM7	79

*Design does not correspond to DIN 69051-5.

11.6.5 Threaded spindle

The concept of the EZM motor states that the threaded spindle of the screw drive can be guided through the entire length of the motor. Contact between the threaded spindle and motor shaft during operation is not permitted. The dimensions of the EZM motor are designed so that they can incorporate the threaded spindles whose maximum outer diameter does not exceed the nominal diameter. Note when selecting your screw drive that there are spindle nut/threaded spindle combinations for which the maximum threaded spindle diameter exceeds the nominal diameter of the threaded nut or spindle nut. In this case, the attachment of the screw drive to the EZM motor is not permitted (see also [▸ 11.6.1] section, maximum threaded spindle diameter Ødkg feature).

11.6.6 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.

11.6.6.1 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		

11.6.6.2 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.

11.6.6.3 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**
Drive controller type code		AA	AB	AC	AD	AE
ID connection plan		442305	442306	442307	442450	442451
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).

11.6.7 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.

11.6.7.1 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)

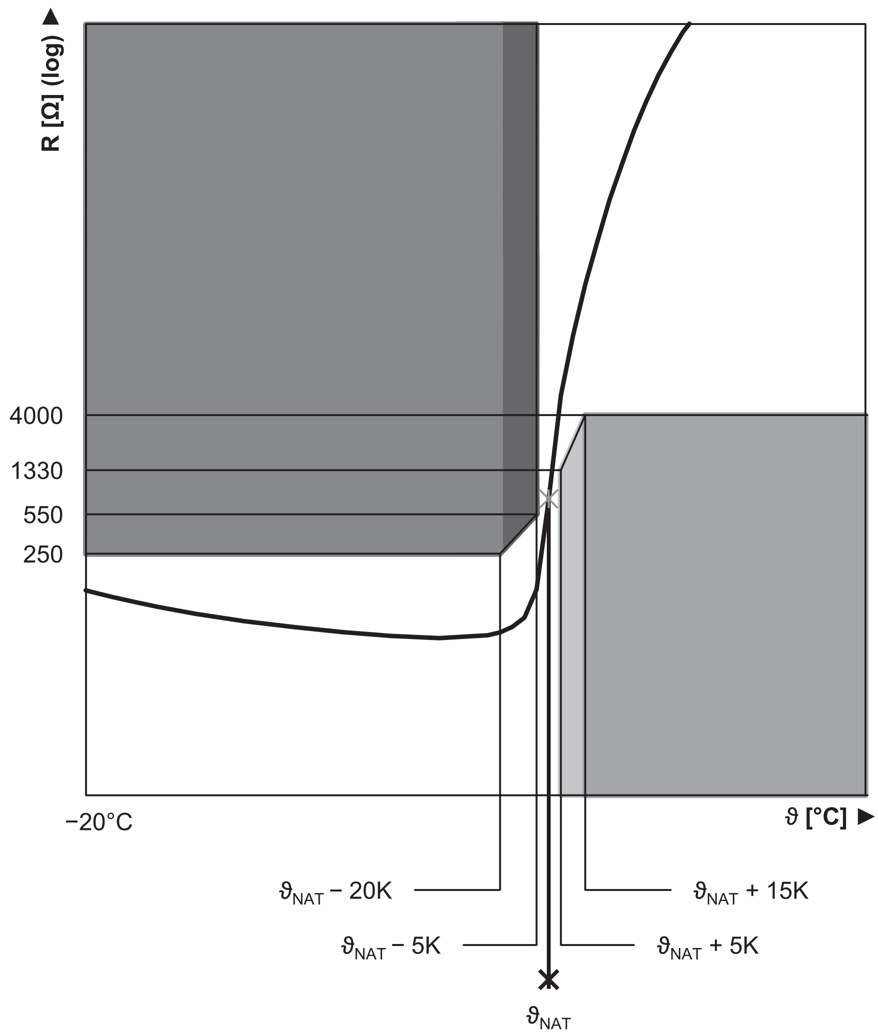


Fig. 2: Characteristic curve of PTC thermistor (single thermistor)

11.6.8 Cooling

A synchronous servo motor in the standard version is cooled by convection cooling (IC 410 in accordance with EN 60034-6). The air flowing around the motor is heated by the radiated motor heat and rises. The motor can optionally be cooled with water.

11.6.8.1 Water cooling

The EZM synchronous servo motors can optionally be cooled with water to increase the performance data for the same size. Water cooling cannot be retrofitted. It must be specified in the purchase order.

The performance data of the motors with water cooling can be found in section [▸ 11.2.2], the dimensional drawings in section [▸ 11.4.2].

Cooling circuit specification

Feature	Description
Coolant	Water
Temperature at inlet	+5 °C to +40 °C (max. 5 K below the surrounding temperature)
Cooling circuit	Closed, with recooling unit
Cleanliness	Clear, with no suspended matter or dirt, use particle filter ≤ 100 µm if necessary
pH value	6.5 – 7.5

Feature	Description
Hardness	1.43 – 2.5 mmol/l
Salinity	NaCl < 100 ppm, demineralized
Anticorrosive	Maximum percentage 25 %, neutral relative to AlCuMgPb F38, GG-220HB
Operating pressure	≤ 3.5 bar (provide a pressure relief valve in the supply line if necessary)
Flow rate	Optimum 6 l/min, minimum 4.5 l/min (EZM5)
	Optimum 7.5 l/min, minimum 5 l/min (EZM7)

Instructions

- The nominal data for synchronous servo motors with water cooling refers to water as a coolant. If another coolant is used, the nominal data must be determined again.
- For detailed information about the cooling system or coolants and coolant additives, please contact the manufacturer of your cooling system.
- Coolant with fresh water from the public supply grid with coolants, lubricants or cutting agents from the machining process is not permitted.
- If the temperature of the coolant is lower than the surrounding temperature, interrupt the supply of coolant when the motor is stopped for extended times to prevent condensation water from forming.
- If you will be storing or transporting the system in which a motor is installed below +3 °C, drain the water completely out of the cooling circuit in advance.
- Further information on water cooling can be found in the operating manual for the motor.

11.6.9 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.

Observe the following for the configuration:

- The holding brake can be used for braking from full speed (following a power failure or when setting up the machine). 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 symbols	Unit	Explanation
$I_{N,B}$	A	Nominal current of the brake at 20 °C
ΔJ_B	10^{-4}kgm^2	Additive mass moment of inertia of a motor with holding brake
J	10^{-4}kgm^2	Mass moment of inertia
J_{Bstop}	10^{-4}kgm^2	Reference mass moment of inertia with braking from full speed: $J_{Bstop} = J \times 2$
J_{tot}	10^{-4}kgm^2	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
$W_{B,Rmax/h}$	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

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

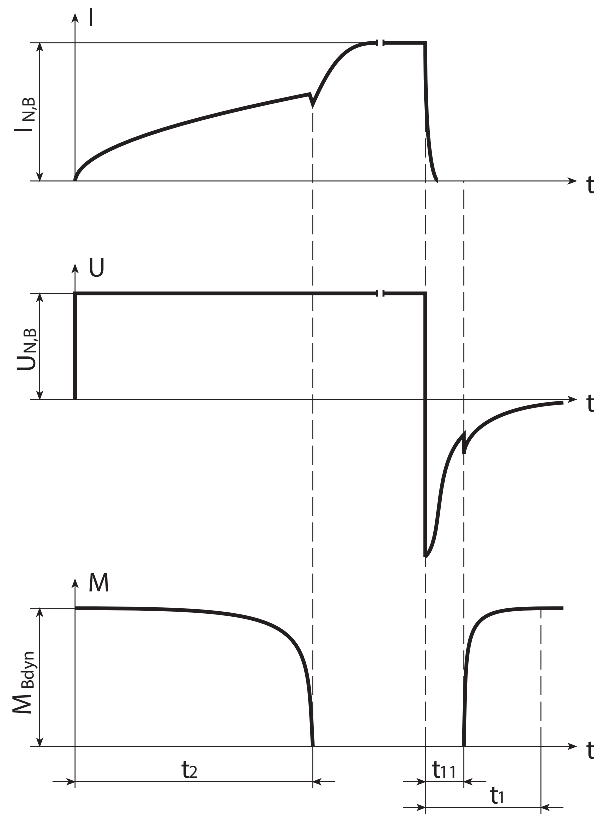
The sign of M_L is positive if the movement runs vertically up or horizontally and negative if the movement runs vertically down.

Calculation of the stop time

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

EZM

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]
EZM511	18	15	1,1	11,0	2100	52,5	550	55	3,0	30	0,3	5,970	2,50
EZM512	18	15	1,1	11,0	1850	59,1	550	55	3,0	30	0,3	5,970	2,50
EZM513	18	15	1,1	11,0	1700	65,5	550	55	3,0	30	0,3	5,970	2,50
EZM711	28	25	1,1	25,0	1900	149	1400	120	4,0	40	0,4	14,100	4,33
EZM712	28	25	1,1	25,0	1650	168	1400	120	4,0	40	0,4	14,100	4,33
EZM713	28	25	1,1	25,0	1500	186	1400	120	4,0	40	0,4	14,100	4,33

11.6.10 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.

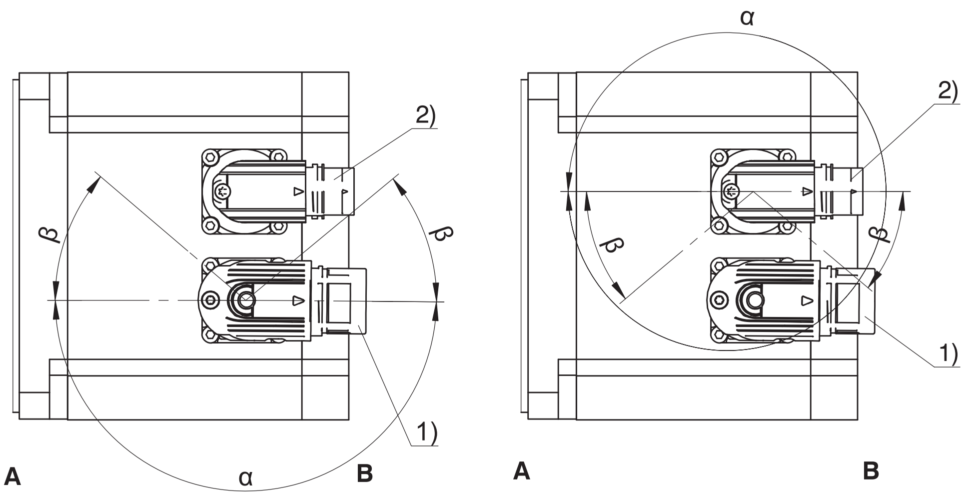
11.6.10.1 Plug connector

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

In motors with water cooling, prevent collisions between the motor connection cables and the connecting lines of the cooling system. In the event of a collision, turn the motor plug connectors appropriately. Details regarding the position of the connections for water cooling can be found in the dimensional drawings 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
EZM	con.23	Quick lock	180°	40°

Encoder plug connector features

Motor type	Size	Connection	Turning range	
			α	β
EZM	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.

11.6.10.2 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.

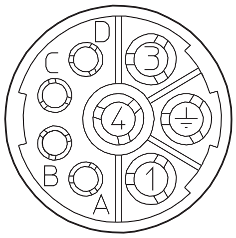
All attachment parts required for the connection of the protective ground to the motor housing are delivered with the motor. The grounding screw of the motor is identified with the symbol ⏚ as per IEC 60417-DB. The minimum cross-section of the protective ground is specified in the following table.

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

11.6.10.3 Connection assignment of the power plug connector

The colors of the connection strands inside the motor and specified according to IEC 60757.

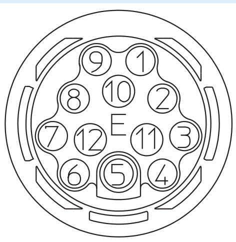
Plug connector size con.23 (1)

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

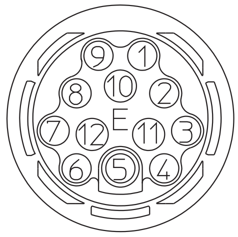
11.6.10.4 Connection assignment of encoder plug connector

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

EZM

11.7 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.

11.7.1 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 symbols	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_{limW}	Nm	Torque limit of the motor with water 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
$n_{m,1*} – n_{m,6*}$	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:

$n_{m*} \leq n_N$

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

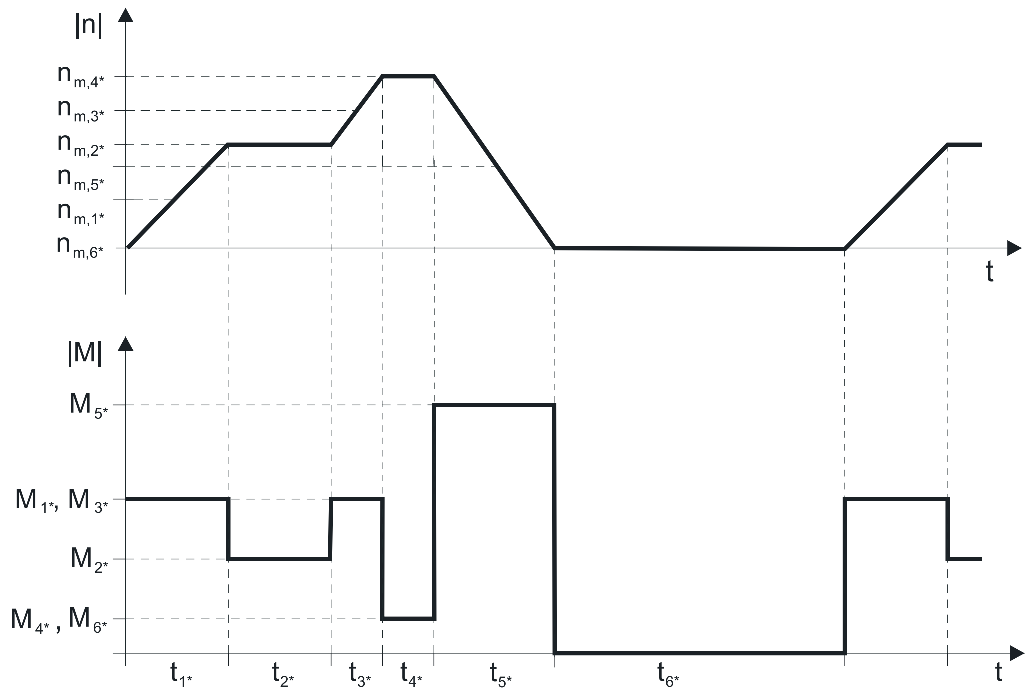
$M_{max*} < M_{max}$

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

The values for M_{limK} or M_{limW} 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

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

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

Calculation of the existing effective torque

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

11.7.2 Design of the screw drive

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

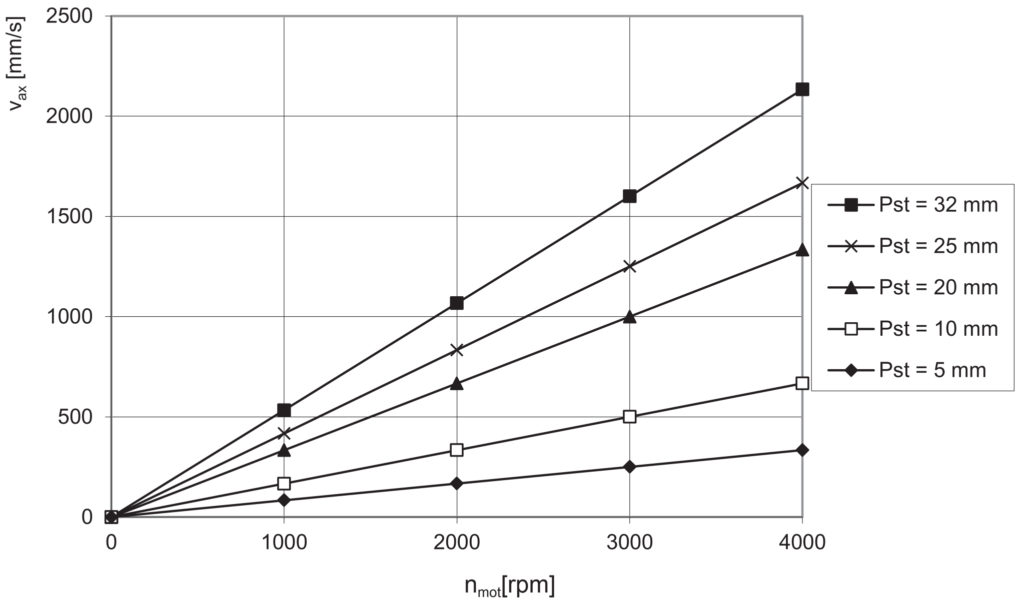
Formula symbols	Unit	Explanation
C_{dyn}	N	Dynamic bearing load rating
η_{gt}	%	Efficiency of the screw drive
F_{ax}	N	Permitted axial force on the output
F_{ax0}	N	Axial force required when the motor is at a standstill to hold the load due to the motor torque
L_{10}		Nominal bearing service life for a survival probability of 90% in 10^6 rollovers
L_{10h}	h	Bearing service life
M_0	Nm	Standstill torque: the torque the motor is able to deliver long term at a speed of 10 rpm (tolerance ±5 %)
n_{mot}	rpm	Speed of the motor
P_{st}	mm	Pitch of the screw drive
v_{ax}	mm/s	Axial velocity

Axial velocity

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

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

The following diagram represents the characteristic curves of screw drives with commonly used pitches which can be implemented with STOBER synchronous servo motors for screw drive.



Axial force

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

$$F_{ax} = \frac{2000 \cdot M_0 \cdot \pi \cdot \eta_{gt}}{P_{st}}$$

If the synchronous servo motor must hold the load due to its torque, the following formula defines the required axial force:

$F_{ax0} \leq 0.6 \cdot F_{ax}$.

You can use the following table to select the matching motor type / screw drive pitch combination for your application. The axial forces are calculated in the table for $_{gt}$ = 0.9.

	M_0 [Nm]	F_{ax} P_{st}=5 [N]	F_{ax} P_{st}=10 [N]	F_{ax} P_{st}=15 [N]	F_{ax} P_{st}=20 [N]	F_{ax} P_{st}=25 [N]	F_{ax} P_{st}=32 [N]
EZM511U	4.3	4807	2403	1602	1202	961	751
EZM511W	5.2	5881	2941	1960	1470	1176	919
EZM512U	7.6	8539	4269	2846	2135	1708	1334
EZM512W	10.6	11932	5966	3977	2983	2386	1864
EZM513U	10.6	11988	5994	3996	2997	2398	1873
EZM513W	14.8	16682	8341	5561	4170	3336	2607
EZM711U	7.3	8256	4128	2752	2064	1651	1290
EZM711W	10.0	11310	5655	3770	2827	2262	1767
EZM712U	12.9	14590	7295	4863	3647	2918	2280
EZM712W	18.8	21262	10631	7087	5316	4252	3322

	M_0 [Nm]	F_{ax} P_{st}=5 [N]	F_{ax} P_{st}=10 [N]	F_{ax} P_{st}=15 [N]	F_{ax} P_{st}=20 [N]	F_{ax} P_{st}=25 [N]	F_{ax} P_{st}=32 [N]
EZM713U	18.9	21375	10688	7125	5344	4275	3340
EZM713W	27.1	30649	15325	10216	7662	6130	4789

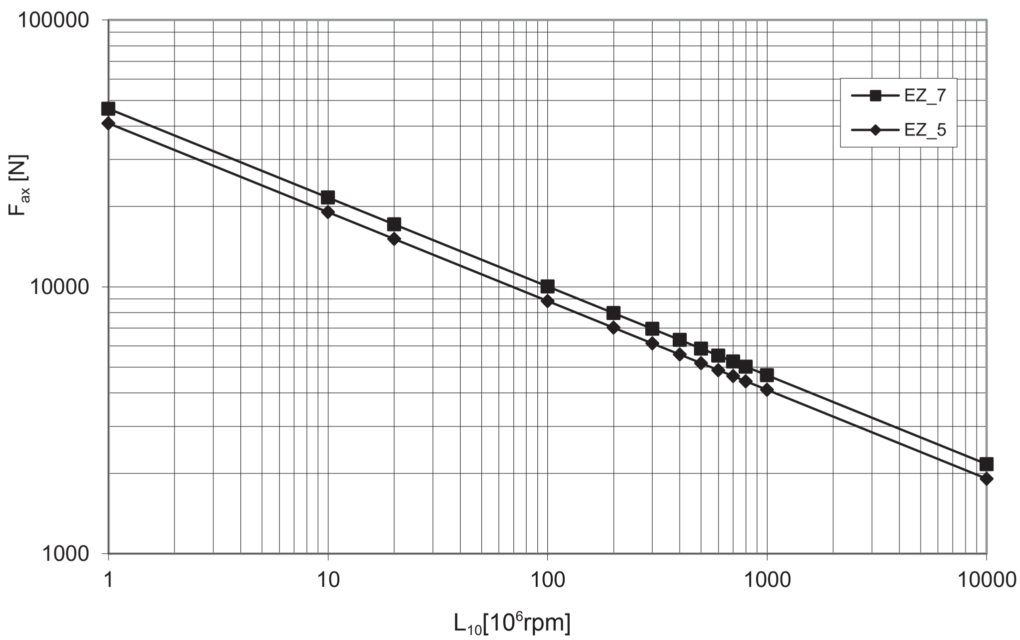
Bearing service life

You can calculate the service life of the axial angular ball bearing of a STOBER synchronous servo motor for screw drive as follows (for the value of C_{dyn} see Technical features section)

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

$$L_{10h} = \frac{L_{10}}{n \cdot 60}$$

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



EZM

11.8 Further information

11.8.1 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

11.8.2 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).

11.8.3 More documentation

More documentation concerning the product can be found at http://www.stoeber.de/en/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

STÖBER

12 EZS synchronous servo motor for screw drive

Table of contents

STOBER

12.1 Overview

Synchronous servo motor for screw drive (direct drive for threaded spindle)

Axial forces of motors with convection cooling

F_{ax}	760 – 22280 N

Axial forces of motors with forced ventilation

F_{ax}	963 – 31271 N

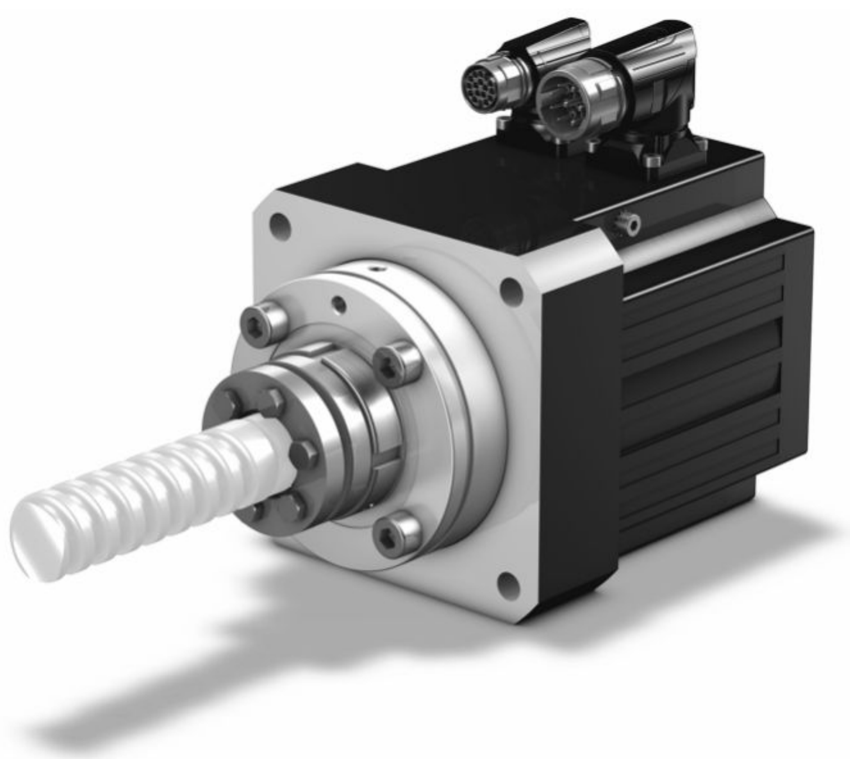
Axial forces of motors with water cooling

F_{ax}	937 – 30649 N

Features

Backlash-free connection with the threaded spindle via clamping unit	✓
Axial angular ball bearing acting on two sides for direct absorption of the threaded spindle forces	✓
Super compact due to tooth winding technology with the highest possible copper fill factor	✓
Backlash-free holding brake (optional)	✓
Convection cooling, forced ventilation (optional) or water cooling (optional)	✓
Optical, inductive EnDat absolute value encoder or resolver	✓
Multiturn absolute value encoders (optional) eliminate the need for referencing	✓
Electronic nameplate for fast and reliable commissioning	✓
Rotating plug connectors with quick lock	✓

EZS



12.2 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
EZS5	23 x 210 x 275 mm	0.16 m^2
EZS7	28 x 300 x 400 mm	0.3 m^2

Formula symbols	Unit	Explanation
F_{ax}	N	Permitted axial force on the output
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 symbols	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

12.2.1 EZS motors with convection cooling

Type	K_{EM} [V/1000 min⁻¹]	n_N [min⁻¹]	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]
EZS501U	97	3000	3.85	3.65	1.05	1.2	4.30	3.95	1.19	0.40	16.0	22.0	3.80	23.50	6.18	6.50	7.10
EZS502U	121	3000	6.90	5.30	1.30	2.2	7.55	5.70	1.40	0.40	31.0	33.0	2.32	16.80	7.24	8.80	8.50
EZS503U	119	3000	9.10	6.70	1.36	2.9	10.7	7.60	1.46	0.40	43.0	41.0	1.25	10.00	8.00	11.1	10.0
EZS701U	95	3000	6.65	6.80	0.98	2.1	7.65	7.70	1.07	0.59	20.0	25.0	1.30	12.83	9.87	20.3	12.6
EZS702U	133	3000	11.0	7.75	1.42	3.5	13.5	9.25	1.53	0.59	41.0	36.0	1.00	11.73	11.73	25.6	14.9
EZS703U	122	3000	15.3	10.8	1.42	4.8	19.7	13.5	1.50	0.59	65.0	62.0	0.52	6.80	13.08	30.8	17.2

12.2.2 EZS motors with forced ventilation

Type	K_{EM} [V/1000 min⁻¹]	n_N [min⁻¹]	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]
EZS501B	97	3000	5.10	4.70	1.09	1.6	5.45	5.00	1.17	0.40	16.0	22.0	3.80	23.50	6.18	6.50	7.10
EZS502B	121	3000	10.0	7.80	1.28	3.1	10.9	8.16	1.38	0.40	31.0	33.0	2.32	16.80	7.24	8.80	8.50
EZS503B	119	3000	14.1	10.9	1.29	4.4	15.6	11.8	1.35	0.40	43.0	41.0	1.25	10.00	8.00	11.1	10.0
EZS701B	95	3000	9.35	9.50	0.98	2.9	10.2	10.0	1.07	0.59	20.0	25.0	1.30	12.83	9.87	20.3	12.6
EZS702B	133	3000	16.3	11.8	1.38	5.1	19.0	12.9	1.51	0.59	41.0	36.0	1.00	11.73	11.73	25.6	14.9
EZS703B	122	3000	23.7	18.2	1.30	7.4	27.7	20.0	1.41	0.59	65.0	62.0	0.52	6.80	13.08	30.8	17.2

12.2.3 EZS motors with water cooling

Type	K_{EM} [V/1000 min⁻¹]	n_N [min⁻¹]	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]
EZS501W	97	3000	5.10	4.75	1.07	1.6	5.30	4.85	1.18	0.40	16.0	22.0	3.80	23.50	6.18	6.50	7.10
EZS502W	121	3000	9.90	7.70	1.29	3.1	10.7	7.85	1.41	0.40	31.0	33.0	2.32	16.80	7.24	8.80	8.50
EZS503W	119	3000	13.2	10.2	1.29	4.2	14.9	11.3	1.35	0.40	43.0	41.0	1.25	10.00	8.00	11.1	10.0
EZS701W	95	3000	9.85	9.95	0.99	3.1	10.0	10.0	1.06	0.59	20.0	25.0	1.30	12.83	9.87	20.3	12.6
EZS702W	133	3000	16.8	12.2	1.37	5.3	18.9	13.1	1.49	0.59	41.0	36.0	1.00	11.73	11.73	25.6	14.9
EZS703W	122	3000	22.1	17.0	1.30	6.9	27.1	19.6	1.42	0.59	65.0	62.0	0.52	6.80	13.08	30.8	17.2

12.3 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 symbols	Unit	Explanation
ED	%	Duty cycle relative to 10 minutes
M_{lim}	Nm	Torque limit without compensating for field weakening
M_{limF}	Nm	Torque limit of the motor with forced ventilation
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_{limW}	Nm	Torque limit of the motor with water 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

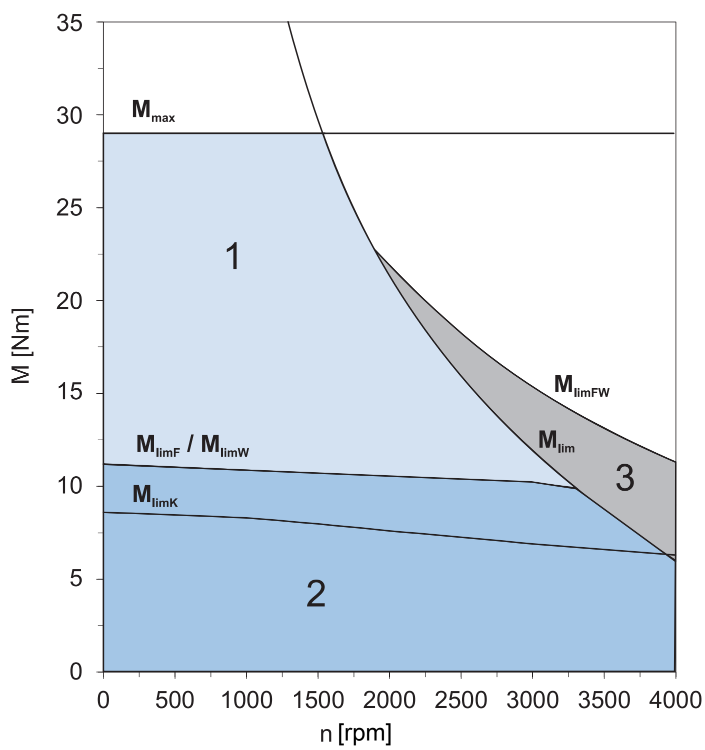
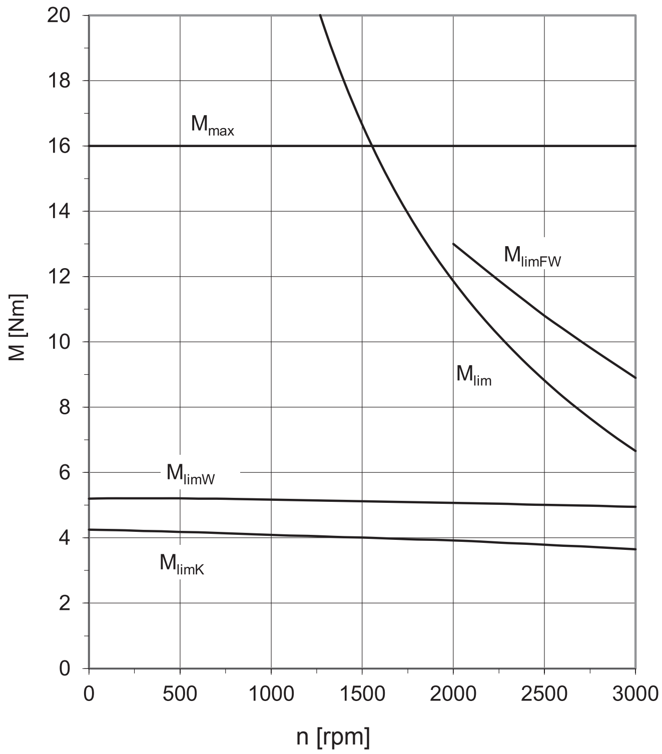


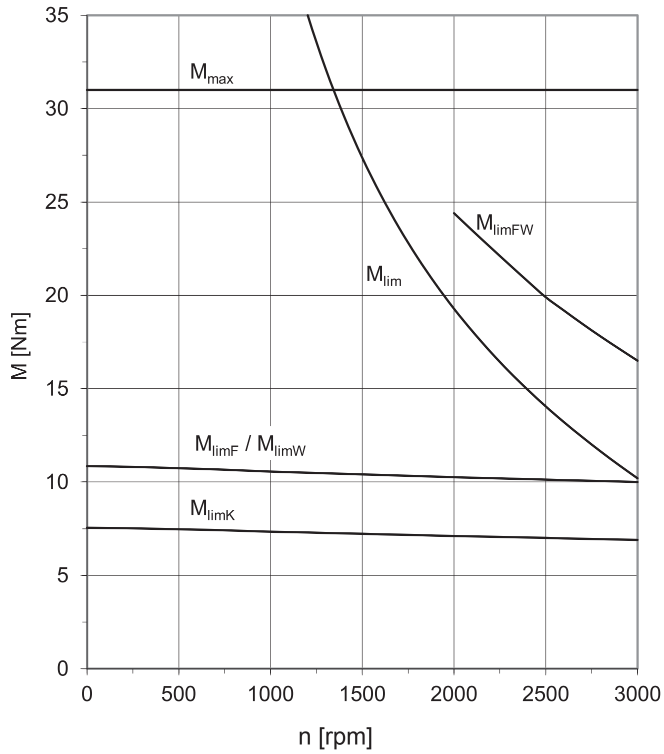
Fig. 1: Explanation of a torque/speed characteristic curve

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)		

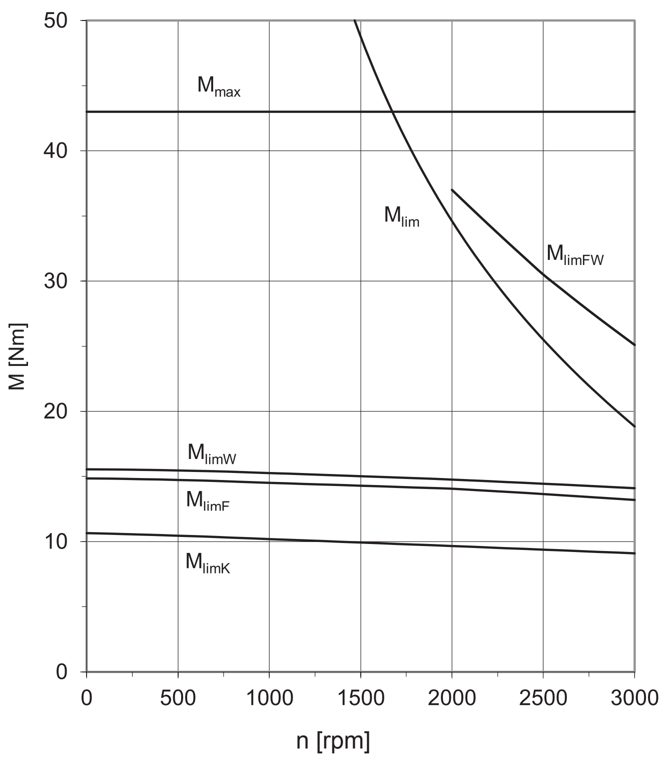
EZS501 (n_N=3000 rpm)



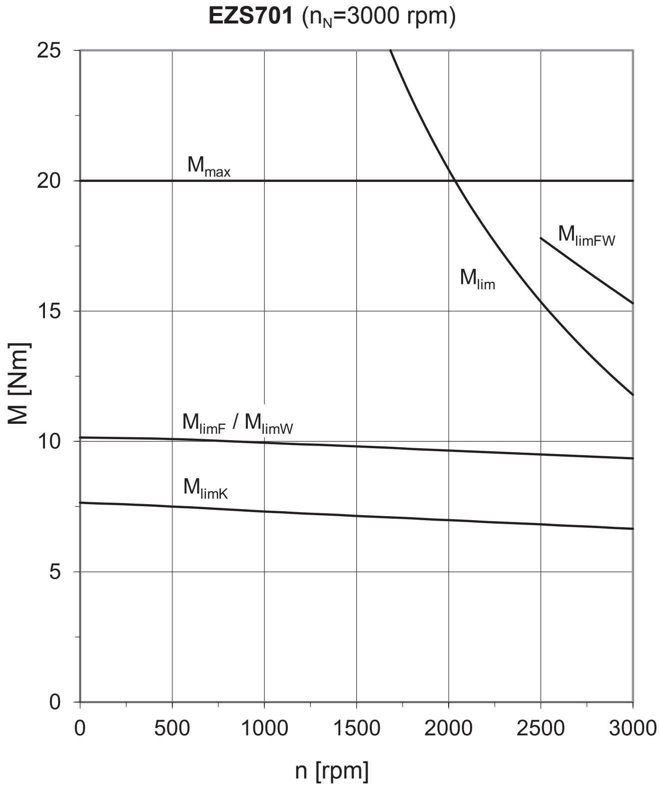
EZS502 (n_N=3000 rpm)

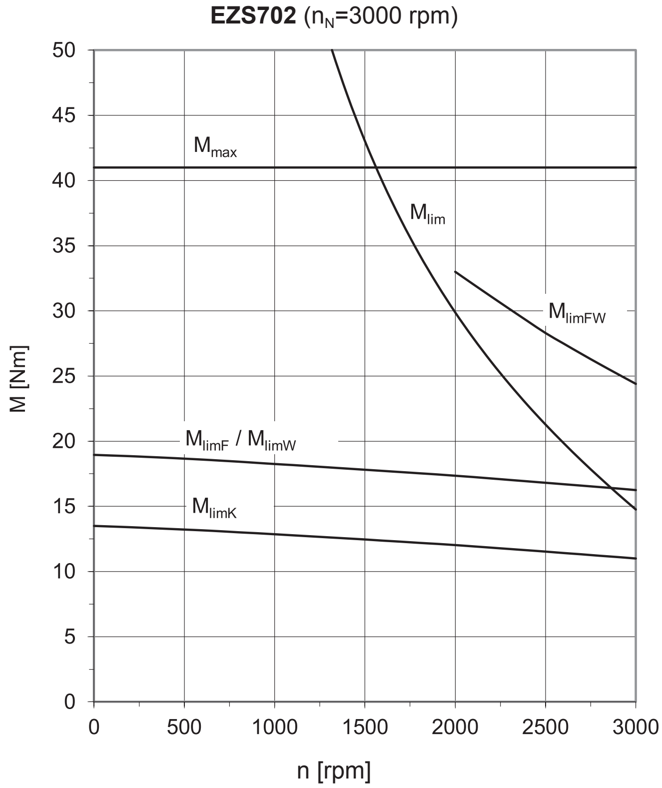


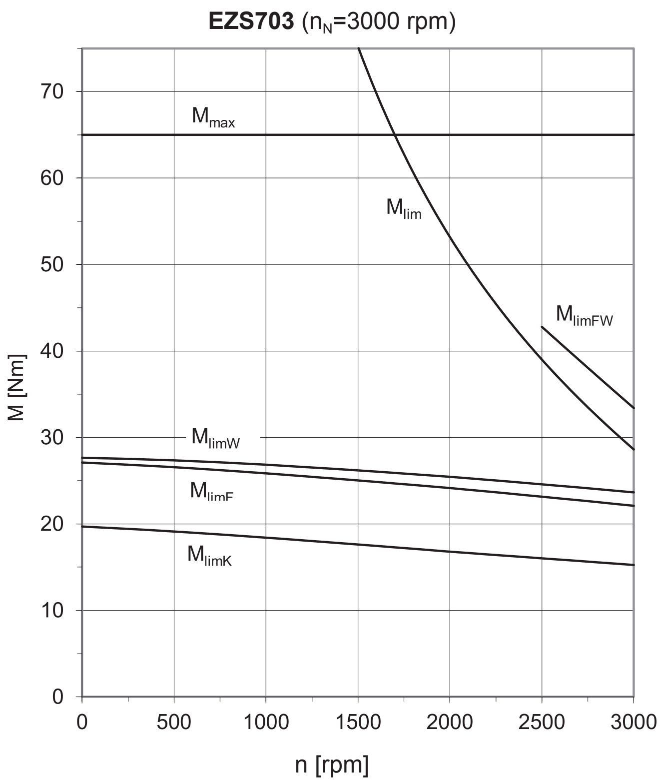
EZS503 (n_N=3000 rpm)



EZS


EZS701 (nN=3000 rpm)
Mmax
MlimFW
Mlim
MlimF / MlimW
MlimK
M [Nm]
n [rpm]
0
5
10
15
20
25
500
1000
1500
2000
2500
3000


EZS702 (nN=3000 rpm)
Mmax
Mlim
MlimFW
MlimF / MlimW
MlimK
M [Nm]
n [rpm]
0
5
10
15
20
25
30
35
40
45
50
500
1000
1500
2000
2500
3000


EZS703 (nN=3000 rpm)
Mmax
Mlim
MlimFW
MlimW
MlimF
MlimK
M [Nm]
n [rpm]
0
10
20
30
40
50
60
70
500
1000
1500
2000
2500
3000

EZS

12.4 Dimensional drawings

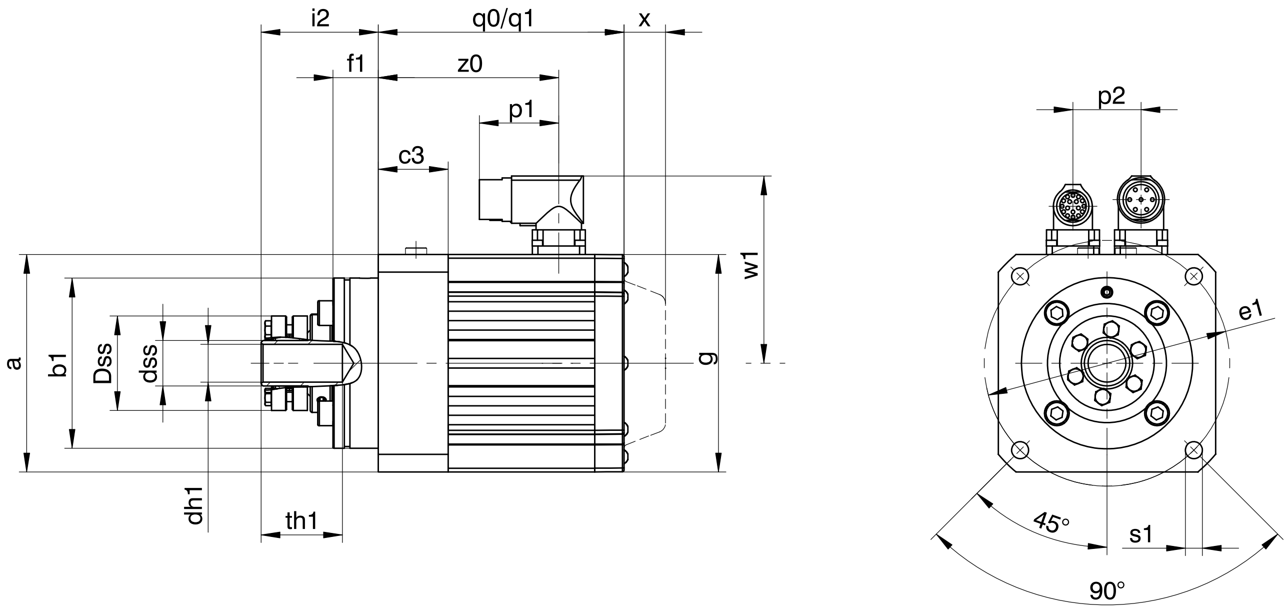
In this chapter you can find the dimensions of the motors.

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.

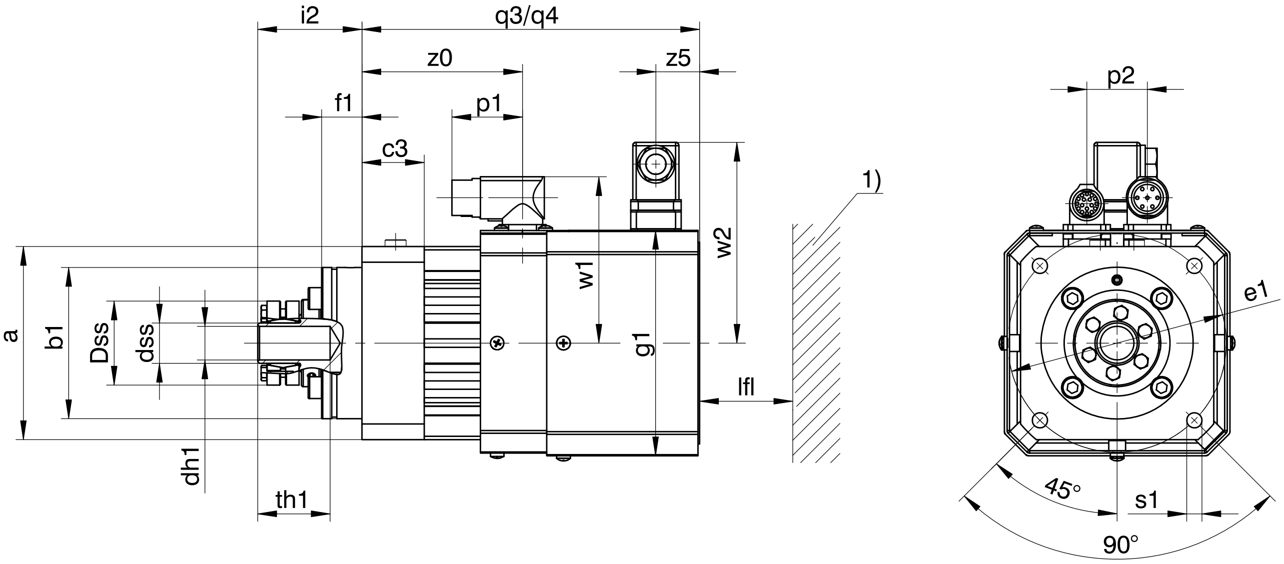
12.4.1 EZS motors with convection cooling



q0	Applies to motors without holding brake.	q1	Applies to motors with holding brake.
x	Applies to encoders based on optical measuring principle.		

Type	□a	∅b1	c3	∅dh1	∅dss	∅Dss	∅e1	f1	□g	i2	p1	p2	q0	q1	∅s1	th1	w1	x	z0
EZS501U	115	$90_{-0,01}$	37	20^{H6}	24_{h7}	50	130	24	115	62.0	40	36	130	184.5	9	41	100	22	95.5
EZS502U	115	$90_{-0,01}$	37	20^{H6}	24_{h7}	50	130	24	115	62.0	40	36	155	209.5	9	41	100	22	120.5
EZS503U	115	$90_{-0,01}$	37	20^{H6}	24_{h7}	50	130	24	115	62.0	40	36	180	234.5	9	41	100	22	145.5
EZS701U	145	$115_{-0,01}$	46	25^{H6}	30_{h7}	60	165	24	145	66.5	40	42	148	206.7	11	45	115	22	110.2
EZS702U	145	$115_{-0,01}$	46	25^{H6}	30_{h7}	60	165	24	145	66.5	40	42	173	231.7	11	45	115	22	135.2
EZS703U	145	$115_{-0,01}$	46	25^{H6}	30_{h7}	60	165	24	145	66.5	40	42	198	256.7	11	45	115	22	160.2

12.4.2 EZS motors with forced ventilation



q3	Applies to motors without holding brake.	q4	Applies to motors with holding brake.
1)	Machine wall		

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}	24_{h7}	50	130	24	134.5	62.0	20	40	36	200	265.0	9	41	100	120	95.5	25
EZS502B	115	$90_{-0,01}$	37	20^{H6}	24_{h7}	50	130	24	134.5	62.0	20	40	36	225	280.0	9	41	100	120	120.5	25
EZS503B	115	$90_{-0,01}$	37	20^{H6}	24_{h7}	50	130	24	134.5	62.0	20	40	36	250	305.0	9	41	100	120	145.5	25
EZS701B	145	$115_{-0,01}$	46	25^{H6}	30_{h7}	60	165	24	164.5	66.5	30	40	42	240	298.7	11	45	115	134	110.2	40
EZS702B	145	$115_{-0,01}$	46	25^{H6}	30_{h7}	60	165	24	164.5	66.5	30	40	42	265	321.7	11	45	115	134	135.2	40
EZS703B	145	$115_{-0,01}$	46	25^{H6}	30_{h7}	60	165	24	164.5	66.5	30	40	42	290	348.7	11	45	115	134	160.2	40

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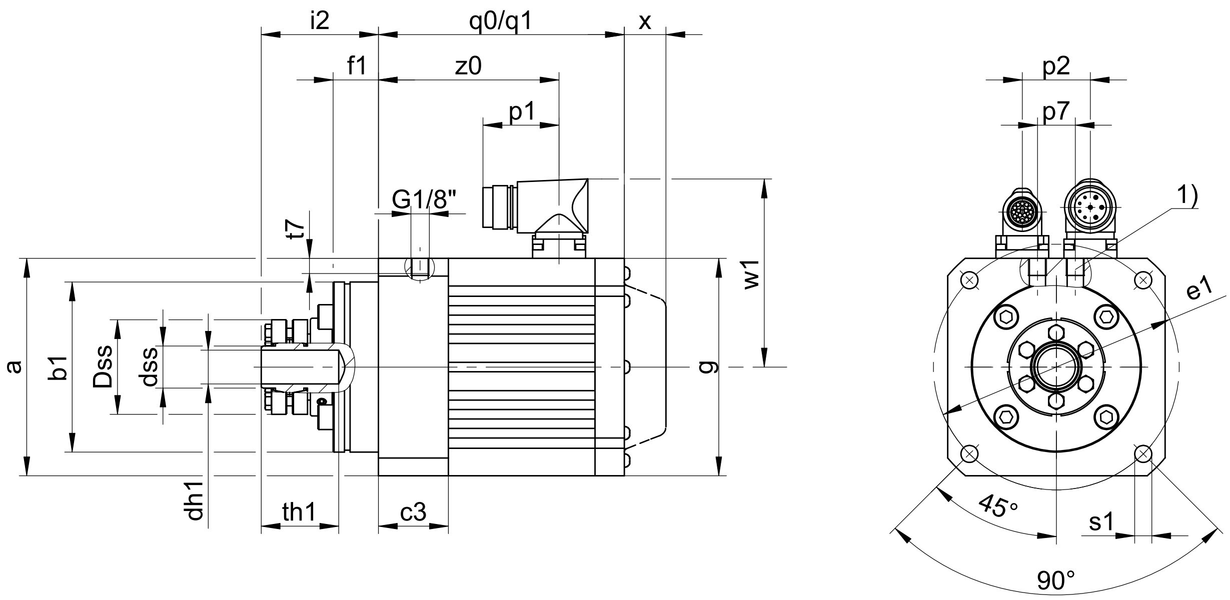
12.4.3 EZS motors with water cooling



EZS

1)	The supply or return line of the cooling system can be connected to both connections for water cooling. The flange with the connections for water cooling can be rotated 180°.
q0	Applies to motors without holding brake.
q1	Applies to motors with holding brake.
x	Applies to encoders based on optical measuring principle.

Type	□a	∅b1	c3	∅dh1	∅dss	∅Dss	∅e1	f1	□g	i2	p1	p2	p7	q0	q1	∅s1	t7	th1	w1	x	z0
EZS501W	115	$90_{-0,01}$	37	20^{H6}	24_{h7}	50	130	24	115	62.0	40	36	20	130	184.5	9	8	41	100	22	95.5
EZS502W	115	$90_{-0,01}$	37	20^{H6}	24_{h7}	50	130	24	115	62.0	40	36	20	155	209.5	9	8	41	100	22	120.5
EZS503W	115	$90_{-0,01}$	37	20^{H6}	24_{h7}	50	130	24	115	62.0	40	36	20	180	234.5	9	8	41	100	22	145.5
EZS701W	145	$115_{-0,01}$	46	25^{H6}	30_{h7}	60	165	24	145	66.5	40	42	20	148	206.7	11	9	45	115	22	110.2
EZS702W	145	$115_{-0,01}$	46	25^{H6}	30_{h7}	60	165	24	145	66.5	40	42	20	173	231.7	11	9	45	115	22	135.2
EZS703W	145	$115_{-0,01}$	46	25^{H6}	30_{h7}	60	165	24	145	66.5	40	42	20	198	256.7	11	9	45	115	22	160.2

12.5 Type designation

Sample code

EZS	**5**	**0**	**1**	**U**	**D**	**AD**	**M4**	**O**	**097**

Explanation

Code	Designation	Design
EZS	Type	Synchronous servo motor for screw drive
5	Motor size	5 (example)
0	Generation	0
1	Length	1 (example)
U B W	Cooling	Convection cooling Forced ventilation Water cooling
D	Design	Dynamic performance
AD	Drive controller	SD6 (example)
M4	Encoder	EQI 1131 FMA EnDat 2.2 (example)
O P	Brake	Without holding brake Permanent magnet holding brake
097	Electromagnetic constant (EMC) K_{EM}	97 V/1000 rpm (example)

Instructions

- You can find information about available encoders in section [▸ 12.6.5].
- In section [▸ 12.6.5.5], you can find information about connecting synchronous servo motors to other STOBER drive controllers.

12.6 Product description

12.6.1 General features

Feature	EZS5	EZS7
∅ Threaded spindle [mm]	25/32	32/40
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) as per EN 60034-1 (155°C, heating $\Delta\vartheta$ = 100 K)	
Surface[4]	Black matte as per RAL 9005	

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

Feature	EZS5	EZS7
Noise level	Limit values as per EN 60034-9/A1	
Cooling	IC 410 convection cooling (IC 416 convection cooling with forced ventilation or optionally water cooling in the A-side flange)	

12.6.2 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

12.6.3 Ambient conditions

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

Feature	Description
Transport/storage surrounding temperature[5]	-30 °C to +85 °C
Surrounding operating temperature	−15 °C to +40 °C (without water cooling) +10 °C to +40 °C (with water cooling)
Installation altitude	≤ 1000 m above sea level
Shock load	≤ 50 m/s^2 (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.

12.6.4 Lubrication of the screw drive

Lubricants that penetrate into the inside of the motor can impair the function of the holding brake and encoder. Therefore take into consideration the protection class of the synchronous servo motor during projecting planning for your screw drive, especially for vertical installation of the synchronous servo motor with the A side on top.

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

[5] If you will be storing or transporting the system in which a motor with water cooling is installed below +3 °C, drain the water completely out of the cooling circuit in advance.

12.6.5 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.

12.6.5.1 Encoder measuring principle selection tool

The following table provides you with a selection tool for an encoder measuring principle that is optimally suited for your application.

Feature	Absolute value encoder		Resolver
Measuring principle	Optical	Inductive	Electromag-netic
Temperature resistance	★★☆	★★★	★★★
Vibration strength and shock resistance	★★☆	★★★	★★★
System accuracy	★★★	★★☆	★☆☆
Version with fault elimination for mechanical mounting FMA (option with EnDat interface)	✓	✓	–
The multiturn version (optional) eliminate the need for referencing	✓	✓	–
- Electronic nameplate ensures easy commissioning	✓	✓	–
Key: ★☆☆ = satisfactory, ★★☆ = good, ★★★ = very good			

12.6.5.2 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		

12.6.5.3 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
EQI 1131 FMA	M4	Inductive	4096	19 bits	524288
EQI 1131	Q6	Inductive	4096	19 bits	524288
EBI 1135	B0	Inductive	65536	18 bits	262144
EQN 1135 FMA	M3	Optical	4096	23 bits	8388608
EQN 1135	Q5	Optical	4096	23 bits	8388608
ECN 1123 FMA	M1	Optical	–	23 bits	8388608
ECN 1123	C7	Optical	–	23 bits	8388608
ECI 1118-G2	C5	Inductive	–	18 bits	262144

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Encoder with EnDat 2.1 interface

Encoder type	Type code	Measuring principle	Recordable revolutions	Resolution	Position values per revolution	Periods per revolution
EQN 1125 FMA	M2	Optical	4096	13 bits	8192	Sin/cos 512
EQN 1125	Q4	Optical	4096	13 bits	8192	Sin/cos 512
ECN 1113 FMA	M0	Optical	–	13 bits	8192	Sin/cos 512
ECN 1113	C6	Optical	–	13 bits	8192	Sin/cos 512

Instructions

- The type code of the encoder is a part of the type designation of the motor.
- FMA = Version with fault elimination for mechanical mounting.
- The encoder EBI 1135 requires an external buffer battery so that the absolute position information will be retained after the power supply is turned off.
- Several revolutions of the motor shaft can only be recorded with multiturn encoders.

EZS

12.6.5.4 Resolver

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

Feature	Description
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

12.6.5.5 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
Drive controller type code		AA	AB	AC	AD	AE
ID connection plan		442305	442306	442307	442450	442451
Encoder	**Encoder type code**					
EQI 1131 FMA	M4	✓	–	–	✓	–
EQI 1131	Q6	✓	✓	–	✓	–
EBI 1135	B0	✓	✓	–	✓	–
EQN 1135 FMA	M3	✓	–	–	✓	–
EQN 1135	Q5	✓	✓	–	✓	–
ECN 1123 FMA	M1	✓	–	–	✓	–
ECN 1123	C7	✓	✓	–	✓	–
ECI 1118-G2	C5	✓	✓	–	✓	–
EQN 1125 FMA	M2	✓	✓	✓	✓	✓
EQN 1125	Q4	✓	✓	✓	✓	✓
ECN 1113 FMA	M0	✓	✓	✓	✓	✓

Drive controller		SDS 5000	MDS 5000	SDS 5000 sin/cos MDS 5000 sin/cos	SD6	SD6 sin/cos
Drive controller type code		AA	AB	AC	AD	AE
ID connection plan		442305	442306	442307	442450	442451
Encoder	**Encoder type code**					
ECN 1113	C6	✓	✓	✓	✓	✓
Resolver	R0	✓	✓	–	–	✓

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).

12.6.6 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.

12.6.6.1 PTC thermistor

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

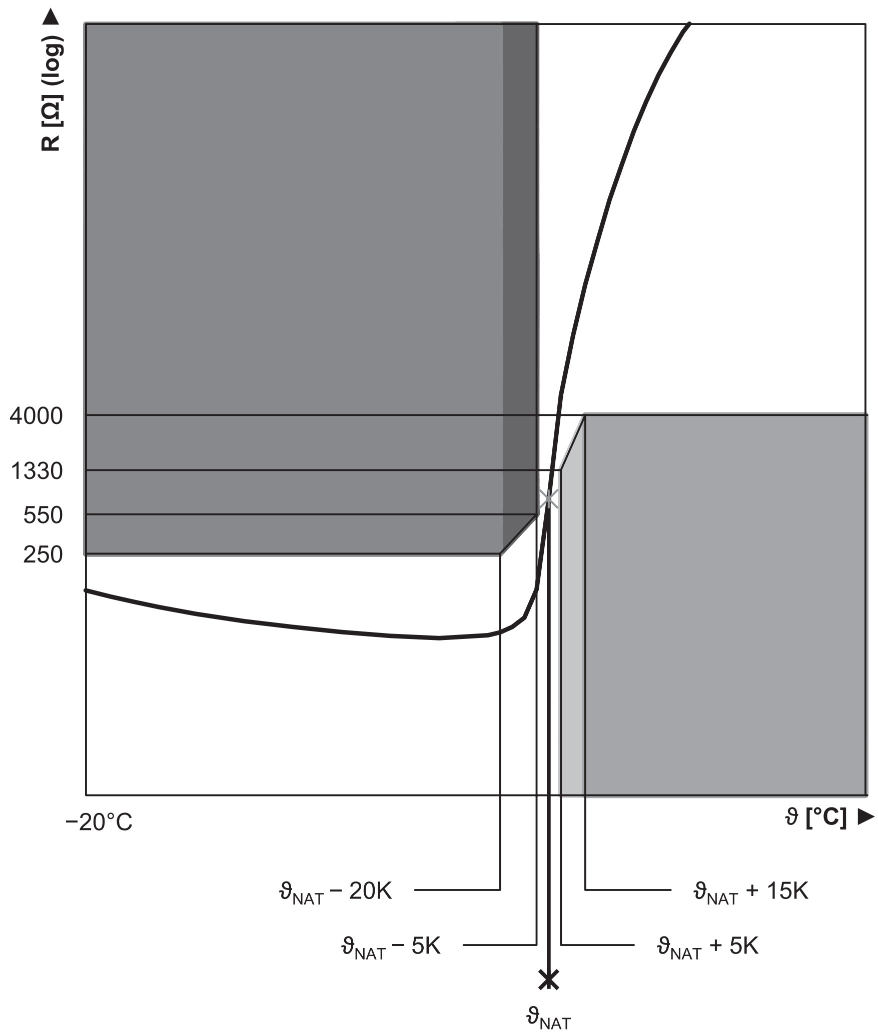


Fig. 2: Characteristic curve of PTC thermistor (single thermistor)

12.6.7 Cooling

A synchronous servo motor in the standard version is cooled by convection cooling (IC 410 in accordance with EN 60034-6). The air flowing around the motor is heated by the radiated motor heat and rises. The motor can optionally be cooled by an forced-cooling fan or with water.

12.6.7.1 Forced ventilation

STOBER synchronous servo motors can optionally be cooled with a forced-cooling fan to increase the performance data for the same size. Retrofitting with a forced-cooling fan is also possible to optimize the drive at a later date. When retrofitting, check whether the core cross-section of the power cable of the motor must be increased. Also take into account the dimensions of the forced-cooling fan.

The performance data of the motors with forced ventilation can be found in section [▸ 12.2.2], the dimensional drawings in section [▸ 12.4.2].

Formula symbols	Unit	Explanation
$I_{N,F}$	A	Nominal current of the forced-cooling fan
$L_{pA,F}$	dBA	Noise level of the forced-cooling fan in the optimum operating range
m_F	kg	Weight of the forced-cooling fan
$P_{N,F}$	W	Nominal output of the forced-cooling fan

Formula symbols	Unit	Explanation
q_{vF}	m³/h	Delivery capacity of the forced-cooling fan in open air
$U_{N,F}$	V	Nominal voltage of the forced-cooling fan

Technical Data

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

Connection assignment for forced-cooling fan plug connectors

Connection diagram	Pin	Connection
	1	L1 (phase)
	2	N (neutral conductor)
	3	
	⏚	PE (protective ground)

12.6.7.2 Water cooling

STOBER synchronous servo motors can optionally be cooled with water to increase the performance data for the same size. Water cooling represents an alternative to forced ventilation if it is not possible due to the surrounding area or space considerations. Water cooling cannot be retrofitted. It must be specified in the purchase order. Water cooling can not be combined with forced ventilation.

The performance data of the motors with water cooling can be found in section [▸ 12.2.3], the dimensional drawings in section [▸ 12.4.3].

Cooling circuit specification

Feature	Description
Coolant	Water
Temperature at inlet	+5 °C to +40 °C (max. 5 K below the surrounding temperature)
Cooling circuit	Closed, with recooling unit
Cleanliness	Clear, with no suspended matter or dirt, use particle filter ≤ 100 µm if necessary
pH value	6.5 – 7.5
Hardness	1.43 – 2.5 mmol/l
Salinity	NaCl < 100 ppm, demineralized
Anticorrosive	Maximum percentage 25 %, neutral relative to AlCuMgPb F38, GG-220HB
Operating pressure	≤ 3.5 bar (provide a pressure relief valve in the supply line if necessary)
Flow rate	Optimum 6 l/min, minimum 4.5 l/min (EZS5)
	Optimum 7.5 l/min, minimum 5 l/min (EZS7)

Instructions

- The nominal data for synchronous servo motors with water cooling refers to water as a coolant. If another coolant is used, the nominal data must be determined again.

- For detailed information about the cooling system or coolants and coolant additives, please contact the manufacturer of your cooling system.
- Coolant with fresh water from the public supply grid with coolants, lubricants or cutting agents from the machining process is not permitted.
- If the temperature of the coolant is lower than the surrounding temperature, interrupt the supply of coolant when the motor is stopped for extended times to prevent condensation water from forming.
- If you will be storing or transporting the system in which a motor is installed below +3 °C, drain the water completely out of the cooling circuit in advance.
- Further information on water cooling can be found in the operating manual for the motor.

12.6.8 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.

Observe the following for the configuration:

- The holding brake can be used for braking from full speed (following a power failure or when setting up the machine). 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 symbols	Unit	Explanation
$I_{N,B}$	A	Nominal current of the brake at 20 °C
ΔJ_B	10^{-4}kgm^2	Additive mass moment of inertia of a motor with holding brake
J	10^{-4}kgm^2	Mass moment of inertia
J_{Bstop}	10^{-4}kgm^2	Reference mass moment of inertia with braking from full speed: $J_{Bstop} = J_{dyn} \times 2$
J_{tot}	10^{-4}kgm^2	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

Formula symbols	Unit	Explanation
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
$W_{B,Rmax/h}$	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

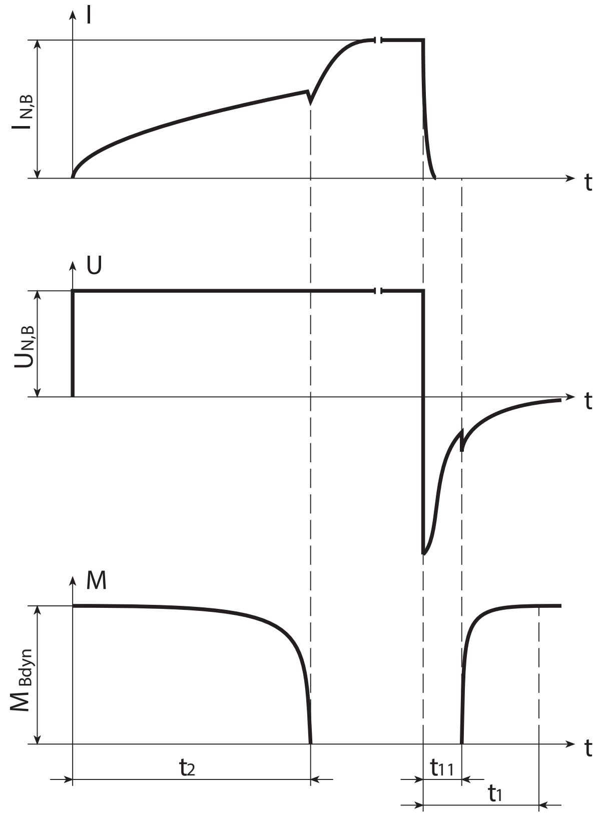
$$W_{B,R/B} = \frac{J_{tot} \cdot n^2}{182.4} \cdot \frac{M_{Bdyn}}{M_{Bdyn} \pm M_L}$$

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]
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

12.6.9 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.

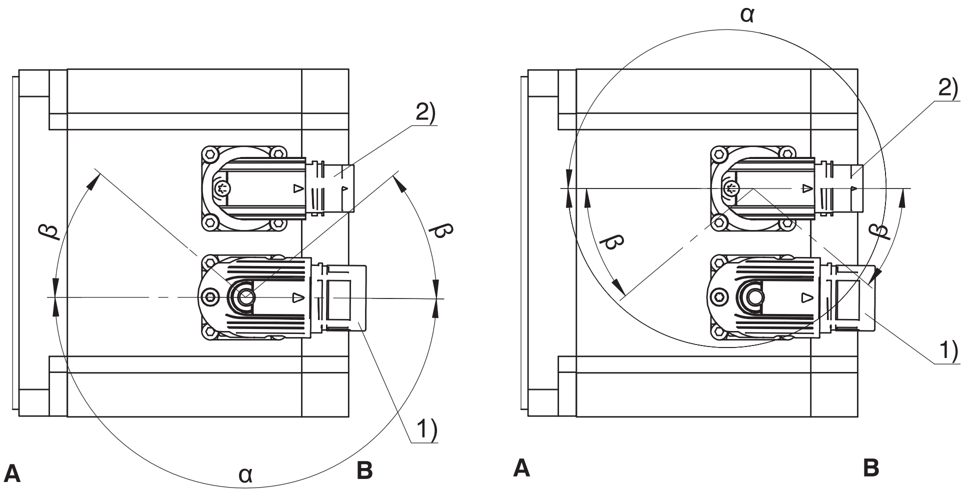
12.6.9.1 Plug connector

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

In motors with forced ventilation or water cooling, prevent collisions between the motor connection cables and the plug connector of the forced-cooling fan or the connecting lines of the cooling system. In the event of a collision, turn the motor plug connectors appropriately. For details on the position of the forced-cooling fan plug connector or the connections for water cooling, see the dimensional drawings 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
EZS	con.23	Quick lock	180°	40°

Encoder plug connector features

Motor type	Size	Connection	Turning range	
			α	β
EZS	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.

12.6.9.2 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.

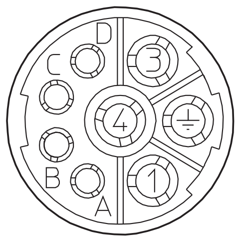
All attachment parts required for the connection of the protective ground to the motor housing are delivered with the motor. The grounding screw of the motor is identified with the symbol ⏚ as per IEC 60417-DB. The minimum cross-section of the protective ground is specified in the following table.

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

12.6.9.3 Connection assignment of the power plug connector

The colors of the connection strands inside the motor and specified according to IEC 60757.

Plug connector size con.23 (1)

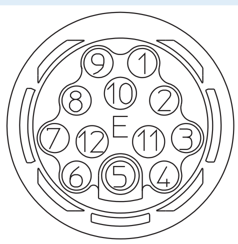
Connection diagram	Pin	Connection	Color
	1	1U1 (phase U)	BK
	3	1V1 (phase V)	BU
	4	1W1 (phase W)	RD
	A	1BD1 (brake +)	RD
	B	1BD2 (brake −)	BK
	C	1TP1/1K1 (temperature sensor)	
	D	1TP2/1K2 (temperature sensor)	
	⏚	PE (protective ground)	GNYE

EZS

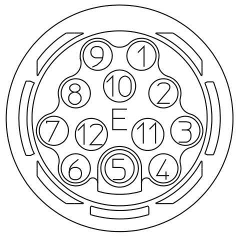
12.6.9.4 Connection assignment of encoder plug connector

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

12.7 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.

12.7.1 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 symbols	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_{limF}	Nm	Torque limit of the motor with forced ventilation
M_{limK}	Nm	Torque limit of the motor with convection cooling
M_{limW}	Nm	Torque limit of the motor with water 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
$n_{m,1*}$ – $n_{m,6*}$	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:

$n_{m*} \leq n_N$

$M_{eff*} \leq M_{limK}$ or $M_{eff*} \leq M_{limF}$ or $M_{eff*} \leq M_{limW}$

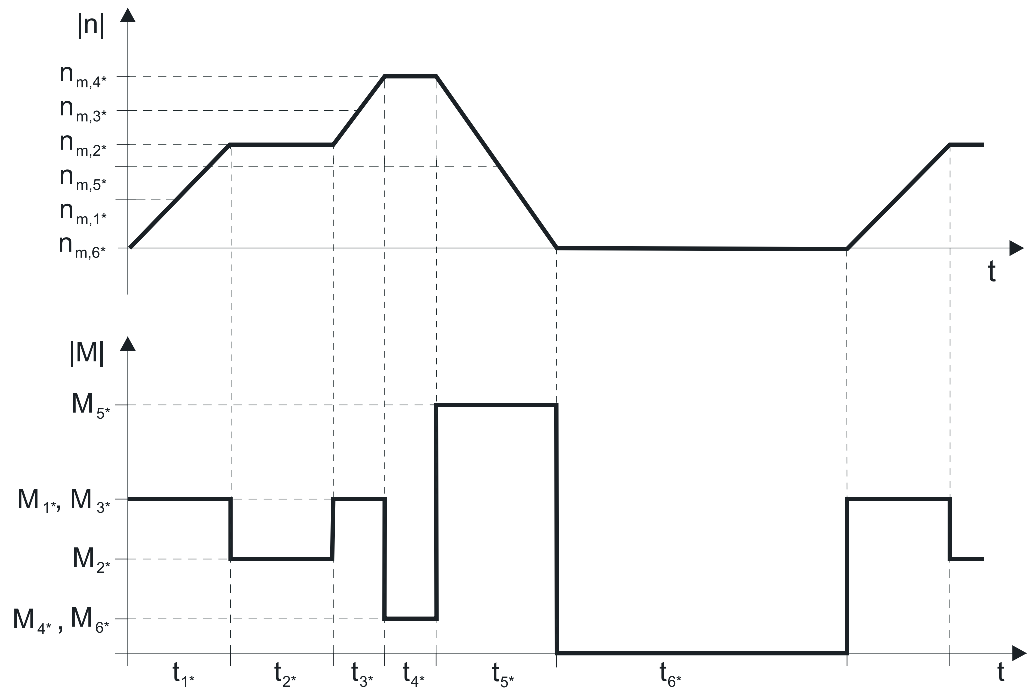
$M_{max*} < M_{max}$

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

The values for M_{limK} or M_{limF} or M_{limW} 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

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

If t_{1^*} + ... + $t_{5^*} \geq 10$ min, determine n_{m^*} without pause t_{6^*}.

Calculation of the existing effective torque

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

12.7.2 Design of the screw drive

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

Formula symbols	Unit	Explanation
C_{dyn}	N	Dynamic bearing load rating
η_{gt}	%	Efficiency of the screw drive
F_{ax}	N	Permitted axial force on the output
F_{ax0}	N	Axial force required when the motor is at a standstill to hold the load due to the motor torque
L_{10}		Nominal bearing service life for a survival probability of 90% in 10^6 rollovers
L_{10h}	h	Bearing service life
M_0	Nm	Standstill torque: the torque the motor is able to deliver long term at a speed of 10 rpm (tolerance ±5 %)
n_{mot}	rpm	Speed of the motor
P_{st}	mm	Pitch of the screw drive
v_{ax}	mm/s	Axial velocity

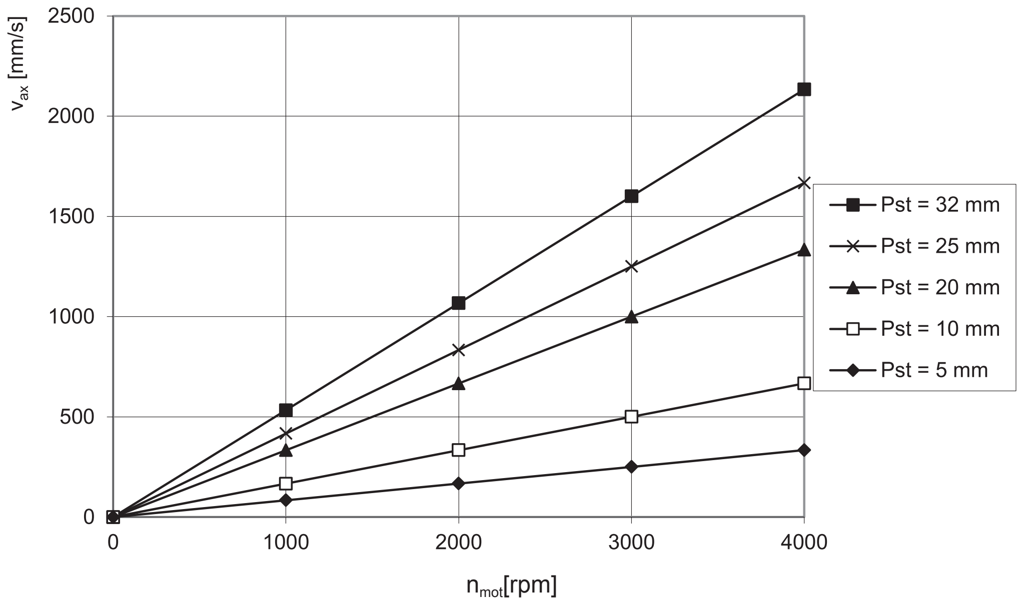
EZS

Axial velocity

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

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

The following diagram represents the characteristic curves of screw drives with commonly used pitches which can be implemented with STOBER synchronous servo motors for screw drive.



Axial force

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

$$F_{ax} = \frac{2000 \cdot M_0 \cdot \pi \cdot \eta_{gt}}{P_{st}}$$

If the synchronous servo motor must hold the load due to its torque, the following formula defines the required axial force:

$F_{ax0} \leq 0.6 \cdot F_{ax}$.

You can use the following table to select the matching motor type / screw drive pitch combination for your application. The axial forces are calculated in the table for $_{gt}$ = 0.9.

	M_0 [Nm]	F_{ax} P_{st}=5 [N]	F_{ax} P_{st}=10 [N]	F_{ax} P_{st}=15 [N]	F_{ax} P_{st}=20 [N]	F_{ax} P_{st}=25 [N]	F_{ax} P_{st}=32 [N]
EZS501U	4.3	4863	2432	1621	1216	973	760
EZS501B	5.5	6164	3082	2055	1541	1233	963
EZS501W	5.3	5994	2997	1998	1499	1199	937
EZS502U	7.6	8539	4269	2846	2135	1708	1334
EZS502B	10.9	12271	6136	4090	3068	2454	1917
EZS502W	10.7	12045	6022	4015	3011	2409	1882
EZS503U	10.7	12045	6022	4015	3011	2409	1882
EZS503B	15.6	17587	8793	5862	4397	3517	2748
EZS503W	14.9	16795	8397	5598	4199	3359	2624
EZS701U	7.7	8652	4326	2884	2163	1730	1352
EZS701B	10.2	11479	5740	3826	2870	2296	1794

	M_0 [Nm]	F_{ax} P_{st}=5 [N]	F_{ax} P_{st}=10 [N]	F_{ax} P_{st}=15 [N]	F_{ax} P_{st}=20 [N]	F_{ax} P_{st}=25 [N]	F_{ax} P_{st}=32 [N]
EZS701W	10.0	11310	5655	3770	2827	2262	1767
EZS702U	13.5	15268	7634	5089	3817	3054	2386
EZS702B	19.0	21432	10716	7144	5358	4286	3349
EZS702W	18.9	21375	10688	7125	5344	4275	3340
EZS703U	19.7	22280	11140	7427	5570	4456	3481
EZS703B	27.7	31271	15636	10424	7818	6254	4886
EZS703W	27.1	30649	15325	10216	7662	6130	4789

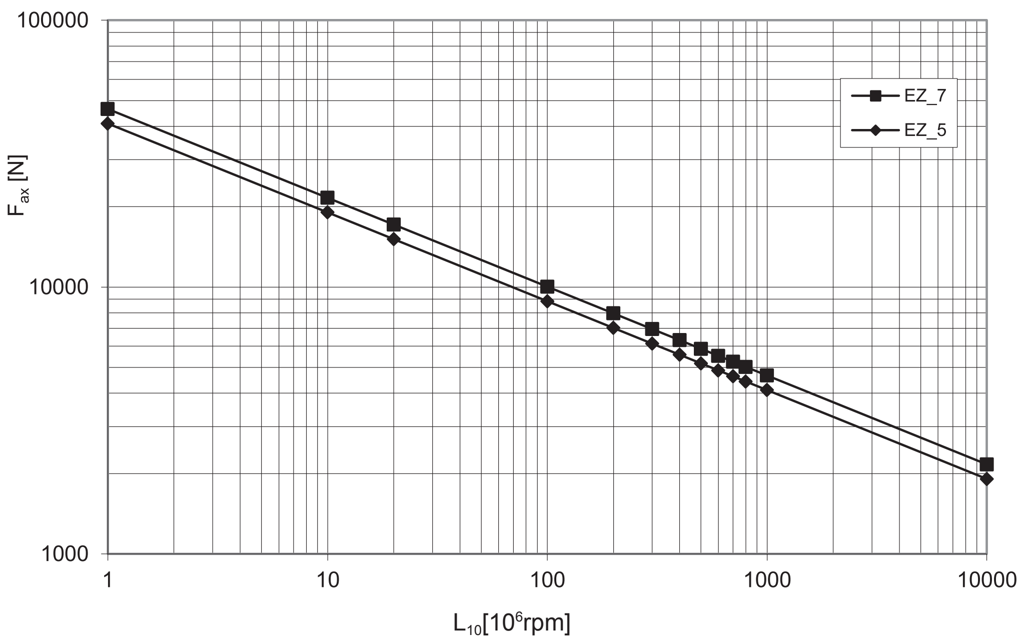
Bearing service life

You can calculate the service life of the axial angular ball bearing of a STOBER synchronous servo motor for screw drive as follows (for the value of C_{dyn} see Technical features section)

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

$$L_{10h} = \frac{L_{10}}{n \cdot 60}$$

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



12.8 Further information

12.8.1 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

12.8.2 Identifiers and test symbols

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

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

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

12.8.3 More documentation

More documentation concerning the product can be found at http://www.stoeber.de/en/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

13 Service

13.1 Close contact with customers worldwide

We can advise and support you with expertise and assistance and are available around the clock if service is required:

- 4 sales centers in Germany
- Worldwide presence in over 40 countries
- STOBER SERVICE NETWORK with over 80 service partners worldwide

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13.3 Sales and delivery conditions

You can find our current sales and delivery conditions at http://www.stoeber.de/en/stoeber_global/agb.html.

13.4 Imprint

Drives and automation ID catalog 442711_en.

You can find suitable geared motor in our catalog Synchronous Servo Geared Motors ID 442437_en.

For the latest pdf files visit us on the Internet at http://www.stoeber.de/en/stoeber_global/service/downloads/downloadcenter.html.

STOBER PRODUCT RANGE

Geared motors	**Synchronous servo geared motors EZ (ID 442437_en)**
	Planetary geared motors
	Right-angle planetary geared motors
	Helical geared motors
	Offset helical geared motors
	Helical bevel geared motors
	Helical worm geared motors
	Synchronous servo geared motors ED/EK (ID 441712)
	Planetary geared motors
	Right-angle planetary geared motors
	Helical geared motors
	Offset helical geared motors
	Helical bevel geared motors
	Helical worm geared motors
	Asynchronous geared motors IE2D (ID 442356)
	Helical geared motors
	Offset helical geared motors
	Helical bevel geared motors
	Helical worm geared motors
	Asynchronous geared motors D (ID 441809)
	Helical geared motors
	Offset helical geared motors
	Helical bevel geared motors
	Helical worm geared motors
Electronics	**Drive controllers/controllers**
	MC6 motion controllers (ID 442711_en)
	SI6 drive controllers (ID 442711_en)
	SD6 drive controllers (ID 442711_en)
	SDS 5000 servo inverters (ID 442711_en)
	MDS 5000 servo inverters (ID 442711_en)
	MDS 5000 frequency inverters (ID 442356)
	FDS 5000 frequency inverters (ID 442356)
Gear units	**Servo gear units (ID 442257)**
	Planetary gear units
	Right-angle planetary gear units
	Helical gear units
	Offset helical gear units
	Helical bevel gear units
	Helical worm gear units
	Power transmission gear units (ID 441834)
	Helical gear units
	Offset helical gear units
	Helical bevel gear units
	Helical worm gear units
	Two-speed gearboxes (ID 442712_en)
	Two-speed gearboxes
Motors	
	EZ synchronous servo motors (ID 442437_en/442711_en)
	EZHD synchronous servo motors with hollow shaft (ID 442437_en/442711_en)
	EZHP synchronous servo geared motors with hollow shaft (ID 442437_en/442711_en)
	EZS/EZM synchronous servo motors for screw drive (ID 442437_en/442711_en)
	ED/EK synchronous servo motors (ID 441712)
	IE2D asynchronous motors (ID 442356)
	D asynchronous motors (ID 441809)
Rack and pinion drives	
	Rack and pinion drives ZTRS/ZTR/ZR (ID 442225)
	Rack and pinion drives ZV (ID 442506)

ID 442711_en.02

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