Drives
and automation

Motion controllers

Drive controllers

Motors

Product catalog

Drives and automation

STÖBER

STÖBER, decades of innovative drive technology

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

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

STÖBER IN MOTION

That very special spirit

A top-level production strategy gives rise to the highest level of product reliability

In demanding applications, you need to be able to depend on strength, smooth operation, repeatability and maximum stability.

This established level of product quality is ensured by the highly skilled employees at STÖBER who have access to state-of-the-art machines and workstations.

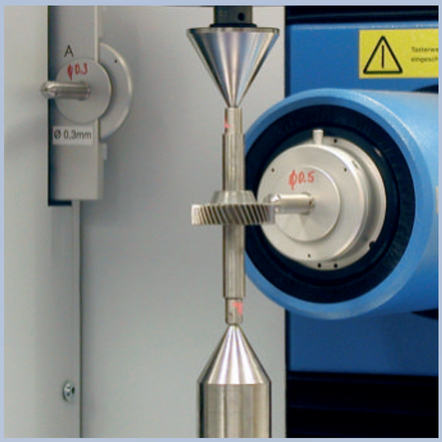

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Table of contents

1 Overview

1.1 Electronics

			
Product chapter		**MC6**	
Chapter number		[▸ 2]	

MC6 motion controllers

Hardware version	**1**	**5**
Processor	Intel Atom Dual-Core E3825, 2 × 1.33 GHz	Intel Core i3-3120ME, 2 × 2.4 GHz
L2 cache	1 MB	3 MB
Main memory	DDR3 RAM, 2 GB	DDR3 RAM, 2 GB
Mass storage	CFast card, 8 GB	CFast card, 8 GB
Non-volatile memory	128 kB nvRAM	128 kB MRAM
USB	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 – 45 °C	0 – 45 °C
Storage temperature	−20 – 75 °C	−20 – 75 °C

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

Drive controllers

Technical data				
Nominal output current (4 kHz)	5 – 50 A	2.3 – 85 A	2.3 – 85 A	2.3 – 85 A
Maximum current (4 kHz)	10.5 – 105 A	4.2 – 153 A	4.2 – 153 A	4.2 – 153 A
Nominal output current (8 kHz)	4.5 – 40 A	1.7 – 60 A	1.7 – 60 A	1.7 – 60 A
Maximum current (8 kHz)	11.3 – 100 A	4.3 – 150 A	4.3 – 150 A	4.3 – 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 chapter	**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	✓			
One Cable Solution	✓			
Live firmware update	✓	✓	✓	
Display and 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 chapter		**Cables**	
Chapter number		[▶ 7]	

Power cables

Design	**con.15**	**con.23**	**con.40**	**con.58**
springtec quick lock	✓			
speedtec quick lock		✓	✓	
Screw technology		On request	On request	✓

Power cores	**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	105.0 mm	52.5 mm
4 × 1.5 mm²	2 × 1.0 mm²	2 × 0.5 mm²	Max. 12.7 mm	127.0 mm	63.5 mm
4 × 2.5 mm²	2 × 1.0 mm²	2 × 1.0 mm²	Max. 15.3 mm	153.0 mm	76.5 mm
4 × 4.0 mm²	2 × 1.0 mm²	2 × 0.75 mm²	Max. 16.0 mm	160.0 mm	80.0 mm
4 × 6.0 mm²	2 × 1.5 mm²	2 × 1.0 mm²	Max. 19.4 mm	194.0 mm	97.0 mm
4 × 10.0 mm²	2 × 1.5 mm²	2 × 1.0 mm²	Max. 23.5 mm	235.0 mm	117.5 mm
4 × 16.0 mm²	2 × 1.5 mm²	2 × 1.5 mm²	Max. 25.5 mm	255.0 mm	191.0 mm
4 × 25.0 mm²	2 × 1.5 mm²	2 × 1.5 mm²	Max. 28.8 mm	288.0 mm	216.0 mm
Bending radius: 1 = free to move, 2 = fixed installation					

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

			
Product chapter		**Cables**	
Chapter number		[▹ 7]	

Encoder cables

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

Encoder	**Cable ∅**	**Bending radius 1**	**Bending radius 2**
EnDat 2.1/2.2 digital	Max. 8.5 mm	85.0 mm	42.5 mm
Resolver	Max. 11.4 mm	114.0 mm	57.0 mm
EnDat 2.1 sin/cos	Max. 13.0 mm	130.0 mm	65.0 mm
Bending radius: 1 = free to move, 2 = fixed installation			

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

HIPERFACE DSL One Cable Solution

Design	**con.15**	**con.23**	**con.40**
springtec quick lock	✓		
speedtec quick lock		✓	✓

Power cores	**Brake**	**Signal line**	**Cable ∅**	**Min. bending radius 1**	**Min. bending radius 2**
4 × 1.0 mm²	2 × 0.75 mm²	2 × AWG24	Max. 12.0 mm	84.0 mm	60.0 mm
4 × 1.5 mm²	2 × 0.75 mm²	2 × AWG22	Max. 13.5 mm	94.5 mm	67.5 mm
4 × 2.5 mm²	2 × 1.0 mm²	2 × AWG22	Max. 15.0 mm	105.0 mm	75.0 mm
4 × 4.0 mm²	2 × 1.0 mm²	2 × AWG22	Max. 16.6 mm	116.2 mm	83.0 mm
Bending radius: 1 = free to move, 2 = fixed installation					

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1.2 Synchronous servo motors

			
Product chapter	**EZ**	**EZHD**	**EZHP**
Chapter number	[▸ 8]	[▸ 9]	[▸ 10]

Technical data

M_N	0.89 – 77.2 Nm	1.9 – 24.6 Nm	
M_0	0.95 – 94 Nm	2.6 – 31.1 Nm	
i			3 – 27
M_{2acc}			47 – 500 Nm
Shaft design			
Solid shaft without feather key	✓		
Flange hollow shaft		✓	✓
Encoder			
EnDat 2.2	✓	✓	✓
EnDat 2.1	✓	✓	✓
HIPERFACE DSL One Cable Solution (OCS)	✓		
Resolver	✓		
Cooling			
Convection cooling	✓	✓	✓
Forced ventilation	✓		
Holding brake			
Permanent magnet brake	✓	✓	✓
Marks and test symbols			
CE	✓	✓	✓
cURus	✓	✓	✓

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

Technical data

F_{ax}	751 – 21375 N	760 – 31271 N
Shaft design		
Direct drive of the threaded nut	✓	
Direct drive of the threaded spindle		✓
Encoder		
EnDat 2.2	✓	✓
EnDat 2.1	✓	✓
HIPERFACE DSL One Cable Solution (OCS)		✓
Resolver		✓
Cooling		
Convection cooling	✓	✓
Forced ventilation		✓
Holding brake		
Permanent magnet brake	✓	✓
Marks and test symbols		
CE	✓	✓
cURus	✓	✓

2 MC6 motion controllers

Table of contents

2.1 Overview

The highest level of flexibility for industrial automation

Features

- MC6 motion controllers based on CODESYS V3
- AutomationControlSuite development environment for convenient program creation
- Up to 100 axes in synchronous operating mode
- IEC 61131-3-compliant programming with ST, AS, CFC, FUP, KOP, AWL
- Cam disk and cam functionality
- 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

MC6

2.1.1 Features

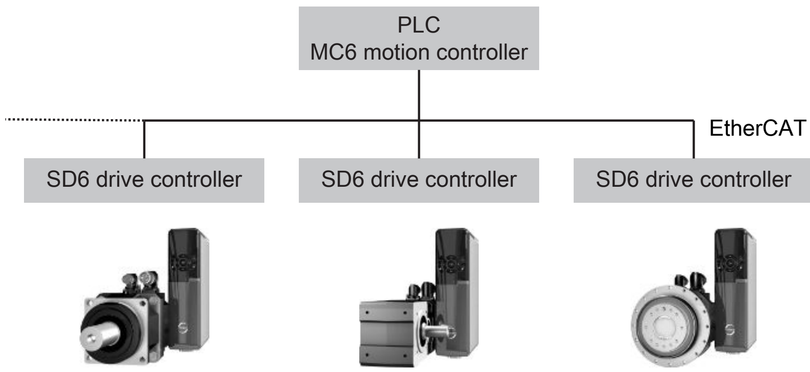
MC6 – Complex motion sequences, high dynamics and precision

The centralization of all control system-related drive functions into one program sequence makes it easier to program multiple axes in many cases.
The use of one or more motion controllers is a requirement for complex interacting functions with high positioning accuracy.
For complex functions in particular, the motion control architecture also facilitates commissioning and, where necessary, service in the event of a fault.
The program can be managed centrally on a motion controller.

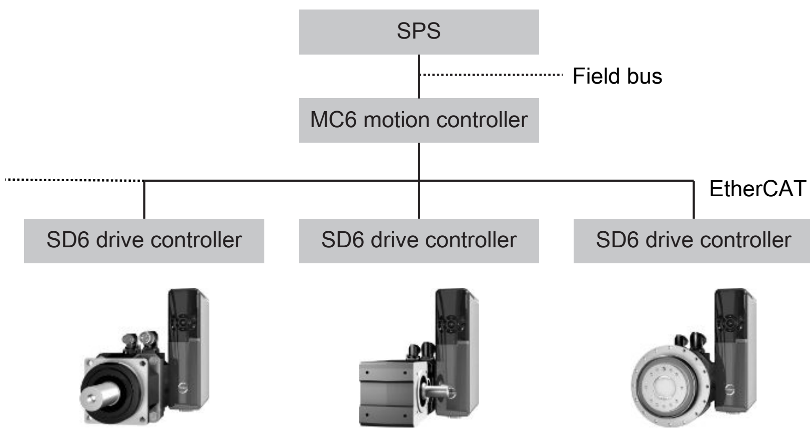
No special user interface (HMI) is required in the MC6 motion controller version with touch panel.

Also suitable for PLC solutions

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

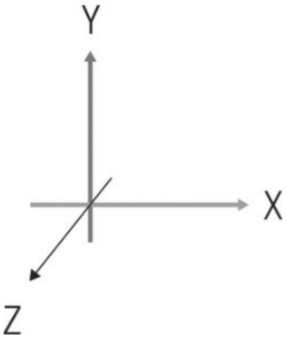


Controllers from third party manufacturers can also be connected.

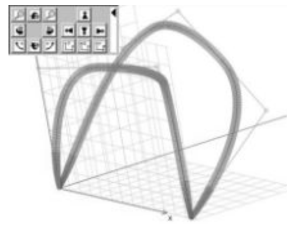


Travel path and robotic function

Motion controllers are capable of interpolating the travel paths 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.



Travel path with interpolation of several axes



CNC function: easy creation of 3D trajectories

SCARA robot: coordinate transformation (spatial axes)

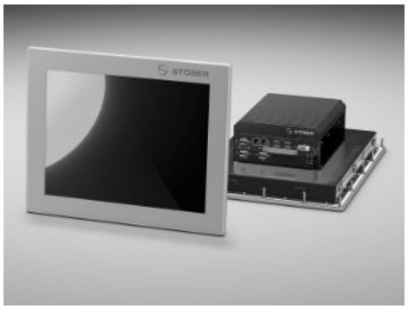
MC6 in the control cabinet PC design

This compact and high-performance motion controller is optimized for operation with the AutomationControlSuite 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 the storage medium. This equipment made it possible to forego any rotating elements.
No data is lost if the 24 V power supply fails.
The Windows operating system can be used for installing separate software. If service is required, the program can be transferred quickly using a CFast card (optional).
HMI panels from third-party manufacturers can be connected.

MC6 motion controller in a control cabinet PC design for easy top-hat rail mounting

MC6 with touch panel for installation in the operating area

The controller in the touch panel design is ideal for use as a master controller.
For applications that require parameterization, the panel design is especially advantageous as a visually sensitive interface, featuring a modern design that facilitates convenient interaction.
The other technical functions match those of the motion controller in the control 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

Human-machine interface (HMI)

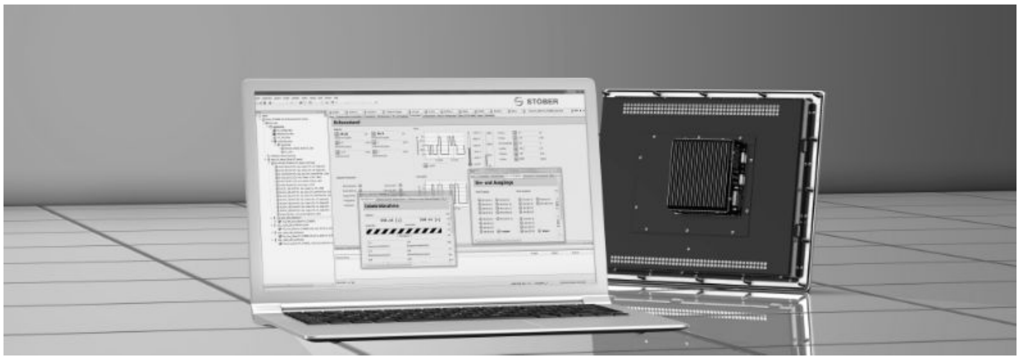
- Large selection of ready-made visualization elements
- Control screens can be generated in the integrated visualization editor
- Entire control screens can be reused as an individual visualization element
- Complex visualization elements can be instantiated by an interface for parameter transfer
- Multi-lingual visualization capability with integrated editor for text lists
- Access to machine visualization using a 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).
In addition, function blocks specially developed by STOBER have been developed from real-world drive operation and are marked as such.
High-performance Drive&Motion libraries are available for program creation. The focus was furthermore on convenient, quick commissioning, without any programing effort and in just a few minutes.

CODESYS



Advantageous for CODESYS users

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

Integrated system solutions

Control and drive technology is nearly always a major focus in 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 in order to make it possible to stay on target when implementing new projects. As a system manufacturer with detailed drive-related experience, STOBER can offer solutions without system interruptions.

Programming languages

The following programming languages are supported:

- Structured text (ST)
- Sequential function chart (SFC)
- Continuous function chart (CFC)
- Function block diagram (FBD)
- Ladder diagram (LD)
- Instruction list (IL)

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

Simulation mode

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

MC6-Data-Link software development kit

Convenient application programming interface (API) for communicating between an MC6 motion controller and client systems such as external visualizations, operating devices, service devices or diagnostics devices. Access by client to IEC 61131-3 variables and the online services of the controller. MC6-Data-Link is implemented as a C, C++ and C# class and is delivered in a software development kit (SDK). The SDK includes an additional C interface, platform-specific files for Windows and source code for demo clients.

Scope of functions:

- Connection set-up and disconnection for the 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 SI6, SD6 or SDS 5000 drive controller.

MC6 Basic

Training content: PLC programming in accordance with IEC 61131-3. Data types, operators, instructions and pointers. The ST, CFC, SFC, IL, FBD and LD programming languages. Creation of programs, function blocks and functions with passed parameters. Simple remote diagnostics via trace, debug, watchlists and force. Creation of a visualization for operation. General basic knowledge about SoftMotion. Parameterization of drives. Configuration of STOBER drives. Use of real and virtual axes and encoders with PLCopen blocks. Use of a master/slave coupling. Disc cam applications with cam function. Practical exercises on training topics. Application of STOBER Drive&Motion library blocks.

Used software: AutomationControlSuite.

MC6 Advanced

Training content: General basic knowledge about CNC track control. Creation of CNC programs in the editor in accordance with 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 on training topics. Application of STOBER Drive&Motion library blocks.

2.2 Technical data

Technical data for the MC6 motion controller can be found in the following chapters.

2.2.1 Type designation

MC	6	C	0	1	C	T

Tab. 1: Example code for the MC6 type designation

Code	Designation	Design
MC	Series	MotionControl
6	Generation	Generation 6
C	Software version	Version of the image
0	Design	As control cabinet PC
1		With touch panel
0...9	Hardware version	1: Atom Dual-Core
		5: Core i3 Dual-Core
N	"Motion" software option	Control
S		SoftMotion
C		SoftMotion CNC
N	"Visualization" software option	None
T		Target visualization
W		Web visualization
A		Target visualization and web visualization

Tab. 2: Meaning of the MC6 example codes

2.2.2 Variants

The following MC6 versions are currently available.

Type	ID No.	Description
MC6C01CT	56564	MC6 motion controller Dual-Core (HW 1) with software version 3.5.9.30: • SoftMotion CNC • Target visualization
MC6C11CT	56565	MC6 motion controller Dual-Core (HW 1) with touch panel and software version 3.5.9.30: • SoftMotion CNC • Target visualization
MC6C01NT	56568	MC6 motion controller Dual-Core (HW 1) with software version 3.5.9.30: • Target visualization
MC6C05CT	56566	MC6 motion controller core i3 (HW 5) with software version 3.5.6.40: • SoftMotion CNC • Target and web visualization
MC6C15CT	56567	MC6 motion controller core i3 (HW 5) with 15" touch panel and software version 3.5.6.40: • SoftMotion CNC • Target and web visualization

Tab. 3: MC6, software variant C

If you require 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:
Phone: + 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 in accordance with IEC 61131-3 and supports the following languages:

- Structured text (ST)
- Sequential function chart (SFC)
- Continuous function chart (CFC)
- Function block diagram (FBD)
- Ladder diagram (LD)
- Instruction list (IL)

"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 unit. 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-axis pelletizing robot
- 6-axis articulated robot

The creation of your own transformations is also supported.
The SoftMotion CNC license also provides a 3D CNC editor as defined by DIN 66025 (G code, dynamic). 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 independent from the the mechanical systems.

2.2.4 Device features

Feature	MC6, hardware version 1
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	• As control cabinet PC: 9 – 32 V_{DC} • With touch panel: 14 – 32 V_{DC}
Power consumption	• As control cabinet PC: max. 10 W • With touch panel: max. 23 W
Front connections	• Realtek RTL8111 Ethernet controller, 10/100/1000 Mbps • Single chip fast Ethernet DM9102D controller, 10/100 Mbps • 3 USB 2.0 interfaces, type A, 480 Mbps, 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 Embedded 7 operating system • Real-time clock with battery backup (internal watchdog)

Tab. 4: Device features for MC6, hardware version 1, Atom Dual-Core

Feature	MC6xx5
Processor	• Intel Core i3-3120ME, 2 × 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	• As control cabinet PC: 9 – 32 V_{DC} • With touch panel: 14 – 32 V_{DC}
Power consumption	• As control cabinet PC: On request • With touch panel: On request
Front connections	• 2 × Realtek RTL8111 Ethernet controller,10/100/1000 Mbps • 4 USB 3.0 interfaces, type A, 480 Mbps, 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 Embedded 7 operating system • Real-time clock with battery backup (internal watchdog)

Tab. 5: Device features for MC6, hardware version 5, core i3 Dual-Core

Feature	Version with touch panel
Display	• 15.0" (38.1 cm) XGA TFT LCD • CCFL backlight • 0.297 pixel pitch • Display mode: Normal white • Resolution 1024 x 768 • 16.7 million colors • 700:1 (typical) contrast rate, 480:1 (minimum) • 450 cd/m² brightness (typical) • 160° horizontal and 160° vertical viewing angle • 50000 h MTBF
Touch panel	• Resistive 4-wire touch panel • IP65 protection class

Tab. 6: Additional device features for design with touch panel

2.2.5 Storage and operating conditions

Storage and operating conditions	
Operating temperature	0 – 45 °C
Storage temperature	–20 – 75 °C
Relative humidity	0 – 80%, non-condensing

Tab. 7: MC6 storage and operating conditions

2.2.6 Electrical data

Electrical data	Version as control cabinet PC	Version with touch panel
Power supply	9 – 32 V_{DC}	14 – 32 V_{DC}
Maximum power consumption	12 W	25 W

Tab. 8: MC6 electrical data

2.2.7 Dimensions

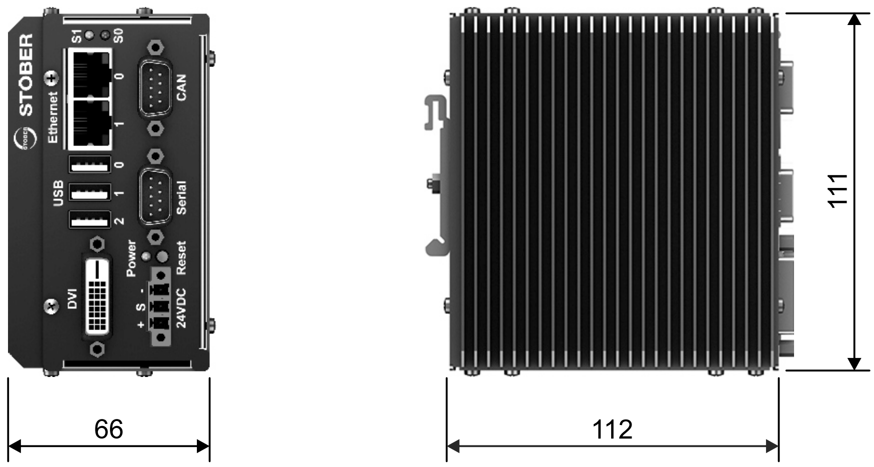


Fig. 1: MC6x01 dimensions, hardware version 1 as control cabinet PC

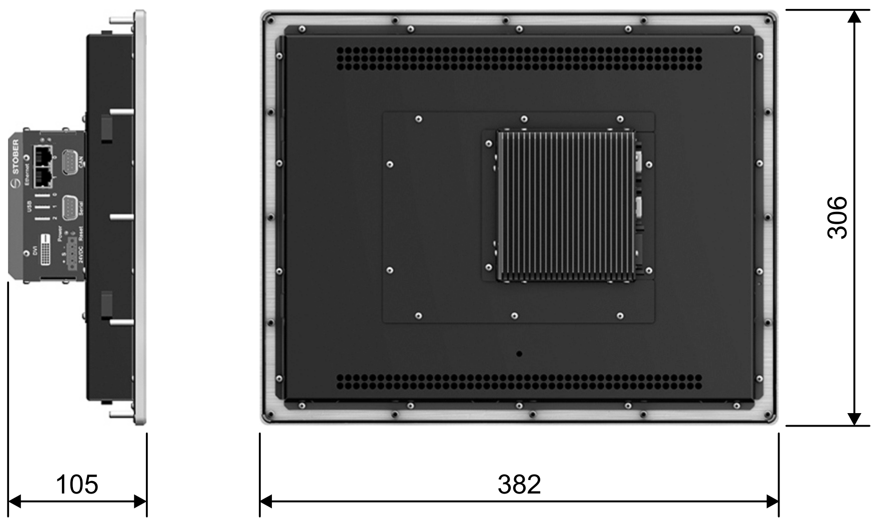


Fig. 2: MC6x11 dimensions, hardware version 1 with touch panel

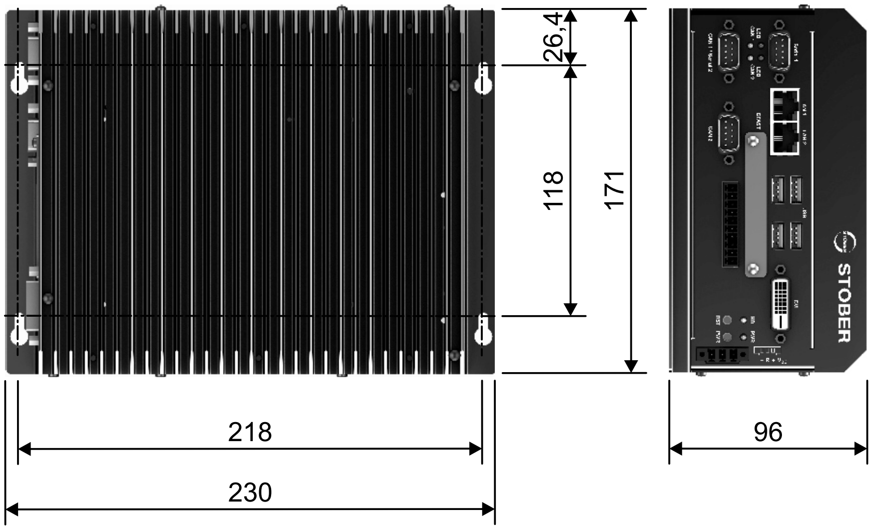


Fig. 3: MC6x05 dimensions, hardware version 5 as control cabinet PC

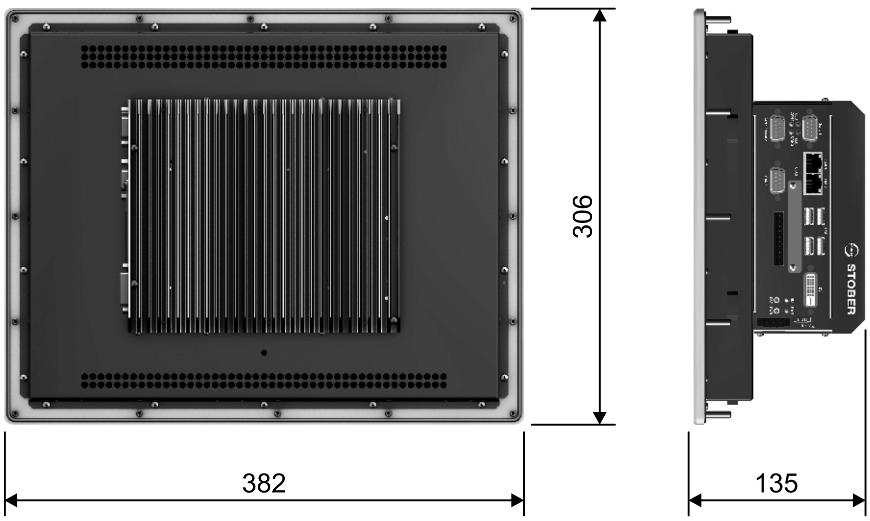


Fig. 4: MC6x15 dimensions, hardware version 5 with touch panel

Type	Height [mm]	Width [mm]	Depth [mm]
MC6x01	111	66	112
MC6x11	306	382	105
MC6x05	171	230	96
MC6x15	306	382	135

Tab. 9: MC6 dimensions [mm]

2.2.8 Weight

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

Tab. 10: Total weights of individual MC6 variants

2.3 Accessories

AutomationControlSuite development environment

ID No. AS6_3580
A 30 day trial version of AutomationControlSuite can be found at https://www.stoeber.de/en/stoeber_global/service/downloads/downloadcenter.html?channel=DE&int=false&productID=3777.
Please contact us if you are interested. You can get advice, offers and further information from our sales staff.

MC6-Data-Link software development kit

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

ELECTRONICS 6 product CD

Included in the standard version.

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

3 SI6 drive controllers

Table of contents

3.1 Overview

Drive control in a multi-axis drive system

Features

- Single or double axis controller with a nominal output current up to 50 A
- 250% overload capacity
- Supply modules up to 20 kW nominal output
- Control of rotary synchronous servo motors, asynchronous motors and torque motors
- HIPERFACE DSL One Cable Solution
- Electronic motor name plate via HIPERFACE DSL and EnDat 2.2 digital encoder interfaces
- Integrated EtherCAT communication
- STO safety technology using terminals or STO and SS1 using FSoE (Safety over Ether-CAT): SIL 3, PL e, category 4
- Integrated holding brake controller
- Energy supply over Quick DC-Link connection
- Single-ended load on double-axis controllers for operation of motors with different power
- Variable feed-in power using supply modules that can be connected in parallel

3.1.1 Features

The completely re-designed STOBER multi-axis drive system consists of the SI6 drive controller and PS6 supply module combination. Matching Quick DC-Link modules handle the power supply for the networked drive controllers. The SI6 drive controller is available in four sizes as a single or double-axis controller with a nominal output current of up to 50 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.

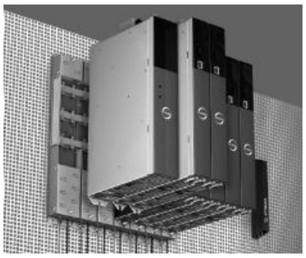
Drive control in multi-axis drive systems with SI6 and PS6

As small as a paperback

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

Dimension capacities precisely

4 axes? 16? Or even 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 scaled without limit. If required, SI6 drive controllers can be combined with stand-alone units from the STOBER SD6 series. For the general power supply, the drive controllers from the SI6 and SD6 series can be connected to each other using Quick DC-Link modules.



Tailored energy yield

The SI6 drive controllers are connected to a central supply module. There is no need for decentralized supply modules or fuses and cabling for each axis. When using double-axis modules, the unused power reserves of one axis can be used for other axes. A significant reduction in space and cost!

Precise dynamics

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

Fewer 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 using a common cable connection. The HIPERFACE DSL encoder system provides an electronic motor nameplate that takes care of the parameterization of motor data simply and safely. EnDat 2.2 digital offers an alternative interface, which also has an electronic nameplate function.

Instant safety

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

Heavy duty

The SI6 has a refined look, but there is an extremely robust design concealed behind the elegant exterior. All components—from the stable, well-shielded sheet steel housing to the motor connectors—far exceed the reference values of industry standards. The inside is also anything but small-scale: ample computer capacities, high-quality components, careful workmanship.

3.1.2 Software components

Project configuration and commissioning

The 6th generation of DriveControlSuite project configuration and commissioning software 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 configuration and parameterization process using wizards.

Open communication

The Ethernet-based EtherCAT field bus system is available in the SI6 drive controller as standard.

Applications

Controller-based motion control is recommended for the central motion control of complex machines.

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, such as an MC6. In addition, the drive controller can also independently handle motion tasks, such as referencing and jogging when commissioning.

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

The drive-based application package from STOBER is the right choice wherever universal and flexible solutions are needed. For the **STOBER Drive Based** application, the PLCOPEN Motion Control command set provides a drive-based motion controller for positioning, velocity and torque/force. These standard commands have been combined into operating modes for different applications and supplemented with additional functions such as jerk limit, motion block linking, cams and much more. For the Command operating 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 operating mode so that only a start signal is necessary to perform the movement. Linking can be used to define complete motion sequences. There is a separate operating 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, installation and commissioning of the drive controller. Use of option modules. Parameterization, commissioning and diagnostics using 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 on training topics.

Software used: DriveControlSuite.

G6 Advanced

Training content: Special knowledge for regulating, control and safety technology. Practical exercises on training topics.

3.2 Technical data

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

3.2.1 Symbols in formulas

Formula symbol	Unit	Explanation
C_{maxPU}	F	Charging capacity of the power unit
C_{PU}	F	Self-capacitance of the power unit
D_{IA}	%	Reduction in the nominal current depending on the installation altitude
D_{T}	%	Reduction in the nominal current depending on the surrounding temperature
f_{2PU}	Hz	Output frequency of the power unit
f_{N}	Hz	Rotating magnetic field frequency at nominal speed
$f_{PWM,PU}$	Hz	Internal pulse clock frequency of the power unit
I_{1maxCU}	A	Maximum input current of the control unit
I_{0}	A	Stall current: RMS value of the line-to-line current when the stall torque M_0 is generated (tolerance ±5%)
$I_{1N,PU}$	A	Nominal input current of the power unit
I_{2maxPU}	A	Maximum output current of the power unit
$I_{2PU(A)}$	A	Output current of the power unit for axis A
$I_{2PU(B)}$	A	Output current of the power unit for axis B
$I_{2N,PU}$	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	Stall torque: The continuous torque the motor is able to deliver 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 unit
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 unit
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 in accordance with EN 61800-3:2012, interference emission class C3
Overvoltage category	III in accordance with 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) in accordance with DIN EN 60068-2-6	5 Hz ≤ f ≤ 9 Hz: 3.5 mm 9 Hz ≤ f ≤ 200 Hz: 10 m/s^2 200 Hz ≤ f ≤ 500 Hz: 15 m/s^2

Tab. 2: Transport and storage conditions

Operating conditions	
Surrounding temperature during operation	0 °C to 45 °C for nominal data 45 °C to 55 °C with −2.5%/°C derating
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 sea level with −1.5%/100 m derating
Pollution degree	Pollution degree level 2 in accordance with EN 50178
Ventilation	Installed fan
Vibration (operation) in accordance with DIN EN 60068-2-6	5 Hz ≤ f ≤ 9 Hz: 0.35 mm 9 Hz ≤ f ≤ 200 Hz: 1 m/s^2

Tab. 3: Operating conditions

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

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	Generation 6
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 sets 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 unit

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

Tab. 8: Control unit electrical data

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}	$\sqrt{2} \times U_{1PU}$
$P_{N,PU}$	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: PS6 electrical data, 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}	$\sqrt{2} \times U_{1PU}$
$P_{N,PU}$	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: PS6 electrical data, 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 to 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 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: Brake chopper electrical data

3.2.3.3.6 Fast discharge

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. Fast discharge does not take 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

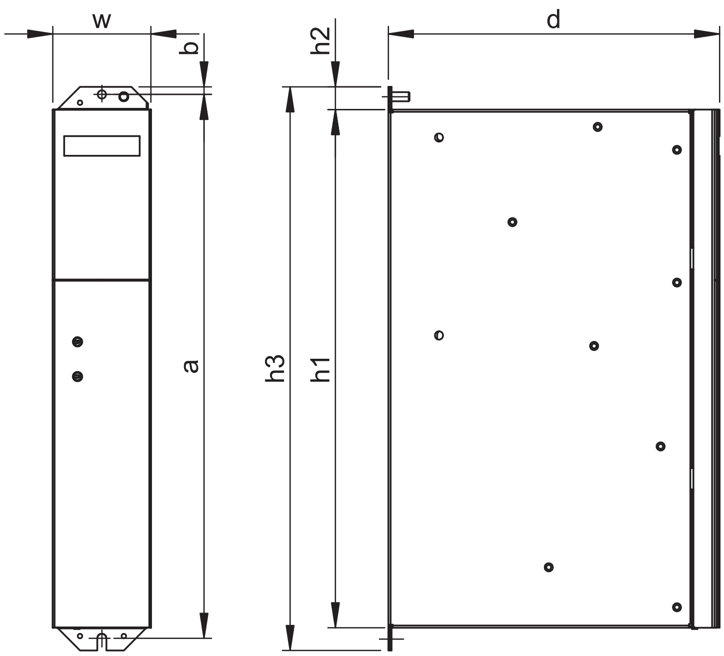


Fig. 2: PS6 dimensional drawing

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

Tab. 13: PS6 dimensions [mm]

3.2.3.5 Weight

Type	Weight without packaging [g]	Weight with packaging [g]
PS6A24	2680	4180
PS6A34	3820	4920

Tab. 14: PS6 weight [g]

3.2.4 Drive controllers

The following chapters contain 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	Generation 6
A	Version	
0 – 3	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 using terminals SY6: STO and SS1 using FSoE

Tab. 16: Meaning of the SI6 example code

3.2.4.2 Sizes

Type	ID No.	Size	Axis controller
SI6A061	56645	Size 0	Single-axis controller
SI6A062	56646	Size 0	Double-axis controller
SI6A161	56647	Size 1	Single-axis controller
SI6A162	56648	Size 1	Double-axis controller
SI6A261	56649	Size 2	Single-axis controller
SI6A262	56653	Size 2	Double-axis controller
SI6A361	56664	Size 3	Single-axis controller

Tab. 17: Available SI6 types and sizes

Fig. 3: SI6 in sizes 0 to 3

Note that the basic device is delivered without terminals. Suitable terminal sets 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 Control unit

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

Tab. 18: Control unit electrical data

3.2.4.3.2 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. 19: SI6 electrical data, 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. 20: SI6 electrical data, size 0, at 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. 21: SI6 electrical data, size 0, at 8 kHz clock frequency

3.2.4.3.3 Power unit: Size 1

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

Tab. 22: SI6 electrical data, 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. 23: SI6 electrical data, size 1, at 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. 24: SI6 electrical data, size 1, at 8 kHz clock frequency

3.2.4.3.4 Power unit: Size 2

Electrical data	SI6A261	SI6A262
U_{1PU}	280 – 800 V_{DC}	
f_{2PU}	0 – 700 Hz	
U_{2PU}	0 – max. $\frac{U_{1PU}}{\sqrt{2}}$	
C_{PU}	940 µF	2250 µF

Tab. 25: SI6 electrical data, size 2

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

Electrical data	SI6A261	SI6A262
$f_{PWM,PU}$	4 kHz	
$I_{2N,PU}$	22 A	2 × 25 A
I_{2maxPU}	210% for 2 s	

Tab. 26: SI6 electrical data, size 2, at 4 kHz clock frequency

Electrical data	SI6A261	SI6A262
$f_{PWM,PU}$	8 kHz	
$I_{2N,PU}$	20 A	2 × 20 A
I_{2maxPU}	250% for 2 s	

Tab. 27: SI6 electrical data, size 2, at 8 kHz clock frequency

3.2.4.3.5 Power unit: Size 3

Electrical data	SI6A361
U_{1PU}	280 – 800 V_{DC}
f_{2PU}	0 – 700 Hz
U_{2PU}	0 – max. $\frac{U_{1PU}}{\sqrt{2}}$
C_{PU}	2250 µF

Tab. 28: SI6 electrical data, size 3

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

Electrical data	SI6A361
$f_{PWM,PU}$	4 kHz
$I_{2N,PU}$	50 A
I_{2maxPU}	210% for 2 s

Tab. 29: SI6 electrical data, size 3, at 4 kHz clock frequency

Electrical data	SI6A361
$f_{PWM,PU}$	8 kHz
$I_{2N,PU}$	40 A
I_{2maxPU}	250% for 2 s

Tab. 30: SI6 electrical data, size 3, at 8 kHz clock frequency

3.2.4.3.6 Single-ended load on double-axis controllers

When operating 2 motors on a SI6 double-axis controller, it is possible to operate one of the motors with a continuous current above the drive controller nominal current if the continuous current of the second connected motor is less than the drive controller nominal current. Economical combinations of double-axis controllers and motors are therefore possible.

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

Example 1

$$I_{2PU(B)} = I_{2N,PU} - \left(I_{2PU(A)} - I_{2N,PU} \right) \times \frac{3}{5} \quad \text{where} \quad 0 \leq I_{2PU(A)} \leq I_{2N,PU}$$

Example 2

$$I_{2PU(B)} = I_{2N,PU} - \left(I_{2PU(A)} - I_{2N,PU} \right) \times \frac{5}{3} \quad \text{where} \quad I_{2N,PU} \leq I_{2PU(A)} \leq 1{,}6 \times I_{2N,PU}$$

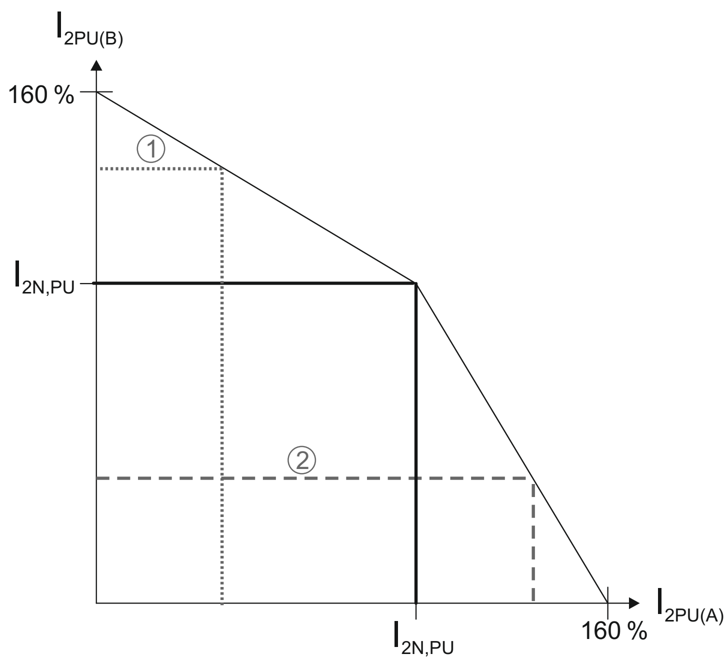


Fig. 4: Single-ended load load on SI6 double-axis controllers

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 a single-ended load.

3.2.4.3.7 Power loss data in accordance with EN 50598

Type	Nominal current $I_{2N,PU}$	Apparent power	Absolute losses $P_{V,CU}$[1]	Operating 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	
SI6A262	25	17.3	Max. 10	0.45	0.62	1.12	0.50	0.74	1.47	0.95	2.12	IE2	
SI6A361	50	34.6	Max. 10	0.45	0.62	1.12	0.50	0.74	1.47	0.95	2.12	IE2	
				Absolute losses P_V									
	[A]	[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
SI6A262	25	17.3	Max. 10	77.9	106.5	193.0	87.1	127.9	254.3	163.8	367.6	IE2	36.4
SI6A361	50	34.6	Max. 10	155.8	213.1	386.0	174.3	255.8	508.6	327.6	735.2	IE2	39.5

Tab. 31: Power loss data in accordance with EN 50598 for one axis of a SI6 drive controller

General conditions

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

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

The loss data applies to drive controllers without any accessories.

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

The calculated data includes a supplement of 10% in accordance with EN 50598.

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

The absolute losses for a power unit that is switched off refer to the 24 V_{DC} power supply of the control electronics.

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

3.2.4.4 Derating

When dimensioning the drive controller, observe the derating of the nominal output current as a function of 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.

Type	$I_{2N,PU}$ 4 kHz [A]	$I_{2N,PU}$ 8 kHz [A]	$I_{2N,PU}$ 16 kHz [A]
SI6A061	5	4,5	3,5
SI6A062	2 × 5	2 × 4,5	2 × 3,5
SI6A161	12	10	6
SI6A162	2 × 12	2 × 10	2 × 6
SI6A261	22	20	10
SI6A262	2 × 25	2 × 20	2 × 10
SI6A361	50	40	20

Tab. 32: Nominal output current $I_{2N,PU}$ dependent on the clock frequency

3.2.4.4.2 Effect of surrounding temperature

Derating as a function of 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 needs to 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 as a function of 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 needs to 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 $I_{2N,PU}$ in accordance with the following formula:
   $I_{2N,PU} = I_{2N,PU} \times D_T \times D_{IA}$

A drive controller of type SI6A061 needs to be operated at a clock frequency of 8 kHz at an altitude of 1500 m above sea level and a 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:
$D_T = 100\% - 5 \times 2.5\% = 87.5\%$

The derating factor D_{IA} is calculated as follows:
$D_{IA} = 100\% - 5 \times 1.5\% = 92.5\%$

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

3.2.4.5 Dimensions

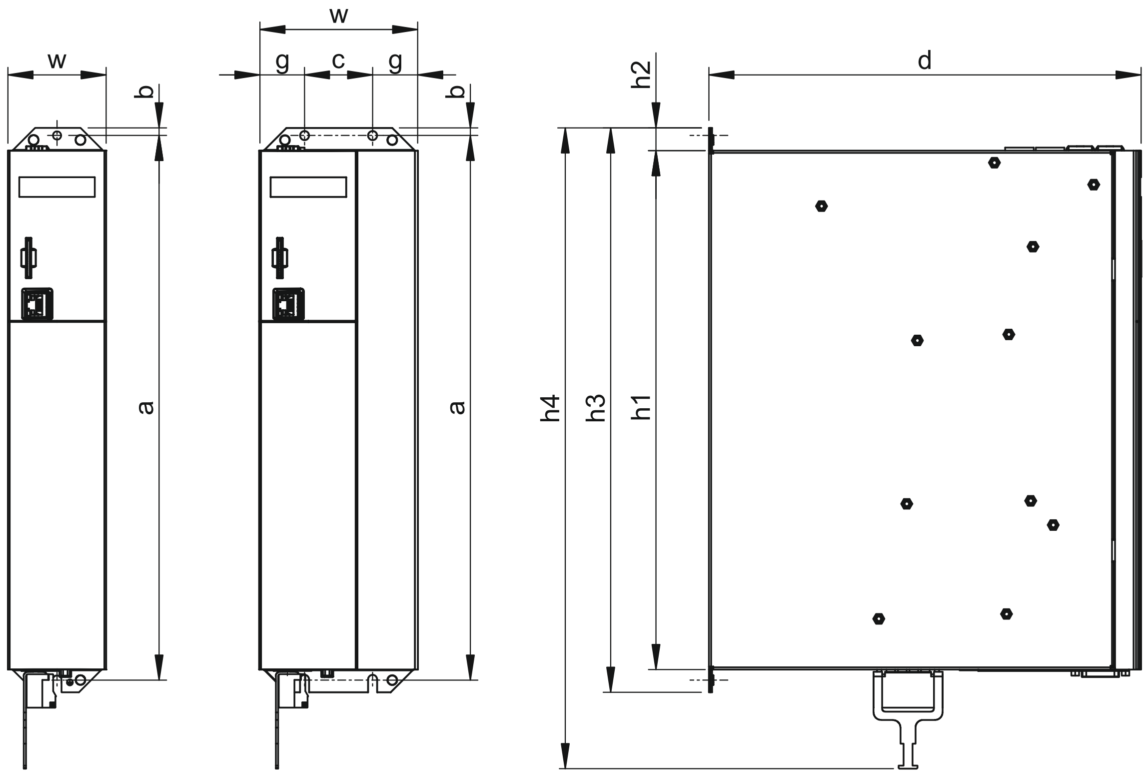


Fig. 5: SI6 dimensional drawing

Dimension			Size 0	Size 1	Size 2[5]	Size 2[6]	Size 3
Drive controller	Width	w	45	65		105	
	Depth	d	265	286			
	Body height	h1	343				
	Fastening clip height	h2	15				
	Height incl. fastening clips	h3	373				
	Total height incl. shield connection	h4	423				
Fastening holes (M5)	Vertical distance	a	360+2				
	Vertical distance to the upper edge	b	5				
	Horizontal spacing of the fastening holes	c	45				
	Horizontal distance to the side edge	g	30				

Tab. 33: SI6 dimensions [mm]

[5] Single-axis controller
[6] Double-axis controller

3.2.4.6 Weight

Type	Weight without packaging [g]	Weight with packaging [g]
SI6A061	2980	4600
SI6A062	3460	5060
SI6A161	3880	5260
SI6A162	4820	6240
SI6A261	4760	6180
SI6A262	6240	7420
SI6A361	6180	7360

Tab. 34: SI6 weight [g]

3.2.5 DC link connection

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

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

Type	DL6B10	DL6B11	DL6B12	DL6B20	DL6B21
ID No.	56655	56656	56663	56657	56658
SI6A061	X	—	—	—	—
SI6A062	X	—	—	—	—
SI6A161	—	X	—	—	—
SI6A162	—	X	—	—	—
SI6A261	—	X	—	—	—
SI6A262	—	—	X	—	—
SI6A361	—	—	X	—	—
PS6A24	—	—	—	X	—
PS6A34	—	—	—	—	X

Tab. 35: DL6B assignment 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 types and supply module types. The maximum DC link voltage is 750 V_{DC} and the maximum permitted total current is 200 A.

3.2.5.2 Dimensions

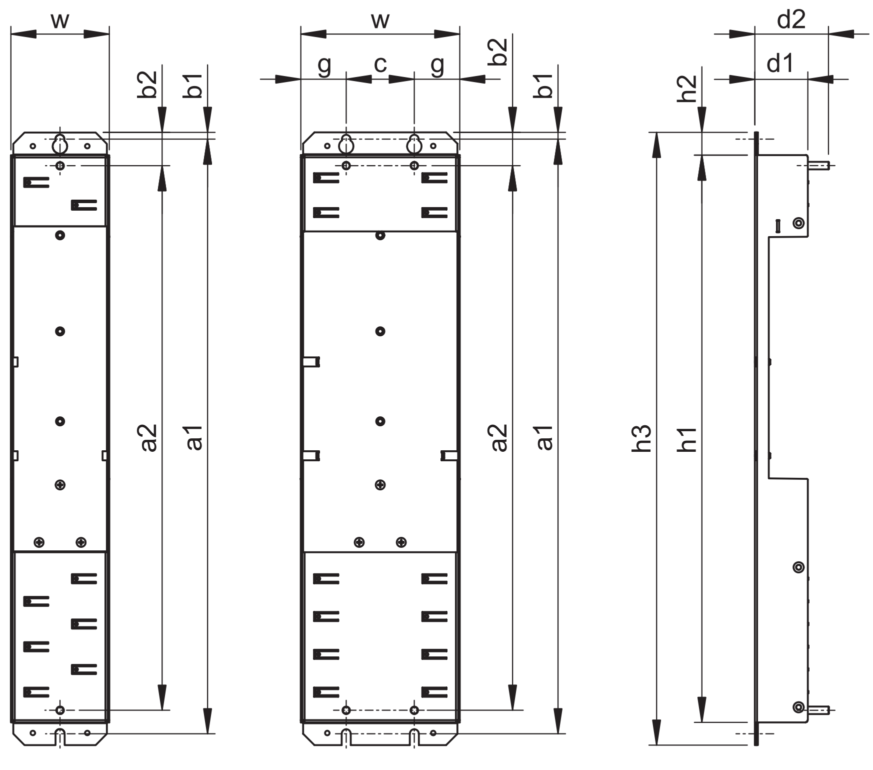


Fig. 6: DL6B dimensional drawing

Dimension			DL6B10 DL6B20	DL6B11 DL6B21	DL6B12
Quick DC-Link	Width	w	45	65	105
	Depth	d1	35		
	Depth incl. attachment bolts	d2	49		
	Height	h1	375		
	Fastening clip height	h2	15		
	Height incl. fastening clips	h3	405		
Fastening holes	Vertical distance (wall mounting)	a1	393+2		
	Vertical distance (module mounting)	a2	360		
	Vertical distance to the upper edge	b1	4.5		
	Vertical distance to the upper edge	b2	22		
	Horizontal spacing of the fastening holes	c	—		45
	Horizontal distance to the side edge	g	—		30

Tab. 36: DL6B dimensions [mm]

3.2.5.3 Weight

Type	Weight without packaging [g]	Weight with packaging [g]
DL6B10	420	460
DL6B11	560	600
DL6B12	920	960
DL6B20	480	520
DL6B21	740	780

Tab. 37: DL6B weight [g]

3.2.6 Minimum clearances

Drive controllers and supply modules

The specified dimensions refer to the outside edges of the drive controller or supply module including the Quick DC-Link rear section module.

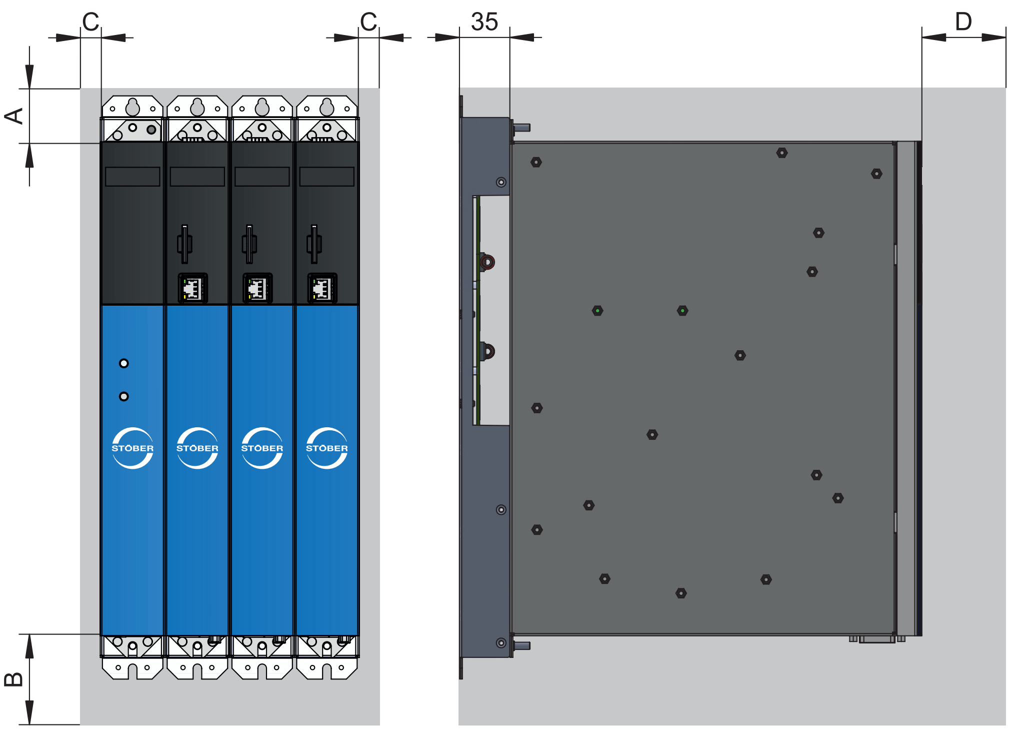


Fig. 7: Minimum clearances

Minimum clearance	A (above)	B (below)	C (on the side)	D (in front)
All sizes	100	200	5	50[7]

Tab. 38: Minimum clearances for the multi-axis drive system [mm]

Choke

For installation in a control cabinet, a distance of approximately 100 mm to neighboring components is recommended. This distance ensures proper heat dissipation for chokes and filters.

Braking resistor

In order for heated air to flow out unimpeded, a minimum clearance of approximately 200 mm must be maintained in relation to neighboring components or walls and approximately 300 mm must be maintained to components above or ceilings.

[7] Minimum clearance to be taken into account for permanent connection of the X9 service interface

STOBER

3.3 Drive controller/motor combinations

EZ synchronous servo motor (n_N = 2000 rpm) – SI6

						SI6A061 SI6A062	SI6A161 SI6A162	SI6A261	SI6A262	SI6A361	SI6A061 SI6A062	SI6A161 SI6A162	SI6A261	SI6A262	SI6A361
$f_{PWM,PU}$						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	$I_{2N,PU}$= 25 A	$I_{2N,PU}$= 50 A	$I_{2N,PU}$= 4.5 A	$I_{2N,PU}$= 10 A	$I_{2N,PU}$= 20 A	$I_{2N,PU}$= 20 A	$I_{2N,PU}$= 40 A
IC 410 convection cooling						$I_{2N,PU}$ / I_0									
EZ805U	142	43.7	25.9	66.1	37.9					1.3					1.1

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

						SI6A061 SI6A062	SI6A161 SI6A162	SI6A261	SI6A262	SI6A361	SI6A061 SI6A062	SI6A161 SI6A162	SI6A261	SI6A262	SI6A361
$f_{PWM,PU}$						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	$I_{2N,PU}$= 25 A	$I_{2N,PU}$= 50 A	$I_{2N,PU}$= 4.5 A	$I_{2N,PU}$= 10 A	$I_{2N,PU}$= 20 A	$I_{2N,PU}$= 20 A	$I_{2N,PU}$= 40 A
IC 410 convection cooling						$I_{2N,PU}$ / 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	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	2.1	
EZ703U	122	16.5	11.4	20.8	14			1.6	1.8				1.4	1.4	
EZ705U	140	21.3	14.2	30.2	19.5			1.1	1.3				1.0	1.0	2.1
EZ802U	136	22.3	13.9	37.1	22.3				1.1						1.8
EZ803U	131	26.6	17.7	48.2	31.1					1.6					1.3
IC 416 forced ventilation						$I_{2N,PU}$ / 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		2.0	
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	2.1				1.7	1.7	
EZ505B	141	20.2	13.7	23.4	14.7			1.5	1.7				1.4	1.4	
EZ701B	95	9.7	9.5	10.5	10		1.2	2.2				1.0	2.0	2.0	
EZ702B	133	16.6	11.8	19.3	12.9			1.7	1.9				1.6	1.6	
EZ703B	122	24	18.2	28	20			1.1	1.3				1.0	1.0	2.0
EZ705B	140	33.8	22.9	41.8	26.5					1.9					1.5
EZ802B	136	34.3	26.5	47.9	28.9					1.7					1.4
EZ803B	131	49	35.9	66.7	42.3					1.2					

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

						SI6A061 SI6A062	SI6A161 SI6A162	SI6A261	SI6A262	SI6A361	SI6A061 SI6A062	SI6A161 SI6A162	SI6A261	SI6A262	SI6A361
$f_{PWM,PU}$						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	$I_{2N,PU}$= 25 A	$I_{2N,PU}$= 50 A	$I_{2N,PU}$= 4.5 A	$I_{2N,PU}$= 10 A	$I_{2N,PU}$= 20 A	$I_{2N,PU}$= 20 A	$I_{2N,PU}$= 40 A
IC 410 convection cooling						$I_{2N,PU}$ / I_0									
EZ505U	103	9.5	8.9	15.3	13.4			1.6	1.9				1.5	1.5	
EZ703U	99	12.1	11.5	20	17.8			1.2	1.4				1.1	1.1	
EZ705U	106	16.4	14.8	30	25.2					2.0					1.6
EZ802U	90	10.5	11.2	34.5	33.3					1.5					1.2
IC 416 forced ventilation						$I_{2N,PU}$ / I_0									
EZ505B	103	16.4	16.4	22	19.4			1.1	1.3				1.0	1.0	2.1
EZ703B	99	19.8	20.3	27.2	24.2				1.0	2.1					1.7
EZ705B	106	27.7	25.4	39.4	32.8					1.5					1.2
EZ802B	90	30.6	30.5	47.4	45.1					1.1					

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

						SI6A061 SI6A062	SI6A161 SI6A162	SI6A261	SI6A262	SI6A361	SI6A061 SI6A062	SI6A161 SI6A162	SI6A261	SI6A262	SI6A361
$f_{PWM,PU}$						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	$I_{2N,PU}$= 25 A	$I_{2N,PU}$= 50 A	$I_{2N,PU}$= 4.5 A	$I_{2N,PU}$= 10 A	$I_{2N,PU}$= 20 A	$I_{2N,PU}$= 20 A	$I_{2N,PU}$= 40 A
IC 410 convection cooling						$I_{2N,PU}$ / 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	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	2.0	
EZ503U	84	6.2	7.64	10.6	11.6		1.0	1.9	2.2				1.7	1.7	
EZ701U	76	5.2	6.68	7.9	9.38		1.3					1.1	2.1	2.1	
EZ702U	82	7.2	8.96	14.3	16.5			1.3	1.5				1.2	1.2	
IC 416 forced ventilation						$I_{2N,PU}$ / 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	2.1	
EZ404B	78	8	9.98	10.5	12		1.0	1.8	2.1				1.7	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	1.9				1.5	1.5	
EZ503B	84	10.4	13.5	14.8	15.9			1.4	1.6				1.3	1.3	
EZ701B	76	7.5	10.6	10.2	12.4			1.8	2.0				1.6	1.6	
EZ702B	82	12.5	16.7	19.3	22.1				1.1						1.8

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

						SI6A061 SI6A062	SI6A161 SI6A162	SI6A261	SI6A262	SI6A361	SI6A061 SI6A062	SI6A161 SI6A162	SI6A261	SI6A262	SI6A361
$f_{PWM,PU}$								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	$I_{2N,PU}$= 25 A	$I_{2N,PU}$= 50 A	$I_{2N,PU}$= 4.5 A	$I_{2N,PU}$= 10 A	$I_{2N,PU}$= 20 A	$I_{2N,PU}$= 20 A	$I_{2N,PU}$= 40 A
IC 410 convection cooling										$I_{2N,PU}$ / 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	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	2.0	
EZHD0713U	122	17.8	13.4	20.4	15.1			1.5	1.7				1.3	1.3	
EZHD0715U	140	24.6	17.2	31.1	21.1			1.0	1.2						1.9

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

						SI6A061 SI6A062	SI6A161 SI6A162	SI6A261	SI6A262	SI6A361	SI6A061 SI6A062	SI6A161 SI6A162	SI6A261	SI6A262	SI6A361
$f_{PWM,PU}$								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	$I_{2N,PU}$= 25 A	$I_{2N,PU}$= 50 A	$I_{2N,PU}$= 4.5 A	$I_{2N,PU}$= 10 A	$I_{2N,PU}$= 20 A	$I_{2N,PU}$= 20 A	$I_{2N,PU}$= 40 A
IC 410 convection cooling										$I_{2N,PU}$ / 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	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	2.0	
EZHP_713U	122	17.8	13.4	20.4	15.1			1.5	1.7				1.3	1.3	
EZHP_715U	140	24.6	17.2	31.1	21.1			1.0	1.2						1.9

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

						SI6A061 SI6A062	SI6A161 SI6A162	SI6A261	SI6A262	SI6A361	SI6A061 SI6A062	SI6A161 SI6A162	SI6A261	SI6A262	SI6A361
$f_{PWM,PU}$								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	$I_{2N,PU}$= 25 A	$I_{2N,PU}$= 50 A	$I_{2N,PU}$= 4.5 A	$I_{2N,PU}$= 10 A	$I_{2N,PU}$= 20 A	$I_{2N,PU}$= 20 A	$I_{2N,PU}$= 40 A
IC 410 convection cooling										$I_{2N,PU}$ / I_0					
EZS501U	97	3.85	3.65	4.3	3.95	1.3					1.1				
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	2.2	
EZS703U	122	15.3	10.8	19.7	13.5			1.6	1.9				1.5	1.5	

IC 416 forced ventilation						$I_{2N,PU} / I_0$									
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	2.1				1.7	1.7	
EZS701B	95	9.35	9.5	10.2	10		1.2	2.2				1.0	2.0	2.0	
EZS702B	133	16.3	11.8	19	12.9			1.7	1.9				1.6	1.6	
EZS703B	122	23.7	18.2	27.7	20			1.1	1.3				1.0	1.0	

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

						SI6A061 SI6A062	SI6A161 SI6A162	SI6A261	SI6A262	SI6A361	SI6A061 SI6A062	SI6A161 SI6A162	SI6A261	SI6A262	SI6A361
$f_{PWM,PU}$						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	$I_{2N,PU}$= 25 A	$I_{2N,PU}$= 50 A	$I_{2N,PU}$= 4.5 A	$I_{2N,PU}$= 10 A	$I_{2N,PU}$= 20 A	$I_{2N,PU}$= 20 A	$I_{2N,PU}$= 40 A
IC 410 convection cooling						$I_{2N,PU} / I_0$									
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	1.9				1.5	1.5	

3.4 Accessories

You can find information about the available accessories in the following chapters.

3.4.1 Safety technology

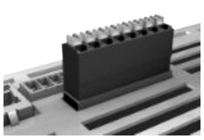
Information

Note that the drive controller is delivered as a standard version without safety technology. If you want a 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.

SR6 safety module – STO through terminals



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

SY6 safety module – STO and SS1 using 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) in accordance with DIN EN ISO 13849-1 and DIN EN 61800-5-2. Connection to the higher-level safety circuit using Fail Safe over EtherCAT (FSoE).

3.4.2 Communication

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

EtherCAT cables

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 X9 service interface to the PC, CAT5e, blue, 5 m.

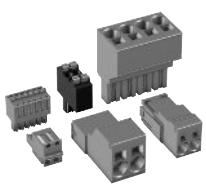
Hi-speed USB 2.0 Ethernet adapter

ID No. 49940
Adapter for connecting Ethernet to a USB port.

3.4.3 Terminal set

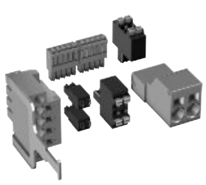
For the connection, you need suitable terminal sets for each PS6 supply module and each SI6 drive controller.

Terminal set for supply module



The following versions are available:
ID No. 138660
Terminal set for PS6A24.
ID No. 138661
Terminal set for PS6A34.

Terminal set for drive controller



The following versions are available:
ID No. 138655
Terminal set for SI6A061Z/Y.
ID No. 138656
Terminal set for SI6A062Z/Y.
ID No. 138657
Terminal set for SI6A161Z/Y.
ID No. 138658
Terminal set for SI6A162Z/Y.
ID No. 138659
Terminal set for SI6A261Z/Y.
ID No. 138662
Terminal set for SI6A262Z/Y.
ID No. 138663
Terminal set for SI6A361Z/Y.

3.4.4 DC link connection

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

You receive the DL6B substructure elements in different designs for horizontal connection, suitable for the size of the drive controller or supply module.

The quick fastening clamps for mounting 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.

DL6B Quick DC-Link for drive controller

The following versions are available:
DL6B10
ID No. 56655
Substructure element for drive controller of size 0.
DL6B11
ID No. 56656
Substructure element for drive controller of size 1 or 2 (single axis controller).
DL6B12
ID No. 56663
Substructure element for drive controller of size 2 (double-axis controllers) or 3.

DL6B Quick DC-Link 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.

DL6B Quick DC-Link 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 below. For the selection, note the minimum permitted braking resistors specified in the technical data of the supply modules.

3.4.5.1 KWADQU 420×91 flat resistor

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	cURus

Tab. 39: KWADQU 420×91 specification

Dimensions

Dimension	KWADQU 420×91
A	420

Tab. 40: KWADQU 420×91 dimensions [mm]

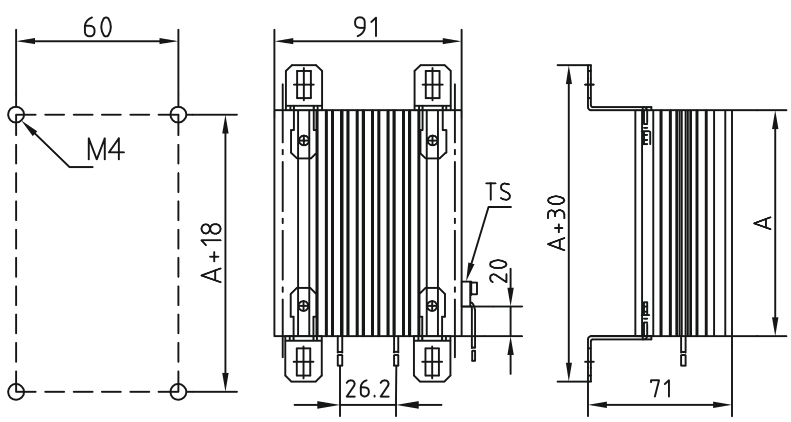


Fig. 8: KWADQU 420×91 dimensional drawing

3.4.5.2 FZZMQU 400×65 tubular fixed resistor

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. 41: FZZMQU 400×65 specification

Dimensions

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

Tab. 42: FZZMQU 400×65 dimensions [mm]

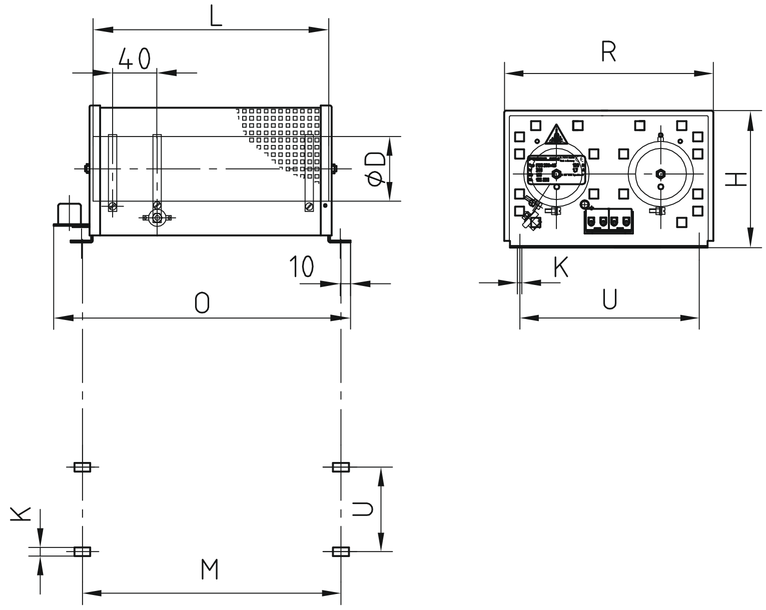


Fig. 9: FZZMQU 400×65 dimensional drawing

3.4.5.3 FGFKQU 31005 steel-grid fixed resistor

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. 43: FGFKQU 31005 specification

Dimensions

Dimension	FGFKQU 31005
A	270
B	295
C	355

Tab. 44: FGFKQU 31005 dimensions [mm]

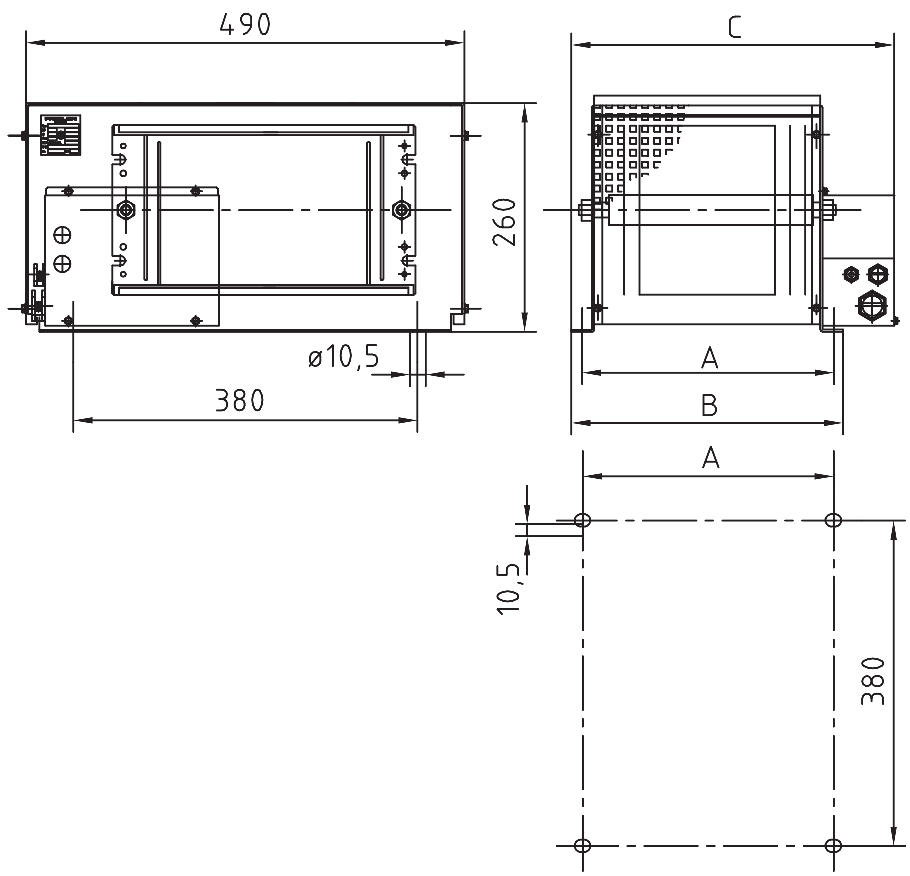


Fig. 10: FGFKQU 31005 dimensional drawing

3.4.6 Choke

Technical specifications for suitable chokes can be found in the following sections.

3.4.6.1 TEP output choke

Output chokes are required starting from a cable length of > 50 m.

Information

The following technical data only applies to a rotating magnetic field frequency of 200 Hz. For example, this rotating magnetic 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 rotating magnetic field frequencies. Also observe the relationship with the clock frequency.

Properties

Specification	TEP3720-0ES41	TEP3820-0CS41	TEP4020-0RS41
ID No.	53188	53189	53190
Voltage range		3 × 0 to 480 V_{DC}	
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			

Tab. 45: TEP specification

Project configuration

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

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

Derating

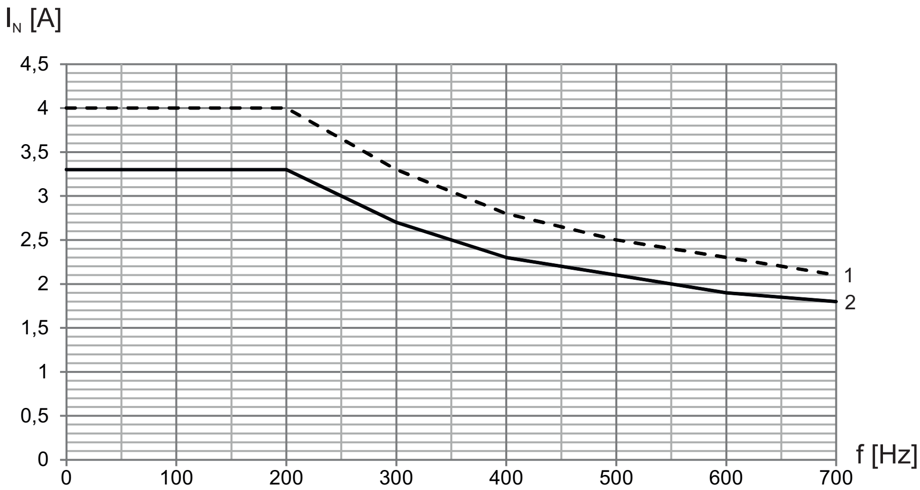


Fig. 11: TEP3720-0ES41 derating

1	4 kHz clock frequency
2	8 kHz clock frequency

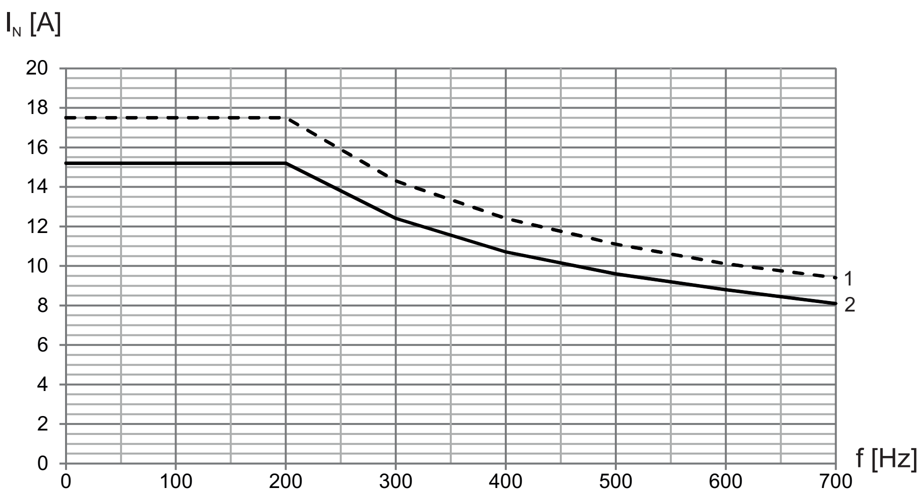


Fig. 12: TEP3820-0CS41 derating

1	4 kHz clock frequency
2	8 kHz clock frequency

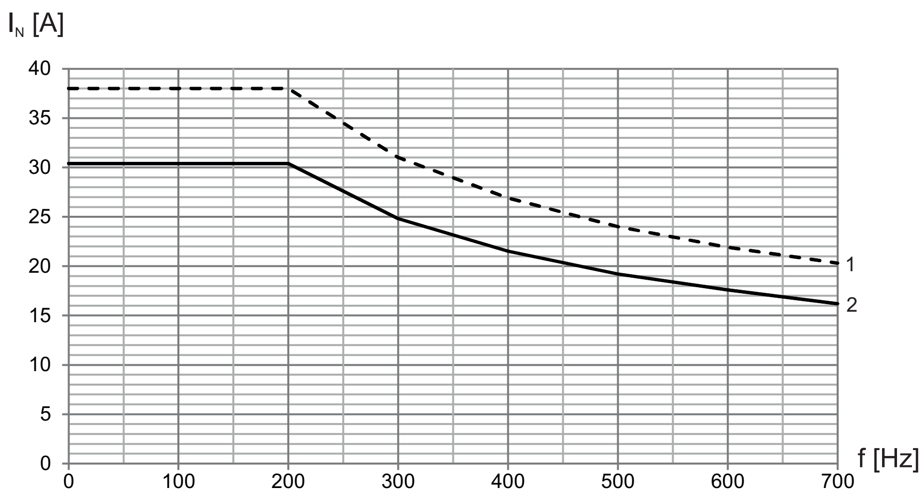


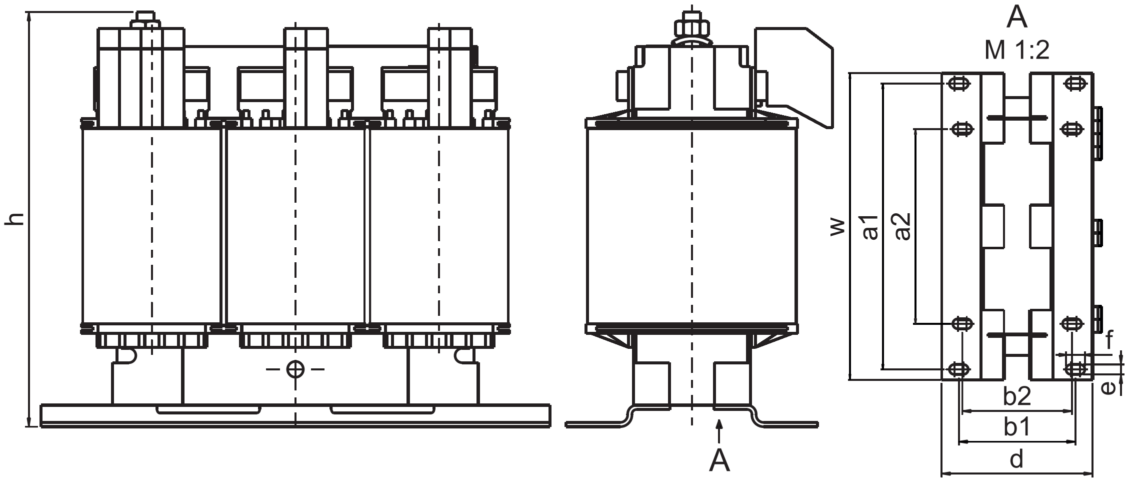
Fig. 13: TEP4020-0RS41 derating

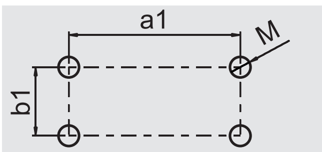
1	4 kHz clock frequency
2	8 kHz clock frequency

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. 46: TEP dimensions and weight





Mounting hole
in accordance with DIN EN
60852-4

Fig. 14: TEP dimensional drawing

3.4.7 Battery module for encoder buffering

Absolute Encoder Support (AES)

ID No. 55452
For buffering the power supply when using the EnDat 2.2 digital inductive encoder with battery-buffered multi-turn power unit, for example EBI1135, EBI135.
A battery is included.

Information

Note that a 15-pin extension cable between terminal X4 and AES may be necessary for the connection to a SI6 drive controller.

AES replacement battery

ID No. 55453
Replacement battery for AES battery module.

3.4.8 HT6 HTL-to-TTL adapter

ID No. 56665
Adapter for level conversion from HTL to TTL signals for connecting an HTL incremental encoder to terminal X4.

3.4.9 Product CD

ELECTRONICS 6 product CD

Included in the standard version.

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

3.5 Further information

3.5.1 Symbols, identifiers and test marks

Grounding symbol
Grounding symbol in accordance with IEC 60417-5019 (DB:2002-10).

RoHS lead-free marking
Marking in accordance with RoHS directive 2011-65-EU.

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

UL mark
This product is listed by UL for the United States 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 controllers

Table of contents

4.1 Overview

High performance and flexibility

Features

- Nominal output current up to 85 A
- 250% overload capacity
- Control of linear and rotary synchronous servo motors and asynchronous motors
- Multi-functional encoder interfaces
- Automatic motor parameterization from the electronic motor nameplate
- Isochronic system bus (IGB) for parameterization and multi-axis applications
- Communication over CANopen, EtherCAT or PROFINET
- Safe Torque Off (STO) safety technology in the standard version: SIL 3, PL e, category 4
- Digital and analog inputs and outputs
- Integrated brake chopper
- Integrated holding brake controller
- Integrated line filter
- Motor temperature evaluation using PTC thermistors, KTY or Pt1000 temperature sensors
- Flexible DC link connection using Quick DC-Link for multi-axis applications
- Fast commissioning with DriveControlSuite software
- Convenient operating unit consisting of graphical display and sensor keys
- One-touch save button
- Paramodul removable data storage for commissioning and service
- Secured remote maintenance concept
- Programming based on IEC 61131-3 with CFC for creating applications

SD6

4.1.1 Features

The SD6 drive controller from the the 6th STOBER drive controller generation 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. The SD6 drive controller is available in four sizes with a nominal output current of up to 85 A.

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 values 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 solution offers a technical innovation that works without system tests that interrupt operation. 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 have been developed together with Pilz GmbH & Co. KG.

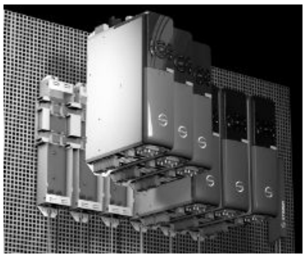
pilz
the spirit of safety
Safety in Motion

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

- SIL 3, HFT 1 in accordance with EN 61800-5-2
- PL e, category 4 in accordance with EN ISO 13849

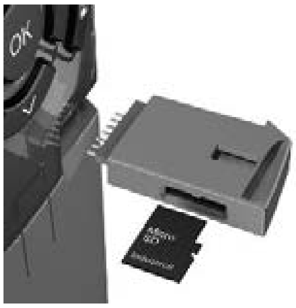
TÜV SÜD
No. Z10 13 04 84451 001

Quick DC-Link



All the product types of the SD6 drive controller have the option of a DC link connection. This technology makes it possible for the regenerative production of energy from one drive to be used as motor energy by another drive. The Quick DC-Link rear structure element has been 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 any tools using quick fastening clamps.

Paramodul removable data storage

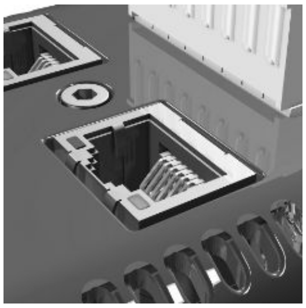


Removable data storage with integrated microSD card is available for fast series commissioning by copying and for easy service when replacing devices. It represents the ideal medium for saving additional project data and documentation and can be used for direct editing on a PC.

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 configuration over Ethernet and isochronic data exchange for the following functions:

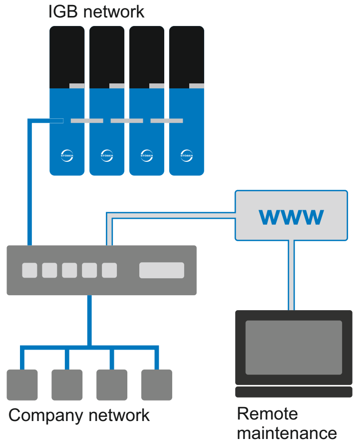
- Direct connection for remote maintenance of individual and multiple drive controllers
- Direct connection between one or more drive controllers and a PC



Interface for Integrated Bus

STOBER remote maintenance concept

STOBER remote maintenance enables commissioning software to be used to perform all processes and sequences just like an on-site service visit. The concept guides users through a controlled and protected procedure. It ensures that the person responsible for the machine is there on site to pay attention to special situations and personal safety. On the other end, the remote maintenance specialist has the assurance of communicating with a responsible employee on site who is monitoring the situation on the machine.



Remote maintenance can be used to perform all processes and sequences just like an on-site service visit.

Brake management

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

- Cyclic brake test
- Grind brake

4.1.2 Software components

Project configuration and commissioning

The 6th generation of DriveControlSuite project configuration and commissioning software 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 configuration and parameterization process using wizards.

Open communication

Device communication is possible using EtherCAT, CANopen or PROFINET.

Applications

Drive-based motion control is recommended for the decentralized motion control of sophisticated machines.

The drive-based application package from STOBER is the right choice wherever universal and flexible solutions are needed. For the **STOBER Drive Based** application, the PLCOPEN Motion Control command set provides a drive-based motion controller for positioning, velocity and torque/force. These standard commands have been combined into operating modes for different applications and supplemented with additional functions such as jerk limit, motion block linking, cams and much more. For the Command operating 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 operating mode so that only a start signal is necessary to perform the movement. Linking can be used to define complete motion sequences. There is a separate operating 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.

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

The following controller-based application is also available:

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, such as an MC6. In addition, the drive controller can also independently handle motion tasks, such as referencing and jogging when commissioning.

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, installation and commissioning of the drive controller. Use of option modules. Parameterization, commissioning and diagnostics using 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 on training topics.

Software used: DriveControlSuite.

G6 Advanced

Training content: Special knowledge for regulating, control and safety technology. Practical exercises on training topics.

4.2 Technical data

Technical data for drive controllers and accessories can be found in the following chapters.

4.2.1 Symbols in formulas

Formula symbol	Unit	Explanation
D_{IA}	%	Reduction in the nominal current depending on the installation altitude
D_T	%	Reduction in the nominal current depending on the surrounding temperature
f_{2PU}	Hz	Output frequency of the power unit
f_N	Hz	Rotating magnetic field frequency at nominal speed
$f_{PWM,PU}$	Hz	Internal pulse clock frequency of the power unit
I_{1maxCU}	A	Maximum input current of the control unit
I_0	A	Stall current: RMS value of the line-to-line current when the stall torque M_0 is 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	Stall torque: The continuous torque the motor is able to deliver 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 unit
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 unit
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	Generation 6
A, B	Version	
0 – 3	Size	
0 – 9	Power output stage	(within the size)
T	Safety module	ST6: STO via terminals
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 in accordance with EN 61800-3:2012, interference emission class C3
Overvoltage category	III in accordance with 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) in accordance with 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 temperature during operation	0 °C to 45 °C for nominal data 45 °C to 55 °C with −2.5%/°C derating
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 sea level with −1.5%/100 m derating
Pollution degree	Pollution degree level 2 in accordance with EN 50178
Ventilation	Installed fan
Vibration (operation) in accordance with 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 min.

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_{AC}, +20% / −40%, 50/60 Hz	3 × 400 V_{AC}, +32% / −50%, 50/60 Hz; 3 × 480 V_{AC}, +10% / −58%, 50/60 Hz	
f_{2PU}	0 – 700 Hz		
U_{2PU}	0 – max. U_1		
C_{PU}	340 µF	135 µF	135 µF
C_{maxPU}	1620 µF	540 µF	540 µF

Tab. 9: SD6 electrical data, 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: SD6 electrical data, 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: SD6 electrical data, size 0, for 8 kHz clock frequency

Electrical data	SD6A02	SD6A04	SD6A06
U_{onCH}	400 – 420 V_{DC}	780 – 800 V_{DC}	
U_{offCH}	360 – 380 V_{DC}	740 – 760 V_{DC}	
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_{AC}, +32% / −50%, 50/60 Hz; 3 × 480 V_{AC}, +10% / −58%, 50/60 Hz	
f_{2PU}	0 – 700 Hz	
U_{2PU}	0 – max. U_1	
C_{PU}	470 µF	560 µF
C_{maxPU}	1405 µF	1405 µF

Tab. 13: SD6 electrical data, 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: SD6 electrical data, 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: SD6 electrical data, size 1, for 8 kHz clock frequency

Electrical data	SD6A14	SD6A16
U_{onCH}	780 – 800 V_{DC}	
U_{offCH}	740 – 760 V_{DC}	
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_{AC}, +32% / −50%, 50/60 Hz; 3 × 480 V_{AC}, +10% / −58%, 50/60 Hz	
f_{2PU}	0 – 700 Hz	
U_{2PU}	0 – max. U_1	
C_{PU}	680 µF	1000 µF
C_{maxPU}	1405 µF	1405 µF

Tab. 17: SD6 electrical data, 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: SD6 electrical data, 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: SD6 electrical data, size 2, for 8 kHz clock frequency

Electrical data	SD6A24	SD6A26
U_{onCH}	780 – 800 V_{DC}	
U_{offCH}	740 – 760 V_{DC}	
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_{AC}, +32% / −50%, 50/60 Hz; 3 × 480 V_{AC}, +10% / −58%, 50/60 Hz		
f_{2PU}	0 – 700 Hz		
U_{2PU}	0 – max. U_1		
C_{PU}	430 µF	900 µF	900 µF
C_{maxPU}	5100 µF	5100 µF	5100 µF

Tab. 21: SD6 electrical data, 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: SD6 electrical data, 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: SD6 electrical data, size 3, for 8 kHz clock frequency

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

Tab. 24: Brake chopper electrical data, size 3

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

4.2.5.6 Power loss data in accordance with 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	
SD6A16	16	11.1	12	0.95	1.12	1.66	0.99	1.23	1.98	1.41	2.52	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	1.67	1.11	2.10	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
SD6A16	16	11.1	12	104.9	124.0	184.6	110.3	136.6	219.8	156.0	279.8	IE2	35.8
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	164.7	214.9	370.5	246.9	465.9	IE2	38.6
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 in accordance with EN 50598

General conditions

The loss data applies to drive controllers without any accessories.

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

The calculated data includes a supplement of 10% in accordance with EN 50598.

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

The absolute losses for a power unit that is switched off refer to the 24 V_{DC} power supply of the control electronics.

[2] Absolute losses for a power unit that is switched off
[3] Operating points for relative motor stator frequency in % and relative torque current in %
[4] IE class in accordance with 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
IO6 terminal module	< 2
XI6 terminal module	< 5
RI6 terminal module	< 5
CA6 fieldbus module	1
EC6 fieldbus module	< 2
PN6 fieldbus module	< 4

Tab. 26: Absolute losses of the accessories

Information

Note the absolute power loss of the encoder (usually < 3 W) and of the brake when designing as well.

4.2.6 Derating

When dimensioning the drive controller, observe the derating of the nominal output current as a function of 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 $I_{2N,PU}$ dependent on the clock frequency

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

4.2.6.2 Effect of installation altitude

Derating as a function of 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 needs to 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 as a function of 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 needs to 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 $I_{2N,PU}$ in accordance with the following formula:
   $I_{2N,PU}$ = $I_{2N,PU}$ x D_T x D_{IA}

A drive controller of type SD6A06 needs to be operated at a clock frequency of 8 kHz at an altitude of 1500 m above sea level and a 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

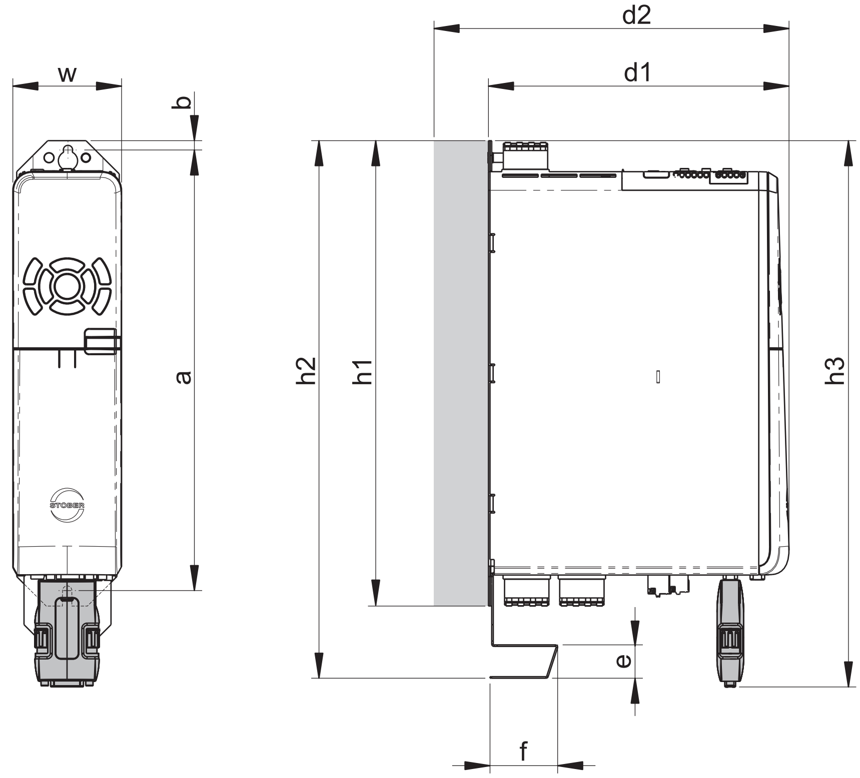


Fig. 2: SD6 dimensional drawing, size 0 to 2

<table>
<tr><th colspan="3">Dimension</th><th>Size 0</th><th>Size 1</th><th>Size 2</th></tr>
<tr><td rowspan="7">Drive controller</td><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. RB 5000 braking resistor</td><td rowspan="2">d2</td><td>212</td><td colspan="2">302</td></tr>
<tr><td>Depth incl. Quick DC-Link</td><td>229</td><td colspan="2">319</td></tr>
<tr><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 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 the 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

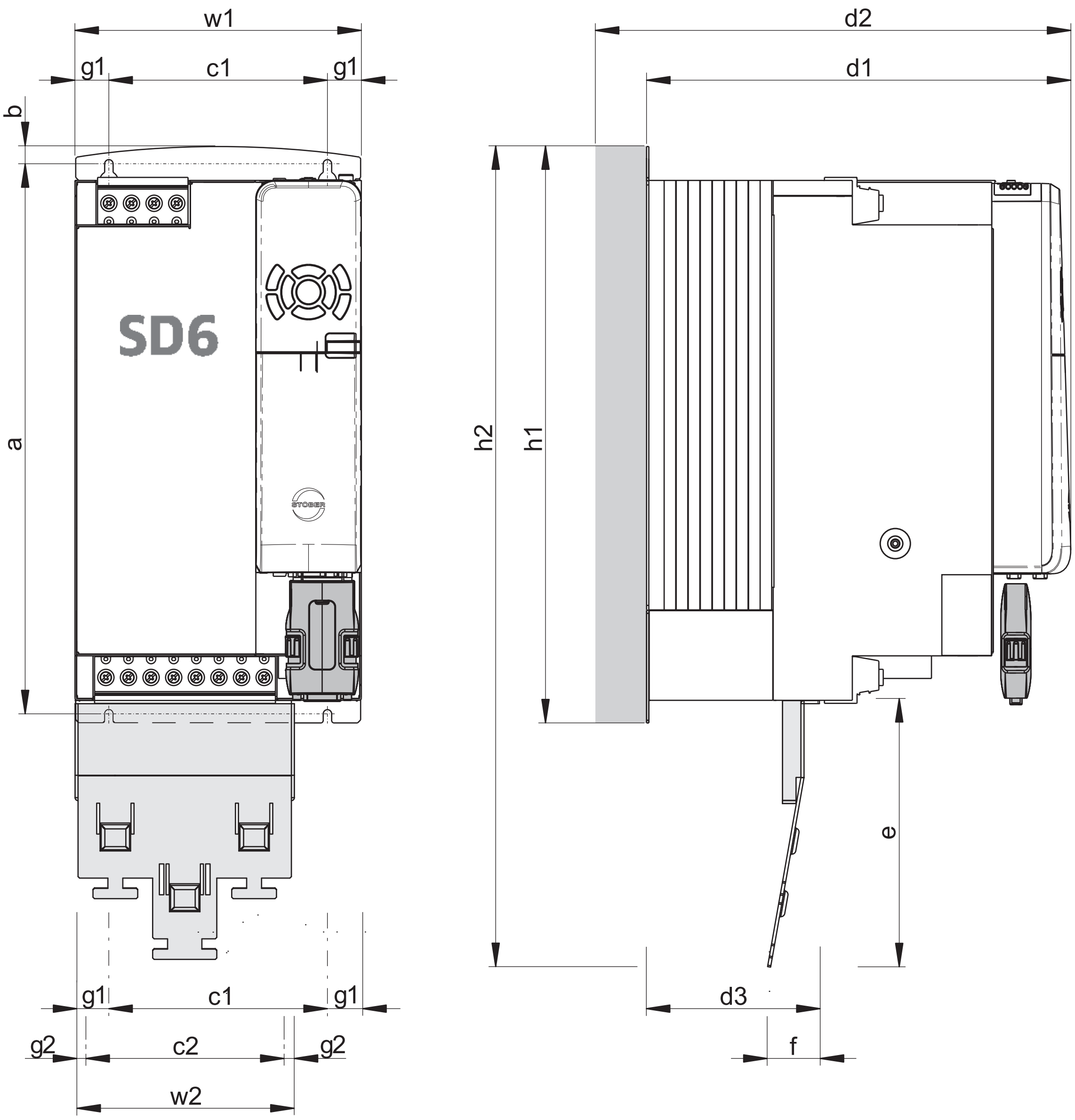


Fig. 3: SD6 dimensional drawing, size 3

Dimension			Size 3
Drive controller	Width	w1	194
	Depth	d1	305
	Depth incl. Quick DC-Link	d2	340
	Height incl. fastening clips	h1	382.5
	Height incl. EMC shroud	h2	540
EMC shroud	Height	e	174
	Width	w2	147
	Depth	f	34
		d3	113
Fastening holes	Vertical distance	a	365+2
	Vertical distance to the upper edge	b	11.5
	Horizontal distance between the fastening holes of the drive controller	c1	150+0.2/−0.2
	Horizontal distance to the side edge of the drive controller	g1	20
	Horizontal distance between the fastening holes of the EMC shroud	c2	132
	Horizontal distance to 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 including the Quick DC-Link rear section module.

Minimum clearance	Above	Below	On 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
IC 410 convection cooling										$I_{2N,PU}$ / I_0				
EZ805U	142	43.7	25.9	66.1	37.9								1.3	1.6
IC 416 forced ventilation										$I_{2N,PU}$ / I_0				
EZ805B	142	77.2	45.2	94	53.9									1.1

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
IC 410 convection cooling										$I_{2N,PU}$ / 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
IC 416 forced ventilation										$I_{2N,PU}$ / 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

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
IC 410 convection cooling										$I_{2N,PU}$ / 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
IC 416 forced ventilation										$I_{2N,PU}$ / 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

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
IC 410 convection cooling										$I_{2N,PU}$ / 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		
IC 416 forced ventilation										$I_{2N,PU}$ / 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		

EZHD synchronous servo motor with hollow shaft and direct drive (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
IC 410 convection cooling										$I_{2N,PU}$ / 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
IC 410 convection cooling						$I_{2N,PU}$ / 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		

EZS synchronous servo motor for screw drive (driven threaded spindle) (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
IC 410 convection cooling						$I_{2N,PU}$ / 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			
IC 416 forced ventilation						$I_{2N,PU}$ / 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		

EZM synchronous servo motor for screw drive (driven threaded nut) (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
IC 410 convection cooling						$I_{2N,PU}$ / 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			

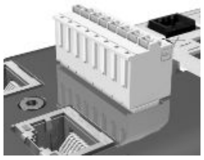
4.4 Accessories

You can find information about the available accessories in the following chapters.

4.4.1 Safety technology

Safe Torque Off – ST6

Included in the standard version.



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 Communication

The standard version of the SD6 drive controller has two interfaces for IGB communication on the top side of the device.
The communication module, through which the drive controller is connected to the fieldbus system, is installed in the shaft on the top side.
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.

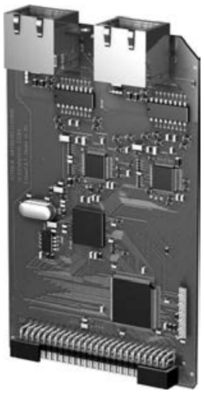
Hi-speed USB 2.0 Ethernet adapter

ID No. 49940
Adapter for connecting Ethernet to a USB port.

CA6 communication module

ID No. 138427
Communication module for the CANopen connection.

EC6 communication module

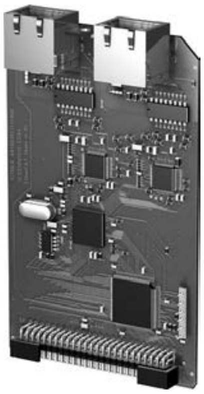


ID No. 138425
Communication module for the EtherCAT connection.

EtherCAT cables

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.

4.4.3 Terminal module

XI6 terminal module

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 bits)

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)

RI6 terminal module

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 bits)

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 using a resolver encoder cable with a con.23 plug connector, you also need the AP6A00 interface adapter (ID No. 56498, 9-pin to 15-pin), which is available separately.

AP6 interface adapter

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.

IO6 terminal module

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)

4.4.4 DC link connection

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

You receive the DL6A substructure elements in different designs for horizontal connection, suitable for the size of the drive controller.

The quick fastening clamps for mounting the copper rails and 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.

DL6A Quick DC-Link for drive controller

The following versions are available:
DL6A0
ID No. 56440
Substructure element for drive controllers of size 0.
DL6A1
ID No. 56441
Substructure element for drive controllers of size 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.

DL6A Quick DC-Link 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 drive controllers, STOBER offers the following braking resistors described below in various sizes and performance classes . For the selection, note the minimum permitted braking resistances specified in the technical data of the individual drive controller types.

4.4.5.1 FZMU, FZZMU 400×65 tubular fixed resistor

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 FZMU, FZZMU 400×65 braking resistor – SD6 drive controller

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. τ_{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: FZMU, FZZMU 400×65 specification

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: FZMU, FZZMU 400×65 dimensions [mm]

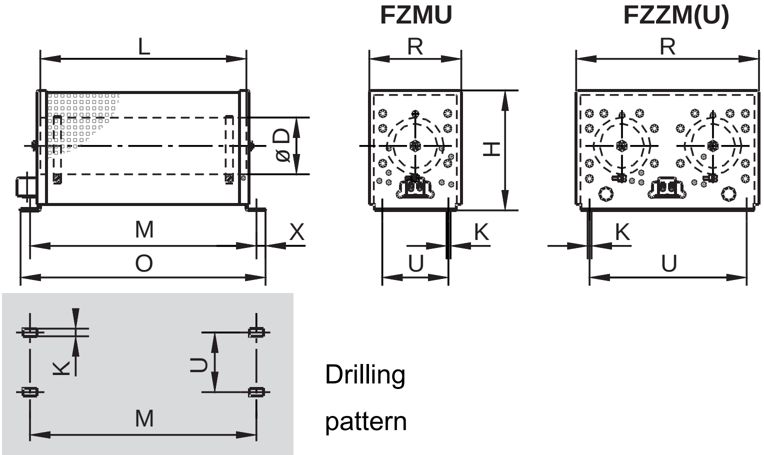


Fig. 4: FZMU, FZZMU 400×65 dimensional drawing

4.4.5.2 GVADU, GBADU flat resistor

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 GVADU, GBADU braking resistor – SD6 drive controller

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. τ_{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	cURus	cURus			

Tab. 35: GVADU, GBADU specification

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: GVADU, GBADU dimensions [mm]

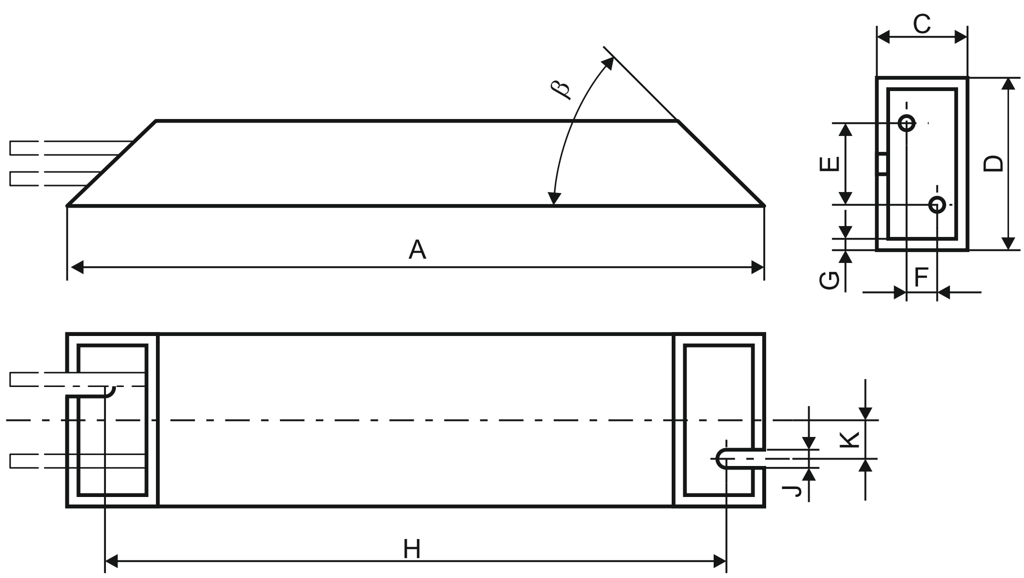


Fig. 5: GVADU, GBADU dimensional drawing

4.4.5.3 FGFKU steel-grid fixed resistor

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 FGFKU braking resistor – SD6 drive controller

—	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. τ_{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. 38: FGFKU specification

Dimensions

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

Tab. 39: FGFKU dimensions [mm]

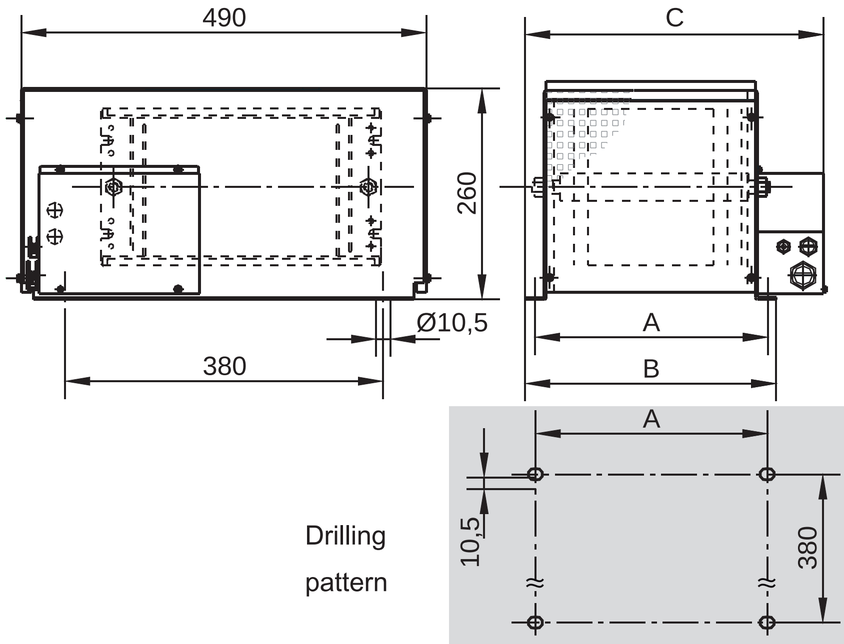


Fig. 6: FGFKU dimensional drawing

4.4.5.4 RB 5000 bottom brake resistor

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 RB 5000 braking resistor – SD6 drive controller

—	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. τ_{th} [s]	8		
Pulse power for < 1 s [kW]	1.5	1.0	1.0
U_{max} [V]	800		
Weight [g]	approx. 640	approx. 460	approx. 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: RB 5000 specification

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: RB 5000 dimensions [mm]

4.4.6 Chokes

4.4.6.1 Power choke

Properties

Specification	TEP4010-2US00
ID No.	56528
Phases	3
Thermally allowed continuous current	100 A
Rated current	90 A
Rated inductance	0.14 mH
Supply 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
Installation	Screws
Directive	EN 61558-2-20
UL Recognized Component (CAN; USA)	Yes
CE mark	Yes
Identification/test mark, symbol	CE, cURus,

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

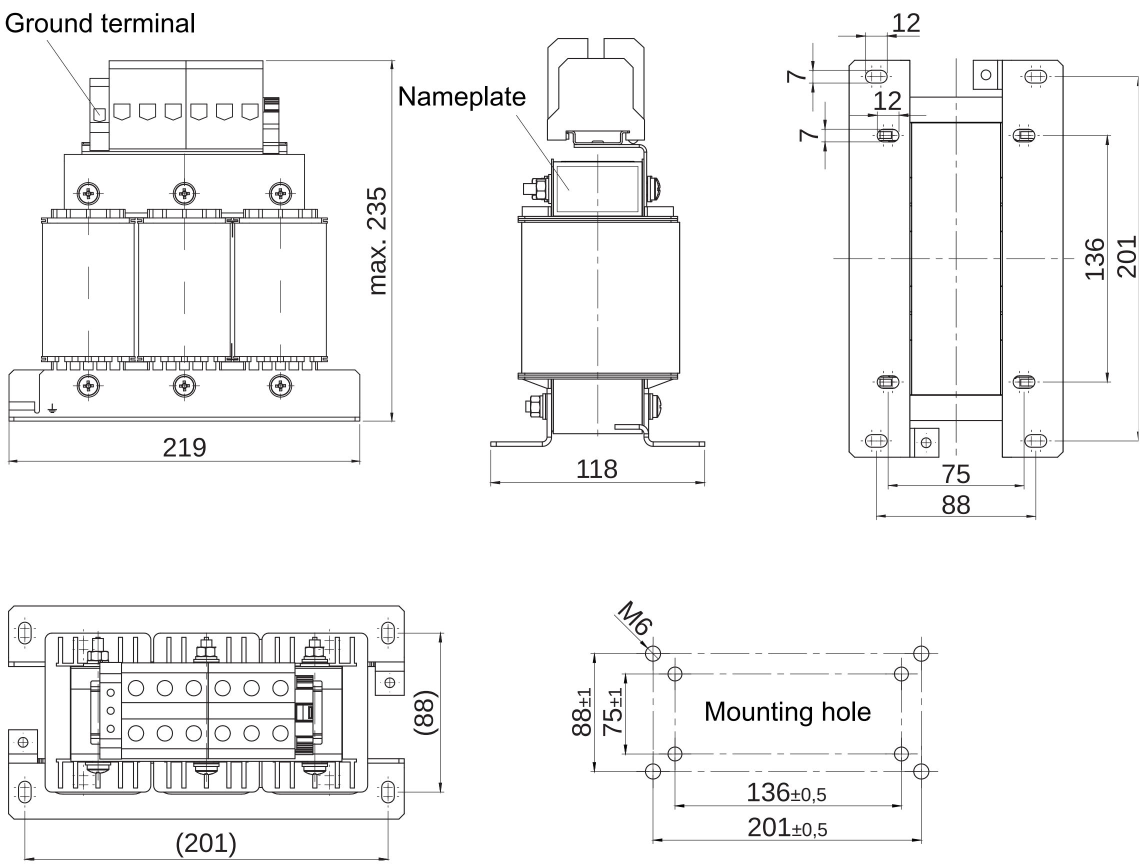


Fig. 7: Dimensional drawing power choke

4.4.6.2 TEP output choke

Output chokes are required starting from a cable length of > 50 m.

Information

The following technical data only applies to a rotating magnetic field frequency of 200 Hz. For example, this rotating magnetic 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 rotating magnetic field frequencies. Also observe the relationship with the clock frequency.

Properties

Specification	TEP3720-0ES41	TEP3820-0CS41	TEP4020-0RS41
ID No.	53188	53189	53190
Voltage range	3 × 0 to 480 V_{DC}		
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. 43: TEP specification

Project configuration

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

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

Derating

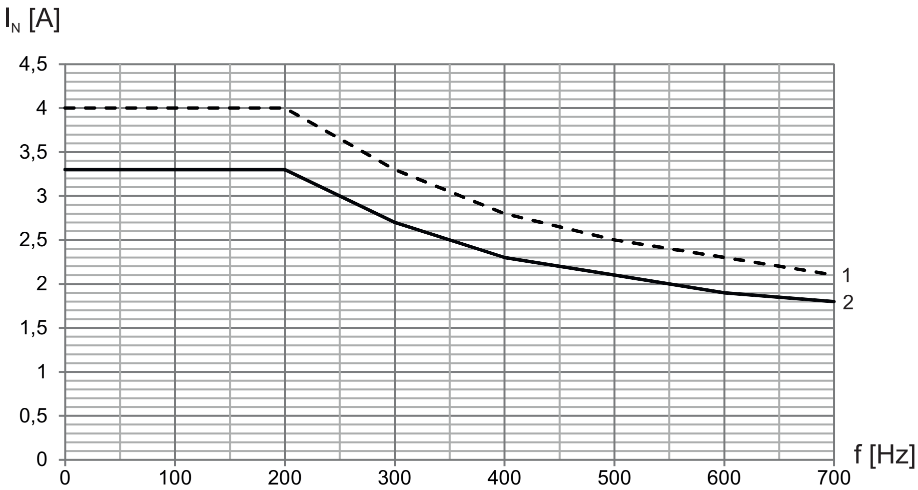


Fig. 8: TEP3720-0ES41 derating

1	4 kHz clock frequency
2	8 kHz clock frequency

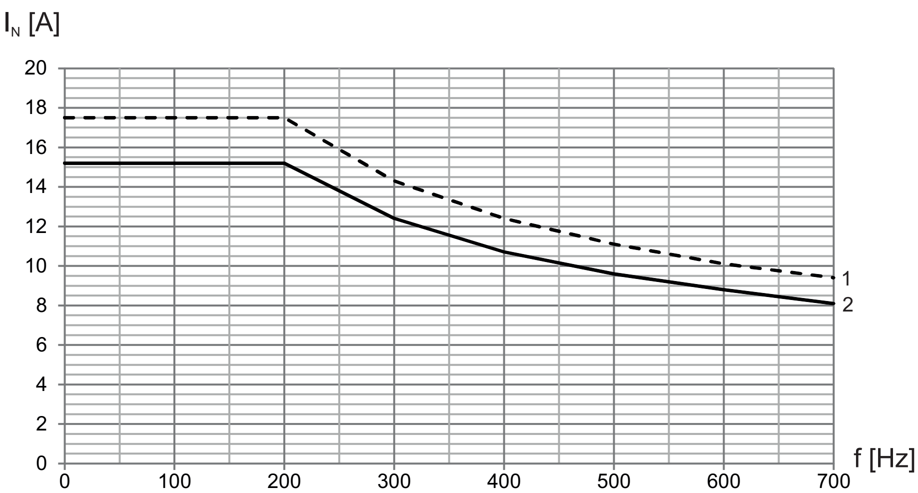


Fig. 9: TEP3820-0CS41 derating

1	4 kHz clock frequency
2	8 kHz clock frequency

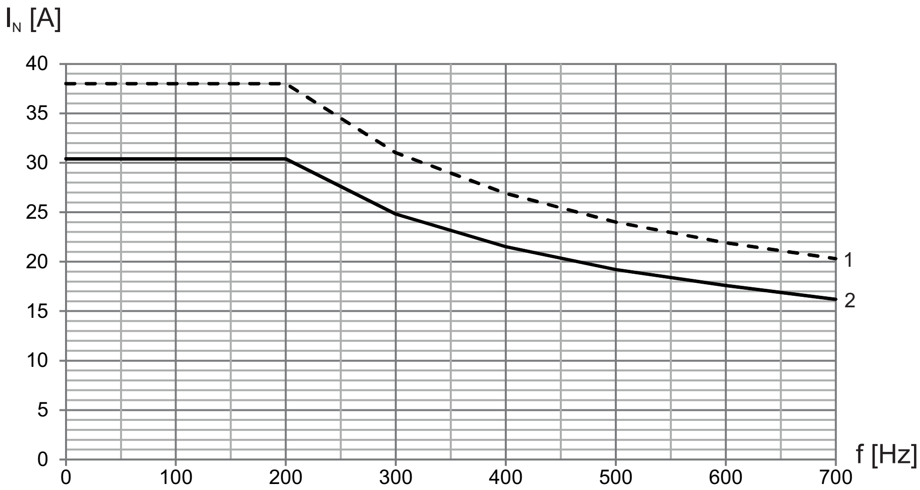


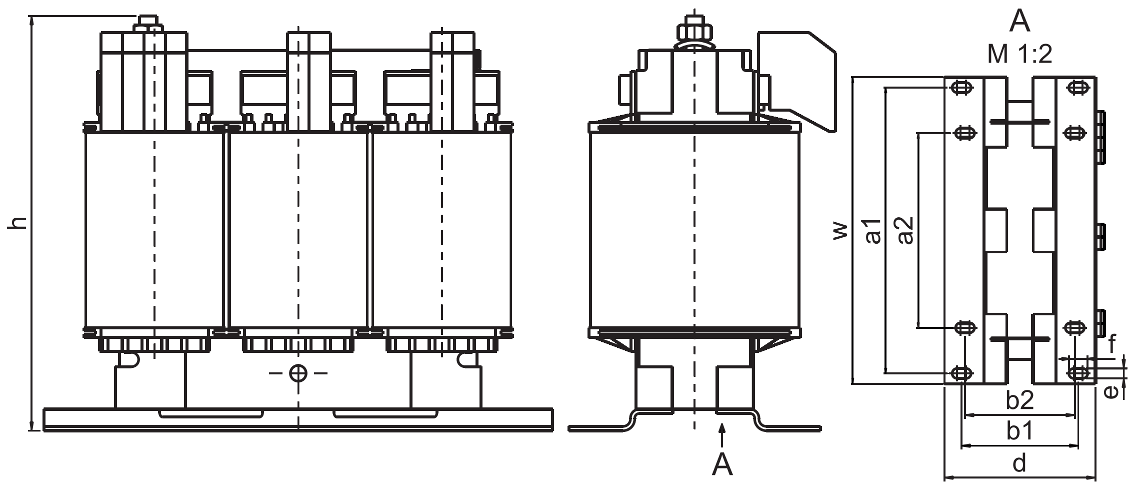
Fig. 10: TEP4020-0RS41 derating

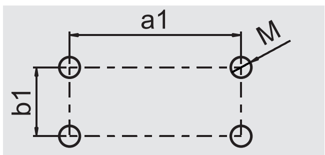
1	4 kHz clock frequency
2	8 kHz clock frequency

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: TEP dimensions and weight





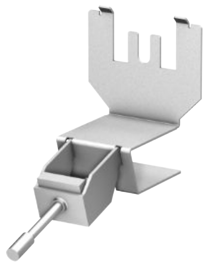
Mounting hole
in accordance with DIN EN
60852-4

Fig. 11: TEP dimensional drawing

4.4.7 EMC shroud

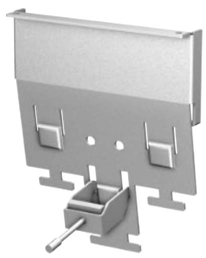
You can use the EM6A EMC shroud to connect the cable shield of the power cable. Two different designs are available.

EMC shroud EM6A0



ID No. 135115
EMC shroud for sizes 0 to 2.
Accessory part for the shield connection of the motor line.
Can be attached to the basic housing. Shield connection terminal included.

EMC shroud EM6A3



ID No. 135120
EMC shroud for size 3.
Accessory part for the shield connection of the motor line.
Can be attached to the basic housing.
Shield connection terminal included.
If necessary, you can also attach the cable shield of the braking resistor and DC link connection to the shroud. Additional shield connection terminals are available as accessories for this purpose (ID No. 56521).

4.4.8 Encoder adapter box

LA6A00 encoder adapter box

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

X120 SSI/TTL connection cable

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

LA6 / AX 5000 connection cable

Cable for connecting the X4 connections on the SD6 drive controller and the X300 on the LA6 adapter box in order to transfer 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

Absolute Encoder Support (AES)

ID No. 55452
For buffering the power supply when using the EnDat 2.2 digital inductive absolute encoder with battery-buffered multi-turn power unit, for example EBI1135, EBI135.
A battery is included.

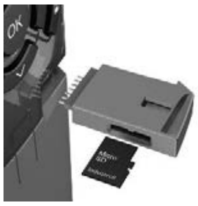
AES replacement battery

ID No. 55453
Replacement battery for AES battery module.

4.4.10 Removable data storage

Paramodul removable data storage

Included in the standard version.



ID No. 56403
The plug-in Paramodul 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

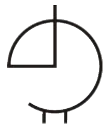
ELECTRONICS 6 product CD

Included in the standard version.

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

4.5 Further information

4.5.1 Symbols, identifiers and test marks



EN 61558-2-20
Choke without overload protection.

Grounding symbol
Grounding symbol in accordance with IEC 60417-5019 (DB:2002-10).

RoHS lead-free marking
Marking in accordance with RoHS directive 2011-65-EU.

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

UL mark
This product is listed by UL for the United States 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 inverters

Table of contents

5.1 Overview

High dynamics for fully digital servo axes

Features

- Nominal output current up to 60 A (at 8 kHz clock frequency)
- 250% overload capacity
- Power range: 0.75 kW to 45 kW
- Control of rotary synchronous servo motors and asynchronous motors
- EnDat 2.1/2.2 digital, SSI, incremental (HTL/TTL) or resolver encoder interfaces
- Automatic motor parameterization from the electronic motor nameplate
- Isochronic system bus (IGB) for parameterization and multi-axis applications
- Communication via PROFIBUS DP, PROFINET, CANopen, EtherCAT
- Safe Torque Off (STO) and Safe Stop 1 (SS1) safety functions: SIL 3, PL e, category 3
- Digital and analog inputs and outputs
- Integrated brake chopper
- Brake management for two 24 V holding brakes
- Integrated line filter
- Motor temperature evaluation using PTC thermistors, KTY or Pt1000 temperature sensors
- Standard applications with speed, torque, positioning and master/slave functionality
- Programming based on IEC 61131-3 with CFC for creating applications
- Fast commissioning with POSITool software
- Convenient operating unit consisting of plain text display and keyboard
- Paramodul removable data storage for commissioning and service
- Secured remote maintenance concept

SDS 5000

5.1.1 Features

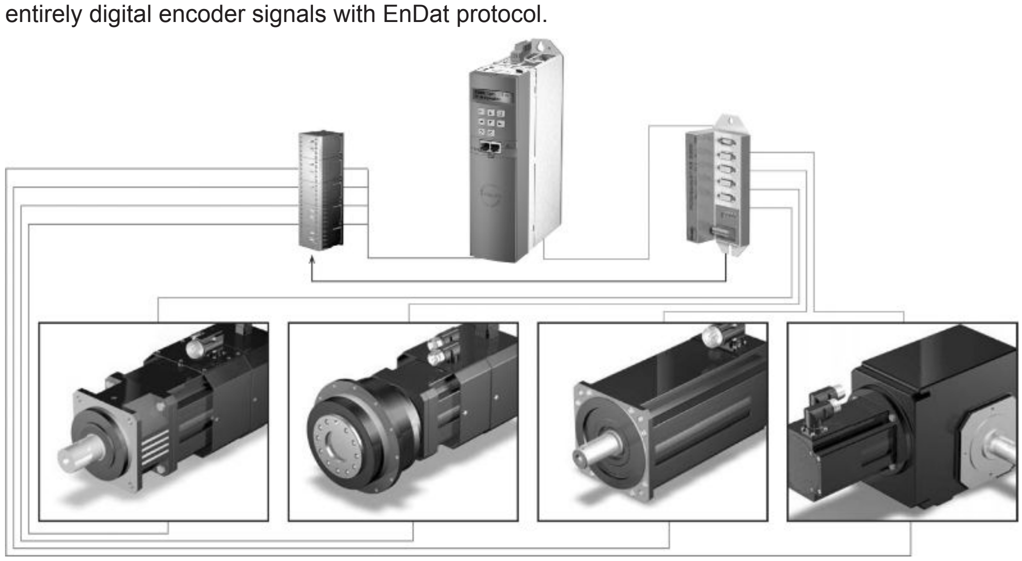
The 5th generation series of STOBER inverters are purely digital, modular inverter systems for operating rotary synchronous and asynchronous motors. It includes product types for direct operation on a one or three-phase network in a voltage range from 200 V_{AC} to 528 V_{AC}. An EMC line filter is integrated. 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 ideally intended for operation with the EnDat 2.1/2.2 digital encoder. These encoder systems can deliver the highest control quality. 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 enable connection to a controller 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 keyboard simplify diagnostics in the event of a fault and enable fast access to parameters. The Paramodul removable data storage 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

The POSISwitch AX 5000 accessory allows for up to four synchronous servo motors to be operated on one inverter sequentially using the EnDat 2.1/2.2 digital absolute encoder. The POSISwitch AX 5000 module is used to switch absolute encoder signals as well as control signals for brake and motor line switching. Switching is easy and EMC interference-free thanks to the entirely digital encoder signals with EnDat protocol.



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 configuration over Ethernet and isochronic data exchange for the following functions:

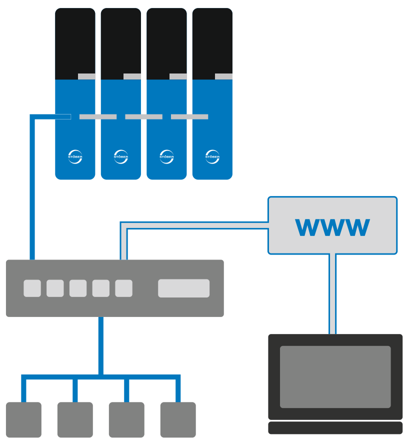
- Multi-axis synchronization between the servo inverters (IGB motion bus)
- Internet connection for remote maintenance of individual and multiple inverters
- Direct connection between servo inverter and PC

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, such as tailor-made applications.

STOBER remote maintenance concept

STOBER remote maintenance enables commissioning software to be used to perform all processes and sequences just like an on-site service visit. The concept guides users through a controlled and protected procedure. It ensures that the person responsible for the machine is there on site to pay attention to special situations and personal safety. On the other end, the remote maintenance specialist has the assurance of communicating with a responsible employee on site who is monitoring the situation on the machine.



Remote maintenance can be used to perform all processes and sequences just like an on-site service visit.

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: BRS 5001 brake module

POSITool

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

Paramodul 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

Various standard applications can be loaded onto the devices of the 5th STOBER inverter generation with the POSITool commissioning software as needed. Furthermore, programming based on IEC 61131-3 with CFC can be used 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 specified using analog inputs as well as digitally.

Torque/force 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 as well as using fixed values, motor potentiometers and other functions.
- **Technology controller**
  PID controller for torque or speed-controlled applications.

Positioning and master/slave mode (standard application)

- **Command, synchronous command**
  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 over 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**
  Extensive positioning application with up to 256 motion blocks based on PLCopen. The motion blocks can be selected individually over fieldbus or with binary inputs. They can also be started in a chain. 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 readily understandable, free graphical programming based on IEC 61131-3 CFC. This also allows for customer-specific adaptations to special system conditions. 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.

G5 Basic

Training content: System overview, installation 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 on training topics.

Software used: POSITool.

G5 Advanced

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

G5 CAM

Training content: Special knowledge of electronic cam disks. Practical exercises on training topics.

5.2 Technical data

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

5.2.1 Symbols in formulas

Formula symbol	Unit	Explanation
f_{2PU}	Hz	Output frequency of the power unit
f_N	Hz	Rotating magnetic field frequency at nominal speed
$f_{PWM,PU}$	Hz	Internal pulse clock frequency of the power unit
I_0	A	Stall current: RMS value of the line-to-line current when the stall torque M_0 is 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	Stall torque: The continuous torque the motor is able to deliver 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 unit
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_{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	Generation 5
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 in accordance with EN 61800-3:2012, interference emission class C3
Overvoltage category	III in accordance with 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) in accordance with 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 temperature during operation	0 °C to 45 °C for nominal data 45 °C to 55 °C with −2.5%/°C derating
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 sea level with −1.5%/100 m derating
Pollution degree	Pollution degree level 2 in accordance with EN 50178
Ventilation	Installed fan
Vibration (operation) in accordance with 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 min.

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: SDS 5000 electrical data, 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: SDS 5000 electrical data, 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: SDS 5000 electrical data, 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 the chapter on derating)
[2] Clock frequency adjustable from 4 to 16 kHz (see the chapter on derating)

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 × 9.3 A	3 × 15.8 A
f_{2PU}	0 – 700 Hz	
U_{2PU}	0 – 400 V	
U_{maxPU}	830 V	

Tab. 12: SDS 5000 electrical data, 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: SDS 5000 electrical data, 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: SDS 5000 electrical data, 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 the chapter on derating)
[4] Clock frequency adjustable from 4 to 16 kHz (see the chapter on derating)

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: SDS 5000 electrical data, 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: SDS 5000 electrical data, 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: SDS 5000 electrical data, 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 the chapter on derating)
[6] Clock frequency adjustable from 4 to 16 kHz (see the chapter on derating)

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: SDS 5000 electrical data, 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: SDS 5000 electrical data, 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: SDS 5000 electrical data, 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 the chapter on derating)
[8] Clock frequency adjustable from 4 to 16 kHz (see the chapter on derating)

5.2.5.5 Power loss data in accordance with 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 unit that is switched off
[10] Operating points for relative motor stator frequency in % and relative torque current in %
[11] IE class in accordance with EN 50598

Type	Nominal current $I_{2N,PU}$	Apparent power	Absolute losses $P_{V,CU}$[12]	Working points[13] (0/25)	(0/50)	(0/100)	(50/25)	(50/50)	(50/100)	(90/50)	(90/100)	IE class[14]	Comparison[15]
				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 SDS 5000 inverter in accordance with EN 50598

General conditions

The loss data applies to inverters without accessories.

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

The calculated data includes a supplement of 10% in accordance with EN 50598.

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

The absolute losses for a power unit that is switched off refer to the 24 V_{DC} power supply of the control electronics.

[12] Absolute losses for a power unit that is switched off
[13] Operating points for relative motor stator frequency in % and relative torque current in %
[14] IE class in accordance with 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]
ASP 5001 safety module	1
SEA 5001 terminal module	< 2
XEA 5001 terminal module	< 5
REA 5001 terminal module	< 5
CAN 5000 fieldbus module	1
DP 5000 fieldbus module	< 2
ECS 5000 fieldbus module	< 2
PN 5000 fieldbus module	< 4
BRM 5000 / BRS 5001 brake module	< 1

Tab. 26: Absolute losses of the accessories

Information

Note the absolute power loss of the encoder (usually < 3 W) and of the brake when designing as well.

5.2.6 Derating by increasing the clock frequency

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

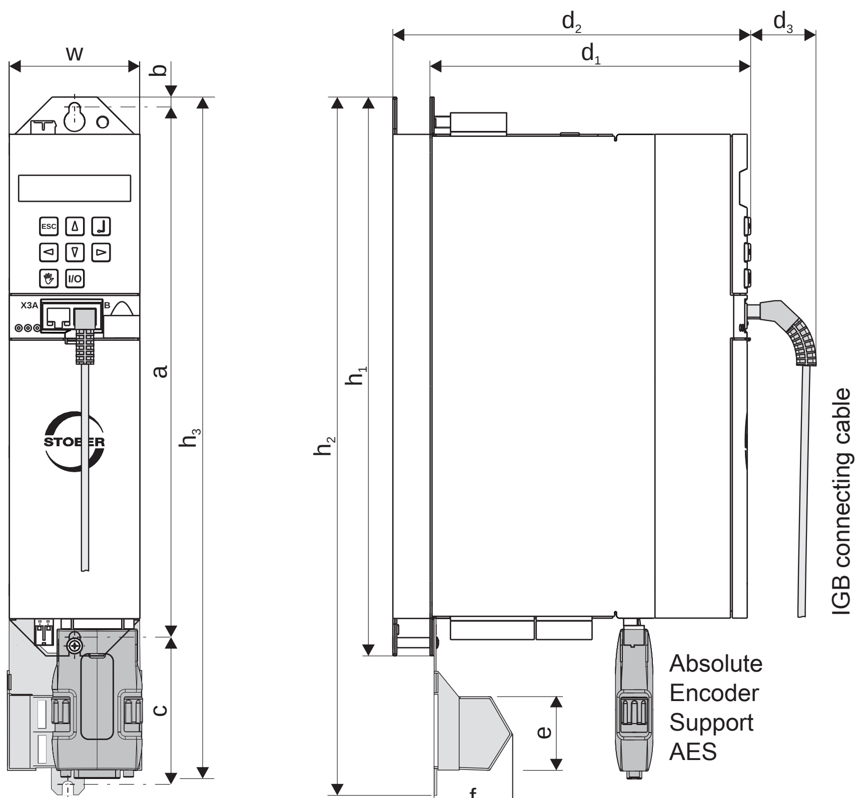
Type	$I_{2N,PU}$ 4 kHz	$I_{2N,PU}$ 8 kHz	$I_{2N,PU}$ 16 kHz
SDS 5007A	4 A	3 A	2 A
SDS 5008A	2.3 A	1.7 A	1.2 A
SDS 5015A	4.5 A	3.4 A	2.2 A
SDS 5040A	10 A	6 A	3.3 A
SDS 5075A	16 A	10 A	5.7 A
SDS 5110A	22 A	14 A	8.1 A
SDS 5150A	32 A	20 A	11.4 A
SDS 5220A	44 A	30 A	18.3 A
SDS 5370A	70 A	50 A	31.8 A
SDS 5450A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

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

5.2.7 Dimensions

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

5.2.7.1 Dimensions: sizes 0 to 2

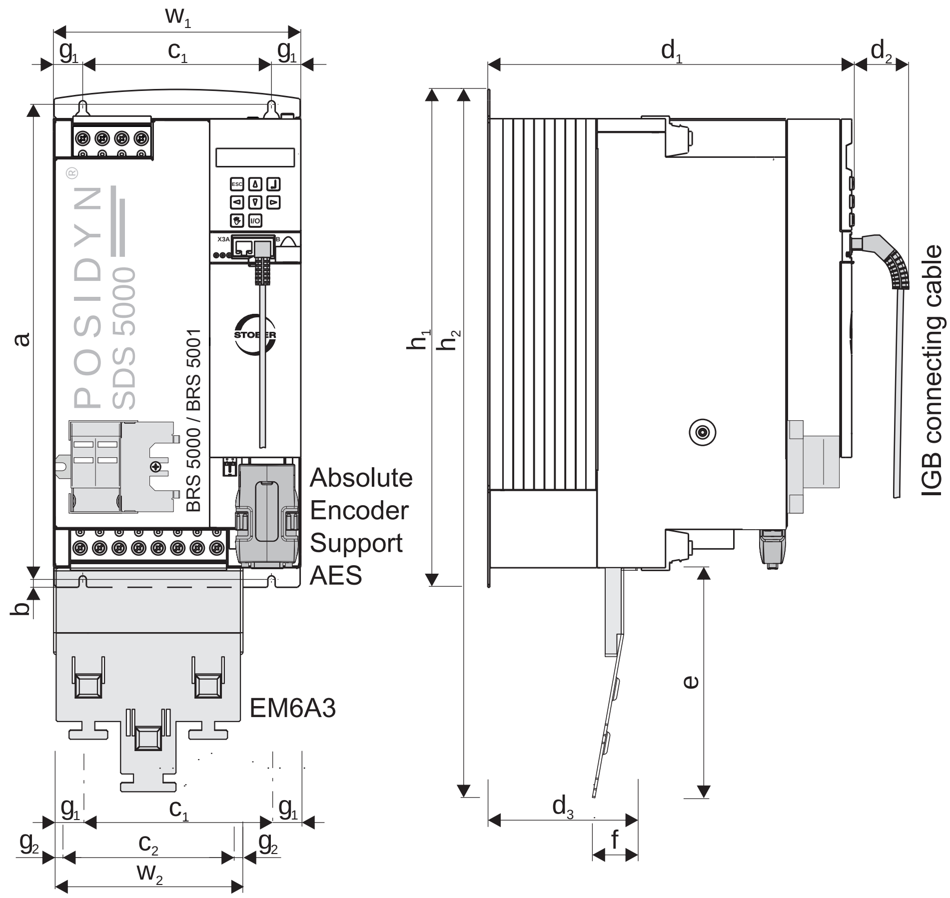


EM 5000 /
BRS 5000 / BRS 5001

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

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 RB 5000 brake resistor
20 e = height of EM 5000 EMC shroud
21 e = height of BRS 5001 brake module
22 c = vertical distance with BRS 5001 brake module

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 the bottom edge	b	6
	Horizontal distance	c_1[24]	150+0.2/−0.2
	Horizontal distance to the side edge	g_1[25]	20
	Horizontal distance	c_2[26]	132
	Horizontal distance to the side edge	g_2[27]	7.5

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

5.2.8 Minimum clearances

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

Minimum clearance	Above	Below	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]

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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
IC 410 convection cooling						$I_{2N,PU}$ / I_0									
EZ805U	142	43.7	25.9	66.1	37.9									1.3	1.6
IC 416 forced ventilation						$I_{2N,PU}$ / I_0									
EZ805B	142	77.2	45.2	94	53.9										1.1

EZ synchronous servo motor (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
IC 410 convection cooling							$I_{2N,PU}$ / 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
IC 416 forced ventilation						$I_{2N,PU}$ / 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

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
IC 410 convection cooling						$I_{2N,PU}$ / 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
IC 416 forced ventilation						$I_{2N,PU}$ / 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

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
IC 410 convection cooling						$I_{2N,PU}$ / 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		
IC 416 forced ventilation						$I_{2N,PU}$ / 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		

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
IC 410 convection cooling						$I_{2N,PU}$ / 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		

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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
IC 410 convection cooling						$I_{2N,PU}$ / 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		

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
IC 410 convection cooling						$I_{2N,PU}$ / 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			
IC 416 forced ventilation						$I_{2N,PU}$ / 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		

EZM synchronous servo motor for screw drive (driven threaded 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
IC 410 convection cooling						$I_{2N,PU}$ / 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			

5.4 Accessories

You can find information about the available accessories in the following chapters.

5.4.1 Safety technology

ASP 5001 – Safe Torque Off

Available with the standard version.

Option module for implementation of integrated Safe Torque Off (STO) safety function.
The ASP 5001 may only be installed by STÖBER ANTRIEBSTECHNIK GmbH & Co. KG.
The ASP 5001 has to be ordered with the base unit.

5.4.2 Communication

IGB connecting cable

Cable for connecting 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 port.

CANopen DS-301 CAN 5000 communication module

ID No. 44574
Accessory part for connecting CAN bus.

PROFIBUS DP-V1 DP 5000 communication module

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

EtherCAT ECS 5000 communication module

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

EtherCAT cables

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.

PROFINET PN 5000 communication module

ID No. 53893
Accessory part for connecting PROFINET.

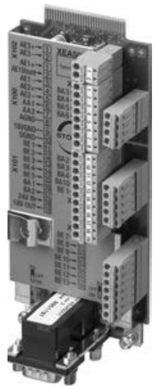
5.4.3 Terminal module

SEA 5001 standard terminal module

ID No. 49576
Terminals:

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

XEA 5001 extended terminal module



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)

X120 SSI/TTL connection cable

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

REA 5001 resolver terminal module

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 using the resolver adapter (9-pin to 15-pin) included in the scope of delivery to terminal X140 of REA 5001.

5.4.4 Braking resistor

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

5.4.4.1 FZMU, FZZMU 400×65 tubular fixed resistor

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 FZMU, FZZMU 400×65 braking resistor – SDS 5000 inverters

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. τ_{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: FZMU, FZZMU 400×65 specification

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: FZMU, FZZMU 400×65 dimensions [mm]

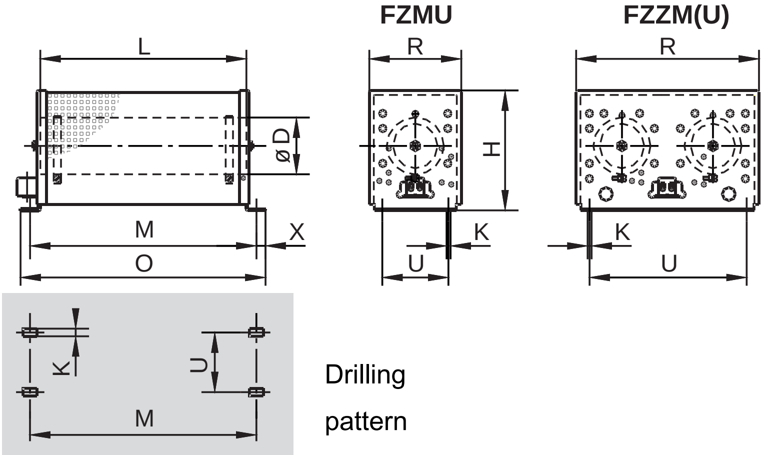


Fig. 2: FZMU, FZZMU 400×65 dimensional drawing

SDS

5.4.4.2 GVADU, GBADU flat resistor

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 GVADU, GBADU braking resistor – SDS 5000 inverters

Properties

Specification	GVADU 210×20	GBADU 265×30		GBADU 335×30	GBADU 405×30
ID No.	55441	55442	55444	55443	55499
Type	Flat resistor	Flat resistor			
Resistance [Ω]	100	100	22	47	100
Power [W]	150	300	300	400	500
Therm. time const. τ_{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: GVADU, GBADU specification

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: GVADU, GBADU dimensions [mm]

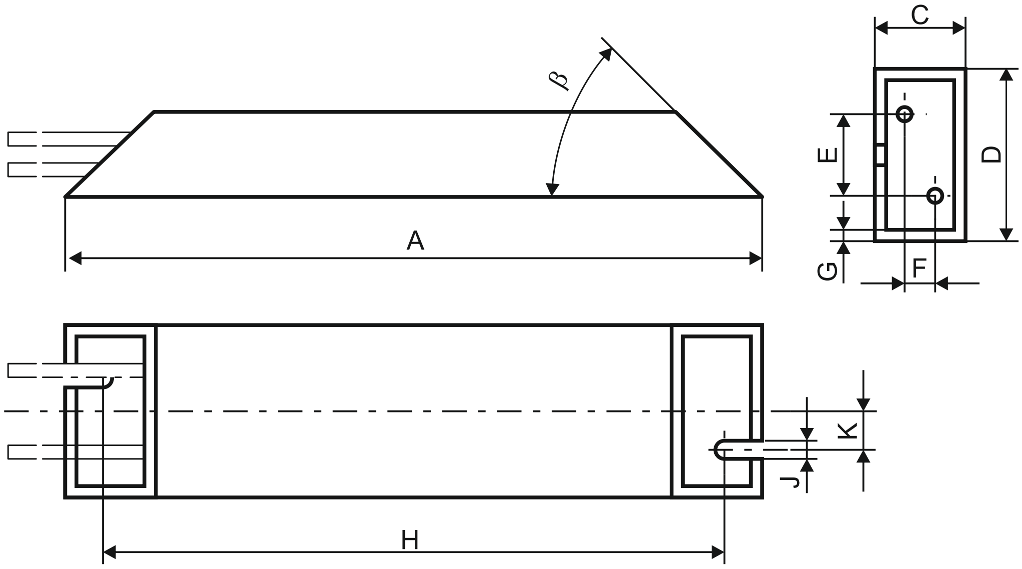


Fig. 3: GVADU, GBADU dimensional drawing

5.4.4.3 FGFKU steel-grid fixed resistor

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 FGFKU braking resistor – SDS 5000 inverters

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. τ_{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: FGFKU specification

Dimensions

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

Tab. 37: FGFKU dimensions [mm]

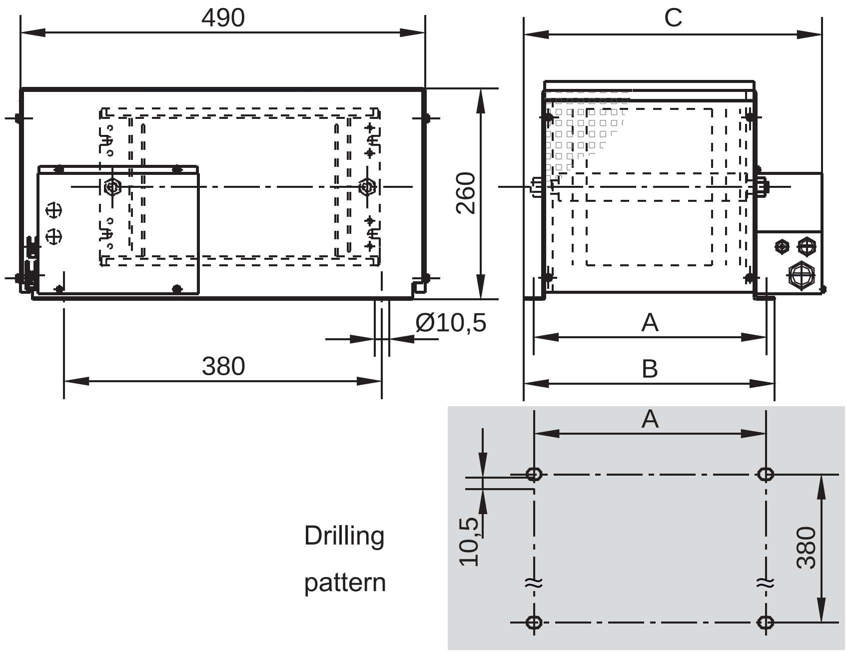


Fig. 4: FGFKU dimensional drawing

5.4.4.4 RB 5000 bottom brake resistor

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 RB 5000 braking resistor – SDS 5000 inverters

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. τ_{th} [s]	8		
Pulse power for < 1 s [kW]	1.5	1.0	1.0
U_{max} [V]	800		
Weight [g]	approx. 640	approx. 460	approx. 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			

Tab. 39: RB 5000 specification

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: RB 5000 dimensions [mm]

5.4.5 TEP output choke

Output chokes are required starting from a cable length of > 50 m.

Information

The following technical data only applies to a rotating magnetic field frequency of 200 Hz. For example, this rotating magnetic 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 rotating magnetic field frequencies. Also observe the relationship with the clock frequency.

Properties

Specification	TEP3720-0ES41	TEP3820-0CS41	TEP4020-0RS41
ID No.	53188	53189	53190
Voltage range	3 × 0 to 480 V_{DC}		
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 UR us		

Tab. 41: TEP specification

Project configuration

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

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

Derating

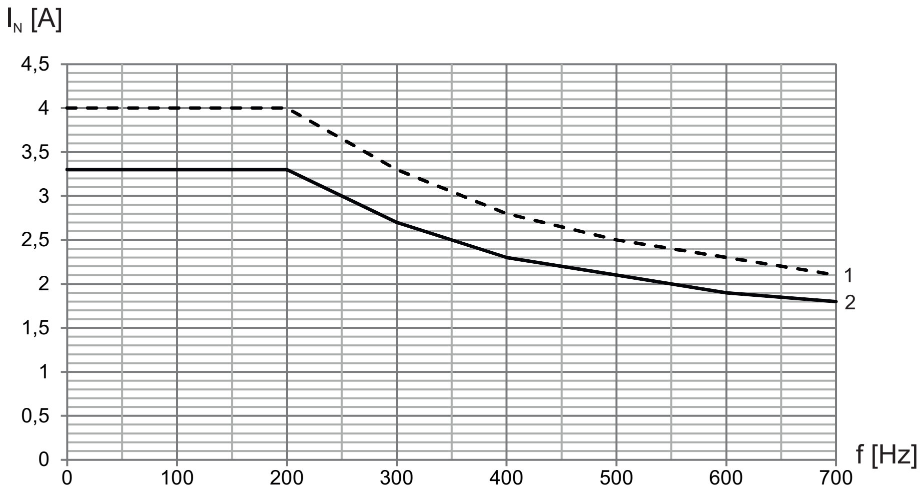


Fig. 5: TEP3720-0ES41 derating

1	4 kHz clock frequency
2	8 kHz clock frequency

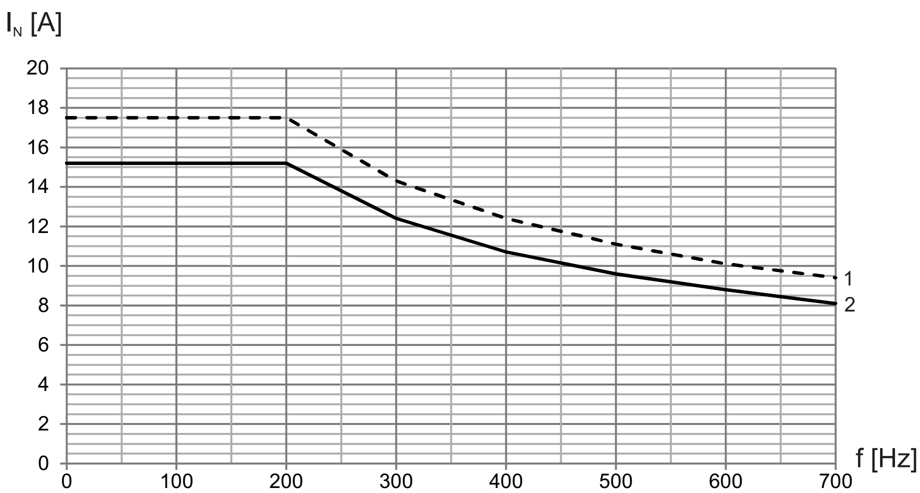


Fig. 6: TEP3820-0CS41 derating

1	4 kHz clock frequency
2	8 kHz clock frequency

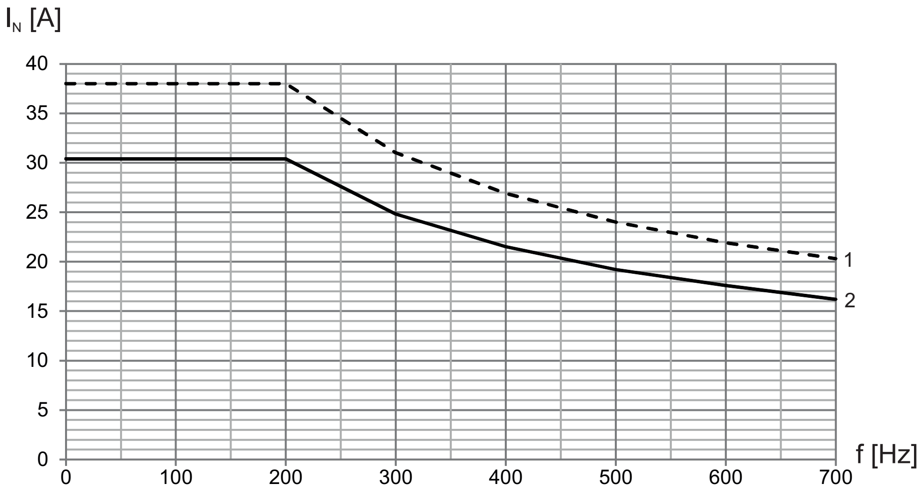


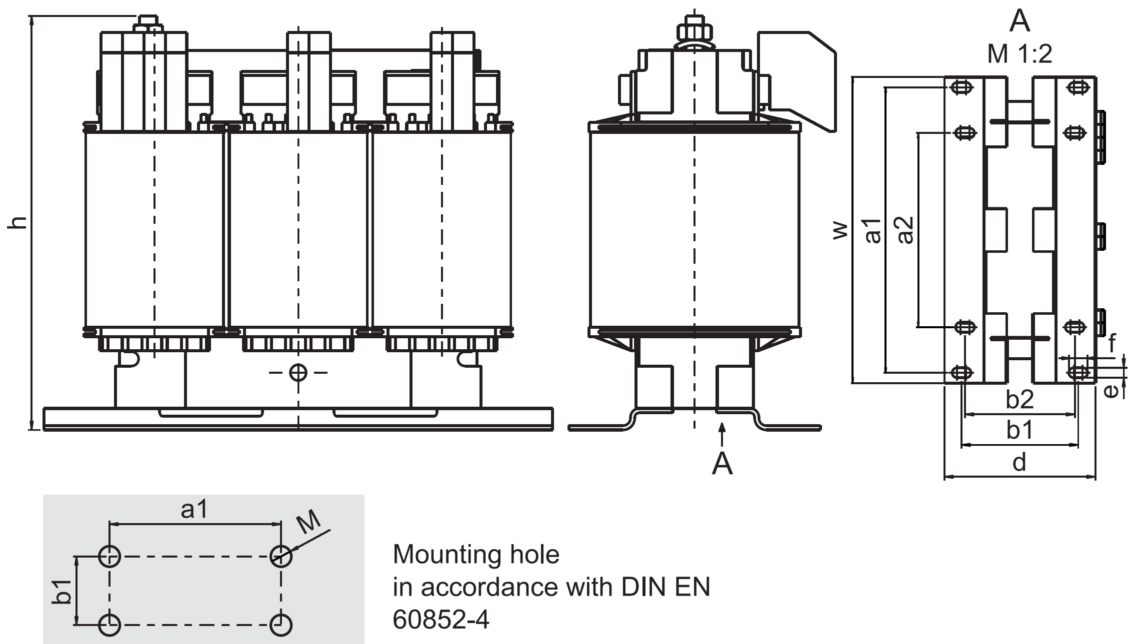
Fig. 7: TEP4020-0RS41 derating

1	4 kHz clock frequency
2	8 kHz clock frequency

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: TEP dimensions and weight



Mounting hole
in accordance with DIN EN
60852-4

Fig. 8: TEP dimensional drawing

5.4.6 Brake module and EMC shroud

BRS 5001 brake module

ID No. 56519
Brake module for inverters of the SDS 5000 series.
Accessory for directly controlling up to two motor stopping brakes (24 V_{DC}) and (for inverters up to size 2) connecting to the shield of the power cable.
Can be mounted on the base housing.
Includes connecting cable to the base unit and shielding connection terminal.

EM 5000 EMC shroud

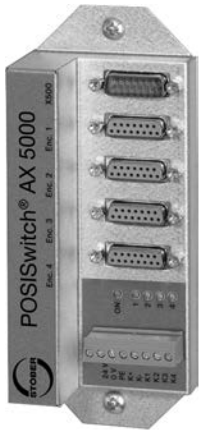
ID No. 44959
EMC shroud for inverters of the FDS 5000 and MDS 5000 series.
Accessory for the shield connection of power cable for inverters up to size 2.
Can be attached to the basic housing.
Shield connection terminal included.

EMC shroud EM6A3

ID No. 135120
EMC shroud for size 3.
Accessory part for the shield connection of the motor line.
Can be attached to the basic housing.
Shield connection terminal included.
If necessary, you can also attach the cable shield of the braking resistor and DC link connection to the shroud. Additional shield connection terminals are available as accessories for this purpose (ID No. 56521).

5.4.7 Axis switcher

POSISwitch AX 5000 4-way axis switcher



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

LA6 / AX 5000 connection cable

Cable to connect inverter and POSISwitch AX 5000 axis switcher.
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 EnDat 2.2 digital inductive absolute encoder with battery-buffered multi-turn power unit, for example EBI1135, EBI135.
A battery is included.

AES replacement battery

ID No. 55453
Replacement battery for AES battery module.

5.4.9 Removable data storage

Paramodul removable data storage

Included in the standard version.

ID No. 55464

Memory module for configuration and parameters.

5.4.10 Product CD

ELECTRONICS 5000 product CD

Included in the standard version.

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 marks

Grounding symbol

Grounding symbol in accordance with IEC 60417-5019 (DB:2002-10).

RoHS lead-free marking

Marking in accordance with RoHS directive 2011-65-EU.

CE mark

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

UL mark

This product is listed by UL for the United States 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.

STÖBER

MDS

6 POSIDRIVE MDS 5000 servo inverters

Table of contents

6.1 Overview

The universal servo inverter for fully digital servo axes

Features

- Nominal output current up to 60 A (at 8 kHz clock frequency)
- 250% overload capacity
- Power range: 0.75 kW to 45 kW
- Control of rotary synchronous servo motors and asynchronous motors
- EnDat 2.1/2.2 digital, SSI, incremental (HTL/TTL) or resolver encoder interfaces
- Automatic motor parameterization from the electronic motor nameplate
- Communication using PROFIBUS DP, PROFINET, CANopen or EtherCAT
- Safe Torque Off (STO) and Safe Stop 1 (SS1) safety functions: SIL 3, PL e, category 3
- Digital and analog inputs and outputs
- Integrated brake chopper
- Integrated line filter
- Motor temperature evaluation using PTC thermistors, KTY or Pt1000 temperature sensors
- Standard applications with speed, torque, positioning and master/slave functionality
- Programming based on IEC 61131-3 with CFC for creating applications
- Fast commissioning with POSITool software
- Convenient operating unit consisting of plain text display and keyboard
- Paramodul removable data storage for commissioning and service

MDS 5000

6.1.1 Features

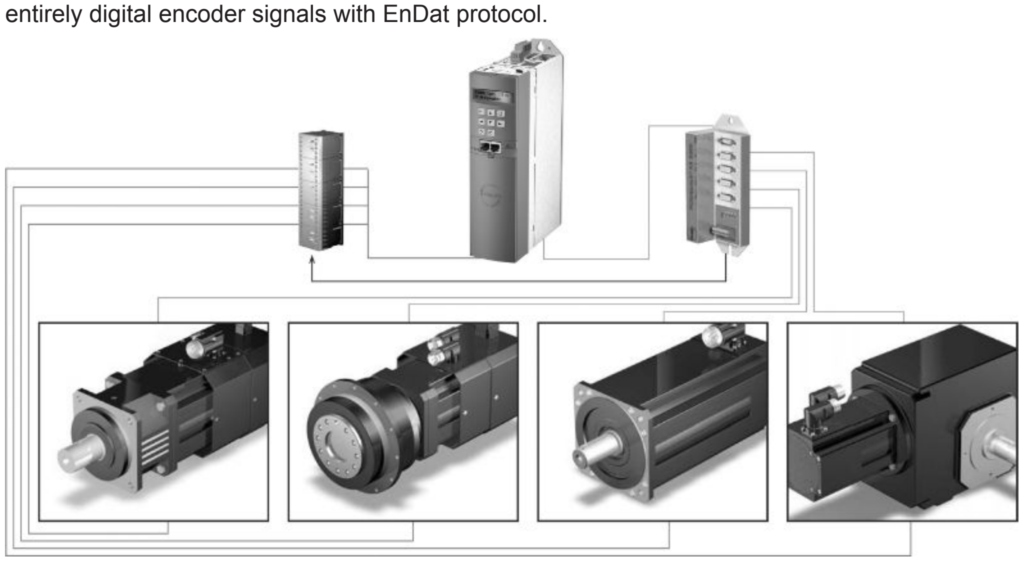
The 5th generation series of STOBER inverters are purely digital, modular inverter systems for operating rotary synchronous and asynchronous motors. It includes product types for direct operation on a one or three-phase network in a voltage range from 200 V_{AC} to 528 V_{AC}. An EMC line filter is integrated. 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 ideally intended for operation with the EnDat 2.1/2.2 digital encoder. These encoder systems can deliver the highest control quality. 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 enable connection to a controller 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 keyboard simplify diagnostics in the event of a fault and enable fast access to parameters. The Paramodul removable data storage 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

The POSISwitch AX 5000 accessory allows for up to four synchronous servo motors to be operated on one inverter sequentially using the EnDat 2.1/2.2 digital absolute encoder. The POSISwitch AX 5000 module is used to switch absolute encoder signals as well as control signals for brake and motor line switching. Switching is easy and EMC interference-free thanks to the entirely digital encoder signals with EnDat protocol.



POSITool

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

Paramodul 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

Various standard applications can be loaded onto the devices of the 5th STOBER inverter generation with the POSITool commissioning software as needed. Furthermore, programming based on IEC 61131-3 with CFC can be used 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 specified using analog inputs as well as digitally.

Torque/force 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 as well as using fixed values, motor potentiometers and other functions.
- **Technology controller**
  PID controller for torque or speed-controlled applications.

Positioning and master/slave mode (standard application)

- **Command, synchronous command**
  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 over 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**
  Extensive positioning application with up to 256 motion blocks based on PLCopen. The motion blocks can be selected individually over fieldbus or with binary inputs. They can also be started in a chain. 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 readily understandable, free graphical programming based on IEC 61131-3 CFC. This also allows for customer-specific adaptations to special system conditions. 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, though it is compatible with the MDS 5000 series to a great extent.

G5 Basic

Training content: System overview, installation 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 on training topics.

Software used: POSITool.

G5 Advanced

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

G5 CAM

Training content: Special knowledge of electronic cam disks. Practical exercises on training topics.

STÖBER

MDS

6.2 Technical data

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

6.2.1 Symbols in formulas

Formula symbol	Unit	Explanation
f_{2PU}	Hz	Output frequency of the power unit
f_N	Hz	Rotating magnetic field frequency at nominal speed
$f_{PWM,PU}$	Hz	Internal pulse clock frequency of the power unit
I_0	A	Stall current: RMS value of the line-to-line current when the stall torque M_0 is 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	Stall torque: The continuous torque the motor is able to deliver 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 unit
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_{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	Generation 5
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 in accordance with EN 61800-3:2012, interference emission class C3
Overvoltage category	III in accordance with 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) in accordance with 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 temperature during operation	0 °C to 45 °C for nominal data 45 °C to 55 °C with −2.5%/°C derating
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 sea level with −1.5%/100 m derating
Pollution degree	Pollution degree level 2 in accordance with EN 50178
Ventilation	Installed fan
Vibration (operation) in accordance with 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 min.

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: MDS 5000 electrical data, 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: MDS 5000 electrical data, 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: MDS 5000 electrical data, 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 the chapter on derating)
[2] Clock frequency adjustable from 4 to 16 kHz (see the chapter on derating)

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 × 9.3 A	3 × 15.8 A
f_{2PU}	0 – 700 Hz	
U_{2PU}	0 – 400 V	
U_{maxPU}	830 V	

Tab. 12: MDS 5000 electrical data, 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: MDS 5000 electrical data, 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: MDS 5000 electrical data, 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 the chapter on derating)
[4] Clock frequency adjustable from 4 to 16 kHz (see the chapter on derating)

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: MDS 5000 electrical data, 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: MDS 5000 electrical data, 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: MDS 5000 electrical data, 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 the chapter on derating)
[6] Clock frequency adjustable from 4 to 16 kHz (see the chapter on derating)

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: MDS 5000 electrical data, 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: MDS 5000 electrical data, 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: MDS 5000 electrical data, 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 the chapter on derating)
[8] Clock frequency adjustable from 4 to 16 kHz (see the chapter on derating)

6.2.5.5 Power loss data in accordance with 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 MDS 5000 inverters according to EN 50598

[9] Absolute losses for a power unit that is switched off
[10] Operating points for relative motor stator frequency in % and relative torque current in %
[11] IE class in accordance with 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 MDS 5000 inverters according to EN 50598

General conditions

The loss data applies to inverters without accessories.

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

The calculated data includes a supplement of 10% in accordance with EN 50598.

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

The absolute losses for a power unit that is switched off refer to the 24 V_{DC} power supply of the control electronics.

[12] Absolute losses for a power unit that is switched off
[13] Operating points for relative motor stator frequency in % and relative torque current in %
[14] IE class in accordance with 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]
ASP 5001 safety module	1
SEA 5001 terminal module	< 2
XEA 5001 terminal module	< 5
REA 5001 terminal module	< 5
CAN 5000 fieldbus module	1
DP 5000 fieldbus module	< 2
ECS 5000 fieldbus module	< 2
PN 5000 fieldbus module	< 4
BRM 5000 / BRS 5001 brake module	< 1

Tab. 26: Absolute losses of the accessories

Information

Note the absolute power loss of the encoder (usually < 3 W) and of the brake when designing as well.

6.2.6 Derating by increasing the clock frequency

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

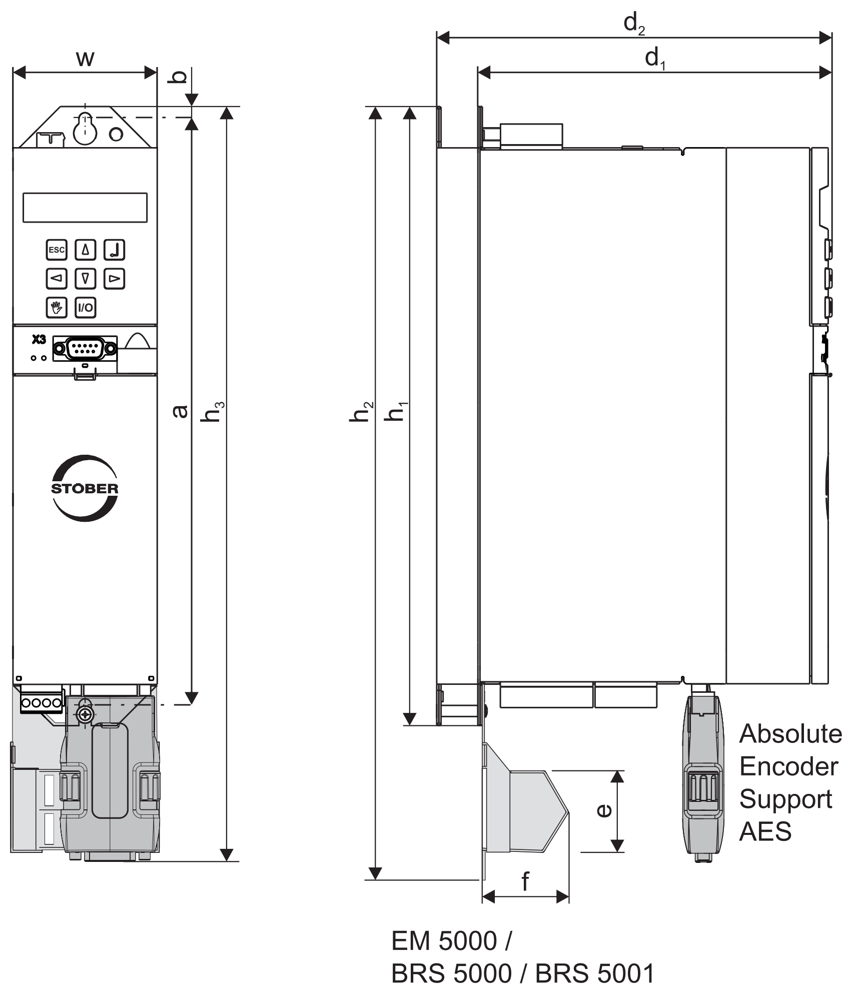
Type	$I_{2N,PU}$ 4 kHz	$I_{2N,PU}$ 8 kHz	$I_{2N,PU}$ 16 kHz
MDS 5007A	4 A	3 A	2 A
MDS 5008A	2.3 A	1.7 A	1.2 A
MDS 5015A	4.5 A	3.4 A	2.2 A
MDS 5040A	10 A	6 A	3.3 A
MDS 5075A	16 A	10 A	5.7 A
MDS 5110A	22 A	14 A	8.1 A
MDS 5150A	32 A	20 A	11.4 A
MDS 5220A	44 A	30 A	18.3 A
MDS 5370A	70 A	50 A	31.8 A
MDS 5450A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

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

6.2.7 Dimensions

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

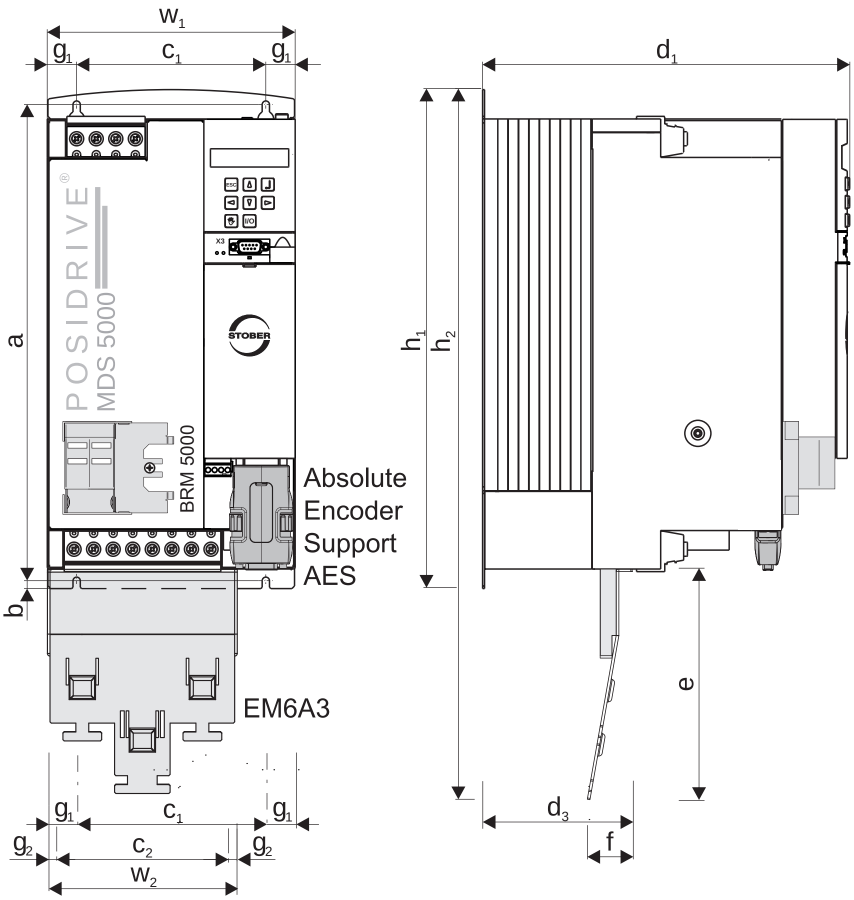
6.2.7.1 Dimensions: size 0 to 2



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 the upper edge	b	6		

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

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 the bottom edge	b	6
	Horizontal distance	c_1[20]	150+0.2/−0.2
	Horizontal distance to the side edge	g_1[21]	20
	Horizontal distance	c_2[22]	132
	Horizontal distance to the side edge	g_2[23]	7.5

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

6.2.8 Minimum clearances

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

Minimum clearance	Above	Below	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
IC 410 convection cooling						$I_{2N,PU} / I_0$									
EZ805U	142	43.7	25.9	66.1	37.9									1.3	1.6
IC 416 forced ventilation						$I_{2N,PU} / I_0$									
EZ805B	142	77.2	45.2	94	53.9										1.1

EZ synchronous servo motor (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
IC 410 convection cooling						$I_{2N,PU} / I_0$									
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
IC 416 forced ventilation						$I_{2N,PU} / I_0$									
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

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MDS

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
IC 410 convection cooling						$I_{2N,PU}$ / 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
IC 416 forced ventilation						$I_{2N,PU}$ / 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

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
IC 410 convection cooling						$I_{2N,PU}$ / 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		
IC 416 forced ventilation						$I_{2N,PU}$ / 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		

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
IC 410 convection cooling						$I_{2N,PU}$ / 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
IC 410 convection cooling						$I_{2N,PU} / I_0$									
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		

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
IC 410 convection cooling						$I_{2N,PU} / I_0$									
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			
IC 416 forced ventilation						$I_{2N,PU} / I_0$									
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		

EZM synchronous servo motor for screw drive (driven threaded 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
IC 410 convection cooling						$I_{2N,PU} / I_0$									
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			

6.4 Accessories

You can find information about the available accessories in the following chapters.

6.4.1 Safety technology

ASP 5001 – Safe Torque Off

Available with the standard version.

Option module for implementation of integrated Safe Torque Off (STO) safety function.
The ASP 5001 may only be installed by STÖBER ANTRIEB-STECHNIK GmbH & Co. KG.
The ASP 5001 has to be ordered with the base unit.

6.4.2 Communication

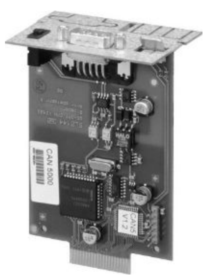
G3 connection cable

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

USB adapter to RS232

ID No. 45616
Adapter for connecting RS232 to a USB port.

CANopen DS-301 CAN 5000 communication module



ID No. 44574
Accessory part for connecting CAN bus.

PROFIBUS DP-V1 DP 5000 communication module

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

EtherCAT ECS 5000 communication module

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

EtherCAT cables

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.

PROFINET PN 5000 communication module

ID No. 53893
Accessory part for connecting PROFINET.

6.4.3 Terminal module

SEA 5001 standard terminal module

ID No. 49576
Terminals:

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

XEA 5001 extended terminal module

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)

X120 SSI/TTL connection cable

ID No. 49482

Cable for connecting the X120 TTL interface on the SD6 drive controller (on terminal module RI6 or XI6) with the X301 interface on the LA6 adapter box in order to transfer Hall sensor signals. 0.3 m.

REA 5001 resolver terminal module

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 using the resolver adapter (9-pin to 15-pin) included in the scope of delivery to terminal X140 of REA 5001.

6.4.4 Braking resistor

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

6.4.4.1 FZMU, FZZMU 400×65 tubular fixed resistor

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 FZMU, FZZMU 400×65 braking resistor – MDS 5000 inverters

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. τ_{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: FZMU, FZZMU 400×65 specification

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: FZMU, FZZMU 400×65 dimensions [mm]

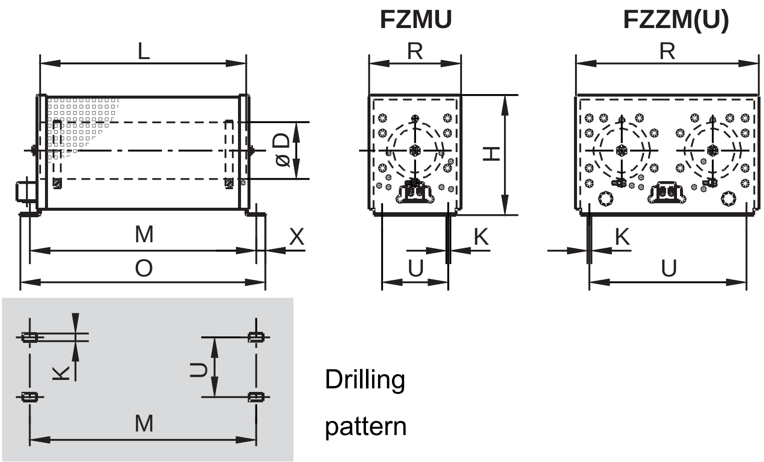


Fig. 2: FZMU, FZZMU 400×65 dimensional drawing

6.4.4.2 GVADU, GBADU flat resistor

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 GVADU, GBADU braking resistor – SDS 5000 inverters

Properties

Specification	GVADU 210×20	GBADU 265×30		GBADU 335×30	GBADU 405×30
ID No.	55441	55442	55444	55443	55499
Type	Flat resistor	Flat resistor			
Resistance [Ω]	100	100	22	47	100
Power [W]	150	300	300	400	500
Therm. time const. τ_{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: GVADU, GBADU specification

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: GVADU, GBADU dimensions [mm]

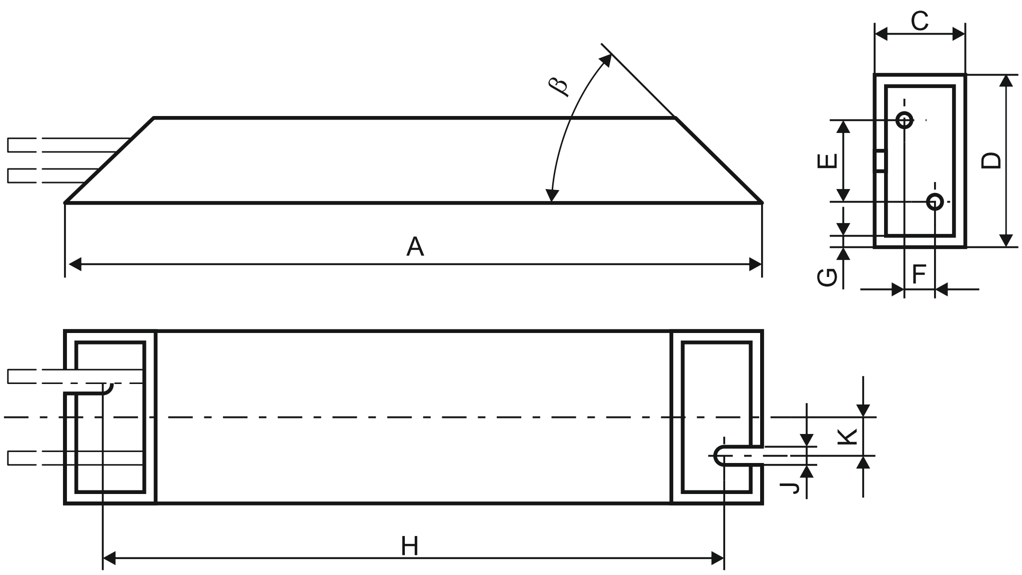


Fig. 3: GVADU, GBADU dimensional drawing

6.4.4.3 FGFKU steel-grid fixed resistor

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 FGFKU braking resistor – SDS 5000 inverters

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. τ_{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: FGFKU specification

Dimensions

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

Tab. 37: FGFKU dimensions [mm]

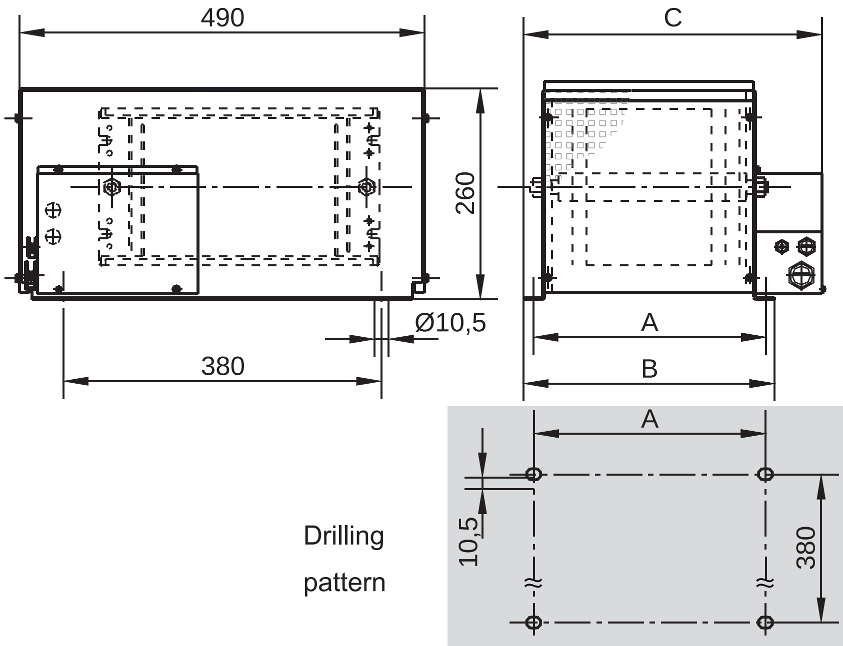


Fig. 4: FGFKU dimensional drawing

6.4.4.4 RB 5000 bottom brake resistor

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 RB 5000 braking resistor – SDS 5000 inverters

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. τ_{th} [s]		8	
Pulse power for < 1 s [kW]	1.5	1.0	1.0
U_{max} [V]		800	
Weight [g]	approx. 640	approx. 460	approx. 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: RB 5000 specification

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: RB 5000 dimensions [mm]

6.4.5 TEP output choke

Output chokes are required starting from a cable length of > 50 m.

Information

The following technical data only applies to a rotating magnetic field frequency of 200 Hz. For example, this rotating magnetic 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 rotating magnetic field frequencies. Also observe the relationship with the clock frequency.

Properties

Specification	TEP3720-0ES41	TEP3820-0CS41	TEP4020-0RS41
ID No.	53188	53189	53190
Voltage range	3 × 0 to 480 V_{DC}		
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: TEP specification

Project configuration

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

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

Derating

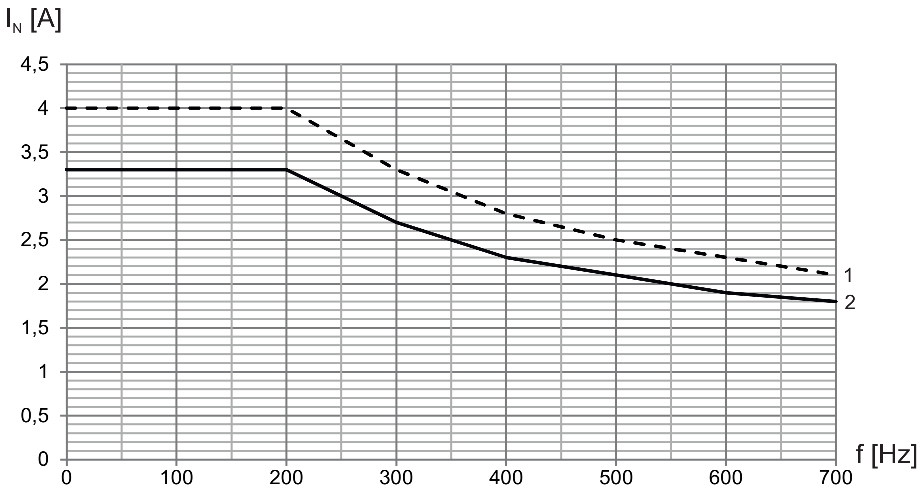


Fig. 5: TEP3720-0ES41 derating

1	4 kHz clock frequency
2	8 kHz clock frequency

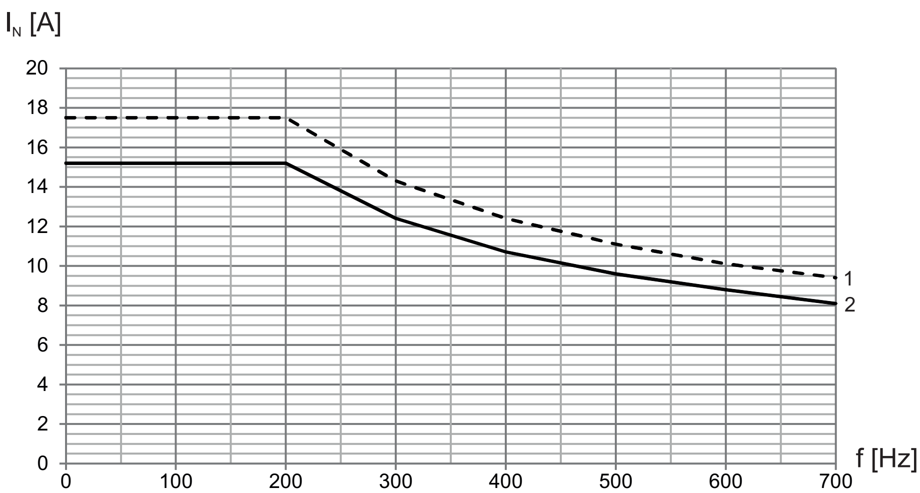


Fig. 6: TEP3820-0CS41 derating

1	4 kHz clock frequency
2	8 kHz clock frequency

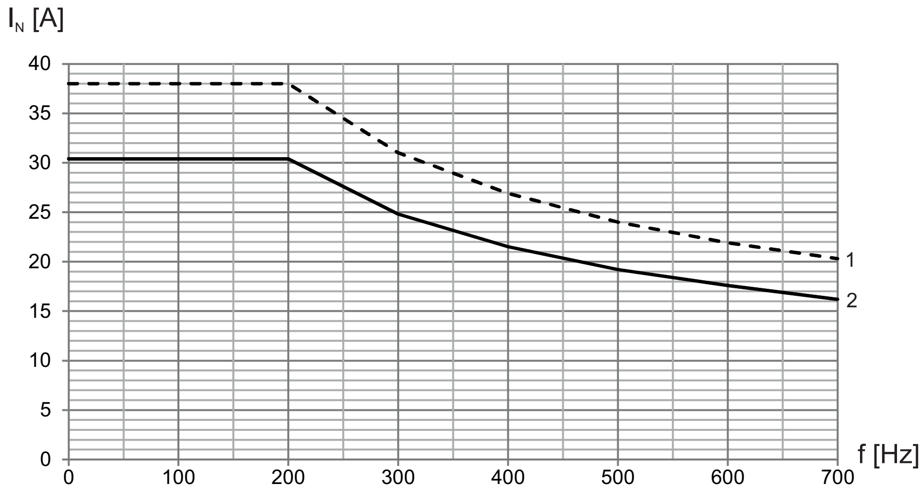


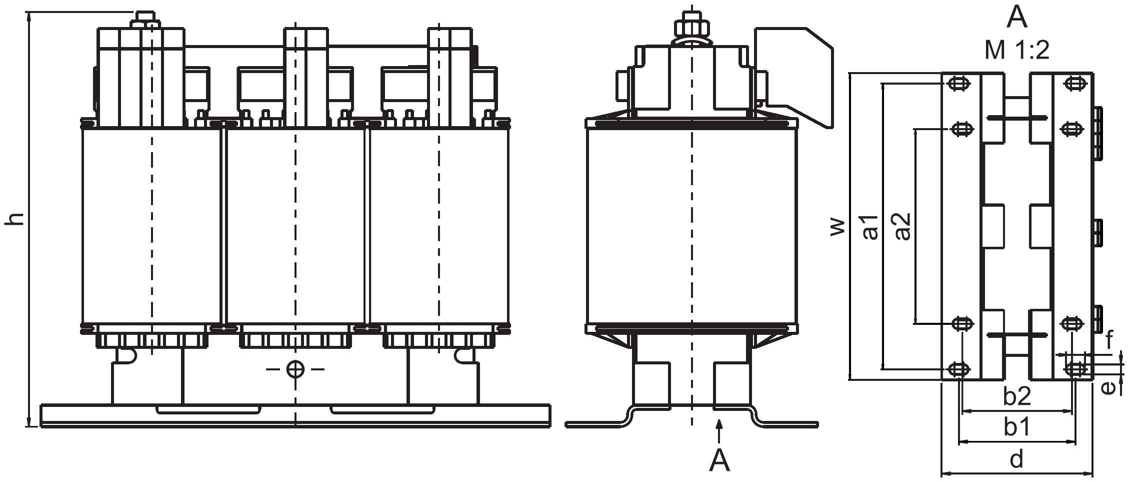
Fig. 7: TEP4020-0RS41 derating

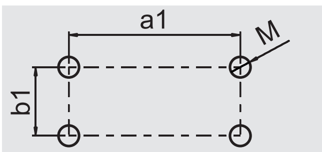
1	4 kHz clock frequency
2	8 kHz clock frequency

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: TEP dimensions and weight



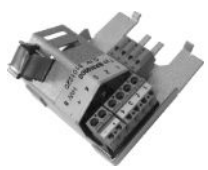


Mounting hole
in accordance with DIN EN
60852-4

Fig. 8: TEP dimensional drawing

6.4.6 Brake module and EMC shroud

Brake module for 24 V brake BRM 5000

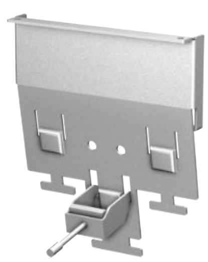


ID No. 44571
Brake module for inverters of the FDS 5000 and MDS 5000 series.
Accessory for controlling a motor stopping brake (24 V_{DC}) and – for inverters up to size 2 – the shield connection of the power cable .
Can be attached to the basic housing.
Shield connection terminal included.

EM 5000 EMC shroud

ID No. 44959
EMC shroud for inverters of the FDS 5000 and MDS 5000 series.
Accessory for the shield connection of power cable for inverters up to size 2.
Can be attached to the basic housing.
Shield connection terminal included.

EMC shroud EM6A3



ID No. 135120
EMC shroud for size 3.
Accessory part for the shield connection of the motor line.
Can be attached to the basic housing.
Shield connection terminal included.
If necessary, you can also attach the cable shield of the braking resistor and DC link connection to the shroud. Additional shield connection terminals are available as accessories for this purpose (ID No. 56521).

6.4.7 Control box

Control box

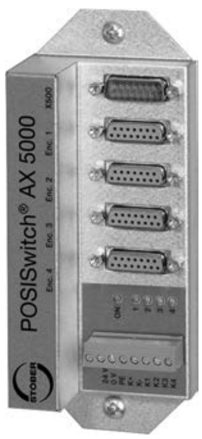
Operating device for parameterization and configuration of the inverter.
The connection cable with a length of 1.5 m is included in the scope of delivery.
The following versions are available:
ID No. 42224: Service versions.
ID No. 42225: Installation DIN housing 96 x 96 mm, protection class IP54.

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

POSISwitch AX 5000 4-way axis switcher



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

LA6 / AX 5000 connection cable

Cable to connect inverter and POSISwitch AX 5000 axis switcher.
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 EnDat 2.2 digital inductive absolute encoder with battery-buffered multi-turn power unit, for example EBI1135, EBI135.
A battery is included.

AES replacement battery

ID No. 55453
Replacement battery for AES battery module.

6.4.10 Removable data storage

Paramodul removable data storage

Included in the standard version.

ID No. 55464
Memory module for configuration and parameters.

6.4.11 Product CD

ELECTRONICS 5000 product CD

Included in the standard version.

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 marks

Grounding symbol
Grounding symbol in accordance with IEC 60417-5019 (DB:2002-10).

RoHS lead-free marking
Marking in accordance with RoHS directive 2011-65-EU.

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

UL mark
This product is listed by UL for the United States 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.

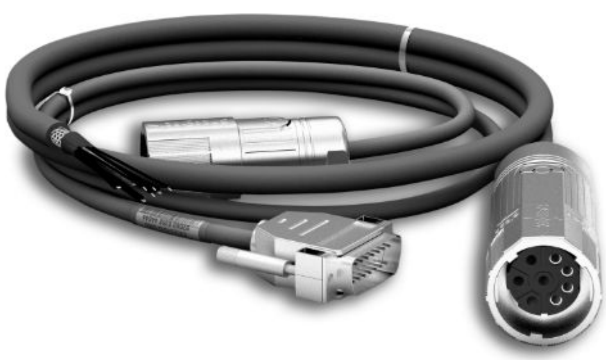
7 Connection method

Table of contents

7.1 Overview

Coordinated connection systems for STOBER drive controllers

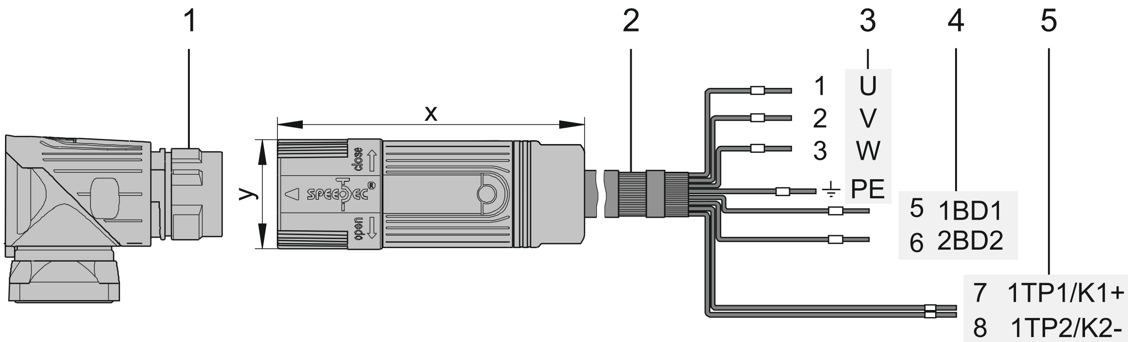
The interaction between drive controller, cable and motor is often underestimated. Every product has its own unique leakage capacitances and inductances. Unsuitable matches can therefore result in impermissibly high voltage peaks on the motor or drive controller, which could destroy the motor and cause 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.



7.2 Power cables

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

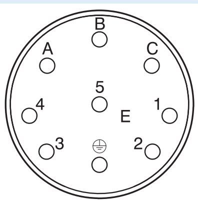
- springtec quick lock for con.15
- speedtec quick lock for con.23 and con.40
- Screw technology for con.58



1:	Plug connector
2:	STOBER power cable, cable shield
3:	Connection to terminal X20, motor
4:	Connection to terminal X300, supply brake
5:	Connection to terminal X2, temperature sensor

Synchronous servo motors from STOBER are equipped with circular plugs as a standard feature. 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 internal motor wiring.

Power cable – con.15 plug connector

Motor connection diagram	Pin	Designation	Int. motor wire color	Wire No./ wire color
	A	1U1	BK	1
	B	1V1	BU	2
	C	1W1	RD	3
	1	1TP1/1TP1/1K1[a)]	BK/RD/BN	7
	2	1TP2/1TP2/1K2[a)]	WH/WH/WH	8
	3	1BD1	RD	5
	4	1BD2	BK	6
	5	—	—	—
	⏚	PE	GNYE	GNYE
	Housing	Shield	—	—

Tab. 1: con.15 power cable pin assignment

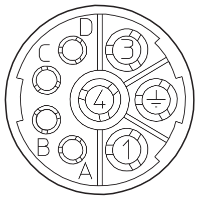
a) PTC/Pt1000/KTY

Length x [mm]	Diameter y [mm]
42	18.7

Tab. 2: con.15 dimensions

CAB

Power cable – con.23 plug connector

Motor connection diagram	Pin	Designation	Int. motor wire color	Wire No./ wire color
	1	1U1	BK	1
	3	1V1	BU	2
	4	1W1	RD	3
	A	1BD1	RD	5
	B	1BD2	BK	6
	C	1TP1/1TP1/1K1[a)]	BK/RD/BN	7
	D	1TP2/1TP2/1K2[a)]	WH/WH/WH	8
	⏚	PE	GNYE	GNYE
	Housing	Shield	—	—

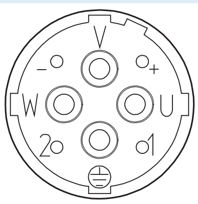
Tab. 3: con.23 power cable pin assignment

a) PTC/Pt1000/KTY

Length x [mm]	Diameter y [mm]
78	26

Tab. 4: con.23 dimensions

Power cable – con.40 plug connector

Motor connection diagram	Pin	Designation	Int. motor wire color	Wire No./ wire color
	U	1U1	BK	1
	V	1V1	BU	2
	W	1W1	RD	3
	+	1BD1	RD	5
	–	1BD2	BK	6
	1	1TP1/1TP1/1K1[a)]	BK/RD/BN	7
	2	1TP2/1TP2/1K2[a)]	WH/WH/WH	8
	⏚	PE	GNYE	GNYE
	Housing	Shield	—	—

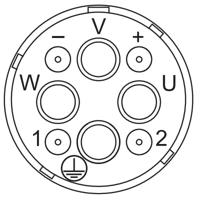
Tab. 5: con.40 power cable pin assignment

a) PTC/Pt1000/KTY

Length x [mm]	Diameter y [mm]
99	46

Tab. 6: con.40 dimensions

Power cable – con.58 plug connector

Motor connection diagram	Pin	Designation	Int. motor wire color	Wire No./ wire color
	U	1U1	BK	1
	V	1V1	BU	2
	W	1W1	RD	3
	+	1BD1	RD	5
	–	1BD2	BK	6
	1	1TP1/1TP1/1K1[a)]	BK/RD/BN	7
	2	1TP2/1TP2/1K2[a)]	WH/WH/WH	8
	⏚	PE	GNYE	GNYE
	Housing	Shield	—	—

Tab. 7: con.58 power cable pin assignment

a) PTC/Pt1000/KTY

Length x [mm]	Diameter y [mm]
146	63.5

Tab. 8: con.58 dimensions

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

Tab. 9: Cable color – key

Two-colored wire:	WHYE	WHITEYELLOW (white and yellow)
Single-colored wire:	BK/BN	BLACK/BROWN (black or brown)

Tab. 10: Formatting conventions

7.2.1 Technical data

Conductor material

Ultra-fine stranded wire made of bare Cu wires in accordance with 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 cables 4 × 1.0 mm² + ...

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

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

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

For cables 4 × 4.0 mm² + ...

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

For cables 4 × 6.0 mm² + ...

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

For cables 4 × 10.0 mm² + ...

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

For cables 4 × 16.0 mm² + ...

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

For cables 4 × 25.0 mm² + ...

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

Power cores

Conductor cross-section A [mm²]	1.0	1.5	2.5	4.0	6.0	10.0	16.0	25.0
Nominal current I_N [A]	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, tables 9, 17, 15 and 20; 0.34 mm² in accordance with DIN VDE 0891, part 1

Pilot cores – brake lines and temperature sensor

Conductor cross-section A [mm²]	0.34	0.5	0.75	1.0
Nominal current I_N [A]	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/operating 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}; starting from 16 mm² = 7.5 × d_{out}

Torsional stress

± 30°/m

Bending resistance

Trailable with 5 million bending cycles at a travel speed of 120 m/min and an acceleration of 5 m/s² under optimum ambient conditions

Resistance

Oil resistant: very good in accordance with 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 in accordance with 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 imprint of "STÖBER 44214" for 1.0 mm²; "STÖBER 44211" for 1.5 mm²;
with imprint of cable manufacturer (not STÖBER) starting from 4 × 2.5 +...mm²

Shield coverage factor

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

CAB

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)) mm²
Max. 12.7 mm	(4 × 1.5 + (2 × 1.0) + (2 × 0.50)) mm²
Max. 15.3 mm	(4 × 2.5 + 2 × (2 × 1.0)) mm²
Max. 16 mm	(4 × 4.0 + (2 × 1.0) + (2 × 0.75)) mm²
Max. 19.4 mm	(4 × 6.0 + (2 × 1.5) + (2 × 1.0)) mm²
Max. 23.5 mm	(4 × 10.0 + (2 × 1.5) + (2 × 1.0)) mm²
Max. 25.5 mm	(4 × 16.0 + 2 × (2 × 1.5)) mm²
Max. 28.8 mm	(4 × 25.0 + 2 x (2 × 1.5)) mm²

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

Design

UL/CSA (E172204)

Capacitance, inductance

Capacitance in accordance with 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:	

Capacitance in accordance with VDE 0472 part 504 test type A; conductor/conductor[1]	
Conductors 10.0 mm^2	Max. 75 nF/km
Pair 1.0 mm^2	Max. 34 nF/km
Pair 1.5 mm^2	Max. 45 nF/km
Conductor cross-section 16.0 mm^2:	
Conductors 16.0 mm^2	Max. 75 nF/km
Pair 1.5 mm^2	Max. 35 nF/km
Conductor cross-section 25.0 mm^2:	
Conductors 25.0 mm^2	Values on request
Pair 1.5 mm^2	Values on request

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

[1] Details in accordance with EN 50289-1-5:2001 in preparation
[2] Details in accordance with EN 50289-1-5:2001 in preparation

Inductance in accordance with 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 in accordance with EN 50289-1-5:2001 in preparation

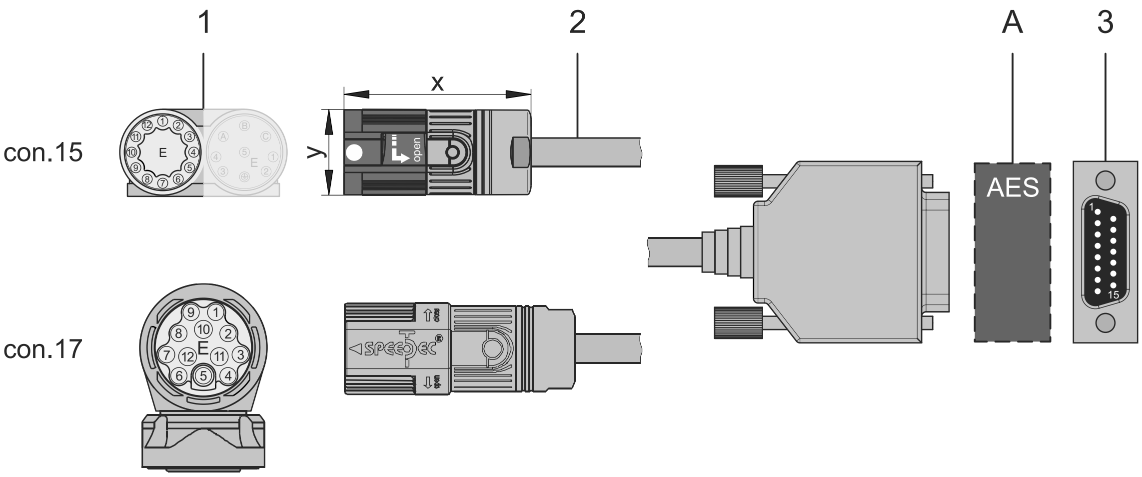
7.3 Encoder cables

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 Encoders EnDat 2.1/2.2 digital

Suitable encoder cables are described below.

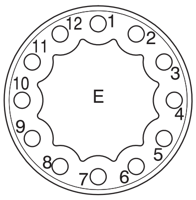


1:	Plug connector
2:	STOBER encoder cable
A:	Absolute Encoder Support (AES)
3:	D-sub X4

CAB

Encoder cable – con.15 plug connector

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

	Motor (1)			Cable (2)	X4 (3)
Connection diagram	**Pin**	**Designation**	**Wire color**	**Wire color**	**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	WHGN	BU	2
	11	—	—	—	—
	12	U_2	BNGN	RD	4
	Housing	Shield	—	—	—

Tab. 11: con.15 encoder cable pin assignment

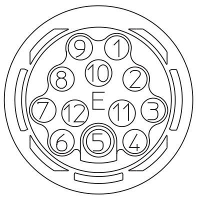
Length x [mm]	Diameter y [mm]
42	18.7

Tab. 12: con.15 dimensions

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

Encoder cable – con.17 plug connector

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

	Motor (1)			Cable (2)	X4 (3)
Connection diagram	**Pin**	**Designation**	**Wire color**	**Wire color**	**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	WHGN	BU	2
	11	—	—	—	—
	12	U_2	BNGN	RD	4
	Housing	Shield	—	—	—

Tab. 13: con.17 encoder cable pin assignment

Length x [mm]	Diameter y [mm]
56	22

Tab. 14: Dimensions – con.17 connector size

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

Tab. 15: Cable color – key

Two-colored wire:	WHYE	WHITEYELLOW (white and yellow)
Single-colored wire:	BK/BN	BLACK/BROWN (black or brown)

Tab. 16: Formatting conventions

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

7.3.1.1 Technical data

Structure

Ultra-fine stranded wire 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): pilot cores max. 350 V
Voltage (UL/CSA): pilot cores max. 300 V

Test voltage

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

Current carrying capacity

In accordance with DIN VDE 0891, part 1

Insulation resistance at 20 °C

Min. 100 MΩ × km

Limit temperature

Temperature range / operating 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 at a travel speed of 180 m/min and an acceleration of 5 m/s² under optimum ambient conditions

Resistance

Oil resistant: very good in accordance with 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 in accordance with 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 "STÖBER 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 in accordance with 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 in accordance with 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

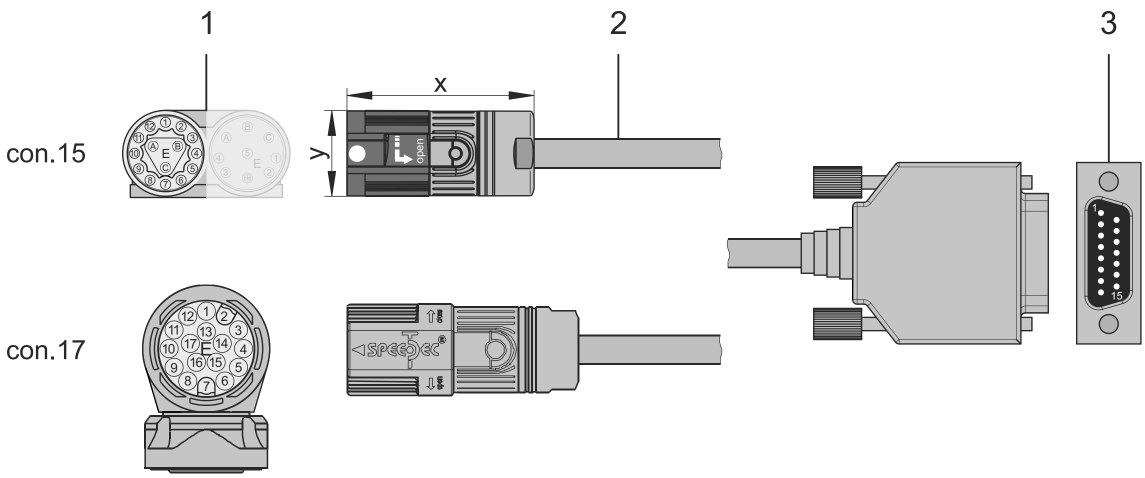
Inductance in accordance with EN 50289-1-12:2005; conductor/conductor	
Pair 0.14 mm^2	Max. 800 μH/km
Pair 0.25 mm^2	Max. 800 μH/km

[8] Details in accordance with EN 50289-1-5:2001 in preparation
[9] Details in accordance with EN 50289-1-5:2001 in preparation

CAB

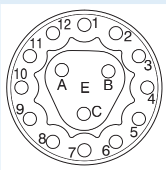
7.3.2 Encoders EnDat 2.1 sin/cos

Suitable encoder cables are described below.



1:	Plug connector
2:	STOBER encoder cable
3:	D-sub X140

Encoder cable – con.15 plug connector

Connection diagram	Motor (1) Pin	Designation	Wire color	Cable (2) Wire color	X140 (3) Pin
	1	Sense+	BU	GNRD	12
	2	Sense-	WH	GNBK	10
	3	U_2	BNGN	BNRD	4
	4	Clock+	VT	WHBK	8
	5	Clock-	YE	WHYE	15
	6	GND	WHGN	BNBU	2
	7	B+ (Sin+)	BUBK	RD	9
	8	B- (Sin-)	RDBK	OG	1
	9	Data+	GY	GY	5
	10	A+ (Cos+)	GNBK	GN	11
	11	A- (Cos-)	YEBK	YE	3
	12	Data-	PK	BU	13
	A	—	—	—	—
	B	—	—	—	—
	C	—	—	—	—
	Housing	Shield	—	—	—

Tab. 17: con.15 encoder cable pin assignment

Length x [mm]	Diameter y [mm]
42	18.7

Tab. 18: con.15 dimensions

Encoder cable – con.17 plug connector

Connection diagram	Motor (1) Pin	Designation	Wire color	Cable (2) Wire color	X140 (3) Pin
	1	Sense+	BU	GNRD	12
	2	—	—	—	—
	3	—	—	—	—
	4	Sense-	WH	GNBK	10
	5	—	—	—	—
	6	—	—	—	—
	7	U_2	BNGN	BNRD	4
	8	Clock+	VT	WHBK	8
	9	Clock-	YE	WHYE	15
	10	GND	WHGN	BNBU	2
	11	—	—	—	—
	12	B+ (Sin+)	BUBK	RD	9
	13	B- (Sin-)	RDBK	OG	1
	14	Data+	GY	GY	5
	15	A+ (Cos+)	GNBK	GN	11
	16	A- (Cos-)	YEBK	YE	3
	17	Data-	PK	BU	13
	Housing	Shield	—	—	—

Tab. 19: con.17 encoder cable pin assignment

Length x [mm]	Diameter y [mm]
56	22

Tab. 20: Dimensions – con.17 connector size

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

Tab. 21: Cable color – key

Two-colored wire:	WHYE	WHITEYELLOW (white and yellow)
Single-colored wire:	BK/BN	BLACK/BROWN (black or brown)

Tab. 22: Formatting conventions

7.3.2.1 Technical data

Conductor material

Ultra-fine stranded wire 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): pilot cores max. 100 V
Voltage (UL/CSA): pilot cores max. 30 V

Test voltage

Conductor/conductor 500 V_{eff}
Conductor/shield 500 V_{eff}

Current carrying capacity

In accordance with DIN VDE 0891, part 1

Insulation resistance at 20 °C

Min. 100 MΩ × km

Limit temperature

Temperature range/operating 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 at a travel speed of 180 m/min and an acceleration of 5 m/s² under optimum ambient conditions

Resistance

Oil resistant: very good in accordance with 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 in accordance with 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 "STÖBER 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 mm^2 + 2 x 2 x 0.14 mm^2 + 2 x (2 x 0.14 mm^2) + 2 x 0.34 mm^2)

"(...)" = Shield

Design

UL/CSA (E172204)

Capacitance, inductance

Capacitance in accordance with VDE 0472 part 504 test type A; conductor/conductor[10]	
Pair 0.14 mm^2	Max. 60 nF/km
Pair 0.25 mm^2	Max. 110 nF/km
Pair 0.37 mm^2	Max. 130 nF/km

[10] Details in accordance with EN 50289-1-5:2001 in preparation

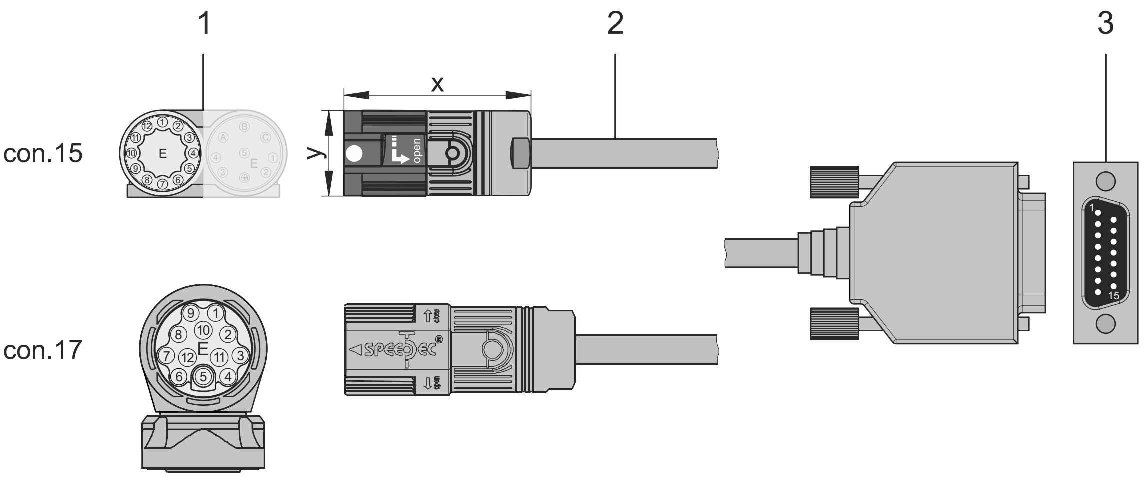
Capacitance in accordance with VDE 0472 part 504 test type B; conductor/remainder[11]	
Pair 0.14 mm²	Max. 300 nF/km
Pair 0.25 mm²	Max. 300 nF/km
Pair 0.37 mm²	Max. 325 nF/km

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 in accordance with EN 50289-1-5:2001 in preparation

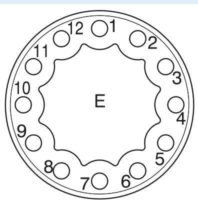
7.3.3 Resolver

Suitable resolver cables are described below.



1:	Plug connector
2:	STOBER encoder cable
3:	D-sub X4/X140

Encoder cable – con.15 plug connector

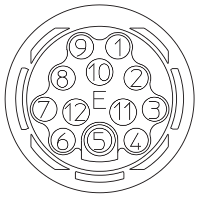
	Motor (1)			Cable (2)	X4/X140 (3)
Connection diagram	**Pin**	**Designation**	**Wire color**	**Wire color**	**Pin**
	1	S3 Cos+	BK	YE	3
	2	S1 Cos-	RD	GN	11
	3	S4 Sin+	BU	WH	1
	4	S2 Sin-	YE	BN	9
	5	—	—	—	Do not connect
	6	—	—	—	Do not connect
	7	R2 Ref+	YEWH	GY	6
	8	R1 Ref-	RDWH	PK	2
	9	—	—	—	—
	10	—	—	—	—
	11	—	—	—	—
	12	—	—	—	—
	Housing	Shield	—	—	—

Tab. 23: con.15 encoder cable pin assignment

Length x [mm]	Diameter y [mm]
42	18.7

Tab. 24: con.15 dimensions

Encoder cable – con.17 plug connector

Connection diagram	Motor (1) Pin	Motor (1) Designation	Motor (1) Wire color	Cable (2) Wire color	X4/X140 (3) 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+	YEWH	GY	6
	8	R1 Ref-	RDWH	PK	2
	9	—	—	—	—
	10	—	—	—	—
	11	—	—	—	—
	12	—	—	—	—
	Housing	Shield	—	—	—

Tab. 25: con.17 encoder cable pin assignment

Length x [mm]	Diameter y [mm]
56	22

Tab. 26: Dimensions – con.17 connector size

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

Tab. 27: Cable color – key

Two-colored wire:	WHYE	WHITEYELLOW (white and yellow)
Single-colored wire:	BK/BN	BLACK/BROWN (black or brown)

Tab. 28: Formatting conventions

7.3.3.1 Technical data

Structure

Ultra-fine stranded wire 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): pilot cores max. 350 V
Voltage (UL/CSA): pilot cores max. 300 V

Test voltage

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

Current carrying capacity

In accordance with DIN VDE 0891, part 1

Insulation resistance at 20 °C

Min. 100 MΩ × km

Limit temperature

Temperature range/ operating 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 at a travel speed of 180 m/min and an acceleration of 5 m/s² under optimum ambient conditions

Resistance

Oil resistant: very good in accordance with 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 in accordance with DIN VDE 0282, part 10)

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 "STÖBER 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 in accordance with 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 in accordance with 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

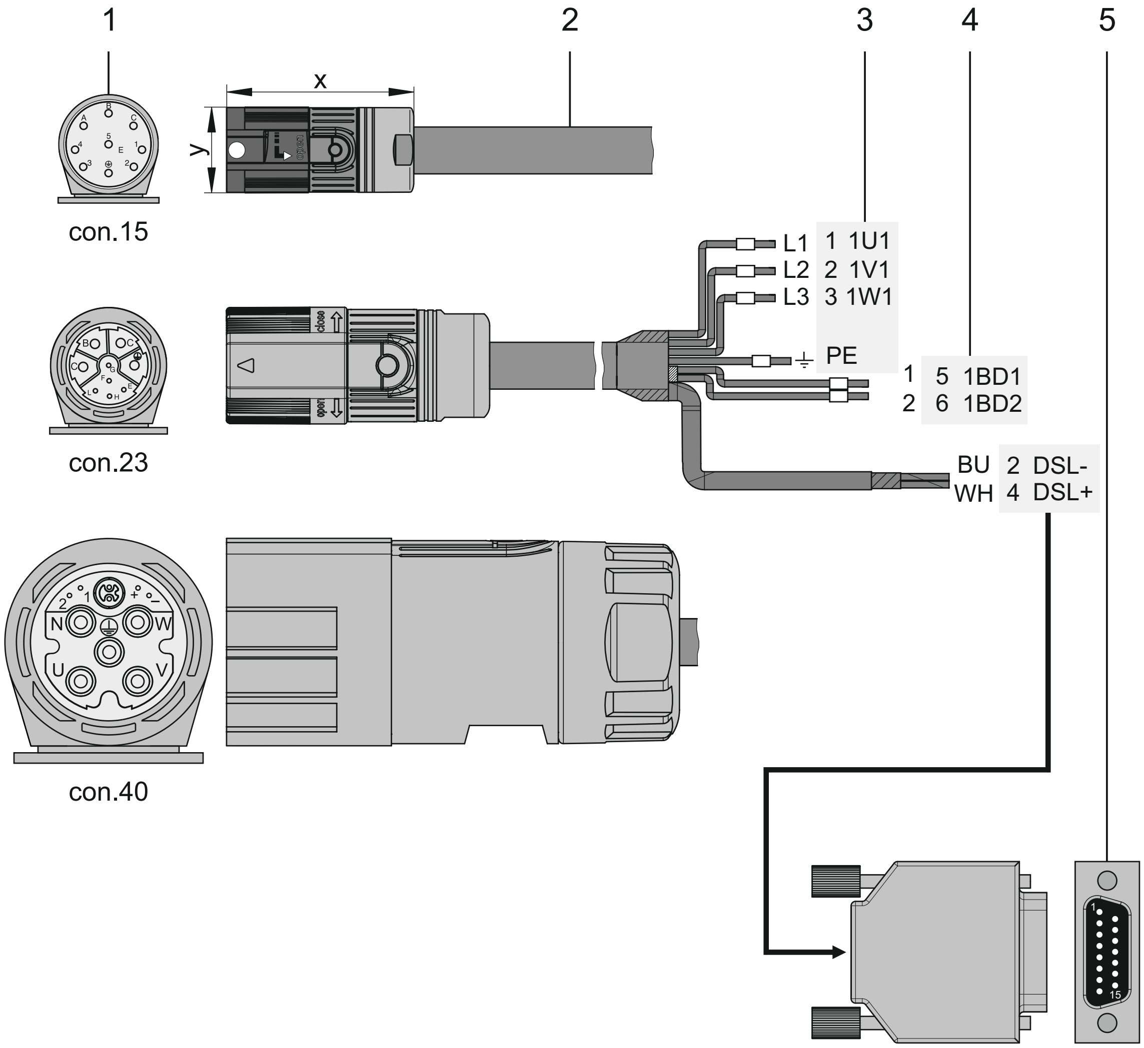
Inductance based on EN 50289-1-12:2005; conductor/conductor	
Pair 0.14 mm²	Max. 800 µH/km
Pair 0.25 mm²	Max. 800 µH/km

[12] Details in accordance with EN 50289-1-5:2001 in preparation
[13] Details in accordance with EN 50289-1-5:2001 in preparation

7.4 One Cable Solution

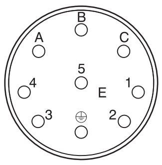
For a motor connection as a One Cable Solution (OCS) you need hybrid cables, which have the encoder communication and power transmission occurring in a shared cable. Hybrid cables are available depending on the plug size in the following designs:

- springtec quick lock for con.15
- speedtec quick lock for con.23 and con.40



1:	Plug connector
2:	STOBER hybrid cables
3:	Connection to terminal X20, motor
4:	Connection to terminal X2, supply brake
5:	D-sub X4

Hybrid cable – con.15 plug connector

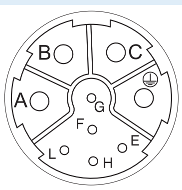
Connection diagram	Motor (1) Pin	Designa-tion	Wire color	Cable (2) Wire No./ wire color	X20 (3) Pin	X2 (4) Pin	X4 (5) Pin
	A	1U1	BK	L1	1	—	—
	B	1W1	RD	L3	3	—	—
	C	1V1	BU	L2	2	—	—
	1	1BD1	RD	1	—	5	—
	2	1BD2	BK	2	—	6	—
	3	DSL+	GY	WH	—	—	4
	4	DSL−	GN	BU	—	—	2
	5	DSL shield	—	—	—	—	Connec-tor
	⏚	PE	GNYE	GNYE	4	—	—
	Housing	Shield	—	—	Shroud	—	—

Tab. 29: con.15 hybrid cable pin assignment

Length x [mm]	Diameter y [mm]
42	18.7

Tab. 30: con.15 dimensions

Hybrid cable – con.23 plug connector

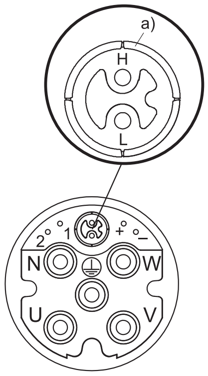
Connection diagram	Motor (1) Pin	Designa-tion	Wire color	Cable (2) Wire No./ wire color	X20 (3) Pin	X2 (4) Pin	X4 (5) Pin
	A	1U1	BK	L1	1	—	—
	B	1V1	BU	L2	2	—	—
	C	1W1	RD	L3	3	—	—
	E	DSL−	GN	BU	—	—	2
	F	DSL shield	—	—	—	—	Connec-tor
	G	1BD1	RD	1	—	5	—
	H	DSL+	GY	WH	—	—	4
	L	1BD2	BK	2	—	6	—
	⏚	PE	GNYE	GNYE	4	—	
	Hous-ing	Shield	—	—	Shroud	—	—

Tab. 31: con.23 hybrid cable pin assignment

Length x [mm]	Diameter y [mm]
78	26

Tab. 32: con.23 dimensions

Hybrid cable – con.40 plug connector

Connection diagram	Motor (1) Pin	Designation	Wire color	Cable (2) Wire No./ wire color	X20 (3) Pin	X2 (4) Pin	X4 (5) Pin
	U	1U1	BK	L1	1	—	—
	V	1V1	BU	L2	2	—	—
	W	1W1	RD	L3	3	—	—
	N	—	—	—	—	—	—
	+	1BD1	RD	1	—	5	—
	–	1BD2	BK	2	—	6	—
	F	—	—	—	—	—	—
	G	—	—	—	—	—	—
	H	DSL+	GY	WH	—	—	4
	L	DSL−	GN	BU	—	—	2
	⏚	PE	GNYE	GNYE	4	—	—
	Housing	Shield	—	—	Shroud	—	—

Tab. 33: con.40 hybrid cable pin assignment

a) Coaxial shield to which the DSL shield is connected.

Length x [mm]	Diameter y [mm]
99	46

Tab. 34: con.40 dimensions

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

Tab. 35: Cable color – key

Two-colored wire:	WHYE	WHITEYELLOW (white and yellow)
Single-colored wire:	BK/BN	BLACK/BROWN (black or brown)

Tab. 36: Formatting conventions

7.4.1 Technical data

Structure

Bare copper, term. 6 in accordance with DIN EN 60228
PP drag chain cable in accordance with UL758 (AWM) style 21223 (sheath) and style 10492 (core)

Voltage

- Nominal voltage (DIN/VDE): power cores U_0/U 600 V/1000 V
- Nominal voltage (DIN/VDE): pilot cores U_0/U 600 V/1000 V
- Voltage (UL/CSA): 1000 V_{AC}

Power cores

Conductor cross-section A [mm²]	1.0	1.5	2.5	4.0
Nominal current I_N [A]	12.5	15.0	20.0	28.3

Current carrying capacity

In accordance with DIN VDE 0891, part 1

Pilot cores – brake lines and temperature sensor

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

Test voltage (50 Hz)

Power cores: 4000 V, 5 min.
Pilot cores: 3000 V, 1 min.

Insulation resistance

Min. 500 MΩ × km

Temperature range

Free to move: −20 °C to +80 °C
Permanently installed: −40 °C to +80 °C
Moving in the drag chain, under mechanical load: −20 °C to +60 °C

Smallest permissible bending radius

Free to move: 7 x d_{out}
Permanently installed: 5 × d_{out}

Bending resistance

Min. 5 million cycles

Travel velocity

Max. 240 m/min

Acceleration

Max. 30 m/s² to 5 m travel path
Max. 15 m/s² to 10 m travel path
Max. 5 m/s² to 20 m travel path

Resistance and other properties

Oil-resistant in accordance with DIN EN 60811-404, HD 22.10 Annex A
Halogen-free in accordance with DIN VDE 0472 T.815
Silicone-free
CFC-free

Outer sheath

PUR

Conductor insulation

PP

Identification

Power cores:
Core 1: Black with imprint U/L1/C/L+
Core 2: Black with imprint V/L2
Core 3: Black with imprint W/L3/D/L−

Pilot cores:
Pair 1: Black with the numbers 1 + 2
Pair 2: White and blue

Jacket: Orange (similar to RAL 2003)

Grounding conductor: Green-yellow

Shielding

Core shielding of the pilot cores in pairs with tinned copper braid,
optical coverage ≥ 85% and metalized plastic non-woven fabric for DSL pair;
complete shielding of tinned Cu braid, optical coverage ≥ 85%

Flammability

Flame-resistant in accordance with IEC 60332-1-2, UL758 cable flame test

Conductor cross-sections

Cable diameter	Description
Max. 12.0 mm	(4G 1.0 + (2 x 0.75) C + (2 x AWG24) C2Y) C
Max. 13.5 mm	(4G 1.5 + (2 x 0.75) C + (2 x AWG22) C2Y) C
Max. 15.0 mm	(4G 2.5 + (2 x 1.0) C + (2 x AWG22) C2Y) C
Max. 16.6 mm	(4G 4 + (2 x 1.0) C + (2 x AWG22) C2Y) C

"(...)" = Shield

STOBER

CAB

7.5 Motor and power or hybrid cable combination

The assigned cable cross-sections are relative to a max. cable length of 100 m.
Cross-sections of longer cables assigned on request.
The cables 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 symbols are used in the following chapters:

Formula symbol	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

EZ motors – IC 410 convection cooling

	n_N 2000 rpm			n_N 3000 rpm			n_N 4500 rpm			n_N 6000 rpm		
	K_{EM} V/1000 rpm	Connector size	Cable-cross section mm²	K_{EM} V/1000 rpm	Connector size	Cable-cross section mm²	K_{EM} V/1000 rpm	Connector size	Cable-cross section mm²	K_{EM} V/1000 rpm	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[a)]	—	—	—
EZ803U	—	—	—	131	con.40	6.0[a)]	—	—	—	—	—	—
EZ805U	142	con.40	10.0[a)]	—	—	—	—	—	—	—	—	—

a) Power cables only

EZ motors – IC 416 forced ventilation

	n_N 2000 rpm			n_N 3000 rpm			n_N 4500 rpm			n_N 6000 rpm		
	K_{EM} V/1000 rpm	Connector size	Cable-cross section mm²	K_{EM} V/1000 rpm	Connector size	Cable-cross section mm²	K_{EM} V/1000 rpm	Connector size	Cable-cross section mm²	K_{EM} V/1000 rpm	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[a)]	—	—	—
EZ802B	—	—	—	136	con.40	6.0[a)]	90	con.40	10.0[a)]	—	—	—
EZ803B	—	—	—	131	con.40	10.0[a)]	—	—	—	—	—	—
EZ805B	142	con.58	16.0[a)]	—	—	—	—	—	—	—	—	—

a) Power cables only

EZHD motors – IC 410 convection cooling (power cables only)

	n_N 3000 rpm		
	K_{EM} V/1000 rpm	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 EZHD motors – IC 410 convection cooling (power cables only)

	n_N 3000 rpm		
	K_{EM} V/1000 rpm	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

CAB

Assignment of EZS motors – IC 410 convection cooling

	n_N 3000 rpm		
	K_{EM} V/1000 rpm	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 EZS motors – IC 416 forced ventilation

	n_N 3000 rpm		
	K_{EM} V/1000 rpm	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 EZM motors – IC 410 convection cooling (power cables only)

	n_N 3000 rpm		
	K_{EM} V/1000 rpm	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

STOBER

EZ

8 EZ synchronous servo motors

Table of contents

8.1 Overview

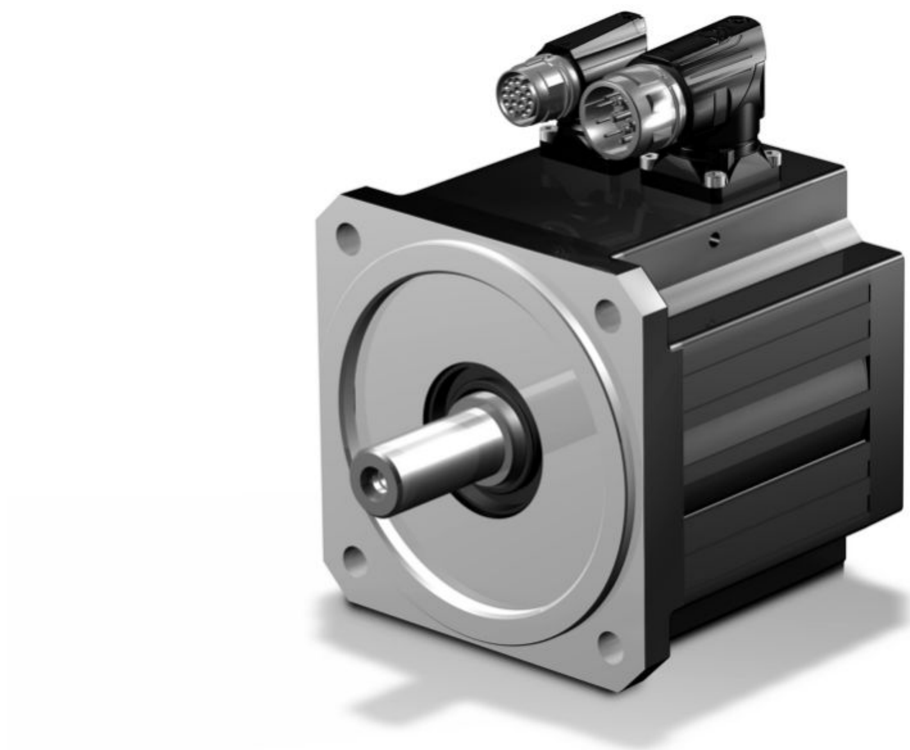
Synchronous servo motors with single tooth winding

Torques

M_N	0.89 – 77.2 Nm
M_0	0.95 – 94 Nm

Features

High dynamics	✓
Short length	✓
Super compact due to tooth-coil winding method with the highest possible copper fill factor	✓
Backlash-free holding brake (optional)	✓
Electronic nameplate for fast and reliable commissioning	✓
Convection cooling or forced ventilation (optional)	✓
Optical, inductive EnDat absolute encoders or resolvers	✓
Elimination of referencing with multi-turn absolute encoders (optional)	✓
One Cable Solution (OCS) with HIPERFACE DSL encoder (optional)	✓
Rotating plug connectors with quick lock	✓



8.2 Selection tables

The technical data specified in the selection tables applies to:

- 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
- Black matte paint as per RAL 9005

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

Motor type	Steel mounting flange dimensions (thickness x width x height)	Convection surface area Steel mounting flange
EZ3 − EZ5	23 x 210 x 275 mm	0.16 m²
EZ7 − EZ8	28 x 300 x 400 mm	0.3 m²

Note the differing ambient conditions in Chapter [▹ 8.7.3]

Formula symbol	Unit	Explanation
I_0	A	Stall current: RMS value of the line-to-line current when the stall torque M_0 is generated (tolerance ±5%)
I_{max}	A	Maximum current: RMS value of the maximum permitted line-to-line current when maximum torque M_{max} is 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 when nominal torque M_N is generated (tolerance ±5%)
J_{dyn}	10^{-4} kgm²	Mass moment of inertia of a motor in dynamic operation
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 stall torque and frictional torque to the stall 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 a resonant circuit)
m_{dyn}	kg	Weight of a motor in dynamic operation
M_0	Nm	Stall torque: The continuous torque the motor is able to deliver at a speed of 10 rpm (tolerance ±5%)
M_{max}	Nm	Maximum torque: the maximum permitted torque the motor is able to deliver over a short period (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 torque values as follows: $M_{N^*} = K_{M0} \cdot I^* - M_R$.
M_R	Nm	Frictional torque (of the bearings and seals) of a motor at winding temperature $\Delta\vartheta$ = 100 K
n_N	rpm	Nominal speed: The speed for which the nominal torque M_N is specified

Formula symbol	Unit	Explanation
P_N	kW	Nominal power: the power 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

8.2.1 EZ motors with convection cooling

Type	K_{EM} [V/1000 rpm]	n_N [rpm]	M_N [Nm]	I_N [A]	$K_{M,N}$ [Nm/A]	P_N [kW]	M_0 [Nm]	I_0 [A]	K_{M0} [Nm/A]	M_R [Nm]	M_{max} [Nm]	I_{max} [A]	R_{U-V} [Ω]	L_{U-V} [mH]	T_{el} [ms]	J_{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

8.2.2 EZ motors with forced ventilation

Type	K_{EM} [V/1000 rpm]	n_N [rpm]	M_N [Nm]	I_N [A]	$K_{M,N}$ [Nm/A]	P_N [kW]	M_0 [Nm]	I_0 [A]	K_{M0} [Nm/A]	M_R [Nm]	M_{max} [Nm]	I_{max} [A]	R_{U-V} [Ω]	L_{U-V} [mH]	T_{el} [ms]	J_{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

8.3 Torque/speed curves

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

Formula symbol	Unit	Explanation
ED	%	Duty cycle based on 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_{max}	Nm	Maximum torque: the maximum permitted torque the motor is able to deliver over a short period (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

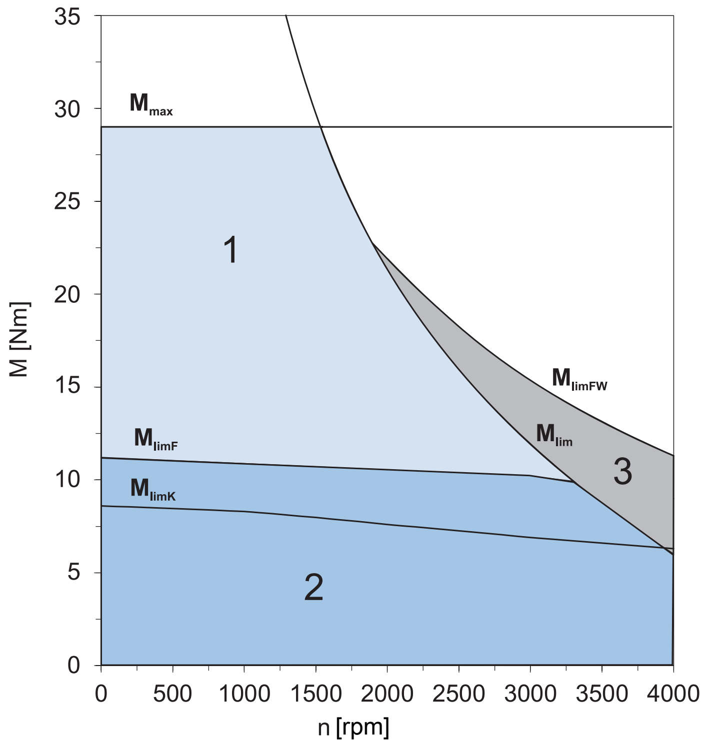
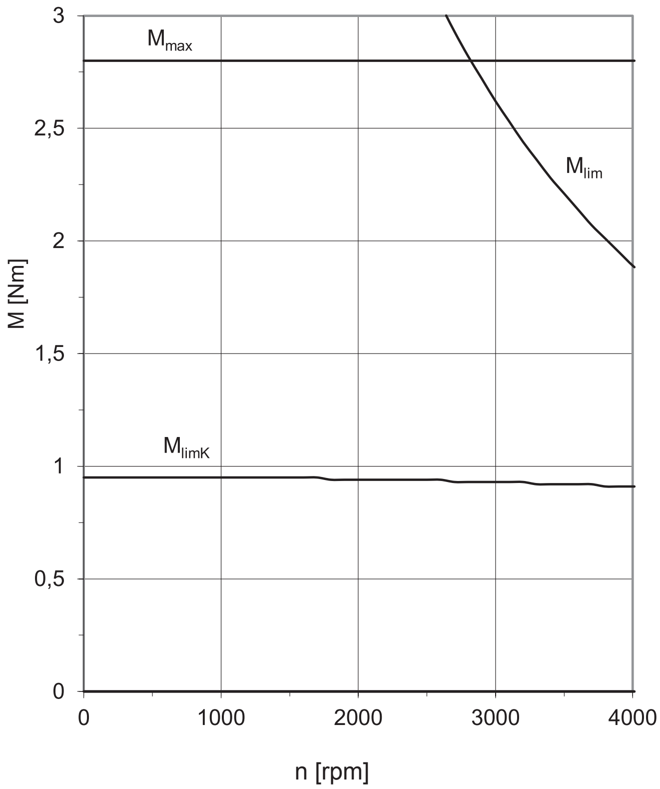


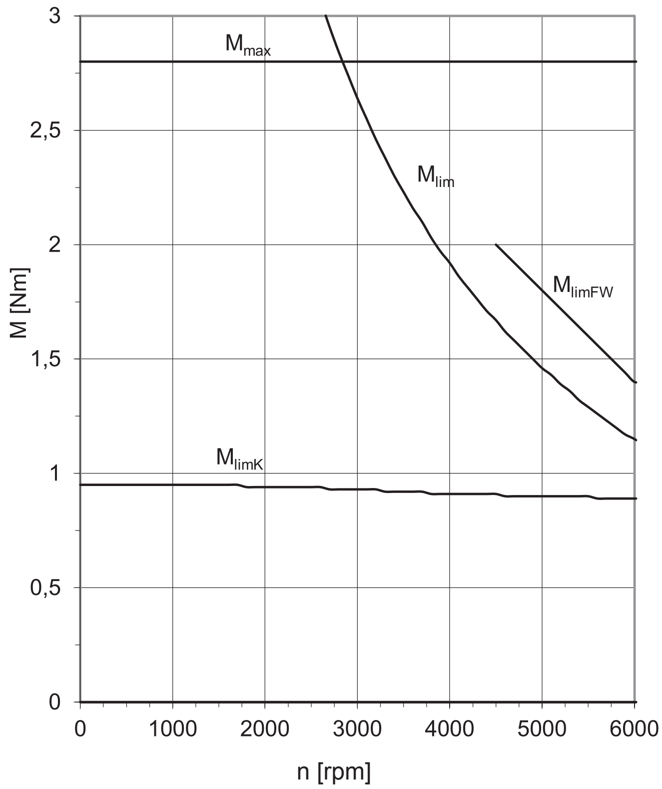
Fig. 1: Explanation of a torque/speed curve

1	Torque range for brief operation (duty cycle < 100%) with Δϑ = 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 be used only with operation on STOBER drive controllers)		

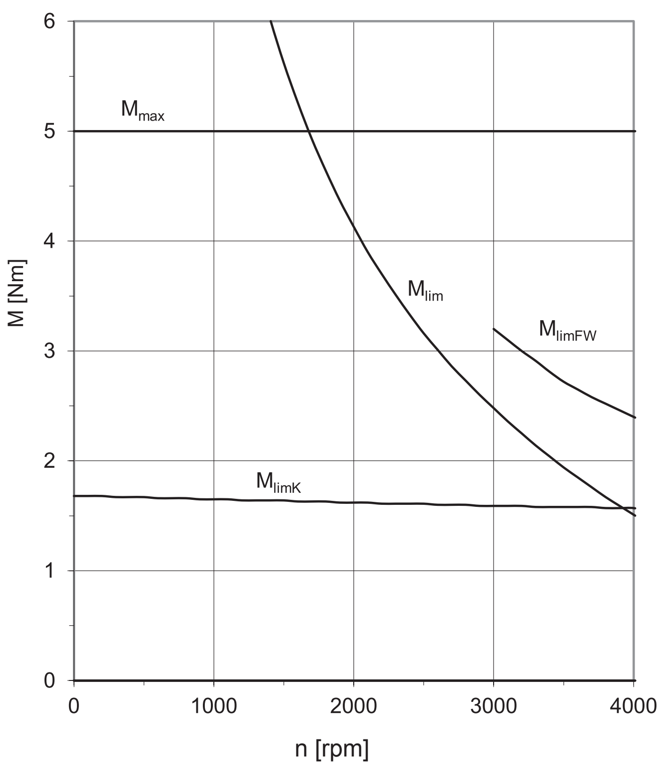
EZ301 (n_N=3000 rpm)



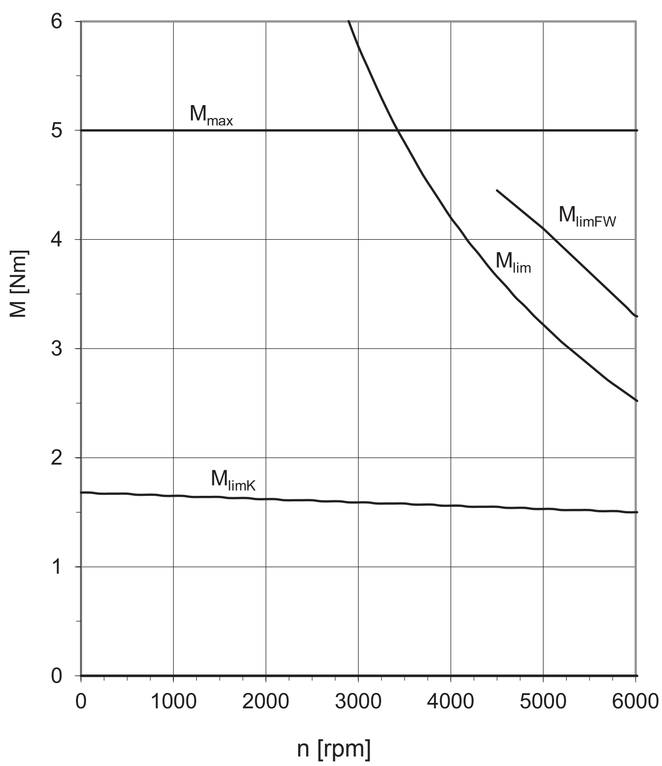
EZ301 (n_N=6000 rpm)



EZ302 (n_N=3000 rpm)



EZ302 (n_N=6000 rpm)



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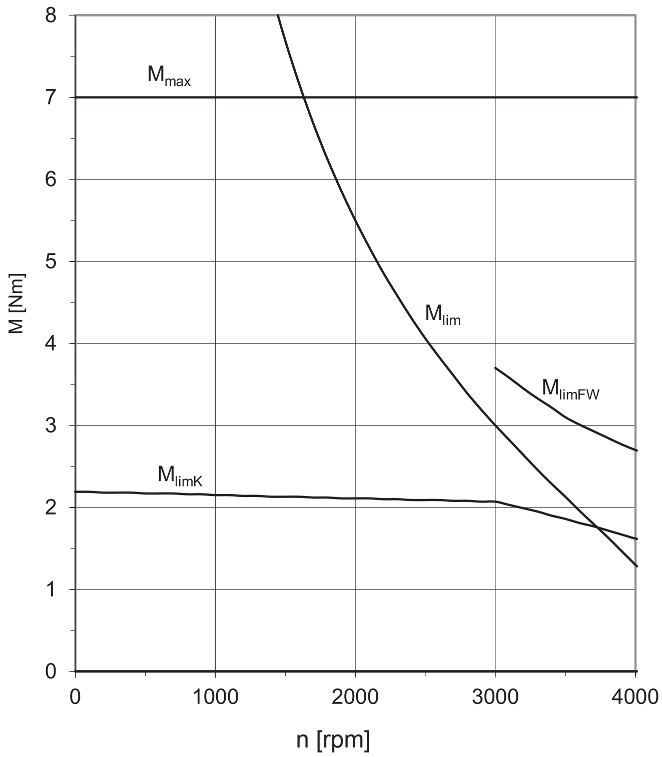
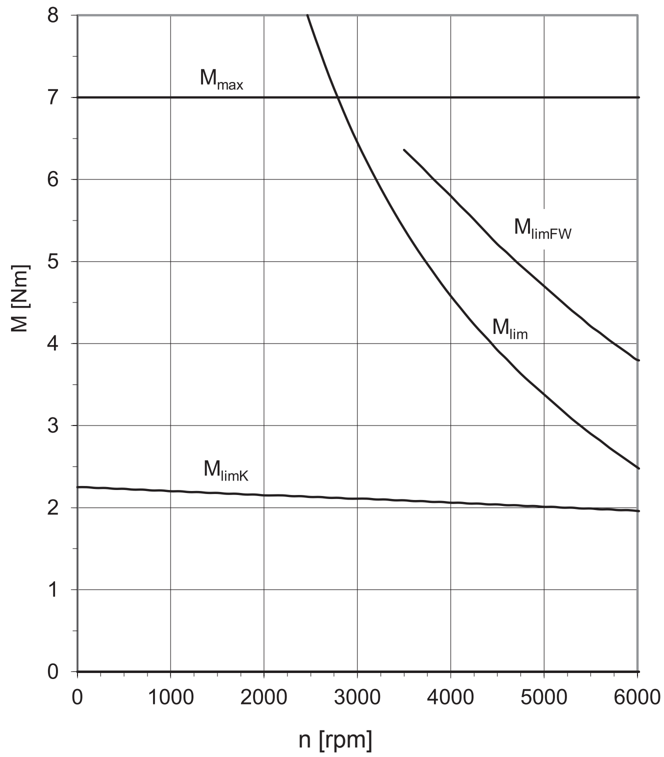
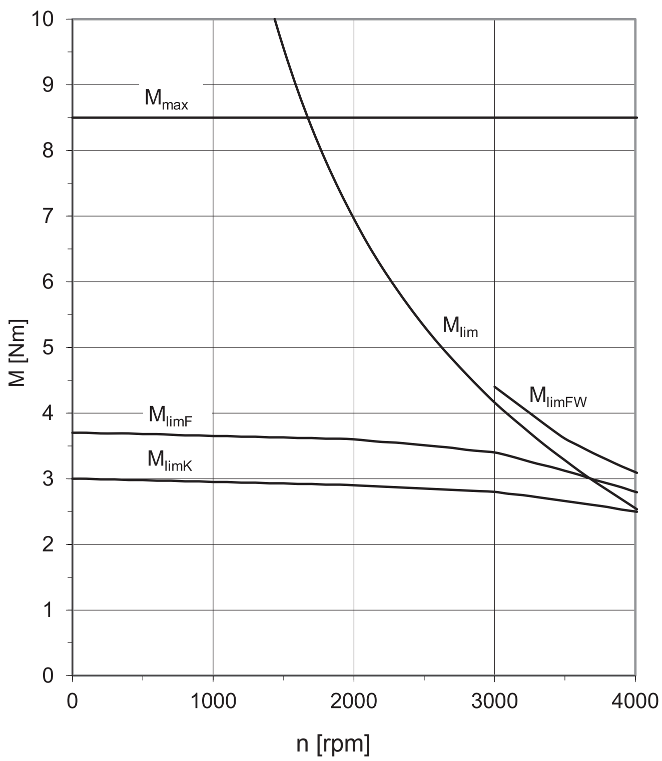
EZ303 (n_N=3000 rpm)



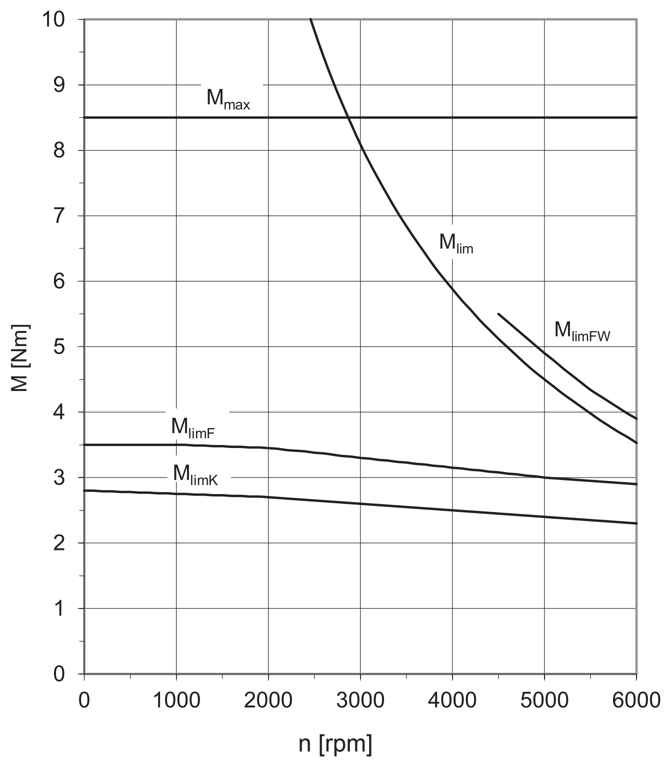
EZ303 (n_N=6000 rpm)



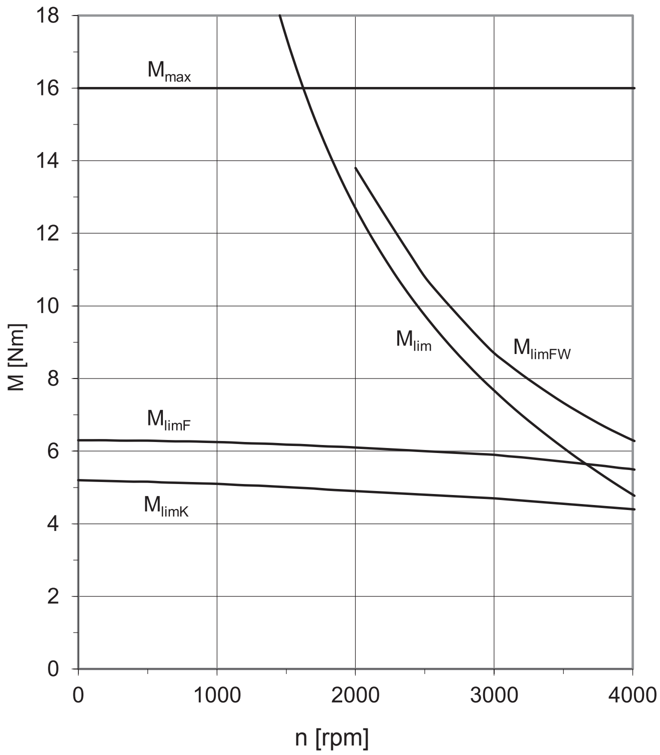
EZ401 (n_N=3000 rpm)



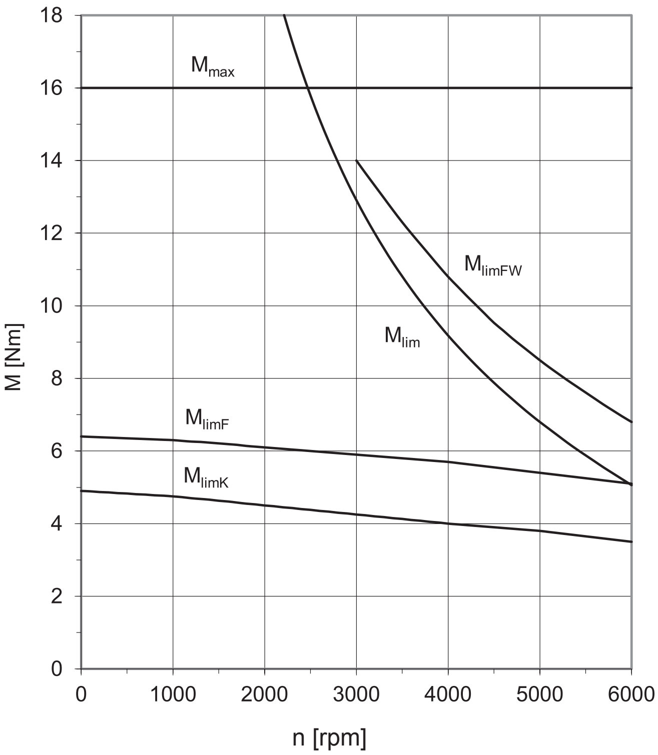
EZ401 (n_N=6000 rpm)



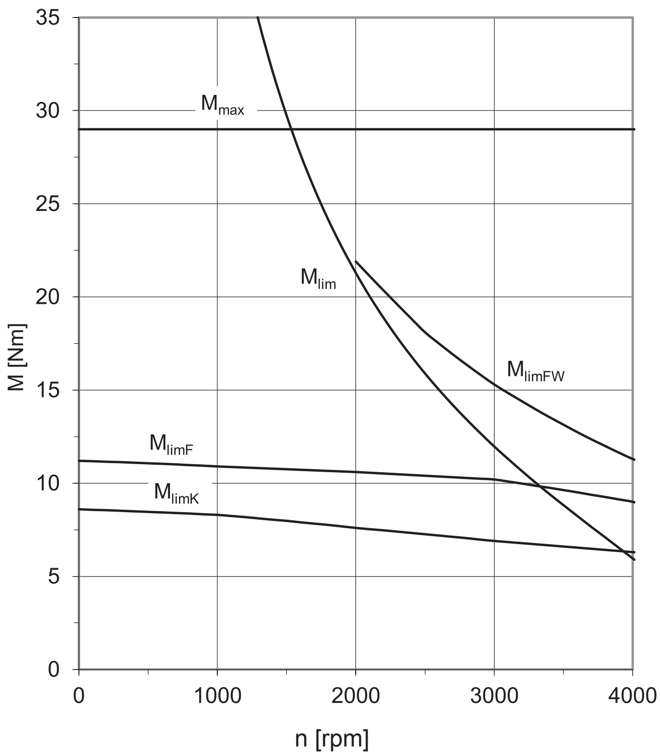
EZ402 (n_N=3000 rpm)



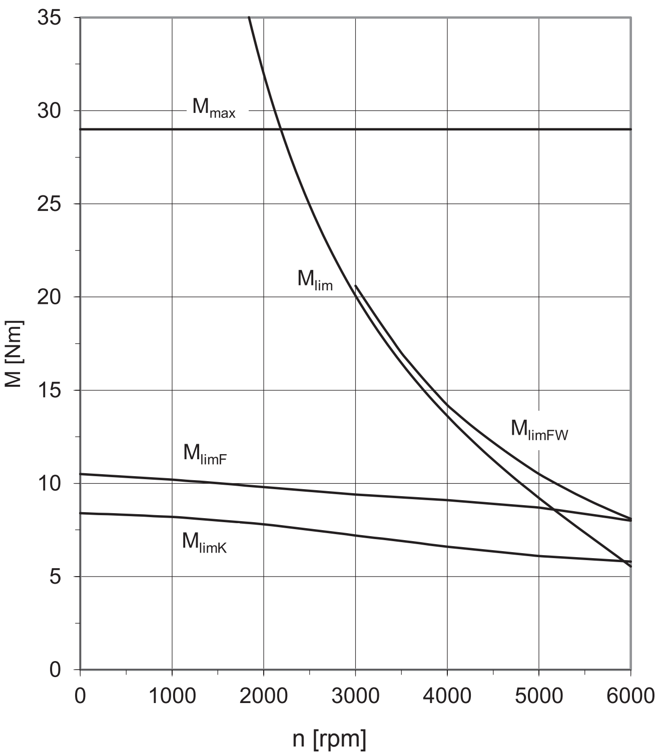
EZ402 (n_N=6000 rpm)



EZ404 (n_N=3000 rpm)



EZ404 (n_N=6000 rpm)



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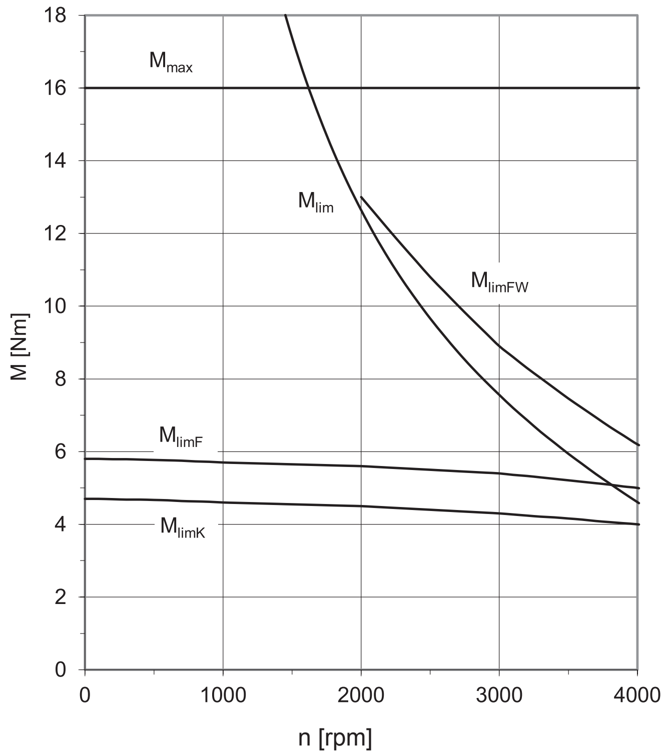
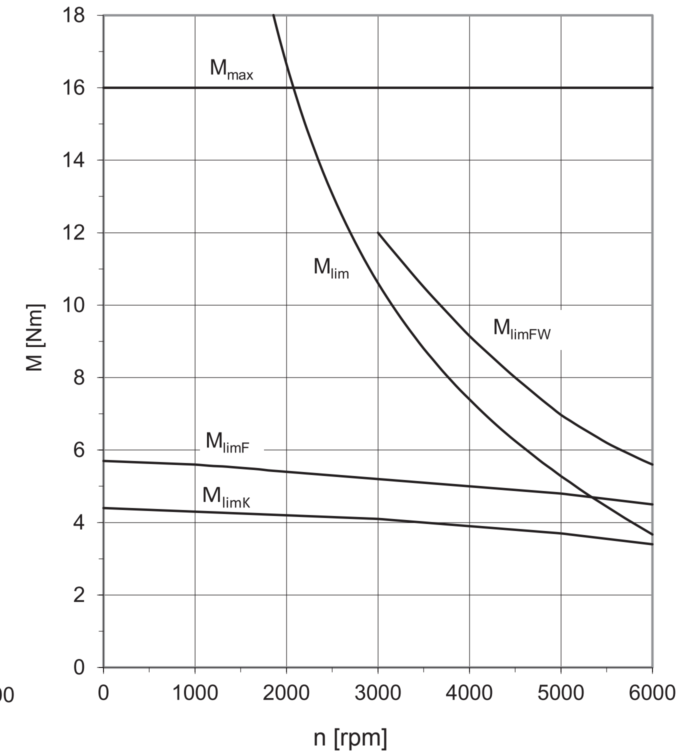
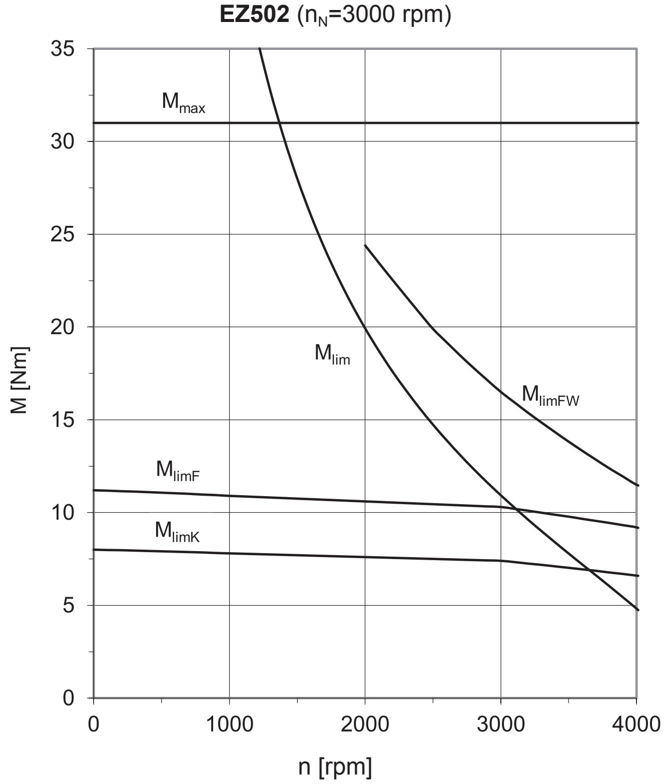
EZ501 (n_N=3000 rpm)



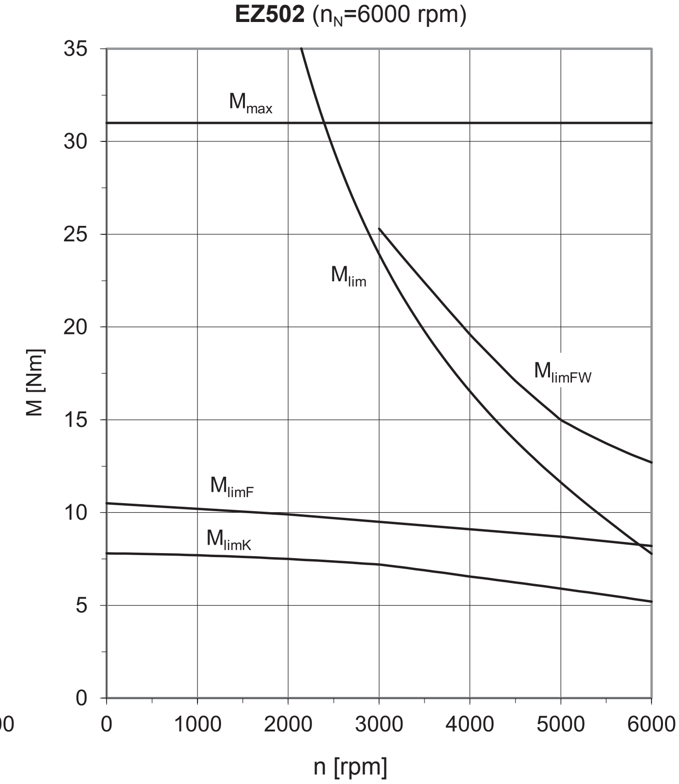
EZ501 (n_N=6000 rpm)



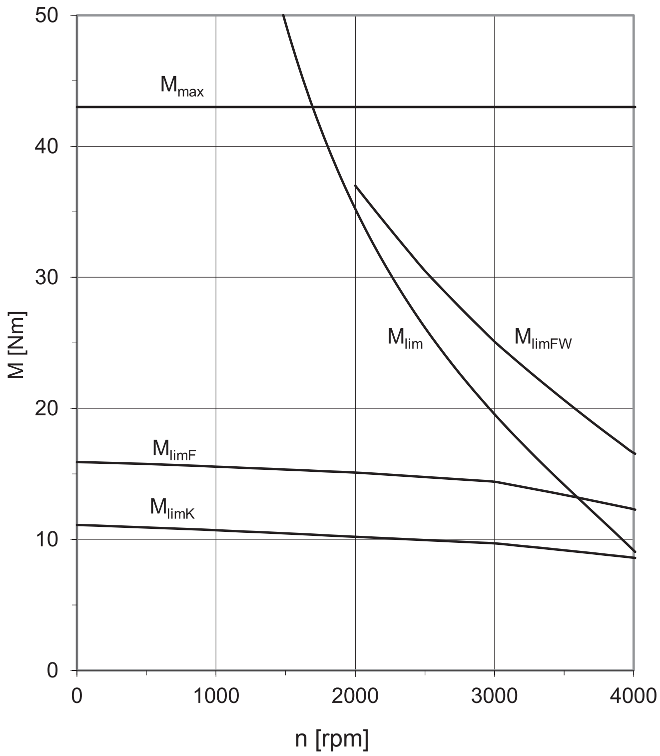
EZ502 (n_N=3000 rpm)



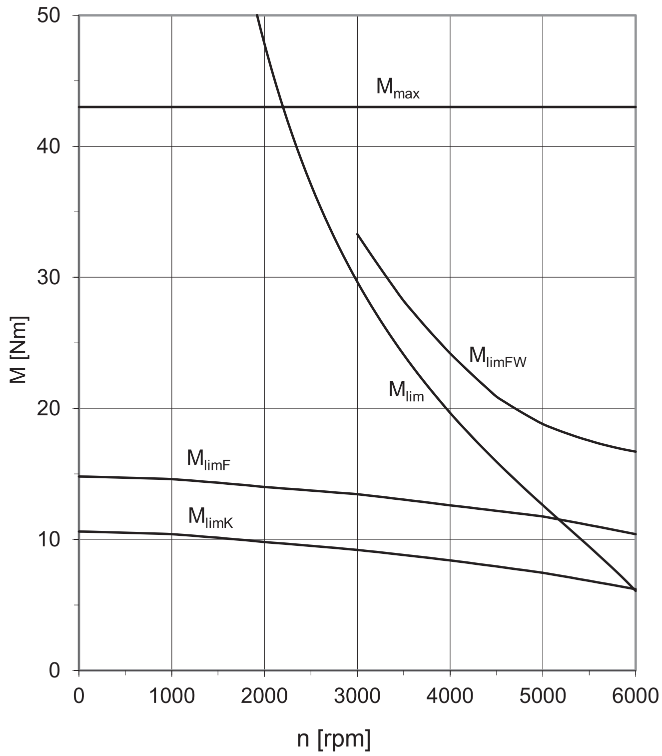
EZ502 (n_N=6000 rpm)



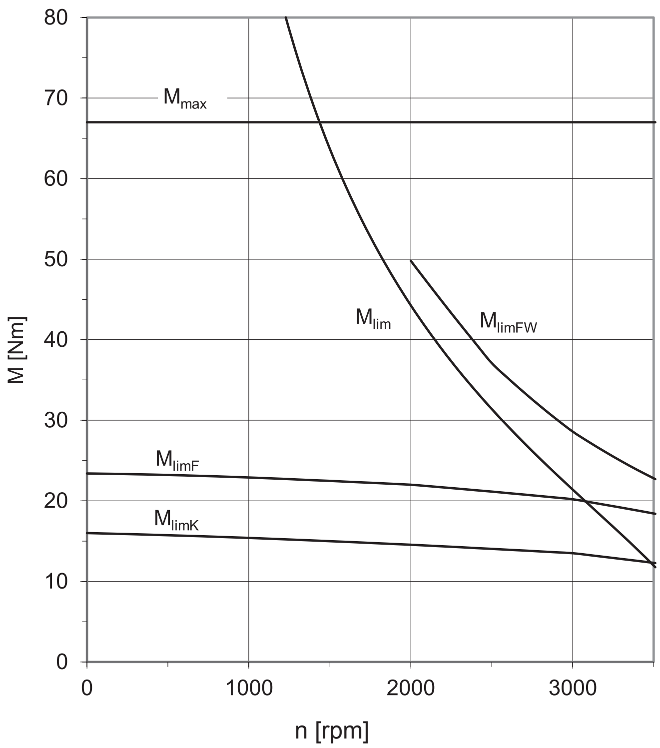
EZ503 (n_N=3000 rpm)



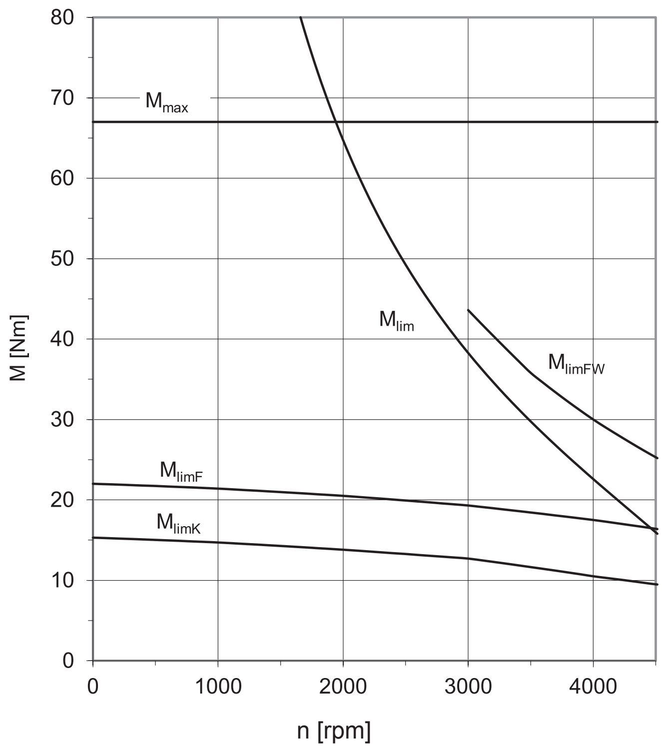
EZ503 (n_N=6000 rpm)



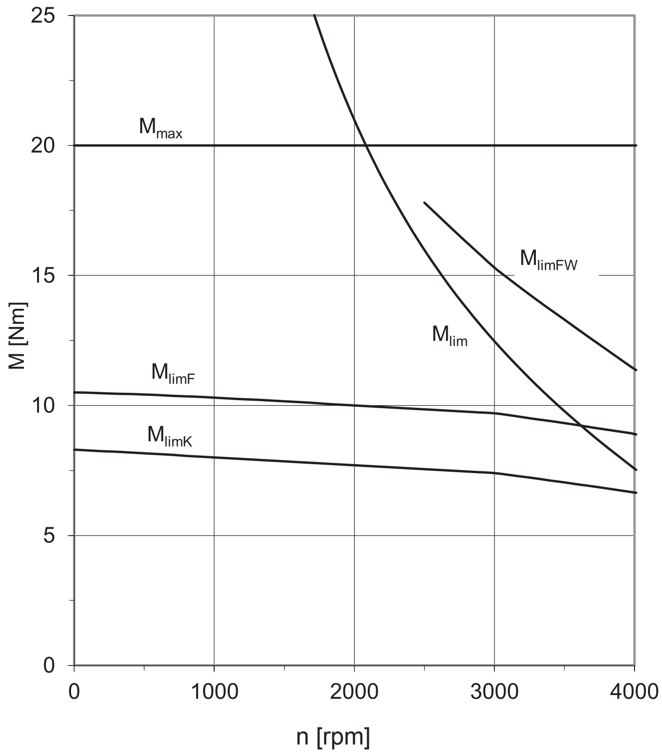
EZ505 (n_N=3000 rpm)



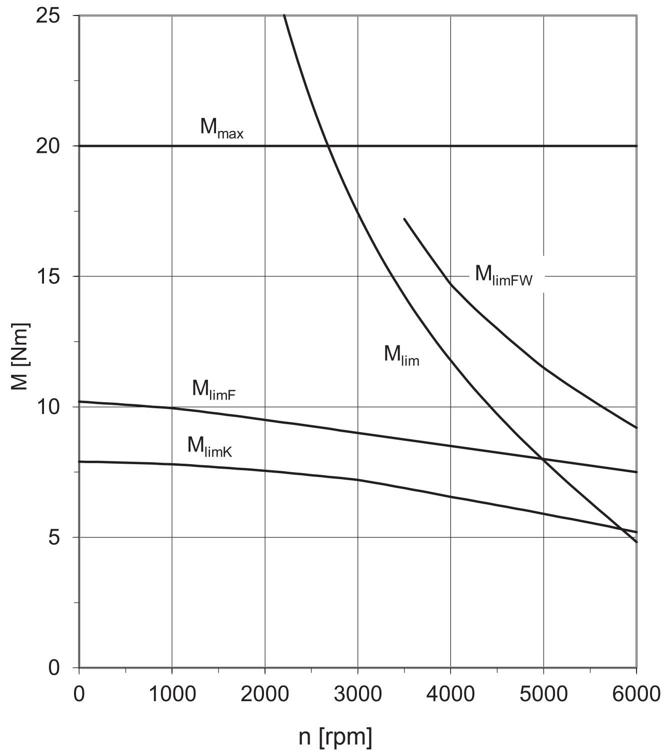
EZ505 (n_N=4500 rpm)



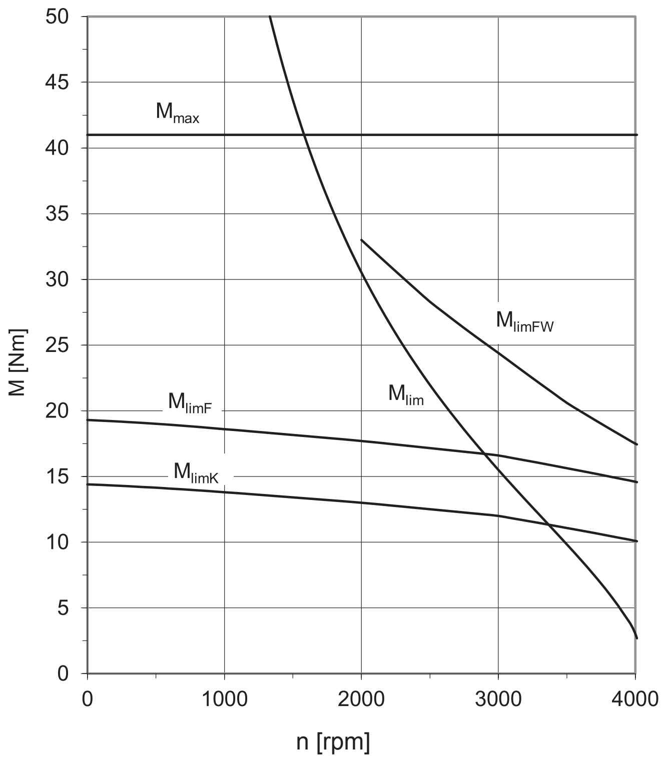
EZ701 (n_N=3000 rpm)



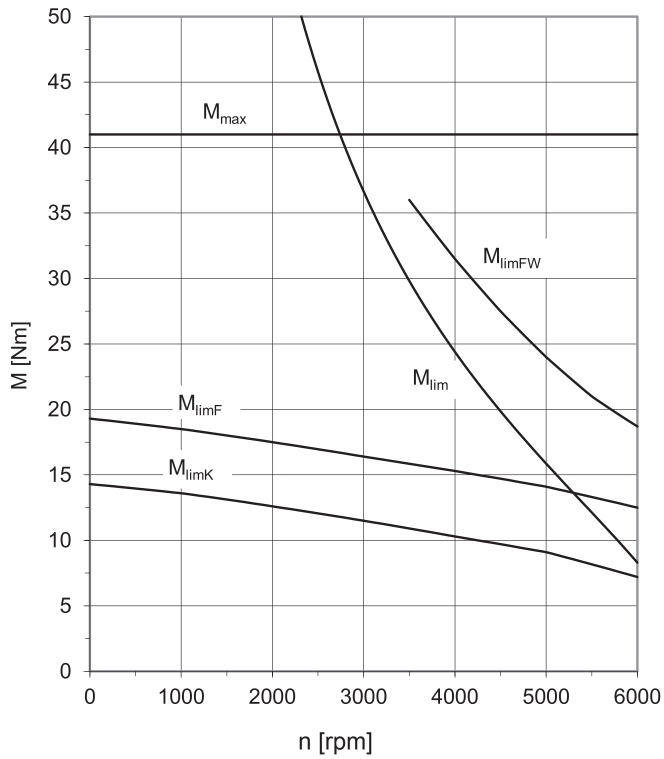
EZ701 (n_N=6000 rpm)



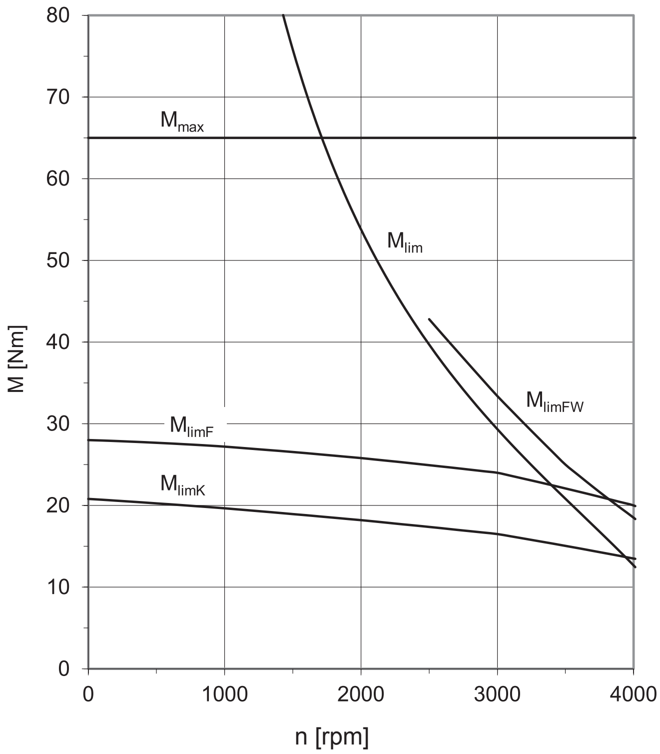
EZ702 (n_N=3000 rpm)



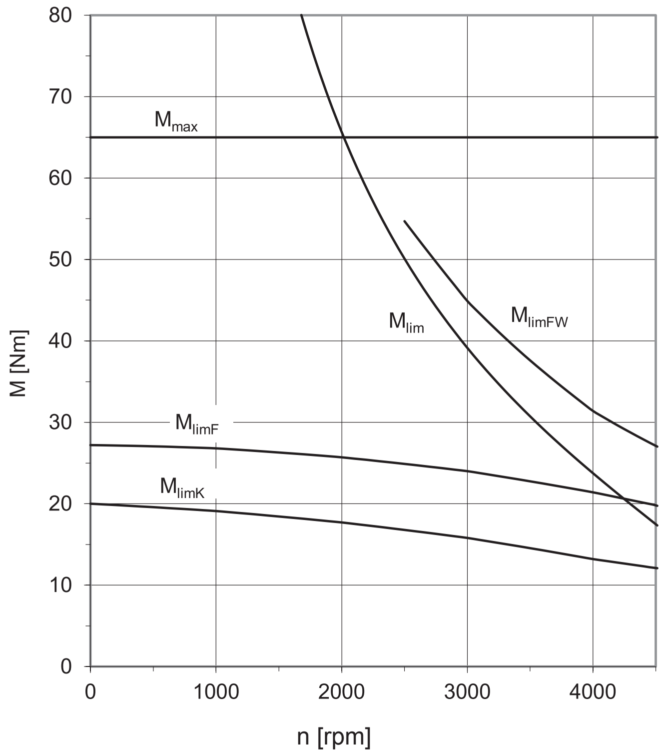
EZ702 (n_N=6000 rpm)



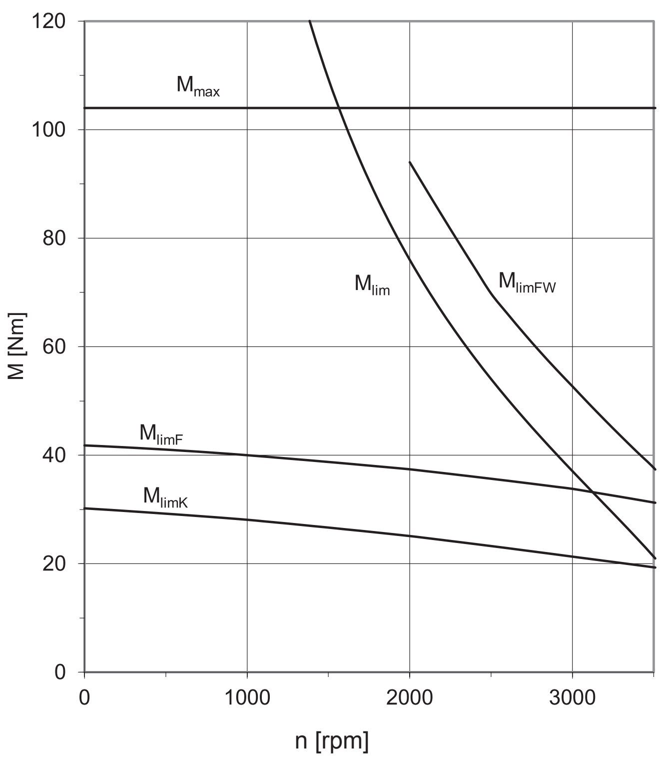
EZ703 (n_N=3000 rpm)



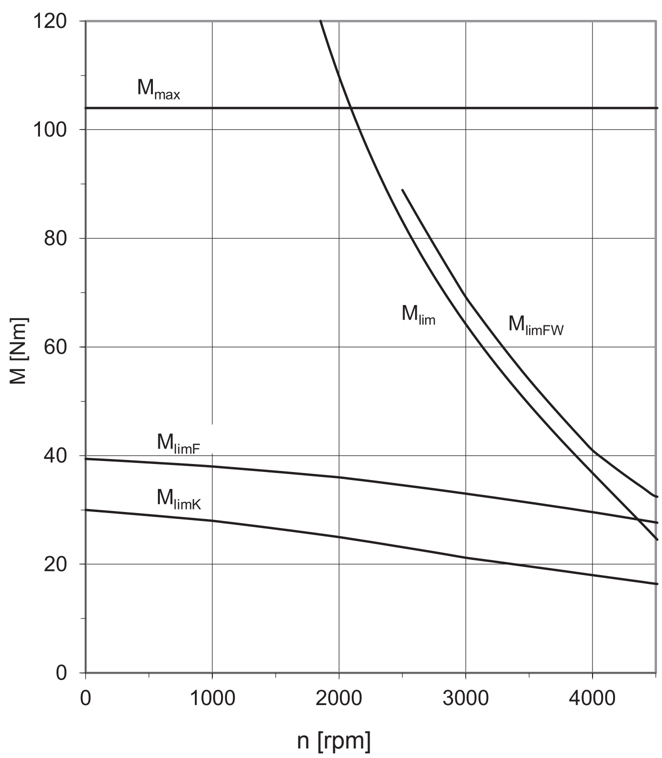
EZ703 (n_N=4500 rpm)



EZ705 (n_N=3000 rpm)



EZ705 (n_N=4500 rpm)



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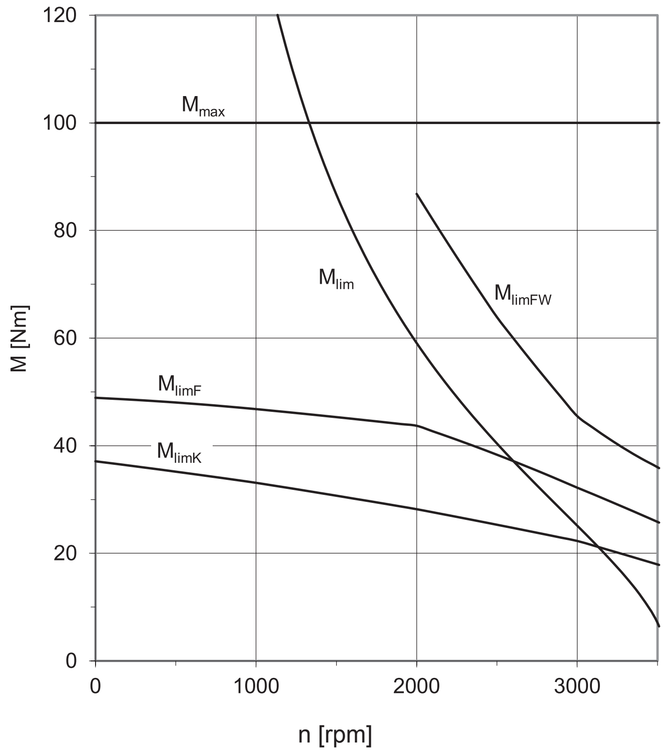
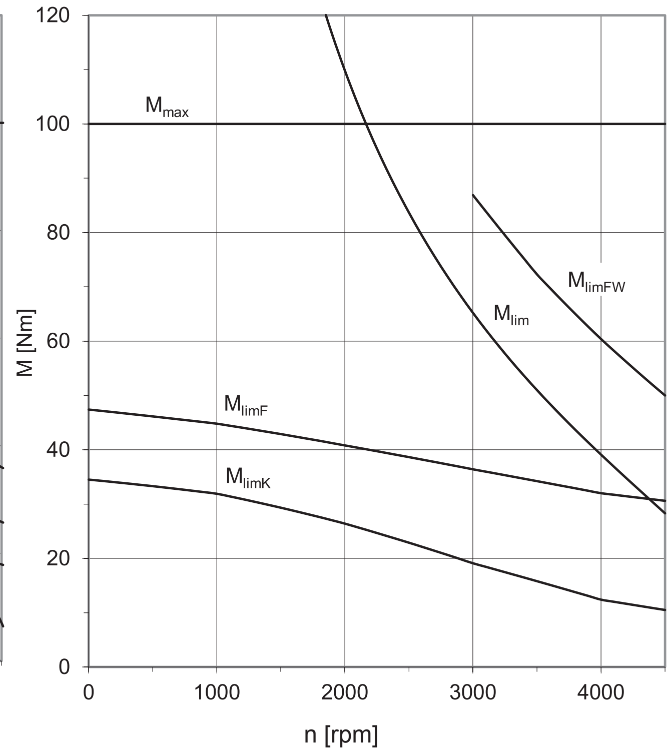
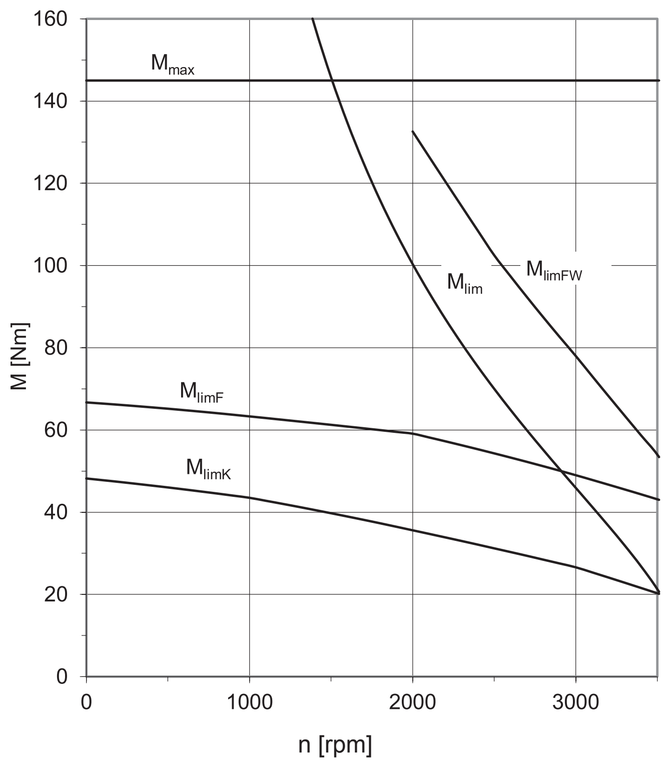
EZ802 (n_N=3000 rpm)



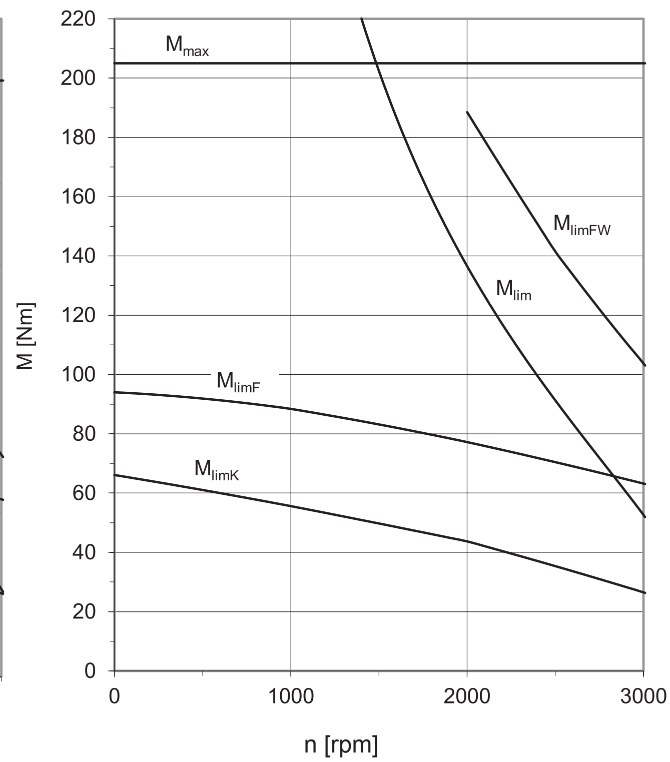
EZ802 (n_N=4500 rpm)



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

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

You can download CAD models of our standard drives at http://cad.stoeber.de.

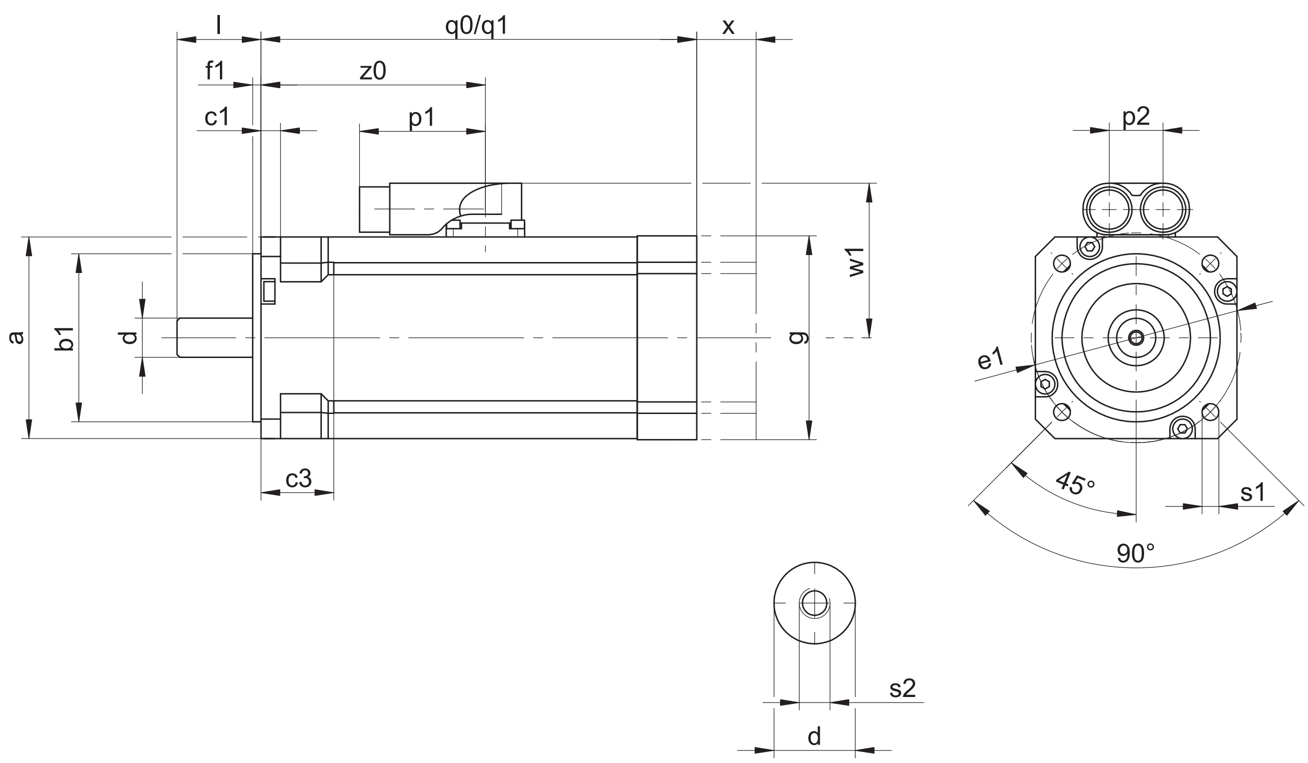
Tolerances

Solid shaft	Tolerance
Fit of shaft end Ø ≤ 50 mm	DIN 748-1, ISO k6
Fit of shaft end ∅ > 50 mm	DIN 748-1, ISO m6

Centering holes in solid shafts in accordance with DIN 332-2, DR form

Thread size	M4	M5	M6	M8	M10	M12	M16	M20	M24
Gewindetiefe	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 an 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

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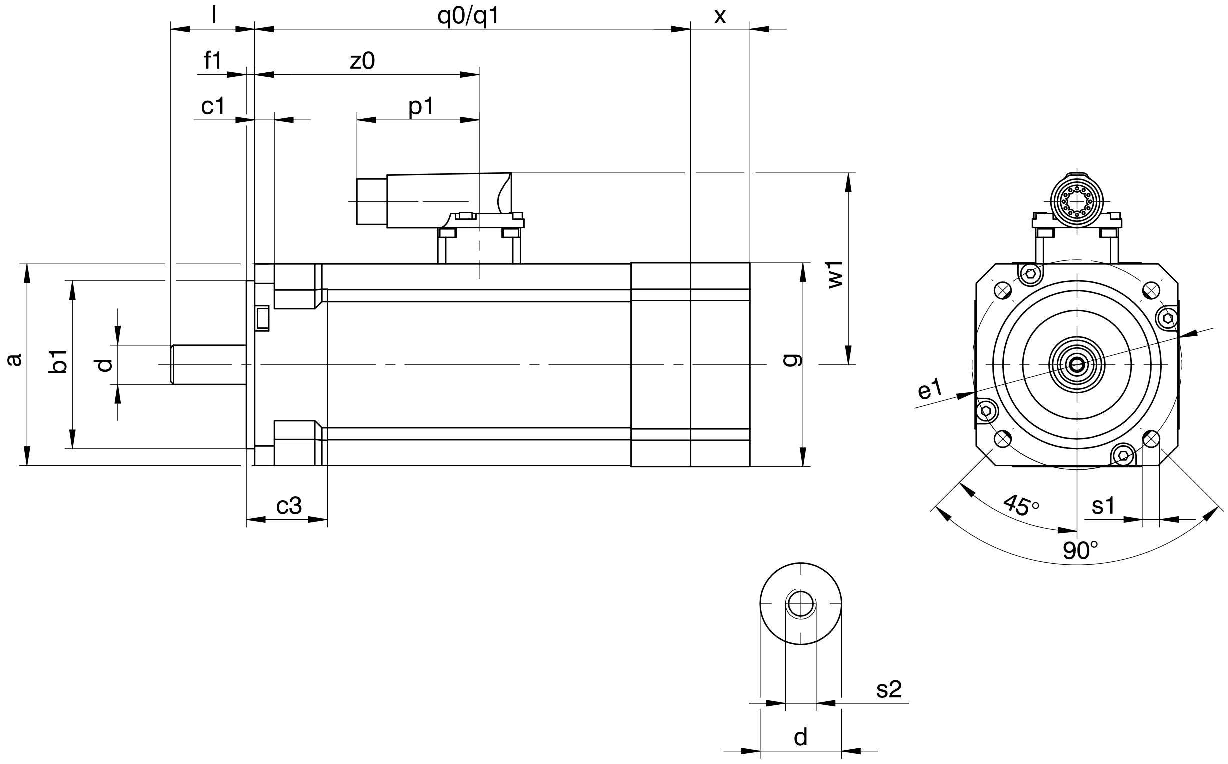
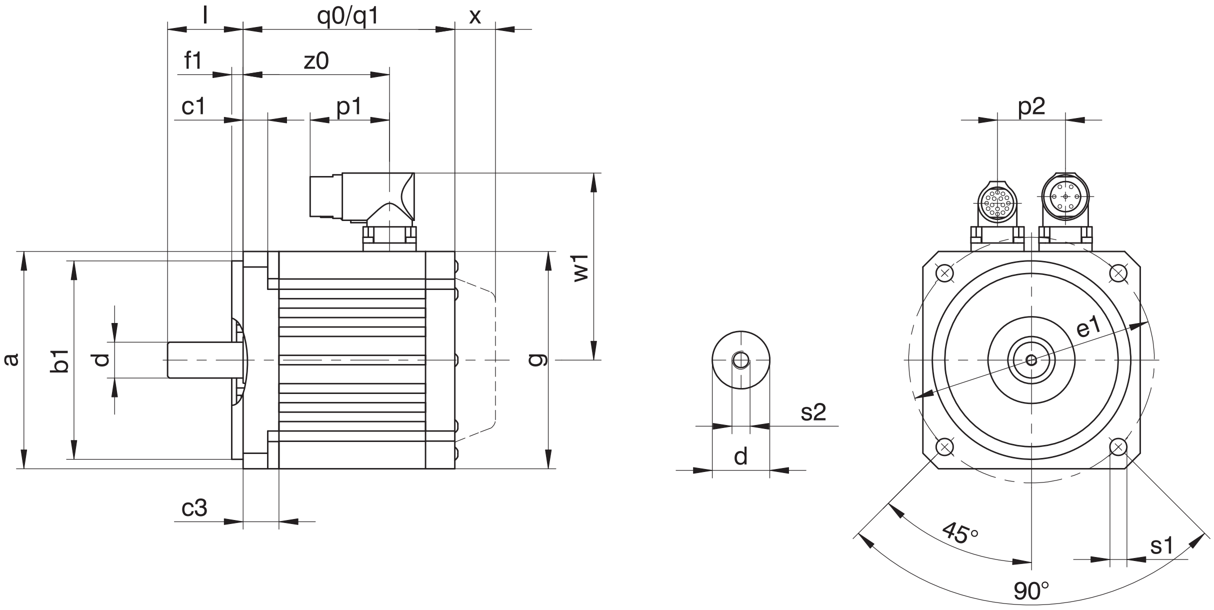
8.4.2 EZ3 motors (One Cable Solution)



q0	Applies to motors without holding brake	q1	Applies to motors with holding brake

Type	□a	∅b1	c1	c3	∅d	∅e1	f1	□g	l	p1	q0	q1	∅s1	s2	w1	x	z0
EZ301U	72	60_{j6}	7	26	14_{k6}	75	3	72	30	45	116	156	6	M5	69	21	80.5
EZ302U	72	60_{j6}	7	26	14_{k6}	75	3	72	30	45	138	178	6	M5	69	21	102.5
EZ303U	72	60_{j6}	7	26	14_{k6}	75	3	72	30	45	160	200	6	M5	69	21	124.5

8.4.3 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 an 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

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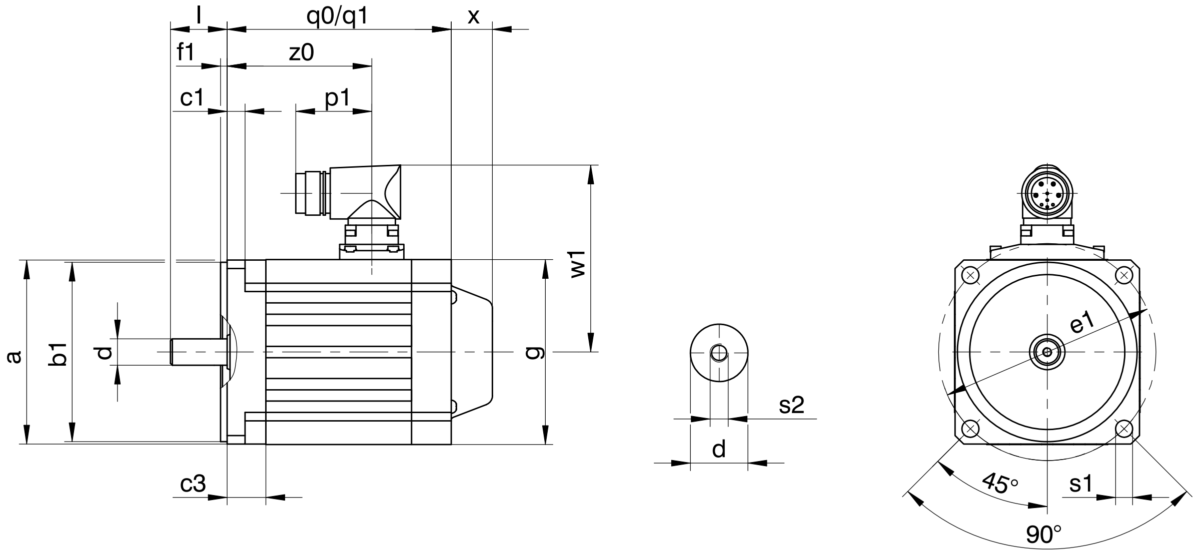
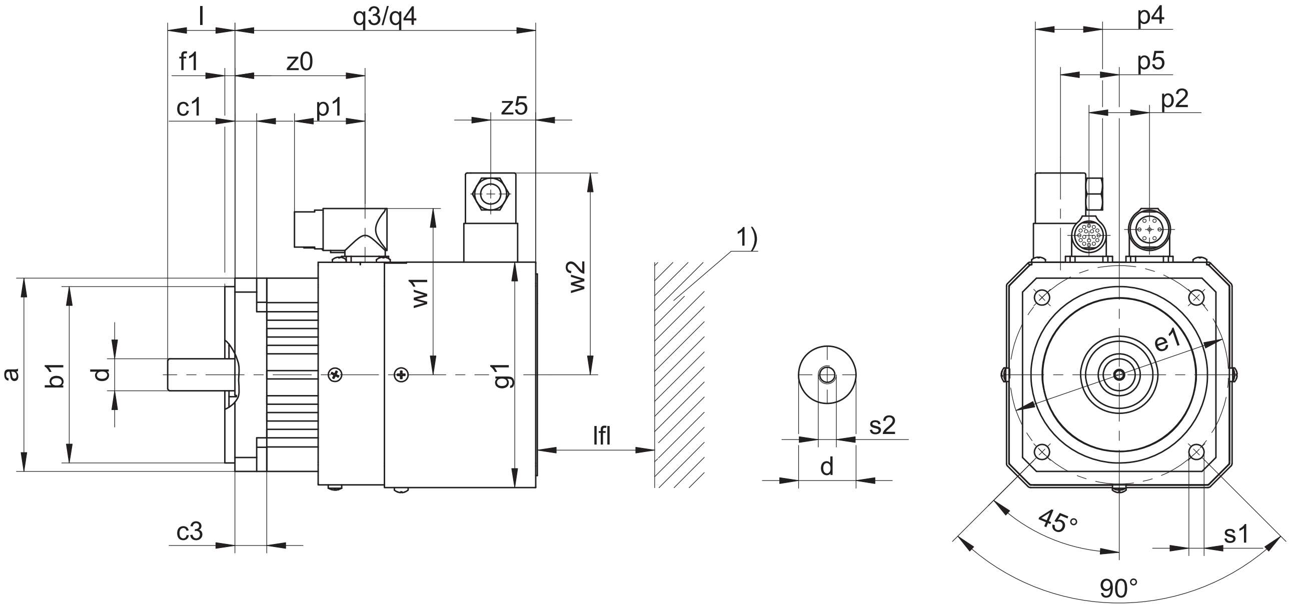
8.4.4 EZ4 – EZ8 motors with convection cooling (One Cable Solution)



q0	Applies to motors without holding brake	q1	Applies to motors with holding brake

Type	□a	∅b1	c1	c3	∅d	∅e1	f1	□g	l	p1	q0	q1	∅s1	s2	w1	x	z0
EZ401U	98	95_{j6}	9.5	20.5	14_{k6}	115	3.5	98	30	40	118.5	167.0	9	M5	99	22	76.5
EZ402U	98	95_{j6}	9.5	20.5	19_{k6}	115	3.5	98	40	40	143.5	192.0	9	M6	99	22	101.5
EZ404U	98	95_{j6}	9.5	20.5	19_{k6}	115	3.5	98	40	40	193.5	242.0	9	M6	99	22	151.5
EZ501U	115	110_{j6}	10.0	16.0	19_{k6}	130	3.5	115	40	40	109.0	163.5	9	M6	110	22	74.5
EZ502U	115	110_{j6}	10.0	16.0	19_{k6}	130	3.5	115	40	40	134.0	188.5	9	M6	110	22	99.5
EZ503U	115	110_{j6}	10.0	16.0	24_{k6}	130	3.5	115	50	40	159.0	213.5	9	M8	110	22	124.5
EZ505U	115	110_{j6}	10.0	16.0	24_{k6}	130	3.5	115	50	40	209.0	263.5	9	M8	110	22	174.5
EZ701U	145	130_{j6}	10.0	19.0	24_{k6}	165	3.5	145	50	40	121.0	180.0	11	M8	125	22	83.0
EZ702U	145	130_{j6}	10.0	19.0	24_{k6}	165	3.5	145	50	40	146.0	205.0	11	M8	125	22	108.0
EZ703U	145	130_{j6}	10.0	19.0	24_{k6}	165	3.5	145	50	40	171.0	230.0	11	M8	125	22	133.0
EZ705U	145	130_{j6}	10.0	19.0	32_{k6}	165	3.5	145	58	71	226.0	285.0	11	M12	125	22	184.0
EZ802U	190	180_{j6}	15.0	25.0	32_{k6}	215	3.5	190	58	71	222.0	299.0	13.5	M12	–	22	168.0
EZ803U	190	180_{j6}	15.0	25.0	38_{k6}	215	3.5	190	80	71	263.0	340.0	13.5	M12	–	22	209.0
EZ805U	190	180_{j6}	15.0	25.0	38_{k6}	215	3.5	190	80	71	345.0	422.0	13.5	M12	–	22	277.0

8.4.5 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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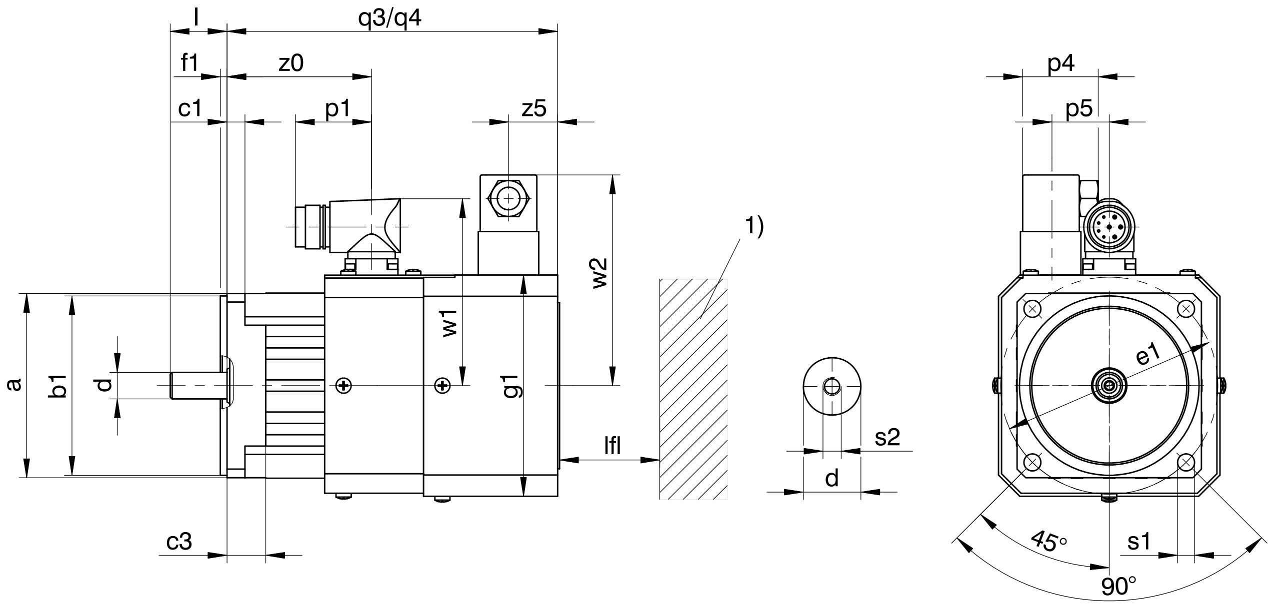
8.4.6 EZ4 – EZ8 motors with forced ventilation (One Cable Solution)



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	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	37.5	0	175	224	9.0	M5	99	111	76.5	25
EZ402B	98	95_{j6}	9.5	20.5	19_{k6}	115	3.5	118	40	20	40	37.5	0	200	249	9.0	M6	99	111	101.5	25
EZ404B	98	95_{j6}	9.5	20.5	19_{k6}	115	3.5	118	40	20	40	37.5	0	250	299	9.0	M6	99	111	151.5	25
EZ501B	115	110_{j6}	10.0	16.0	19_{k6}	130	3.5	135	40	20	40	37.5	0	179	234	9.0	M6	110	120	74.5	25
EZ502B	115	110_{j6}	10.0	16.0	19_{k6}	130	3.5	135	40	20	40	37.5	0	204	259	9.0	M6	110	120	99.5	25
EZ503B	115	110_{j6}	10.0	16.0	24_{k6}	130	3.5	135	50	20	40	37.5	0	229	284	9.0	M8	110	120	124.5	25
EZ505B	115	110_{j6}	10.0	16.0	24_{k6}	130	3.5	135	50	20	40	37.5	0	279	334	9.0	M8	110	120	174.5	25
EZ701B	145	130_{j6}	10.0	19.0	24_{k6}	165	3.5	165	50	30	40	37.5	0	213	272	11.0	M8	125	134	83.0	40
EZ702B	145	130_{j6}	10.0	19.0	24_{k6}	165	3.5	165	50	30	40	37.5	0	238	297	11.0	M8	125	134	108.0	40
EZ703B	145	130_{j6}	10.0	19.0	24_{k6}	165	3.5	165	50	30	40	37.5	0	263	322	11.0	M8	125	134	133.0	40
EZ705B	145	130_{j6}	10.0	19.0	32_{k6}	165	3.5	165	58	30	71	37.5	0	318	377	11.0	M12	125	134	184.0	40
EZ802B	190	180_{j6}	15.0	25.0	32_{k6}	215	3.5	215	58	30	71	37.5	62	322	399	13.5	M12	–	160	168.0	40
EZ803B	190	180_{j6}	15.0	25.0	38_{k6}	215	3.5	215	80	30	71	37.5	62	363	440	13.5	M12	–	160	209.0	40

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	Cooling[1]	Convection cooling Forced ventilation
D	Design	Dynamic
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)

Notes

- In Chapter [▸ 8.6.4], you can find information about available encoders.
- In Chapter [▸ 8.6.4.6], you can find information about connecting synchronous servo motors to other drive controllers from STOBER.

8.6 Product description

8.6.1 General features

Feature	Description
Design	IM B5, IM V1, IM V3 in accordance with EN 60034-7
Protection class	IP56 / IP66 (option)
Thermal class	155 (F) in accordance with EN 60034-1 (155 °C, heating $\Delta\vartheta$ = 100 K)
Surface[2]	Matte black as per RAL 9005
Cooling	IC 410 convection cooling (IC 416 convection cooling with optional forced ventilation)
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
Radial runout accuracy	Normal tolerance class in accordance with IEC 60072-1
Concentricity	Normal tolerance class in accordance with IEC 60072-1
Axial runout	Normal tolerance class in accordance with IEC 60072-1
Vibration intensity	A in accordance with EN 60034-14
Noise level	Limit values in accordance with EN 60034-9

[1] EZ3 motors only available with convection cooling
[2] Repainting the motor will change the thermal properties and therefore the performance limits.

8.6.2 Electrical features

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

Feature	Description
DC link voltage	DC 540 V (max. 620 V) on STOBER drive controllers
Winding	Three-phase, single-tooth coil design
Circuit	Star, center not led through
Protection class	I (protective grounding) in accordance with EN 61140
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 chapter. Information about differing ambient conditions can be found in Chapter [▸ 8.7.3].

Feature	Description
Surrounding temperature for transport/storage	−30 °C to +85 °C
Surrounding temperature for operation	−15 °C to +40 °C
Installation altitude	≤ 1000 m above sea level
Shock load	≤ 50 m/s² (5 g), 6 ms in accordance with EN 60068-2-27

Notes

- STOBER synchronous servo motors are not suitable for potentially explosive atmospheres in accordance with (ATEX) Directive2014/34/EU.
- Secure 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 by shock loading.
- Also take into consideration the shock load of the motor due to output units (such as gear units and pumps) which are coupled with the motor.

8.6.4 Encoders

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

8.6.4.1 Encoder measuring method selection tool

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

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

8.6.4.2 Selection tool for EnDat interface

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

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

8.6.4.3 EnDat encoders

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

Encoders with EnDat 2.2 interface

Encoder type	Type code	Measuring method	Recordable revolutions	Resolution	Position values per revolution
EQI 1131 FMA	M4	Inductive	4096	19 bit	524288
EQI 1131	Q6	Inductive	4096	19 bit	524288
EBI 1135	B0	Inductive	65536	18 bit	262144
EQN 1135 FMA	M3	Optical	4096	23 bit	8388608
EQN 1135	Q5	Optical	4096	23 bit	8388608
ECN 1123 FMA	M1	Optical	–	23 bit	8388608
ECN 1123	C7	Optical	–	23 bit	8388608
ECI 1118-G2	C5	Inductive	–	18 bit	262144

Encoders with EnDat 2.1 interface

Encoder type	Type code	Measuring method	Recordable revolutions	Resolution	Position values per revolution	Periods per revolution
EQN 1125 FMA	M2	Optical	4096	13 bit	8192	Sin/Cos 512
EQN 1125	Q4	Optical	4096	13 bit	8192	Sin/Cos 512
ECN 1113 FMA	M0	Optical	–	13 bit	8192	Sin/Cos 512
ECN 1113	C6	Optical	–	13 bit	8192	Sin/Cos 512

Notes

- The encoder type code is a part of the type designation of the motor.
- FMA = Version with fault elimination for mechanical coupling.
- The EBI 1135 encoder requires an external buffer battery so that absolute position information is retained after the power supply is turned off (AES option for STOBER drive controllers).
- Multiple revolutions of the motor shaft can be recorded only using multi-turn encoders.

8.6.4.4 HIPERFACE DSL encoders

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

The One Cable Solution offers the following advantages:

- Significantly reduced wiring effort by eliminating the encoder cable
- Significantly reduced space requirements by eliminating the encoder plug connector
- Transmission of measured values from the temperature sensor using the HIPERFACE DSL protocol

The encoder has the following features:

Encoder type	Type code	Measuring method	Recordable revolutions	Resolution	Position values per revolution
EKM36	H3	Optical	4096	20 bit	1048576

8.6.4.5 Resolver

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

Feature	Description
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

8.6.4.6 Possible combinations with drive controllers

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

Drive controller		**SDS 5000**	**MDS 5000**	**SDS 5000/ MDS 5000**	**SD6**		**SI6**		
Drive controller type code		AA	AB	AC	AD	AE	AP	AQ	AS
Connection plan ID		442305	442306	442307	442450	442451	442771	442772	442788
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	✓	✓	✓	✓	✓	–	–	–
ECN 1113	C6	✓	✓	✓	✓	✓	–	–	–
EKM36	H3	–	–	–	–	–	–	–	✓
Resolver	R0	✓	✓	–	–	✓	–	✓	–

Notes

- The drive controller and encoder type codes are a part of the type designation of the motor (see the "Type designation" chapter).

8.6.5 Temperature sensor

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

Some encoders have their own integrated analysis electronics for temperature monitoring with warning and shut-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 instance where an encoder with internal temperature monitoring forces the motor to shut down, even before the motor has reached its nominal data.

You can find information about the electrical connection of the temperature sensor in the "Connection 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 triple thermistor in accordance with DIN 44082 that allows the temperature of each winding phase to be monitored.

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

Feature	Description
Nominal response temperature ϑ_{NAT}	145 °C ± 5 K
Resistance R −20 °C up to ϑ_{NAT} − 20 K	≤ 250 Ω
Resistance R with ϑ_{NAT} − 5 K	≤ 550 Ω
Resistance R with ϑ_{NAT} + 5 K	≥ 1330 Ω
Resistance R with ϑ_{NAT} + 15 K	≥ 4000 Ω
Operating voltage	≤ DC 7.5 V
Thermal response time	< 5 s
Thermal class	155 (F) in accordance with EN 60034-1 (155 °C, heating Δϑ = 100 K)

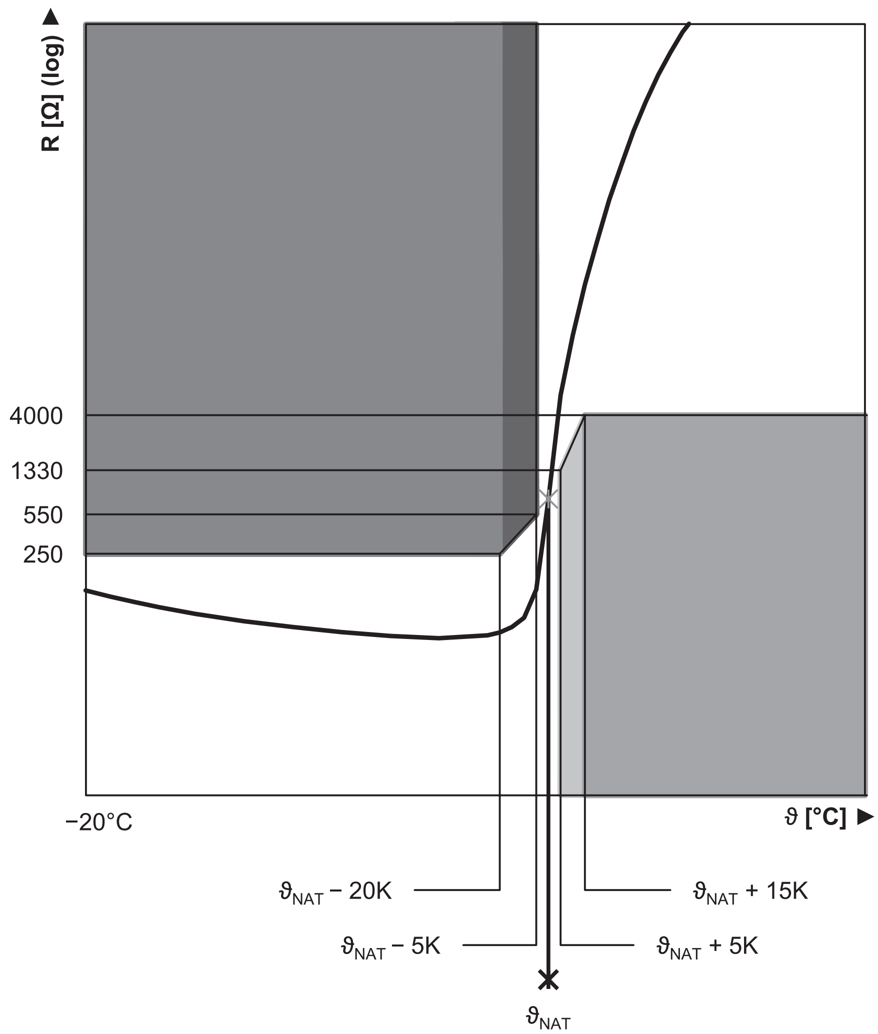


Fig. 2: PTC thermistor curve (single thermistor)

8.6.5.2 Pt1000 temperature sensor

STOBER synchronous servo motors are available in versions with a Pt1000 temperature sensor. The Pt1000 is a temperature-dependent resistor that has a resistance curve with a linear relationship with temperature. As a result, the Pt1000 allows for measurements of the winding temperature. These measurements are limited to one phase of the motor winding, however. In order to adequately protect the motor from exceeding the maximum permitted winding temperature, use a i²t model in the drive controller to monitor the winding temperature.

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

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

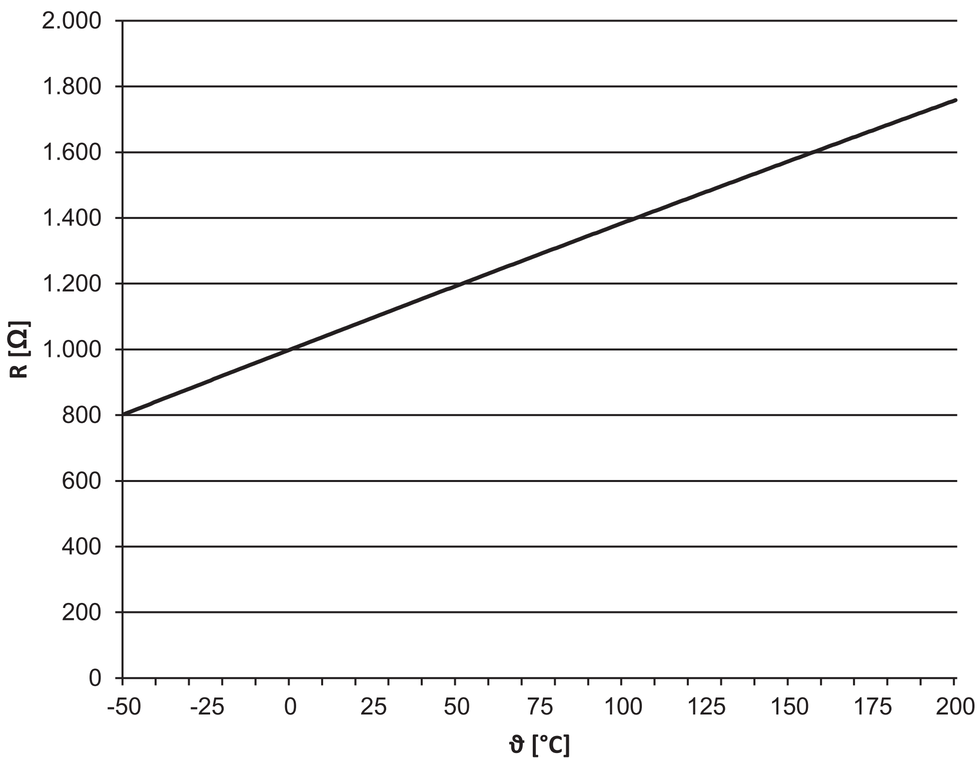


Fig. 3: Pt1000 temperature sensor characteristic curve

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. Optionally, forced ventilation can be used to cool the motor.

8.6.6.1 Forced ventilation

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

The performance data for motors with forced ventilation can be found in Chapter [▸ 8.2.2] and the dimensional drawings in Chapter [▸ 8.4.5].

Formula symbol	Unit	Explanation
$I_{N,F}$	A	Nominal current of the forced ventilation unit
$L_{pA,F}$	dBA	Noise level of the forced ventilation unit in the optimal operating range
m_F	kg	Weight of the forced ventilation unit
$P_{N,F}$	W	Nominal output of the forced ventilation unit

Formula symbol	Unit	Explanation
q_{vF}	m³/h	Delivery capacity of the forced ventilation unit in open air
$U_{N,F}$	V	Nominal voltage of the forced ventilation unit

Technical data

Motor	Forced ventilation unit	$U_{N,F}$ [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 ventilation unit plug connectors

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

8.6.7 Holding brake

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

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

Observe the following during project configuration:

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

Formula symbol	Unit	Explanation
$I_{N,B}$	A	Nominal current of the brake at 20 °C
ΔJ_B	10^{-4} kgm²	Additive mass moment of inertia of a motor with holding brake
J_{Bstop}	10^{-4} kgm²	Reference mass moment of inertia when braking from full speed: $J_{B-stop} = J_{dyn} \times 2$
J_{dyn}	10^{-4} kgm²	Mass moment of inertia of a motor in dynamic operation
J_{tot}	10^{-4} kgm²	Total mass moment of inertia (based on 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	Work done by friction for braking
$W_{B,Rlim}$	J	Work done by friction until wear limit is reached
$W_{B,Rmax/h}$	J	Maximum permitted work done by friction per hour with individual braking
$x_{B,N}$	mm	Nominal air gap of brake

Calculation of work done by friction per braking process

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

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

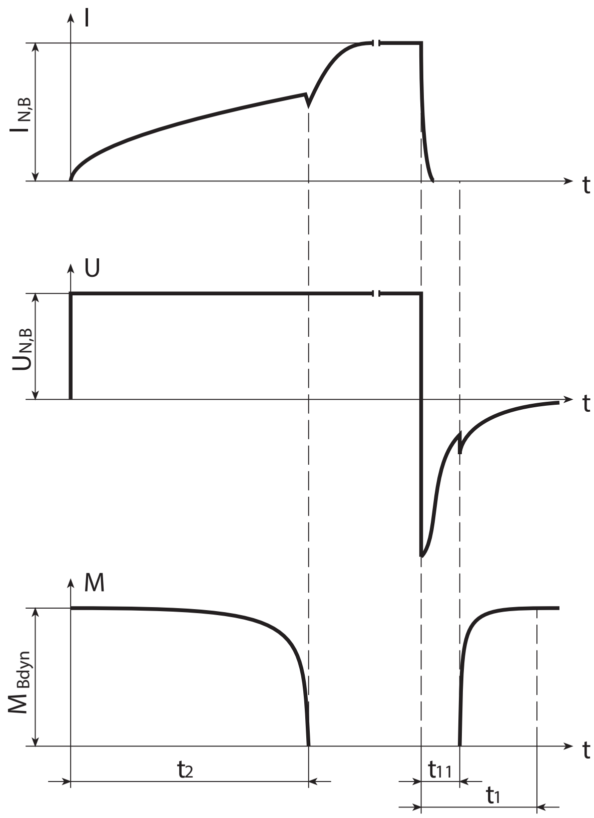
Calculation of the stop time

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

STOBER

EZ

Switching behavior



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

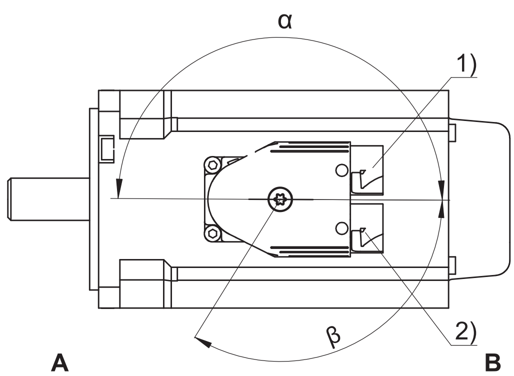
8.6.8.1 Plug connectors

STOBER synchronous servo motors are equipped with twistable quick-lock plug connectors in the standard version (except for plug connector size con.58). Details can be found in this chapter.

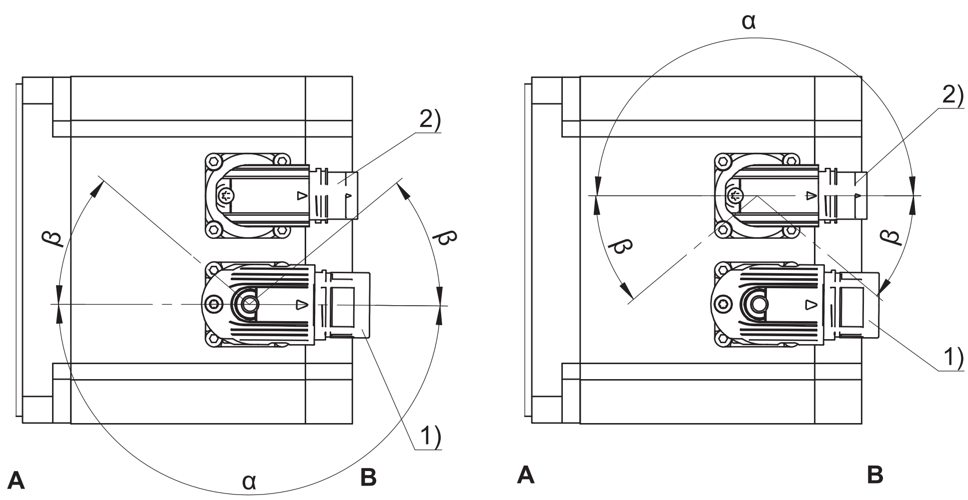
For motors with forced ventilation, avoid collisions between the motor connection cables and the plug connector of the forced ventilation unit. In the event of a collision, turn the motor plug connectors accordingly. Details regarding the position of the plug connector for the forced ventilation unit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

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

Turning ranges of plug connectors (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 side of the motor

Power plug connector features

Motor type	Size	Connection	Turning range	
			α	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	con.58	Screw thread[3]	0°	0°

Encoder plug connector features

Motor type	Size	Connection	Turning range	
			α	β
EZ3	con.15	Quick lock	180°	120°
EZ4, EZ5, EZ7, EZ802, EZ803, EZ805U	con.17	Quick lock	180°	20°
EZ805B	con.17	Quick lock	180°	0°

Notes

- The number after "con." indicates the approximate external thread diameter of the plug connector in mm (for example, con.23 designates a plug connector with an external thread diameter of about 23 mm).
- In the β turning range, 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.

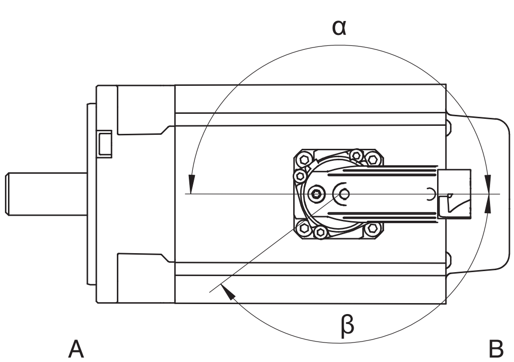
8.6.8.2 Plug connectors (One Cable Solution)

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

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

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

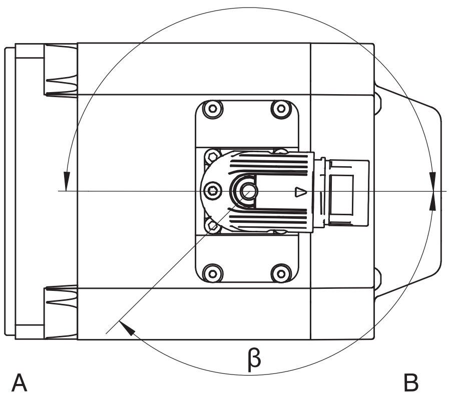
Turning ranges of plug connectors (EZ3 motors)



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

[3] Specify alignment on side A or B in the purchase order.

Turning ranges of plug connectors (EZ4 – EZ8 motors)



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

Plug connector features

Motor type	Size	Connection	Turning range	
			α	β
EZ3	con.15	Quick lock	180°	135°
EZ4, EZ5, EZ701, EZ703	con.23	Quick lock	180°	135°
EZ705, EZ802, EZ803, EZ805U	con.40	Quick lock	180°	135°

Notes

- The number after "con." indicates the approximate external thread diameter of the plug connector in mm (for example, con.23 designates a plug connector with an external thread diameter of about 23 mm).

8.6.8.3 Connection of the motor housing to the grounding conductor system

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

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

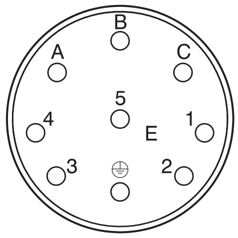
Cross-section of the copper grounding conductor in the power cable (A)	Cross-section of the copper grounding conductor for the motor housing (A_E)
A < 10 mm²	A_E = A
A ≥ 10 mm²	A_E ≥ 10 mm²

EZ

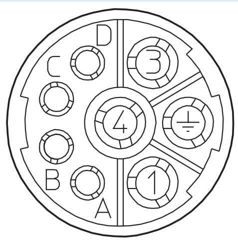
8.6.8.4 Connection assignment of the power plug connector

The size and connection plan of the power plug connector depend on the size of the motor. The colors of the connecting wires inside the motor are specified in accordance with IEC 60757.

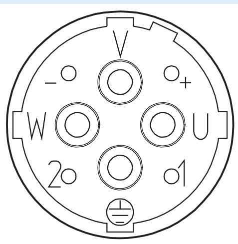
Plug connector size con.15

Connection diagram	Pin	Connection	Color
	A	1U1 (U phase)	BK
	B	1V1 (V phase)	BU
	C	1W1 (W phase)	RD
	1	1TP1/1K1 (temperature sensor)	
	2	1TP2/1K2 (temperature sensor)	
	3	1BD1 (brake +)	RD
	4	1BD2 (brake −)	BK
	⏚	PE (grounding conductor)	GNYE

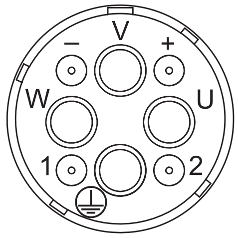
Plug connector size con.23 (1)

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

Plug connector size con.40 (1.5)

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

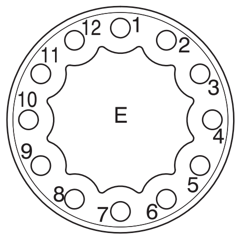
Plug connector size con.58 (3)

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

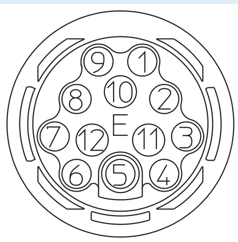
8.6.8.5 Connection assignment of the encoder plug connector

The size and connection assignment of the encoder plug connectors depend on the type of encoder installed and the size of the motor.

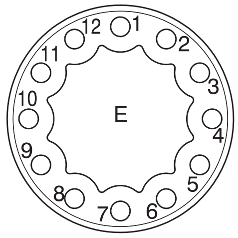
EnDat 2.1/2.2 digital encoders, plug connector size con.15

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		

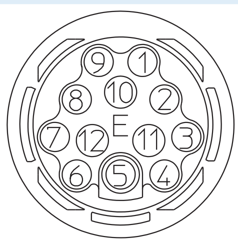
EnDat 2.1/2.2 digital encoders, plug connector size con.17

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		

EnDat 2.2 digital encoder 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		

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

Connection diagram	Pin	Connection	Color
	1	Clock +	VT
	2	UBatt +	BU
	3	UBatt −	WH
	4		
	5	Data −	PK
	6	Data +	GY
	7		
	8	Clock −	YE
	9		
	10	0 V GND	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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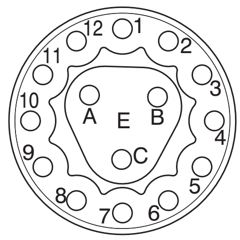
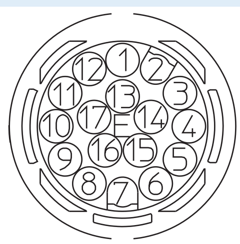
EZ

EnDat 2.1 encoder with sin/cos incremental signals, plug connector size con.15



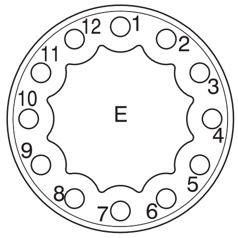
Connection diagram	Pin	Connection	Color
	1	Up sense	BU
	2	0 V sense	WH
	3	Up +	BN GN
	4	Clock +	VT
	5	Clock −	YE
	6	0 V GND	WH GN
	7	B + (Sin +)	BU BK
	8	B − (Sin −)	RD BK
	9	Data +	GY
	10	A + (Cos +)	GN BK
	11	A − (Cos −)	YE BK
	12	Data −	PK
	A		
	B		
	C		

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

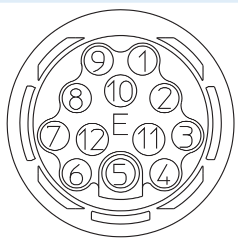


Connection diagram	Pin	Connection	Color
	1	Up sense	BU
	2		
	3		
	4	0 V sense	WH
	5		
	6		
	7	Up +	BN GN
	8	Clock +	VT
	9	Clock −	YE
	10	0 V GND	WH GN
	11		
	12	B + (Sin +)	BU BK
	13	B − (Sin −)	RD BK
	14	Data +	GY
	15	A + (Cos +)	GN BK
	16	A − (Cos −)	YE BK
	17	Data −	PK

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		

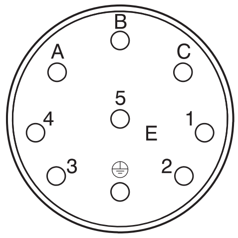
8.6.8.6 Connection assignment of the plug connector (One Cable Solution)

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

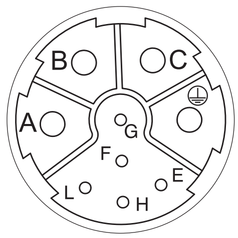
The temperature sensor of the motor is connected to the encoder internally. The measured values from the temperature sensor are transmitted via the HIPERFACE DSL log of the encoder.

The size of the plug connector depends on the size of the motor.

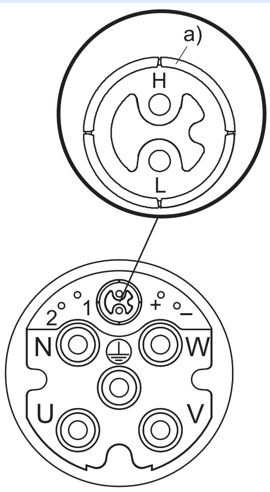
Plug connector size con.15

Connection diagram	Pin	Connection	Color
	A	1U1 (U phase)	BK
	B	1W1 (W phase)	RD
	C	1V1 (V phase)	BU
	1	1BD1 (brake +)	
	2	1BD2 (brake −)	
	3	DSL+ (H)	GY
	4	DSL− (L)	GN
	5	DSL shield	
	⏚	PE (grounding conductor)	GNYE

Plug connector size con.23 (1)

Connection diagram	Pin	Connection	Color
	A	1U1 (U phase)	BK
	B	1V1 (V phase)	BU
	C	1W1 (W phase)	RD
	E	DSL− (L)	GN
	F	DSL shield	
	G	1BD1 (brake +)	
	H	DSL+ (H)	GY
	L	1BD2 (brake −)	
	⏚	PE (grounding conductor)	GNYE

Plug connector size con.40 (1.5)

Connection diagram	Pin	Connection	Color
	U	1U1 (U phase)	BK
	V	1V1 (V phase)	BU
	W	1W1 (W phase)	RD
	N		
	+	1BD1 (brake +)	
	−	1BD2 (brake −)	
	F		
	G		
	H	DSL+ (H)	GY
	L	DSL− (L)	GN
	⏚	PE (grounding conductor)	GNYE

a) Coaxial shield to which the DSL shield is connected

8.7 Project configuration

Project your drive using our SERVOsoft designing software. You can receive SERVOsoft for free from your adviser at one of our sales centers. Observe the limit conditions in this chapter to ensure a safe design for your drives.

8.7.1 Calculation of the operating point

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

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

Formula symbol	Unit	Explanation
ED	%	Duty cycle based on 10 minutes
M_{op}	Nm	Torque of motor at the operating point from the motor characteristic curve at n_{1m*}
$M_{1*} – M_{6*}$	Nm	Actual torque of the motor in the respective time segment (1 to 6)
M_{eff*}	Nm	Actual 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_{max}	Nm	Maximum torque: the maximum permitted torque the motor is able to deliver over a short period (when accelerating or decelerating) (tolerance ±10%)
M_{max*}	Nm	Actual maximum torque
M_{n*}	Nm	Actual torque of the motor in the n-th time segment
M_N	Nm	Nominal torque of the motor
n_{m*}	rpm	Actual average motor speed
$n_{m,1*} – n_{m,6*}$	rpm	Actual average speed of the motor in the respective time segment (1 to 6)
$n_{m,n*}$	rpm	Actual 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 respective 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 M_N specified in the selection tables:

$n_{m*} \leq n_N$

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

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

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

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

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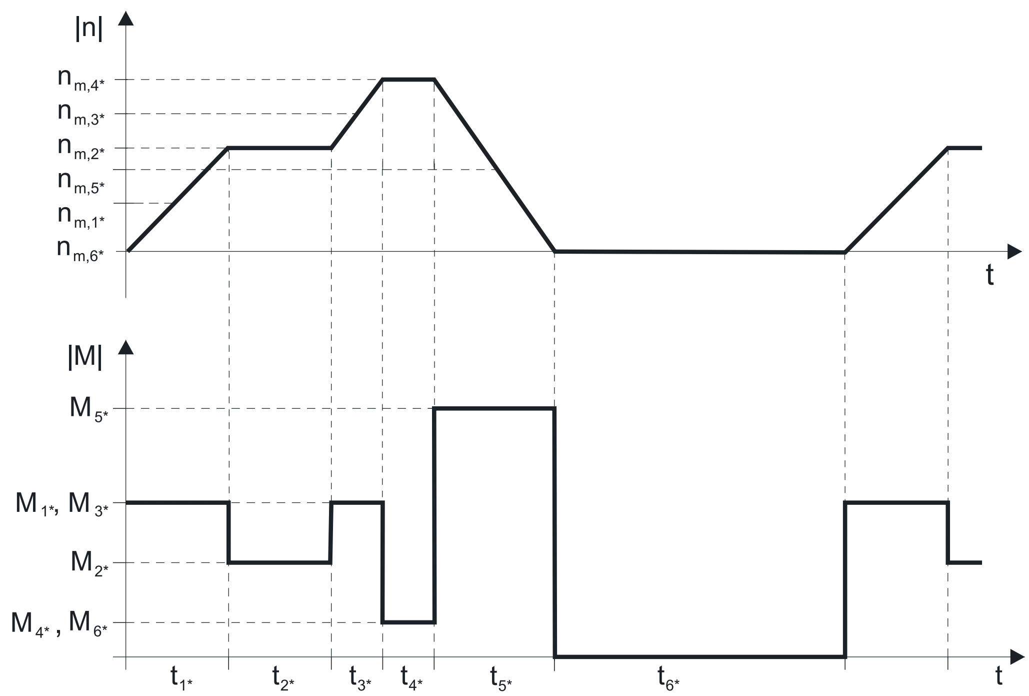
Example of cycle sequence

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



Calculation of the actual average 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 the rest phase t_{6^*}.

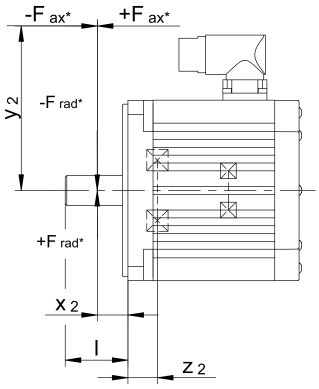
Calculation of the actual effective torque

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

8.7.2 Permitted shaft loads

Formula symbol	Unit	Explanation
F_{ax^*}	N	Actual 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	Actual 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	Actual 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	Actual average motor speed

Formula symbol	Unit	Explanation
x_2	mm	Distance of the shaft shoulder to the force application point
y_2	mm	Distance of the shaft axis to the axial force application point
z_2	mm	Distance of the shaft shoulder to the middle of the output bearing



Permitted 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 the permitted shaft loads:

- For shaft dimensions in accordance with the catalog
- If force is applied at the center of the output shaft: $x_2 = l / 2$ (shaft dimensions can be found in Chapter [8.4]).
- Output speed $n_{m*} \leq 100$ rpm ($F^{ax} = F_{ax100}$; $F_{rad} = F_{rad100}$; $M_k = M_{k100}$)

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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 applies to other force application points:

$$M_{k*} = \frac{2 \cdot F_{ax*} \cdot y_2 + F_{rad*} \cdot (x_2 + z_2)}{1000} \leq M_{k100}$$

$$F_{rad*} \leq F_{rad100}$$

$$F_{ax*} \leq F_{ax100}$$

For applications with multiple axial and/or radial forces, you must add the forces as vectors.

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 is reduced. In this chapter, you can find information for calculating the reduced nominal torque.

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

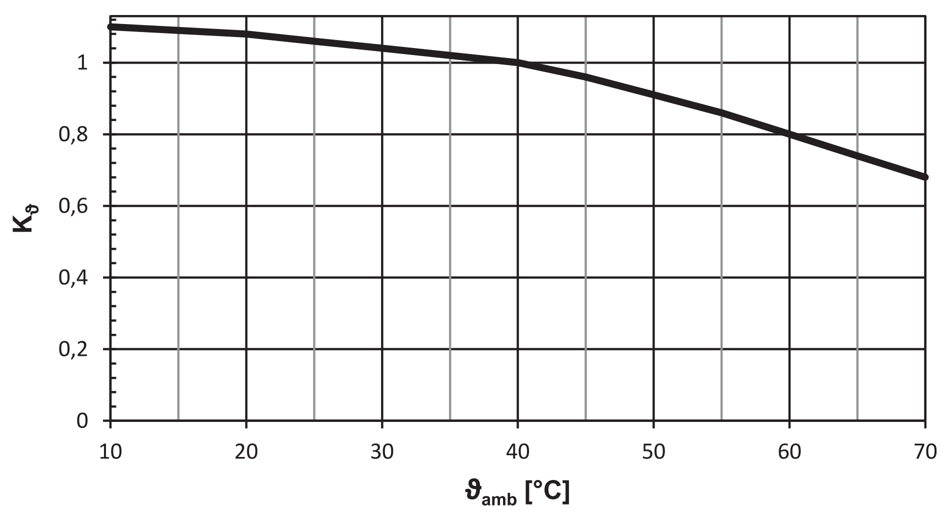


Fig. 4: Derating depending on the surrounding temperature

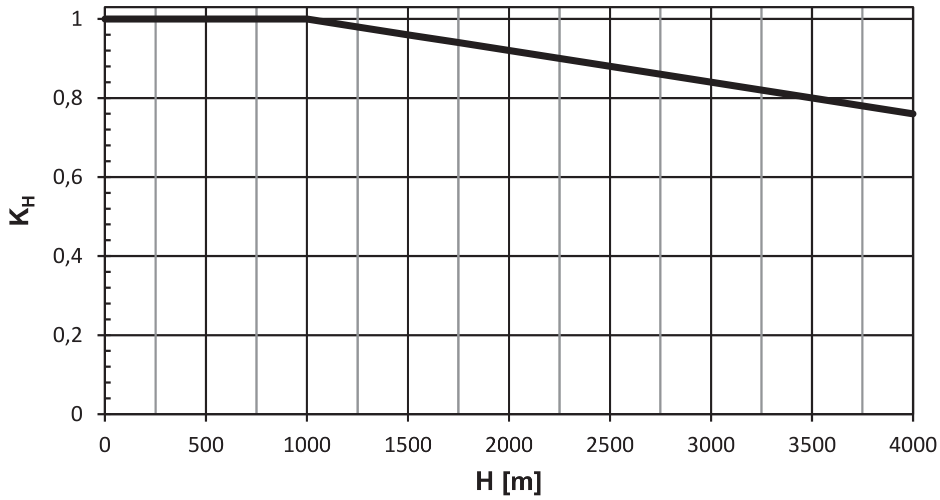


Fig. 5: Derating depending on the installation height

Calculation

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

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

If installation altitude H > 1000 m above sea level:

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

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

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

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 61000-6-2:2005
- EN 61000-6-4:2007 + A1:2011
- EN 60034-1:2010 + Cor.:2010
- EN 60034-5:2001 + A1:2007
- EN 60034-6:1993

EZ

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 "COMPONENT - SERVO AND STEPPER MOTORS"; registered under UL number E488992 with Underwriters Laboratories USA (optional).

8.8.3 Additional documentation

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

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

Documentation	ID
Operating manual for EZ synchronous servo motors	442585

9 EZHD synchronous servo motors with hollow shaft

Table of contents

EZHD

9.1 Overview

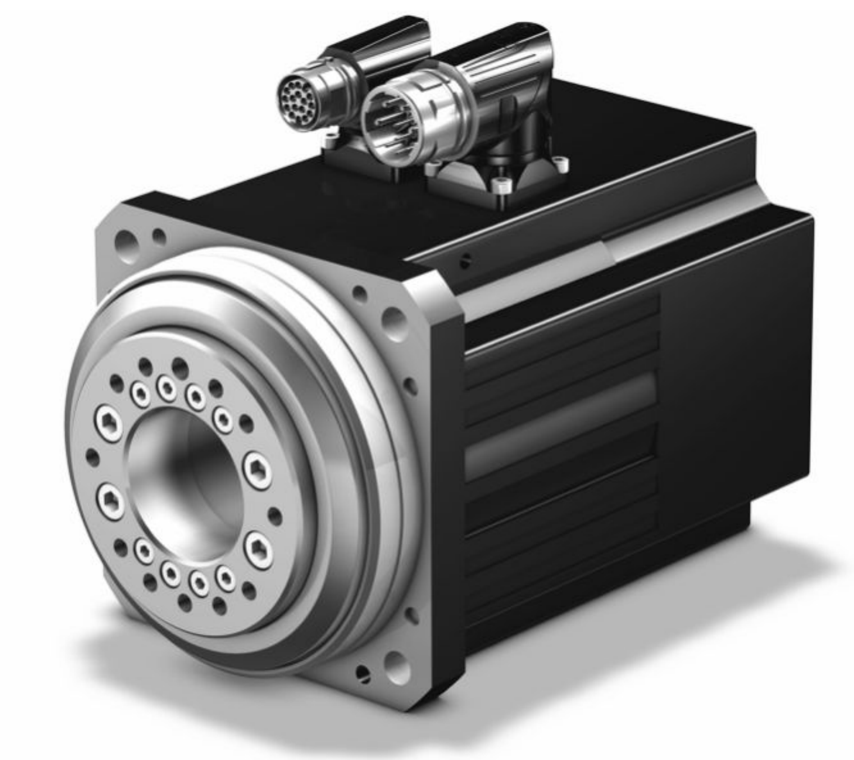
Synchronous servo motors with hollow shaft

Torques

M_N	1.9 – 24.6 Nm
M_0	2.6 – 31.1 Nm

Features

Continuous flange hollow shaft for conveying media	✓
Reinforced A-side bearing for absorbing radial forces	✓
Reinforced B-side bearing for absorbing axial forces	✓
High dynamics	✓
Super compact due to tooth-coil winding method with the highest possible copper fill factor	✓
Backlash-free holding brake (optional)	✓
Convection cooling	✓
Inductive EnDat absolute encoders	✓
Elimination of referencing with multi-turn absolute encoders (optional)	✓
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 to:

- 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
- Black matte paint as per RAL 9005

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

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

Note the differing ambient conditions in Chapter [▷ 9.7.3]

Formula symbol	Unit	Explanation
I_0	A	Stall current: RMS value of the line-to-line current when the stall torque M_0 is generated (tolerance ±5%)
I_{max}	A	Maximum current: RMS value of the maximum permitted line-to-line current when maximum torque M_{max} is 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 when nominal torque M_N is 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 stall torque and frictional torque to the stall 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 a resonant circuit)
m	kg	Weight
M_0	Nm	Stall torque: The continuous torque the motor is able to deliver at a speed of 10 rpm (tolerance ±5%)
M_{max}	Nm	Maximum torque: the maximum permitted torque the motor is able to deliver over a short period (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 torque values as follows: $M_{N^*} = K_{M0} \cdot I^* - M_R$.
M_R	Nm	Frictional torque (of the bearings and seals) of a motor at winding temperature $\Delta\vartheta$ = 100 K

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

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

9.3 Torque/speed curves

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

Formula symbol	Unit	Explanation
ED	%	Duty cycle based on 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 over a short period (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

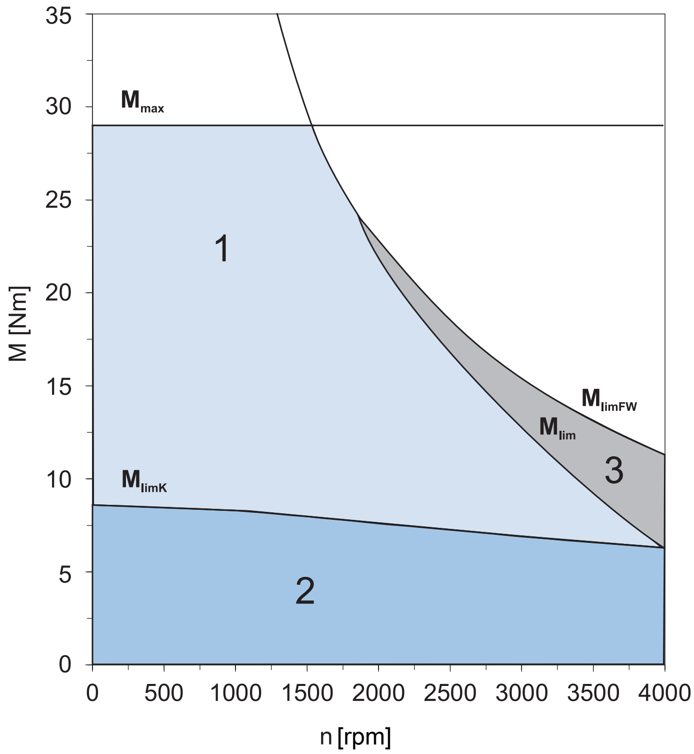
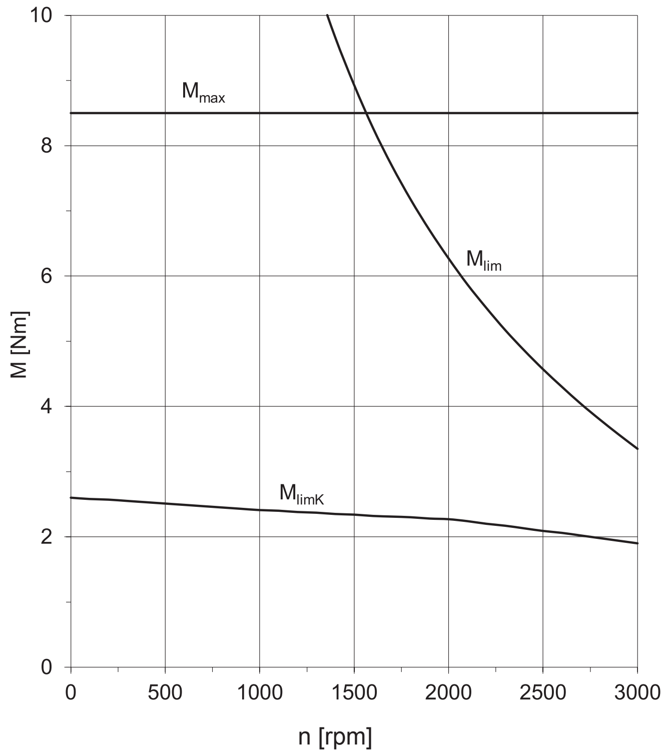


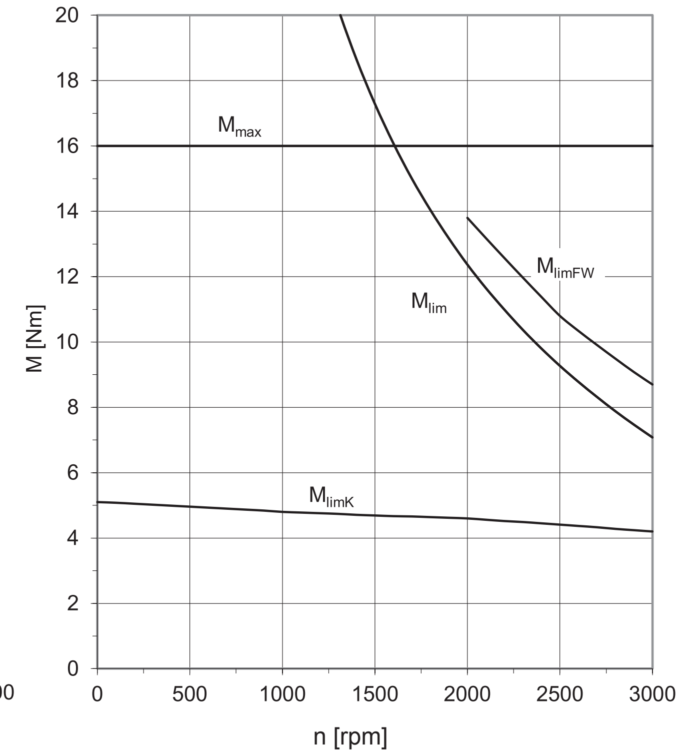
Fig. 1: Explanation of a torque/speed curve

1	Torque range for brief operation (duty cycle < 100%) with $\Delta\vartheta$ = 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 be used only with operation on STOBER drive controllers)		

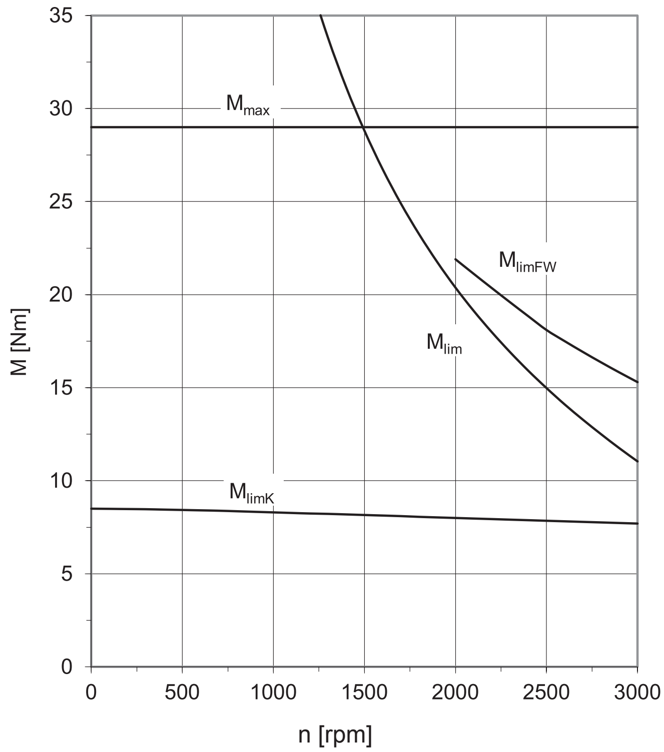
EZHD0411U (n_N=3000 rpm)



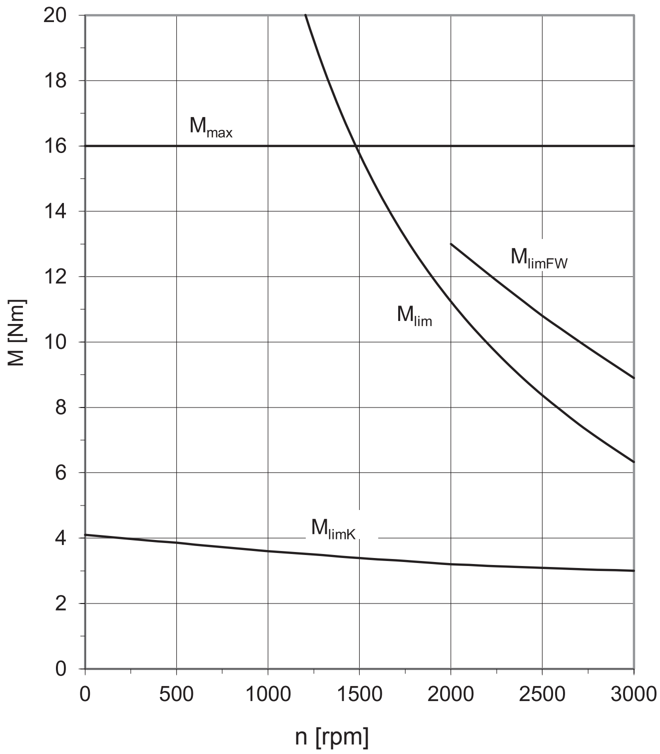
EZHD0412U (n_N=3000 rpm)



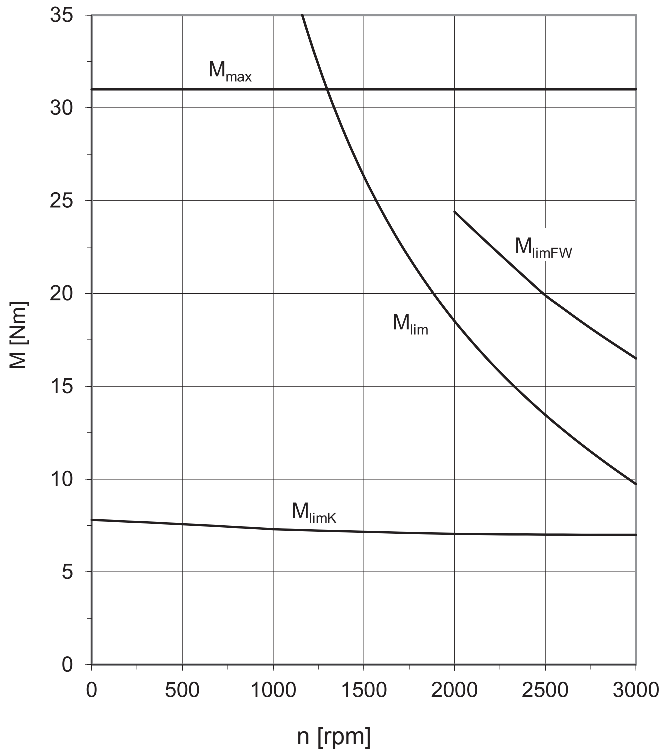
EZHD0414U (n_N=3000 rpm)



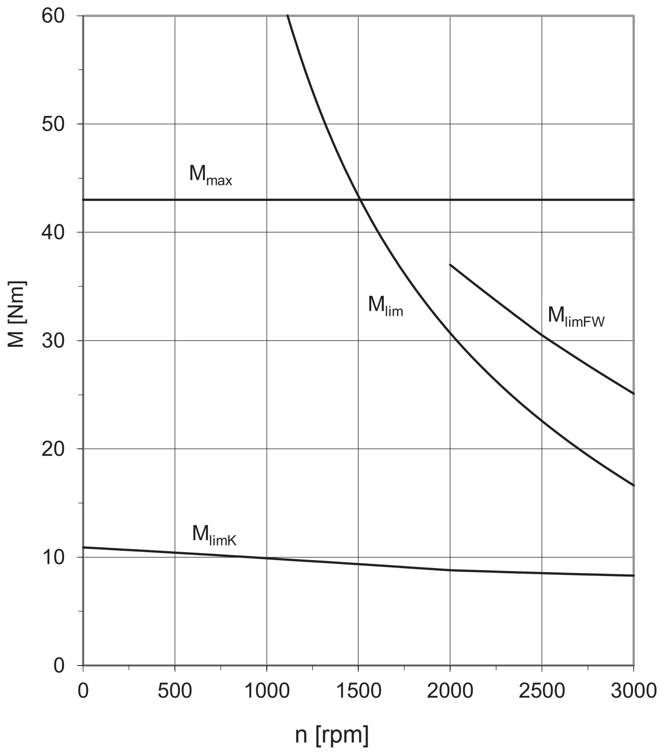
EZHD0511U (n_N=3000 rpm)



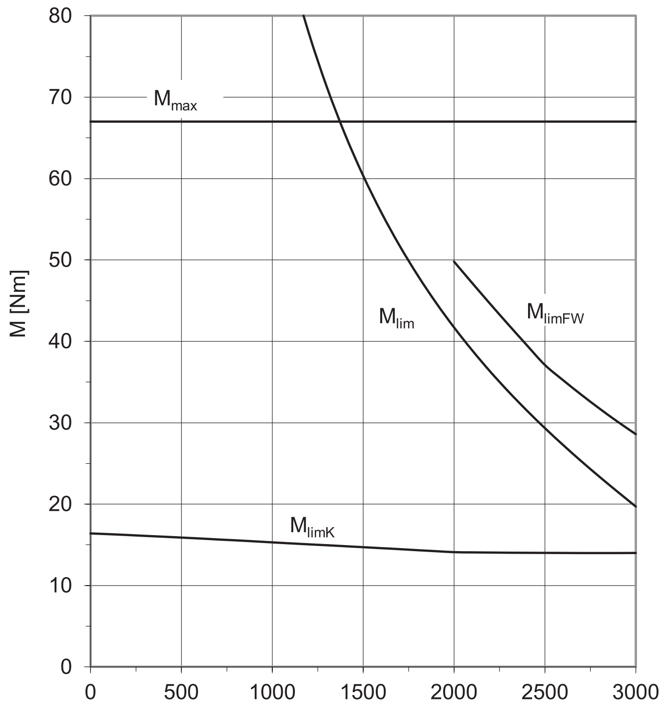
EZHD0512U (n_N=3000 rpm)



EZHD0513U (n_N=3000 rpm)



EZHD0515U (n_N=3000 rpm)



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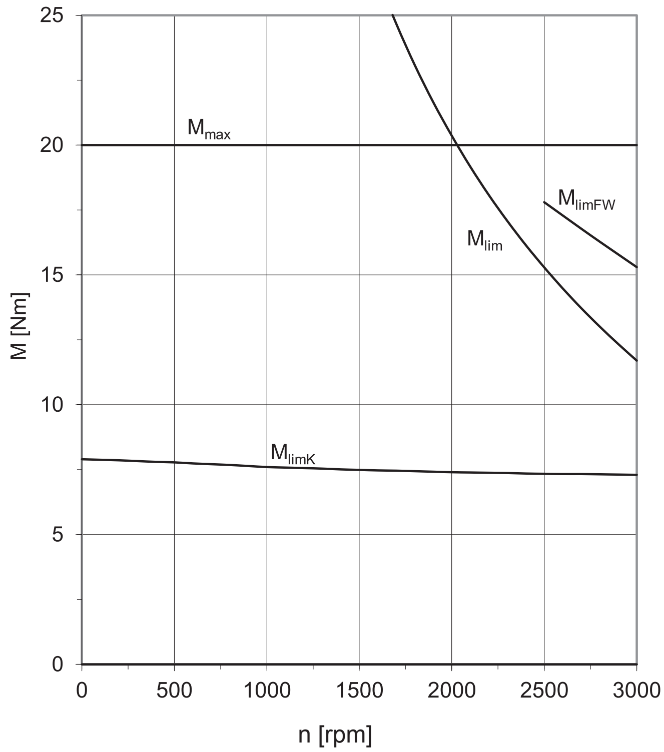
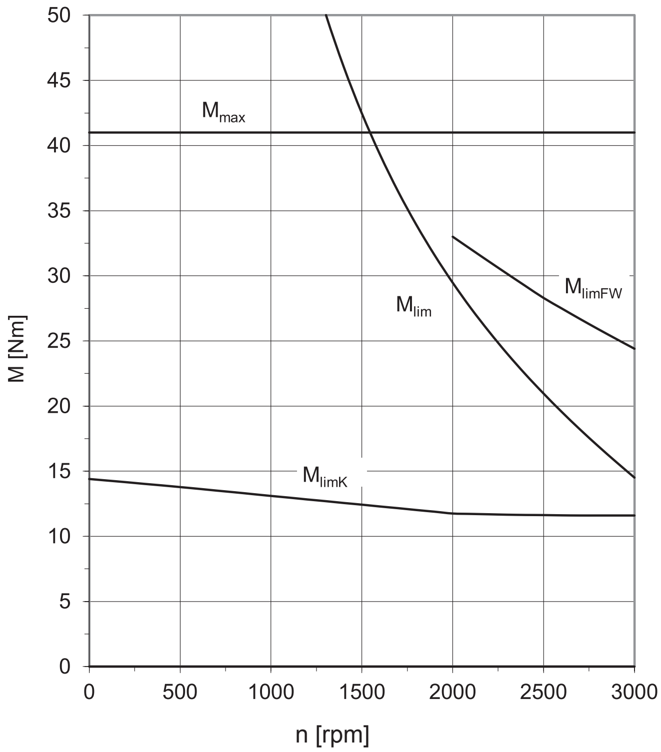
EZHD

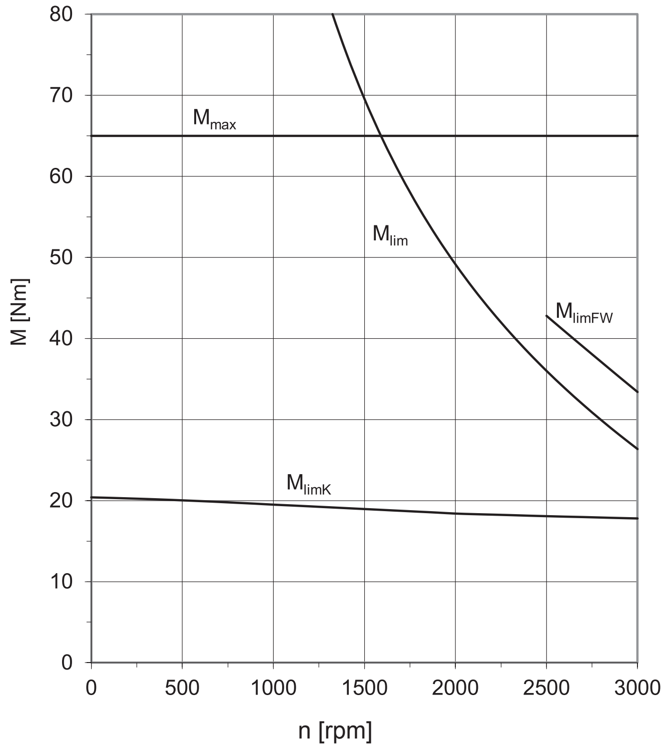
EZHD0711U (n_N=3000 rpm)



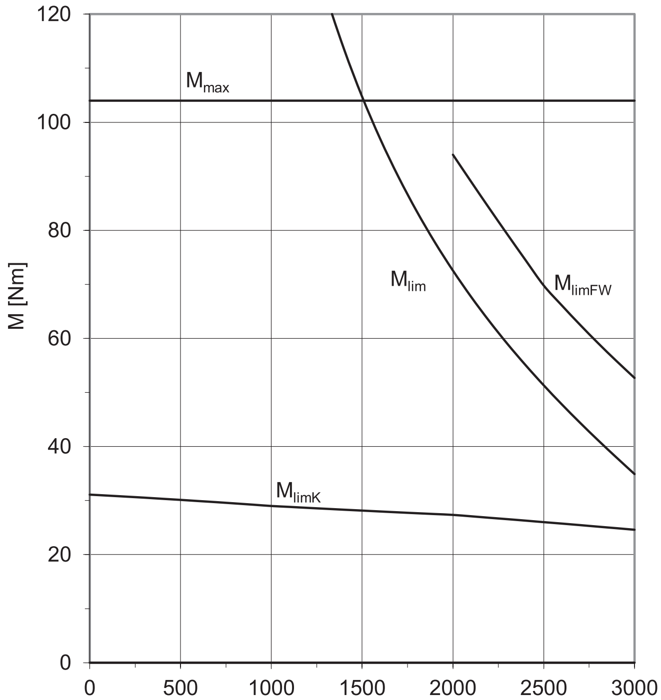
EZHD0712U (n_N=3000 rpm)



EZHD0713U (n_N=3000 rpm)



EZHD0715U (n_N=3000 rpm)



9.4 Dimensional drawings

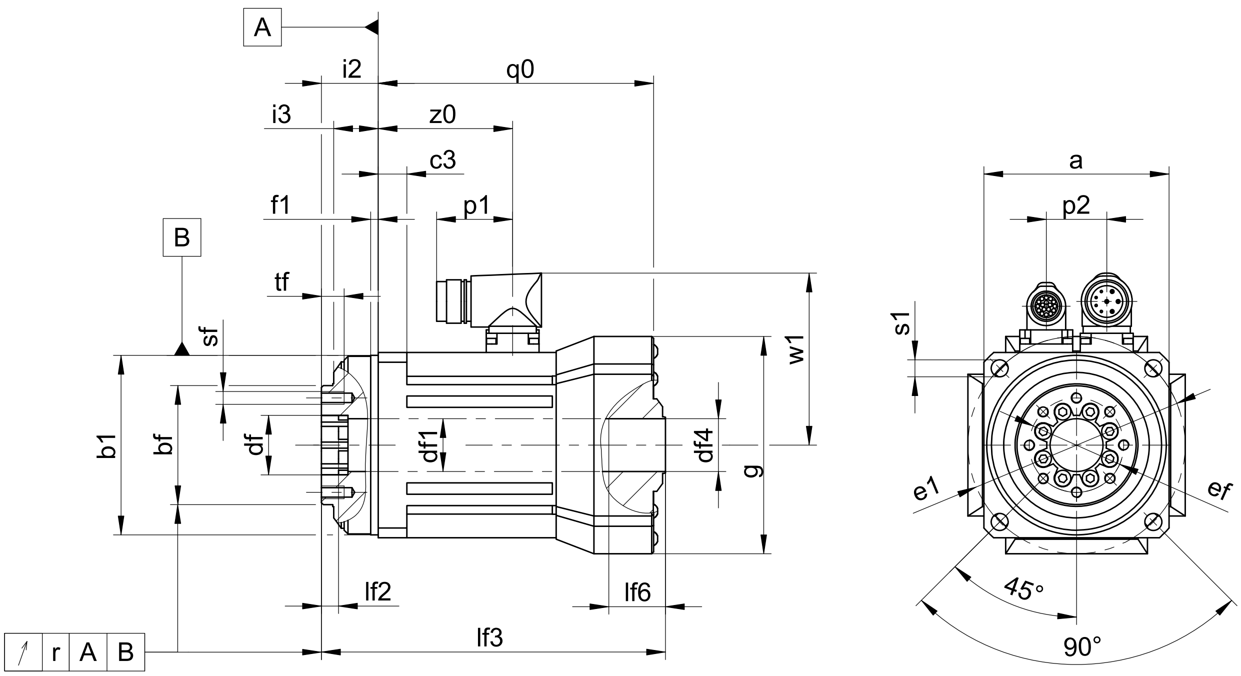
In this chapter, you can find the dimensions of the motors.

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

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

You can download CAD models of our standard drives at 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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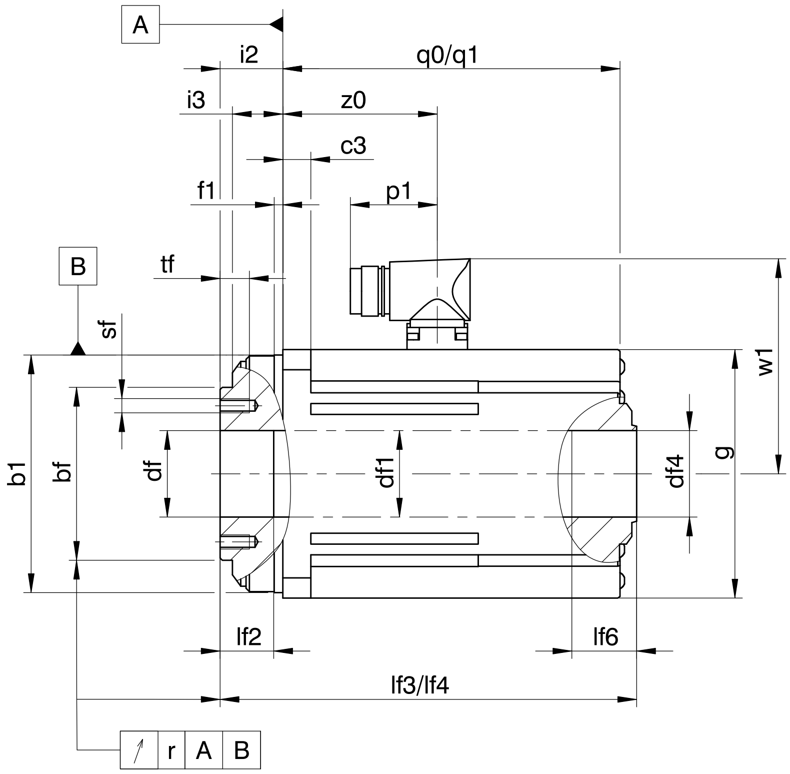
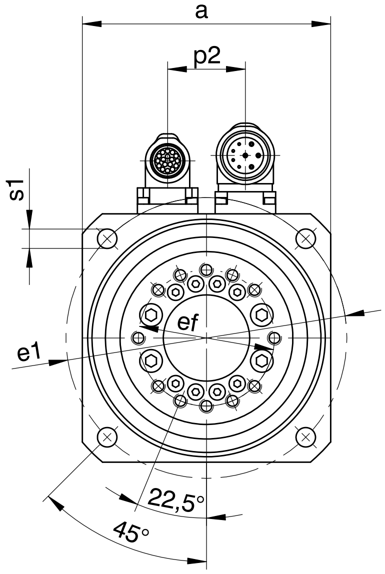
EZHD

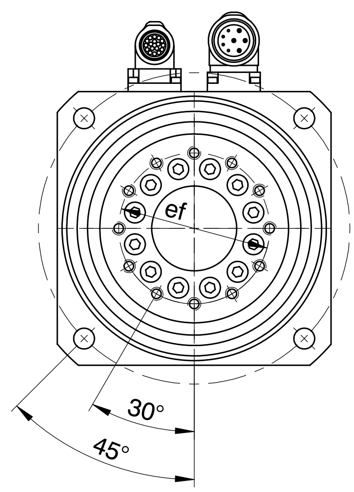
9.4.2 EZHD05 – EZHD07 motors



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	Zero-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)

Notes

- In Chapter [▹ 9.6.4], you can find information about available encoders.
- In Chapter [▹ 9.6.4.3], you can find information about connecting synchronous servo motors to other drive controllers from STOBER.

9.6 Product description

9.6.1 General features

Feature	Description
Design	IM B5, IM V1, IM V3 in accordance with EN 60034-7
Protection class	IP56
Thermal class	155 (F) in accordance with EN 60034-1 (155 °C, heating Δϑ = 100 K)
Surface[2]	Matte black 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 in accordance with EN 60034-14
Noise level	Limit values in accordance with EN 60034-9

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

EZHD

9.6.2 Electrical features

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

Feature	Description
DC link voltage	DC 540 V (max. 620 V) on STOBER drive controllers
Winding	Three-phase, single-tooth coil design
Circuit	Star, center not led through
Protection class	I (protective grounding) in accordance with EN 61140
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 chapter. Information about differing ambient conditions can be found in Chapter [9.7.3].

Feature	Description
Surrounding temperature for transport/storage	−30 °C to +85 °C
Surrounding temperature for operation	−15 °C to +40 °C
Installation altitude	≤ 1000 m above sea level
Shock load	≤ 50 m/s² (5 g), 6 ms in accordance with EN 60068-2-27

Notes

- STOBER synchronous servo motors are not suitable for potentially explosive atmospheres in accordance with (ATEX) Directive2014/34/EU.
- Secure 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 by shock loading.
- Also take into consideration the shock load of the motor due to output units (such as gear units and pumps) which are coupled with the motor.

9.6.4 Encoders

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

9.6.4.1 Selection tool for EnDat interface

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

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

9.6.4.2 EnDat encoders

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

Encoders with EnDat 2.2 interface

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

Encoders with EnDat 2.1 interface

Encoder type	Type code	Measuring method	Recordable revolutions	Resolution	Position values per revolution	Periods per revolution
ECI 119	C4	Inductive	–	19 bit	524288	Sin/Cos 32

Notes

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

9.6.4.3 Possible combinations with drive controllers

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

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

Notes

- The drive controller and encoder type codes are a part of the type designation of the motor (see the "Type designation" chapter).

9.6.5 Temperature sensor

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

Some encoders have their own integrated analysis electronics for temperature monitoring with warning and shut-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 instance where an encoder with internal temperature monitoring forces the motor to shut down, even before the motor has reached its nominal data.

You can find information about the electrical connection of the temperature sensor in the "Connection 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 triple thermistor in accordance with DIN 44082 that allows the temperature of each winding phase to be monitored.

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

Feature	Description
Nominal response temperature ϑ_{NAT}	145 °C ± 5 K
Resistance R −20 °C up to ϑ_{NAT} − 20 K	≤ 250 Ω
Resistance R with ϑ_{NAT} − 5 K	≤ 550 Ω
Resistance R with ϑ_{NAT} + 5 K	≥ 1330 Ω
Resistance R with ϑ_{NAT} + 15 K	≥ 4000 Ω
Operating voltage	≤ DC 7.5 V
Thermal response time	< 5 s
Thermal class	155 (F) in accordance with EN 60034-1 (155 °C, heating $\Delta\vartheta$ = 100 K)

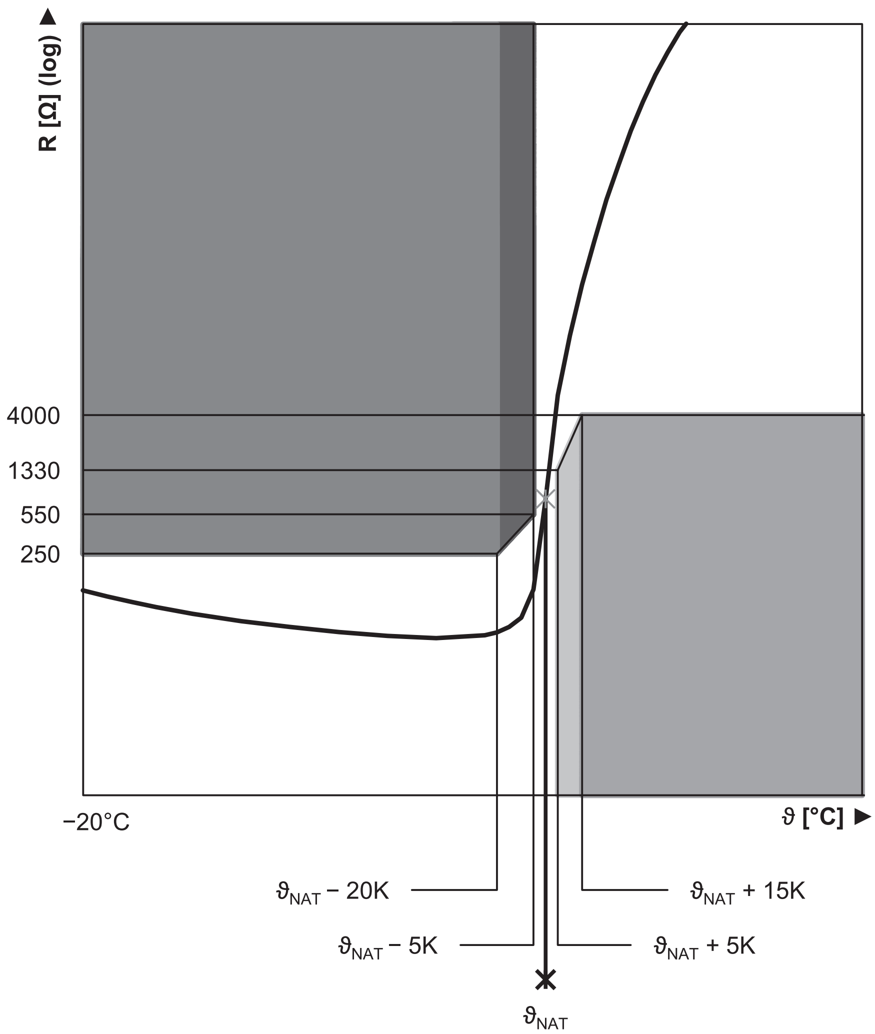


Fig. 2: PTC thermistor curve (single thermistor)

9.6.5.2 Pt1000 temperature sensor

STOBER synchronous servo motors are available in versions with a Pt1000 temperature sensor. The Pt1000 is a temperature-dependent resistor that has a resistance curve with a linear relationship with temperature. As a result, the Pt1000 allows for measurements of the winding temperature. These measurements are limited to one phase of the motor winding, however. In order to adequately protect the motor from exceeding the maximum permitted winding temperature, use a i²t model in the drive controller to monitor the winding temperature.

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

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

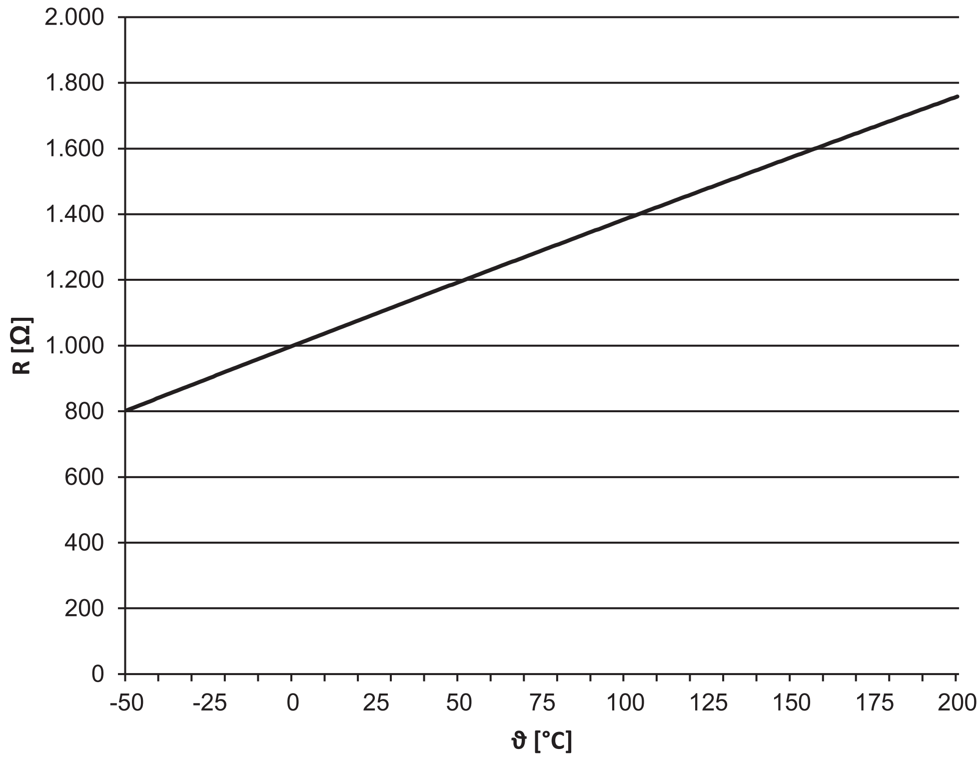


Fig. 3: Pt1000 temperature sensor characteristic curve

9.6.6 Cooling

An EZHD motor 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.

9.6.7 Holding brake

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

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

Observe the following during project configuration:

- In exceptional circumstances, the holding brake can be used for braking from full speed (following a power failure or when setting up the machine). The maximum permitted work done by friction $W_{B,Rmax/h}$ may not be exceeded. Activate other braking processes during operation using the corresponding brake functions of the drive controller to prevent premature wear on the holding brake.
- Note that the braking torque M_{Bdyn} may initially be up to 50% less when braking from full speed. As a result, the braking effect has a delayed action and braking distances become longer.
- Regularly perform a brake test to ensure the functional safety of the brakes. Details can be found in the documentation of the motor and the drive controller.
- Connect a varistor of type S14 K35 (or comparable) in parallel to the brake coil to protect your machine from switching surges. (Not necessary for connecting the holding brake to STOBER drive controllers with BRS/BRM brake module).
- The holding brake of the synchronous servo motor does not offer adequate safety for persons in the hazardous area of gravity-loaded vertical axes. Therefore take additional measures to minimize risk, e.g. by providing a mechanical substructure for maintenance work.

- Take into consideration voltage losses in the connection cables that connect the voltage source to the holding brake connections.
- The braking torque of the brake can be reduced by shock loading. Information about shock loading can be found in the "Ambient conditions" chapter.

Formula symbol	Unit	Explanation
$I_{N,B}$	A	Nominal current of the brake at 20 °C
ΔJ_B	10^{-4} kgm²	Additive mass moment of inertia of a motor with holding brake
J	10^{-4} kgm²	Mass moment of inertia
J_{Bstop}	10^{-4} kgm²	Reference mass moment of inertia when braking from full speed: $J_{B\text{-}stop} = J \times 2$
J_{tot}	10^{-4} kgm²	Total mass moment of inertia (based on 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	Work done by friction for braking
$W_{B,Rlim}$	J	Work done by friction until wear limit is reached
$W_{B,Rmax/h}$	J	Maximum permitted work done by friction per hour with individual braking
$x_{B,N}$	mm	Nominal air gap of brake

Calculation of work done by friction per braking process

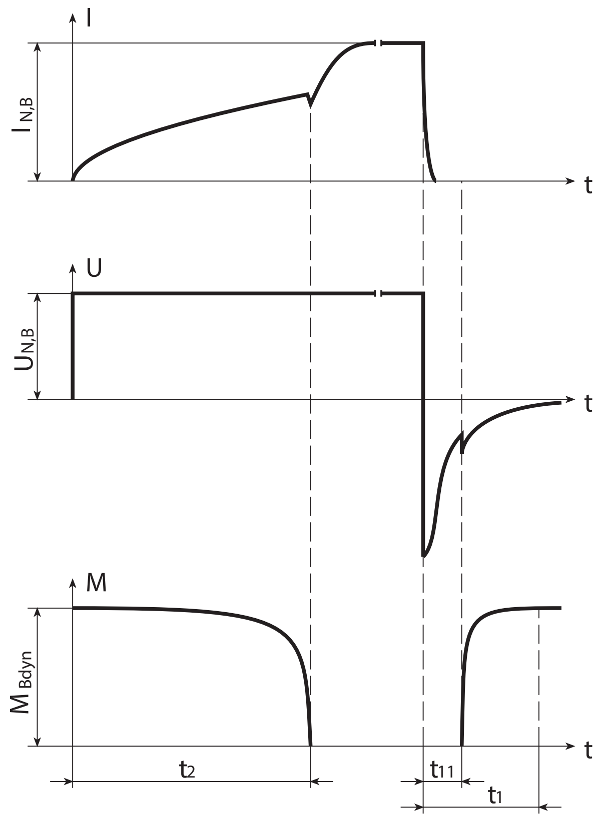
$$W_{B,R/B} = \frac{J_{tot} \cdot n^2}{182.4} \cdot \frac{M_{Bdyn}}{M_{Bdyn} \pm M_L}$$

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

Calculation of the stop time

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

Switching behavior



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

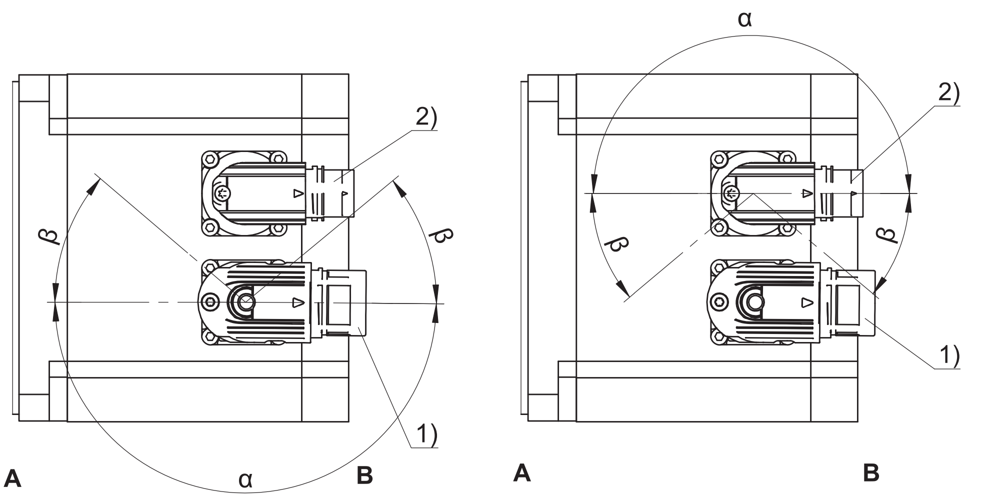
The following chapters describe the connection technology of STOBER synchronous servo motors in the standard version on STOBER drive controllers. You can find further information relating to the drive controller type that was specified in your order in the connection plan that is delivered with every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

9.6.8.1 Plug connectors

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

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

Turning ranges of plug connectors



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

Power plug connector features

Motor type	Size	Connection	Turning range	
			α	β
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°

Notes

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

9.6.8.2 Connection of the motor housing to the grounding conductor system

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

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

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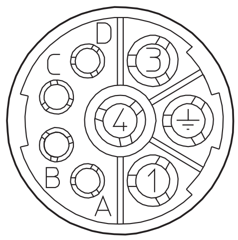
Cross-section of the copper grounding conductor in the power cable (A)	Cross-section of the copper grounding conductor for the motor housing (A_E)
A < 10 mm²	A_E = A
A ≥ 10 mm²	A_E ≥ 10 mm²

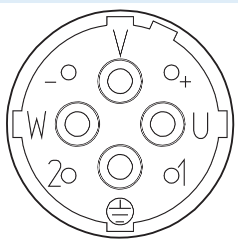
9.6.8.3 Connection assignment of the power plug connector

The size and connection plan of the power plug connector depend on the size of the motor. The colors of the connecting wires inside the motor are specified in accordance with IEC 60757.

Plug connector size con.23 (1)

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

Plug connector size con.40 (1.5)

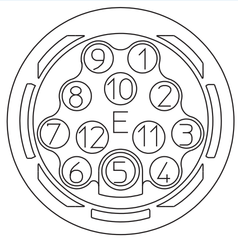
Connection diagram	Pin	Connection	Color
	U	1U1 (U phase)	BK
	V	1V1 (V phase)	BU
	W	1W1 (W phase)	RD
	+	1BD1 (brake +)	RD
	−	1BD2 (brake −)	BK
	1	1TP1/1K1 (temperature sensor)	
	2	1TP2/1K2 (temperature sensor)	
	⏚	PE (grounding conductor)	GNYE

EZHD

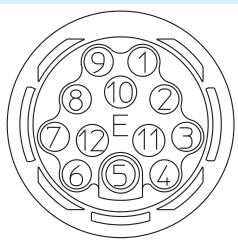
9.6.8.4 Connection assignment of the encoder plug connector

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

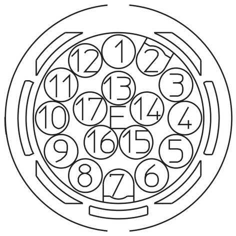
EnDat 2.1/2.2 digital encoders, plug connector size con.17

Connection diagram	Pin	Connection	Color
	1	Clock +	VT
	2	Up sense	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		

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

Connection diagram	Pin	Connection	Color
	1	Clock +	VT
	2	UBatt +	BU
	3	UBatt −	WH
	4		
	5	Data −	PK
	6	Data +	GY
	7		
	8	Clock −	YE
	9		
	10	0 V GND	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		

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

Connection diagram	Pin	Connection	Color
	1	Up sense	BU
	2		
	3		
	4	0 V sense	WH
	5		
	6		
	7	Up +	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 Project configuration

Project your drive using our SERVOsoft designing software. You can receive SERVOsoft for free from your adviser at one of our sales centers. Observe the limit conditions in this chapter to ensure a safe design for your drives.

9.7.1 Calculation of the operating point

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

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

Formula symbol	Unit	Explanation
ED	%	Duty cycle based on 10 minutes
M_{op}	Nm	Torque of motor at the operating point from the motor characteristic curve at n_{1m*}
$M_{1*} – M_{6*}$	Nm	Actual torque of the motor in the respective time segment (1 to 6)
M_{eff*}	Nm	Actual 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 over a short period (when accelerating or decelerating) (tolerance ±10%)
M_{max*}	Nm	Actual maximum torque
M_{n*}	Nm	Actual torque of the motor in the n-th time segment
M_N	Nm	Nominal torque of the motor
n_{m*}	rpm	Actual average motor speed
$n_{m,1*} – n_{m,6*}$	rpm	Actual average speed of the motor in the respective time segment (1 to 6)
$n_{m,n*}$	rpm	Actual 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 respective 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 M_N specified in the selection tables:

$n_{m*} \leq n_N$

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

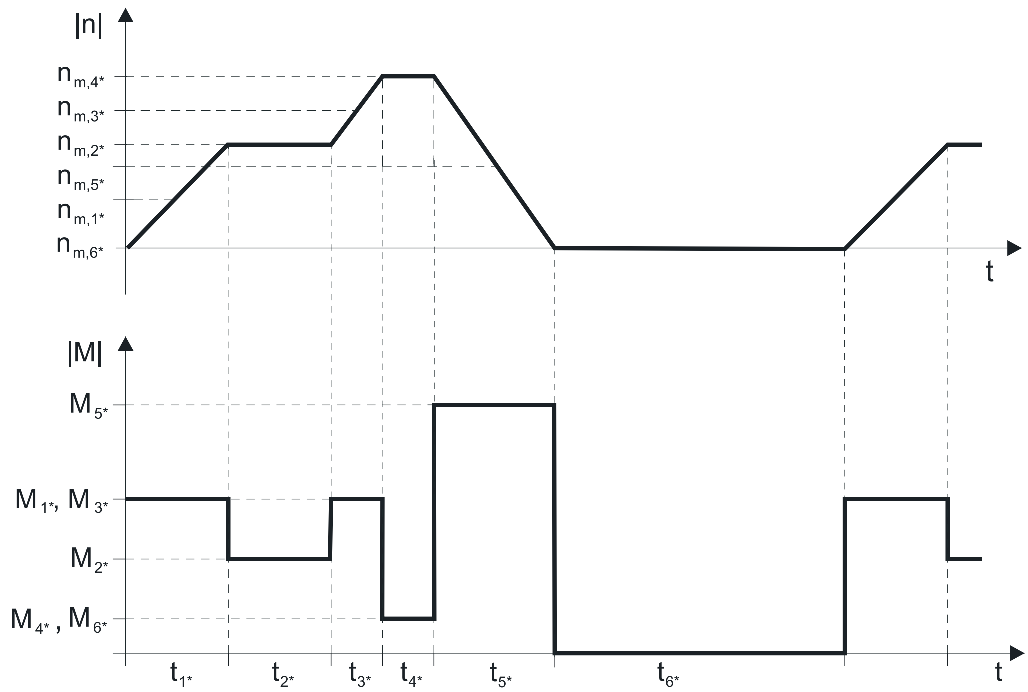
$M_{max*} < M_{max}$

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 delivered at the motor shaft based on the following example:



Calculation of the actual 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 the rest phase t_{6*}.

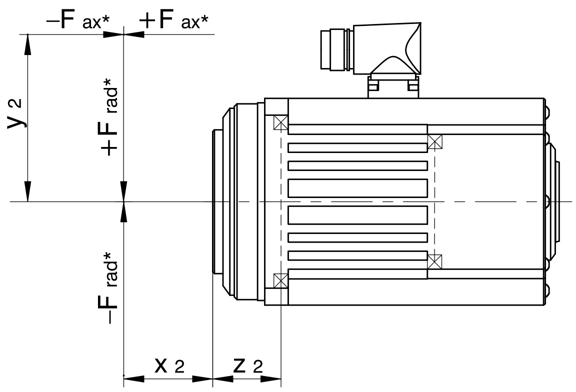
Calculation of the actual effective torque

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

9.7.2 Permitted shaft loads

Formula symbol	Unit	Explanation
C_{2k}	Nm/ar-cmin	Tilting stiffness
F_{ax}	N	Permitted axial force on the output
F_{ax*}	N	Actual 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	Actual 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	Actual breakdown torque on the output
M_{k300}	Nm	Permitted breakdown torque on the output for n_{m*} ≤ 300 rpm
n_{m*}	rpm	Actual average motor speed
x_2	mm	Distance of the shaft shoulder to the force application point

Formula symbol	Unit	Explanation
y_2	mm	Distance of the shaft axis to the axial force application point
z_2	mm	Distance of the shaft shoulder to the middle of the output bearing



Permitted 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 for permitted shaft loads specified in the table apply:

- For shaft dimensions in accordance with 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 to 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 applies to other force application points:

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

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

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

For applications with multiple axial and/or radial forces, you must add the forces as vectors.

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EZHD

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 is reduced. In this chapter, you can find information for calculating the reduced nominal torque.

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

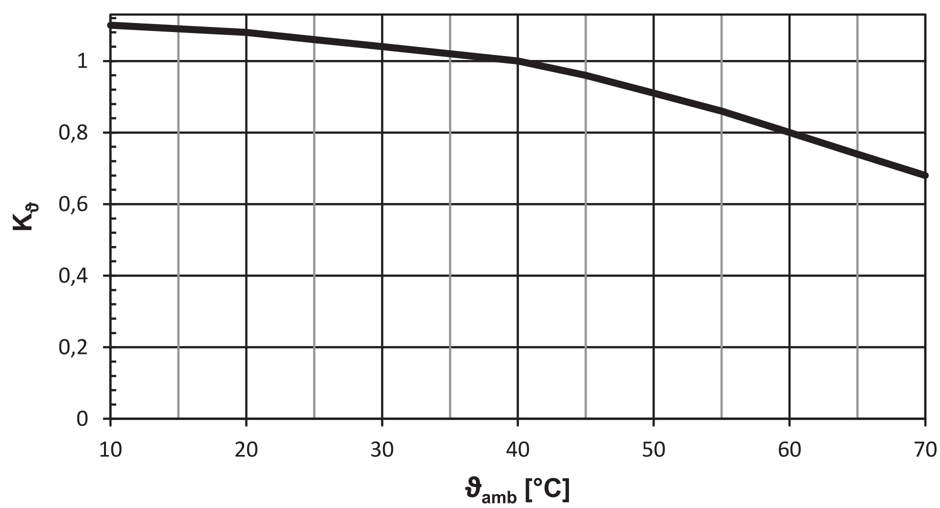


Fig. 4: Derating depending on the surrounding temperature

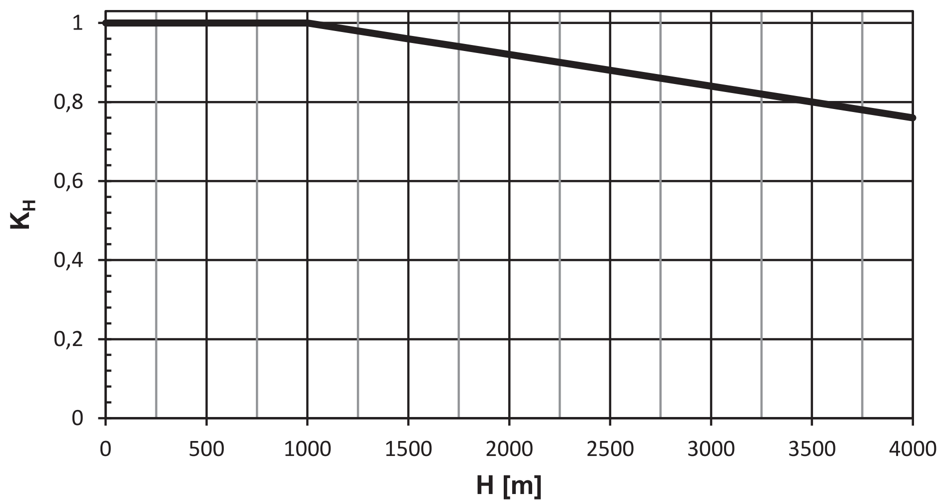


Fig. 5: Derating depending on the installation height

Calculation

If surrounding temperature $\vartheta_{amb} > 40$ °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 $\vartheta_{amb} > 40$ °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 61000-6-2:2005
- EN 61000-6-4:2007 + A1:2011
- EN 60034-1:2010 + Cor.:2010
- EN 60034-5:2001 + A1:2007
- EN 60034-6:1993

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 "COMPONENT - SERVO AND STEPPER MOTORS"; registered under UL number E488992 with Underwriters Laboratories USA (optional).

9.8.3 Additional documentation

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

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

Documentation	ID
Operating manual for EZ synchronous servo motors	442585

STOBER

10 EZHP synchronous servo geared motors with hollow shaft

Table of contents

10.1 Overview

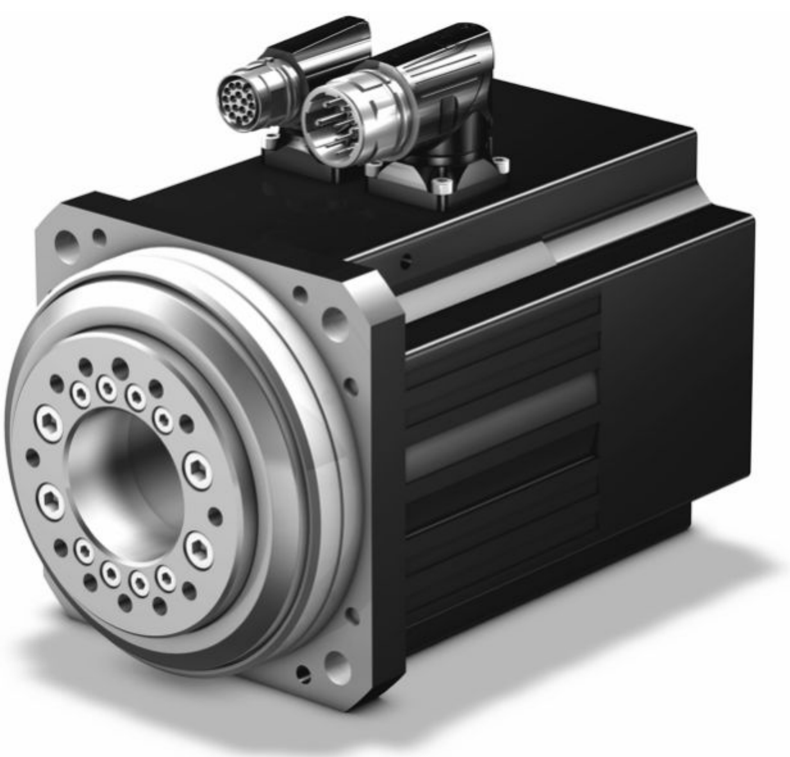
Synchronous servo geared motors with hollow shaft

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	✓
Inductive EnDat absolute encoders	✓
Elimination of referencing with multi-turn absolute encoders (optional)	✓
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 to:

- 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
- Black matte paint as per RAL 9005

Formula symbol	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 at the output shaft with a blocked input
i	–	Gear ratio
i_{exakt}	–	Mathematically exact gear ratio
I_0	A	Stall current: RMS value of the line-to-line current when the stall torque M_0 is generated (tolerance ±5%)
I_{max}	A	Maximum current: RMS value of the maximum permitted line-to-line current when maximum torque M_{max} is 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 when nominal torque M_N is 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 stall torque and frictional torque to the stall 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 a resonant circuit)
m	kg	Weight
M_0	Nm	Stall torque: The continuous torque the motor is able to deliver at a speed of 10 rpm (tolerance ±5%)
$M_{2.0}$	Nm	Stall 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 motors whose size and nominal torque n_{1N} are the same
M_{max}	Nm	Maximum torque: the maximum permitted torque the motor is able to deliver over a short period (when accelerating or decelerating) (tolerance ±10%)
M_{2N}	Nm	Nominal torque on the gear unit output (relative to n_{1N})
M_{2NOT}	Nm	Gear unit emergency-off torque on the 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%)

Formula symbol	Unit	Explanation
		You can calculate other torque values as follows: $M_{N*} = K_{M0} \cdot I* - M_R$.
M_R	Nm	Frictional torque (of the bearings and seals) 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}	min^{-1}	Nominal speed at the gear unit input
n_{2N}	min^{-1}	Nominal speed at the gear unit output
n_{1maxDB}	min^{-1}	Maximum permitted input speed of the gear unit in continuous operation
n_{1maxZB}	min^{-1}	Maximum permitted input speed of the gear unit in cyclic operation
P_N	kW	Nominal power: the power 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	–	Load value: Quotient of gear unit and motor nominal torque without regard to the thermal performance limit. Represents a value 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 table shows 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 Chapter [▸ 10.7.1])

Type	K_{EM} [V/1000 rpm]	n_N [rpm]	M_N [Nm]	I_N [A]	$K_{M,N}$ [Nm/A]	P_N [kW]	M_0 [Nm]	I_0 [A]	K_{M0} [Nm/A]	M_R [Nm]	M_{max} [Nm]	I_{max} [A]	R_{U-V} [Ω]	L_{U-V} [mH]	T_{el} [ms]
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

10.2.2 Selection tables for synchronous servo geared motor

n_{2N} [rpm]	M_{2N} [Nm]	$M_{2,0}$ [Nm]	a_{th}	S	Type	M_{2acc} [Nm]	M_{2NOT} [Nm]	i	i_{exakt}	n_{1max} DB [rpm]	n_{1max} ZB [rpm]	J_1 [10^{-4} kgm²]	$\Delta\varphi_2$ [arcmin]	C_2 [Nm/ arcmin]	m [kg]
EZHP_5 (n_{1N} = 3000rpm, $M_{2acc,max}$ = 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} = 3000rpm, $M_{2acc,max}$ = 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 curves

Torque/speed curves depend on the nominal speed and/or winding design of the motor and the DC link voltage of the drive controller that is used. The following torque/speed 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 symbol	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_{max}	Nm	Maximum torque: the maximum permitted torque the motor is able to deliver over a short period (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

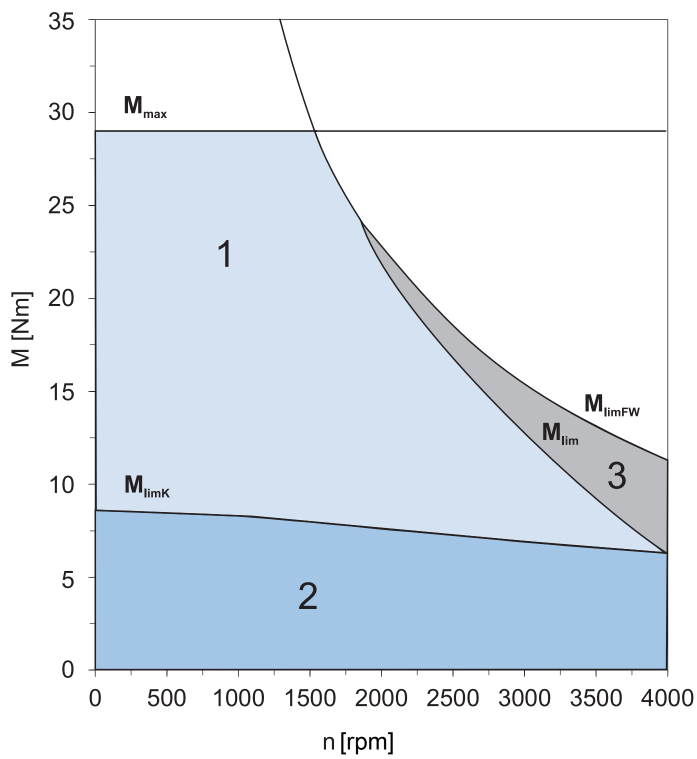
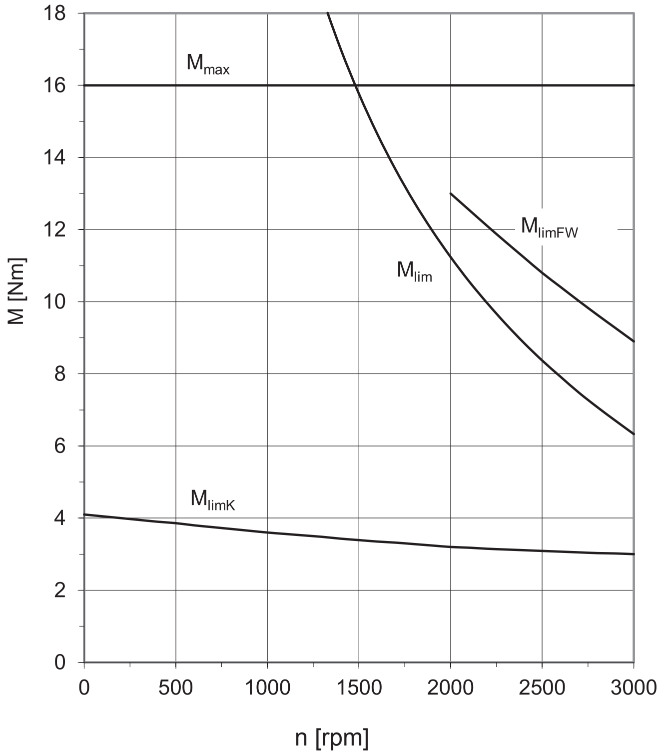


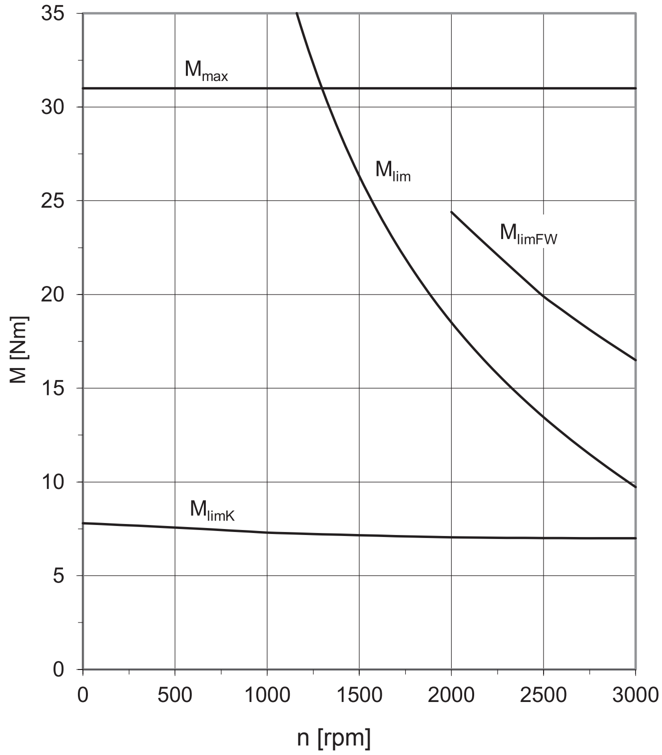
Fig. 1: Explanation of a torque/speed curve

1	Torque range for brief operation (duty cycle < 100%) with $\Delta\vartheta$ = 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 be used only with operation on STOBER drive controllers)		

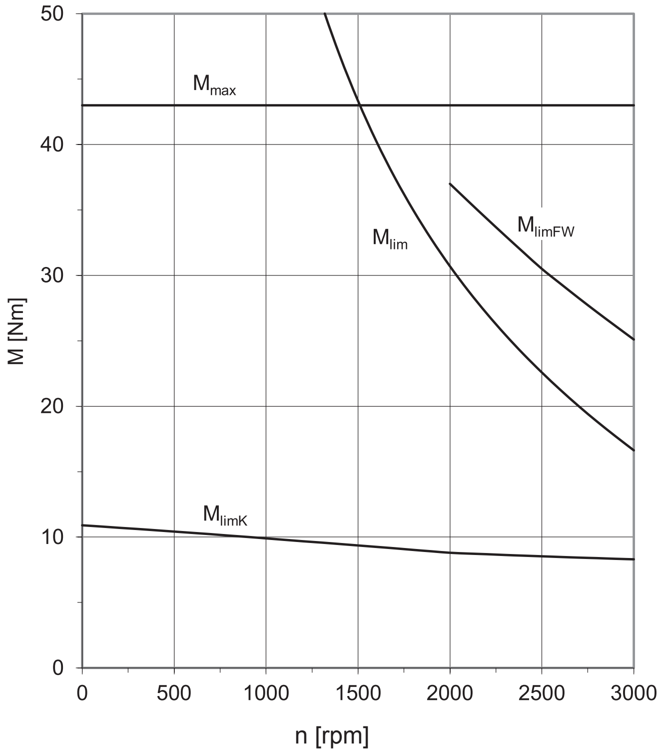
EZHP_511 (n_N=3000 rpm)



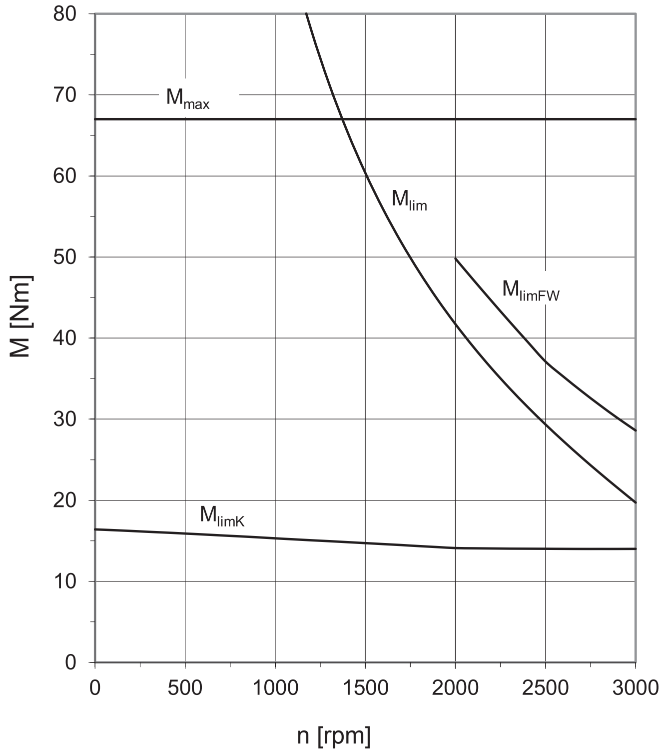
EZHP_512 (n_N=3000 rpm)



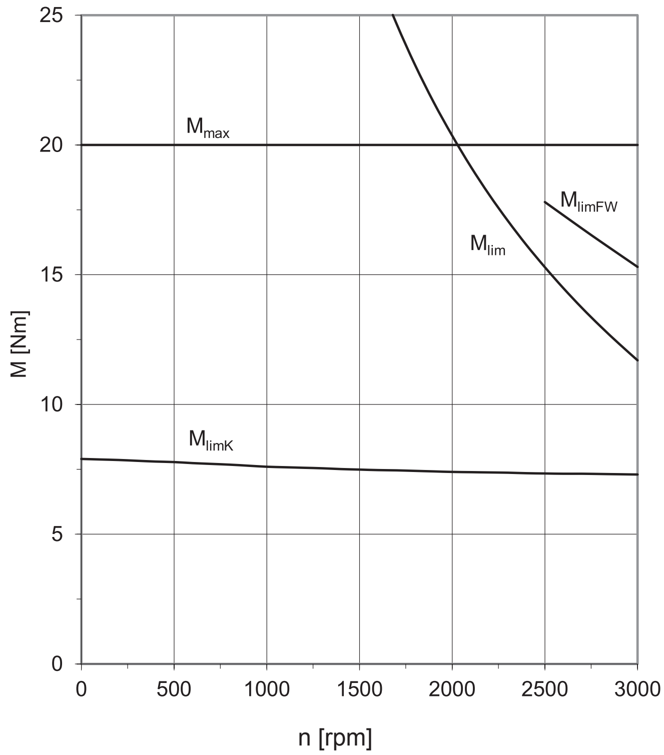
EZHP_513 (n_N=3000 rpm)



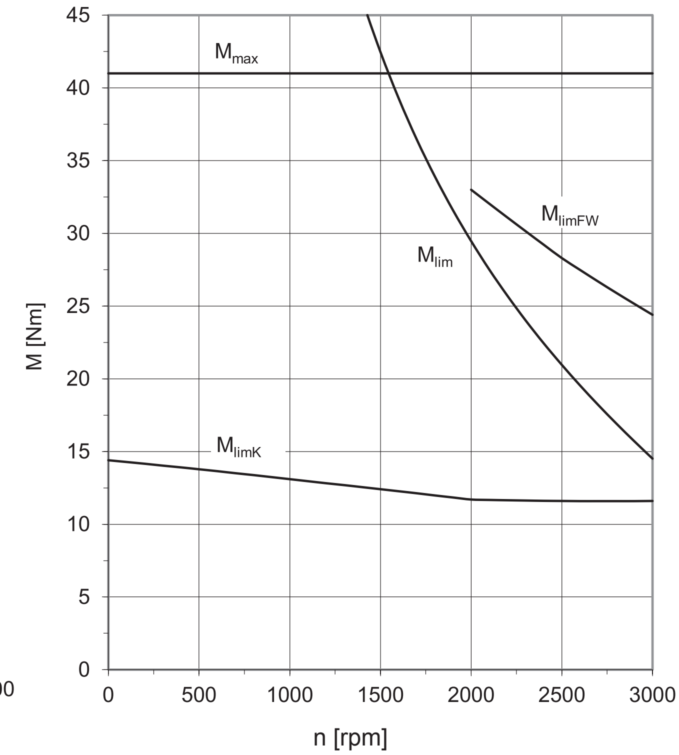
EZHP_515 (n_N=3000 rpm)



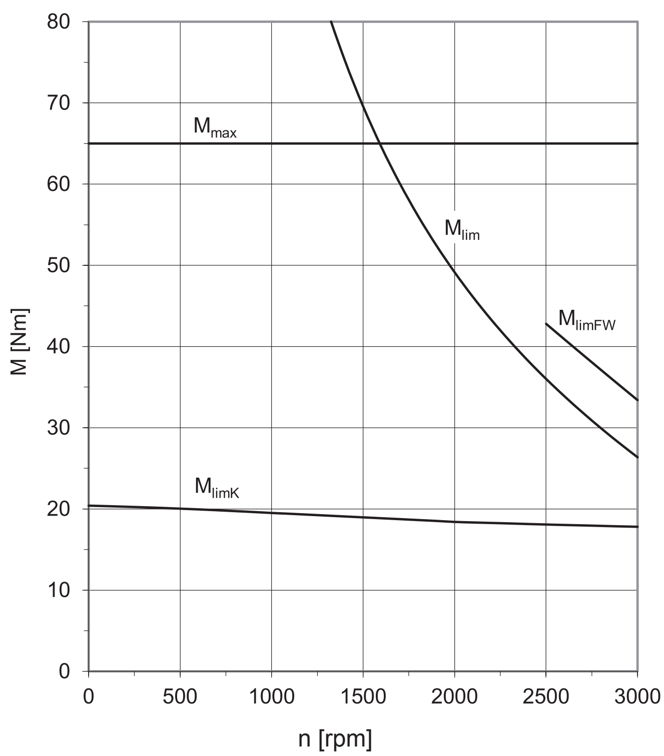
EZHP_711 (n_N=3000 rpm)



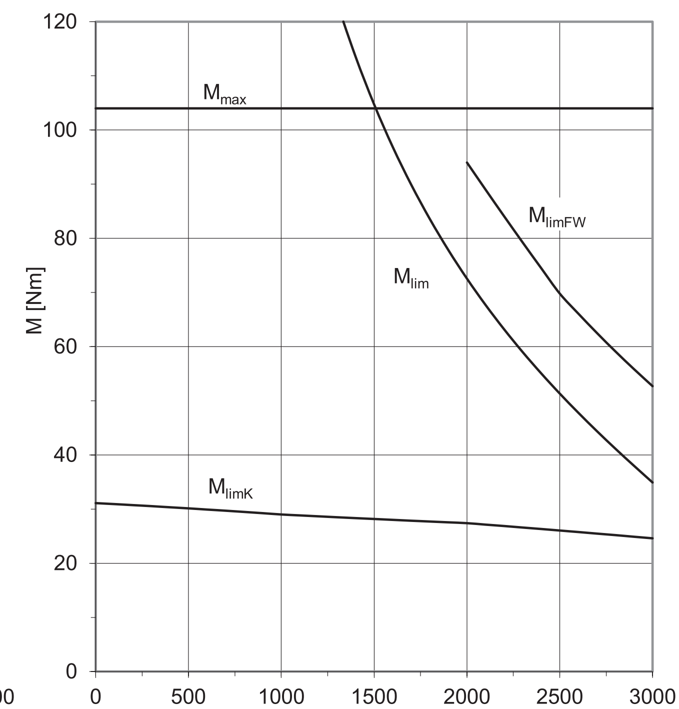
EZHP_712 (n_N=3000 rpm)



EZHP_713 (n_N=3000 rpm)



EZHP_715 (n_N=3000 rpm)



10.4 Dimensional drawings

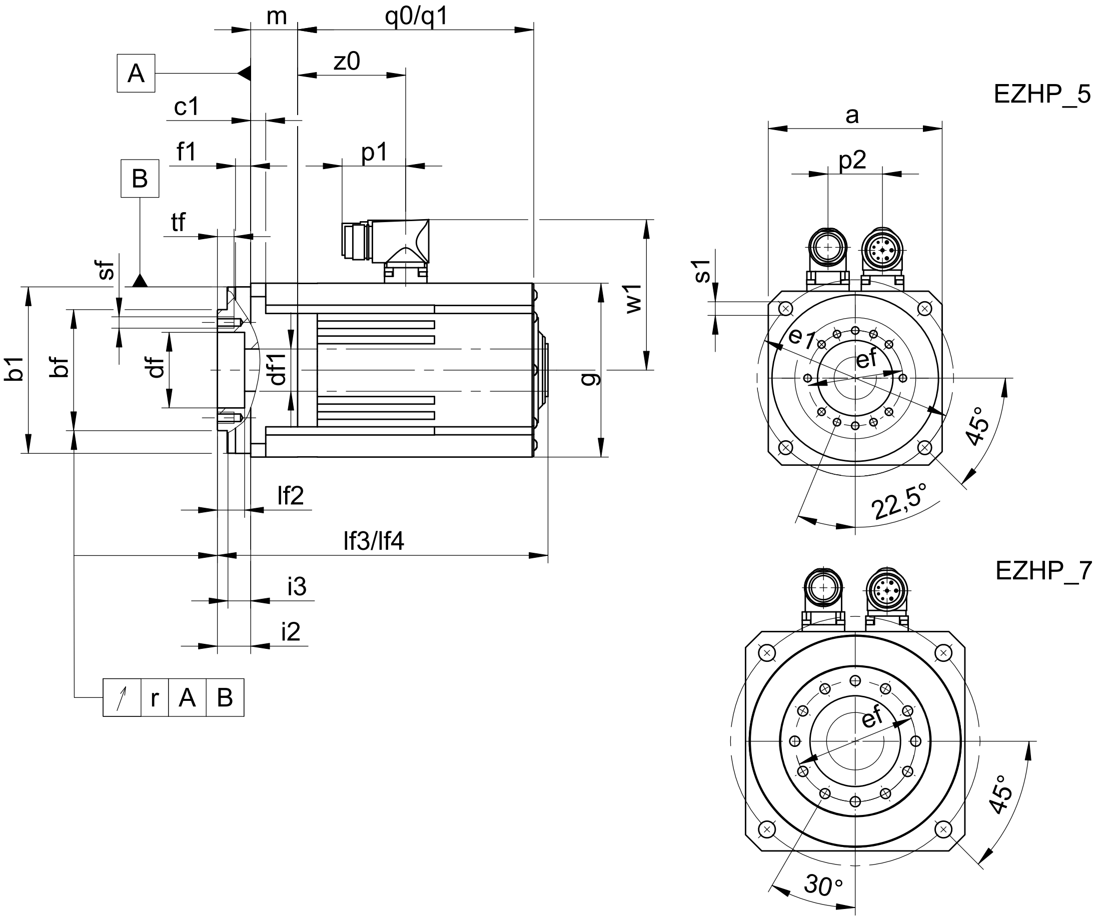
In this chapter, you can find the dimensions of the motors.

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

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

You can download CAD models of our standard drives at http://cad.stoeber.de.

10.4.1 EZHP geared motors



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

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	Single-stage (i=3) Two-stage (i=9) Three-stage (i=27)
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
097	Electromagnetic constant (EMC) K_{EM}	97 V/1000 rpm (example)

Notes

- In Chapter [▹ 10.6.7], you can find information about available encoders.
- In Chapter [▹ 10.6.7.3], you can find information about connecting the synchronous servo geared motors to other drive controllers from STOBER.

10.6 Product description

10.6.1 General features

Feature	Description
Design	IM B5, IM V1, IM V3 in accordance with EN 60034-7
Protection class	IP56 / IP66 (option)
Thermal class	155 (F) in accordance with EN 60034-1 (155 °C, heating Δϑ = 100 K)
Maximum permitted temperature at the surface of the geared motor	≤ 80 °C
Surface[1]	Matte black as per RAL 9005
Cooling	IC 410 convection cooling
Sealing	Gamma ring (on B side), shaft seal ring (on A side)
Shaft	Flange hollow shaft

[1] Repainting the motor will change the thermal properties and therefore the performance limits.

Feature	Description
Vibration intensity	A in accordance with EN 60034-14
Noise level	Limit values in accordance with EN 60034-9 (motor component) Limit values in accordance with VDI 2159 (geared component)

10.6.2 Electrical features

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

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

10.6.3 Installation conditions

The specified torques and forces only apply when attaching gear units at the machine side using screws of quality 10.9. In addition, the gear housing must be adjusted at the pilot (H7).

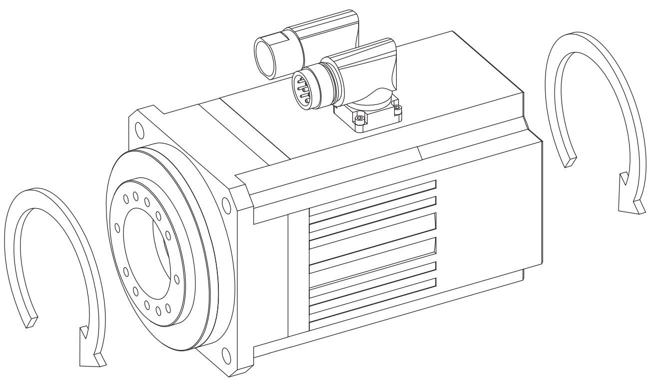
10.6.4 Lubricants

STOBER fills the gear units with the amount and type of lubricant specified on the nameplate.

Lubricant filling quantities 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 rotate 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 chapter.

Feature	Description
Surrounding temperature for transport/storage	−30 °C to +85 °C
Surrounding temperature for operation	−15 °C to +40 °C
Installation altitude	≤ 1000 m above sea level
Shock load	≤ 50 m/s² (5 g), 6 ms in accordance with EN 60068-2-27

Notes

- EHZP synchronous servo geared motors are not suitable for use in potentially explosive atmospheres in accordance with ATEX Directive.
- Secure 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 by shock loading.
- Also take into consideration the shock load of the geared motor due to output units which are coupled with the geared motor.

10.6.7 Encoders

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

10.6.7.1 Selection tool for EnDat interface

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

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

10.6.7.2 EnDat encoders

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

Encoders with EnDat 2.2 interface

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

Encoders with EnDat 2.1 interface

Encoder type	Type code	Measuring method	Recordable revolutions	Resolution	Position values per revolution	Periods per revolution
ECI 119	C4	Inductive	–	19 bit	524288	Sin/Cos 32

Notes

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

10.6.7.3 Possible combinations with drive controllers

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

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

Notes

- The drive controller and encoder type codes are a part of the type designation of the motor (see the "Type designation" chapter).

10.6.8 Temperature sensor

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

Some encoders have their own integrated analysis electronics for temperature monitoring with warning and shut-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 instance where an encoder with internal temperature monitoring forces the motor to shut down, even before the motor has reached its nominal data.

You can find information about the electrical connection of the temperature sensor in the "Connection 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 triple thermistor in accordance with DIN 44082 that allows the temperature of each winding phase to be monitored.

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

Feature	Description
Nominal response temperature ϑ_{NAT}	145 °C ± 5 K
Resistance R −20 °C up to ϑ_{NAT} − 20 K	≤ 250 Ω
Resistance R with ϑ_{NAT} − 5 K	≤ 550 Ω
Resistance R with ϑ_{NAT} + 5 K	≥ 1330 Ω
Resistance R with ϑ_{NAT} + 15 K	≥ 4000 Ω
Operating voltage	≤ DC 7.5 V
Thermal response time	< 5 s
Thermal class	155 (F) in accordance with EN 60034-1 (155 °C, heating Δϑ = 100 K)

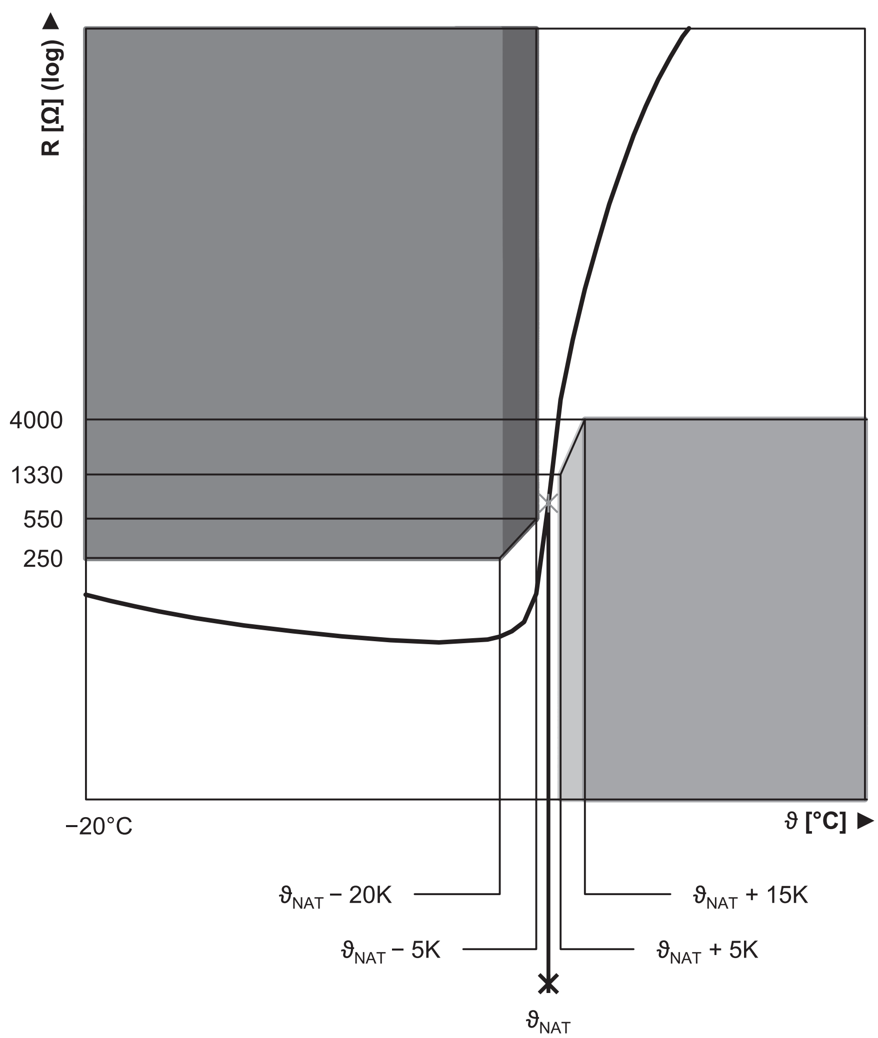


Fig. 2: PTC thermistor curve (single thermistor)

10.6.8.2 Pt1000 temperature sensor

STOBER synchronous servo motors are available in versions with a Pt1000 temperature sensor. The Pt1000 is a temperature-dependent resistor that has a resistance curve with a linear relationship with temperature. As a result, the Pt1000 allows for measurements of the winding temperature. These measurements are limited to one phase of the motor winding, however. In order to adequately protect the motor from exceeding the maximum permitted winding temperature, use a i²t model in the drive controller to monitor the winding temperature.

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

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

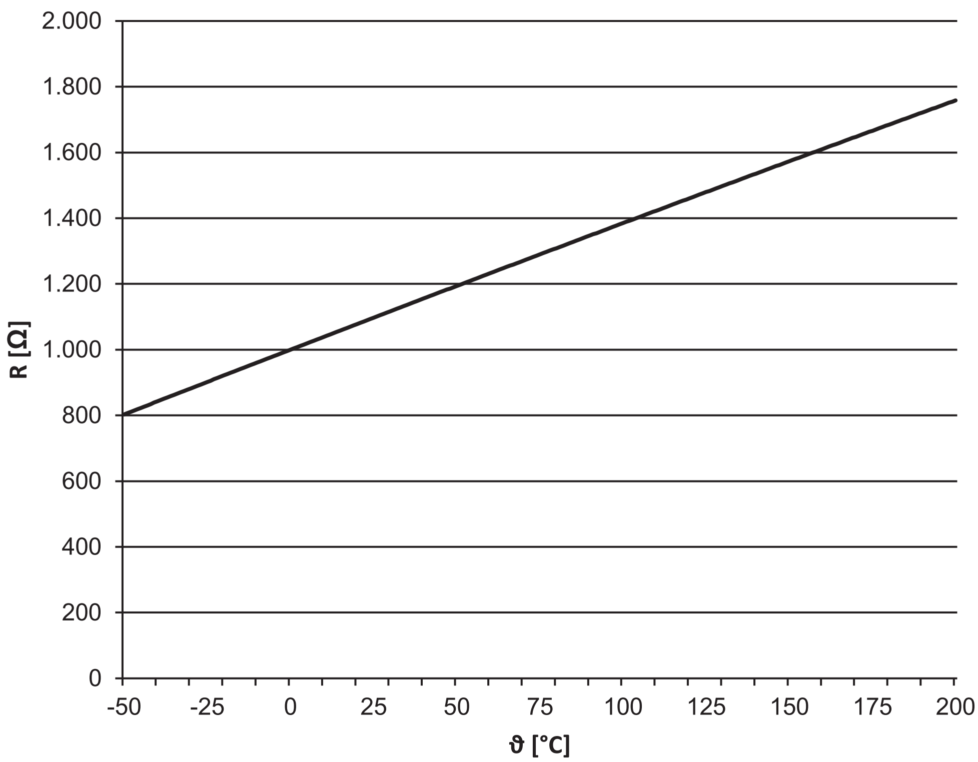


Fig. 3: Pt1000 temperature sensor characteristic curve

10.6.9 Cooling

An EZHP synchronous servo geared motor 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.

10.6.10 Holding brake

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

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

Observe the following during project configuration:

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

Formula symbol	Unit	Explanation
$I_{N,B}$	A	Nominal current of the brake at 20 °C
ΔJ_B	10^{-4} kgm²	Additive mass moment of inertia of a motor with holding brake
J	10^{-4} kgm²	Mass moment of inertia
J_{Bstop}	10^{-4} kgm²	Reference mass moment of inertia when braking from full speed: $J_{Bstop} = J \times 2$
J_{tot}	10^{-4} kgm²	Total mass moment of inertia (based on 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 symbol	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	Work done by friction for braking
$W_{B,Rlim}$	J	Work done by friction until wear limit is reached
$W_{B,Rmax/h}$	J	Maximum permitted work done by friction per hour with individual braking
$x_{B,N}$	mm	Nominal air gap of brake

Calculation of work done by friction per braking process

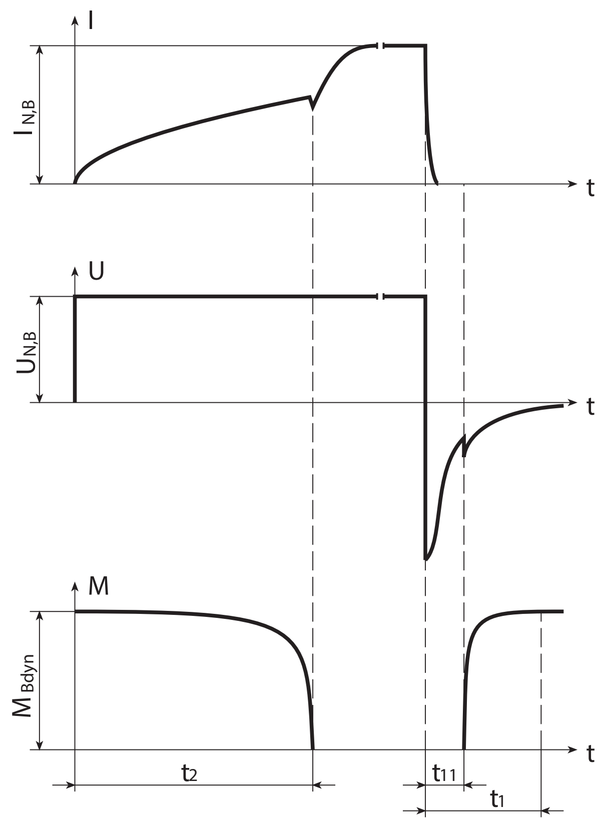
$$W_{B,R/B} = \frac{J_{tot} \cdot n^2}{182.4} \cdot \frac{M_{Bdyn}}{M_{Bdyn} \pm M_L}$$

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

Calculation of the stop time

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

Switching behavior



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

EZHP

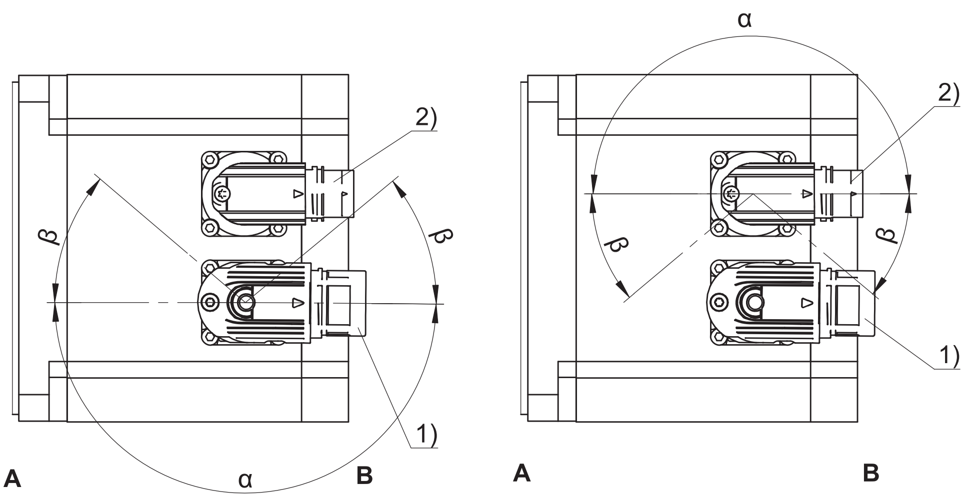
The following chapters describe the connection technology of STOBER synchronous servo motors in the standard version on STOBER drive controllers. You can find further information relating to the drive controller type that was specified in your order in the connection plan that is delivered with every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

10.6.11.1 Plug connectors

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

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

Turning ranges of plug connectors



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

Power plug connector features

Motor type	Size	Connection	Turning range	
			α	β
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°

Notes

- The number after "con." indicates the approximate external thread diameter of the plug connector in mm (for example, con.23 designates a plug connector with an external thread diameter of about 23 mm).
- In the β turning range, 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 grounding conductor system

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

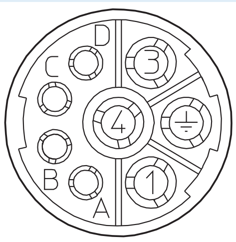
All attachment parts required for the connection of the grounding conductor to the motor housing are delivered with the motor. The grounding screw of the motor is identified with the symbol ⏚ in accordance with IEC 60417-DB. The minimum cross-section of the grounding conductor is specified in the following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

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

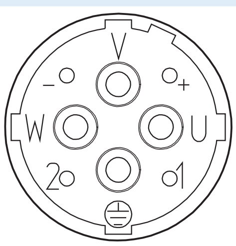
10.6.11.3 Connection assignment of the power plug connector

The size and connection plan of the power plug connector depend on the size of the motor. The colors of the connecting wires inside the motor are specified in accordance with IEC 60757.

Plug connector size con.23 (1)

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

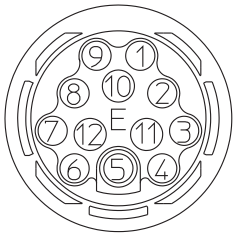
Plug connector size con.40 (1.5)

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

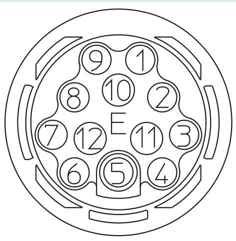
10.6.11.4 Connection assignment of the encoder plug connector

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

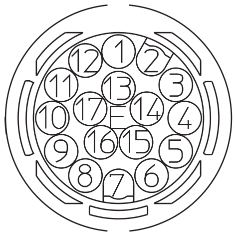
EnDat 2.1/2.2 digital encoders, plug connector size con.17

Connection diagram	Pin	Connection	Color
	1	Clock +	VT
	2	Up sense	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		

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

Connection diagram	Pin	Connection	Color
	1	Clock +	VT
	2	UBatt +	BU
	3	UBatt −	WH
	4		
	5	Data −	PK
	6	Data +	GY
	7		
	8	Clock −	YE
	9		
	10	0 V GND	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		

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

Connection diagram	Pin	Connection	Color
	1	Up sense	BU
	2		
	3		
	4	0 V sense	WH
	5		
	6		
	7	Up +	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 Project configuration

Project your drive using our SERVOsoft designing software. You can receive SERVOsoft for free from your adviser at one of our sales centers. Observe the limit conditions in this chapter to ensure a safe design for your drives.

10.7.1 Calculation of the operating point

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

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

Formula symbol	Unit	Explanation
a_{th}	–	Parameter for calculating $K_{mot,th}$
ED	%	Duty cycle relative to 20 minutes
fB_{op}	–	Operating mode operating factor
fB_t	–	Run-time operating factor
fB_T	–	Temperature operating factor
i	–	Gear ratio
$K_{mot,th}$	–	Factor for determining the thermal limit torque
$\|M_2\|$	Nm	Amount of torque on the output
$M_{2,1*}$ – $M_{2,6*}$	Nm	Actual torque in the respective time segment (1 to 6)
M_{2acc}	Nm	Maximum permitted acceleration torque on the gear unit output
M_{2acc*}	Nm	Actual acceleration torque on the gear unit output
M_{2eff*}	Nm	Actual effective torque on the gear unit output
M_{2eq*}	Nm	Equivalent torque present on the gear unit output
M_{2N}	Nm	Nominal torque on the gear unit output (relative to n_{1N})
M_{2NOT}	Nm	Gear unit emergency-off torque on the gear unit output for max. 1000 load changes
M_{2NOT*}	Nm	Actual 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 at the operating point from the motor characteristic curve at n_{1m*}
n_{1m*}	rpm	Actual average input speed
n_{1max*}	rpm	Actual maximum input speed
n_{1maxDB}	min^{-1}	Maximum permitted input speed of the gear unit in continuous operation
n_{1maxZB}	min^{-1}	Maximum permitted input speed of the gear unit in cyclic operation
$\|n_2\|$	rpm	Value of output speed
$n_{2m,1*}$ – $n_{2m,6*}$	rpm	Actual average output speed in the respective time segment (1 to 6)
n_{2m*}	rpm	Actual average output speed
n_N	rpm	Nominal speed: The speed for which the nominal torque M_N is specified
S	–	Load value: Quotient of gear unit and motor nominal torque without regard to the thermal performance limit. Represents a value for the reserve of the geared motor.
t	s	Time
t_{1*} – t_{6*}	s	Duration of the respective time segment (1 to 6)

Check the following conditions for operating points other than the nominal point M_{2N} specified in the selection tables.

$$n_{1m*} \leq \frac{n_{1maxDB}}{fB_T}$$

$$n_{1max*} \leq \frac{n_{1max\,ZB}}{fB_T}$$

$$M_{2eff*} \leq M_{2th}$$

$$M_{2acc*} \leq M_{2acc}$$

$$M_{2NOT*} \leq M_{2NOT}$$

$$M_{2eq*} \leq M_{2N} \cdot \frac{S}{fB_{op} \cdot fB_t}$$

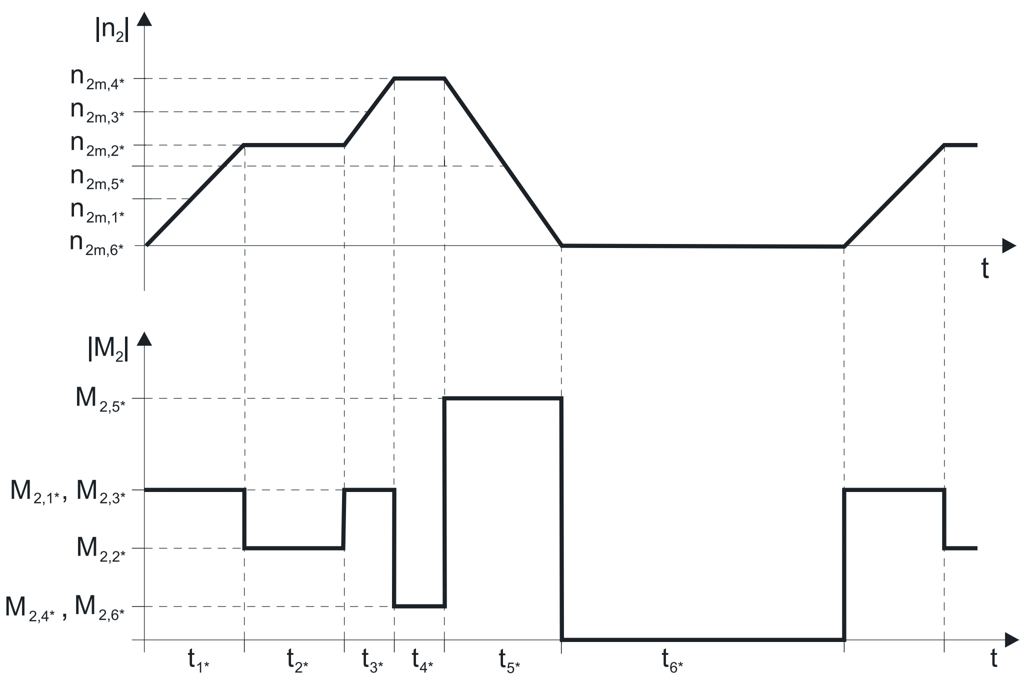
The values for n_{1maxDB}, n_{1maxZB}, M_{2acc}, M_{2NOT}, M_{2N} and S can be found in the selection tables.

The values for fB_T, fB_{op} and fB_t can be found in the corresponding tables in this chapter.

Calculate the thermal limit torque M_{2th} for a duty cycle > 50%.

Example of cycle sequence

The following calculations are based on a representation of the power taken from the output based in accordance with the following example:



Calculation of the actual 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, calculate n_{2m*} without the rest phase t_{6*}.

The values for the ratio i can be found in the selection tables.

Calculation of the actual 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 actual 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

Calculate the thermal limit torque M_{2th} for a duty cycle ED > 50% and the actual average input speed n_{1m*}. (At $K_{mot,th} \leq 0$ you must reduce the average input speed n_{1m*} accordingly or select another geared motor size.)

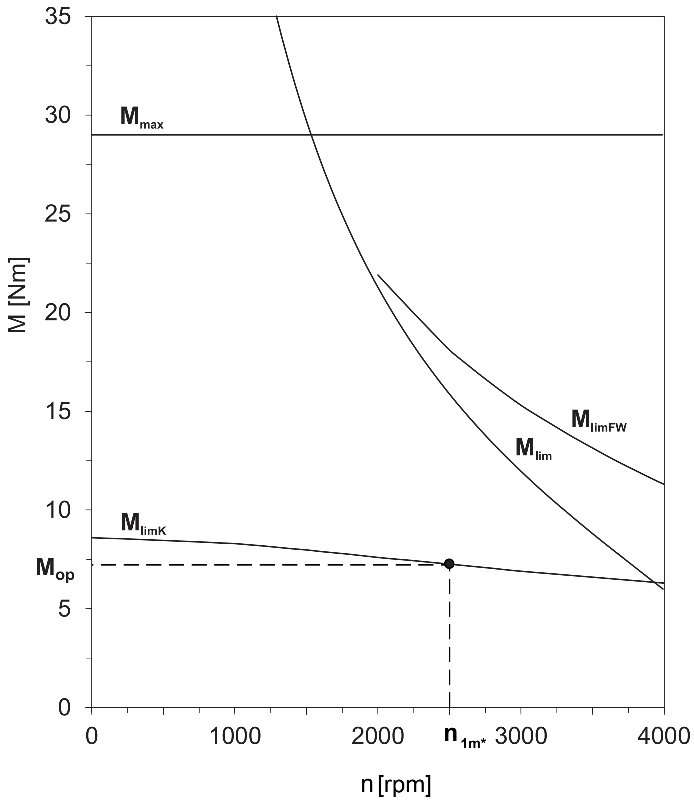
$$M_{2th} = M_{op} \cdot i \cdot K_{mot,th}$$

$$K_{mot,th} = 0{,}93 - \frac{a_{th}}{1000} \cdot fB_T \cdot \left(\frac{n_{1m*}}{1000}\right)^3$$

The values for i and a_{th} can be found in the selection tables.

The values for fB_T can be found in the corresponding table in this chapter.

The value for the torque of the motor at operating point M_{op} with the determined average input speed n_{1m*} can be found in the motor curve of Chapter [▸ 10.3]. Note the size and nominal speed n_N of the motor. The figure below shows an example of reading the torque M_{op} at the operating point.



Operating factors

Operating mode	fB_{op}
Uniform continuous operation	1.00
Cyclic operation	1.00
Reversing load cyclic operation	1.00

Run time	fB_t
Daily run time ≤ 8 h	1.00
Daily run time ≤ 16 h	1.15
Daily run time ≤ 24 h	1.20

Temperature	fB_T
Surrounding temperature ≤ 20 °C	1.0
Surrounding temperature ≤ 30 °C	1.1
Surrounding temperature ≤ 40 °C	1.25

Notes

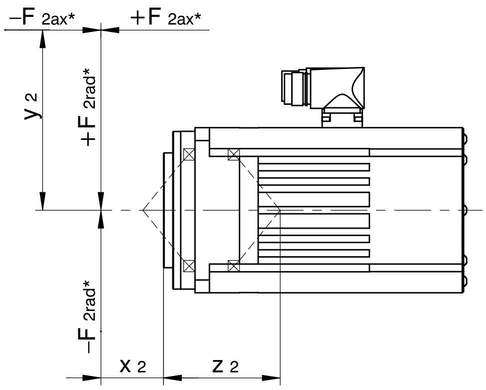
- The maximum permitted gear unit temperature (see the "General product features" chapter) must not be exceeded. Doing so may result in damage to the geared motor.
- For braking from full speed (for example when the power fails or when setting up the machine), note the permitted gear unit torques (M_{2acc}, M_{2NOT}) in the selection tables.

10.7.2 Permitted shaft loads

Formula symbol	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	Actual axial force at the gear unit output
F_{2ax100}	N	Permitted axial force at 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 at the gear unit output
F_{2rad*}	N	Actual radial force on the gear unit output
$F_{2rad100}$	N	Permitted radial force at the gear unit output for $n_{2m*} \leq 100$ rpm
F_{2radN}	N	Permitted nominal radial force at the gear unit output
$F_{2rad,acc*}$	N	Actual radial acceleration force at the gear unit output
$F_{2rad,acc}$	N	Permitted radial acceleration force at the gear unit output
$F_{2rad,acc,n*}$	N	Actual radial acceleration force at the gear unit output in the n-th time segment
$F_{2rad,eq*}$	N	Actual equivalent force at the gear unit output
L_{10h}	h	Bearing service life
M_{2k*}	Nm	Actual 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	Actual equivalent breakdown torque on the gear unit output
M_{2kN}	Nm	Permitted nominal breakdown torque on the gear unit output
n_{2m*}	rpm	Actual average output speed
$n_{2m,n*}$	rpm	Actual average output speed in the n-th time segment
t_{n*}	s	Duration of the n-th time segment
x_2	mm	Distance of the shaft shoulder to the force application point
y_2	mm	Distance of the shaft axis to the axial force application point
z_2	mm	Distance of the shaft shoulder to the middle of the output bearing

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

- For shaft dimensions in accordance with 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)



For other output speeds, download diagrams at http://products.stoeber.de.

The following applies to 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 transverse forces can be determined from the permitted breakdown torque M_{2kN} and $M_{2k,acc}$. The actual transverse forces must not exceed the permitted transverse forces. The permitted transverse forces are based on the end of the hollow shaft (x2 = 0).

$$M_{2k,acc*} = \frac{2 \cdot F_{2ax*} \cdot y_2 + F_{2rad,acc*} \cdot (x_2 + z_2)}{1000} \leq M_{2k,acc}$$

For applications with multiple axial and/or radial forces, you must add the forces as vectors.

In the event of EMERGENCY OFF operation (max. 1000 load changes), you can multiply the permitted forces and torques for F_{2ax100}, $F_{2rad100}$ and M_{2k100} by a factor of two.

Also note 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*}

For different duty cycles:

$$L_{10h} > L_{10h(ED=40\%)} \cdot \frac{40\%}{ED}$$

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 61000-6-2:2005
- EN 61000-6-4:2007 + A1:2011
- EN 60034-1:2010 + Cor.:2010
- EN 60034-5:2001 + A1:2007
- EN 60034-6:1993

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 "COMPONENT - SERVO AND STEPPER MOTORS"; registered under UL number E488992 with Underwriters Laboratories USA (optional).

10.8.3 Additional documentation

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

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

Documentation	ID
Operating manual for EZ synchronous servo motors	442585

11 EZM synchronous servo motor for screw drives

Table of contents

STOBER

11.1 Overview

Synchronous servo motor for screw drives (direct drive for threaded nut)

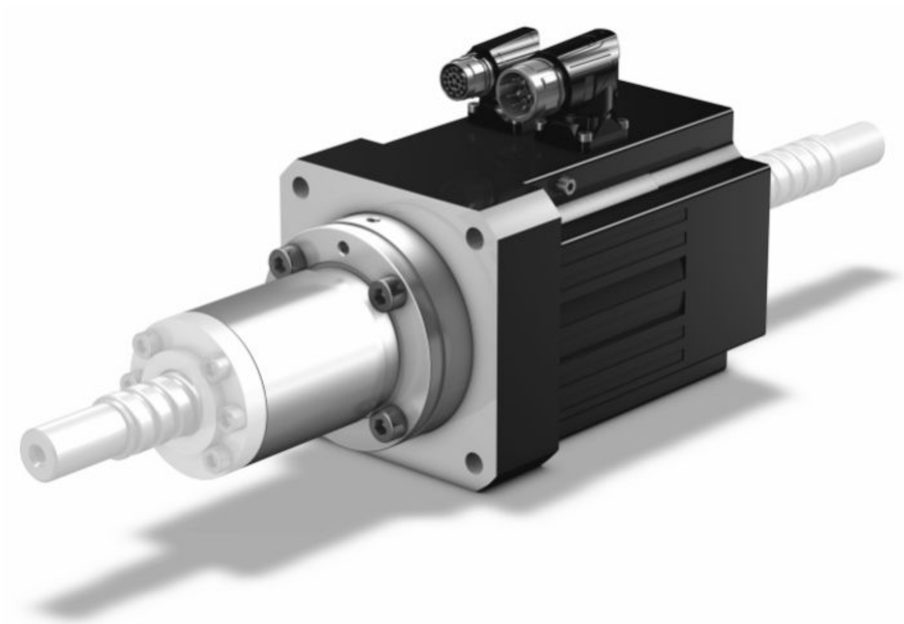
Axial forces

F_{ax}	751 – 21375 N

Features

Designed for driving the ball-threaded nut of ball screws in accordance with DIN 69051-2.	✓
Axial angular contact ball bearing acting on two sides for direct absorption of the threaded spindle forces	✓
Super compact due to tooth-coil winding method with the highest possible copper fill factor	✓
Backlash-free holding brake (optional)	✓
Convection cooling	✓
Inductive EnDat absolute encoders	✓
Elimination of referencing with multi-turn absolute encoders (optional)	✓
Electronic nameplate for fast and reliable commissioning	✓
Rotating plug connectors with quick lock	✓

EZM



11.2 Selection tables

The technical data specified in the selection tables applies to:

- 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
- Black matte paint as per RAL 9005

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

Motor type	Steel mounting flange dimensions (thickness x width x height)	Convection surface area 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 symbol	Unit	Explanation
F_{ax}	N	Permitted axial force on the output
I_0	A	Stall current: RMS value of the line-to-line current when the stall torque M_0 is generated (tolerance ±5%)
I_{max}	A	Maximum current: RMS value of the maximum permitted line-to-line current when maximum torque M_{max} is 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 when nominal torque M_N is 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 stall torque and frictional torque to the stall 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 a resonant circuit)
m	kg	Weight
M_0	Nm	Stall torque: The continuous torque the motor is able to deliver at a speed of 10 rpm (tolerance ±5%)
M_{max}	Nm	Maximum torque: the maximum permitted torque the motor is able to deliver over a short period (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 torque values as follows: $M_{N^*} = K_{M0} \cdot I^* - M_R$.
M_R	Nm	Frictional torque (of the bearings and seals) of a motor at winding temperature $\Delta\vartheta$ = 100 K

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

Type	K_{EM} [V/1000 rpm]	n_N [rpm]	M_N [Nm]	I_N [A]	$K_{M,N}$ [Nm/A]	P_N [kW]	M_0 [Nm]	I_0 [A]	K_{M0} [Nm/A]	M_R [Nm]	M_{max} [Nm]	I_{max} [A]	R_{U-V} [Ω]	L_{U-V} [mH]	T_{el} [ms]
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

11.2.1 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 curves

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

Formula symbol	Unit	Explanation
ED	%	Duty cycle based on 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 over a short period (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

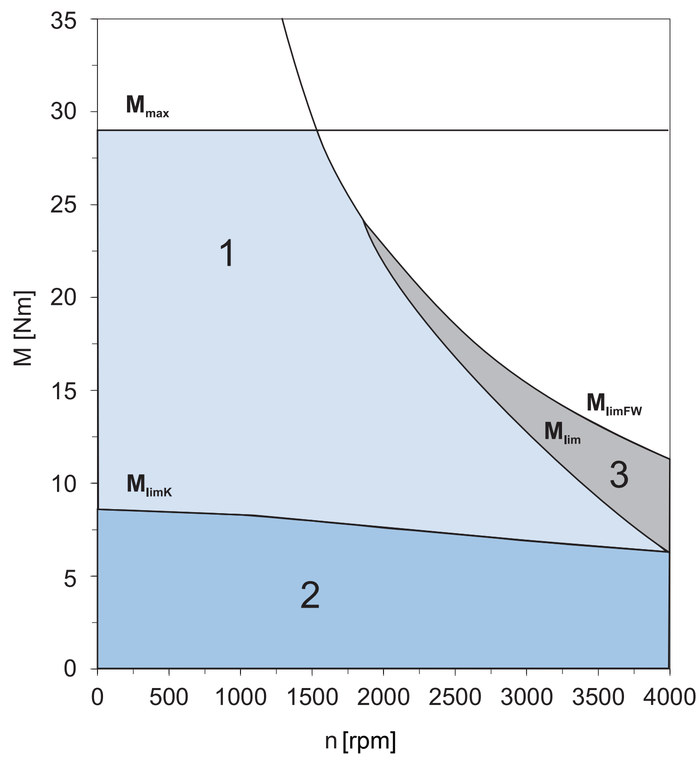
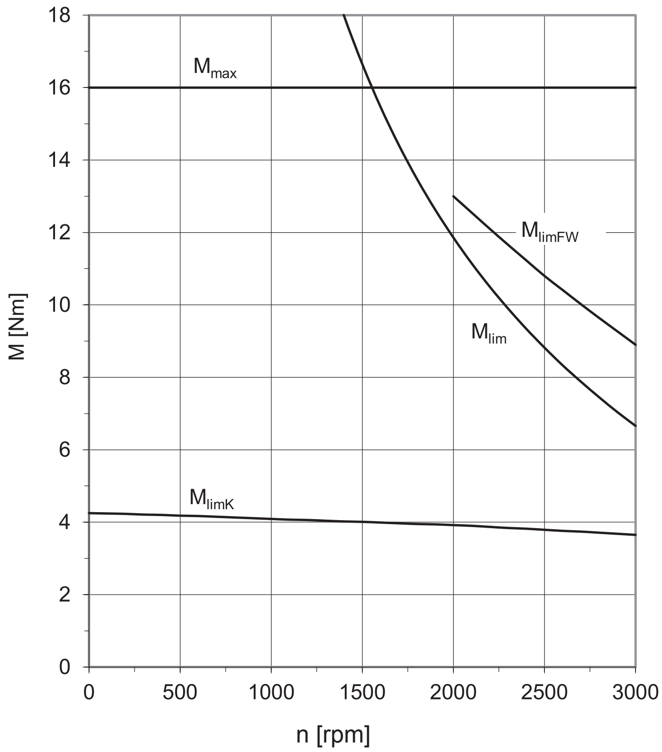


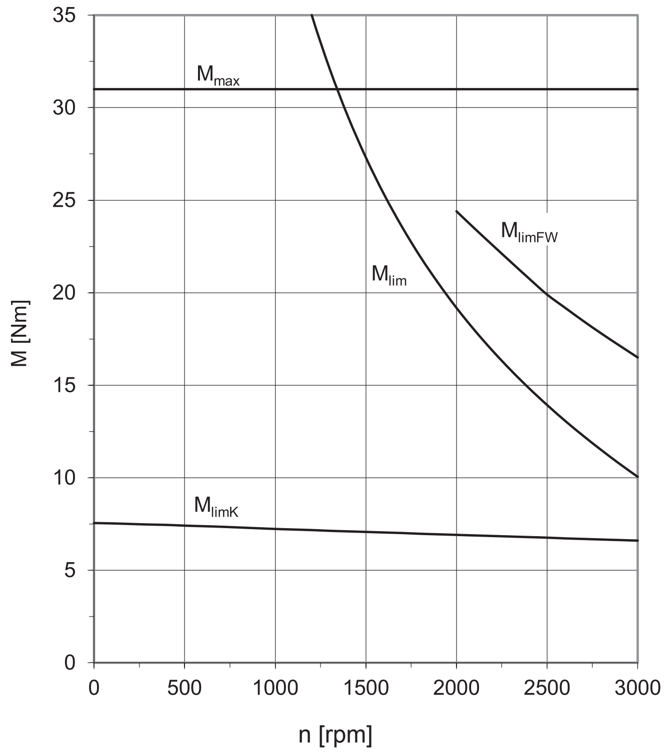
Fig. 1: Explanation of a torque/speed curve

1	Torque range for brief operation (duty cycle < 100%) with $\Delta\vartheta$ = 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 be used only with operation on STOBER drive controllers)		

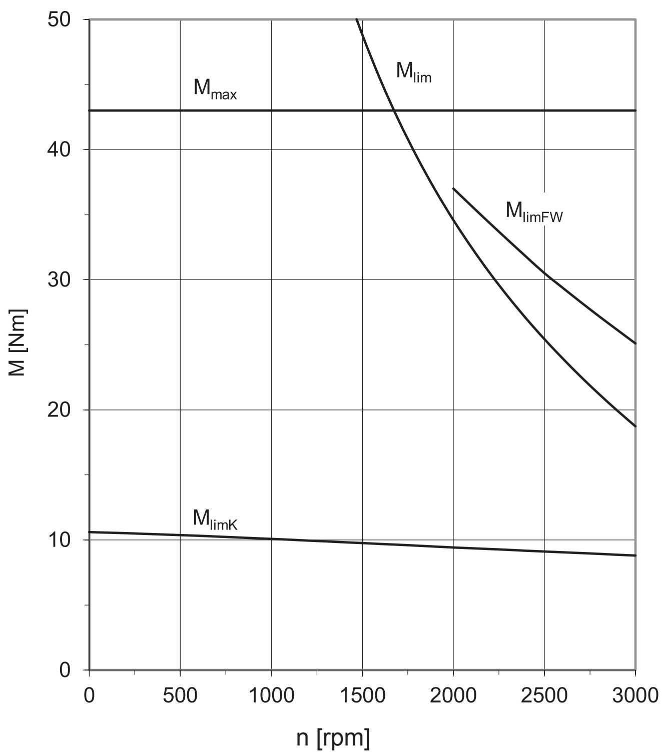
EZM511 (n_N=3000 rpm)



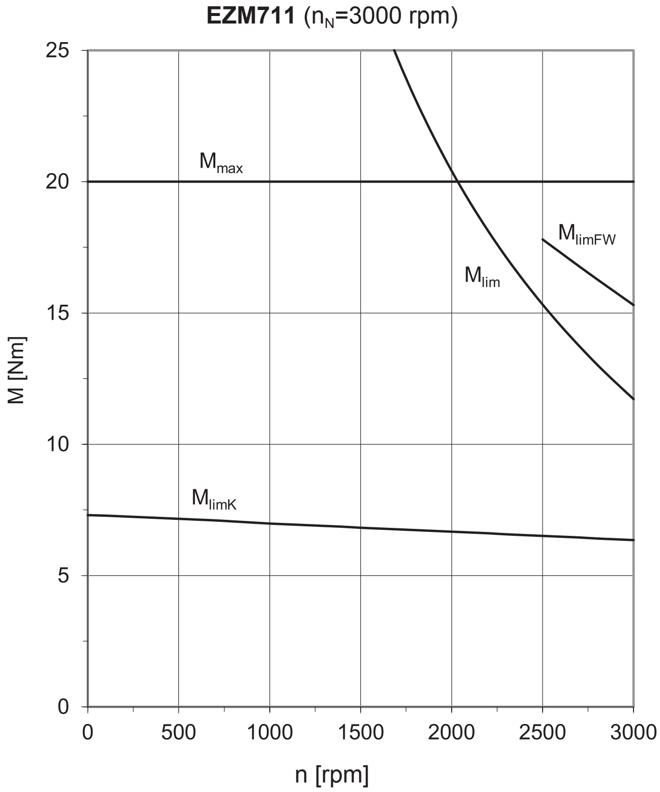
EZM512 (n_N=3000 rpm)

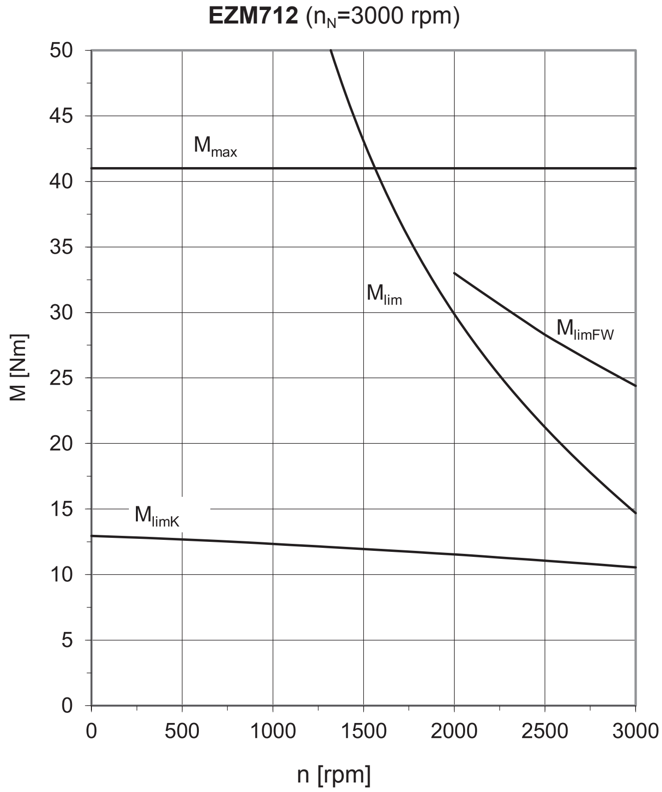


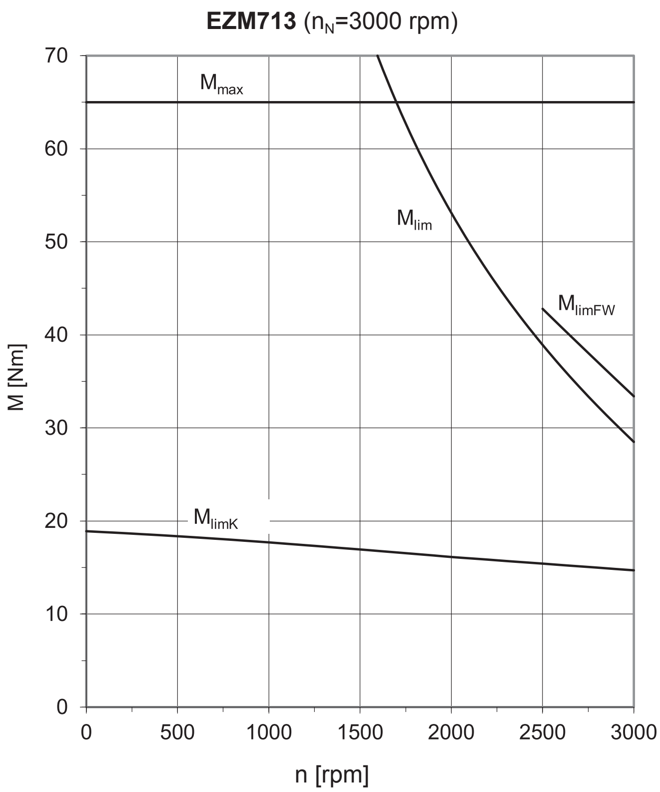
EZM513 (n_N=3000 rpm)



EZM


EZM711 (n_N=3000 rpm)
25
20
15
10
5
0
M [Nm]
M_{max}
M_{lim}
M_{limFW}
M_{limK}
0
500
1000
1500
2000
2500
3000
n [rpm]


EZM712 (n_N=3000 rpm)
50
45
40
35
30
25
20
15
10
5
0
M [Nm]
M_{max}
M_{lim}
M_{limFW}
M_{limK}
0
500
1000
1500
2000
2500
3000
n [rpm]


EZM713 (n_N=3000 rpm)
70
60
50
40
30
20
10
0
M [Nm]
M_{max}
M_{lim}
M_{limFW}
M_{limK}
0
500
1000
1500
2000
2500
3000
n [rpm]

11.4 Dimensional drawings

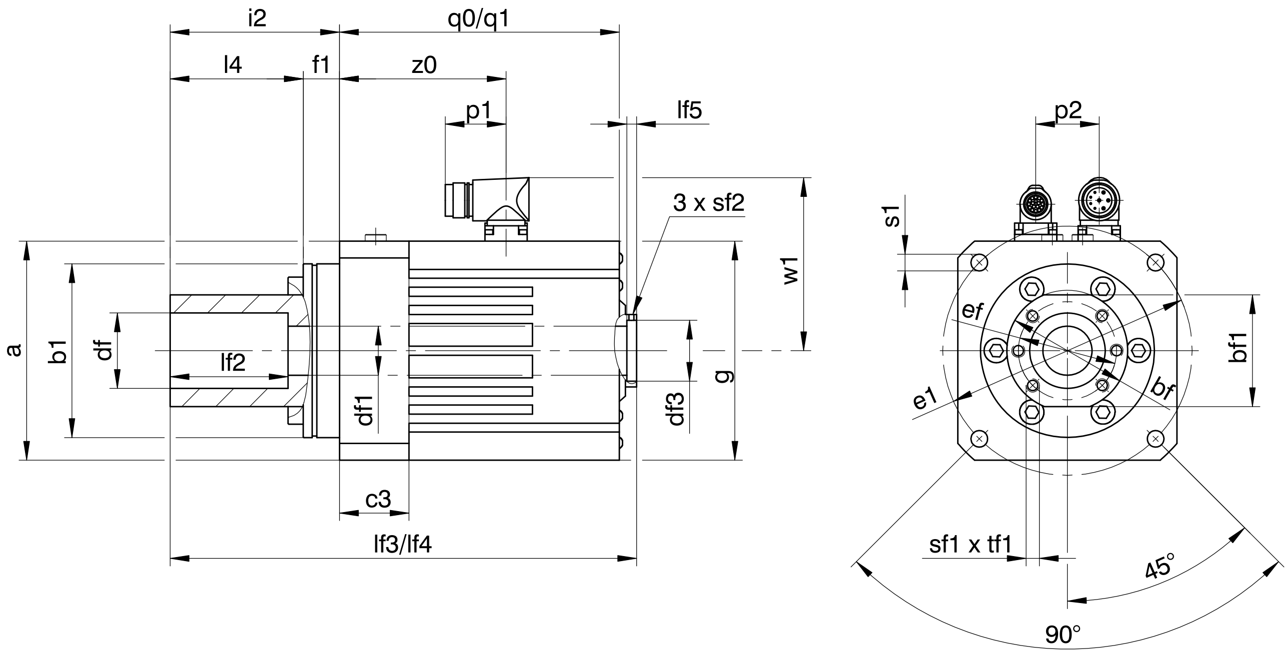
In this chapter, you can find the dimensions of the motors.

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

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

You can download CAD models of our standard drives at http://cad.stoeber.de.

11.4.1 EZM motors



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

11.5 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 drives
5	Motor size	5 (example)
1	Generation	1
1	Length	1 (example)
U	Cooling	Convection 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)

Notes

- In Chapter [▸ 11.6.6], you can find information about available encoders.
- In Chapter [▸ 11.6.6.3], you can find information about connecting synchronous servo motors to other drive controllers from STOBER.

11.6 Product description

11.6.1 General features

Feature	EZM5	EZM7
Maximum threaded spindle diameter ∅dkg [mm]	25.00	32.00
Pitch of threaded spindle P_{st}	5 – 25	5 – 32
Pilot ∅Dkg [mm]	40	50/56
Bolt 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) in accordance with EN 60034-1 (155°C, heating $\Delta\vartheta$ = 100 K)	
Surface[4]	Matte black as per RAL 9005	

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

Feature	EZM5	EZM7
Noise level	Limit values in accordance with EN 60034-9	
Cooling	IC 410 convection cooling	

11.6.2 Electrical features

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

Feature	Description
DC link voltage	DC 540 V (max. 620 V) on STOBER drive controllers
Winding	Three-phase, single-tooth coil design
Circuit	Star, center not led through
Protection class	I (protective grounding) in accordance with EN 61140
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 chapter.

Feature	Description
Surrounding temperature for transport/storage	−30 °C to +85 °C
Surrounding temperature for operation	−15 °C to +40 °C
Installation altitude	≤ 1000 m above sea level
Shock load	≤ 50 m/s² (5 g), 6 ms in accordance with EN 60068-2-27

Notes

- STOBER synchronous servo motors are not suitable for potentially explosive atmospheres in accordance with (ATEX) Directive2014/34/EU.
- Secure 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 by shock loading.

11.6.4 Threaded nut

The driven threaded nut (stationary mounting of threaded spindle) has the following advantages compared to the driven threaded spindle (stationary mounting of threaded nut):

- Higher axial velocity can be achieved with long threaded spindles because the swinging of the threaded spindle is less problematic.
- Drastic reduction in the power loss of the threaded spindle bearing because the stretching forces of the threaded spindle do not have to be channeled 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.

11.6.4.1 Lubrication of the threaded nut

As the system makes supplying lubricant to the driven threaded nut difficult, it should be lubricated via the threaded spindle. The following options are available for this purpose.

- For threaded nut with axial motion: using a lubrication channel in the threaded spindle that is implemented 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 correctly aligned in this position. The amount of lubricant is generally sufficient until the next tool change without any problems.
- For threaded spindle with axial motion: using lubrication brushes attached to the machine that are connected to the lubrication supply and dispense the lubricant to the threaded spindle as it moves axially.

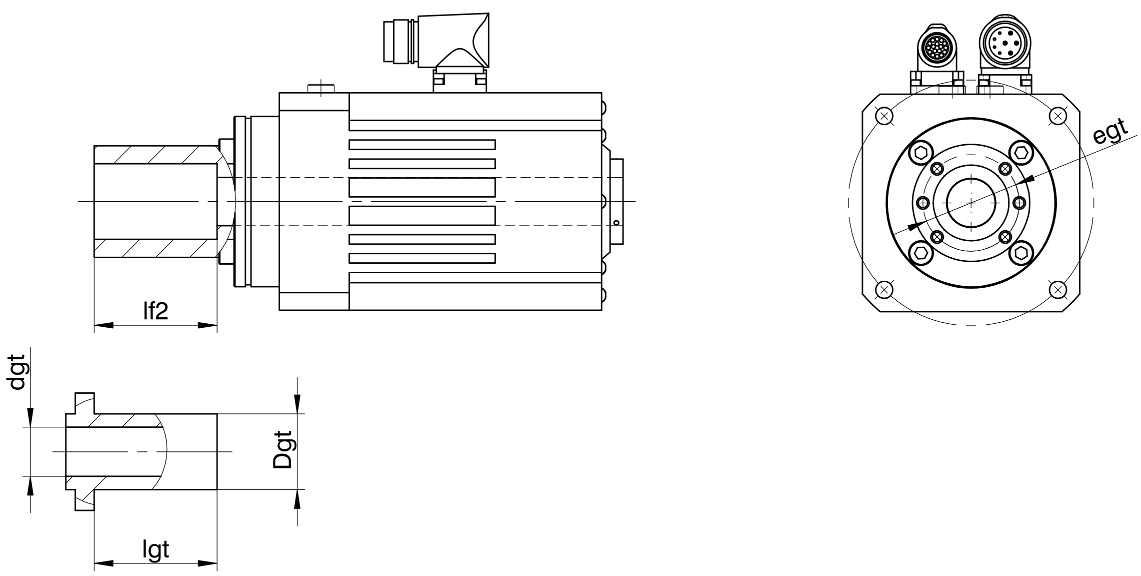
Lubricants that enter into the inside of the motor can impair the function of the holding brake and encoder. Therefore, take the protection class of the synchronous servo motor into account when configuring your screw drive, especially when installing the synchronous servo motor vertically with the A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

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 chapters 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 symbol	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 design of the EZM motor allows for the threaded spindle of the screw drive to 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 threaded spindles with a maximum outer diameter that does not exceed the nominal diameter. Be aware 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 (also see the maximum threaded spindle diameter Ødkg feature in Chapter [▸ 11.6.1]).

11.6.6 Encoders

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

11.6.6.1 Selection tool for EnDat interface

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

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

11.6.6.2 EnDat encoders

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

Encoders with EnDat 2.2 interface

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

Encoders with EnDat 2.1 interface

Encoder type	Type code	Measuring method	Recordable revolutions	Resolution	Position values per revolution	Periods per revolution
ECI 119	C4	Inductive	–	19 bit	524288	Sin/Cos 32

Notes

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

11.6.6.3 Possible combinations with drive controllers

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

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

Notes

- The drive controller and encoder type codes are a part of the type designation of the motor (see the "Type designation" chapter).

11.6.7 Temperature sensor

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

Some encoders have their own integrated analysis electronics for temperature monitoring with warning and shut-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 instance where an encoder with internal temperature monitoring forces the motor to shut down, even before the motor has reached its nominal data.

You can find information about the electrical connection of the temperature sensor in the "Connection 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 triple thermistor in accordance with DIN 44082 that allows the temperature of each winding phase to be monitored.

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

Feature	**Description**
Nominal response temperature ϑ_{NAT}	145 °C ± 5 K
Resistance R −20 °C up to ϑ_{NAT} − 20 K	≤ 250 Ω
Resistance R with ϑ_{NAT} − 5 K	≤ 550 Ω
Resistance R with ϑ_{NAT} + 5 K	≥ 1330 Ω
Resistance R with ϑ_{NAT} + 15 K	≥ 4000 Ω
Operating voltage	≤ DC 7.5 V
Thermal response time	< 5 s
Thermal class	155 (F) in accordance with EN 60034-1 (155 °C, heating $\Delta\vartheta$ = 100 K)

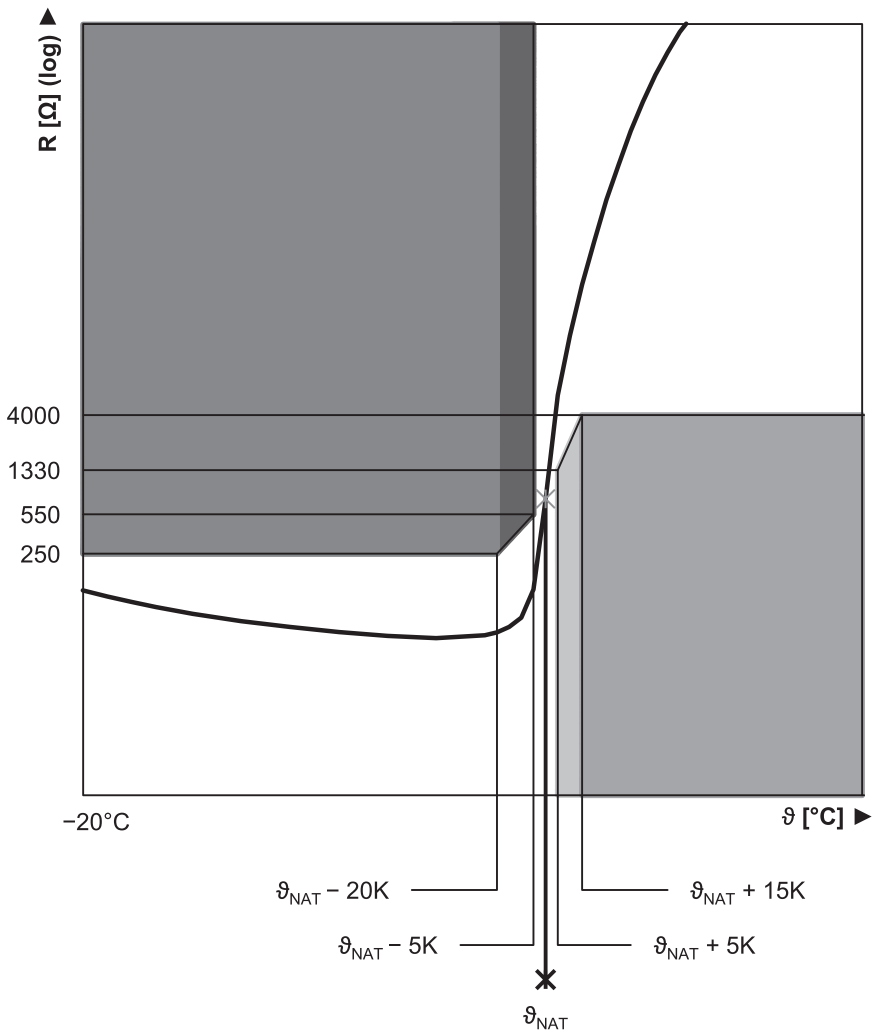


Fig. 2: PTC thermistor curve (single thermistor)

11.6.7.2 Pt1000 temperature sensor

STOBER synchronous servo motors are available in versions with a Pt1000 temperature sensor. The Pt1000 is a temperature-dependent resistor that has a resistance curve with a linear relationship with temperature. As a result, the Pt1000 allows for measurements of the winding temperature. These measurements are limited to one phase of the motor winding, however. In order to adequately protect the motor from exceeding the maximum permitted winding temperature, use a i^2t model in the drive controller to monitor the winding temperature.

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

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

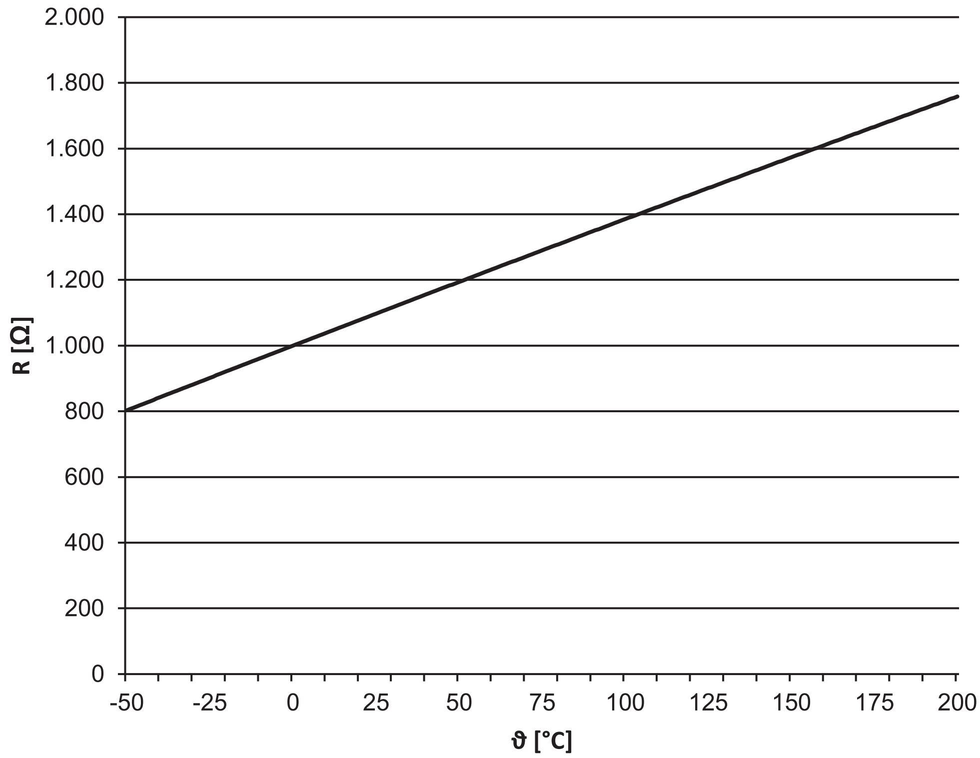


Fig. 3: Pt1000 temperature sensor characteristic curve

11.6.8 Cooling

An EZM motor 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.

11.6.9 Holding brake

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

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

Observe the following during project configuration:

- In exceptional circumstances, the holding brake can be used for braking from full speed (following a power failure or when setting up the machine). The maximum permitted work done by friction $W_{B,Rmax/h}$ may not be exceeded. Activate other braking processes during operation using the corresponding brake functions of the drive controller to prevent premature wear on the holding brake.
- Note that the braking torque M_{Bdyn} may initially be up to 50% less when braking from full speed. As a result, the braking effect has a delayed action and braking distances become longer.
- Regularly perform a brake test to ensure the functional safety of the brakes. Details can be found in the documentation of the motor and the drive controller.
- Connect a varistor of type S14 K35 (or comparable) in parallel to the brake coil to protect your machine from switching surges. (Not necessary for connecting the holding brake to STOBER drive controllers with BRS/BRM brake module).
- The holding brake of the synchronous servo motor does not offer adequate safety for persons in the hazardous area of gravity-loaded vertical axes. Therefore take additional measures to minimize risk, e.g. by providing a mechanical substructure for maintenance work.

- Take into consideration voltage losses in the connection cables that connect the voltage source to the holding brake connections.
- The braking torque of the brake can be reduced by shock loading. Information about shock loading can be found in the "Ambient conditions" chapter.

Formula symbol	Unit	Explanation
$I_{N,B}$	A	Nominal current of the brake at 20 °C
ΔJ_B	10^{-4} kgm²	Additive mass moment of inertia of a motor with holding brake
J	10^{-4} kgm²	Mass moment of inertia
J_{Bstop}	10^{-4} kgm²	Reference mass moment of inertia when braking from full speed: $J_{B\text{-}stop} = J \times 2$
J_{tot}	10^{-4} kgm²	Total mass moment of inertia (based on 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	Work done by friction for braking
$W_{B,Rlim}$	J	Work done by friction until wear limit is reached
$W_{B,Rmax/h}$	J	Maximum permitted work done by friction per hour with individual braking
$x_{B,N}$	mm	Nominal air gap of brake

Calculation of work done by friction per braking process

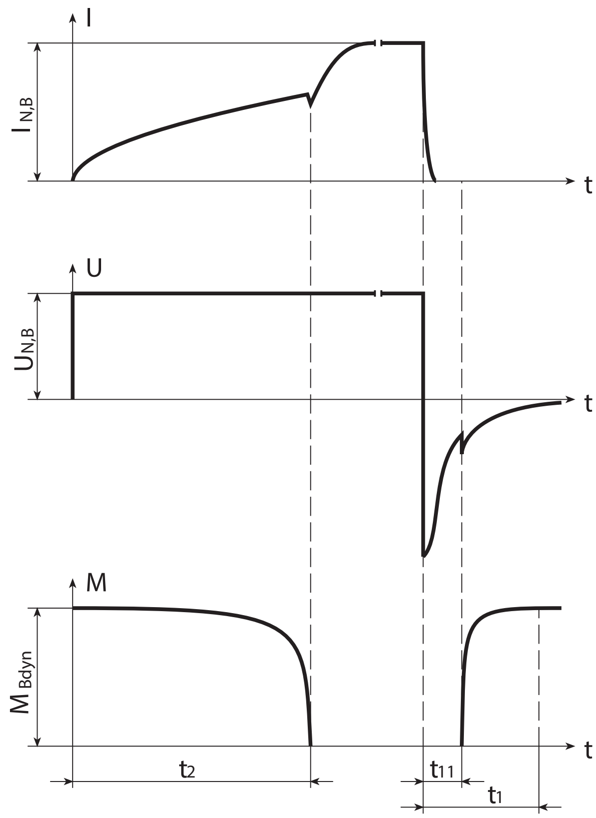
$$W_{B,R/B} = \frac{J_{tot} \cdot n^2}{182.4} \cdot \frac{M_{Bdyn}}{M_{Bdyn} \pm M_L}$$

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

Calculation of the stop time

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

Switching behavior



Technical data

	M_{Bstat}	M_{Bdyn}	$I_{N,B}$	$W_{B,Rmax/h}$	$N_{B,stop}$	$J_{B,stop}$	$W_{B,Rlim}$	t_2	t_{11}	t_1	$x_{B,N}$	ΔJ_B	Δm_B
	[Nm]	[Nm]	[A]	[kJ]		[10^{-4}kgm²]	[kJ]	[ms]	[ms]	[ms]	[mm]	[10^{-4}kgm²]	[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 chapters describe the connection technology of STOBER synchronous servo motors in the standard version on STOBER drive controllers. You can find further information relating to the drive controller type that was specified in your order in the connection plan that is delivered with every synchronous servo motor.

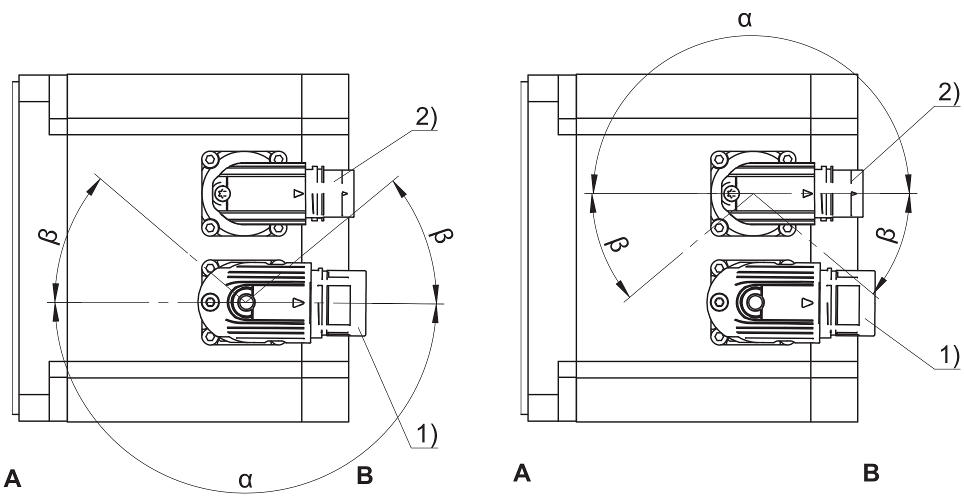
11.6.10.1 Plug connectors

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

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

EZM

Turning ranges of plug connectors



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

Power plug connector features

Motor type	Size	Connection	Turning range	
			α	β
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°

Notes

- The number after "con." indicates the approximate external thread diameter of the plug connector in mm (for example, con.23 designates a plug connector with an external thread diameter of about 23 mm).
- In the β turning range, 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 grounding conductor system

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

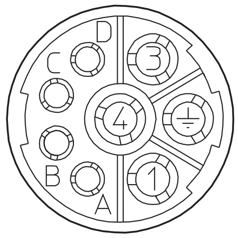
All attachment parts required for the connection of the grounding conductor to the motor housing are delivered with the motor. The grounding screw of the motor is identified with the symbol ⏚ in accordance with IEC 60417-DB. The minimum cross-section of the grounding conductor is specified in the following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

Cross-section of the copper grounding conductor in the power cable (A)	Cross-section of the copper grounding conductor for the 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 connecting wires inside the motor are specified in accordance with IEC 60757.

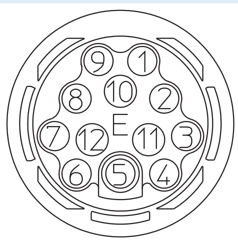
Plug connector size con.23 (1)

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

11.6.10.4 Connection assignment of the encoder plug connector

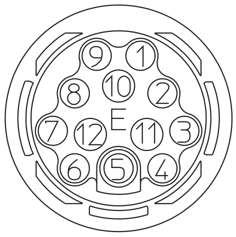
The size and connection assignment of the encoder plug connectors depend on the type of encoder installed and the size of the motor. The colors of the connecting wires inside the motor are specified in accordance with IEC 60757.

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

Connection diagram	Pin	Connection	Color
	1	Clock +	VT
	2	Up sense	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		

EZM

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

Connection diagram	Pin	Connection	Color
	1	Clock +	VT
	2	UBatt +	BU
	3	UBatt −	WH
	4		
	5	Data −	PK
	6	Data +	GY
	7		
	8	Clock −	YE
	9		
	10	0 V GND	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		

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

Connection diagram	Pin	Connection	Color
	1	Up sense	BU
	2		
	3		
	4	0 V sense	WH
	5		
	6		
	7	Up +	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

11.7 Project configuration

Project your drive using our SERVOsoft designing software. You can receive SERVOsoft for free from your adviser at one of our sales centers. Observe the limit conditions in this chapter to ensure a safe design for your drives.

11.7.1 Design of the screw drive

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

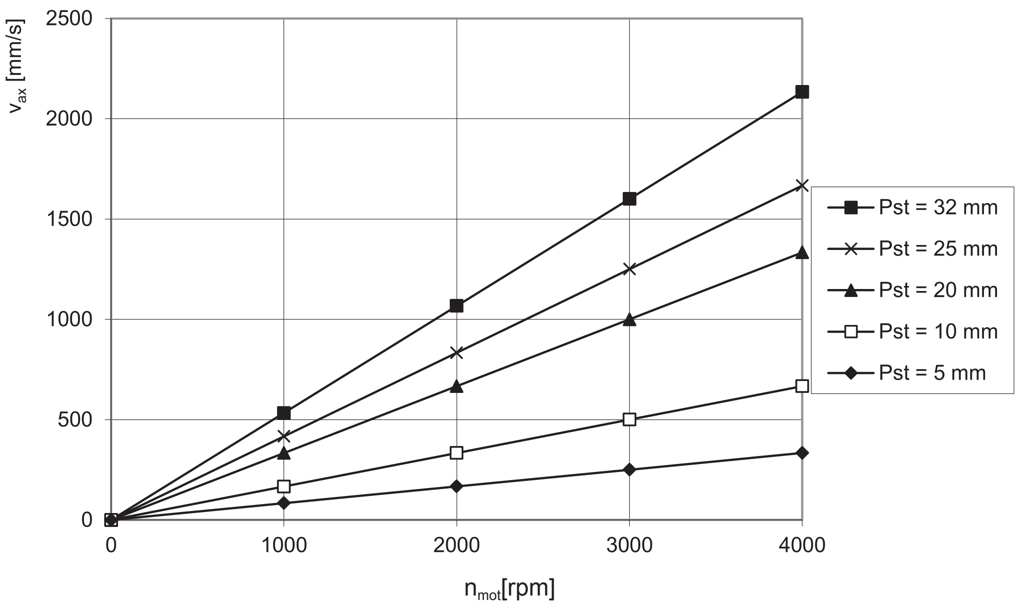
Formula symbol	Unit	Explanation
η_{gt}	%	Efficiency of the screw drive
F_{ax}	N	Permitted axial force on the output
F_{ax0}	N	Permitted axial force when the motor is at a standstill for holding the load using the motor torque
$F_{ax0,abs}$	N	Permitted axial force when the motor is at an absolute standstill (n_{mot}=0) for holding the load using motor torque
M	Nm	Torque
M_0	Nm	Stall torque: The continuous torque the motor is able to deliver 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 common pitches that can be implemented with STOBER synchronous servo motors for screw drives.



Axial force

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

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

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

	M_0 [Nm]	F_{ax0} P_{st}=5 [N]	F_{ax0} P_{st}=10 [N]	F_{ax0} P_{st}=15 [N]	F_{ax0} P_{st}=20 [N]	F_{ax0} P_{st}=25 [N]	F_{ax0} P_{st}=32 [N]
EZM511U	4.3	4807	2403	1602	1202	961	751
EZM512U	7.6	8539	4269	2846	2135	1708	1334
EZM513U	10.6	11988	5994	3996	2997	2398	1873
EZM711U	7.3	8256	4128	2752	2064	1651	1290
EZM712U	13.0	14646	7323	4882	3662	2929	2288
EZM713U	18.9	21375	10688	7125	5344	4275	3340

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

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

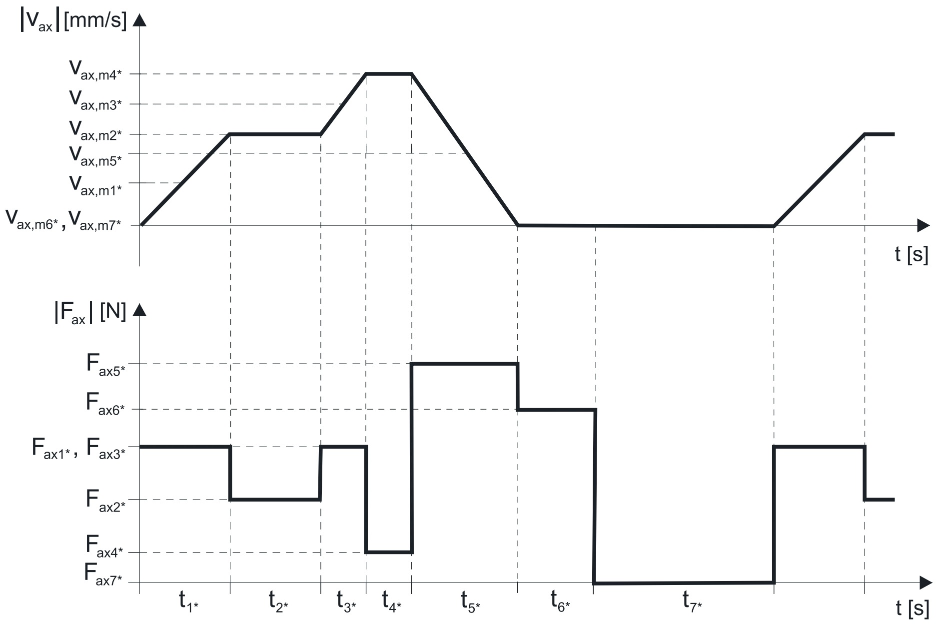
11.7.2 Calculation of the operating point

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

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

Formula symbol	Unit	Explanation
η_{gt}	%	Efficiency of the screw drive
F_{ax}	N	Permitted axial force on the output
$F_{ax1*} – F_{axn*}$	N	Actual axial force in the respective time segment
$F_{ax,eff*}$	N	Actual effective axial force on the output
M_{limK}	Nm	Torque limit of the motor with convection cooling
M_{op}	Nm	Torque of motor at the operating point from the motor curve for n_{m*}
M_{eff*}	Nm	Actual effective torque of the motor
M_{max}	Nm	Maximum torque: the maximum permitted torque the motor is able to deliver over a short period (when accelerating or decelerating) (tolerance ±10%)
n_{m*}	rpm	Actual average motor speed
n_N	rpm	Nominal speed: The speed for which the nominal torque M_N is specified
P_{st}	mm	Pitch of the screw drive
t	s	Time
$t_{1*} – t_{n*}$	s	Duration of the respective time segment
v_{ax}	mm/s	Axial velocity
$v_{ax,m*}$	mm/s	Actual average axial velocity
$v_{ax,m1*} – v_{ax,mn*}$	mm/s	Actual average axial velocity in the respective time segment

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



Calculation of the actual average axial velocity

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

If t_{1^*} + ... + $t_{6^*} \geq 10$ min, determine v_{ax,m^*} without the rest phase t_{7^*}.

Calculation of the actual average speed

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

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

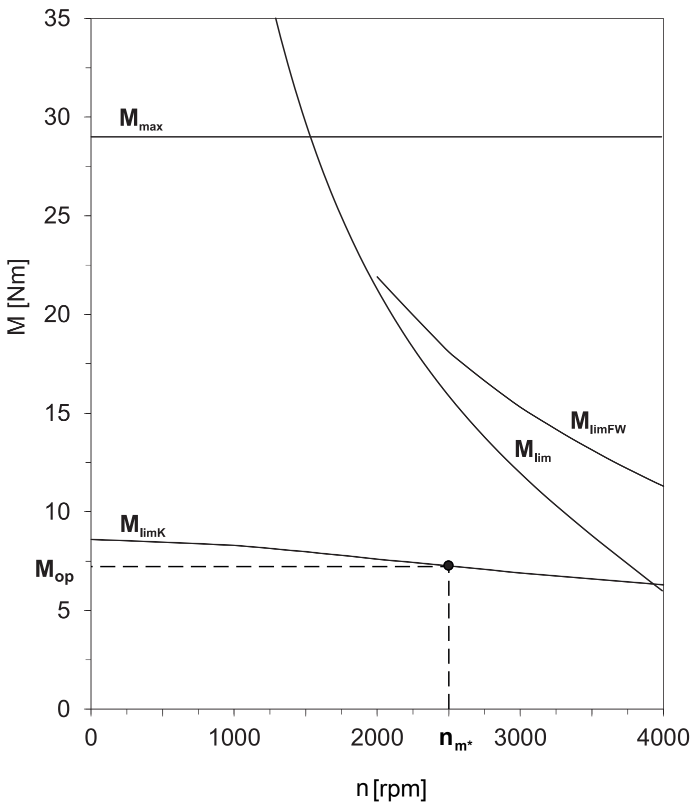
Calculation of the actual effective axial force

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

Calculation of the actual effective torque

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

You can find the value for the torque of the motor at operating point M_{op} with the determined average input speed n_{m^*} in the motor curve in Chapter [▶ 11.3]. In doing so, keep the size of the motor in mind. The figure below shows an example of reading the torque M_{op} of a motor at the operating point.



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

11.7.3 Calculation of the bearing service life

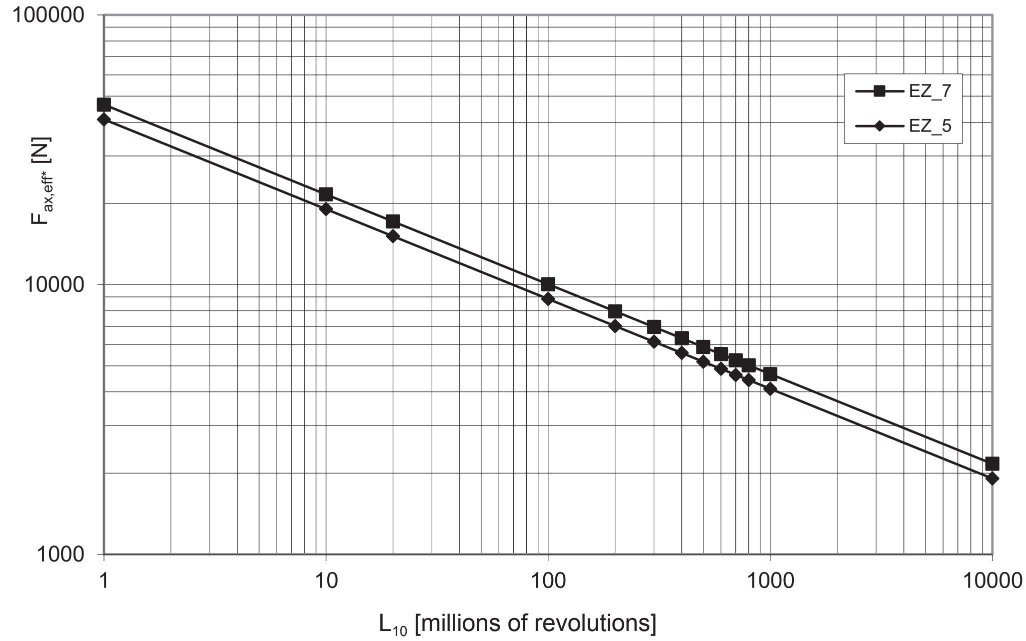
Formula symbol	Unit	Explanation
C_{dyn}	N	Dynamic bearing load rating
$F_{ax,eff*}$	N	Actual effective axial force on the output
L_{10}		Nominal bearing service life for a survival probability of 90% in 10^6 rollovers
L_{10h}	h	Bearing service life
n_{m*}	rpm	Actual average motor speed

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

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

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

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



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

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 61000-6-2:2005
- EN 61000-6-4:2007 + A1:2011
- EN 60034-1:2010 + Cor.:2010
- EN 60034-5:2001 + A1:2007
- EN 60034-6:1993

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 "COMPONENT - SERVO AND STEPPER MOTORS"; registered under UL number E488992 with Underwriters Laboratories USA (optional).

11.8.3 Additional documentation

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

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

Documentation	ID
Operating manual for EZ synchronous servo motors	442585

12 EZS synchronous servo motor for screw drives

Table of contents

STOBER

12.1 Overview

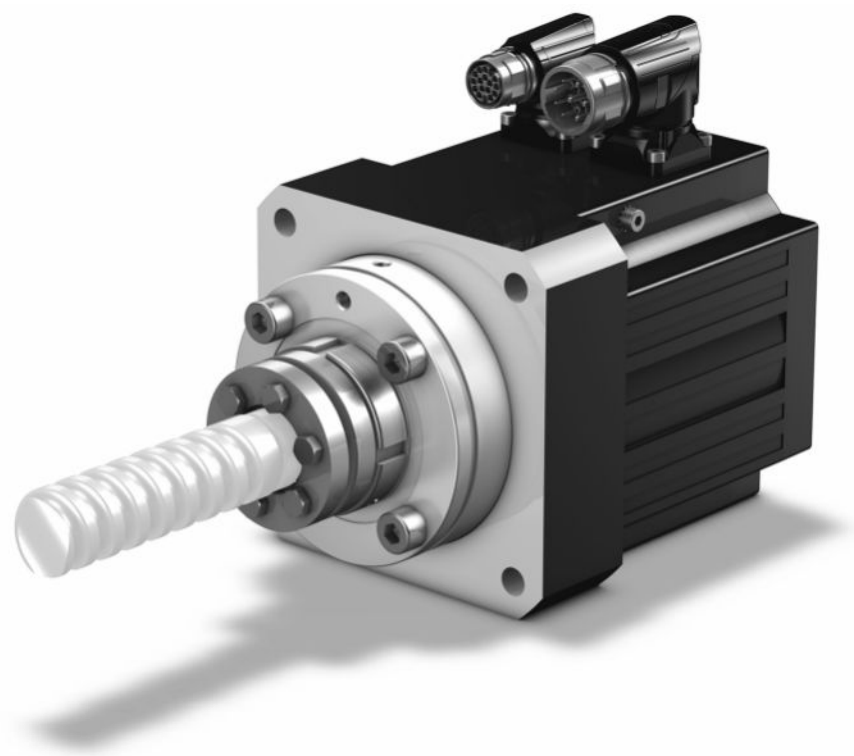
Synchronous servo motors for screw drives (direct drive for threaded spindle)

Axial forces

F_{ax}	760 – 31271 N

Features

Backlash-free connection with the threaded spindle using a clamping unit	✓
Axial angular contact ball bearing acting on two sides for direct absorption of the threaded spindle forces	✓
Super compact due to tooth-coil winding method with the highest possible copper fill factor	✓
Backlash-free holding brake (optional)	✓
Convection cooling or forced ventilation (optional)	✓
Optical, inductive EnDat absolute encoders or resolvers	✓
Elimination of referencing with multi-turn absolute encoders (optional)	✓
One Cable Solution (OCS) with HIPERFACE DSL encoder (optional)	✓
Electronic nameplate for fast and reliable commissioning	✓
Rotating plug connectors with quick lock	✓



12.2 Selection tables

The technical data specified in the selection tables applies to:

- 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
- Black matte paint as per RAL 9005

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

Motor type	Steel mounting flange dimensions (thickness x width x height)	Convection surface area 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 symbol	Unit	Explanation
F_{ax}	N	Permitted axial force on the output
I_0	A	Stall current: RMS value of the line-to-line current when the stall torque M_0 is generated (tolerance ±5%)
I_{max}	A	Maximum current: RMS value of the maximum permitted line-to-line current when maximum torque M_{max} is 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 when nominal torque M_N is 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 stall torque and frictional torque to the stall 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 a resonant circuit)
m	kg	Weight
M_0	Nm	Stall torque: The continuous torque the motor is able to deliver at a speed of 10 rpm (tolerance ±5%)
M_{max}	Nm	Maximum torque: the maximum permitted torque the motor is able to deliver over a short period (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 torque values as follows: $M_{N^*} = K_{M0} \cdot I^* - M_R$.
M_R	Nm	Frictional torque (of the bearings and seals) of a motor at winding temperature $\Delta\vartheta$ = 100 K

Formula symbol	Unit	Explanation
n_N	rpm	Nominal speed: The speed for which the nominal torque M_N is specified
P_N	kW	Nominal power: the power 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 rpm]	n_N [rpm]	M_N [Nm]	I_N [A]	$K_{M,N}$ [Nm/A]	P_N [kW]	M_0 [Nm]	I_0 [A]	K_{M0} [Nm/A]	M_R [Nm]	M_{max} [Nm]	I_{max} [A]	R_{U-V} [Ω]	L_{U-V} [mH]	T_{el} [ms]	J [10^{-4} kgm²]	m [kg]
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 rpm]	n_N [rpm]	M_N [Nm]	I_N [A]	$K_{M,N}$ [Nm/A]	P_N [kW]	M_0 [Nm]	I_0 [A]	K_{M0} [Nm/A]	M_R [Nm]	M_{max} [Nm]	I_{max} [A]	R_{U-V} [Ω]	L_{U-V} [mH]	T_{el} [ms]	J [10^{-4} kgm²]	m [kg]
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

12.3 Torque/speed curves

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

Formula symbol	Unit	Explanation
ED	%	Duty cycle based on 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_{max}	Nm	Maximum torque: the maximum permitted torque the motor is able to deliver over a short period (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

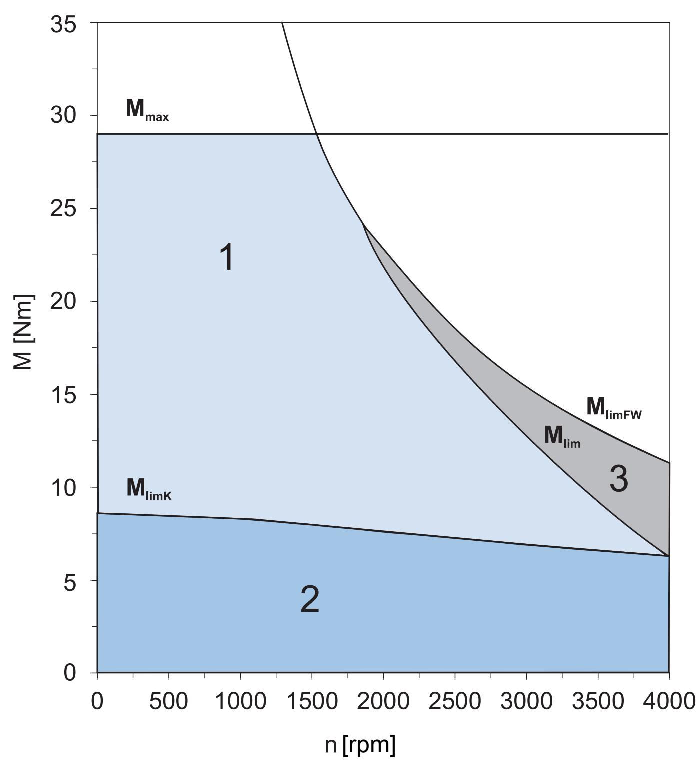
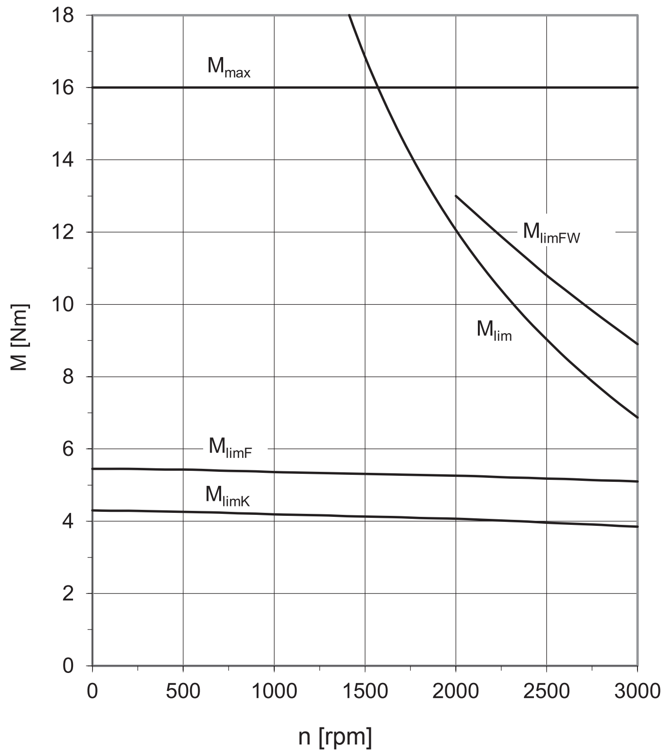


Fig. 1: Explanation of a torque/speed curve

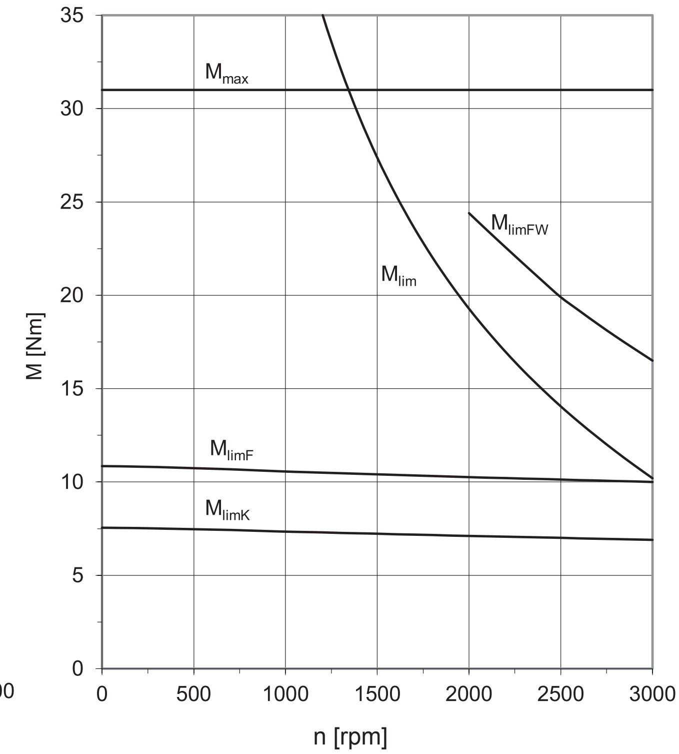
1	Torque range for brief operation (duty cycle < 100%) with $\Delta\vartheta$ = 100 K	2	Torque range for continuous operation at a constant load (S1 mode, duty cycle = 100%) with ϑ = 100 K
3	Field weakening range (can be used only with operation on STOBER drive controllers)		

STÖBER

EZS501 (n_N=3000 rpm)

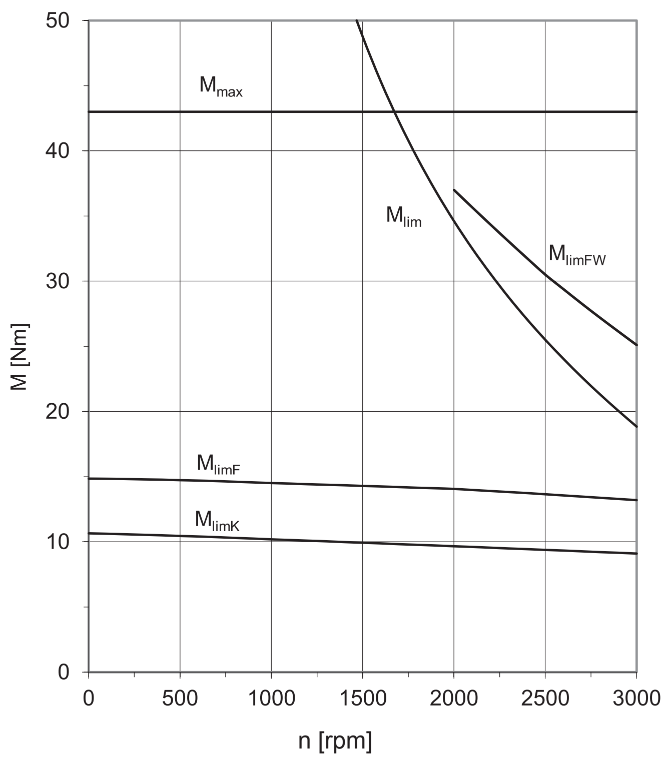


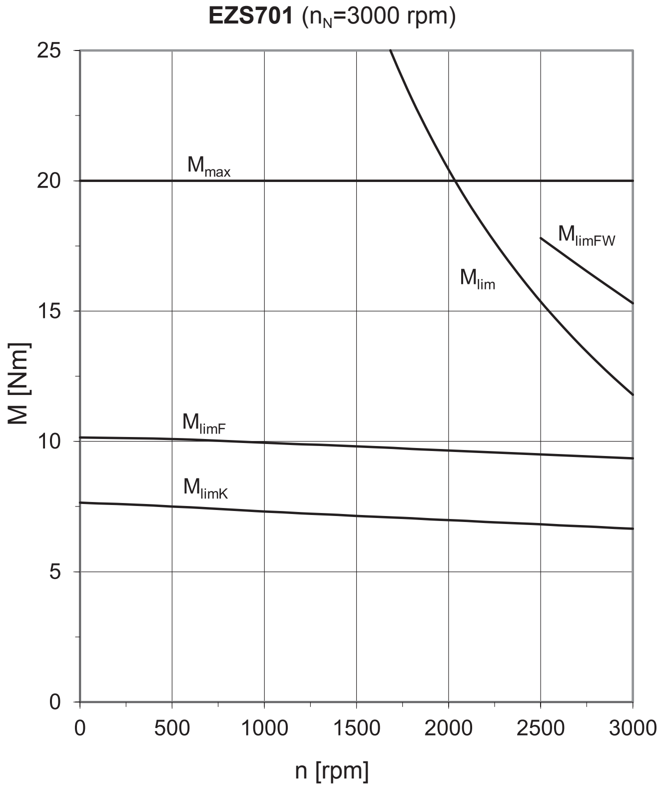
EZS502 (n_N=3000 rpm)

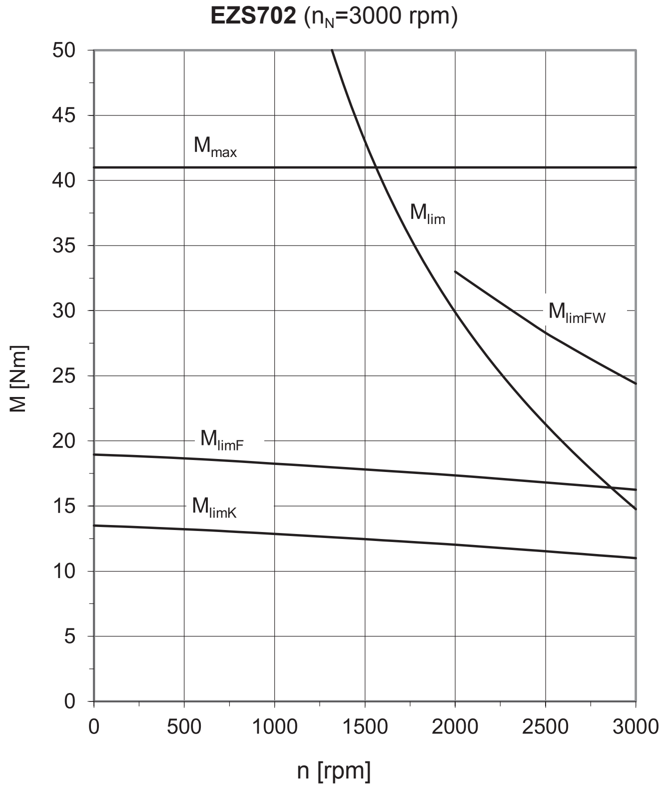


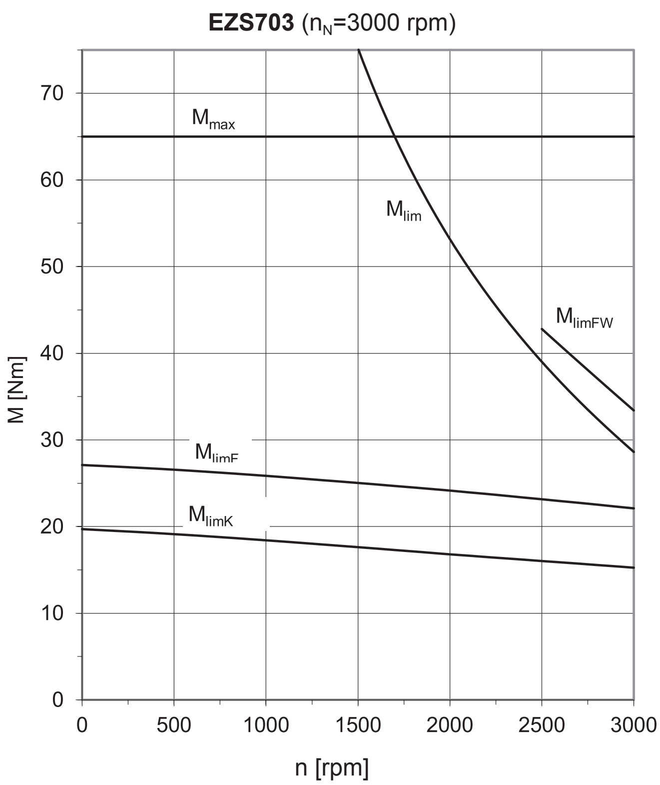
EZS

EZS503 (n_N=3000 rpm)




EZS701 (nN=3000 rpm)
25
20
15
10
5
0
M [Nm]
Mmax
MlimFW
Mlim
MlimF
MlimK
0
500
1000
1500
2000
2500
3000
n [rpm]


EZS702 (nN=3000 rpm)
50
45
40
35
30
25
20
15
10
5
0
M [Nm]
Mmax
Mlim
MlimFW
MlimF
MlimK
0
500
1000
1500
2000
2500
3000
n [rpm]


EZS703 (nN=3000 rpm)
70
60
50
40
30
20
10
0
M [Nm]
Mmax
Mlim
MlimFW
MlimF
MlimK
0
500
1000
1500
2000
2500
3000
n [rpm]

12.4 Dimensional drawings

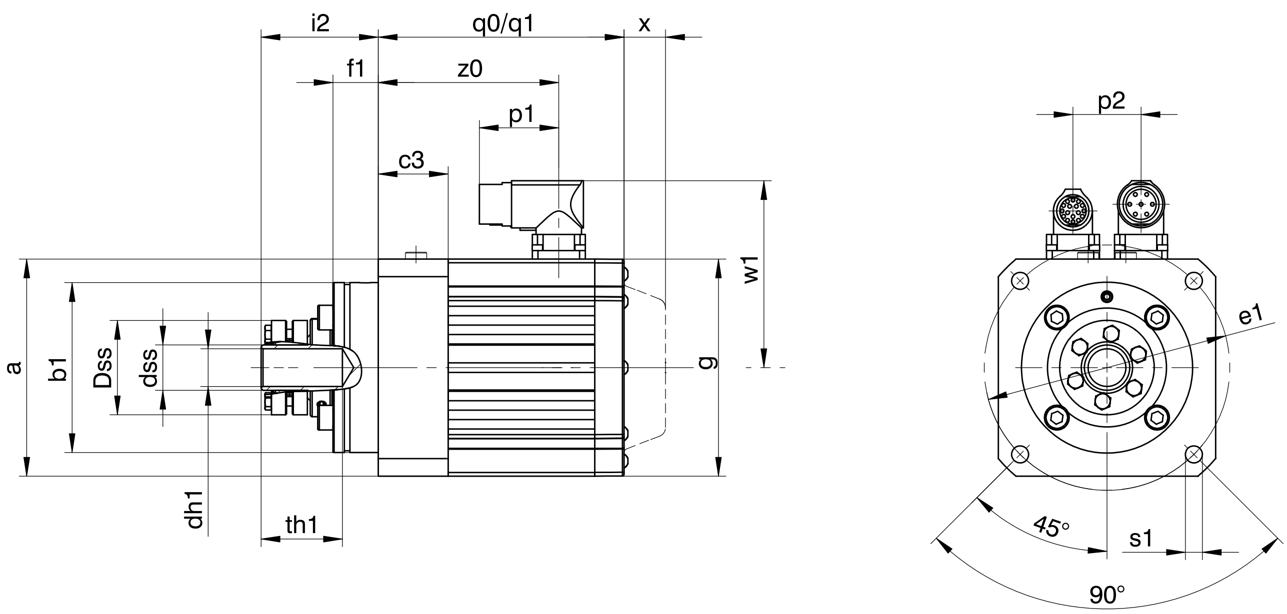
In this chapter, you can find the dimensions of the motors.

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

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

You can download CAD models of our standard drives at http://cad.stoeber.de.

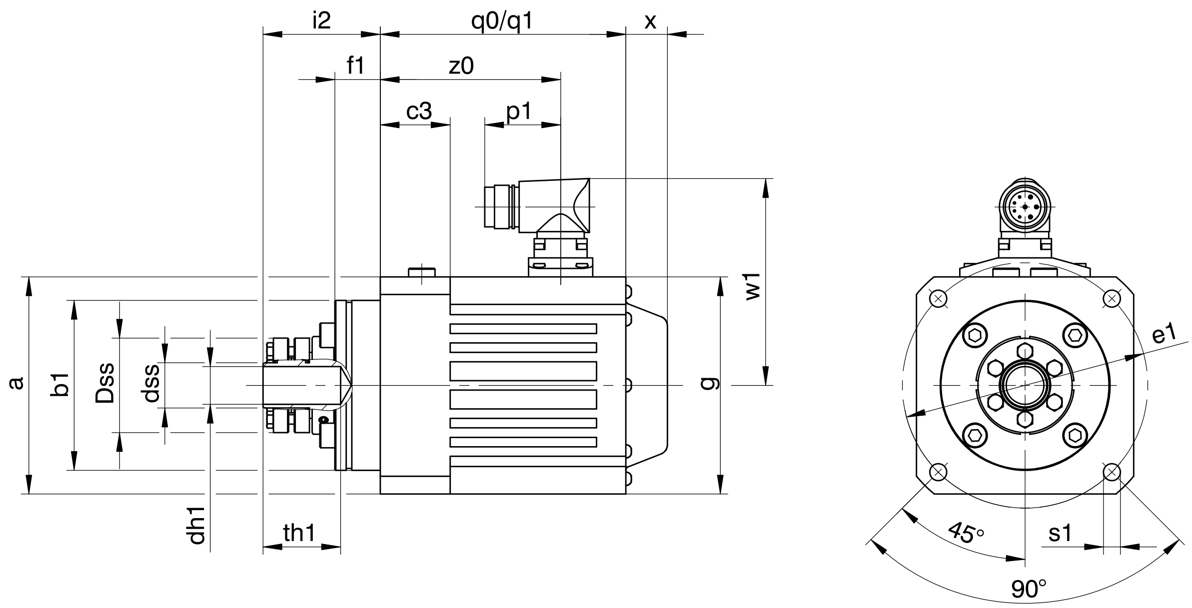
12.4.1 EZS motors with convection cooling



q0	Applies to motors without holding brake	q1	Applies to motors with holding brake
x	Applies to encoders based on an 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

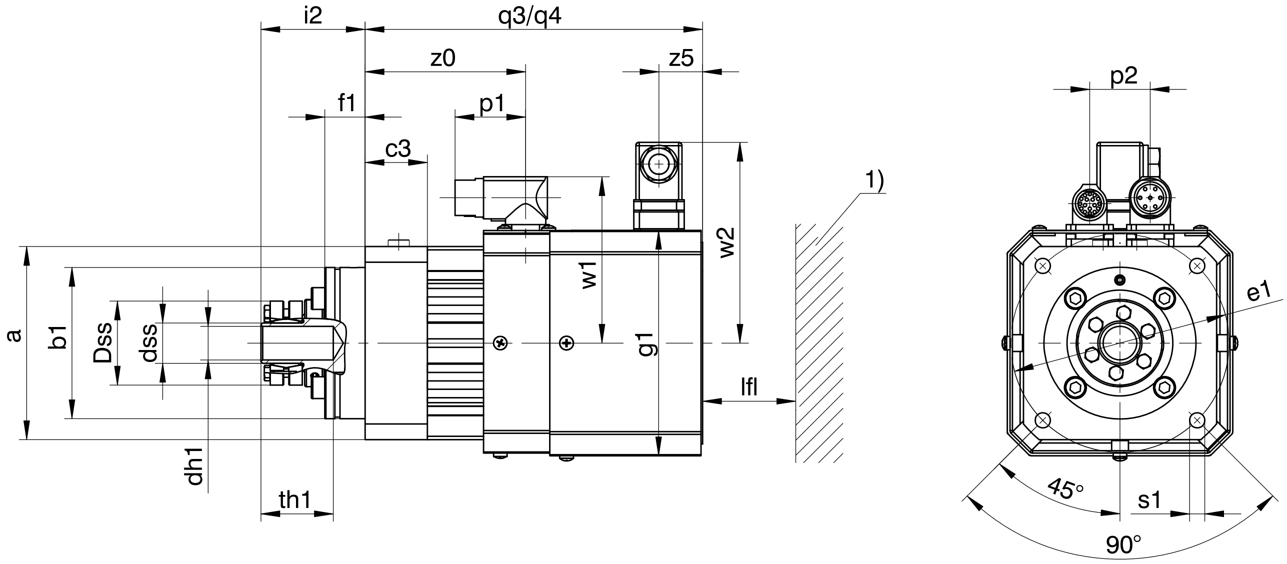
12.4.2 EZS motors with convection cooling (One Cable Solution)



q0	Applies to motors without holding brake	q1	Applies to motors with holding brake

Type	□a	∅b1	c3	∅dh1	∅dss	∅Dss	∅e1	f1	□g	i2	p1	q0	q1	∅s1	th1	w1	x	z0
EZS501U	115	$90_{-0,01}$	37	20^{H6}	24_{h7}	50	130	24	115	62.0	40	130	184.5	9	41	110	22	95.5
EZS502U	115	$90_{-0,01}$	37	20^{H6}	24_{h7}	50	130	24	115	62.0	40	155	209.5	9	41	110	22	120.5
EZS503U	115	$90_{-0,01}$	37	20^{H6}	24_{h7}	50	130	24	115	62.0	40	180	234.5	9	41	110	22	145.5
EZS701U	145	$115_{-0,01}$	46	25^{H6}	30_{h7}	60	165	24	145	66.5	40	148	206.7	11	45	125	22	110.2
EZS702U	145	$115_{-0,01}$	46	25^{H6}	30_{h7}	60	165	24	145	66.5	40	173	231.7	11	45	125	22	135.2
EZS703U	145	$115_{-0,01}$	46	25^{H6}	30_{h7}	60	165	24	145	66.5	40	198	256.7	11	45	125	22	160.2

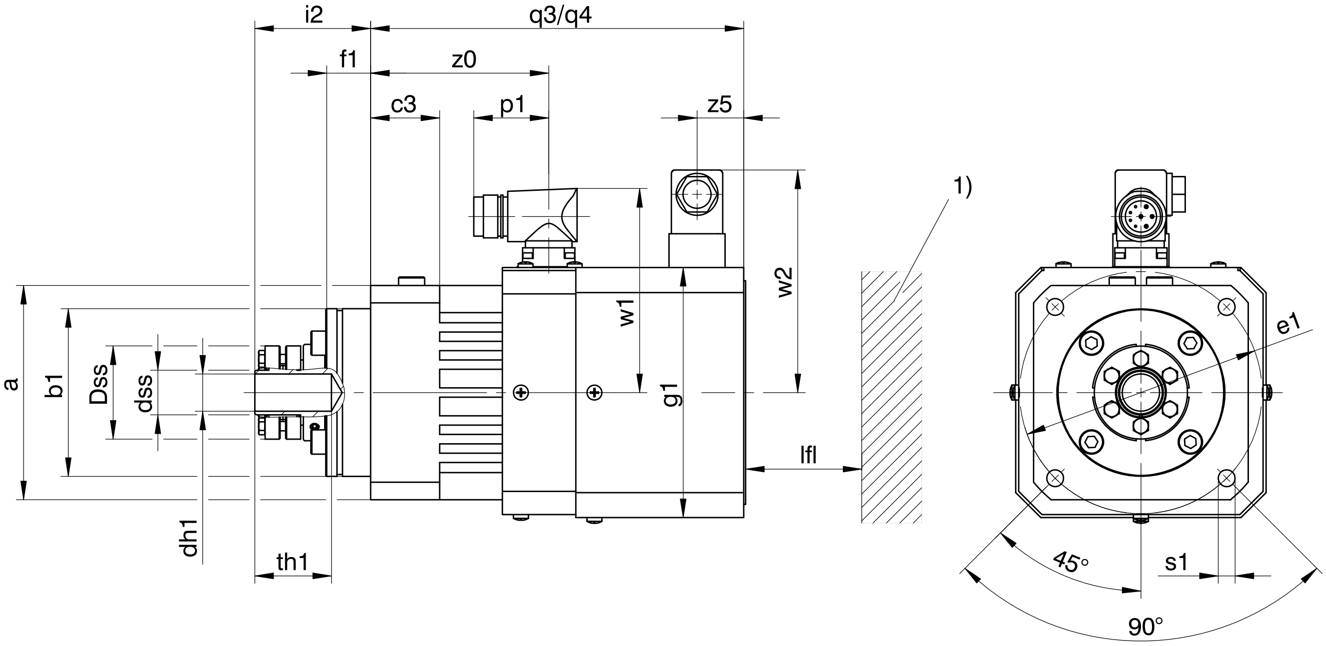
12.4.3 EZS motors with forced ventilation



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

12.4.4 EZS motors with forced ventilation (One Cable Solution)



q3	Applies to motors without holding brake	q4	Applies to motors with holding brake
1)	Machine wall		

Type	□a	∅b1	c3	∅dh1	∅dss	∅Dss	∅e1	f1	□g1	i2	lfl_{min}	p1	q3	q4	∅s1	th1	w1	w2	z0	z5
EZS501B	115	$90_{-0,01}$	37	20^{H6}	24_{h7}	50	130	24	134.5	62.0	20	40	200	265.0	9	41	110	120	95.5	25
EZS502B	115	$90_{-0,01}$	37	20^{H6}	24_{h7}	50	130	24	134.5	62.0	20	40	225	280.0	9	41	110	120	120.5	25
EZS503B	115	$90_{-0,01}$	37	20^{H6}	24_{h7}	50	130	24	134.5	62.0	20	40	250	305.0	9	41	110	120	145.5	25
EZS701B	145	$115_{-0,01}$	46	25^{H6}	30_{h7}	60	165	24	164.5	66.5	30	40	240	298.7	11	45	125	134	110.2	40
EZS702B	145	$115_{-0,01}$	46	25^{H6}	30_{h7}	60	165	24	164.5	66.5	30	40	265	321.7	11	45	125	134	135.2	40
EZS703B	145	$115_{-0,01}$	46	25^{H6}	30_{h7}	60	165	24	164.5	66.5	30	40	290	348.7	11	45	125	134	160.2	40

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 drives
5	Motor size	5 (example)
0	Generation	0
1	Length	1 (example)
U B	Cooling	Convection cooling Forced ventilation
D	Design	Dynamic
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)

Notes

- In Chapter [▸ 12.6.5], you can find information about available encoders.
- In Chapter [▸ 12.6.5.6], you can find information about connecting synchronous servo motors to other drive controllers from STOBER.

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) in accordance with EN 60034-1 (155°C, heating $\Delta\vartheta$ = 100 K)	
Surface[4]	Matte black as per RAL 9005	

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

Feature	EZS5	EZS7
Noise level	Limit values in accordance with EN 60034-9	
Cooling	IC 410 convection cooling (IC 416 convection cooling with optional forced ventilation)	

12.6.2 Electrical features

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

Feature	Description
DC link voltage	DC 540 V (max. 620 V) on STOBER drive controllers
Winding	Three-phase, single-tooth coil design
Circuit	Star, center not led through
Protection class	I (protective grounding) in accordance with EN 61140
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 chapter.

Feature	Description
Surrounding temperature for transport/storage	−30 °C to +85 °C
Surrounding temperature for operation	−15 °C to +40 °C
Installation altitude	≤ 1000 m above sea level
Shock load	≤ 50 m/s² (5 g), 6 ms in accordance with EN 60068-2-27

Notes

- STOBER synchronous servo motors are not suitable for potentially explosive atmospheres in accordance with (ATEX) Directive2014/34/EU.
- Secure 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 by shock loading.

12.6.4 Lubrication of the screw drive

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

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

12.6.5 Encoders

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

12.6.5.1 Encoder measuring method selection tool

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

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

12.6.5.2 Selection tool for EnDat interface

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

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

12.6.5.3 EnDat encoders

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

Encoders with EnDat 2.2 interface

Encoder type	Type code	Measuring method	Recordable revolutions	Resolution	Position values per revolution
EQI 1131 FMA	M4	Inductive	4096	19 bit	524288
EQI 1131	Q6	Inductive	4096	19 bit	524288
EBI 1135	B0	Inductive	65536	18 bit	262144
EQN 1135 FMA	M3	Optical	4096	23 bit	8388608
EQN 1135	Q5	Optical	4096	23 bit	8388608
ECN 1123 FMA	M1	Optical	–	23 bit	8388608
ECN 1123	C7	Optical	–	23 bit	8388608
ECI 1118-G2	C5	Inductive	–	18 bit	262144

Encoders with EnDat 2.1 interface

Encoder type	Type code	Measuring method	Recordable revolutions	Resolution	Position values per revolution	Periods per revolution
EQN 1125 FMA	M2	Optical	4096	13 bit	8192	Sin/Cos 512
EQN 1125	Q4	Optical	4096	13 bit	8192	Sin/Cos 512
ECN 1113 FMA	M0	Optical	–	13 bit	8192	Sin/Cos 512
ECN 1113	C6	Optical	–	13 bit	8192	Sin/Cos 512

Notes

- The encoder type code is a part of the type designation of the motor.
- FMA = Version with fault elimination for mechanical coupling.
- The EBI 1135 encoder requires an external buffer battery so that absolute position information is retained after the power supply is turned off (AES option for STOBER drive controllers).
- Multiple revolutions of the motor shaft can be recorded only using multi-turn encoders.

12.6.5.4 HIPERFACE DSL encoders

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

The One Cable Solution offers the following advantages:

- Significantly reduced wiring effort by eliminating the encoder cable
- Significantly reduced space requirements by eliminating the encoder plug connector
- Transmission of measured values from the temperature sensor using the HIPERFACE DSL protocol

The encoder has the following features:

Encoder type	Type code	Measuring method	Recordable revolutions	Resolution	Position values per revolution
EKM36	H3	Optical	4096	20 bit	1048576

12.6.5.5 Resolver

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

Feature	Description
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

12.6.5.6 Possible combinations with drive controllers

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

Drive controller		SDS 5000	MDS 5000	SDS 5000/ MDS 5000	SD6		SI6		
Drive controller type code		AA	AB	AC	AD	AE	AP	AQ	AS
Connection plan ID		442305	442306	442307	442450	442451	442771	442772	442788
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	✓	✓	✓	✓	✓	–	–	–
ECN 1113	C6	✓	✓	✓	✓	✓	–	–	–
EKM36	H3	–	–	–	–	–	–	–	✓
Resolver	R0	✓	✓	–	–	✓	–	✓	–

Notes

- The drive controller and encoder type codes are a part of the type designation of the motor (see the "Type designation" chapter).

12.6.6 Temperature sensor

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

Some encoders have their own integrated analysis electronics for temperature monitoring with warning and shut-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 instance where an encoder with internal temperature monitoring forces the motor to shut down, even before the motor has reached its nominal data.

You can find information about the electrical connection of the temperature sensor in the "Connection 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 triple thermistor in accordance with DIN 44082 that allows the temperature of each winding phase to be monitored.

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

Feature	Description
Nominal response temperature ϑ_{NAT}	145 °C ± 5 K
Resistance R −20 °C up to ϑ_{NAT} − 20 K	≤ 250 Ω

EZS

Feature	Description
Resistance R with ϑ_{NAT} − 5 K	≤ 550 Ω
Resistance R with ϑ_{NAT} + 5 K	≥ 1330 Ω
Resistance R with ϑ_{NAT} + 15 K	≥ 4000 Ω
Operating voltage	≤ DC 7.5 V
Thermal response time	< 5 s
Thermal class	155 (F) in accordance with EN 60034-1 (155 °C, heating Δϑ = 100 K)

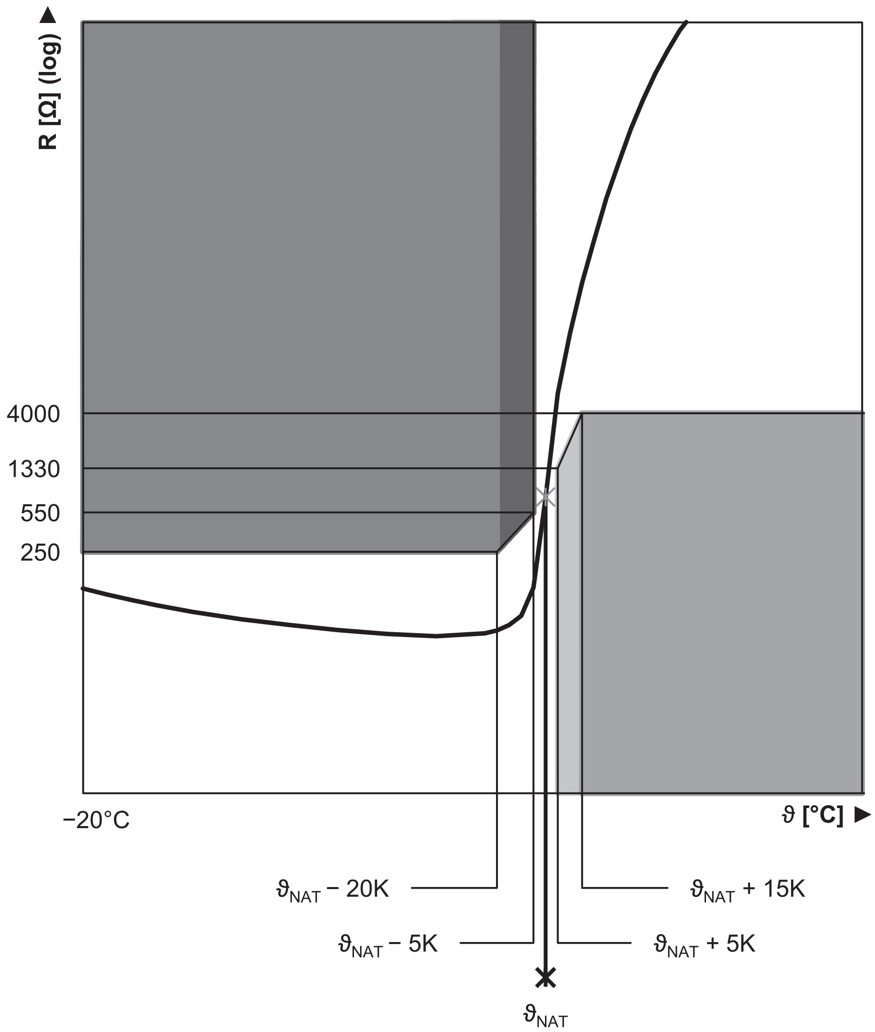


Fig. 2: PTC thermistor curve (single thermistor)

12.6.6.2 Pt1000 temperature sensor

STOBER synchronous servo motors are available in versions with a Pt1000 temperature sensor. The Pt1000 is a temperature-dependent resistor that has a resistance curve with a linear relationship with temperature. As a result, the Pt1000 allows for measurements of the winding temperature. These measurements are limited to one phase of the motor winding, however. In order to adequately protect the motor from exceeding the maximum permitted winding temperature, use a i²t model in the drive controller to monitor the winding temperature.

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

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

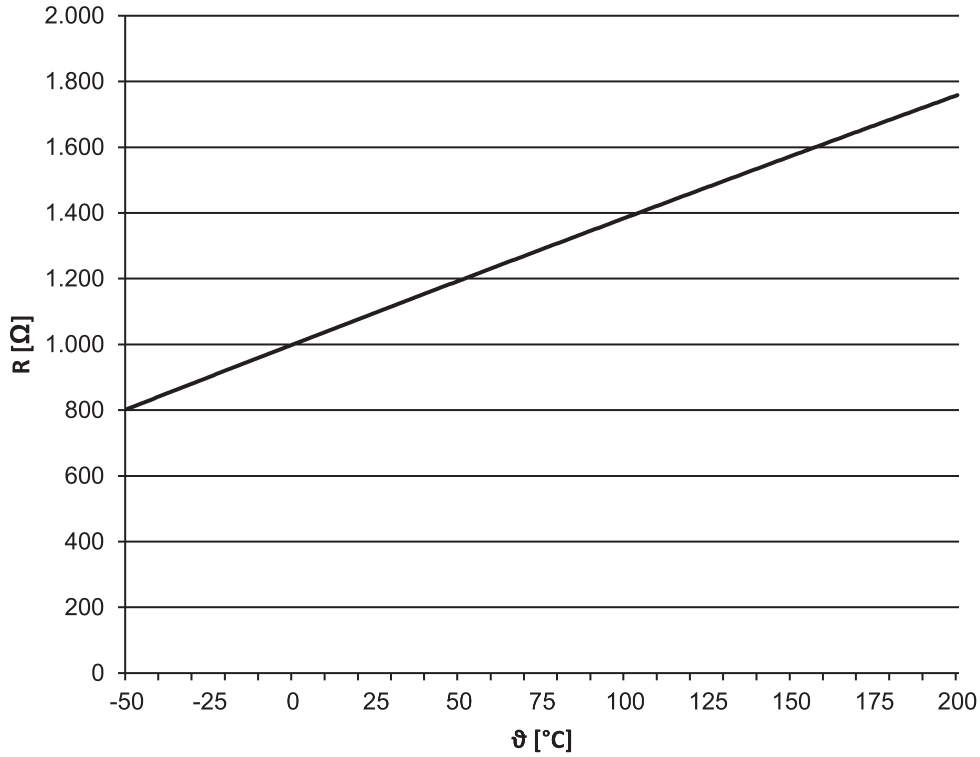


Fig. 3: Pt1000 temperature sensor characteristic curve

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. Optionally, forced ventilation can be used to cool the motor.

12.6.7.1 Forced ventilation

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

The performance data for motors with forced ventilation can be found in Chapter [▹ 12.2.2] and the dimensional drawings in Chapter [▹ 12.4.3].

Formula symbol	Unit	Explanation
$I_{N,F}$	A	Nominal current of the forced ventilation unit
$L_{pA,F}$	dBA	Noise level of the forced ventilation unit in the optimal operating range
m_F	kg	Weight of the forced ventilation unit
$P_{N,F}$	W	Nominal output of the forced ventilation unit

Formula symbol	Unit	Explanation
q_{vF}	m³/h	Delivery capacity of the forced ventilation unit in open air
$U_{N,F}$	V	Nominal voltage of the forced ventilation unit

Technical data

Motor	Forced ventilation unit	$U_{N,F}$ [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 ventilation unit plug connectors

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

12.6.8 Holding brake

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

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

Observe the following during project configuration:

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

Formula symbol	Unit	Explanation
$I_{N,B}$	A	Nominal current of the brake at 20 °C
ΔJ_B	10^{-4} kgm²	Additive mass moment of inertia of a motor with holding brake
J	10^{-4} kgm²	Mass moment of inertia
J_{Bstop}	10^{-4} kgm²	Reference mass moment of inertia when braking from full speed: $J_{B-stop} = J_{dyn} \times 2$
J_{tot}	10^{-4} kgm²	Total mass moment of inertia (based on 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	Work done by friction for braking
$W_{B,Rlim}$	J	Work done by friction until wear limit is reached
$W_{B,Rmax/h}$	J	Maximum permitted work done by friction per hour with individual braking
$x_{B,N}$	mm	Nominal air gap of brake

Calculation of work done by friction per braking process

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

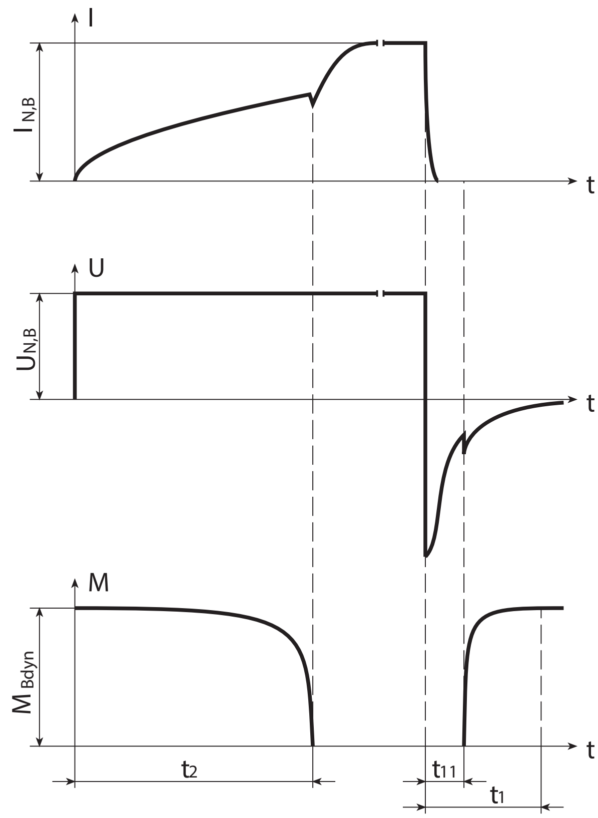
The sign of M_L is positive if the movement runs vertically upwards or horizontally and it is negative if the movement runs vertically down.

Calculation of the stop time

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

EZS

Switching behavior



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

12.6.9.1 Plug connectors

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

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

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

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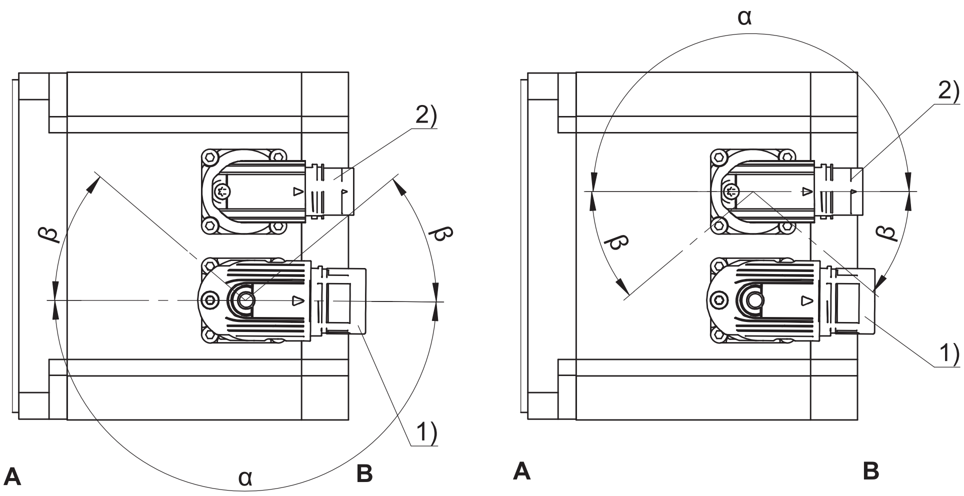
EZS

Turning ranges of plug connectors



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

Power plug connector features

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

Encoder plug connector features

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

Notes

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

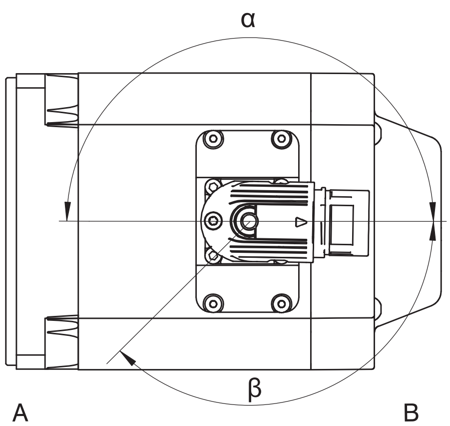
12.6.9.2 Plug connectors (One Cable Solution)

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

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

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

Turning ranges of plug connectors



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

Motor type	Size	Connection	Turning range	
			α	β
EZS	con.23	Quick lock	180°	135°

Notes

- The number after "con." indicates the approximate external thread diameter of the plug connector in mm (for example, con.23 designates a plug connector with an external thread diameter of about 23 mm).

12.6.9.3 Connection of the motor housing to the grounding conductor system

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

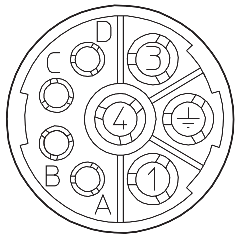
All attachment parts required for the connection of the grounding conductor to the motor housing are delivered with the motor. The grounding screw of the motor is identified with the symbol ⏚ in accordance with IEC 60417-DB. The minimum cross-section of the grounding conductor is specified in the following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

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

12.6.9.4 Connection assignment of the power plug connector

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

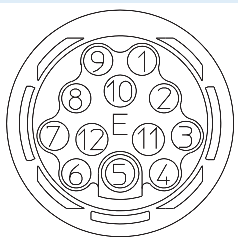
Plug connector size con.23 (1)

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

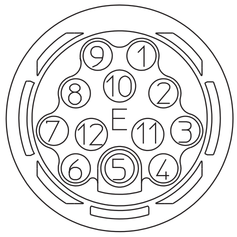
12.6.9.5 Connection assignment of the encoder plug connector

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

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

Connection diagram	Pin	Connection	Color
	1	Clock +	VT
	2	Up sense	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		

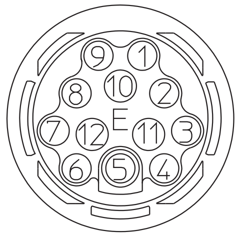
EnDat 2.2 digital encoder with battery buffering, plug connector size con.17

Connection diagram	Pin	Connection	Color
	1	Clock +	VT
	2	UBatt +	BU
	3	UBatt −	WH
	4		
	5	Data −	PK
	6	Data +	GY
	7		
	8	Clock −	YE
	9		
	10	0 V GND	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		

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

Connection diagram	Pin	Connection	Color
	1	Up sense	BU
	2		
	3		
	4	0 V sense	WH
	5		
	6		
	7	Up +	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.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		

EZS

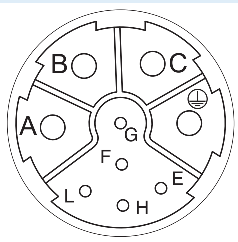
12.6.9.6 Connection assignment of the plug connector (One Cable Solution)

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

The temperature sensor of the motor is connected to the encoder internally. The measured values from the temperature sensor are transmitted via the HIPERFACE DSL log of the encoder.

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

Plug connector size con.23 (1)



Connection diagram	Pin	Connection	Color
	A	1U1 (U phase)	BK
	B	1V1 (V phase)	BU
	C	1W1 (W phase)	RD
	E	DSL− (L)	GN
	F	DSL shield	
	G	1BD1 (brake +)	
	H	DSL+ (H)	GY
	L	1BD2 (brake −)	
	⏚	PE (grounding conductor)	GNYE

12.7 Project configuration

Project your drive using our SERVOsoft designing software. You can receive SERVOsoft for free from your adviser at one of our sales centers. Observe the limit conditions in this chapter to ensure a safe design for your drives.

12.7.1 Design of the screw drive

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

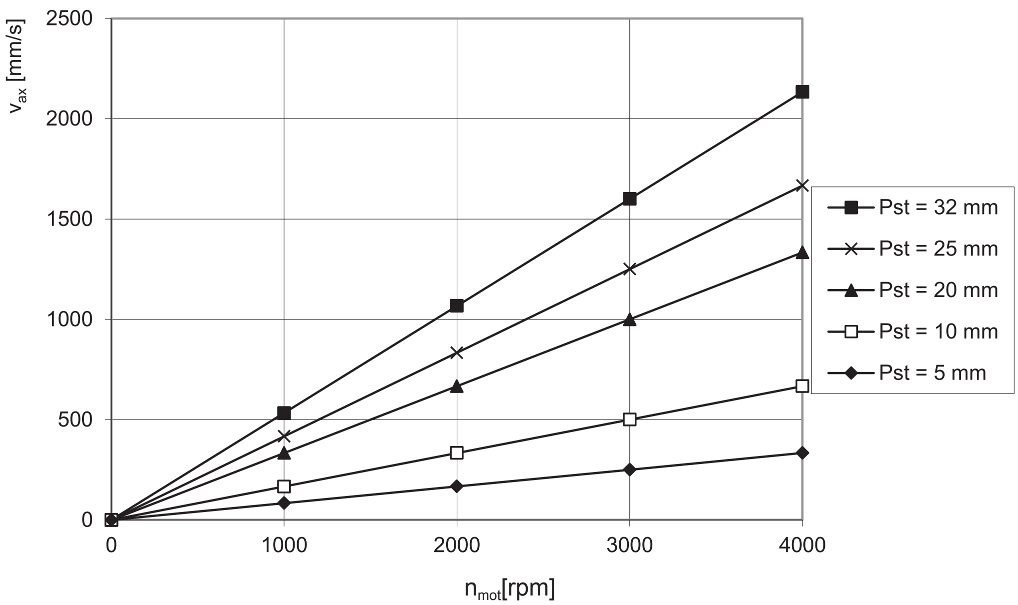
Formula symbol	Unit	Explanation
η_{gt}	%	Efficiency of the screw drive
F_{ax}	N	Permitted axial force on the output
F_{ax0}	N	Permitted axial force when the motor is at a standstill for holding the load using the motor torque
$F_{ax0,abs}$	N	Permitted axial force when the motor is at an absolute standstill (n_{mot}=0) for holding the load using motor torque
M	Nm	Torque
M_0	Nm	Stall torque: The continuous torque the motor is able to deliver 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 common pitches that can be implemented with STOBER synchronous servo motors for screw drives.



Axial force

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

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

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

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

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

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

12.7.2 Calculation of the operating point

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

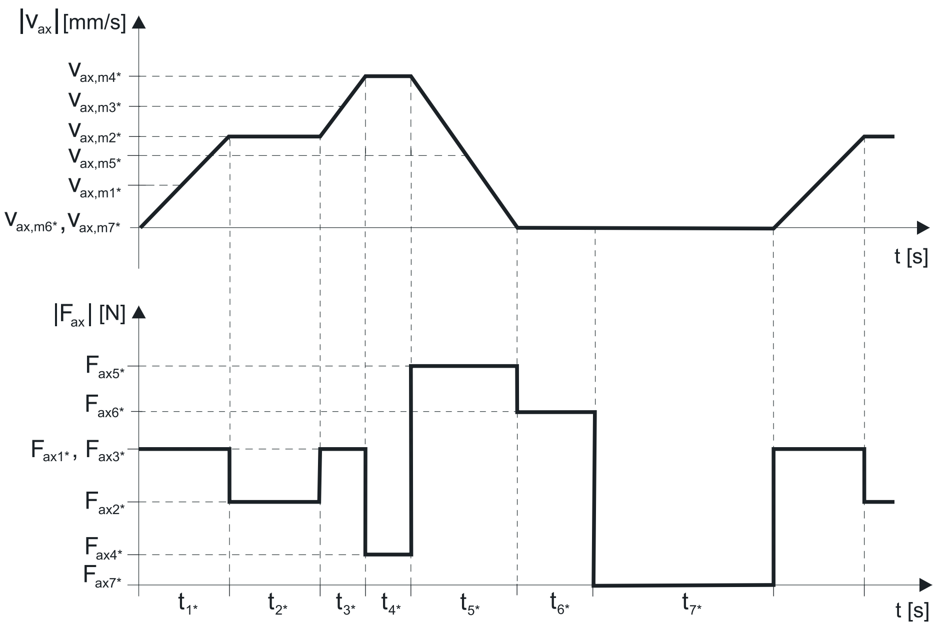
The formula symbols for values actually present in the application are marked with *.

Formula symbol	Unit	Explanation
η_{gt}	%	Efficiency of the screw drive
F_{ax}	N	Permitted axial force on the output
$F_{ax1*} - F_{axn*}$	N	Actual axial force in the respective time segment
$F_{ax,eff*}$	N	Actual effective axial force on the output
M_{limK}	Nm	Torque limit of the motor with convection cooling
M_{limF}	Nm	Torque limit of the motor with forced ventilation
M_{op}	Nm	Torque of motor at the operating point from the motor curve for n_{m*}
M_{eff*}	Nm	Actual effective torque of the motor
M_{max}	Nm	Maximum torque: the maximum permitted torque the motor is able to deliver over a short period (when accelerating or decelerating) (tolerance ±10%)
n_{m*}	rpm	Actual average motor speed

EZS

Formula symbol	Unit	Explanation
n_N	rpm	Nominal speed: The speed for which the nominal torque M_N is specified
P_{st}	mm	Pitch of the screw drive
t	s	Time
$t_{1*} – t_{n*}$	s	Duration of the respective time segment
v_{ax}	mm/s	Axial velocity
$v_{ax,m*}$	mm/s	Actual average axial velocity
$v_{ax,m1*} – v_{ax,mn*}$	mm/s	Actual average axial velocity in the respective time segment

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



Calculation of the actual average axial velocity

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

If t_{1*} + ... + t_{6*} ≥ 10 min, determine $v_{ax,m*}$ without the rest phase t_{7*}.

Calculation of the actual average speed

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

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

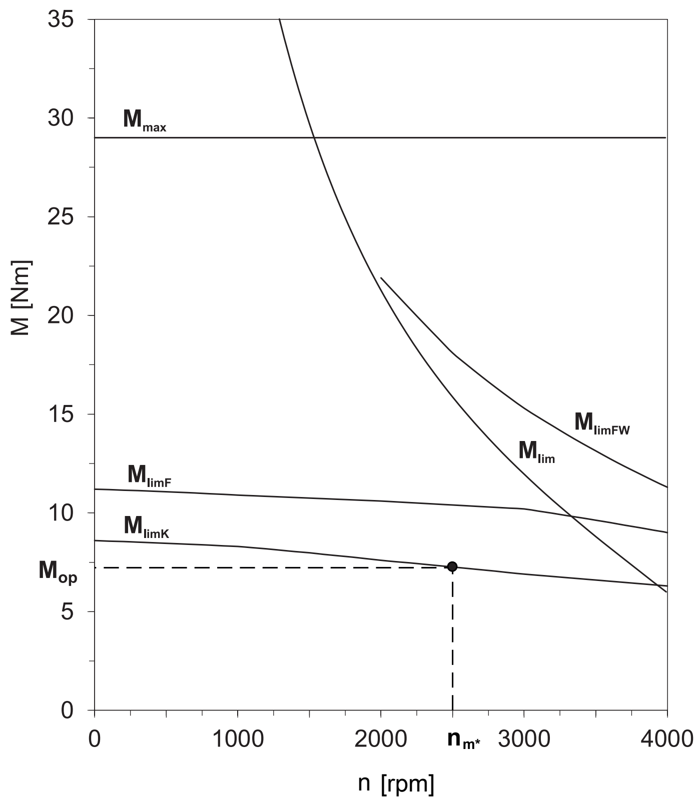
Calculation of the actual effective axial force

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

Calculation of the actual effective torque

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

You can find the value for the torque of the motor at operating point M_{op} with the determined average input speed n_{m*} in the motor curve in Chapter [11.3]. In doing so, keep the size and cooling type of the motor in mind. The figure below shows an example of reading the torque M_{op} of a motor with convection cooling at the operating point.



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

12.7.3 Calculation of the bearing service life

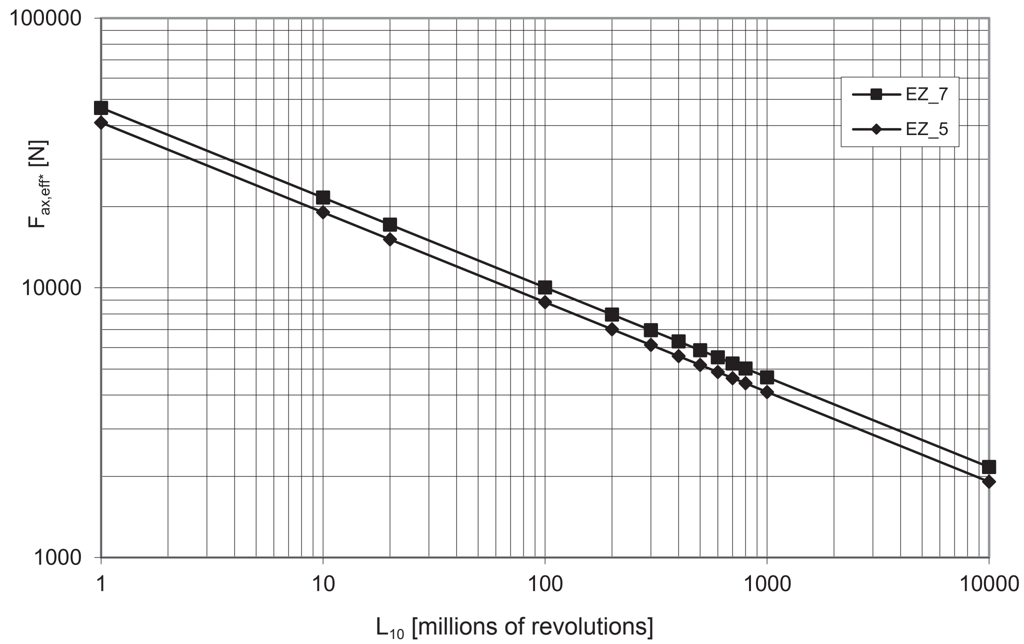
Formula symbol	Unit	Explanation
C_{dyn}	N	Dynamic bearing load rating
$F_{ax,eff*}$	N	Actual effective axial force on the output
L_{10}		Nominal bearing service life for a survival probability of 90% in 10^6 rollovers
L_{10h}	h	Bearing service life
n_{m*}	rpm	Actual average motor speed

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

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

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

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



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

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 61000-6-2:2005
- EN 61000-6-4:2007 + A1:2011
- EN 60034-1:2010 + Cor.:2010
- EN 60034-5:2001 + A1:2007
- EN 60034-6:1993

12.8.2 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 "COMPONENT - SERVO AND STEPPER MOTORS"; registered under UL number E488992 with Underwriters Laboratories USA (optional).

12.8.3 Additional documentation

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

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

Documentation	ID
Operating manual for EZ synchronous servo motors	442585

STOBER

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13.3 Sales terms and delivery conditions

You can find our current sales terms and delivery conditions at http://www.stoeber.de/en/gtc.

13.4 Publication details

Drives and automation catalog, ID 442711_en.

You can find suitable geared motors in our Synchronous Servo Geared Motors catalog, ID 442437_en.

You can find current versions of PDF files online at http://www.stoeber.de/en/download.

STÖBER 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/control system**
	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 drives (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.04

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