SC6 drive controller
Manual

en-US
11/2022
ID 442790.06

STÖBER

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1 Foreword

The compact stand-alone SC6 drive controller allows for sensorless control of Lean motors of the LM series. These motors provide energy efficiency at the performance level of synchronous servo motors. They also guarantee high investment protection, thanks to energy efficiency class IE5 and the corresponding higher efficiency compared to IE4 asynchronous motors. However, the SC6 can also be used in combination with asynchronous motors or synchronous servo motors with encoders (e.g. the EZ series). SC6 is available in three sizes with a nominal output current of up to 19 A: Sizes 0 and 1 as a double-axis controller, size 2 as a single-axis controller.

Features

- Sensorless position control of STOBER Lean motors
- Control of rotary synchronous servo motors, asynchronous motors and torque motors
- One Cable Solution EnDat 3
- Electronic motor nameplate via EnDat encoder interfaces
- Integrated EtherCAT or PROFINET communication
- STO safety technology using terminals or STO and SS1 using FSoE or PROFIsafe: SIL 3, PL e (Cat. 4)
- Integrated brake control
- Single-ended nominal power consumption on double-axis controllers for operation of motors with different power
- Energy supply through direct power supply
- Flexible DC link connection for multi-axis applications

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2 User information

This documentation covers the SC6 drive controller. You will receive support for the assembly of the individual modules along with the associated components that you will need to operate the drive controllers in the control cabinet.

You will also find information on wiring the modules correctly and checking their functionality in the group with an initial test.

Combinations with other 6th generation STOBER drive controllers are possible under certain boundary conditions.

More detailed information on project configuration, diagnostics and service are additional topics covered in this manual.

2.1 Storage and transfer

As this documentation contains important information for handling the product safely and efficiently, it must be stored in the immediate vicinity of the product until product disposal and be accessible to qualified personnel at all times.

Also pass on this documentation if the product is transferred or sold to a third party.

2.2 Described product

This documentation is binding for:

SC6 series drive controllers in conjunction with the
DriveControlSuite software (DS6) in V 6.5-H or higher and associated firmware in V 6.5-H or higher.

Type		ID No.
Drive controller	SC6A062	56690
	SC6A162	56691
	SC6A261	56692

Tab. 1: Described product types, SC6 drive controllers

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2.3 UL file number

cULus-certified devices with corresponding test symbols meet the requirements of the standards UL 61800-5-1 and CSA C22.2 No. 274.

Under the file number specified in the following table, you can find the product in the online database of Underwriter Laboratories (UL):
https://iq2.ulprospector.com

Type		File number	UL Category Control Number		Certification
			America	Canada	cULus/cURus
Drive controller	SC6A062	E189114	NMMS	NMMS7	cULus
	SC6A162				
	SC6A261				
Braking resistors	FZMU, FZZMU	E212934	NMTR2	NMTR8	cURus
	GVADU, GBADU				
Output chokes	TEP3720-0ES41	E333628	NMMS2	NMMS8	cURus
	TEP3820-0CS41				
	TEP4020-0RS41				
Motors	EZ or LM series synchronous servo motors	E488992	PRHZ2	PRHZ8	cURus
	Asynchronous motors	E216143	PRGY2	PRGY8	cURus
Encoder and power cables	All types	E172204	AVLV2	AVLV8	cURus
One Cable Solution Basic	All types	E356538	AVLV2	AVLV8	cURus
One Cable Solution Advanced	All types	E170315	AVLV2	AVLV8	cURus

Tab. 2: File number-certified products

2.4 Timeliness

Check whether this document is the latest version of the documentation. We make the latest document versions for our products available for download on our website:
http://www.stoeber.de/en/downloads/.

2.5 Original language

The original language of this documentation is German; all other language versions are derived from the original language.

2.6 Limitation of liability

This documentation was created taking into account the applicable standards and regulations as well as the current state of technology.

No warranty or liability claims for damage shall result from failure to comply with the documentation or from use that deviates from the intended use of the product. This is especially true for damage caused by individual technical modifications to the product or the project configuration and operation of the product by unqualified personnel.

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2.7 Formatting conventions

Orientation guides in the form of signal words, symbols and special text markups are used to emphasize specific information so that you are able identify it in this documentation quickly.

2.7.1 Display of safety instructions

Safety instructions are identified with the following symbols. They indicate special risks when handling the product and are accompanied by relevant signal words that express the extent of the risk. Furthermore, useful tips and recommendations for efficient, error-free operation are specially highlighted.

ATTENTION!

Attention

This indicates that damage to property may occur

- if the stated precautionary measures are not taken.

⚠ CAUTION!

Caution

This word with a warning triangle indicates that minor personal injury may occur

- if the stated precautionary measures are not taken.

⚠ WARNING!

Warning

This word with a warning triangle means there may be a considerable risk of fatal injury

- if the stated precautionary measures are not taken.

⚠ DANGER!

Danger

This word with a warning triangle indicates that there is a considerable risk of fatal injury

- if the stated precautionary measures are not taken.

Information

Information indicates important information about the product or serves to emphasize a section in the documentation that deserves special attention from the reader.

Ⓤ WARNINGS!

Warnings

Warnings with the UL symbol mark text passages quoted from the original.

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2.7.2 Markup of text elements

Certain elements of the continuous text are distinguished as follows.

Important information	Words or expressions with a special meaning
Interpolated position mode	Optional: File or product name or other name
Detailed information	Internal cross-reference
http://www.samplelink.com	External cross-reference

Software and other displays

The following formatting is used to identify the various information content of elements referenced by the software interface or a drive controller display, as well as any user entries.

Main menu Settings	Window names, dialog box names, page names or buttons, combined proper nouns, functions referenced by the interface
Select `Referencing method A`	Predefined entry
Save your `<own IP address>`	User-defined entry
EVENT 52: COMMUNICATION	Displays (status, messages, warnings, faults)

Keyboard shortcuts and command sequences or paths are represented as follows.

[Ctrl], [Ctrl] + [S]	Key, shortcut
Table > Insert table	Navigation to menus/submenus (path specification)

2.7.3 Mathematics and formulas

The following signs are used to represent mathematical relationships and formulas.

-	Subtraction
+	Addition
×	Multiplication
÷	Division
| |	Absolute value

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2.7.4 Conventions for cables

In the cable connection descriptions, core colors are shortened and used as follows.

Cable colors

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

Formatting conventions

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

2.8 Marks and test symbols

The following marks and test symbols are mentioned in the technical data.

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

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

UKCA test symbol
Manufacturer's self declaration: The product meets the requirements of UK directives.

UL test symbol (cULus)
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 symbol for recognized component mark (cURus)
This component or material is recognized by UL. Representative samples of this product have been evaluated by UL and meet applicable requirements.

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2.9 Trademarks

The following names used in connection with the device, its optional equipment and its accessories are trademarks or registered trademarks of other companies:

CANopen®, CiA®	CANopen® and CiA® are registered European Union trademarks of CAN in AUTOMATION e.V., Nuremberg, Germany.
EnDat®	EnDat® and the EnDat® logo are registered trademarks of Dr. Johannes Heidenhain GmbH, Traunreut, Germany.
EtherCAT®, Safety over EtherCAT®, TwinCAT®	EtherCAT®, Safety over EtherCAT® and TwinCAT® are registered trademarks of patented technologies licensed by Beckhoff Automation GmbH, Verl, Germany.
HIPERFACE®	HIPERFACE® and the HIPERFACE DSL® logo are registered trademarks of SICK STEGMANN GmbH, Donaueschingen, Germany.
Hyper-V®	Hyper-V® is a registered trademark of the Microsoft Corporation in the United States and/or other countries.
PLCopen®	PLCopen® is a registered trademark of the PLCopen Organisation, Gorinchem, Netherlands.
PROFIBUS®, PROFINET®	PROFIBUS® and PROFINET® are registered trademarks of PROFIBUS Nutzerorganisation e.V., Karlsruhe, Germany.
PROFIdrive®, PROFIsafe®	PROFIdrive® and PROFIsafe® are registered trademarks of Siemens AG, Munich, Germany.
speedtec®	speedtec® is a registered trademark of TE Connectivity Industrial GmbH, Niederwinkling, Germany.
TORX®	TORX® and the TORX® logo are registered trademarks of Acument Intellectual Properties in the USA and/or other countries.
VirtualBox®	VirtualBox® is a registered trademark of Oracle America, Inc., Redwood Shores, USA.
VMware®	VMware® is a registered trademark of VMware, Inc., Palo Alto, USA.
Windows®, Windows® 7, Windows® 10	Windows®, das Windows®-Logo, Windows® XP, Windows® 7 und Windows® 10 are registered trademarks of Microsoft Corporation in the United States and/or other countries.

All other trademarks not listed here are the property of their respective owners.

Products that are registered as trademarks are not specially indicated in this documentation. Existing property rights (patents, trademarks, protection of utility models) are to be observed.

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3 General safety instructions

There are risks associated with the product described in this documentation that can be prevented by complying with the described warning and safety instructions as well as the included technical rules and regulations.

3.1 Directives and standards

The following European directives and standards are relevant to the drive controllers:

- Machinery Directive 2006/42/EC
- Low Voltage Directive 2014/35/EU
- EMC Directive 2014/30/EU
- EN ISO 13849-1:2015
- EN ISO 13849-2:2012
- EN 61800-3:2018
- EN 61800-5-1:2017
- EN 61800-5-2:2017

Subsequent references to the standards do not specify the respective year in order to improve readability.

3.2 Qualified personnel

In order to be able to perform the tasks described in this documentation, the persons instructed to perform them must have the appropriate professional qualification and be able to assess the risks and residual hazards when handling the products. For this reason, all work on the products as well as their operation and disposal may be performed only by professionally qualified personnel.

Qualified personnel are persons who have acquired the authorization to perform these activities either through training to become a specialist and/or instruction by specialists.

Furthermore, valid regulations, legal requirements, applicable basic rules, this documentation and the safety instructions included in it must be carefully read, understood and observed.

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3.3 Intended use

As defined by EN 50178, drive controllers are electrical devices operating as power electronics to control the flow of energy in high-voltage systems.

The drive controllers are intended solely for the operation of motors that meet the requirements of EN 60034-1:

- Lean motors of the LM series
- Synchronous servo motors (e.g. of the EZ series)
- Asynchronous motors
- Torque motors

The connection of other electronic loads or operation outside applicable technical specifications constitutes improper use.

When installing drive controllers in machines, commissioning (i.e. commencing intended operation) may not be performed until it has been determined that the machine is in compliance with local laws and directives. For example, in the European region, the following applies:

- Machinery Directive 2006/42/EC
- Low Voltage Directive 2014/35/EU
- EMC Directive 2014/30/EU

EMC-compliant installation

The SC6 drive controller and accessories must be installed and wired compliant for EMC

Modification

As the user, you may not make any physical, technical or electrical modifications to the SC6 drive controller and the accessories.

Maintenance

The SC6 drive controller and accessories are maintenance-free. However, take appropriate measures to detect or prevent possible errors in the connecting wiring.

3.4 Transport and storage

Inspect the delivery for any transport damage immediately after you receive it. Notify the transport company of any damage immediately. Do not put a damaged product into operation.

To ensure the faultless and safe operation of the products, they must be professionally configured, installed, operated and maintained.

Store the products in a dry and dust-free room if you do not install them immediately.

Transport and store the products in the original packaging and protect the products from mechanical impacts and vibrations. Observe the transport and storage conditions recommended in the technical data.

Reform drive controllers in storage annually or before commissioning (see Storage [▶ 73]).

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3.5 Operational environment and operation

The products are subject to sales restrictions in accordance with EN IEC 61800-3.

The products are not designed for use in a public low-voltage network that supplies residential areas. Radio-frequency interference can be expected if the products are used in this type of network.

The products are intended exclusively for installation in control cabinets with at least protection class IP54.

Always operate the products within the limits specified by the technical data.

The following applications are prohibited:

- Use in potentially explosive atmospheres
- Use in environments with harmful substances as specified by EN 60721, such as oils, acids, gases, vapors, dust and radiation

Implementation of the following applications is permitted only after approval from STOBER:

- Use in non-stationary applications
- The use of active components (drive controllers, supply modules, regenerative feedback modules or discharge units) from third-party manufacturers

The drive controller is designed exclusively for operation in TN networks or on wye sources. At a nominal voltage of 200 to 480 V_{AC}, they are permitted to supply a maximum differential short-circuit current in accordance with the following table:

Size	Max. differential short-circuit current
Size 0 – size 2	5000 A

Tab. 3: Maximum differential short-circuit current

The drive controller has a configurable restart. If the drive controller is designed for an automatic restart after energy shutdown, this must be clearly specified on the system in accordance with EN 61800-5-1.

The drive controller has the option of a Safe Torque Off safety function (STO) in accordance with EN 61800-5-2 for safely disconnecting the energy supply to the motor. Measures based on this for protection against unexpected startup are described in EN ISO 12100 and EN ISO 14118, for example.

3.6 Working on the machine

Before all work on machines and systems, apply the 5 safety rules in accordance with DIN VDE 0105-100 (Operation of electrical installations – Part 100: General requirements) in the order listed:

- Disconnect (also ensure that the auxiliary circuits are disconnected).
- Ensure power cannot be switched on again.
- Ensure that everything is de-energized.
- Ground and short circuit.
- Cover adjacent live parts.

Information

Note the discharge time of the DC link capacitors in the general technical data for the devices. You can only determine the absence of voltage after this time period.

3.7 Ensuring traceability

The orderer must ensure traceability of the products using the serial number.

3.8 Decommissioning

In safety-oriented applications, note the mission time T_M = 20 years in the safety-relevant key performance indicators. A drive controller with integrated safety module must be taken out of operation 20 years after the production date. The production date of the drive controller is found on the accompanying nameplate.

For detailed information about using the safety technology, refer to the corresponding manual (see Detailed information [▶ 347]).

3.9 Disposal

Observe the current national and regional regulations when disposing of the packaging and product! Dispose of the packaging and individual product parts depending on their properties, e.g. as:

- Cardboard
- Electronic waste (circuit boards)
- Plastic
- Sheet metal
- Copper
- Aluminum
- Battery

3.10 Firefighting

⚠ DANGER!

Electrical voltage! Risk of fatal injury due to electric shock!

There is a risk of fatal injury due to electric shock when using conductive firefighting equipment.

- Use ABC powder or carbon dioxide (CO_2) for firefighting.

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4 Security

Security refers to the protection and safety of your components and systems with regard to confidentiality, integrity and availability.

While functional safety technology focuses on the avoidance of systematic or random faults, security technology is based on targeted influences. These influences may be intentional or unintentional with direct or indirect access to equipment.

Security risks

- Incorrect operation, e.g. connection to an incorrect device
- Hardware:
  - Changing the wiring
  - Changing the device configuration, e.g. the FSoE address
  - Disassembly of accessories, e.g. the SD card
- Software:
  - Changing the firmware
  - Changing the device configuration, e.g. via DriveControlSuite, via the SD card or using script mode
  - Changing parameters
- Network structure

Recognizing and avoiding risks

For example, the following tools are available to help you identify risks and avoid tampering.

- Provide a unique device ID:
  - Reference identification
  - Communication address(es)
- After establishing the connection, make sure that communication with the desired device has been established.
- Test and log the (re)commissioning.
- Limit access:
  - Physically (close off the control cabinet and electrical operating room)
  - Logically (restrict communication, e.g. by means of a firewall)
- Use sealing tape to detect tampering at the following interfaces:
  - Ethernet service interface X9
  - Fieldbus interfaces X200 and X201
- Make sure that the controller runs a plausibility check:
  - Device status
  - Application-specific configuration ID

Planning measures

The requirements from the locally applicable safety and application standards regarding protection against tampering must be observed. The authorization of personnel and the implementation of the necessary protective measures are the responsibility of the operator.

All systems to be protected must be considered individually. Organizational protective measures are supported by technical measures. Technical measures alone are not sufficient.

In the course of planning, you should name and document the measures to be taken.

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Such measures include:

- Sensible division of user groups
- Use of appropriate passwords
- Updated network plans

Network plans can be used to ensure that secure networks are permanently separated from public networks and, if necessary, that there is only defined access (e.g. via a firewall or a DMZ).

A regular, e.g. annual, review of the security measures is advisable.

Defense in depth concept

Counter risks with layered security solutions.

In accordance with EN IEC 62443-4-1, the defense in depth concept is an approach to defend the system against any kind of attack by applying multiple independent methods.

Features:

- The approach is based on the fundamental idea that any protective measure can be, and probably will be, overcome.
- Attackers have to overcome or bypass each layer without being detected.
- A weakness in one layer can be mitigated by the capabilities of another layer.
- The system's IT security becomes a set of layers within the overall IT network security.
- Each layer should stand alone, should not be based on the same functionality as the other layers and should not have the same failure modes as them.

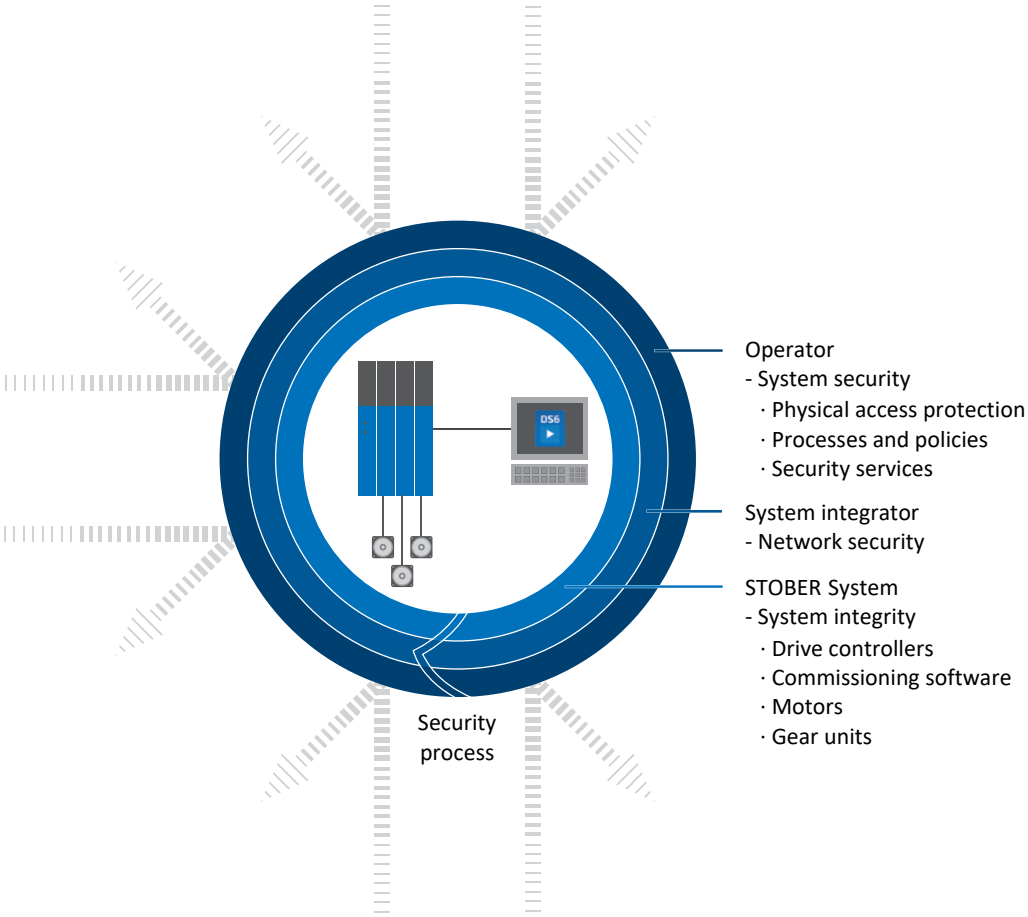

Fig. 1: Defense-in-depth concept

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5 UL-compliant use

This chapter contains relevant information for use under UL conditions (UL – Underwriters Laboratories).

Surrounding air temperature and pollution degree

The maximum surrounding air temperature for UL-compliant operation is 45 °C. Use in an environment with pollution degree 2 is permitted.

Network layout

All device types supplied with 480 V_{AC} are intended solely for operation with grounded wye sources at 480/277 V_{AC}.

The drive controller is designed exclusively for operation in TN networks or on wye sources. At a nominal voltage of 240 to 480 V_{AC}, they are permitted to supply a maximum differential short-circuit current in accordance with the following table:

Size	Max. differential short-circuit current
Size 0 – size 2	5000 A

Tab. 4: Maximum differential short-circuit current

Line fuse

Obey the information on the UL-compliant line fuse of the supplied drive controllers [▶ 91].

Branch circuit protection

Integral solid state short circuit protection does not provide branch circuit protection (line fuse) upstream of the drive controller. Branch circuit protection must be provided in accordance with the manufacturer instructions, the National Electrical Code, the Canadian Electrical Code, part I, and any additional local codes.

Protective grounding

The protective grounding of motors connected to the drive controller must not be connected using terminals X20A and X20B. The grounding conductor connection of the motor must be ensured for the respective application in accordance with the valid electrical standards.

The grounding at terminal X10 of the SC6 drive controller must not be used for protective grounding. The housing for the drive controllers must be connected to the protective grounding using the M6 ground bolt (4.0 Nm, 35 Lb.inch).

Original text:

WARNINGS!

Safety grounding

The external motors which are connected to the drive units SC6A shall not be grounded over the drive units. The bonding/ grounding of the motor(s) shall occur in the end use application in accordance with the requirements of applicable electrical codes/standards.

The grounding provisions present on the terminals X20A/X20B of the SC6 unit are not intended for safety grounding of the motors. The grounding provision present on terminal X10 of the inverter unit is not to be used for the grounding of the drive system.

The chassis of each SC6A drive unit is to be bonded through the M6 grounding stud present on each SC6A unit.

The connection for the protective grounding on the housing is identified by the grounding symbol in accordance with IEC 60417 (symbol 5019).

For correct installation, obey the instructions for UL-compliant connection of the grounding conductor [▶ 95].

Functional grounding

In addition to the protective grounding, a functional grounding is required for proper operation of the SC6 drive controller and the motor. The functional grounding of the drive controller is connected using terminal X10, while that of the motor is connected using terminals X20A and X20B. The connections for the functional grounding to terminals X10, X20A and X20B are marked with **PE**. For UL-compliant operation: The connections marked with PE are intended solely for the functional grounding.

Terminals

Note that the basic device is delivered without terminals. Suitable terminal sets are available separately for each size. An order overview of the available terminal sets can be found in the appendix.

Motor overload protection/motor temperature protection

Use motor overload protection/motor temperature protection. The SC6 drive controller features connections for PTC thermistors (NAT 145 °C, sensor voltage = 3.3 V_{DC}, sensor current = max. 0.6 mA) at X2A/X2B, pins 7 and 8. The devices are only intended for use with motors with integrated temperature protection. In accordance with UL certification, operation without motor overload protection/motor temperature protection in or on the motor (X2 jumpers) is not permitted!

For a proper connection, obey the terminal description X2A: Motor temperature sensor A [▶ 99].

For EnDat 3 or HIPERFACE DSL encoders, the motor temperature is transmitted together with the encoder data over connector X4A/X4B. Additional cabling at terminal X2A/X2B is not needed.

Brake

Obey the technical data for the brake [▶ 57].

Digital inputs

For the terminals at X101 and X103, obey the technical data for the digital inputs [▶ 41].

Power terminals

Use only copper conductors for a surrounding temperature of 60/75 °C.

24 V supply and fuses

Low-voltage circuits must be supplied by an isolated source with a maximum output voltage that does not exceed 30 V_{DC}.

Fuses for 24 V_{DC} supplies must be approved for DC voltage in accordance with UL 248.

- Protect the 24 V_{DC} supply of the control unit with a 10 A fuse (time delay). Obey the terminal description for X11 [▶ 107].
- Protect the 24 V_{DC} supply for the brake with a 10 A fuse (time delay). Obey the terminal description for X300 [▶ 116].
- For the STO safety function via terminal X12: Use a 3.15 A fuse (time delay) to protect the supply voltage of the status signal. Obey the X12: Safety technology (option SR6) [▶ 108].

UL test

Only the risks of electric shock and the risk of fire have been examined during UL acceptance. Functional safety aspects have not been assessed during the UL approval process. These are assessed for STOBER by bodies such as the TÜV SÜD certification service.

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6 System design

For connecting to a controller, we recommend the PROFINET fieldbus in combination with the Drive Based or PROFIdrive application. As an alternative, you can use the EtherCAT fieldbus and an application with a CiA 402 interface. You commission the drive controller using the DriveControlSuite software.

The drive controllers offer the STO safety function in accordance with EN 61800-5-2 as an option. For connection to a higher-level safety circuit, different interfaces are available.

The following graphic explains the principle system design.

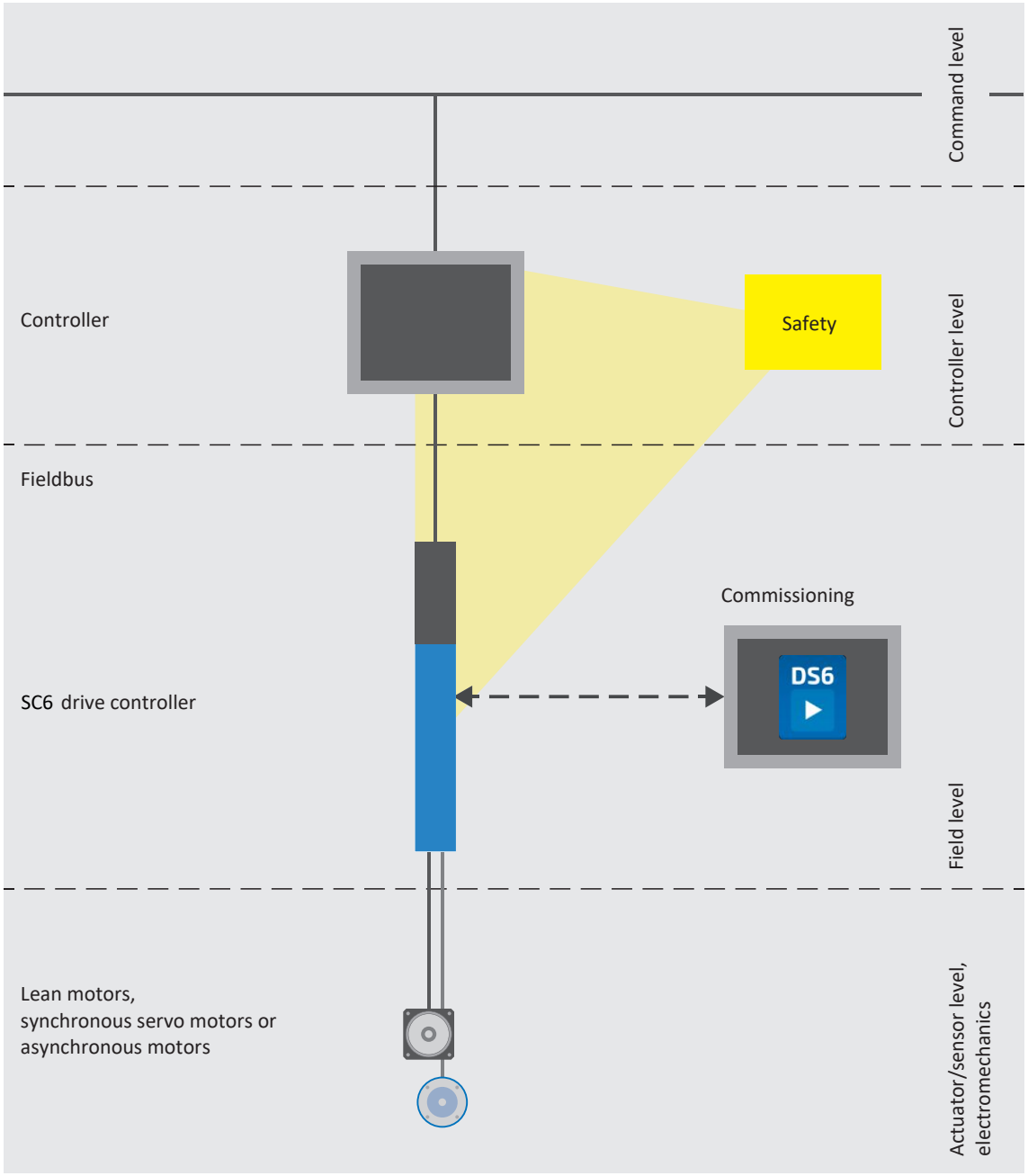

Fig. 2: System overview

6.1 Hardware components

Below you will find an overview of the available hardware components.

6.1.1 Drive controllers

The SC6 drive controller is available in three sizes. Various safety options are also available.

6.1.1.1 Nameplate

The nameplate is placed on the side of the drive controller.

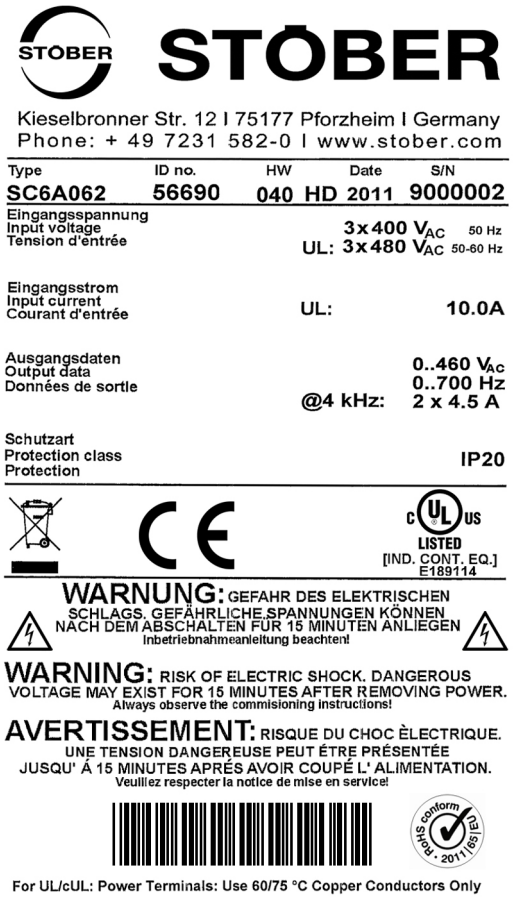

Fig. 3: SC6A062 nameplate

Designation	Value in example	Meaning
Type	SC6A062	Production information
ID No.	56690	
HW	040 HD	
Date	2011 (year/calendar week)	
S/N	9000002	
Input voltage	3 × 400 V_{AC} 50 Hz UL: 3 × 480 V_{AC} 50 – 60 Hz	Input voltage
Input current	UL: 10.0 A	Input current
Output data	0 to 460 V_{AC} 0 to 700 Hz @4 kHz: 2 × 4.5 A	Output voltage Output frequency Output current for 4 kHz clock frequency
Protection class	IP20	Protection class

Tab. 5: Meaning of the specifications on the nameplate

Information

UL and cUL-certified devices with corresponding test symbols meet the requirements of the standards UL 61800-5-1 and CSA C22.2 No. 274.

6.1.1.2 Type designation

SC	**6**	**A**	**0**	**6**	**2**	**Z**

Tab. 6: Example code for type designation

Code	Designation	Design
SC	Series	
6	Generation	Generation 6
A	Version	
0 – 2	Size	
6	Power output stage	Power output stage within the size
2 1	Axis controller	Double-axis controller Single-axis controller
Z R U Y	Safety technology	SZ6: Without safety technology SR6: STO using terminals SU6: STO and SS1 using PROFIsafe SY6: STO and SS1 using FSoE

Tab. 7: Meaning of the example code

6.1.1.3 Material variant

On the side of the drive controller above the nameplate, there is another sticker with the material variant (MV) and serial number (SN).

Fig. 4: Sticker with MV and serial number

Designation	Value in example	Meaning
MV	MV0000012345	MV number
SN	6001192064	Serial number
—	SC6A062Z	Device type according to type designation
—	1000914812/001100	Order number/order item

Tab. 8: Meaning of the specifications on the sticker

6.1.1.4 Sizes

Type	ID No.	Size	Axis controller
SC6A062	56690	Size 0	Double-axis controller
SC6A162	56691	Size 1	Double-axis controller
SC6A261	56692	Size 2	Single-axis controller

Tab. 9: Available SC6 types and sizes

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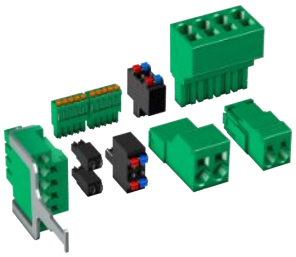
SC6 in sizes 0 to 2

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

Terminal set for drive controllers – SZ6 option (without safety technology), SU6 option (STO and SS1 using PROFIsafe) or SY6 option (STO and SS1 using FSoE)



(Fig. similar)

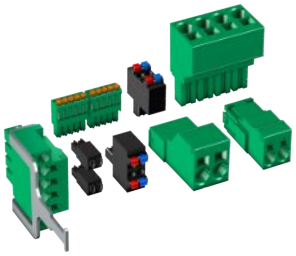
The following designs are available:

ID No. 138652
Terminal set for SC6A062Z/U/Y.

ID No. 138653
Terminal set for SC6A162Z/U/Y.

ID No. 138654
Terminal set for SC6A261Z/U/Y.

Terminal set for drive controllers – SR6 option (STO via terminals)



(Fig. similar)

The following designs are available:

ID No. 138680
Terminal set for SC6A062R.

ID No. 138681
Terminal set for SC6A162R.

ID No. 138682
Terminal set for SC6A261R.

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6.1.2 Operating motors, encoders and brakes

You can use the SC6 drive controller to operate STOBER Lean motors of the LM series, synchronous servo motors (such as those of the EZ series), asynchronous motors or torque motors.

Evaluation options for feedback are available on the X4 connection for the following encoders:

- EnDat 2.2 digital encoders
- SSI encoders
- Differential TTL and differential HTL incremental encoders (HTL via HT6 adapter)
- Resolver
- EnDat 3 or HIPERFACE DSL encoder (One Cable Solution design)

In addition, evaluation options for the following encoders are available on the X101 and X103 connection:

- Single-ended HTL incremental encoders
- Single-ended HTL pulse/direction interface

All device types of the SC6 drive controller have connections for PTC thermistors and can control a 24 V_{DC} brake as standard.

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6.1.3 Accessories

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

6.1.3.1 Safety technology

The safety modules are used to realize the STO safety function. They prevent the generation of a rotating magnetic field in the power unit of the drive controller. For an external requirement or in the event of error, the safety module switches the drive controller to the STO state. Different human-machine interfaces and additional safety functions are available depending on the selected design of the accessories.

For double-axis controllers, the STO safety function has a two-channel structure that acts upon both axes.

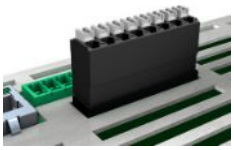
Information

The drive controller is delivered in the standard design without safety technology (option SZ6). 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.

SZ6 option – Without safety technology

ID No. 56660
Design without safety technology.

SR6 safety module – STO using terminals



ID No. 56661
Optional accessory for the use of the Safe Torque Off safety function (STO) in safety-relevant applications (PL e, SIL 3) in accordance with EN ISO 13849-1 and EN 61800-5-2. Connection to a higher-level safety circuit via terminal X12.

SY6 safety module – STO and SS1 using FSoE

Safety over EtherCAT®

ID No. 56662
Optional accessory for the use of the Safe Torque Off (STO) and Safe Stop 1 (SS1) safety functions in safety-relevant applications (PL e, SIL 3) in accordance with EN ISO 13849-1 and EN 61800-5-2. Connection to the higher-level safety circuit using Fail Safe over EtherCAT (FSoE).

SU6 safety module – STO and SS1 using PROFIsafe

PROFIsafe

ID No. 56696
Optional accessory for the use of the Safe Torque Off (STO) and Safe Stop 1 (SS1) safety functions in safety-relevant applications (PL e, SIL 3) in accordance with EN ISO 13849-1 and EN 61800-5-2. Connection to a higher-level safety circuit via PROFINET (PROFIsafe).

For detailed information about using the safety technology, refer to the corresponding manual (see Detailed information [▶ 347]).

6.1.3.2 Communication

The drive controller has two interfaces for the fieldbus 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 or PROFINET fieldbus system

Please specify the desired fieldbus system when placing your order for the base device, since the fieldbus communication is defined using the firmware.

EtherCAT cables

Ethernet patch cable, CAT5e, yellow.

The following designs are available:

ID No. 49313: Length approx. 0.25 m.
ID No. 49314: Length approx. 0.5 m.

PC connecting cables

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

USB 2.0 Ethernet adapter

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

For detailed information about the fieldbus connection, refer to the corresponding manual (see Detailed information [▶ 347]).

6.1.3.3 DC link connection

If you want to connect SC6 drive controllers in the DC link group, you will need Quick DC-Link modules of type DL6B.

You receive the DL6B rear section modules in different designs for a horizontal connection, suitable for the size of the drive controller.

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

Quick DC-Link DL6B for drive controller

The following designs are available:

DL6B10
ID No. 56655
Rear section module for size 0 drive controller:
SC6A062

DL6B11
ID No. 56656
Rear section module for size 1 or 2 drive controller:
SC6A162 and SC6A261

Quick DC-Link DL6B insulation end section

ID No. 56659
Insulation end sections for the left and right termination of the group, 2 pcs.

6.1.3.4 Braking resistor

STOBER offers braking resistors in different sizes and performance classes.

For more detailed information on this, refer to the technical data (see Braking resistor [▶ 58]).

6.1.3.5 Choke

STOBER offers various chokes corresponding to your application.

For more detailed information, refer to the technical data (see Choke [▶ 62]).

6.1.3.6 Encoder battery module

Absolute Encoder Support AES

ID No. 55452
Battery module for buffering the supply voltage when using the EnDat 2.2 digital inductive encoder with battery-buffered multi-turn stage, for example EBI1135 or EBI135.
A battery is included.

Information

Note that a 15-pin extension cable between the socket and the AES may be necessary for the connection to the drive controller due to limited space.

- A commercially available shielded extension cable with a 15-pin D-sub connector and a length of ≤ 1 m can be used between the socket and the AES.

AES replacement battery

ID No. 55453
Replacement battery for AES battery module.

6.1.3.7 HTL-to-TTL adapter

HT6 HTL-to-TTL adapter

ID No. 56665
Adapters for SC6 and SI6 series drive controllers for level conversion from HTL signals to TTL signals.
It is used to connect an HTL differential incremental encoder to terminal X4 of the drive controller.

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6.1.3.8 Interface adapters

AP6A00 interface adapters

ID No. 56498
Adapter (9/15-pin) for connecting resolver cables with a 9-pin D-sub connector to the X4 encoder interface of the drive controller.

6.2 Software components

The available software components help you implement your drive system.

6.2.1 Project configuration and parameterization

For project configuration and parameterization, the drive controller can be addressed using the DriveControlSuite commissioning software. The program guides you step by step through the complete project configuration and parameterization process using wizards.

6.2.2 Applications

A drive-based application 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. The Drive Based application provides drive-based motion control for positioning, velocity and torque/force with the PLCopen Motion Control command set. These standard commands have been combined into operating modes for different applications and supplemented with additional functions such as 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.

In addition, the CiA 402 and PROFIdrive applications are also available, which include both the controller-based and drive-based operating modes and application classes.

Furthermore, programming based on IEC 61131-3 with CFC can be used to create new applications or expand existing ones.

For detailed information about the available applications, refer to the corresponding manual (see Detailed information [▶ 347]).

7 Technical data

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

7.1 Drive controllers

The following chapters contain specifications for the electrical data, dimensions and weight of the drive controller.

7.1.1 General technical data

The following information applies to all device types.

Device features	
Protection class of the device	IP20
Protection class of the installation space	At least IP54
Protection class	Protection class I in accordance with EN 61140
Radio interference suppression	Integrated line filter in accordance with EN 61800-3, interference emission class C3
Overvoltage category	III in accordance with EN 61800-5-1
Marks and test symbols	CE, cULus, RoHS

Tab. 10: Device features

Transport and storage conditions	
Storage/ transport temperature	−20 °C to +70 °C Maximum change: 20 K/h
Relative humidity	Maximum relative humidity 85%, non-condensing
Vibration (transport) in accordance with 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
Fall height for freefall[1] Weight < 100 kg in accordance with EN 61800-2 (or IEC 60721-3-2, class 2M1)	0.25 m

Tab. 11: Transport and storage conditions

Operating conditions	
Surrounding temperature during operation	0 °C to 45 °C with nominal data 45 °C to 55 °C with derating −2.5% / K
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 2 in accordance with EN 50178
Ventilation	Installed fan
Vibration (operation) in accordance with EN 60068-2-6	5 Hz ≤ f ≤ 9 Hz: 0.35 mm 9 Hz ≤ f ≤ 200 Hz: 1 m/s²

Tab. 12: Operating conditions

Discharge times	
Self-discharge of DC link	15 min

Tab. 13: Discharge times of the DC link circuit

[1] Only valid for components in original packaging

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7.1.2 Electrical data

The electrical data of the available SC6 sizes as well as the properties of the brake chopper can be found in the following sections.

Information

For the time span between energizing two devices, note that:

- Direct, repeat activation of the supply voltage is possible for cyclical power-on/power-off operation.
- A time span of > 15 minutes must be observed between two energizing processes during continuous, cyclical power-on/power-off operation with increased charging capacity.

Information

The STO safety function is available for safe stopping as an alternative to continuous, cyclical power-on/power-off operation.

For an explanation of the formula symbols used, see Symbols in formulas [▶ 348].

7.1.2.1 Control unit

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

Tab. 14: Control unit electrical data

7.1.2.2 Power unit: Size 0

Electrical data	SC6A062
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_{1PU}
$U_{2PU,ZK}$	√2 × U_{1PU}
C_{PU}	270 µF
$C_{N,PU}$	1400 µF
C_{maxPU}	1880 µF

Tab. 15: SC6 electrical data, size 0

The charging capacity depends on the time between two energizing processes:

Information

For the maximum charging capacity C_{maxPU}, a time span of ≥ 15 min must be maintained between two energizing processes.

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

Electrical data	SC6A062
$f_{PWM,PU}$	4 kHz
$I_{1N,PU}$	10 A
$I_{2N,PU}$	2 × 4.5 A
I_{2maxPU}	210% for 2 s; 150% for 30 s

Tab. 16: SC6 electrical data, size 0, for 4 kHz clock frequency

Electrical data	SC6A062
$f_{PWM,PU}$	8 kHz
$I_{1N,PU}$	8.9 A
$I_{2N,PU}$	2 × 4 A
I_{2maxPU}	250% for 2 s; 200% for 5 s

Tab. 17: SC6 electrical data, size 0, for 8 kHz clock frequency

Electrical data	SC6A062
U_{onCH}	780 – 800 V_{DC}
U_{offCH}	740 – 760 V_{DC}
R_{2minRB}	100 Ω
P_{maxRB}	6.4 kW
P_{effRB}	2.9 kW

Tab. 18: Brake chopper electrical data, size 0

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7.1.2.3 Power unit: Size 1

Electrical data	SC6A162
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_{1PU}
$U_{2PU,ZK}$	√2 × U_{1PU}
C_{PU}	940 µF
$C_{N,PU}$	1400 µF
C_{maxPU}	1880 µF

Tab. 19: SC6 electrical data, size 1

The charging capacity depends on the time between two energizing processes:

Information

For the maximum charging capacity C_{maxPU}, a time span of ≥ 15 min must be maintained between two energizing processes.

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

Electrical data	SC6A162
$f_{PWM,PU}$	4 kHz
$I_{1N,PU}$	23.2 A
$I_{2N,PU}$	2 × 10 A
I_{2maxPU}	210% for 2 s; 150% for 30 s

Tab. 20: SC6 electrical data, size 1, for 4 kHz clock frequency

Electrical data	SC6A162
$f_{PWM,PU}$	8 kHz
$I_{1N,PU}$	20.9 A
$I_{2N,PU}$	2 × 9 A
I_{2maxPU}	250% for 2 s; 200% for 5 s

Tab. 21: SC6 electrical data, size 1, for 8 kHz clock frequency

Electrical data	SC6A162
U_{onCH}	780 – 800 V_{DC}
U_{offCH}	740 – 760 V_{DC}
R_{2minRB}	47 Ω
P_{maxRB}	13.6 kW
P_{effRB}	6.2 kW

Tab. 22: Brake chopper electrical data, size 1

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7.1.2.4 Power unit: Size 2

Electrical data	SC6A261
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_{1PU}
$U_{2PU,ZK}$	√2 × U_{1PU}
C_{PU}	940 µF
$C_{N,PU}$	1400 µF
C_{maxPU}	1880 µF

Tab. 23: SC6 electrical data, size 2

The charging capacity depends on the time between two energizing processes:

Information

For the maximum charging capacity C_{maxPU}, a time span of ≥ 15 min must be maintained between two energizing processes.

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

Electrical data	SC6A261
$f_{PWM,PU}$	4 kHz
$I_{1N,PU}$	22.6 A
$I_{2N,PU}$	19 A
I_{2maxPU}	210% for 2 s; 150% for 30 s

Tab. 24: SC6 electrical data, size 2, for 4 kHz clock frequency

Electrical data	SC6A261
$f_{PWM,PU}$	8 kHz
$I_{1N,PU}$	17.9 A
$I_{2N,PU}$	15 A
I_{2maxPU}	250% for 2 s; 200% for 5 s

Tab. 25: SC6 electrical data, size 2, for 8 kHz clock frequency

Electrical data	SC6A261
U_{onCH}	780 – 800 V_{DC}
U_{offCH}	740 – 760 V_{DC}
R_{2minRB}	47 Ω
P_{maxRB}	13.6 kW
P_{effRB}	6.2 kW

Tab. 26: Brake chopper electrical data, size 2

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7.1.2.5 DC link connection

The charging capacity of the drive controllers can be increased by a DC link connection only if the power grid supply is connected to all drive controllers simultaneously.

Obey the general conditions for DC link connection (see Project configuration [▶ 64]).

7.1.2.6 Digital inputs

X101 specification for digital signals

The inputs are suitable for the connection of PELV voltage in accordance with EN 60204-1.

Electrical data	Digital input	Value
Low level	DI1 – DI4	0 – 8 V_{DC}
High level		12 – 30 V_{DC}
U_{1max}		30 V_{DC}
I_{1max}		16 mA
f_{1max}	DI1 – DI2	10 kHz
	DI3 – DI4	250 kHz
Internal device update rate	DI1 – DI4	Cycle time for the application parameterized in A150; t_{min} = 250 µs; also applicable to digital inputs DI3 and DI4: with timestamp correction in an accuracy range of 1 µs
Max. cable length		30 m

Tab. 27: X101 electrical data

X103 specification for digital signals

The inputs are suitable for the connection of PELV voltage in accordance with EN 60204-1.

Electrical data	Digital input	Value
Low level	DI6 – DI9	0 – 8 V_{DC}
High level		12 – 30 V_{DC}
U_{1max}		30 V_{DC}
I_{1max}		16 mA
f_{1max}	DI6 – DI7	10 kHz
	DI8 – DI9	250 kHz
Internal device update rate	DI6 – DI9	Cycle time for the application parameterized in A150; t_{min} = 250 µs; also applicable to digital inputs DI8 and DI9: with timestamp correction in an accuracy range of 1 µs
Max. cable length		30 m

Tab. 28: X103 electrical data

7.1.2.7 Single-ended nominal power consumption on double-axis controllers

Operating two motors on one double-axis controller makes it possible to operate one of the motors with a continuous current above the nominal current of the drive controller if the continuous current of the second connected motor is lower than the nominal current of the drive controller. This enables economical combinations of double-axis controllers and motors.

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

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

Example 2

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

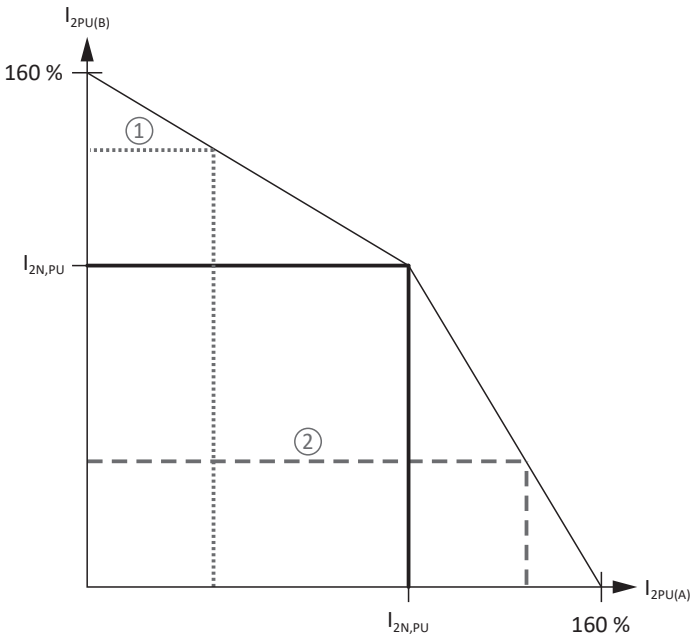

Fig. 5: Asymmetric load on double-axis controllers

Information

Note that the available maximum currents I_{2maxPU} of the axis controllers are also relative to the nominal output current $I_{2N,PU}$ for single-ended nominal power consumption.

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7.1.2.8 Power loss data in accordance with EN 61800-9-2

Type	Nominal current $I_{2N,PU}$	Apparent power	Absolute losses $P_{V,CU}$[2]	Operating points[3]								IE class[4]	Comparison[5]
				(0/25)	(0/50)	(0/100)	(50/25)	(50/50)	(50/100)	(90/50)	(90/100)		
				Relative losses									
	[A]	[kVA]	[W]	[%]									
SC6A062	4.5	6.2	Max. 10	1.34	1.49	1.86	1.40	1.63	2.19	1.84	2.77	IE2	
SC6A162	10	13.9	Max. 10	0.76	0.92	1.43	0.81	1.04	1.75	1.22	2.29	IE2	
SC6A261	19	13.2	10	0.77	0.95	1.56	0.82	1.08	1.89	1.25	2.43	IE2	
				Absolute losses P_V									
	[A]	[kVA]	[W]	[W]									[%]
SC6A062	4.5	6.2	Max. 10	83.2	92.5	115.2	86.7	100.8	135.8	113.9	171.7	IE2	36.0
SC6A162	10	13.9	Max. 10	105.5	128.3	198.8	113.1	145.1	243.5	170.1	318.7	IE2	40.8
SC6A261	19	13.2	Max. 10	101.2	125.8	206.1	108.5	142.0	249.5	165.6	320.4	IE2	41.0

Tab. 29: Power loss data of the SC6 drive controller in accordance with EN 61800-9-2

General conditions

The specified losses apply to a drive controller. They apply to both axes together in the case of double-axis controllers.

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 61800-9-2.

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 61800-9-2
[5] Comparison of the losses for the reference related to IE2 in the nominal point (90, 100)

7.1.2.9 Power loss data of accessories

If you intend to order the drive controller with accessory parts, losses increase as follows.

Type	Absolute losses P_V [W]
SR6 safety module	1
SY6 or SU6 safety module	2

Tab. 30: 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.

Loss specifications for other optional accessories can be found in the technical data of the respective accessory part.

7.1.3 Cycle times

Possible cycle times can be found in the following table.

Type	Cycle times	Relevant parameters
Application	250 µs, 500 µs, 1 ms, 2 ms, 4 ms, 8 ms	Adjustable in A150
EtherCAT fieldbus, cyclical communication	250 µs, 500 µs, 1 ms, 2 ms, 4 ms, 8 ms	Adjustable in A150
PROFINET RT fieldbus, cyclical communication	1 ms, 2 ms, 4 ms, 8 ms	Adjustable in A150
PROFINET IRT fieldbus, cyclical communication	1 ms, 2 ms, 4 ms	Adjustable in A150
Motion core (movement calculation)	250 µs	—
Control cascade	62.5 µs, 125 µs	Depending on B24

Tab. 31: Cycle times

7.1.4 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.

7.1.4.1 Effect of the clock frequency

Changing the clock frequency f_{PWM} affects the amount of noise produced by the drive, among 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.

Information

Select the defined clock frequency using parameter B24. The clock frequency for double-axis controllers always applies to both axis controllers.

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7.1.4.2 Effect of the 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%/K

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%

7.1.4.3 Effect of the 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%

7.1.4.4 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 $I_{2N,PU(red)}$ in accordance with the following formula:
   $I_{2N,PU(red)} = I_{2N,PU} \times D_T \times D_{IA}$

Example

A drive controller of type SC6A062 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 SC6A062 at 8 kHz is 4 A per axis. 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 of importance for the project configuration is:
$I_{2N,PU(red)}$ = 4 A × 0.875 × 0.925 = 3.24 A

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7.1.5 Dimensions

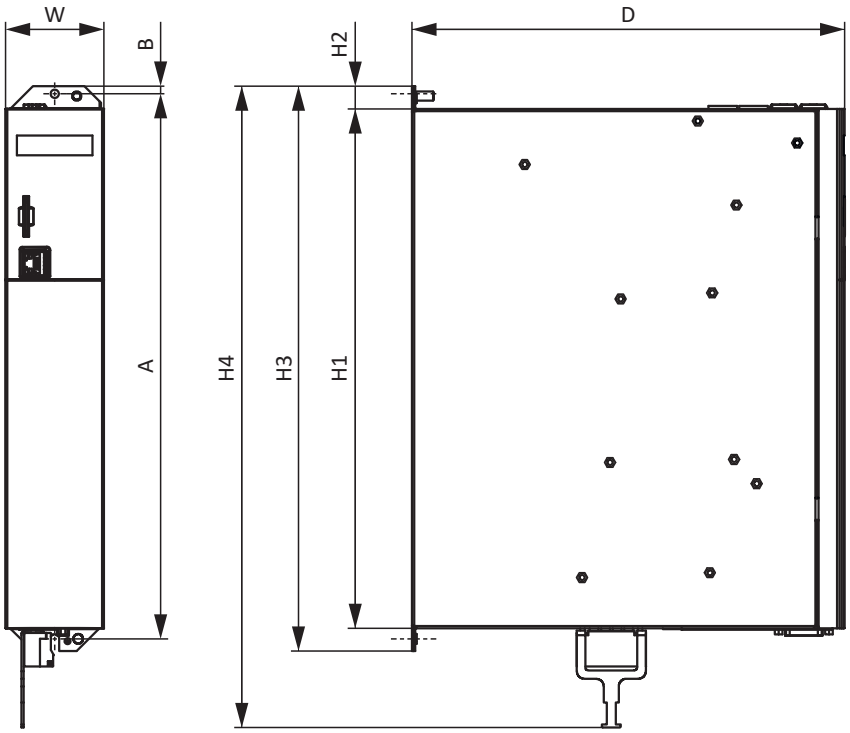

Fig. 6: SC6 dimensional drawing

Dimension			Size 0	Size 1	Size 2
Drive controller	Width	W	45	65	
	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		

Tab. 32: SC6 dimensions [mm]

7.1.6 Weight

Type	Weight without packaging [g]	Weight with packaging [g]
SC6A062	3600	5200
SC6A162	5300	6700
SC6A261	5200	6400

Tab. 33: SC6 weight [g]

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7.2 DC link connection

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

7.2.1 General technical data

The following information applies to all Quick DC-Link modules and corresponds to the general technical data for the base device.

Device features	
Protection class of the device	IP20 (if built over with drive controller or supply module)
Protection class	Protection class I in accordance with EN 61140 (if built over with drive controller or supply module)
Protection class of the installation space	At least IP54

Tab. 34: Device features

Transport and storage conditions	
Storage/ transport temperature	−20 °C to +70 °C Maximum change: 20 K/h
Relative humidity	Maximum relative humidity 85%, non-condensing
Vibration (transport) in accordance with 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
Fall height for freefall[6] Weight < 100 kg in accordance with EN 61800-2 (or IEC 60721-3-2, class 2M1)	0.25 m

Tab. 35: Transport and storage conditions

Operating conditions	
Surrounding temperature during operation	0 °C to 45 °C with nominal data 45 °C to 55 °C with derating −2.5% / K
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 2 in accordance with EN 50178
Vibration (operation) in accordance with EN 60068-2-6	5 Hz ≤ f ≤ 9 Hz: 0.35 mm 9 Hz ≤ f ≤ 200 Hz: 1 m/s²

Tab. 36: Operating conditions

[6] Only valid for components in original packaging

7.2.2 Assignment of DL6B to SC6

DL6B is available in the following designs suitable for the individual types:

Type	DL6B10	DL6B11
ID No.	56655	56656
SC6A062	X	—
SC6A162	—	X
SC6A261	—	X

Tab. 37: Assignment of DL6B to SC6

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7.2.3 Dimensions

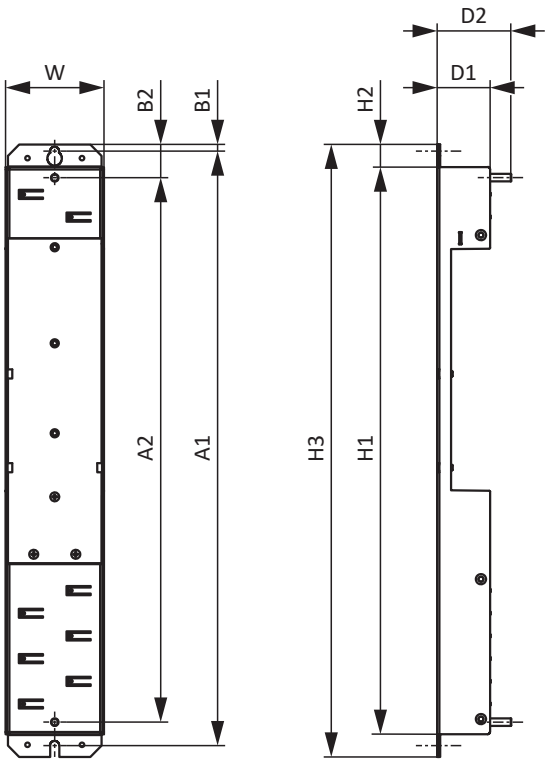

Fig. 7: DL6B dimensional drawing

Dimension			DL6B10	DL6B11
Quick DC-Link	Width	W	45	65
	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	

Tab. 38: DL6B dimensions [mm]

7.2.4 Weight

Type	Weight without packaging [g]	Weight with packaging [g]
DL6B10	440	480
DL6B11	560	600

Tab. 39: DL6B weight [g]

7.3 SR6 safety module

The SR6 option adds the STO safety function to the SC6 drive controller via terminal X12.

For double-axis controllers, the STO safety function has a two-channel structure that acts upon both axes.

Information

If you would like to use the STO safety function via terminals, be sure to read the manual for the SR6 safety module.

Specification	Electrical data
STO_a	U_{1max} = 30 V_{DC} (PELV) High level = 15 – 30 V_{DC} Low level = 0 – 8 V_{DC} I_{1max} = 100 mA I_{1N} = 10 – 15 mA per channel C_{1max} = 10 nF
STO_b	
STO_{status}	$U_2 = U_1 - (1.5\ \Omega * I_1)$
STO_{status} supply	U_1 = +24 V_{DC}, +20%/25% I_{1max} = 100 mA
GND	—

Tab. 40: X12 electrical data

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7.4 Operating motors

The drive controller supports rotational motors with a number of motor poles from 2 to 120 poles (1 through 60 pole pairs). You can operate the following motors with the specified control modes.

Motor type	B20 Control mode	Encoders	Other settings	Characteristics
Lean motor	32: LM - sensorless vector control	No encoder required	—	Dynamics, high speed accuracy, constant speed, overcurrent protection
Synchronous servo motor, torque motor	64: SSM - vector control	Absolute encoder required: EnDat 2.2 digital, SSI, resolver, EnDat 3 or HIPERFACE DSL encoders	Without field weakening (B91 Field weakening = 0: Inactive)	High dynamics, high speed accuracy, very constant speed, high overcurrent protection
			With field weakening (B91 Field weakening = 1: Active)	High dynamics, high speed accuracy, very constant speed, high overcurrent protection, greater speed range, but also higher current requirement
	48: SSM-vector control incremental encoder	Incremental encoder required	Without field weakening (B91 Field weakening = 0: Inactive)	High dynamics, high speed accuracy, very constant speed, high overcurrent protection
			With field weakening (B91 Field weakening = 1: Active)	High dynamics, high speed accuracy, very constant speed, high overcurrent protection, greater speed range, but also higher current requirement
Asynchronous motor	2: ASM - vector control	Encoder required	—	High dynamics, high speed accuracy, very constant speed, high overcurrent protection
	3: ASM - sensorless vector control	No encoder required	—	Dynamics, speed accuracy, constant speed, overcurrent protection
	1: ASM - V/f-slip compensated		Linear characteristic curve (B21 V/f-characteristic = 0: Linear)	Very constant speed
			Quadratic characteristic curve (B21 V/f-characteristic = 1: Square)	Very constant speed, especially suitable for fan applications
	0: ASM - V/f-control		Linear characteristic curve (B21 V/f-characteristic = 0: Linear)	Very constant speed
			Quadratic characteristic curve (B21 V/f-characteristic = 1: Square)	Very constant speed, especially suitable for fan applications

Tab. 41: Motor types and control modes

Unsuitable drive controller/motor combinations

Lean motors of size 5 cannot be operated on drive controllers of size 0 (type SC6A062). Lean motors of size 7 cannot be operated on drive controllers of size 0 or 1 (type SC6A062 or SC6A162).

7.5 Evaluable encoders

The technical data of the evaluable encoder can be found in the following chapters.

7.5.1 Overview

The following table explains which connections are available for the various encoders.

Encoder	Connection	Note
EnDat 2.1 digital	X4	Only encoders with 12 V_{DC} power supply
EnDat 2.2 digital	X4	—
SSI	X4	—
Incremental TTL	X4	TTL signals, differential
Incremental HTL	X4	With HT6 adapter for level conversion: HTL signals, differential
	X101	HTL signals, single-ended
	X103	HTL signals, single-ended
HTL pulse and direction	X101	HTL signals, single-ended
	X103	HTL signals, single-ended
Resolver	X4	—
EnDat 3	X4	In One Cable Solution (OCS) design
HIPERFACE DSL	X4	In One Cable Solution (OCS) design

Tab. 42: Encoder connections

7.5.2 Signal transmission

You can find the signal levels valid for the signal transmission in the following chapters.

7.5.2.1 Encoder inputs

The following signal levels apply to the encoder inputs for single-ended signal transmission:

Signal level	HTL, single-ended
Low level	0 to 8 V_{DC}
High level	15 to 30 V_{DC}

Tab. 43: Signal level encoder inputs, single-ended

The following signal levels apply to the encoder inputs for differential signal transmission:

Signal level	HTL, differential[7]	TTL, differential (ANSI TIA/EIA-422)
Low level	−30 to −4.2 V_{DC}	−6 to −0.2 V_{DC}
High level	4.2 to 30 V_{DC}	0.2 to 6 V_{DC}

Tab. 44: Signal level encoder outputs, differential

[7] Encoder-side level at HTL to TTL adapter HT6

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7.5.3 X4

ATTENTION!

Risk of encoder destruction!

The drive controller provides 12 V_{DC} for the encoder supply. Take this into account when selecting the encoder. Only connect an encoder that is made for operation with a supply voltage of 12 V_{DC}.

EnDat 2.1 digital encoders

Specification	EnDat 2.1 digital
U_2	12 V_{DC} +/−5%
I_{2max}	250 mA
I_{2min}	—
Encoder type	Single-turn and multi-turn
Clock frequency	2 MHz
Max. cable length	100 m, shielded

Tab. 45: EnDat 2.1 digital specification

EnDat 2.2 digital encoders

Specification	EnDat 2.2 digital
U_2	12 V_{DC} +/−5%
I_{2max}	250 mA
Encoder type	Single-turn and multi-turn
Clock frequency	4 MHz
Max. cable length	100 m, shielded

Tab. 46: EnDat 2.2 digital specification

SSI encoder (free setting)

Obey the instructions on how to freely set SSI encoders (see SSI encoder at X4 with free setting (H00 = 78) [▶ 345]).

Specification	SSI signals
U_2	12 V_{DC} +/−5%
I_{2max}	250 mA
Encoder type	Single-turn and multi-turn
Data length	Various resolutions possible
Clock frequency	150 – 1000 kHz
Sampling rate	250 µs
Monoflop time	10 – 100 µs
Code	Binary or gray
Transfer	Double or single
Max. cable length	100 m, shielded

Tab. 47: SSI specification (free setting)

SSI encoders

Obey the instructions on how to set SSI encoders (see SSI encoder at X4 (H00 = 65) [▶ 346]).

Specification	SSI signals
U_2	12 V_{DC} +/−5%
I_{2max}	250 mA
Encoder type	Single-turn and multi-turn
Data length	13, 24 or 25 bits
Clock frequency	250 or 600 kHz
Sampling rate	250 µs
Monoflop time	30 µs
Code	Binary or gray
Transfer	Double or single
Max. cable length	100 m, shielded

Tab. 48: SSI specification

Incremental encoders

Specification	Incremental signals
U_2	12 V_{DC} +/−5%
I_{2max}	250 mA
f_{max}	1 MHz
Signal level	TTL, differential
Max. cable length	100 m, shielded

Tab. 49: Specification for TTL differential incremental signals

Information

Calculation example – Maximum frequency f_{max}
for an encoder with 2,048 pulses per revolution: 3,000 revolutions per minute (equivalent to 50 revolutions per second) * 2,048 pulses per revolution = 102,400 pulses per second = 102.4 kHz << 1 MHz

Information

Using an HT6 adapter for level conversion from HTL signals to TTL signals, it is also possible to connect a differential HTL incremental encoder to terminal X4. Note that, with an external power supply, the maximum level of 20 V_{DC} for the HTL signals may not be exceeded.

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Resolver

Specification	Resolver signals
Measuring range	± 2.5 V
Resolution	12 bits
U_2	± 10 V
I_{2max}	80 mA
f_2	7 – 9 kHz
P_{max}	0.8 W
Transfer ratio	0.5 ± 5%
Number of poles	2, 4, 6 and 8
Signal shape	Sine
Max. cable length	100 m, shielded

Tab. 50: Specification for resolver signals

EnDat 3 encoder (One Cable Solution)

Specification	EnDat 3
U_2	12 V_{DC} +/−5%
I_{2max}	250 mA
Encoder type	Single-turn and multi-turn
Max. cable length	100 m, shielded

Tab. 51: EnDat 3 specification

HIPERFACE DSL encoder (One Cable Solution)

Specification	HIPERFACE DSL
U_2	12 V_{DC} +/−5%
I_{2max}	250 mA
Encoder type	Single-turn and multi-turn
Max. cable length	100 m, shielded

Tab. 52: Specification for HIPERFACE DSL

Unsuitable encoder models

The following STOBER encoder models may **not** be connected:

Encoder model	Code according to type designation
ECI 1118	C0
EQI 1130	Q0
ECI 1319	CR
EQI 1329	QP
EQI 1331	QR

Tab. 53: Encoder models with unsuitable supply voltage range

7.5.4 X101 for encoders

Electrical data	Digital input	Incremental signals, pulse/direction signals
Low level	DI1 – DI4	0 – 8 V_{DC}
High level		15 – 30 V_{DC}
U_{1max}		30 V_{DC}
I_{1max}		16 mA
f_{1max}	DI1 – DI2	10 kHz
	DI3 – DI4	250 kHz
Max. cable length	DI1 – DI4	30 m

Tab. 54: Specification for single-ended HTL incremental signals and single-ended HTL pulse/direction signals

Information

Calculation example – Maximum frequency f_{max}
for an encoder with 2,048 pulses per revolution: 3,000 revolutions per minute (equivalent to 50 revolutions per second) * 2,048 pulses per revolution = 102,400 pulses per second = 102.4 kHz < 250 kHz

7.5.5 X103 for encoders

Electrical data	Digital input	Incremental signals, pulse/direction signals
Low level	DI6 – DI9	0 – 8 V_{DC}
High level		15 – 30 V_{DC}
U_{1max}		30 V_{DC}
I_{1max}		16 mA
f_{1max}	DI6 – DI7	10 kHz
	DI8 – DI9	250 kHz
Max. cable length	DI6 – DI9	30 m

Tab. 55: Specification for single-ended HTL incremental signals and single-ended HTL pulse/direction signals

Information

Calculation example – Maximum frequency f_{max}
for an encoder with 2,048 pulses per revolution: 3,000 revolutions per minute (equivalent to 50 revolutions per second) * 2,048 pulses per revolution = 102,400 pulses per second = 102.4 kHz < 250 kHz

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7.6 Controllable brakes

The brake of axis A is connected to X2A. Connect the brake of axis B to X2B for double-axis controllers.

You can control the following brakes:

- Directly connected 24 V_{DC} brakes
- Brakes connected indirectly over contactor

The brake is supplied over X300.

Electrical data	Brake output
U_2	24 V_{DC}, +20 %
I_{2max}	2.5 A
f_{2max}	1 Hz at $I_N \leq 2.1$ A; 0.25 Hz at $I_N > 2.1$ A
E_{2max}	1.83 J

Tab. 56: Electrical data of the brake output

Information

In the case of a nominal brake current > 2.1 A, the system controller must ensure compliance with the maximum switching frequency of 0.25 Hz.

Information

The 48: SSM-vector control incremental encoder control mode with commutation finding using Wake and Shake may only be used in combination with a brake for axes without gravity load.

For more information, see B20 = 32, 48 or 64 [▶ 187].

7.7 Evaluable motor temperature sensors

You can connect a PTC triplet at terminal X2 or a Pt1000 motor temperature sensor using the One Cable Solution to the SC6 drive controller.

Information

Evaluation of the temperature sensors is always active. If operation without a temperature sensor is permitted, the connections must be bridged to X2. Otherwise a fault is triggered when the device is switched on.

Type	Triggering limit
PTC thermistor	4000 Ω
Pt1000 temperature sensor	Can be parameterized in °C in parameter B39

Tab. 57: Triggering limit of temperature sensor

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7.8 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 resistors specified in the technical data of the individual drive controller types.

7.8.1 Tubular fixed resistor FZMU, FZZMU

Type	FZMU 400×65	FZZMU 400×65
ID No.	49010	53895
SC6A062	X	—
SC6A162	(X)	X
SC6A261	(X)	X

Tab. 58: Assignment of FZMU, FZZMU braking resistor – SC6 drive controller

X	Recommended
(X)	Possible
—	Not possible

Properties

Specification	FZMU 400×65	FZZMU 400×65
ID No.	49010	53895
Type	Tubular fixed resistor	Tubular fixed resistor
Resistance [Ω]	100 ±10%	47 ±10%
Thermal drift	±10%	±10%
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 without packaging [g]	2200	4170
Protection class	IP20	IP20
Marks and test symbols	cURus, CE, UKCA	cURus, CE, UKCA

Tab. 59: FZMU, FZZMU specification

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Dimensions

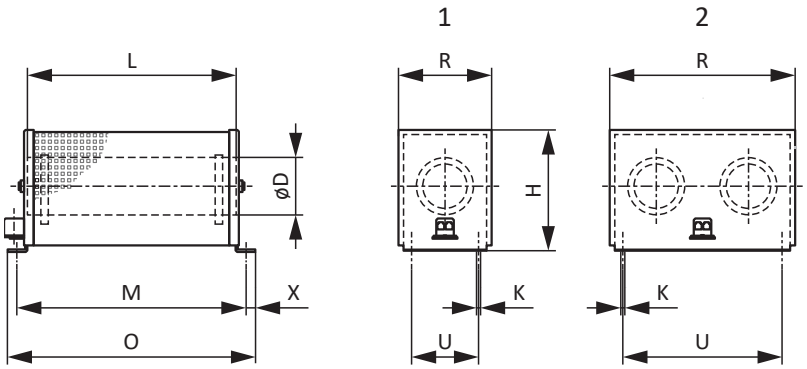

Fig. 8: FZMU (1), FZZMU (2) dimensional drawing

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

Tab. 60: FZMU, FZZMU dimensions [mm]

7.8.2 GVADU, GBADU flat resistor

Type	GVADU 210×20	GBADU 265×30	GBADU 335×30
ID No.	55441	55442	55443
SC6A062	X	X	—
SC6A162	(X)	(X)	X
SC6A261	(X)	(X)	X

Tab. 61: Assignment of GVADU, GBADU braking resistor – SC6 drive controller

X	Recommended
(X)	Possible
—	Not possible

Properties

Specification	GVADU 210×20	GBADU 265×30	GBADU 335×30
ID No.	55441	55442	55443
Type	Flat resistor		
Resistance [Ω]	100 ±10%	100 ±10%	47 ±10%
Thermal drift	±10%	±10%	±10%
Power [W]	150	300	400
Therm. time const. τ_{th} [s]	60	60	60
Pulse power for < 1 s [kW]	3.3	6.6	8.8
U_{max} [V]	848	848	848
Cable design	Radox	FEP	FEP
Cable length [mm]	500	1500	1500
Conductor cross-section [AWG]	18/19 (0.82 mm²)	14/19 (1.9 mm²)	14/19 (1.9 mm²)
Weight without packaging [g]	300	930	1200
Protection class	IP54	IP54	IP54
Marks and test symbols	cURus, CE, UKCA		

Tab. 62: GVADU, GBADU specification

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Dimensions

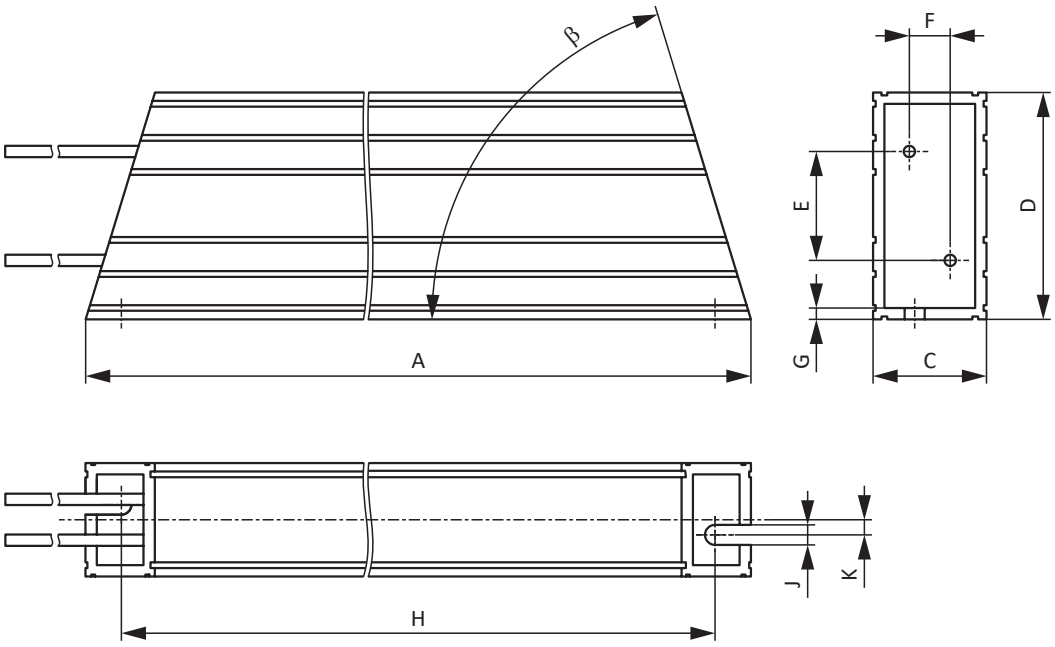

Fig. 9: GVADU, GBADU dimensional drawing

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

Tab. 63: GVADU, GBADU dimensions [mm]

7.9 Choke

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

7.9.1 TEP output choke

Output chokes are required for connecting size 0 to 2 drive controllers to synchronous servo motors or asynchronous motors from a cable length > 50 m in order to reduce interference pulses and protect the drive system. If Lean motors are connected, output chokes must not be used.

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_{AC}		
Frequency range	0 – 200 Hz		
Nominal current $I_{N,MF}$ at 4 kHz	4 A	17.5 A	38 A
Nominal current $I_{N,MF}$ 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		
Protection class	IP00		
Winding losses	11 W	29 W	61 W
Iron losses	25 W	16 W	33 W
Connection	Screw terminal		
Max. conductor cross-section	10 mm²		
UL Recognized Component (CAN; USA)	Yes		
Marks and test symbols	cURus, CE		

Tab. 64: TEP specification

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Dimensions

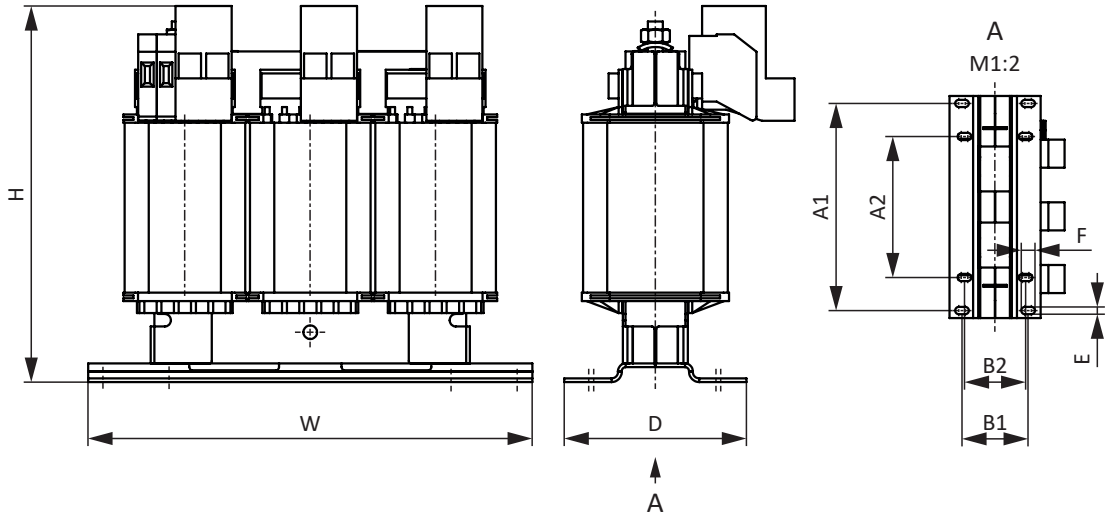

Fig. 10: TEP dimensional drawing

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 without packaging [g]	2900	5900	8800

Tab. 65: TEP dimensions and weight

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8 Project configuration

Relevant information on the project configuration and design of your drive system can be found in the following chapters.

8.1 Drive controllers

Minimum time between two energizing processes

The drive controllers have temperature-dependent resistors in the charging circuit that prevent the devices from being damaged when being connected to the grid after a fault, such as a short-circuited DC link, incorrect wiring, etc. These resistors are heated when charging the DC link. In order to prevent overloading, a specified, minimum time period must be maintained between energizing two devices.

Information

For the time span between energizing two devices, note that:

- Direct, repeat activation of the supply voltage is possible for cyclical power-on/power-off operation.
- A time span of > 15 minutes must be observed between two energizing processes during continuous, cyclical power-on/power-off operation with increased charging capacity.

Information

The STO safety function is available for safe stopping as an alternative to continuous, cyclical power-on/power-off operation.

8.2 DC link connection

Braked motors work like generators: Operating with an active drive controller, they convert kinetic energy from movement into electrical energy. This electrical energy is stored in the DC link capacitors of the drive controller. It can be supplied to powered motors with connected DC circuits and be used efficiently as a result.

However, capacitors in the DC link can only accept a limited amount of energy. The DC link voltage increases when a motor decelerates. If the DC link voltage rises above a defined limit, a chopper circuit is activated that tries to convert the excess energy into heat by means of a connected braking resistor. If the permitted maximum voltage is nonetheless reached, any possible damage must be prevented. The drive controller switches to the Fault state and shuts down.

In a DC link connection, the DC link capacitors of the drive controllers involved are connected in parallel. As a result, the maximum acceptable amount of energy increases in the DC link in comparison to a single unit.

The DC link connection can help save energy and reduce costs, especially in coil winding technology or during regular acceleration and braking cycles.

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8.2.1 Information on design and operation

In order to connect the capacitors of multiple drive controllers, you need a separate Quick DC-Link module of type DL6B for each drive controller in the group.

Information

Note that Quick DC-Link can be subject to system or country-specific standards.

Central braking resistor

During a controlled emergency stop, all drive controllers may brake at the same time. During the design phase, check whether a central braking resistor is necessary to be able to stop certain system parts safely within a prescribed time.

Electrical data of the drive controllers

The electrical data of the individual types of drive controllers must be observed in the design and operation of Quick DC-Link, including the following in particular:

- Self-capacitance C_{PU}
- Charging capacity $C_{N,PU}$
- Nominal input current $I_{1N,PU}$
- Derating of the nominal input current

You can find the values in the technical data for the drive controllers.

Maximum voltage and maximum current

The maximum DC link voltage is 750 V_{DC} and the maximum permitted overall current is 200 A.

Protective measures

Note the information in the following chapters:

- Power grid supply with DC link connection [▶ 89]
- Line fuses for DC link connection [▶ 90]
- Grid connection for DC link connection [▶ 92]

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8.2.2 Design

Charging capacity

The charging circuit integrated into a drive controller can charge the DC links of other drive controllers in addition to its own DC link.

Information

When designing the Quick DC-Link, note that the sum of the charging capacities of the drive controllers connected to the grid is greater than or equal to the sum of the self-capacitances of all drive controllers in the DC link group.

Example – Checking the charging capacity of drive controllers connected to the grid

A SC6A261 drive controller connected to the grid is intended to charge another SC6A261 drive controller.

The DC link capacitance in the group to be charged corresponds to the sum of the self-capacitance values of all drive controllers in the group: 2 × 940 µF = 1880 µF.

The maximum charging capacity of the drive controller connected to the grid is 1400 µF.

Information

If a time span of ≥ 15 min is maintained between two energizing processes, the maximum charging capacity increases to C_{maxPU} = 1880 µF.

In this case, Quick DC-Link is permitted only if the minimum time of 15 min between two energizing processes is maintained.

Current load capacity of the input rectifiers

Information

When designing the Quick DC-Link, note that the required supply current does not exceed the maximum supply current in total.

$$I_{minLINE} < I_{maxLINE}$$

For calculating the effective as well as maximum supply current, SERVOsoft is helpful mechanical and electrical design software for drive systems.

Calculating supply current for motors

The necessary supply current for motors can be determined using the required drive output:

$$P_{LINE} \cong P_{totalMOT}$$

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Calculating motor rating and voltage

The following formulas and assumptions are used to calculate the motor rating and voltage:

$$P_{MOT} = \sqrt{3} \times U_{MOT} \times I_{MOT} \times \cos\varphi_{MOT}$$

$$P_{Line} = \sqrt{3} \times U_{Line} \times I_{Line,nec} \times \lambda_{Line}$$

$$U_{maxMOT} = 0,8 \times U_{LINE}$$

$$I_{minLINE} = \frac{U_{MOT}}{U_{LINE}} \times I_{MOT} \times \frac{\cos\varphi_{MOT}}{\lambda_{LINE}}$$

In addition, the field weakening range begins.

The active factor for a synchronous servo motor ($\cos \phi_{MOT}$) is about 0.9 in 4 kHz operation and about 0.98 in 8 kHz operation. The active factor of an asynchronous motor can be determined according to the accompanying electrical data.

The following is true for the power factor of the supply grid:

$$\lambda_{LINE} = 0,6 \rightarrow I_{LINE} < 40A$$

$$\lambda_{LINE} = 0,7 \rightarrow I_{LINE} > 40A$$

The required motor rating must be calculated in order to determine the necessary supply current and the number and sizes of the drive controllers to be connected to the grid as part of Quick DC-Link.

The overall maximum permitted input current $I_{maxLINE}$ is the sum of the maximum input currents of all connected drive controllers in continuous operation. Dynamic movements of the connected motors are possible in the permitted range.

The following is true for the sum of the input currents of the connected drive controllers:

- If the respective power of all drive controllers connected to the grid is identical, the sum of the maximum input currents in the network is calculated using the formula
  $I_{maxLINE} = 0,8 \times n_{fed} \times I_{1N,PU}$
- If the respective power of all drive controllers connected to the grid differs, the sum of the input current is calculated by multiplying the input current of the smallest drive controller connected to the grid by the number of connected drive controllers
  $I_{maxLINE} = 0,9 \times n_{fed} \times I_{IN,PUmin}$

To prevent current asymmetry, all drive controllers connected to the grid with different ratings must contain the same fuse protection, which in turn must correspond to the drive controller with the least power.

Current load capacity of the copper rails

DC rails connect the DC link capacitors of the drive controllers with one another. They are copper rails that are installed using the quick fastening clamps. DC rails must have a cross-section of 5 x 12 mm. The maximum permitted current load capacity of the copper rails is 200 A.

Wiring example

The example in the attachment (see Wiring examples [▶ 315]) illustrates the basic connection to Quick DC-Link DL6B based on a DC link connection.

8.3 Motor

During the project configuration for motors, note the framework conditions described below.

Rotational motors (Lean motors, synchronous servo motors, asynchronous motors, torque motors)

The maximum possible motor speed is limited to 36000 rpm.

The following relationship applies:
Rotating magnetic field frequency = Motor speed × Number of pole pairs ÷ 60

Since the output frequency f_{2PU} can be a maximum of 700 Hz, the motor speed can only be reached if the calculated rotating magnetic field frequency is less than f_{2PU}.

The specified torque/speed curve or the nominal points can only be reached in vector control if field weakening operation is not in effect. Theoretical field weakening operation begins when a voltage is required for the speed (speed × KE constant) that is greater than the available DC link voltage. In practice, however, field weakening must begin before reaching this voltage limit (control reserve).

You define the voltage limit in B92. The default value is 80%.

Note that the field weakening is always active for Lean motors (B91 Field weakening = 1: Active). The voltage limit preset in B92 is 95% for Lean motors.

8.4 Choke

For project configuration of the chokes, note the general conditions described below.

8.4.1 TEP output choke

Select the output chokes in accordance with the nominal currents of the output chokes, motor and drive controller. 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 – Effect of the clock frequency

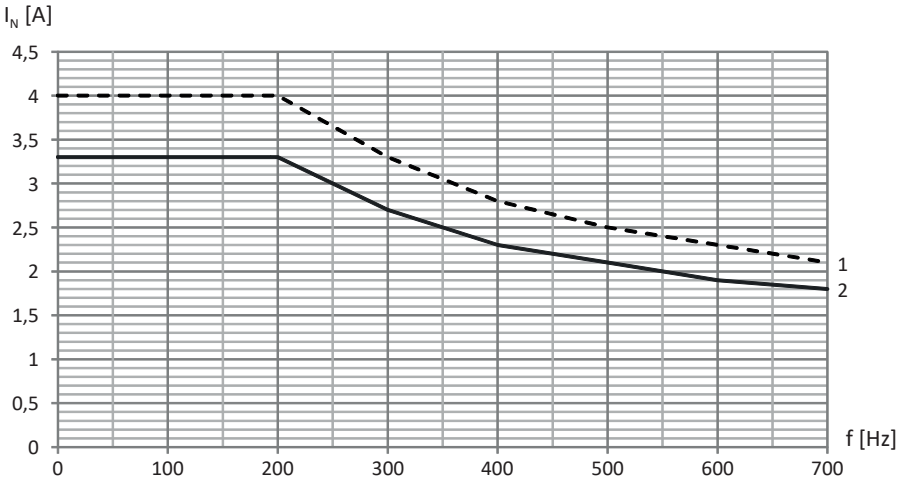

Fig. 11: Derating the nominal current depending on the clock frequency, TEP3720-0ES41

1 4 kHz clock frequency

2 8 kHz clock frequency

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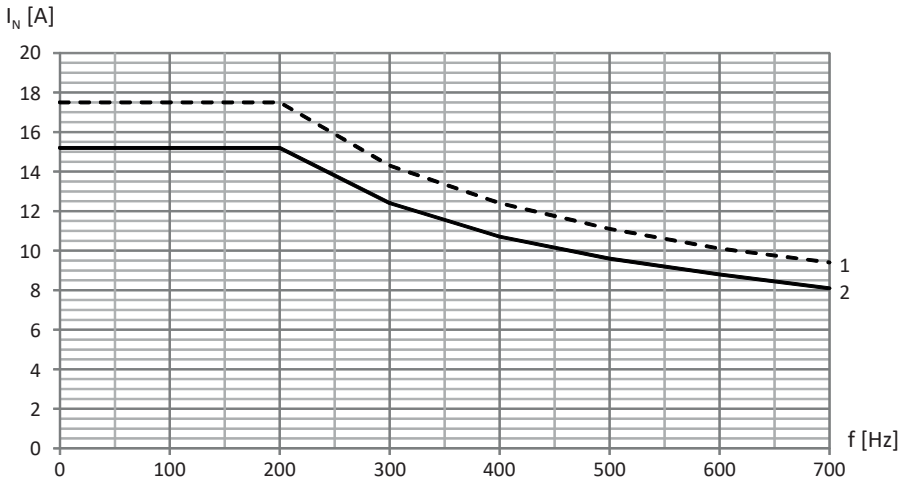

Fig. 12: Derating the nominal current depending on the clock frequency, TEP3820-0CS41

1 4 kHz clock frequency

2 8 kHz clock frequency

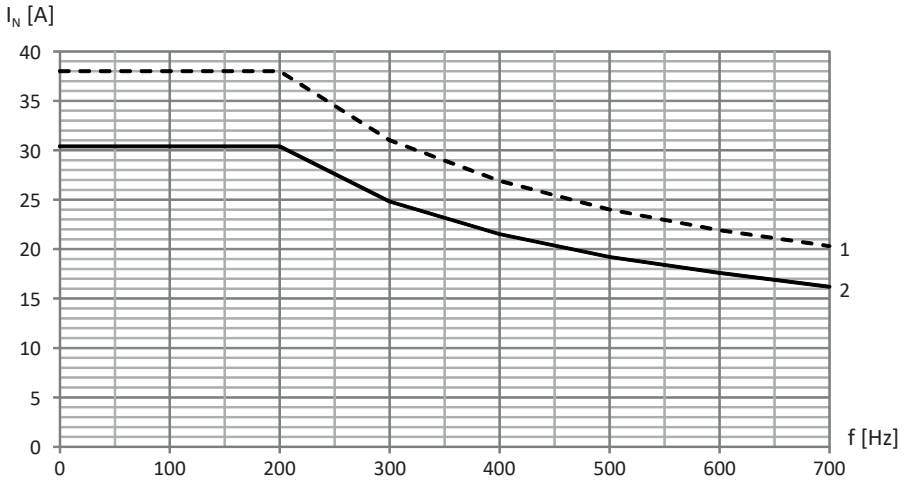

Fig. 13: Derating the nominal current depending on the clock frequency, TEP4020-0RS41

1 4 kHz clock frequency

2 8 kHz clock frequency

Derating – Effect of surrounding temperature

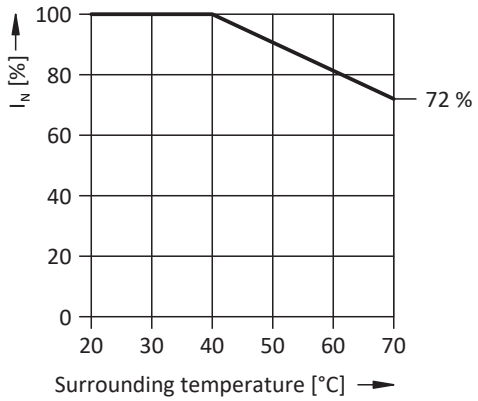

Fig. 14: Derating the nominal current based on surrounding temperature

Derating – Effect of the installation elevation

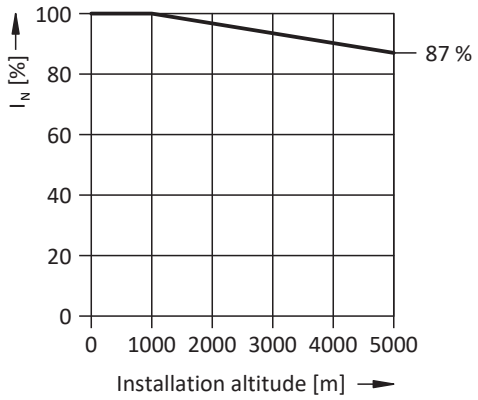

Fig. 15: Derating the nominal current depending on installation elevation

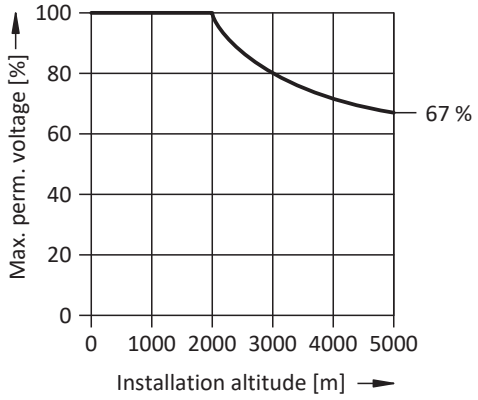

Fig. 16: Derating the voltage depending on installation elevation

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8.5 Mixed operation

You can combine the SC6 drive controller with other 6th generation STOBER drive controllers.

For a DC link connection in mixed operation, however, only devices of the same series (e.g. SD6) and of same type (e.g. SD6A16) may be supplied with power.

For example, two SC6A261 drive controllers are to be coupled with one SD6A06 drive controller in the DC link. In this case, both SC6A261 drive controllers are connected to the supply grid. The SD6A06 drive controller may only be connected to the DC link of the SC6A261 drive controllers in this case, not to the supply grid.

The graphic below shows an example of the grounding concept in mixed operation with SI6 and SD6 with power from an SC6 drive controller. The grounding conductor connection between the drive controller and the associated Quick DC-Link rear section module (type DL6B or DL6A) is made using the metallic connection of the housings. The grounding conductor connection between DL6B type rear section modules is made using a copper rail (PE rail). Obey the requirements for connecting a 2nd protective grounding conductor to the drive controllers (see Connection of the grounding conductor [▶ 94]).

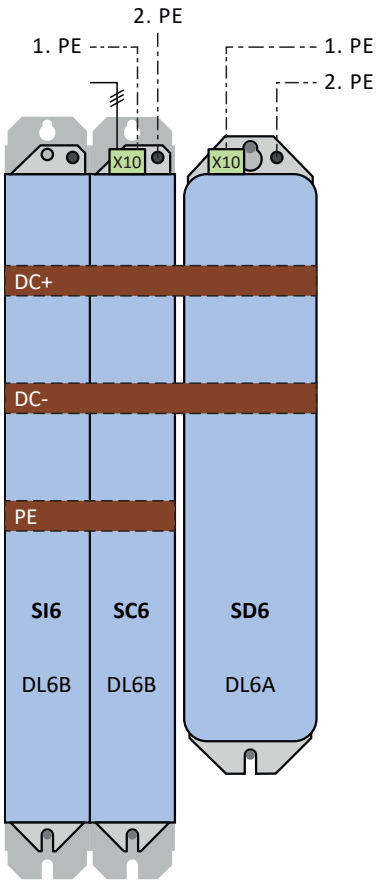

Fig. 17: Grounding concept in mixed operation with SI6 and SD6 with powered SC6 drive controller

If the grounding conductor connection over the 3rd copper rail is omitted between the DL6B rear section modules, the SI6 drive controllers also have to be grounded using the ground bolt.

If you would like to connect two drive controllers directly via terminal X22 without a rear section module, there are special requirements for the connecting wiring:

- The connection lines must satisfy a nominal voltage of up to 750 V_{DC} to ground, e.g. requirement H07V-K.
- The connection lines have to be implemented as twisted pairs.
- At line lengths of 30 cm or more, the lines also have to be implemented with shielding and the shield must be applied over a wide area in immediate proximity to the drive controller.
- The requirements of the drive controller with the smaller size apply to the maximum conductor cross-section.
- Obey the terminal specifications for terminal X22 (see Overview [▶ 309]).

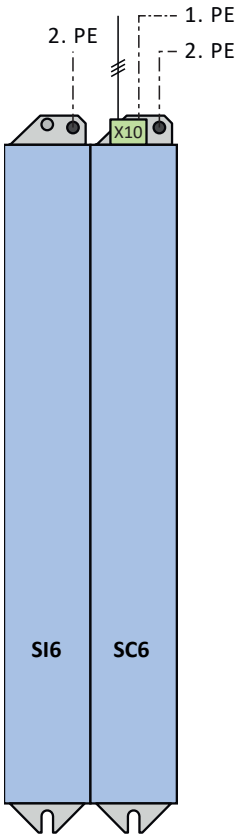

Fig. 18: Grounding concept in mixed operation with SI6 with powered SC6 drive controller

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9 Storage

Store the products in a dry and dust-free room if you do not install them immediately.

Observe the Transport and storage conditions [▶ 36] specified in the technical data.

9.1 Drive controllers

The DC link capacitors can lose their electrical strength due to long storage times and must be reformed before commissioning.

ATTENTION!

Material damage due to reduced electrical strength!

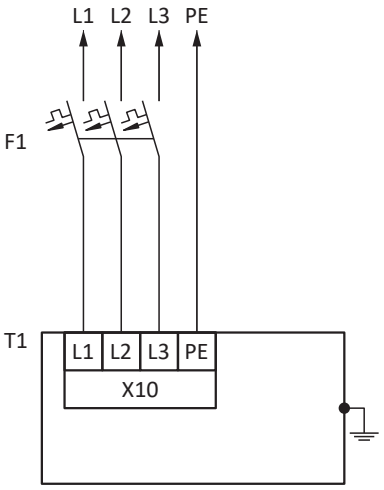
Reduced electrical strength can cause considerable material damage when switching on the drive controller.

- Reform drive controllers in storage annually or before commissioning.

9.1.1 Annual reforming

To prevent damage to stored drive controllers, STOBER recommends connecting stored devices to the supply voltage once per year for one hour.

The following graphics show the basic line connection for 3-phase devices.



L1 – L3	Lines 1 to 3
N	Neutral conductor
PE	Grounding conductor
F1	Fuse
T1	Drive controller

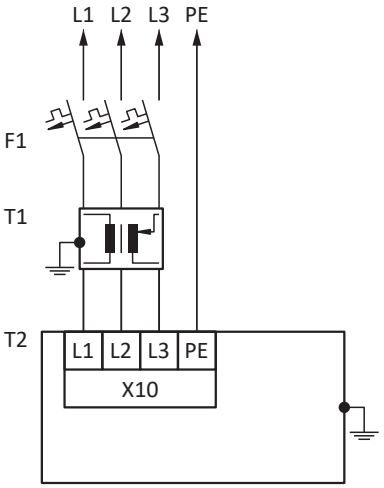
Information

For UL-compliant operation: The connections marked with PE are intended solely for the functional grounding.

9.1.2 Reforming before commissioning

If annual reforming is not possible, implement reforming on stored devices before commissioning. Note that the voltage levels depend on the storage time.

The following graphic shows the predominant supply connection.



L1 – L3	Lines 1 to 3
N	Neutral conductor
PE	Grounding conductor
F1	Fuse
T1	Variable transformer
T2	Drive controller

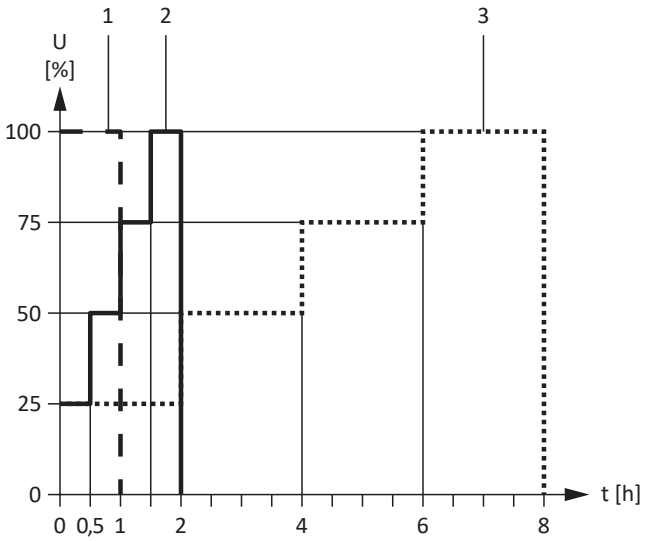


Fig. 19: Voltage levels dependent on storage time

1	Storage time of 1 – 2 years:	Apply voltage for 1 hour before switching on.
2	Storage time of 2 – 3 years:	Implement reforming according to the graph before switching on.
3	Storage time ≥ 3 years:	Implement reforming according to the graph before switching on.
	Storage time < 1 year:	No actions required.

Information

For UL-compliant operation: The connections marked with PE are intended solely for the functional grounding.

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10 Installation

The following chapters describe the installation of a drive controller and the available accessories.

For information on replacing a drive controller, see Replacement [▶ 299].

10.1 Safety instructions for installation

Installation work is permitted only when no voltage is present. Observe the 5 safety rules (see Working on the machine [▶ 19]).

To protect the devices from overheating, obey the operating conditions described in the technical data and comply with the required minimum clearances for installation.

Protect the devices against falling parts (bits or strands of wire, pieces of metal, etc.) during installation or other work in the control cabinet. Parts with conductive properties may result in a short circuit inside the devices and device failure as a result.

10.2 Basic assembly instructions

Note the points described below for installation.

10.2.1 Drive controllers

Note the following points for installation:

- Prevent condensation, e.g. with anti-condensation heating elements.
- For reasons related to EMC, use installation plates with a conductive surface (unpainted, etc.).
- Avoid installation above or in the immediate vicinity of heat-generating devices, e.g. output chokes or braking resistors.
- To ensure there is sufficient air circulation in the control cabinet, observe the minimum clearances.
- Install the devices vertically.

Reference identification

Attach a sticker to the provided field on the front on the device with the unique reference identification of the respective device to prevent mix-ups during installation or replacement.

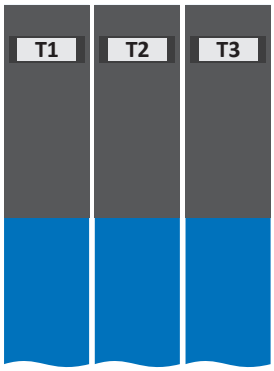
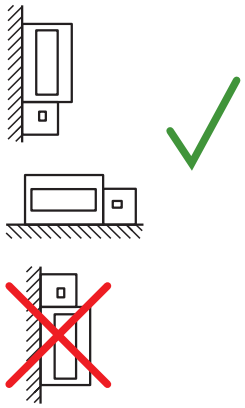


Fig. 20: Fields for equipment identification on the front of the device

10.2.2 Braking resistor

Note the permitted mounting positions for the braking resistor.

FZMU, FZZMU tubular fixed resistor



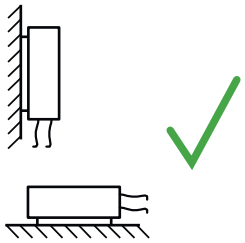
Permitted installation:

- On vertical surfaces with terminals downwards
- On horizontal surfaces
- In control cabinets

Impermissible installation:

- On vertical surfaces with terminals upwards, left or right
- Outside of control cabinets

GVADU, GBADU flat resistor



Permitted installation:

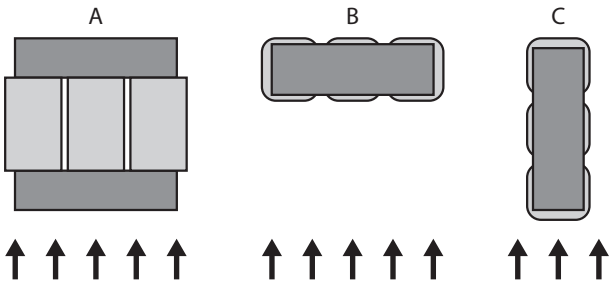
- On vertical surfaces with cables downwards
- On horizontal surfaces
- Installation outside of the control cabinet possible for mechanical protection of the conductors

Impermissible installation:

- On vertical surfaces with cables upwards

10.2.3 Choke

In relation to the flow of cooling air, the following mounting positions are permitted for the TEP output choke:



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10.3 Minimum clearances

Note the minimum clearances for installation below.

Drive controller

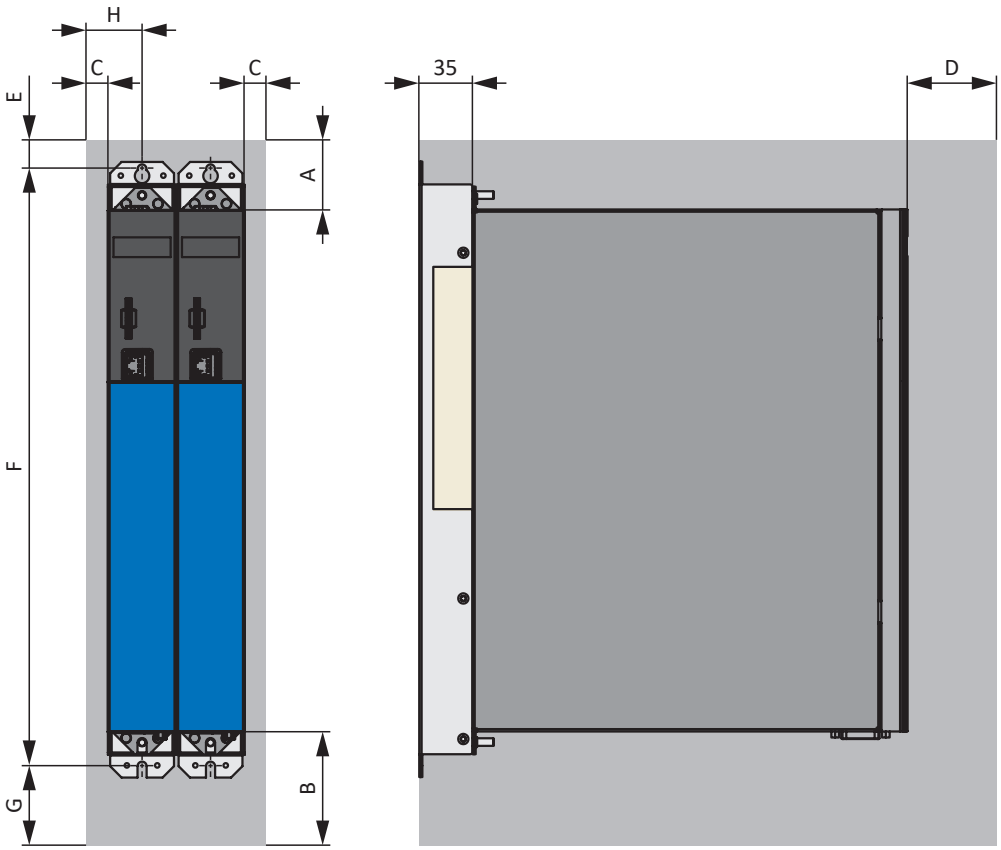

Fig. 21: Minimum clearances

The specified dimensions relate to the outer edges of the drive controller.

Minimum clearance	A (above)	B (below)	C (on the side)	D (in front)
All sizes	100	200	5	50[8]

Tab. 66: Minimum clearances [mm]

Dimension	E	F	G	H
SC6A062	73.5	393+2	approx. 174.5	27.5
SC6A162 SC6A261	73.5	393+2	approx. 174.5	37.5

Tab. 67: Dimensions [mm]

Chokes and filters

Avoid installation below drive controllers or supply modules. For installation in a control cabinet, a distance of approximately 100 mm to other neighboring components is recommended. This distance ensures proper heat dissipation for chokes and filters.

Braking resistors

Avoid installation below drive controllers or supply modules. 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.

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

10.4 Drilling diagrams and bore dimensions

Drilling diagrams and dimensions can be found in the following chapters.

10.4.1 Drive controllers

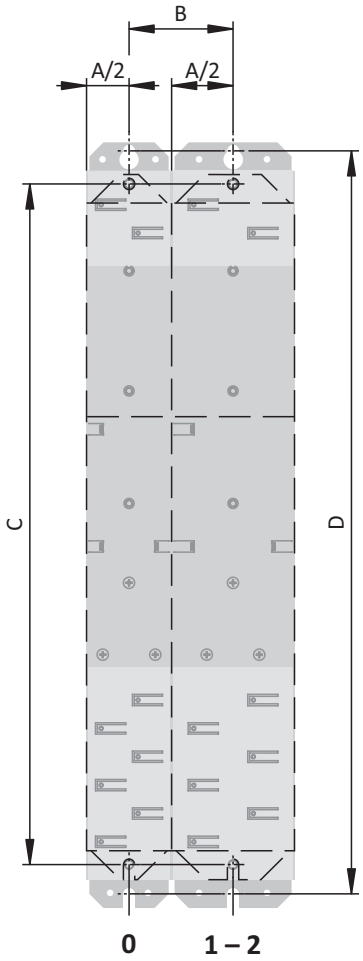

Fig. 22: SC6 and DL6B drilling diagram

The drilling dimensions depend on the selected design.

The following specifications apply to installation without a rear section module:

SC6 dimension			Size 0	Size 1, size 2
Horizontal fastening holes ∅ 4.2 (M5)	A		45	65
	B	Size 0	46±1	56±1
	B	Size 1, size 2	56±1	66±1
Vertical fastening holes ∅ 4.2 (M5)	C		360+2	360+2

Tab. 68: Drilling dimensions for SC6 drive controller [mm]

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The following specifications apply to installation with Quick DC-Link DL6B:

DL6B dimensions			Size 0	Size 1, size 2
Horizontal fastening holes ∅ 4.2 (M5)	A		45	65
	B	Size 0	46±1	56±1
	B	Size 1, size 2	56±1	66±1
Vertical fastening holes ∅ 4.2 (M5)	D		393+2	393+2

Tab. 69: Drilling dimensions for Quick DC-Link DL6B [mm]

10.4.2 Braking resistor

10.4.2.1 FZMU, FZZMU tubular fixed resistor

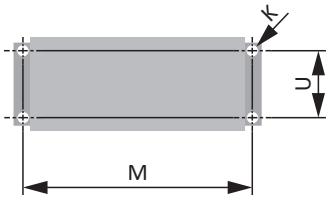

Fig. 23: FZMU, FZZMU drilling diagram

Dimension	FZMU 400×65	FZZMU 400×65
K	6.5 × 12	6.5 × 12
M	430	426
U	64	150

Tab. 70: FZMU, FZZMU dimensions [mm]

10.4.2.2 GVADU, GBADU flat resistor

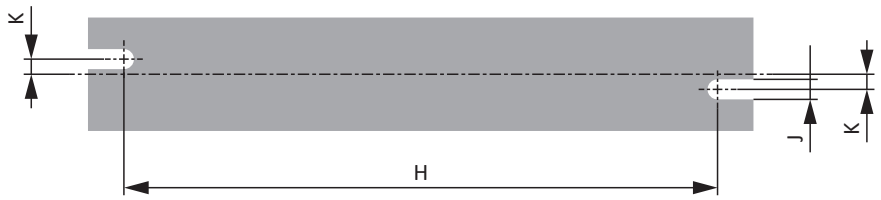

Fig. 24: GVADU, GBADU drilling diagram

Dimension	GVADU 210×20	GBADU 265×30	GBADU 335×30
H	192	246	316
K	2.5	4	4
J	4.3	5.3	5.3

Tab. 71: GVADU, GBADU dimensions [mm]

10.4.3 Choke

10.4.3.1 TEP output choke

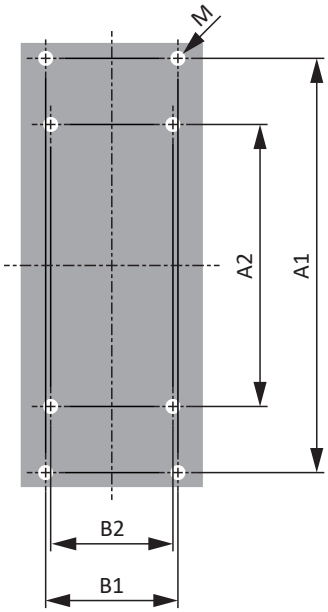

Fig. 25: TEP drilling diagram

Dimension	TEP3720-0ES41	TEP3820-0CS41	TEP4020-0RS41
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

Tab. 72: TEP dimensions

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10.5 Length of copper rails

For the installation of the Quick DC-Link modules, you require three prepared copper rails with a cross-section of 5 × 12 mm.

The length of the copper rails is 5 mm shorter than the total width of the group, i.e. the total width of all DL6B Quick DC-Link modules present in the group:
B = A − 5 mm

Note that the correct length of the copper rails can be determined only after installation of all modules:

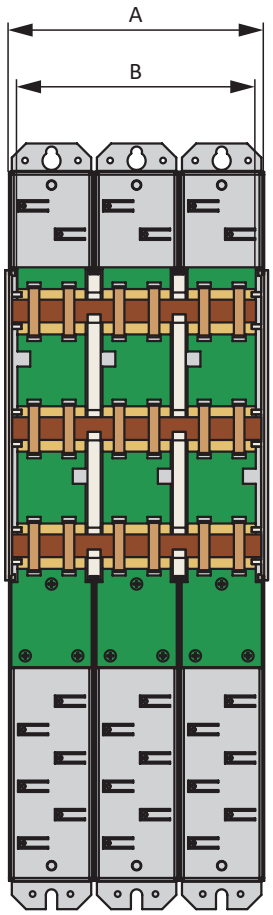

Fig. 26: Determination of the correct length of the copper rails

A Total width of the group after installation

B Length of the copper rails = A − 5 mm

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10.6 Installing the drive controller without a rear section module

This chapter describes the installation of the SC6 drive controller without a rear section module. If you would like to connect the drive controllers in the DC link, you must first mount the Quick DC-Link modules of type DL6B and then build the appropriate drive controllers over them.

⚠ WARNING!

Electrical voltage! Risk of fatal injury due to electric shock!

- Always switch off all power supply voltage before working on the devices!
- Note the discharge time of the DC link capacitors in the general technical data. You can only determine the absence of voltage after this time period.

Information

Note that drive controllers in storage require reforming each year or before commissioning at the latest.

Tools and material

You will need:

- Fastening screws
- Tool for tightening the fastening screws

Requirements and installation

Perform the following steps for each drive controller within the group and in the specified order.

✓ In accordance with the drilling diagram, taking into consideration the various device dimensions, you have made threaded holes for the threaded bolts on the mounting plate at the mounting position.

✓ The mounting plate has been cleaned (free of oil, grease and swarf).

1. Fasten the top of the drive controller on the mounting plate.
2. Fasten the bottom of the drive controller on the mounting plate.
3. Connect the grounding conductor to the ground bolt. Obey the instructions and requirements for Protective grounding [▶ 93].

⇨ The installation is completed. In the next step, connect the drive controller.

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10.7 Installing the DC link connection

If you would like to connect the SC6 drive controllers in the DC link group, you must first mount the Quick DC-Link modules of type DL6B and then build the appropriate drive controllers over them.

⚠ WARNING!

Electrical voltage! Risk of fatal injury due to electric shock!

- Always switch off all power supply voltage before working on the devices!
- Note the discharge time of the DC link capacitors in the general technical data. You can only determine the absence of voltage after this time period.

Tools and material

You will need:

- 3 copper rails with sufficient length and a cross-section of 5 x 12 mm (see Length of copper rails [▶ 81])
- The nut and washer assemblies (M5) as well as the quick fastening clamps included with the Quick DC-Link modules
- The insulation end sections for the left and right termination of the group that are available separately
- Fastening screws and tool for tightening the fastening screws

Requirements and installation

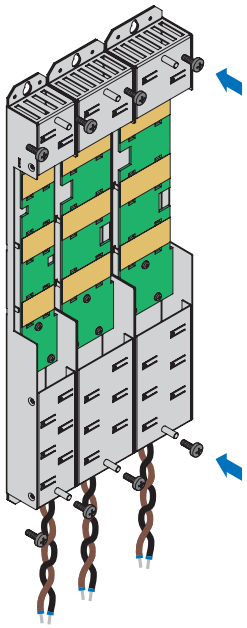
Perform the following steps in the specified order.

✓ You have tapped holes for fastening screws on the mounting plate at the installation location in accordance with the drilling diagram and taking into consideration the different device dimensions.

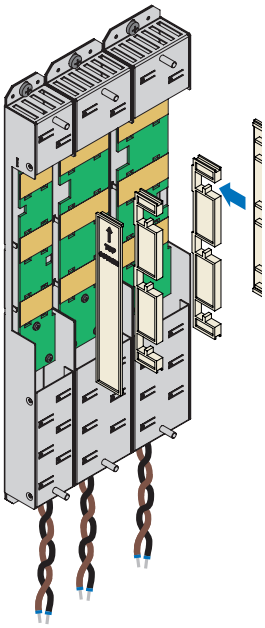
✓ The mounting plate has been cleaned (free of oil, grease and swarf).

✓ The copper rails must be straight, smooth, free of burrs and cleaned (free of oil and grease).

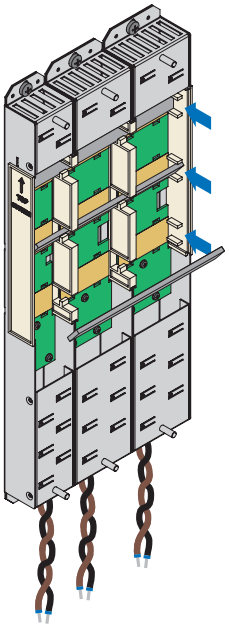
1. Fasten the Quick DC-Link modules onto the mounting plate with the fastening screws.



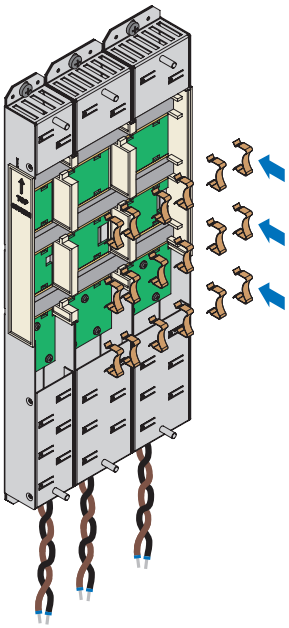
2. Insert the insulation connection pieces between the modules and insulation end section each at the left edge of the first module and at the right edge of the last module. Ensure correct alignment of the end section using the marking on the outside and the insertion aids for the copper rails on the inside.



3. Shorten the copper rails to the correct length.
4. Clean the copper rails, especially at the contact points.
5. Insert the three copper rails one after the other.



6. Fasten each of the copper rails with two quick fastening clamps per rail and Quick DC-Link module. Make certain the contact points of the copper rails do not become contaminated.



⇨ You have installed the Quick DC-Link. In the next step, build over the Quick DC-Link modules with the appropriate drive controllers.

10.8 Mounting the drive controller on the rear section module

⚠ WARNING!

Electrical voltage! Risk of fatal injury due to electric shock!

- Always switch off all power supply voltage before working on the devices!
- Note the discharge time of the DC link capacitors in the general technical data. You can only determine the absence of voltage after this time period.

Information

Note that drive controllers in storage require reforming each year or before commissioning at the latest.

Tools and material

You will need:

- A suitable terminal set for each drive controller
- An 8 mm hexagonal socket wrench to tighten the nut and washer assemblies on the threaded bolts

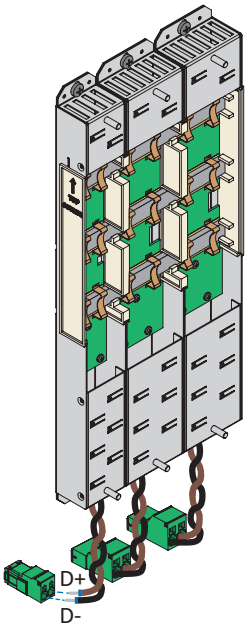
Requirements and installation

Perform the following steps for each drive controller within the group.

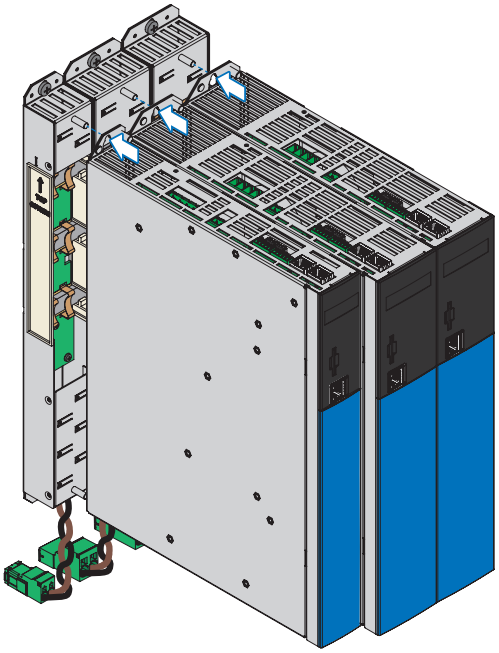
✓ There is a circuit diagram of the system that describes the connection of the drive controllers.

✓ For each drive controller, the appropriate Quick DC-Link rear section modules for the DC link connection have already been installed in the installation position.

1. Remove terminal X22 from the appropriate terminal set. Connect the brown cable D+ on the bottom of the Quick DC-Link module to D+ of terminal X22, and the black cable D- of the Quick DC-Link module to D- of terminal X22. Make sure that the conductors of the Quick DC-Link module are twisted pairs.



2. Place the drive controller on the bottom threaded bolt of the Quick DC-Link module and properly align it vertically with the bottom and top threaded bolt.



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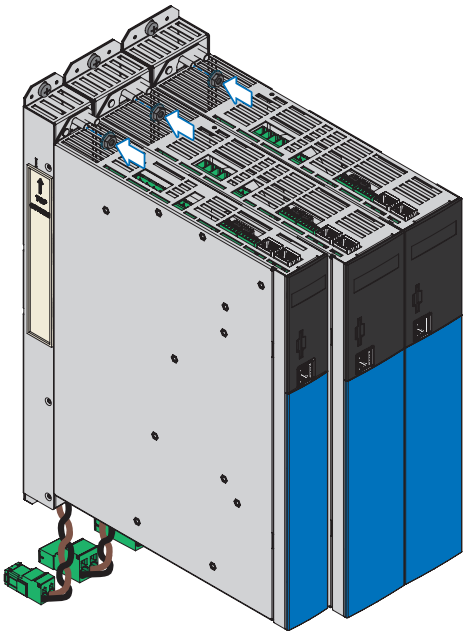
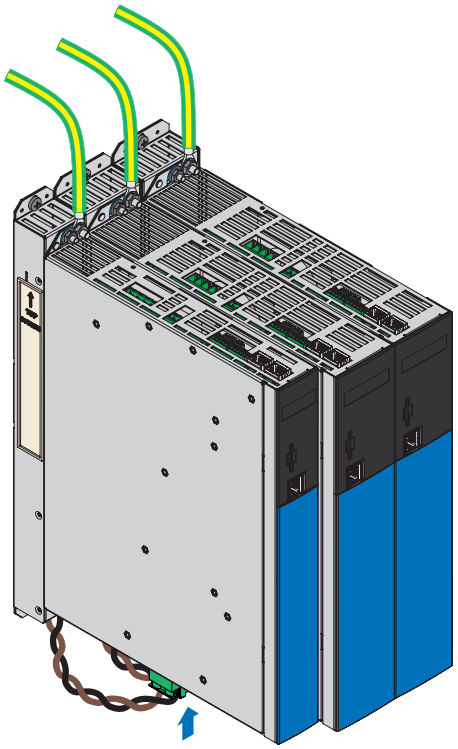
3. Fasten the drive controller to both threaded bolts of the Quick DC-Link module using the nut and washer assemblies (M5). The nut and washer assemblies are included with the Quick DC-Link module.



4. Connect the grounding conductor to the ground bolt. Obey the instructions and requirements for Protective grounding [▶ 93].

5. Attach the X22 terminal of the Quick DC-Link module.



⇨ The installation is completed. In the next step, connect the drive controller.

11 Connection

The following chapter describes the connection of the drive controller and the available accessories.

11.1 Safety instructions for connection

Connection work is permitted only when no voltage is present. Observe the 5 safety rules (see Working on the machine [▶ 19]).

If you couple the drive controller in the DC link, ensure that all Quick DC-Link modules are built over with a drive controller.

The device housing must be closed before you turn on the supply voltage.

When the power supply voltage is turned on, hazardous voltages may be present on the connection terminals and the cables connected to them.

The device and the cables connected to it are not necessarily de-energized when the supply voltage is switched off and all displays have gone out!

Information

Note the discharge time of the DC link capacitors in the general technical data for the devices. You can only determine the absence of voltage after this time period.

Opening the housing, plugging in or unplugging connection terminals, connecting or removing a connecting wiring, and installing or removing accessories are prohibited while the voltage supply is switched on.

Protect the devices against falling parts (bits or strands of wire, pieces of metal, etc.) during installation or other work in the control cabinet. Parts with conductive properties may result in a short circuit inside the devices and device failure as a result.

Use only copper conductors. For the corresponding conductor cross-sections, consult the standards DIN VDE 0298-4 or EN 60204-1 (Annexes D, G) as well as the relevant terminal specifications in this documentation.

The protection class of the devices is protective grounding (protection class I in accordance with EN 61140). This means that operation is permitted only if the grounding conductor is connected according to requirements.

All protective ground connections are identified by "PE" or the international grounding symbol (IEC 60417, symbol 5019).

The products are not designed for use in a public low-voltage network that supplies residential areas. Radio-frequency interference can be expected if the products are used in this type of network.

11.2 Line routing

Observe the valid provisions for your machine or system, e.g. IEC 60364 or EN 50110, during the installation of electrical equipment.

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11.3 Protective measures

Take the following protective measures into account.

11.3.1 Power grid supply with DC link connection

All drive controllers must be connected to the same supply grid.

ATTENTION!

Damage to device due to the emission of electromagnetic interference!

If the EMC threshold limits are exceeded during the operation of a DC link connection, devices in the immediate area can be interrupted or damaged.

- Take suitable measures to comply with the electromagnetic compatibility.
- Always route the shortest possible connections for DC links. If they are longer than 30 cm, they must be shielded.

ATTENTION!

Damage to device in case of drive controller failure!

The failure of a drive controller in the DC link can result in damage to additional drive controllers.

- A failure must trigger the isolation of the entire DC link group from the grid.

Wiring example

The example in the attachment (see Wiring examples [▶ 315]) illustrates the basic connection to Quick DC-Link DL6B based on a DC link connection.

11.3.2 Line fuse

The drive controller is designed exclusively for operation in TN networks or on wye sources. At a nominal voltage of 200 to 480 V_{AC}, they are permitted to supply a maximum differential short-circuit current in accordance with the following table:

Size	Max. differential short-circuit current
Size 0 – size 2	5000 A

Tab. 73: Maximum differential short-circuit current

The line fuse ensures the line and overload protection in the drive controller. To that end, observe the requirements described below, which vary based on the configuration.

11.3.2.1 Line fuses in stand-alone operation

You can use the following protective devices when operating a single drive controller:

- Full-range safety fuses for cable and line protection with operating class gG in accordance with IEC 60269-2-1 or time delay triggering characteristics in accordance with DIN VDE 0636
- Miniature circuit breakers with triggering characteristic C in accordance with EN 60898
- Circuit breakers

Information on the recommended maximum line fuse can be found in the following table:

Size	Type	$I_{1N,PU}$ (4 kHz) [A]	Recommended max. line fuse [A]
0	SC6A062	10	10
1	SC6A162	23.2	25
2	SC6A261	22.6	25

Tab. 74: Line fuses in stand-alone operation

Information

To ensure problem-free operation, always comply with the recommended trigger limits and trigger characteristics of the fuse elements.

11.3.2.2 Line fuses for DC link connection

Every drive controller connected to the grid in the DC link group must be protected at the line input against overload and short circuit. To do this, a fuse combination consisting of overload protection and semiconductor short-circuit protection is connected in series. A miniature circuit breaker protects against overload and a safety fuse with gR triggering characteristics protects against short circuit.

Information

The installation of short-circuit fuses is not necessary under ideal requirements and ambient conditions. However, if the application conditions pose the risk of contaminating the drive controllers, short-circuit fuses can protect against damage to or failure of other devices within the DC link group.

You can use the following fuse combinations:

Size	Type	$I_{1N,PU}$ (4 kHz) [A]	I_{1maxPU} (4 kHz) [A]	Fuse selection	
				Miniature circuit breakers	Safety fuse
0	SC6A062	10	21 A	EATON Type: FAZ-Z10/3, Item No.: 278926 Triggering characteristics: Z 10 A	SIBA Type: URZ, Item No. 50 140 06.25 Triggering characteristics: gR 25 A
1	SC6A162	23.2	48.7 A	EATON Type: FAZ-Z25/3, Item No.: 278929 Triggering characteristics: Z 25 A	SIBA Type: URZ, Item No. 50 140 06.50 Triggering characteristics: gR 50 A
2	SC6A261	22.6	47.4 A	EATON Type: FAZ-Z25/3, Item No.: 278929 Triggering characteristics: Z 25 A	SIBA Type: URZ, Item No. 50 140 06.50 Triggering characteristics: gR 50 A

Tab. 75: Line fuses for DC link connection

Information

To ensure problem-free operation, always comply with the recommended trigger limits and trigger characteristics of the fuse elements.

Maximum number of drive controllers

Two drive controllers of the same rating can be connected using a common fuse combination. The fuses and the resulting maximum line input current correspond to that of a single drive controller.

In order to prevent gradual damage to the safety fuse, you can operate a maximum of two drive controllers on one fuse combination.

ATTENTION!

Damage due to overload!

In order to ensure an even distribution of charging current on all AC-supplied drive controllers, all circuit breakers must be closed when engaging the power supply.

- In order that the input rectifier is not overloaded in the event of a possible fuse failure in the group, evaluation of the grid monitoring for AC-supplied drive controllers must lead to deactivation of the entire DC link group.

11.3.2.3 UL-compliant line fuses

For UL compliance, use one of the following protection measures:

- Class CC, CF, J, T, G or RK1 safety fuses
- Circuit breakers

More detailed specifications about the appropriate fuses can be found in the following table:

Size	Type	Safety fuse		Circuit breakers
		I_N [A]	U_N [V_{AC}]	
0	SC6A062	15	600	Recommendation: EATON FAZ-B10/3-NA Manufacturer No. 132723
				Alternative: EATON FAZ-B15/3-NA Manufacturer No. 132721
1	SC6A162	25	600	EATON FAZ-B25/3-NA Manufacturer No. 132726
1	SC6A261			

Tab. 76: UL-compliant line fuses

Information

To ensure problem-free operation, always comply with the recommended trigger limits and trigger characteristics of the fuse elements.

11.3.3 Grid connection for DC link connection

All drive controllers must be connected to the power grid simultaneously. Simultaneously in this case means that the time difference may be a maximum of 20 ms. This condition is generally met if you use contactors of identical design from one manufacturer.

Provided that simultaneous connection to the grid is achieved, the design with one contactor per drive controller is also permitted.

ATTENTION!

Damage due to overload!

If the grid does not connect to all drive controllers simultaneously in the design with one contactor per drive controller, their charging resistors can be damaged.

11.3.4 Residual current protective device

Depending on the function, leakage currents may occur when operating drive controllers. Leakage currents are interpreted as residual currents by residual current protective devices (RCDs) and may therefore lead to false triggering. Depending on the relevant power supply connections, residual currents may occur with or without a DC current component. Because of this, you should take into consideration both the magnitude as well as the profile of the possible leakage or residual current when selecting a suitable residual current protective device.

Leakage and residual currents with a DC current component can restrict the functionality of type A and AC residual current protective devices.

Protect 1-phase installations using type B universal current-sensitive residual current protective devices or type F mixed frequency-sensitive devices.

Protect 3-phase installations with type B universal current-sensitive residual current protective devices.

⚠ DANGER!

Electrical voltage! Risk of fatal injury due to electric shock!

In 3-phase installations, this product can cause a direct current in the protective grounding conductor.

- If a residual current protective device (RCD) or residual current monitoring device (RCM) is used for protection in case of direct or indirect contact, only one RCD or RCM of type B is permitted on the power supply side of this product.

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False triggering – Causes

Depending on stray capacitances and imbalances, leakage currents above 30 mA may occur during operation.

Undesirable false triggering occurs under the following conditions:

- Connecting the installation to the supply voltage:
  This false triggering can be remedied by using short-time delayed (super-resistant), delayed switch-off (selective) residual current protective devices or those with increased tripping current (e.g. 300 or 500 mA).
- Higher frequency leakage currents for long power cables under normal operating conditions:
  For example, use low-capacitance cables or use an output choke.
- High imbalances in the supply grid.
  This false triggering can be rectified, e.g. using an isolating transformer.

⚠ DANGER!

Electrical voltage! Risk of fatal injury due to electric shock!

Residual current protective devices with increased tripping current as well as with short-time delayed or delayed switch-off trigger characteristics may not meet the requirements for personal protection.

- Check whether the use of the selected residual current protective device is permitted in your application.

11.3.5 Protective grounding

In order to dimension the grounding, it must be ensured that the upstream fuse is triggered in the event of a short circuit. Observe the requirements described below for the correct connection of the protective grounding.

11.3.5.1 Minimum cross-section of the grounding conductor

Leakage currents > 10 mA can arise in normal operation. The minimum cross-section of the protective grounding conductor must comply with the local safety regulations for protective grounding conductors with high leakage current. To fulfill regulations such as EN 60204-1, connect a copper conductor according to the following table:

Cross-section A Power grid line	Minimum cross-section A_{min} Grounding conductor
A ≤ 2.5 mm²	2.5 mm²
2.5 mm² < A ≤ 16 mm²	A
16 mm² < A ≤ 35 mm²	≥ 16 mm²
> 35 mm²	A/2

Tab. 77: Minimum cross-section of the grounding conductor

11.3.5.2 Cable shields and sheaths

In accordance with DIN EN 60204-1, the following parts of a machine and its electrical equipment must be connected to the grounding conductor system, but must not be used as grounding conductors:

- Metal cable shields
- Sheath

11.3.5.3 Connection of the grounding conductor

You connect the grounding conductor to the drive controller over terminal X10.

Additional requirements for protective equipotential bonding apply in the event of ground leakage currents > 10 mA. At least one of the following conditions must be fulfilled:

- The grounding conductor must have a minimum cross-section of 10 mm² Cu over its overall length
- If the grounding conductor has a cross-section of less than 10 mm², a 2nd grounding conductor must be provided with a cross-section of at least the same size, as at terminal X10, up to the point at which the grounding conductor exhibits the minimum cross-section of 10 mm²

A ground bolt is mounted to the devices for connecting the 2nd grounding conductor. The ground bolt is marked with the grounding symbol according to IEC 60417 (symbol 5019).

You will need an open-ended wrench or external hex key with a width across flats of 10 mm.

Obey a tightening torque of 4.0 Nm (35 Lb.inch).

Observe the order for assembly:

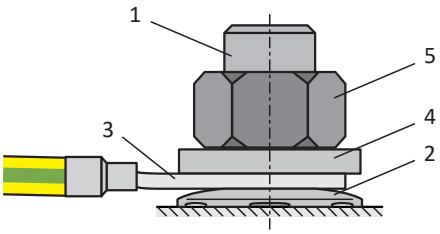

Fig. 27: Connection of the grounding conductor

1	M6 ground bolt
2	Contact disk
3	Cable lug
4	Washer
5	Nut

The contact disk, washer and nut are supplied with the drive controller.

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11.3.5.4 UL-compliant connection of the grounding conductor

Note that UL-compliant operation requires just a single grounding conductor.

The grounding at terminal X10 of the SC6 drive controller must not be used for protective grounding. The housing for the drive controllers must be connected to the protective grounding using the M6 ground bolt (4.0 Nm, 35 Lb.inch).

The connection for the protective grounding on the housing is identified by the grounding symbol in accordance with IEC 60417 (symbol 5019).

You will need an open-ended wrench or external hex key with a width across flats of 10 mm.

Observe the order for assembly:

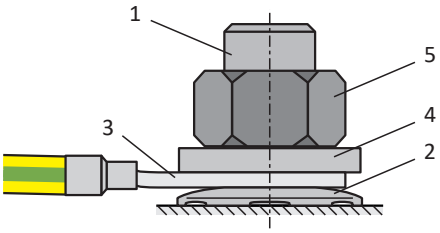

Fig. 28: Connection of the grounding conductor

1 M6 ground bolt
2 Contact disk
3 Cable lug
4 Washer
5 Nut

The contact disk, washer and nut are supplied with the drive controller.

11.3.6 EMC recommendations

Information

This chapter provides general information on EMC-compliant installation. These are recommendations. Depending on the application, the ambient conditions as well as the legal requirements, measures beyond these recommendations may be required.

Lay the power line, power cable and signal lines separately from each other, e.g. in separate cable ducts.

Only use shielded, low-capacitance cables as power cables.

If the brake line is carried in the power cable, it must be shielded separately.

Ground and insulate free line ends if they cannot be connected to the terminals provided for this purpose on the drive controller, e.g. using a connecting terminal.

Connect the shield of the power cable to the grounding conductor system over a wide area and in the immediate vicinity of the drive controller. For this purpose, use the shield contact provided for the drive controllers or suitable accessories.

The connection lines for braking resistors as well as the cores of the Quick DC-Link modules must be implemented as twisted pairs. At line lengths of 30 cm or more, the lines also must be implemented with shielding and the shield must be applied over a wide area in the immediate vicinity of the drive controller.

For motors with terminal boxes, connect the shield to the terminal box over large contact areas. For example, use EMC cable screw connections.

Connect the shield of the control lines on one side to the reference potential of the source, e.g. the PLC or CNC.

You may use chokes to improve the EMC and protect the drive system. Output chokes reduce current peaks caused by line capacity at the power output of the drive controller.

ATTENTION!

Material damage due to incorrect or uncontrolled movement!

When connecting Lean motors in combination with an output choke, a successful position and speed determination is not ensured. This can lead to an incorrect or uncontrolled movement right from the start.

- If Lean motors are connected, output chokes must not be used.

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11.4 Drive controllers

The following section contains detailed information about the terminals and the correct connection of the drive controller.

Information

For UL-compliant operation: The connections marked with PE are intended solely for the functional grounding.

11.4.1 Overview

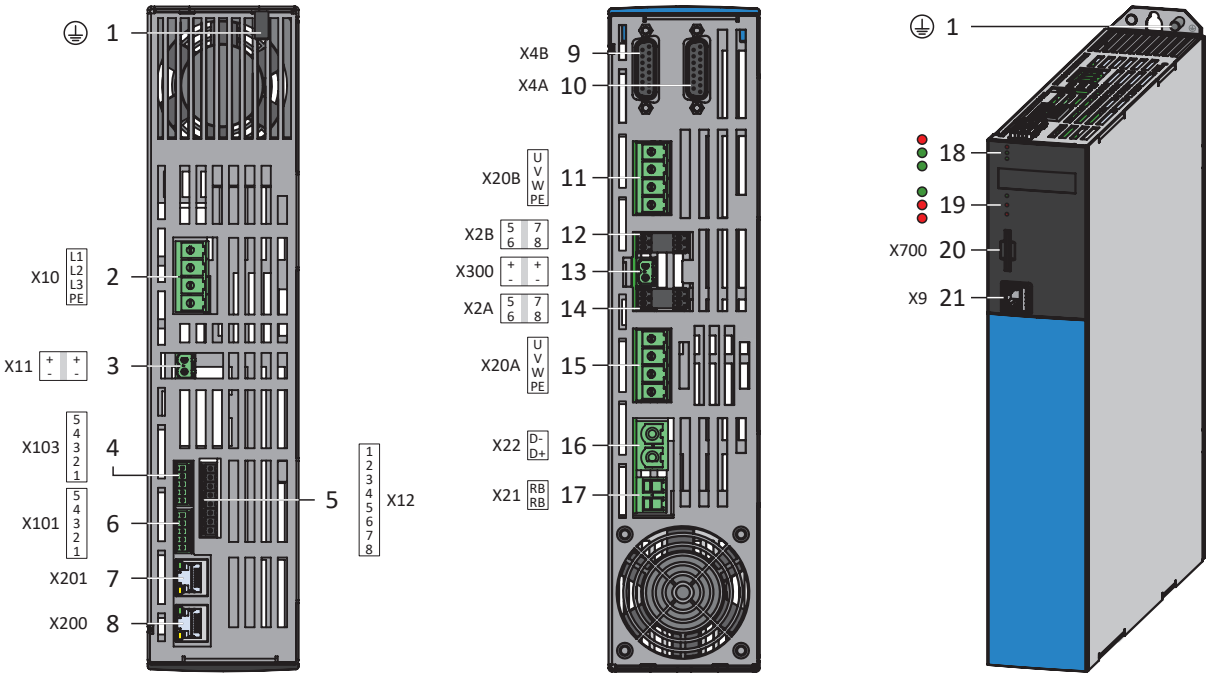

Fig. 29: Connection overview using the example of the SC6A162

	Top of the device		Bottom of the device		Front of the device
1	Ground bolt	9	X4B: Encoder B (only for double-axis controllers)	18	3 diagnostic LEDs for communication and safety technology
2	X10: 400 V_{AC} supply	10	X4A: Encoder A	19	3 diagnostic LEDs for drive controller
3	X11: 24 V_{DC} supply	11	X20B: Motor B (only for double-axis controllers)	20	X700: SD slot
4	X103: DI6 – DI9	12	X2B: Brake B (pin 5/6) and temperature sensor B (pin 7/8); (only for double-axis controllers)	21	X9: Ethernet service interface
5	X12: STO via terminals (only for SR6 option)	13	X300: Brake 24 V_{DC} supply		
6	X101: DI1 – DI4	14	X2A: Brake A (pin 5/6) and temperature sensor A (pin 7/8)		
7	X201: EtherCAT Out / PROFINET	15	X20A: Motor A		
8	X200: EtherCAT In / PROFINET	16	X22: DC link connection		
		17	X21: Braking resistor		

11.4.2 X2A: Brake A

The brake of axis A is connected to X2A. All device types of the SC6 drive controller can control a 24 V_{DC} brake as standard.

Information

Note that brakes from other manufacturers may be connected only after consultation with STOBER.

Controllable brakes

Obey the technical data of the brakes controllable at X2A (see Controllable brakes [▶ 57]).

	Pin	Designation	Function
5 | 6	5	1BD1	Brake actuation
	6	1BD2	Reference potential

Tab. 78: X2A connection description, brake A

For the connecting wiring, obey the terminal specification BCF 3,81 180 SN [▶ 310].

Cable requirements

Motor type	Connection	Size 0 to 2
Synchronous servo motor, asynchronous motor	Without output choke	50 m, shielded
Synchronous servo motor, asynchronous motor	With output choke	100 m, shielded
Lean motor	Without output choke	50 m, shielded[a)]

Tab. 79: Maximum cable length of the power cable [m]

The use of cables with a length greater than 50 m and up to maximum 100 m must be checked by STOBER for the application.

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11.4.3 X2A: Motor temperature sensor A

The motor temperature sensor of axis A is connected to terminal X2A. All device types of the SC6 drive controller have connections for PTC thermistors.

Information

Evaluation of the temperature sensor is always active. If operation without a temperature sensor is permitted, the connections must be bridged to X2. Otherwise a fault is triggered when the device is switched on.

Information

Note that a temperature sensor does not have to be connected to terminal X2 for EnDat 3 or HIPERFACE DSL encoders. In this case, the temperature sensor signal is transferred together with the encoder signal over connector X4.

	Pin	Designation	Function
7 | 8	7	1TP1+	PTC connection
	8	1TP2–	

Tab. 80: X2A connection description, motor temperature sensor A

For the connecting wiring, obey the terminal specification BCF 3,81 180 SN [▶ 310].

Cable requirements

Motor type	Connection	Size 0 to 2
Synchronous servo motor, asynchronous motor	Without output choke	50 m, shielded
Synchronous servo motor, asynchronous motor	With output choke	100 m, shielded
Lean motor	Without output choke	50 m, shielded[a)]

Tab. 81: Maximum cable length of the power cable [m]

The use of cables with a length greater than 50 m and up to maximum 100 m must be checked by STOBER for the application.

11.4.4 X2B: Brake B

The brake of axis B is connected to X2B for double-axis controllers. Only X2A is available for single-axis controllers. The connection description of X2B matches the X2A description.

11.4.5 X2B: Motor temperature sensor B

The motor temperature sensor of axis B is connected to X2B for double-axis controllers. Only X2A is available for single-axis controllers. The connection description of X2B matches the X2A description.

11.4.6 X4A: Encoder A

The encoder of axis A is connected to terminal X4A.

ATTENTION!

Risk of encoder destruction!

X4 may not be plugged in or unplugged when the device is switched on!

ATTENTION!

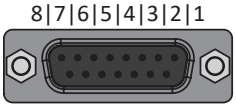
Risk of encoder destruction!

Only encoders with a suitable input voltage range (minimum 12 V_{DC}) may be connected to X4.

Evaluable encoders

Obey the technical data of the evaluable encoders at X4 (see Evaluable encoders [▶ 52]).

EnDat 2.2 digital encoders and SSI encoders

Socket	Pin	Designation	Function
8|7|6|5|4|3|2|1  15|14|13|12|11|10|9	1	—	—
	2	0 V GND	Reference potential for encoder supply to pin 4
	3	—	—
	4	U_2	Encoder supply
	5	Data +	Differential input for DATA
	6	—	—
	7	—	—
	8	Clock +	Differential input for CLOCK
	9	—	—
	10	—	—
	11	—	—
	12	—	—
	13	Data −	Inverse differential input for DATA
	14	—	—
	15	Clock −	Inverse differential input for CLOCK

Tab. 82: X4A connection description for EnDat 2.2 digital encoders and SSI encoders

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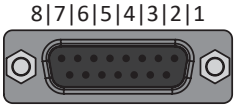
Differential TTL and differential HTL incremental encoders (HTL via HT6 adapter)

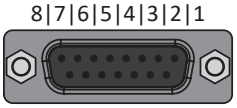
Socket	Pin	Designation	Function
8|7|6|5|4|3|2|1  15|14|13|12|11|10|9	1	—	—
	2	0 V GND	Reference potential for encoder supply to pin 4
	3	—	—
	4	U_2	Encoder supply
	5	B +	Differential input for B channel
	6	—	—
	7	N +	Differential input for N channel
	8	A +	Differential input for A channel
	9	—	—
	10	—	—
	11	—	—
	12	—	—
	13	B −	Inverse differential input for B channel
	14	N −	Inverse differential input for N channel
	15	A −	Inverse differential input for A channel

Tab. 83: X4A connection description for differential TTL and differential HTL incremental encoders (HTL via HT6 adapter)

Information

Using an HT6 adapter for level conversion from HTL signals to TTL signals, it is also possible to connect a differential HTL incremental encoder to terminal X4. Note that, with an external power supply, the maximum level of 20 V_{DC} for the HTL signals may not be exceeded.

Resolver

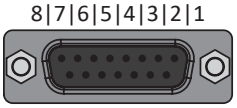
Socket	Pin	Designation	Function
8|7|6|5|4|3|2|1  15|14|13|12|11|10|9	1	S4 Sin +	Sin input
	2	R1 Ref −	Reference potential for pin 6
	3	S3 Cos +	Cos input
	4	—	—
	5	—	—
	6	R2 Ref +	Resolver excitation signal
	7	—	—
	8	—	—
	9	S2 Sin −	Reference potential for pin 1
	10	—	—
	11	S1 Cos −	Reference potential for pin 3
	12	—	—
	13	—	—
	14	—	—
	15	—	—

Tab. 84: X4A connection description for resolvers

Information

For connecting STOBER resolver cables with a 9-pin D-sub connector, use the AP6A00 interface adapter (ID No. 56498, 9-pin to 15-pin D-sub), available separately.

EnDat 3 and HIPERFACE DSL encoders

Socket	Pin	Designation	Function
8|7|6|5|4|3|2|1  15|14|13|12|11|10|9	1	—	—
	2	P_D –	Inverse EnDat 3 or HIPERFACE DSL signal (motor temperature sensor evaluation over EnDat or DSL communication)
	3	—	—
	4	P_D +	EnDat 3 or HIPERFACE DSL signal (motor temperature sensor evaluation over EnDat or DSL communication)
	5	—	—
	6	—	—
	7	—	—
	8	—	—
	9	—	—
	10	—	—
	11	—	—
	12	—	—
	13	—	—
	14	—	—
	15	—	—

Tab. 85: X4A connection description for EnDat 3 and HIPERFACE DSL encoders

Cable requirements

Feature	All sizes
Max. cable length	100 m, shielded

Tab. 86: Cable length [m]

Information

To ensure proper functionality, we recommend using cables from STOBER that are matched to the complete system.
If unsuitable connection cables are used, we reserve the right to reject claims under the warranty.

Unsuitable encoder models

The following STOBER encoder models may **not** be connected:

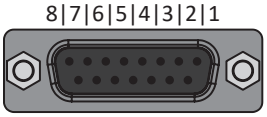
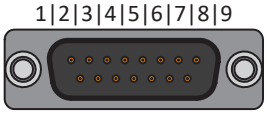
Encoder model	Code according to type designation
ECI 1118	C0
EQI 1130	Q0
ECI 1319	CR
EQI 1329	QP
EQI 1331	QR

Tab. 87: Encoder models with unsuitable supply voltage range

11.4.6.1 HT6 interface adapter (HTL to TTL)

HT6 – HTL to TTL (15-pin to 15-pin)

Adapter for level conversion from HTL signals to TTL signals.

Socket[9]	Pin	Designation	Function	Pin	Connector[10]
8|7|6|5|4|3|2|1  15|14|13|12|11|10|9	1	B +	Differential input for B channel	5	1|2|3|4|5|6|7|8|9  10|11|12|13|14|15
	2	0 V GND	Reference potential for encoder supply to pin 4	2	
	3	N +	Differential input for N channel	7	
	4	U_2	Encoder supply	4	
	5	—	—	—	
	6	A +	Differential input for A channel	8	
	7	—	—	—	
	8	—	—	—	
	9	B –	Inverse differential input for B channel	13	
	10	N –	Inverse differential input for N channel	14	
	11	A –	Inverse differential input for A channel	15	
	12	—	—	—	
	13	—	—	—	
	14	—	—	—	
	15	—	—	—	

Tab. 88: HT6 connection description for HTL differential encoder (15-pin to 15-pin)

[9] View of 15-pin D-sub for connecting the encoder cable
[10] View of 15-pin D-sub for connecting to terminal X4

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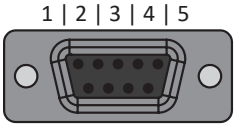
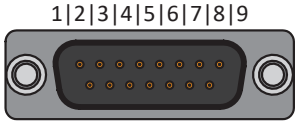
11.4.6.2 AP6 interface adapter (resolver)

AP6A00 – resolver (9-pin to 15-pin)

Socket[11]	Pin	Designation	Function	Pin	Connector[12]
1 | 2 | 3 | 4 | 5  6 | 7 | 8 | 9	1	—	—	—	1|2|3|4|5|6|7|8|9  10|11|12|13|14|15
	2	1TP1	—	—	
	3	S2 Sin –	Reference potential for sin input	9	
	4	S1 Cos –	Reference potential for cos input	11	
	5	R1 Ref –	Reference potential for resolver excitation signal	2	
	6	1TP2	—	—	
	7	S4 Sin +	Sin input	1	
	8	S3 Cos +	Cos input	3	
	9	R2 Ref +	Resolver excitation signal	6	

Tab. 89: AP6A00 connection description for resolver (9-pin to 15-pin)

11.4.7 X4B: Encoder B

The encoder of axis B is connected to X4B for double-axis controllers. Only X4A is available for single-axis controllers. The connection description of X4B matches the X4A description.

Information

Note that a master encoder must be connected to axis A during synchronous operation.

11.4.8 X9: Ethernet service interface

X9 is used to connect the drive controller to a PC with DriveControlSuite commissioning software installed.

Socket	Pin	Designation	Function
1|2|3|4|5|6|7|8	1	TxData+	Ethernet communication
	2	TxData–	
	3	RecvData+	
	4	–	–
	5	–	–
	6	RecvData–	Ethernet communication
	7	–	–
	8	–	–

Tab. 90: X9 connection description

[11] View of 9-pin D-sub for connecting the SDS 4000-compatible resolver cable
[12] View of 15-pin D-sub for connecting to terminal X4

Cable requirements

Feature	All sizes
Max. cable length	100 m, shielded

Tab. 91: Cable length [m]

Information

To ensure proper functionality, we recommend using cables from STOBER that are matched to the complete system.
If unsuitable connection cables are used, we reserve the right to reject claims under the warranty.

It is also possible to use cables with the following specification:

Feature	Design
Connector wiring	Patch or crossover
Quality	CAT 5e
Shielding	SF/FTP, S/FTP or SF/UTP

Tab. 92: Cable requirements

Device addressing

For information on device addressing, see Device addressing [▶ 318].

11.4.9 X10: 400 V supply

Terminal X10 serves to connect the drive controller to the supply grid.

Conductor cross-sections for the power connection

When selecting the conductor cross-section, note the line fuse, the maximum permitted conductor cross-section of terminal X10, the routing method and the surrounding temperature.

UL-compliant operation

The grounding at terminal X10 of the SC6 drive controller must not be used for protective grounding. The housing for the drive controllers must be connected to the protective grounding using the M6 ground bolt (4.0 Nm, 35 Lb.inch).

Size 0

Terminal	Pin	Designation	Function
1 | 2 | 3 | 4	1	L1	Power supply
	2	L2	
	3	L3	
	4	PE	Grounding conductor

Tab. 93: X10 connection description, size 0

For the connecting wiring, obey the terminal specification GFKC 2,5 -ST-7,62 [▶ 312].

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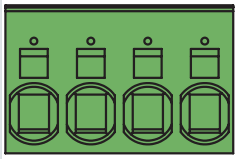
Sizes 1 and 2

Terminal	Pin	Designation	Function
 1 | 2 | 3 | 4	1	L1	Power supply
	2	L2	
	3	L3	
	4	PE	Grounding conductor

Tab. 94: X10 connection description, size 1 and 2

For the connecting wiring, obey the terminal specification SPC 5 -ST-7,62 [▶ 314].

11.4.10 X11: 24 V supply

The connection of 24 V_{DC} to X11 is required for the power supply of the control unit.

ATTENTION!

Device damage due to overload!

If the 24 V_{DC} power supply is looped to multiple devices over the terminal, the terminal may be damaged by a current that is too high.

- Make sure that the current over the terminal does not exceed the value 15 A (UL: 10 A).

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

Tab. 95: Control unit electrical data

	Pin	Designation	Function
1 | 3 2 | 4	1	+	24 V_{DC} supply for the control unit; bridged in the terminal; design in accordance with EN 60204: PELV, secondary grounded, recommended fuse protection: max. 15 AT[13]
	2		
	3	−	Reference potential for +24 V_{DC}, bridged in the terminal
	4		

Tab. 96: X11 connection description

Information

The device may not be connected to a DC supply grid. Instead, supply it over a local 24 V_{DC} power supply unit.

For the connecting wiring, obey the terminal specification BLDF 5.08 180 SN [▶ 310].

[13] For UL-compliance, use of a 10 A fuse (time delay) is required. Be sure that the fuse meets certification requirements for DC voltage in accordance with UL 248.

Cable requirements

Feature	All sizes
Max. cable length	30 m

Tab. 97: Cable length [m]

11.4.11 X12: Safety technology (option SR6)

The SR6 option adds the STO safety function to the SC6 drive controller via terminal X12.

For double-axis controllers, the STO safety function has a two-channel structure that acts upon both axes.

Information

If you would like to use the STO safety function via terminals, be sure to read the manual for the SR6 safety module.

Technical data

Obey the technical data of the safety options at X12 (see SR6 safety module [▶ 50]).

Terminal	Pin	Designation	Function
1|2|3|4|5|6|7|8	1	STO_a	Input of safety channel 1
	2		
	3	STO_b	Input of safety channel 2
	4		
	5	0 V GND	Reference potential for STO_a and STO_b, internally bridged with pin 7
	6	STO_{status}	Feedback signal of safety channels 1 and 2 for diagnostic purposes
	7	0 V GND	Reference potential for STO_a and STO_b, internally bridged with pin 5
	8	$U_{1status}$	STO supply $_{status}$; recommended fuse protection: max. 3.15 AT[14]

Tab. 98: X12 connection description

Connecting wiring

For the connecting wiring, obey the terminal specification BCF 3,81 180 SN [▶ 310].

Cable requirements

Feature	All sizes
Max. cable length	30 m

Tab. 99: Cable length [m]

[14] For UL-compliance, use of a 3.15 A fuse (time delay) is required. The fuse must be certified for DC voltage in accordance with UL 248.

11.4.12 X20A: Motor A

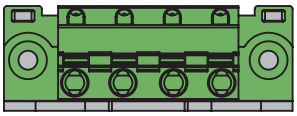
The motor of axis A is connected to X20A.

UL-compliant operation

The protective grounding of motors connected to the drive controller must not be connected using terminals X20A and X20B. The grounding conductor connection of the motor must be ensured for the respective application in accordance with the valid electrical standards.

For the protective grounding of the motor, use the grounding conductor connection available on the motor.

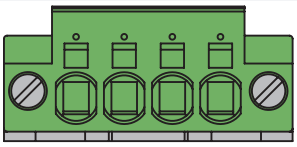
Size 0

Terminal	Pin	Designation	Function
 1 | 2 | 3 | 4	1	U	Motor phase U connection
	2	V	Motor phase V connection
	3	W	Motor phase W connection
	4	PE	Grounding conductor

Tab. 100: X20A connection description, size 0

For the connecting wiring, obey the terminal specification GFKC 2,5 -ST-7,62 [▶ 312].

Sizes 1 and 2

Terminal	Pin	Designation	Function
 1 | 2 | 3 | 4	1	U	Motor phase U connection
	2	V	Motor phase V connection
	3	W	Motor phase W connection
	4	PE	Grounding conductor

Tab. 101: X20A connection description, sizes 1 and 2

For the connecting wiring, obey the terminal specification SPC 5 -ST-7,62 [▶ 314].

Cable requirements

Motor type	Connection	Size 0 to 2
Synchronous servo motor, asynchronous motor	Without output choke	50 m, shielded
Synchronous servo motor, asynchronous motor	With output choke	100 m, shielded
Lean motor	Without output choke	50 m, shielded[a)]

Tab. 102: Maximum cable length of the power cable [m]

The use of cables with a length greater than 50 m and up to maximum 100 m must be checked by STOBER for the application.

Information

To ensure proper functionality, we recommend using cables from STOBER that are matched to the complete system. If unsuitable connection cables are used, we reserve the right to reject claims under the warranty.

Shielded connection of the power cable

Note the following points for the connection of the power cable:

- Ground the shield of the power cable on the shield contact on the drive controller intended for this.
- Keep the exposed conductors as short as possible. All devices and circuits that are sensitive to EMC must be kept at a distance of at least 0.3 m.

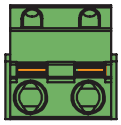
11.4.13 X20B: Motor B

The motor of axis B is connected to X20B for double-axis controllers. Only X20A is available for single-axis controllers. The connection description of X20B matches the X20A description.

11.4.14 X21: Braking resistor

Terminal X21 is available for the connection of a braking resistor.

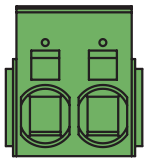
Size 0

Terminal	Pin	Designation	Function
 1 | 2	1	RB	Braking resistor connection
	2	RB	

Tab. 103: X21 connection description, size 0

For the connecting wiring, obey the terminal specification GFKIC 2.5 -ST-7.62 [▶ 312].

Sizes 1 and 2

Terminal	Pin	Designation	Function
 1 | 2	1	RB	Braking resistor connection
	2	RB	

Tab. 104: X21 connection description, sizes 1 and 2

For the connecting wiring, obey the terminal specification ISPC 5 -STGCL-7,62 [▶ 313].

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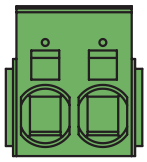
11.4.15 X22: DC link connection

Terminal X22 is available for the DC link connection of the drive controller.

For setting up the Quick DC-Link, obey the information on project configuration (see DC link connection [▶ 64]).

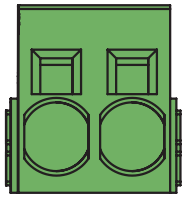
Size 0

Terminal	Pin	Designation	Function
 1 | 2	1	D–	DC link connection
	2	D+	

Tab. 105: X22 connection description, size 0

For the connecting wiring, obey the terminal specification ISPC 5 -STGCL-7,62 [▶ 313].

Sizes 1 and 2

Terminal	Pin	Designation	Function
 1 | 2	1	D–	DC link connection
	2	D+	

Tab. 106: X22 connection description, sizes 1 and 2

For the connecting wiring, obey the terminal specification ISPC 16 -ST-10,16 [▶ 313].

Wiring example

The example in the attachment (see Wiring examples [▶ 315]) illustrates the basic connection to Quick DC-Link DL6B based on a DC link connection.

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11.4.16 X101: DI1 – DI4

Digital inputs 1 to 4 are available at terminal X101.

X101 for digital signals

For evaluating digital signals at X101, obey the specification for the digital inputs in the technical data of the drive controller (see Digital inputs [▶ 41]).

Terminal	Pin	Designation	Function
5|4|3|2|1	1	DI1	Digital inputs
	2	DI2	
	3	DI3	
	4	DI4	
	5	0 V DGND	Reference potential; not bridged with X103, pin 5

Tab. 107: X101 connection description for digital signals

X101 for encoders

If you would like to use X101 as an encoder connection, obey the technical data of the evaluable encoders at X101 (see X101 for encoders [▶ 56]).

Single-ended HTL incremental encoders

Terminal	Pin	Designation	Function
5|4|3|2|1	1	DI1	—
	2	DI2	N channel
	3	DI3	A channel
	4	DI4	B channel
	5	0 V DGND	Reference potential; not bridged with X103, pin 5

Tab. 108: X101 connection description for single-ended HTL incremental signals, axis A

Single-ended HTL pulse/direction interface

Terminal	Pin	Designation	Function
5|4|3|2|1	1	DI1	—
	2	DI2	—
	3	DI3	Frequency
	4	DI4	Direction
	5	0 V DGND	Reference potential; not bridged with X103, pin 5

Tab. 109: X101 connection description for single-ended HTL pulse/direction signals, axis A

Connecting wiring

For the connecting wiring, obey the terminal specification FMC 1,5 -ST-3,5 [▶ 311].

Cable requirements

Feature	All sizes
Max. cable length	30 m

Tab. 110: Cable length [m]

11.4.17 X103: DI6 – DI9

Digital inputs 6 to 9 are available at terminal X103.

X103 for digital signals

For the evaluation of digital signals at X103, obey the technical data of the drive controller (see Digital inputs [▶ 41]).

Terminal	Pin	Designation	Function
5|4|3|2|1	1	DI6	Digital inputs
	2	DI7	
	3	DI8	
	4	DI9	
	5	0 V DGND	Reference potential; not bridged with X101, pin 5

Tab. 111: X103 connection description for digital signals

X103 for encoders

If you would like to use X103 as an encoder connection, obey the technical data of the evaluable encoders at X103 (see X103 for encoders [▶ 56]).

Information

Note that a master encoder must be connected to X101 during synchronous operation.

Single-ended HTL incremental encoders

Terminal	Pin	Designation	Function
5|4|3|2|1	1	DI6	—
	2	DI7	N channel
	3	DI8	A channel
	4	DI9	B channel
	5	0 V DGND	Reference potential; not bridged with X101, pin 5

Tab. 112: X103 connection description for single-ended HTL incremental signals, axis B

Single-ended HTL pulse/direction interface

Terminal	Pin	Designation	Function
5|4|3|2|1	1	DI6	—
	2	DI7	—
	3	DI8	Frequency
	4	DI9	Direction
	5	0 V DGND	Reference potential; not bridged with X101, pin 5

Tab. 113: X103 connection description for single-ended HTL pulse/direction signals, axis B

Connecting wiring

For the connecting wiring, obey the terminal specification FMC 1,5 -ST-3,5 [▶ 311].

Cable requirements

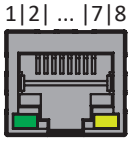
Feature	All sizes
Max. cable length	30 m

Tab. 114: Cable length [m]

11.4.18 X200, X201: EtherCAT

The drive controllers have both RJ-45 sockets X200 and X201. The sockets are located on top of the device. The associated pin assignment and color coding correspond to the EIA/TIA-T568B standard.

X200 is to be connected as an input with the cable coming from the EtherCAT master. X201 is to be connected as an output with any subsequent EtherCAT nodes.

Socket	Pin	Designation	Function
1|2| ... |7|8 	1	Tx+	Communication
	2	Tx–	
	3	Rx+	
	4	—	—
	5	—	—
	6	Rx–	Communication
	7	—	—
	8	—	—

Tab. 115: X200 and X201 connection description

Cable requirements

Information

To ensure proper functionality, we recommend using cables from STOBER that are matched to the complete system. If unsuitable connection cables are used, we reserve the right to reject claims under the warranty.

STOBER provides ready-made cables for the EtherCAT connection. It is also possible to use cables with the following specification:

Ethernet patch cables or crossover cables meeting the CAT 5e quality level are the ideal cables. The Fast Ethernet technology allows a maximum cable length of 100 m between two nodes.

Information

Ensure that you only use shielded cables with an SF/FTP, S/FTP or SF/UTP design.

Device addressing and fieldbus connection

For information on device addressing, see Device addressing [▶ 318].

Detailed information about the fieldbus connection can be found in the corresponding manual for communication with EtherCAT.

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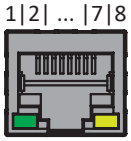
11.4.19 X200, X201: PROFINET

In order to be able to connect the drive controllers to other PROFINET nodes, an integrated switch with both X200 and X201 RJ-45 sockets is provided. The sockets are located on top of the device. The associated pin assignment and color coding correspond to the EIA/TIA-T568B standard.

Connect X200 or X201 with the IO controller and the remaining connection with the next drive controller.

Socket	Pin	Designation	Function
1|2| ... |7|8 	1	Tx+	Communication
	2	Tx–	
	3	Rx+	
	4	—	—
	5	—	—
	6	Rx–	Communication
	7	—	—
	8	—	—

Tab. 116: X200 and X201 connection description

Cable requirements

The connections between the nodes of a PROFINET network generally consist of symmetrical, shielded copper cables twisted in pairs (shielded twisted pair, CAT 5e quality level). Fiber-optic cables are also a possible means of transmission.

Signals are transmitted according to the 100BASE TX method, i.e. with a transfer rate of 100 Mbps at a frequency of 125 MHz. A maximum of 1440 bytes can be transferred per frame. The maximum cable length is 100 m.

PROFINET cables exist in different versions that are tailored to different application scenarios and ambient conditions.

We recommend using the cables and plug connectors specified in the PROFINET installation guidelines. They are adjusted for use in automation technology with regard to usage, resistance, EMC properties and color coding.

There are type A, B and C cables, differentiated by installation type:

- Type A
  4-wire shielded copper cable for fixed installation
- Type B
  4-wire shielded copper cable for flexible installation
- Type C
  4-wire shielded copper cable for constant movements

Device addressing and fieldbus connection

For information on device addressing, see Device addressing [▶ 318].

Detailed information about the fieldbus connection can be found in the corresponding manual for communication with PROFINET.

11.4.20 X300: Brake 24 V supply

X300 is used to supply the brake.

ATTENTION!

Device damage due to overload!

If the 24 V_{DC} power supply is looped to multiple devices over the terminal, the terminal may be damaged by a current that is too high.

- Make sure that the current over the terminal does not exceed the value 15 A (UL: 10 A).

Electrical data	Single-axis controller	Double-axis controller
U_1	+24 V_{DC}, +25%/−0%	
I_{1max}	2.5 A	2 × 2.5 A

Tab. 117: Electrical data of the control unit brake control

	Pin	Designation	Function
1 | 3 2 | 4	1	+	24 V_{DC} supply for the brake; bridged in the terminal; design in accordance with EN 60204-1: PELV, secondary grounded, recommended fuse protection: max. 15 AT[15]
	2		
	3	−	Reference potential for supply voltage of the brake
	4		

Tab. 118: X300 connecection description

For the connecting wiring, obey the terminal specification BLDF 5.08 180 SN [▶ 310].

Cable requirements

Feature	All sizes
Max. cable length	30 m

Tab. 119: Cable length [m]

[15] For UL-compliance, use of a 10 A fuse (time delay) is required. Be sure that the fuse meets certification requirements for DC voltage in accordance with UL 248.

11.4.21 X700: SD slot

The SD slot is used for data backup in case of service. SD and SDHC cards with storage capacity from 128 MB to 32 GB are supported. SDHC cards with a storage capacity of 64 GB can be used only if they have been first reformatted to max. 32 GB (FAT32). Since higher capacities increase the controller starting time, STOBER recommends the use of cards with a storage capacity from 2 to 4 GB.

Information

The drive controller has internal configuration memory and can therefore be operated without an inserted SD card. In the DriveControlSuite commissioning software, the action Save values always saves to both the internal configuration memory and the inserted SD card. Back up your configuration to an SD card after completing commissioning in order to allow transfer of the configuration to the replacement drive controller in case of service. When the replacement drive controller is switched on, the data is loaded with priority given to the inserted SD card. To make a non-volatile back-up in the internal configuration memory, you must run the action Save values in parameter A00.

11.4.22 Connecting a drive controller

⚠ WARNING!

Electrical voltage! Risk of fatal injury due to electric shock!

- Always switch off all power supply voltage before working on the devices!
- Note the discharge time of the DC link capacitors in the general technical data. You can only determine the absence of voltage after this time period.

Tools and material

You will need:

- A suitable terminal set for the drive controller
- Tool for tightening the fastening screws

Requirements and connection

Bottom of the device:

✓ You have a system circuit diagram describing the connection of the drive controller.

1. Optional: Connect the braking resistor to terminal X21 and attach the terminal. Make sure that the conductors are twisted pairs.
2. In order to connect the motor temperature sensor, the control of the brake and the motor itself to the drive controller, wire the cores of the power cables with terminals X2A and X20A.

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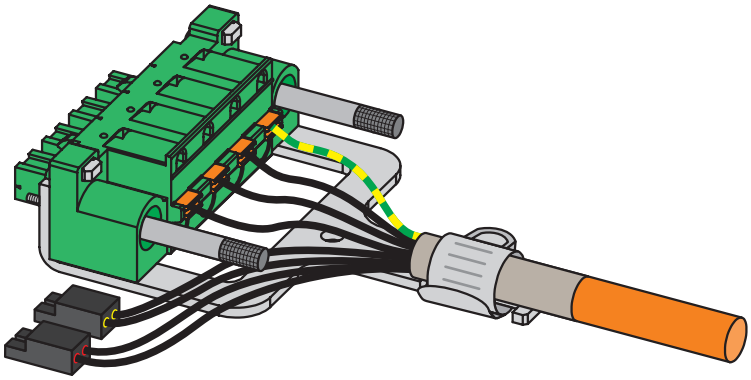
3. Attach the power cable with the shield clamp to the shield contact of terminal X20A.



4. Attach terminals X20A and X2A and tighten the screws of X20A.
5. Optional: Connect the supply voltage for the brakes to terminal X300 and attach it.
6. For double-axis controllers: Repeat steps 2 to 4 for the terminals X2B and X20B.
7. Optional: Connect an encoder to terminal X4A.
8. Optional for double-axis controllers: Connect an encoder to terminal X4B.

Top of the device:

✓ There is a circuit diagram of the system that describes the connection of the drive controller.

1. Connect the power supply to terminal X10 and attach the terminal.
2. Connect the 24 V_{DC} power supply for the control electronics to terminal X11 and attach the terminal.
3. If you use the STO safety function, connect it as follows:
   - 3.1. SR6 option: Connect terminal X12 according to your safety configuration and attach the terminal.
   - 3.2. SY6 option: In order to be able to identify the safety module in the FSoE network, you must transfer its unique address in the FSoE network to the drive controller using the DIP switches.
   - 3.3. SU6 option: In order to be able to identify the safety module in the PROFIsafe network, you must transfer its unique address in the PROFIsafe network to the drive controller using the DIP switches.
4. Optional: Connect the digital inputs to terminals X101 and X103 and attach the terminals.
5. Connect the fieldbus to the sockets X200 and X201.

Examples can be found in the appendix (see Wiring examples [▶ 315])

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11.5 Braking resistor

Housing grounding of the braking resistor

When grounding the housing of the braking resistor, obey the information on how to connect the grounding conductor correctly (see Connection of the grounding conductor [▶ 94]).

11.5.1 FZMU, FZZMU connection description

The internal connections of the tubular fixed resistor are wired to terminals with heat-resistant, silicone-insulated strands of wire. Also ensure a heat-resistant and sufficiently surge-proof design for the connection!

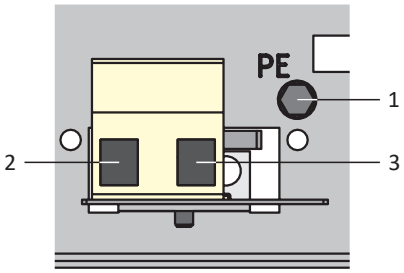


Fig. 30: FZMU connection overview

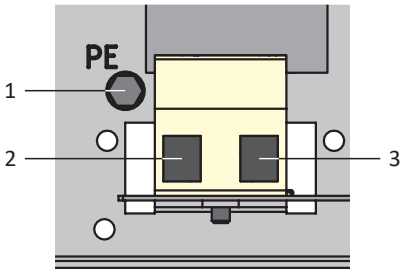


Fig. 31: FZZMU connection overview

No.	Function
1	Grounding conductor
2	RB drive controller braking resistor connection: X21, pin 1
3	RB drive controller braking resistor connection: X21, pin 2

Tab. 120: FZMU, FZZMU connection description

For the connecting wiring of the braking resistor, obey the terminal specification G 10/2 [▶ 311].

11.5.2 GVADU, GBADU connection description

GVADU flat resistors have two red cores for connecting to the drive controller, while GBADU flat resistors have one gray and one white core.

No.	Function
RD/GY	RB drive controller braking resistor connection: X21, pin 1
RD/WH	RB drive controller braking resistor connection: X21, pin 2

Tab. 121: GVADU, GBADU connection description

11.6 Output choke

⚠ WARNING!

Risk of burns! Fire hazard! Material damage!

Chokes and braking resistors can heat up to over 100 °C under permitted operating conditions.

- Take protective measures against accidental and intentional contact with the choke or braking resistor.
- Make sure that no flammable material is in the vicinity of the choke or braking resistor.
- Note the specified minimum clearances for installation.

⚠ WARNING!

Fire hazard due to overheating!

Using chokes or braking resistors outside of the nominal data (cable length, current, frequency, etc.) can cause them to overheat.

- Always comply with the maximum nominal data when operating the chokes and braking resistors.

11.6.1 Connection description

Designation	Function
1U1	Phase U drive controller connection: X20, pin 1
1U2	Motor phase U connection
1V1	Phase V drive controller connection: X20, pin 2
1V2	Motor phase V connection
1W1	Phase W drive controller connection: X20, pin 3
1W2	Motor phase W connection
7	Drive controller grounding conductor: X20, Pin 4
8	Power cable grounding conductor

Tab. 122: TEP output choke connection description

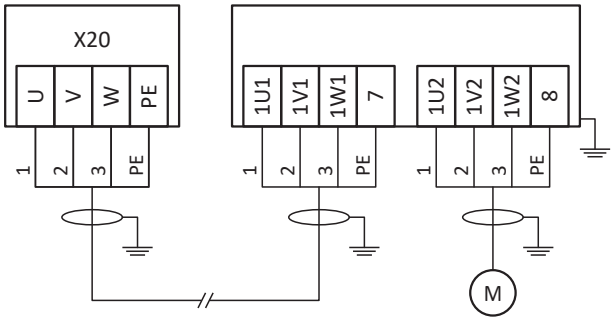


Fig. 32: TEP output choke connection example

Shielded connection of the power cable

Note the following points for the connection of the power cable for a motor with output choke:

- Ground the shield of the power cable over large contact areas in the immediate vicinity of the output choke, for example with electrically conductive metal cable clips on a grounded busbar.
- Keep the exposed conductors as short as possible. All devices and circuits that are sensitive to EMC must be kept at a distance of at least 0.3 m.

The following graphic shows an example of the shielded connection of the power cable.

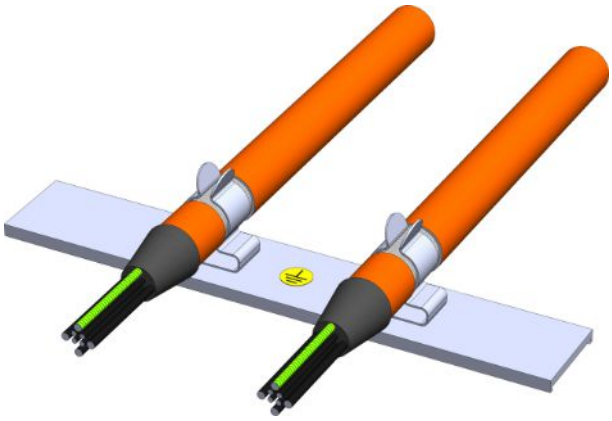


Fig. 33: Shielded connection of the power cable

Choke housing grounding

When connecting the grounding conductor, obey the requirements described (see Connection of the grounding conductor [▶ 94]).

11.7 Cables

Note that the motor, cables and drive controller each have electrical properties which influence one another. Unfavorable combinations could possibly result in impermissible voltage peaks on the motor and drive controller and increased wear as a result.

Take into consideration the following instructions when selecting suitable cables:

- Cable cross-sections for connection to the motor:
  Note the permitted stall current I_0 for the motor when making your selection.
- Conductor cross-sections for the power connection:
  Note the line fuse, the maximum permitted conductor cross-section for terminal X10, the routing method and the surrounding temperature when making your selection.
- Also pay attention to the trailing and torsional strength of the lines.
- When using a motor brake, pay attention to the voltage drop in the supply voltage on the line.

Information

To ensure proper functionality, we recommend using cables from STOBER that are matched to the complete system. If unsuitable connection cables are used, we reserve the right to reject claims under the warranty.

Information

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

11.7.1 Power cables

Synchronous servo motors and Lean motors from STOBER are equipped with plug connectors as standard, while asynchronous motors are equipped with terminal boxes.

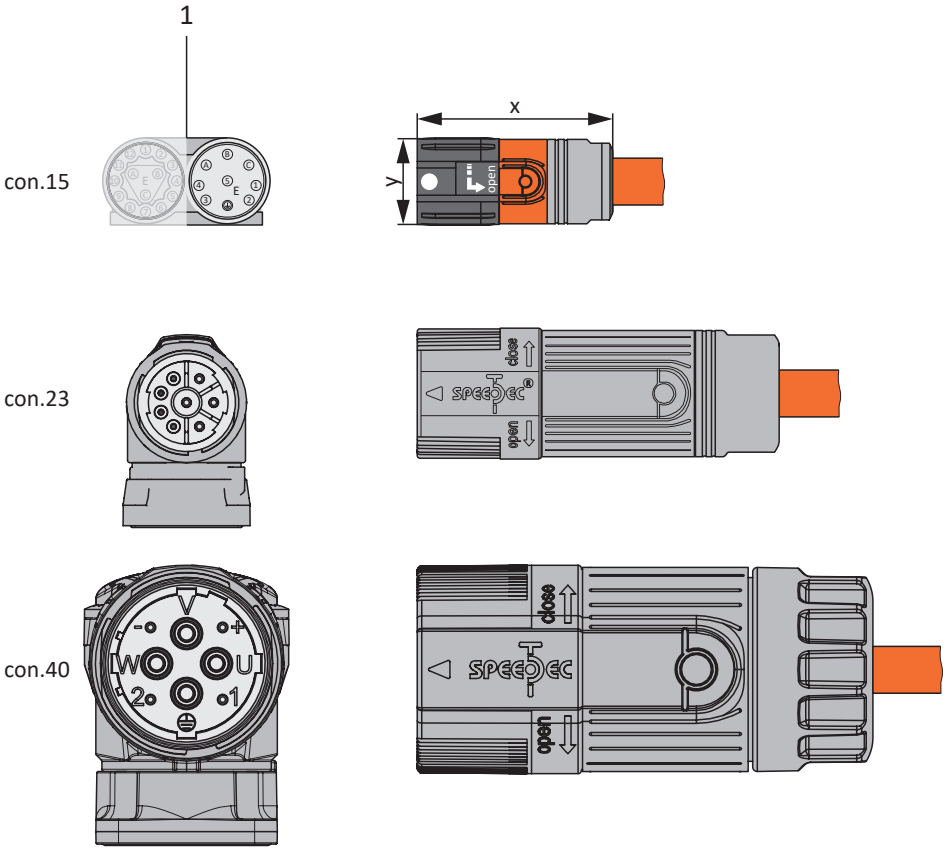
STOBER provides suitable cables in various lengths, conductor cross-sections and connector sizes.

11.7.1.1 Connection description

Depending on the size of the motor plug connector, power cables are available in the following designs:

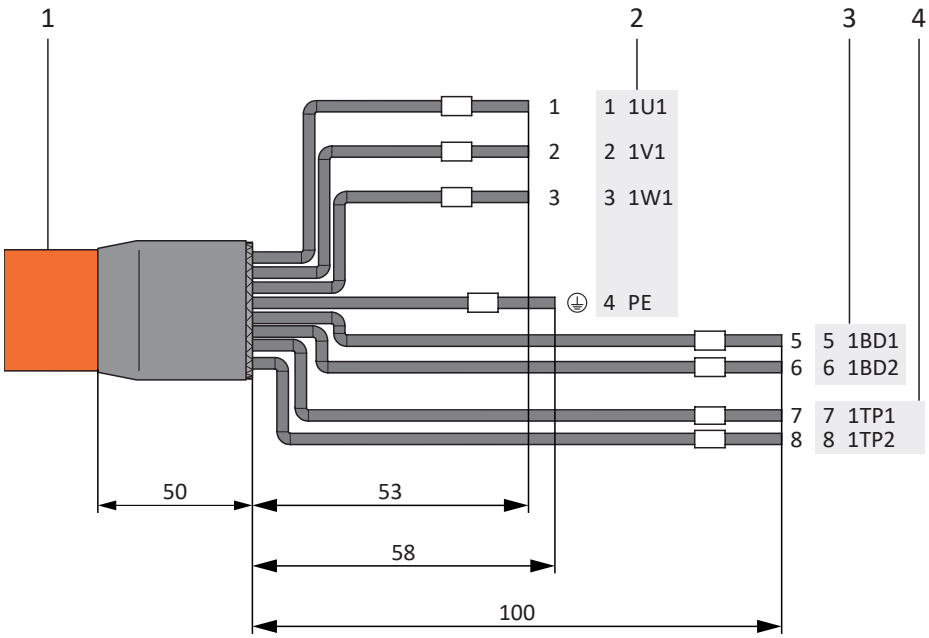
- Quick lock for con.15
- speedtec quick lock for con.23 and con.40

Motor-side connection



1 Plug connectors

Drive controller-side connection



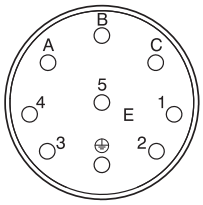
1 Power cable with cable shield
2 Connection to terminal X20, motor
3 Connection of terminal X2, brake
4 Connection to terminal X2, temperature sensor

Motor type	Connection	Size 0 to 2
Synchronous servo motor, asynchronous motor	Without output choke	50 m, shielded
Synchronous servo motor, asynchronous motor	With output choke	100 m, shielded
Lean motor	Without output choke	50 m, shielded[a)]

Tab. 123: Maximum cable length of the power cable [m]

The use of cables with a length greater than 50 m and up to maximum 100 m must be checked by STOBER for the application.

Power cables – con.15 plug connector

Motor (1)				Cable (2)	Drive controller (3) – (5)		
Motor connection diagram	Pin	Designation	Int. motor Core color	Core No./ Core color	Pin X20	Pin X2	Pin X2
	A	1U1	BK	1	1	—	—
	B	1V1	BU	2	2	—	—
	C	1W1	RD	3	3	—	—
	1	1TP1	BK[a)]	7	—	—	7
	2	1TP2	WH[a)]	8	—	—	8
	3	1BD1	RD	5	—	5	—
	4	1BD2	BK	6	—	6	—
	5	—	—	—	—	—	—
	⏚	PE	GNYE	GNYE	4	—	—
	Housing	Shield	—	—	Shield contact	—	—

Tab. 124: con.15 power cable pin assignment

a) Color depends on the type of temperature sensor (PTC), which is specified on the motor nameplate.

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

Tab. 125: con.15 connector dimensions

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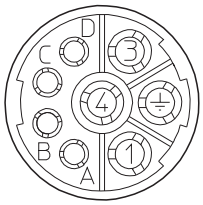
Power cables – con.23 plug connectors

Motor (1)				Cable (2)	Drive controller (3) – (5)		
Motor connection diagram	Pin	Designation	Int. motor Core color	Core No./ Core color	Pin X20	Pin X2	Pin X2
	1	1U1	BK	1	1	—	—
	3	1V1	BU	2	2	—	—
	4	1W1	RD	3	3	—	—
	A	1BD1	BK/RD[a)]	5	—	5	—
	B	1BD2	BK	6	—	6	—
	C	1TP1	BK[b)]	7	—	—	7
	D	1TP2	WH[b)]	8	—	—	8
	⏚	PE	GNYE	GNYE	4	—	—
	Housing	Shield	—	—	Shield contact	—	—

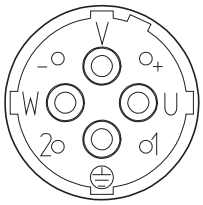
Tab. 126: con.23 power cable pin assignment

a) Color depends on the type of motor
b) Color depends on the type of temperature sensor (PTC) which is specified on the motor nameplate.

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

Tab. 127: con.23 connector dimensions

Power cables – con.40 plug connector

Motor (1)				Cable (2)	Drive controller (3) – (5)		
Motor connection diagram	Pin	Designation	Int. motor Core color	Core No./ Core color	Pin X20	Pin X2	Pin X2
	U	1U1	BK	1	1	—	—
	V	1V1	BU	2	2	—	—
	W	1W1	RD	3	3	—	—
	+	1BD1	RD	5	—	5	—
	–	1BD2	BK	6	—	6	—
	1	1TP1	BK[a)]	7	—	—	7
	2	1TP2	WH[a)]	8	—	—	8
	⏚	PE	GNYE	GNYE	4	—	—
	Housing	Shield	—	—	Shield contact	—	—

Tab. 128: con.40 power cable pin assignment

a) Color depends on the type of temperature sensor (PTC), which is specified on the motor nameplate.

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

Tab. 129: con.40 connector dimensions

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11.7.2 Encoder cables

STOBER motors are equipped with encoder systems and plug connectors as standard.

STOBER provides suitable cables in various lengths, conductor cross-sections and connector sizes.

Depending on the respective motor types, different encoder systems can be used.

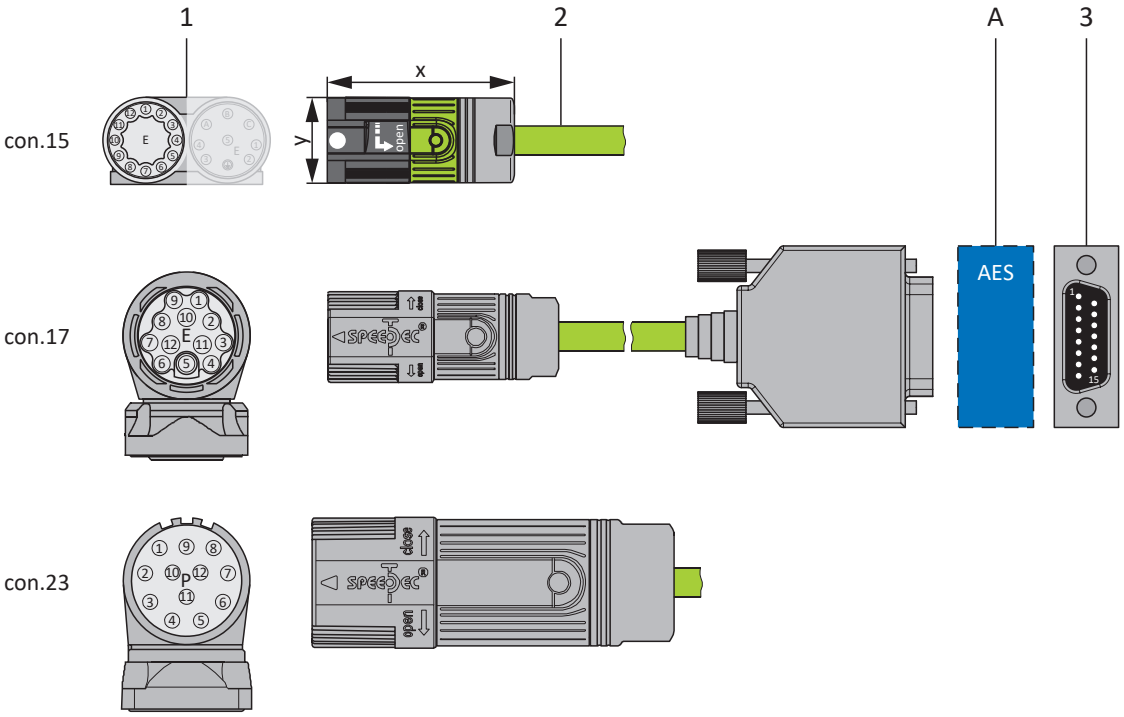
11.7.2.1 EnDat 2.1/2.2 digital encoders

Suitable encoder cables are described below.

11.7.2.1.1 Connection description

Depending on the size of the motor plug connector, encoder cables are available in the following designs:

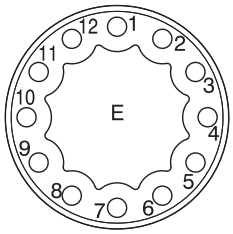
- Quick lock for con.15
- speedtec quick lock for con.17 and con.23



1 Plug connectors
2 STOBER encoder cable
A Only con.15 and con.17: Optional Absolute Encoder Support (AES) battery module
3 D-sub X4

Encoder cables – con.15 plug connectors

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

Motor (1)				Cable (2)	Drive controller (3)
Connection diagram	Pin	Designation	Core color	Core color	Pin X4
	1	Clock +	VT	YE	8
	2	U_2 Sense	BNGN	PK	12
		U_{2BAT+} [16]	BU		
	3	—	—	GY	3
		U_{2BAT-} [17]	WH		
	4	—	—	—	—
	5	Data −	PK	BN	13
	6	Data +	GY	WH	5
	7	—	—	—	—
	8	Clock −	YE	GN	15
	9	—	—	—	—
	10	0 V GND	WHGN	BU	2
	11	—	—	—	—
	12	U_2	BNGN	RD	4
	Housing	Shield	—	—	Housing

Tab. 130: con.15 encoder cable pin assignment, EnDat 2.1/2.2 digital

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

Tab. 131: con.15 connector dimensions

[16] Only relevant for EBI encoders
[17] Only relevant for EBI encoders

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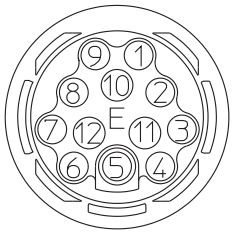
Encoder cables – con.17 plug connectors

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

Motor (1)				Cable (2)	Drive controller (3)
Connection diagram	Pin	Designation	Core color	Core color	Pin X4
	1	Clock +	VT	YE	8
	2	U_2 Sense	BNGN	PK	12
		U_{2BAT+} [18]	BU		
	3	—	—	GY	3
		U_{2BAT-} [19]	WH		
	4	—	—	—	—
	5	Data −	PK	BN	13
	6	Data +	GY	WH	5
	7	—	—	—	—
	8	Clock −	YE	GN	15
	9	—	—	—	—
	10	0 V GND	WHGN	BU	2
	11	—	—	—	—
	12	U_2	BNGN	RD	4
	Housing	Shield	—	—	Housing

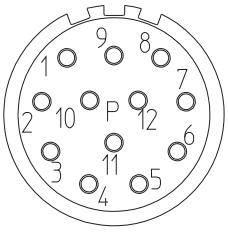
Tab. 132: con.17 encoder cable pin assignment, EnDat 2.1/2.2 digital

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

Tab. 133: con.17 connector dimensions

[18] Only relevant for EBI encoders
[19] Only relevant for EBI encoders

Encoder cables – con.23 plug connector

Motor (1)				Cable (2)	Drive controller (3)
Connection diagram	Pin	Designation	Core color	Core color	Pin X4
	1	Clock +	VT	YE	8
	2	U_2 Sense	BNGN	PK	12
	3	—	—	—	—
	4	—	—	—	—
	5	Data –	PK	BN	13
	6	Data +	GY	WH	5
	7	—	—	—	—
	8	Clock –	YE	GN	15
	9	—	—	—	—
	10	0 V GND	WHGN	BU	2
	11	—	—	—	—
	12	U_2	BNGN	RD	4
	Housing	Shield	—	—	Housing

Tab. 134: con.23 encoder cable pin assignment, EnDat 2.1/2.2 digital

Length x [mm]	Diameter y [mm]
58	26

Tab. 135: con.23 dimensions

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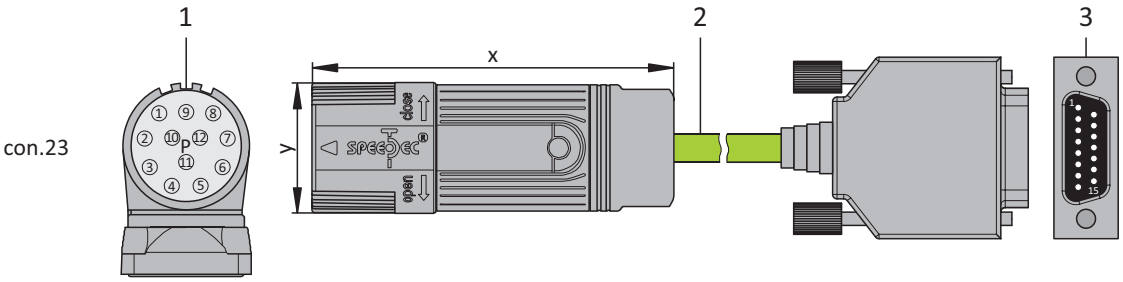
11.7.2.2 SSI encoders

Suitable encoder cables are described below.

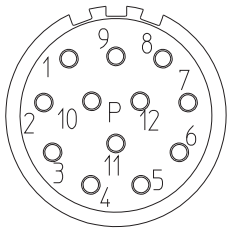
11.7.2.2.1 Connection description

The encoder cable is available in plug connector size con.23 with a speedtec quick lock.



1 Plug connectors
2 STOBER encoder cable
3 D-sub X4

Encoder cables – con.23 plug connectors

Motor (1)				Cable (2)	Drive controller (3)
Connection diagram	Pin	Designation	Core color	Core color	Pin X4
	1	Clock +	VT	YE	8
	2	U_2 Sense	BNGN	PK	12
	3	—	—	—	—
	4	—	—	—	—
	5	Data –	PK	BN	13
	6	Data +	GY	WH	5
	7	—	—	—	—
	8	Clock –	YE	GN	15
	9	—	—	—	—
	10	0 V GND	WHGN	BU	2
	11	—	—	—	—
	12	U_2	BNGN	RD	4
	Housing	Shield	—	—	Housing

Tab. 136: con.23 encoder cable pin assignment, SSI

Length x [mm]	Diameter y [mm]
58	26

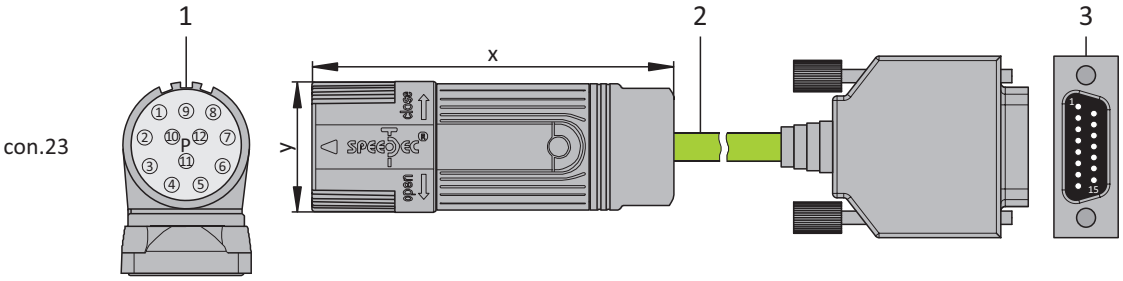
Tab. 137: con.23 dimensions

11.7.2.3 Differential HTL incremental encoders

Suitable encoder cables are described below.

11.7.2.3.1 Connection description

The encoder cable is available in plug connector size con.23 with a speedtec quick lock.

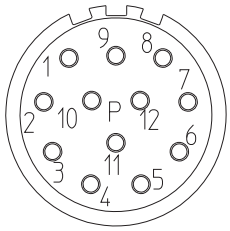


1 Plug connectors
2 STOBER encoder cable
3 D-sub X4

Information

For the connection of an HTL incremental encoder to terminal X4 of SC6 or SI6 drive controllers, you need the HT6 adapter (ID No. 56665). HT6 takes over level conversion from HTL signals to TTL signals.

Encoder cables – con.23 plug connectors

Motor (1)					Cable (2)	Drive controller (3)
Connection diagram	Pin	Designation	Core color up to size 80	Core color size 90 or larger	Core color	Pin X4
	1	B –	PK	BK	YE	9
	2	—	—	YE	—	—
	3	N +	BU	PK	PK	3
	4	N –	RD	WH	GY	10
	5	A +	GN	GN	BN	6
	6	A –	YE	BN	WH	11
	7	—	—	—	—	—
	8	B +	GY	GY	GN	1
	9	—	—	—	—	—
	10	0 V GND	WH	BU	BU	2[20]
	11	—	—	VT	—	—
	12	U_2	BN	RD	RD	4
	Housing	Shield	—	—	—	Housing

Tab. 138: con.23 encoder cable pin assignment, incremental HTL

Length x [mm]	Diameter y [mm]
58	26

Tab. 139: con.23 dimensions

[20] Pin 12 (U2 Sense) with pin 2 (0 V GND) bridged: The bridge is constructed in the cable connector that is connected to X4.

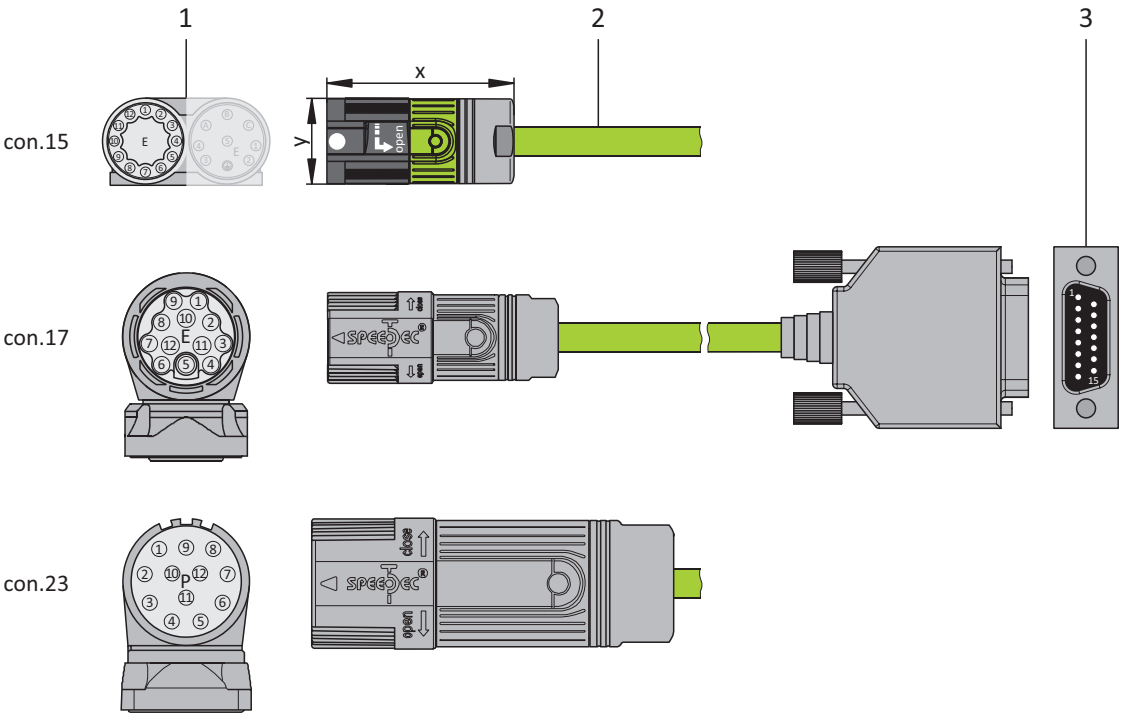
11.7.2.4 Resolver

Suitable encoder cables are described below.

11.7.2.4.1 Connection description

Depending on the size of the motor plug connector, encoder cables are available in the following designs:

- Quick lock for con.15
- speedtec quick lock for con.17 and con.23



1 Plug connectors
2 STOBER encoder cable
3 D-sub X4

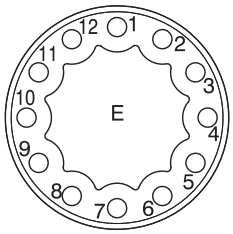
Information

Note that the cores for the temperature sensor in STOBER are routed in the power cable as standard. For motors that provide the temperature sensor at the encoder connection, you need an interface adapter to lead out the temperature sensor cores for connecting the cable to the drive controller.

Information

For connecting STOBER resolver cables with a 9-pin D-sub connector, use the AP6A00 interface adapter (ID No. 56498, 9-pin to 15-pin D-sub), available separately.

Encoder cables – con.15 plug connectors

Motor (1)				Cable (2)	Drive controller (3)
Connection diagram	Pin	Designation	Core color	Core color	Pin X4
	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	1TP1	BK	RD	7
	6	1TP2	WH	BU	14
	7	R2 Ref +	YEWH/ BKWH	GY	6
	8	R1 Ref –	RDWH	PK	2
	9	—	—	—	—
	10	—	—	—	—
	11	—	—	—	—
	12	—	—	—	—
	Housing	Shield	—	—	Housing

Tab. 140: con.15 encoder cable pin assignment, resolver

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

Tab. 141: con.15 connector dimensions

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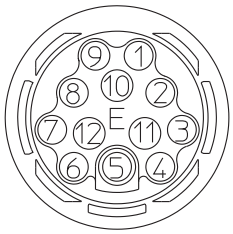
Encoder cables – con.17 plug connectors

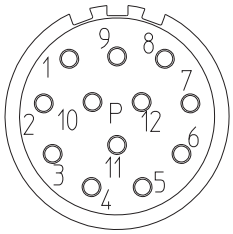
Motor (1)				Cable (2)	Drive controller (3)
Connection diagram	Pin	Designation	Core color	Core color	Pin X4
	1	S3 Cos +	BK	YE	3
	2	S1 Cos –	RD	GN	11
	3	S4 Sin +	BU	WH	1
	4	S2 Sin –	YE	BN	9
	5	1TP1	BK	RD	7
	6	1TP2	WH	BU	14
	7	R2 Ref +	YEWH/ BKWH	GY	6
	8	R1 Ref –	RDWH	PK	2
	9	—	—	—	—
	10	—	—	—	—
	11	—	—	—	—
	12	—	—	—	—
	Housing	Shield	—	—	Housing

Tab. 142: con.17 encoder cable pin assignment, resolver

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

Tab. 143: con.17 connector dimensions

Encoder cables – con.23 plug connectors

Motor (1)				Cable (2)	Drive controller (3)
Connection diagram	Pin	Designation	Core color	Core color	Pin X4
	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	1TP1	BK	RD	—
	6	1TP2	WH	BU	—
	7	R2 Ref +	YEWH/ BKWH	GY	6
	8	R1 Ref –	RDWH	PK	2
	9	—	—	—	—
	10	—	—	—	—
	11	—	—	—	—
	12	—	—	—	—
	Housing	Shield	—	—	Housing

Tab. 144: con.23 encoder cable pin assignment, resolver

Length x [mm]	Diameter y [mm]
58	26

Tab. 145: con.23 dimensions

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11.7.3 One Cable Solution EnDat 3 and HIPERFACE DSL

STOBER synchronous servo motors are equipped with plug connectors as standard.

A motor connection as a One Cable Solution (OCS) combined with an EnDat 3 or HIPERFACE DSL encoder requires hybrid cables which feature encoder communication and power transmission in a shared cable.

STOBER provides suitable cables in various lengths, conductor cross-sections and connector sizes.

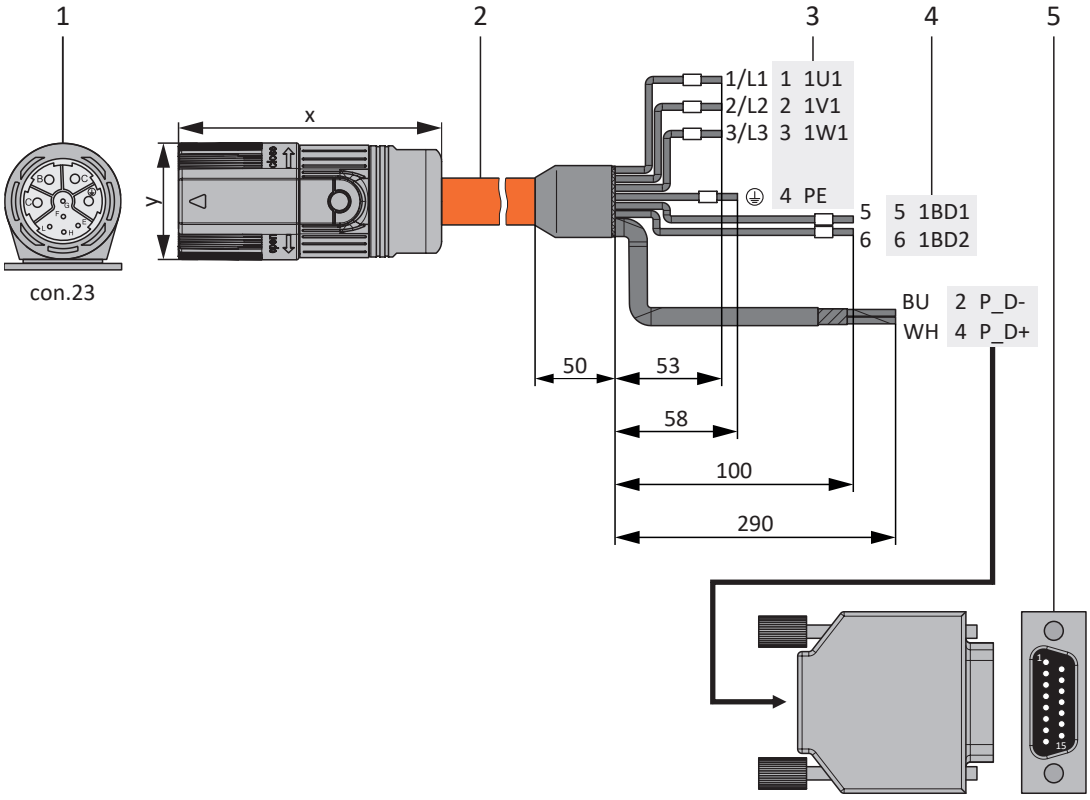
For applications with a cable length of up to 12.5 m, conductor cross-sections of 1.0 or 1.5 mm² and a non-moving installation, STOBER recommends the OCS-Basic hybrid cables. For longer lengths or installation in moving cable runs (such as a drag chain), please use the OCS-Advanced hybrid cables.

Information

For connecting as a One Cable Solution, use exclusively hybrid cables from STOBER. The use of unsuitable cables or poorly made connections can cause subsequent damage. For this reason, we reserve the right to reject claims under the warranty in this case.

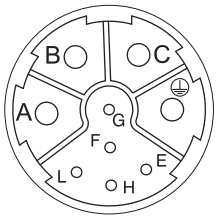
11.7.3.1 Connection description

The hybrid cables are available in plug connector size con.23 with a speedtec quick lock.



1 Plug connectors
2 STOBER hybrid cable
3 Connection to terminal X20, motor
4 Connection of terminal X2, brake
5 D-sub X4

Hybrid cables – con.23 plug connectors

Motor (1)				Cable (2)	Drive controller (3) – (5)		
Connection diagram	Pin	Designation	Core color	Core No./ Core color	Pin X20	Pin X2	Pin X4
	A	1U1	BK	1/L1	1	—	—
	B	1V1	BU	2/L2	2	—	—
	C	1W1	RD	3/L3	3	—	—
	E	P_D–	YE	BU	—	—	2
	F	P_D shield	—	—	—	—	Housing
	G	1BD1	RD	5	—	5	—
	H	P_D+	VT	WH	—	—	4
	L	1BD2	BK	6	—	6	—
	⏚	PE	GNYE	GNYE	4	—	
	Housing	Shield	—	—	Shield contact	—	—

Tab. 146: con.23 hybrid cable pin assignment

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

Tab. 147: con.23 connector dimensions

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12 What you should know before commissioning

The following chapters provide a quick introduction to the structure of the program interface and accompanying window designations as well as relevant information about parameters and generally saving your project configuration.

12.1 DS6 program interface

Using the graphical interface of the DriveControlSuite commissioning software (DS6), you can project, parameterize and commission your drive project quickly and efficiently. In case of service, you can evaluate diagnostic information such as operating states, fault memories and fault counters of your drive project using DriveControlSuite.

Information

The program interface of DriveControlSuite is available in German, English and French. To change the language of the program interface, select Settings > Language.

Information

The DriveControlSuite help in the menu bar can be reached via Help > Help or via the [F1] key on your keyboard. When you press [F1] in an area of the program, the corresponding help topic opens.

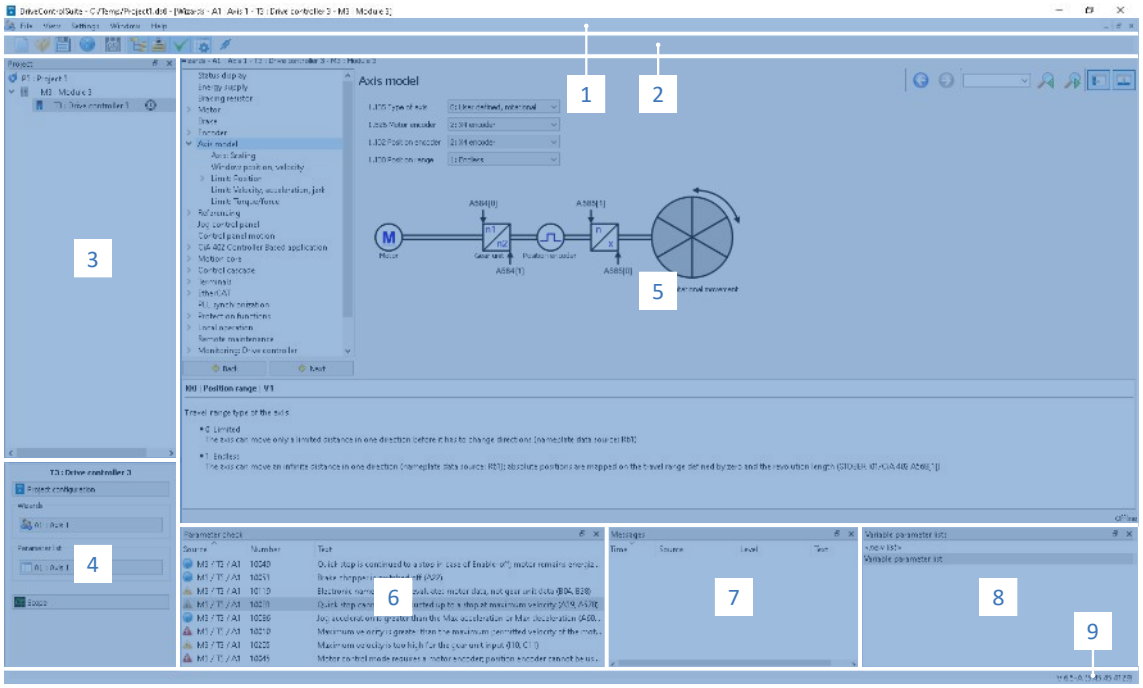

Fig. 34: DS6: Program interface

No.	Area	Description
1	Menu bar	Using the File, View, Settings and Window menus, you can open and save projects, display and hide program windows, select the interface language and access level and change between different windows in the workspace.
2	Toolbar	The toolbar enables quick access to frequently needed functions, like opening and saving projects and hiding and displaying windows in the program interface.
3	Project tree	The project tree forms the structure of your drive project in the form of modules and drive controllers. Select an element using the project tree first in order to edit it using the project menu.
4	Project menu	The project menu offers you various functions for editing the project, module and drive controller. The project menu adapts to the element that you selected in the project tree.
5	Workspace	The different windows which can be used to edit your drive project, such as the configuration dialog, wizards, the parameter list or the scope analysis tool, open in the workspace.
6	Parameter check	The parameter check points out irregularities and inconsistencies that were detected in the plausibility check of calculable parameters.
7	Messages	The entries in the messages log the connection and communication status of the drive controllers, incorrect inputs caught by the system, errors when opening a project or rule violations in the graphical programming.
8	Variable parameter lists	You can use variable parameter lists to compile any parameters in individual parameter lists for a quick overview.
9	Status bar	In the status bar, you can find the specifications of the software version and get additional information about the project file, the devices and the progress of the process during processes such as loading projects.

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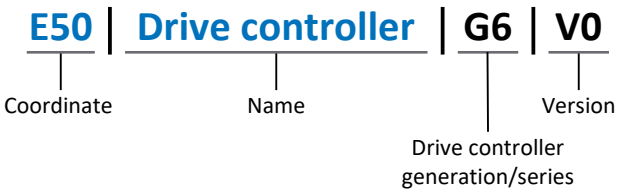
12.2 Meaning of parameters

You can use parameters to adapt the function of the drive controller to your individual application. In addition, parameters visualize the current actual values (actual velocity, actual torque, etc.) and trigger actions such as Save values, Test phase, etc.

Interpretation of parameter identification

Parameter identification consists of the following elements, where short forms are also possible, i.e. only specifying a coordinate or the combination of coordinate and name.



12.2.1 Parameter groups

Parameters are assigned to individual groups by topic. The 6th generation of STOBER drive controllers differentiates between the following parameter groups.

Group	Topic
A	Drive controllers, communication, cycle times
B	Motor
C	Machine, velocity, torque/force, comparators
D	Set value
E	Display
F	Terminals, analog and digital inputs and outputs, brake
G	Technology – Part 1 (application-dependent)
H	Encoder
I	Motion (all motion settings)
J	Motion blocks
K	Control panel
L	Technology – Part 2 (application-dependent)
M	Profiles (application-dependent)
N	Additional functions (application-dependent; e.g. extended cam control unit)
P	Customer-specific parameters (programming)
Q	Customer-specific parameters, instance-dependent (programming)
R	Production data for the drive controller, motor, brakes, motor adapter, gear unit and geared motor
S	Safety (safety technology)
T	Scope
U	Protection functions
Z	Fault counter

Tab. 148: Parameter groups

12.2.2 Parameter types and data types

In addition to topic-based sorting in individual groups, all parameters belong to a certain data type and parameter type. The data type of a parameter is displayed in the parameter list, properties table. The connections between parameter types, data types and their value range can be found in the following table.

Data type	Parameter type	Length	Value range (decimal)
INT8	Integer or selection	1 byte (signed)	-128 – 127
INT16	Integer	2 bytes (1 word, signed)	-32768 – 32767
INT32	Integer or position	4 bytes (1 double word, signed)	-2147483648 – 2147483647
BOOL	Binary number	1 bit (internal: LSB in 1 byte)	0, 1
BYTE	Binary number	1 byte (unsigned)	0 – 255
WORD	Binary number	2 bytes (1 word, unsigned)	0 – 65535
DWORD	Binary number or parameter address	4 bytes (1 double word, unsigned)	0 – 4294967295
REAL32 (single type according to IEE754)	Floating-point number	4 bytes (1 double word, signed)	-3.40282×10^{38} – 3.40282×10^{38}
STR8	Text	8 characters	—
STR16	Text	16 characters	—
STR80	Text	80 characters	—

Tab. 149: Parameters: data types, parameter types, possible values

Parameter types: Use

- Integer, floating-point number
  For general computing processes
  Example: Set and actual values
- Selection
  Numeric value to which a direct meaning is assigned
  Example: Sources for signals or set values
- Binary number
  Bit-oriented parameter information that is collected in binary
  Example: Control and status words
- Position
  Integer combined with associated units and decimal places
  Example: Actual and set values of positions
- Velocity, acceleration, deceleration, jerk
  Floating-point number combined with associated units
  Example: Actual and set values for velocity, acceleration, deceleration, jerk
- Parameter address
  Referencing of a parameter
  Example: In F40 AO1 source, for example, E08 n-motor filtered can be parameterized
- Text
  Outputs or messages

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12.2.3 Parameter types

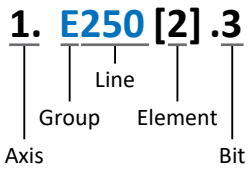
The following types of parameters are differentiated.

Parameter type	Description	Example
Simple parameters	Consist of one group and one line with a defined value.	A21 Brake resistor R: Value = 100 ohms
Array parameters	Consist of a group, a line and multiple sequential (listed) elements, which have the same properties but different values.	A10 Access level ▪ A10[0] access level: Value = Access level via operating unit ▪ A10[2] access level: Value = Access level via CANopen and EtherCAT ▪ A10[4] access level: Value = Access level via PROFINET
Record parameters	Consist of a group, a line and multiple sequential (listed) elements, which can have different properties and different values.	A00 Save values ▪ A00[0] Start: Value = Start action ▪ A00[1] Progress: Value = Display action progress ▪ A00[2] Result: Value = Display action result

Tab. 150: Parameter types

12.2.4 Parameter structure

Every parameter has specific coordinates with the following structure.



- Axis (optional)
  In case of multiple axes, the one to which a parameter is assigned; not applicable for global parameters (value range: 1 – 4).
- Group
  The thematic group to which a parameter belongs (value range: A – Z).
- Line
  Distinguishes the parameters within a parameter group (value range: 0 – 999).
- Element (optional)
  Elements of an array or record parameter (value range: 0 – 16000).
- Bit (optional)
  Selection of a single bit for complete data addressing; depends on the data type (value range: 0 – 31).

12.2.5 Parameter visibility

The visibility of a parameter is primarily controlled by the access level you set in DriveControlSuite and by the properties you project for the respective drive controller (e.g. hardware, firmware and application). A parameter can also be shown or hidden depending on other parameters or settings. For example, the parameters of an additional function are only shown as soon as you activate the relevant additional function.

Access level

The access options for the individual software parameters are ranked hierarchically and divided into individual levels. This means that parameters can be hidden for a specific purpose and, relatedly, their configuration options can be locked starting from a specific level.

Each parameter has 2 access levels: the access level for read access (visibility) and the access level for write access (editability). The following levels are present:

- Level 0
  Elementary parameters
- Level 1
  Important parameters of an application
- Level 2
  Important parameters for service with extensive diagnostic options
- Level 3
  All parameters needed for commissioning and optimizing an application

The parameter A10 Access level controls general access to parameters:

- Over CANopen or EtherCAT (A10[2])
- Over PROFINET (A10[3])

Information

It is not possible to write to or read the parameter hidden in DriveControlSuite during communication via fieldbus.

Hardware

Which parameters are available to you in DriveControlSuite is determined by which series you select in the configuration dialog for the drive controller, for example, or whether you project an option module. Basically, the only parameters that are displayed are the ones you need to parameterize the configured hardware.

Firmware

Due to the further development and updating of functions for the 6th generation of STOBER drive controllers, new parameters and also new versions of existing parameters are continuously being implemented in DriveControlSuite and in the firmware. The parameters are displayed in the software according to the DriveControlSuite version used and the configured firmware version of the respective drive controller.

Applications

Applications generally differ in terms of functions and their control. For this reason, different parameters are available with each application.

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12.3 Signal sources and process data mapping

The transmission of control signals and set values in DriveControlSuite meets the following principles.

Signal sources

Drive controllers are controlled either over a fieldbus, using mixed operation consisting of a fieldbus system and terminals or exclusively using terminals.
You can use the corresponding selection parameters, referred to as signal sources, to configure whether the control signals and set values of the application are obtained over a fieldbus or using terminals.

In case of activation over a fieldbus, parameters that are selected as data sources for control signals or set values must be part of the subsequent process data mapping. In the case of activation using terminals, the respective analog or digital inputs are specified directly.

Process data mapping

If you are working with a fieldbus system and have selected the source parameters for control signals and set values, configure the fieldbus-specific settings, e.g. the assignment of the process data channels for transmitting receive and transmit process data, as the last step. The respective procedure can be found in the accompanying STOBER fieldbus manuals.

12.4 Non-volatile memory

All project configurations, parameterizations and related changes to parameter values are in effect after transmission to the drive controller, but are only stored in volatile memory.

Saving to a drive controller

To save the configuration in non-volatile memory on a drive controller, you have the following options:

- Saving the configuration using the Save values wizard:
  Project menu > Wizards area > Projected axis > Save values wizard: Select the Save values action
- Saving the configuration using the parameter list:
  Project menu > Parameter list area > Projected axis > Group A: Drive controller > A00 Save values: Set the parameter A00[0] to the value 1: Active

Saving to all drive controllers within a project

To save the configuration in non-volatile memory on several drive controllers, you have the following options:

- Saving the configuration using the toolbar:
  Toolbar > Save values icon: Click the Save values icon
- Saving the configuration using the Online functions window:
  Project menu > Online connection button > Online functions window: Click on Save values (A00)

Information

Do not shut off the drive controller while saving. If the supply voltage to the control unit is interrupted while saving, the drive controller will start without an executable configuration the next time it is switched on. In this case, the configuration must be transferred to the drive controller again and stored in non-volatile memory.

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13 Commissioning

The following chapters describe how to commission your drive system using the DriveControlSuite software.

Information on system requirements and software installation can be found in the appendix (see DriveControlSuite [▶ 319]).

For the components of your axis model, we require one of the following two combinations as an **example**:

STOBER synchronous servo motor with EnDat 2.2 digital or EnDat 3 encoder (and optional brake)

These motors together with all relevant data for the project configuration are saved in the motor database of DriveControlSuite as well as in the electronic nameplate.
Upon selecting the motor from the database, such as when reading out the nameplate, all data is transferred to the corresponding parameters. There is no need for complex parameterization of the motor, encoder and brake.

STOBER LM Lean motor without encoder (with optional brake)

These motors are stored in the motor database of the DriveControlSuite, along with all the data relevant for project configuration. Furthermore, the motor data and the release and engaging times of the brake are part of the firmware. Upon selecting the desired motor from the database, all data is transmitted to the corresponding parameters. The release and engaging times of the brake are also stored. If a brake is present, you must only activate this manually. However, complex parameterization of the motor and brake is not necessary.

For STOBER asynchronous motors, the motor data relevant for project configuration is also taken from the motor database. All other motor types need to have their parameters configured manually.

Make sure that the system nodes are wired and supplied with control voltage before commissioning.

Information

The commissioning process described below is particularly suitable for quick initial commissioning of your drive system with subsequent testing of your projected axis model. Since steps or their sequence may vary depending on the application, refer to the corresponding application manual for detailed information.

Information

Always perform the steps described below in the specified order!

Some parameters are interdependent and do not become accessible to you until you have first configured certain settings. Follow the steps in the specified sequence so that you can finish the parameterization completely.

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13.1 Initiating the project

In order to be able to configure all drive controllers and axes of your drive system using DriveControlSuite, you must record them as part of a project.

13.1.1 Projecting the drive controller and axis

Create a new project and project the first drive controller along with the accompanying axis.

Creating a new project

1. Start DriveControlSuite.
2. On the start screen, click Create new project.
   ⇨ The new project is created and the configuration dialog for the first drive controller opens.
   ⇨ The Drive controller button is active.

Projecting the drive controller

1. Properties tab:
   Establish the relationship between your circuit diagram and the drive controller to be projected in DriveControlSuite.
   Reference: Specify the reference code (equipment code) of the drive controller.
   Designation: Give the drive controller a unique name.
   Version: Version your project configuration.
   Description: If necessary, specify additional supporting information, such as the change history of the project configuration.
2. Drive controller tab:
   Select the series, device type and firmware version of the drive controller.
3. Option modules tab:
   Safety module: If the drive controller is part of a safety circuit, select the SR6, SU6 or SY6 safety module.
4. Device controller tab:
   Device controller: Select the device controller that defines the underlying activation signals for the drive controller.
   Rx process data, Tx process data: If you control the drive controller using a fieldbus, select the fieldbus-specific receive and send process data.
   If you operate the drive controller in combination with the SY6 safety module, select EtherCAT Rx and EtherCAT Tx for transmitting the EtherCAT process data.
   If you operate the drive controller in combination with the SU6 safety module, select PROFINET Rx and PROFINET Tx for transmitting the PROFINET process data.
   If you operate the drive controller in combination with the SR6 safety module or without safety technology (SZ6), the fieldbus connection is optional. If you do not use a fieldbus, project No transmission.

Information

Make sure that you project the correct series in the Drive controller tab. The projected series cannot be changed afterwards.

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Projecting the axis

1. Click on Axis 1.
2. Properties tab:
   Establish the connection between your circuit diagram and the axis to be projected in DriveControlSuite.
   Reference: Specify the reference code (equipment code) of the axis.
   Designation: Give the axis a unique name.
   Version: Version your project configuration.
   Description: If necessary, specify supporting additional information such as the change history of the project configuration.
3. Application tab:
   Select the desired control or drive-based application.
4. Motor tab:
   Select the motor category, the series and the type of motor operated using this axis. If you are working with motors from third-party suppliers, enter the accompanying motor data at a later time.
5. Repeat steps 2 – 4 for the 2nd axis (only for double-axis controllers).
6. Confirm with OK.

13.1.2 Configuring safety technology

If the drive controller is part of a safety circuit, you must configure the safety technology in accordance with the commissioning steps outlined in the corresponding manual in the next step (siehe Detailed information [▶ 347]).

13.1.3 Creating other modules and drive controllers

We recommend sorting all drive controllers of your project in DriveControlSuite either functionally by groups and combining a group under a module, or organizing several drive controllers in corresponding modules based on their distribution to different control cabinets.

1. Select your P1 project in the project tree > Context menu Create new module.
   ⇨ Your M2 module is created in the project tree.
2. Select your M2 module in the project tree > Context menu Create new drive controller.
   ⇨ Your T2 drive controller is created in the project tree.
3. Mark your T2 drive controller in the project tree.
4. Change to the project menu and click Project configuration.
5. Project the drive controller and specify the newly created module.
6. Repeat the steps for all other drive controllers and modules of your project.

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13.1.4 Projecting the module

Give your module a unique name, enter the reference code and, as an option, store additional information like the version and change history of the module.

1. Select the module in the project tree and click on Project configuration in the project menu.
   ⇨ The configuration dialog for the module opens.
2. Establish the relationship between your circuit diagram and the module in DriveControlSuite.
   Reference: Specify the reference code (equipment code) of the module.
   Designation: Give the module a unique name.
   Version: Version the module.
   Description: If necessary, specify additional supporting information, such as the change history of the module.
3. Confirm with OK.

13.1.5 Projecting the project

Give your project a unique name, enter the reference code and, as an option, store additional information like the version and change history of the project.

1. Mark the project in the project tree and click on Project configuration in the project menu.
   ⇨ The configuration dialog for the project opens.
2. Establish the relationship between your circuit diagram and the project in DriveControlSuite.
   Reference: Specify the reference code (equipment code) of the project.
   Designation: Give the project a unique name.
   Version: Version the project.
   Description: If necessary, specify additional supporting information, such as the change history of the project.
3. Confirm with OK.

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13.2 Mapping the mechanical axis model

To be able to put your real drive train with one or more drive controllers into operation, you must map your complete mechanical environment in DriveControlSuite.

13.2.1 Parameterizing the STOBER motor

You have projected one of the following motors:

STOBER synchronous servo motor with EnDat 2.2 digital encoder or EnDat 3 (with optional brake)

By projecting the corresponding motor, limiting values for currents and torques as well as associated temperature data are automatically transferred to the respective parameters of the individual wizards. All additional data on the brake and encoder is transferred at the same time.

STOBER Lean motor without encoder (with optional brake)

By projecting the corresponding motor, limiting values for currents and torques as well as associated temperature data are automatically transferred to the respective parameters of the individual wizards. You only have to parameterize the cable length in use. Even the brake purging and engaging times are already stored. You just have to activate the brake.

1. Select the relevant drive controller in the project tree and click on the first projected axis in the Project menu > Wizard area.
2. Select the Motor wizard.
3. B101 Cable length:
   Select the cable length of the power cable in use.
4. Repeat the steps for the 2nd axis (only for double-axis controllers).

Then activate the brake.

1. Select the relevant drive controller in the project tree and click on the first projected axis in the Project menu > Wizard area.
2. Select the Brake wizard.
3. F00 Brake:
   Select 1: Active.
4. Repeat the steps for the 2nd axis (only for double-axis controllers).

Motor protection

All models of the 6th STOBER drive controller generation feature an i^2t model – a computational model for thermal monitoring of the motor. To activate it and set up the protective function, configure the following settings (deviating from the presets): U10 = 2: Warning and U11 = 1.00 s. This model can be used instead of or in addition to temperature-monitored motor protection.

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13.2.2 Parameterizing the axis model

Parameterize the setup of your drive in this order:

- Define the axis model
- Scale the axis
- Parameterize the position and velocity window
- Limit the axis (optional)
  - Limit the position
  - Limit the velocity, acceleration and jerk
  - Limit the torque and force

Information

If you are using a double-axis controller with two projected axes, you must parameterize the axis model for each axis individually.

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13.2.2.1 Define the axis model

1. Select the relevant drive controller in the project tree and click on the first projected axis in the project menu > Wizard area.
2. Select the Axis model wizard.
3. I05 Type of axis:
   Define whether the axis type is rotational or translational.
   3.1. If you would like to configure the units of measure and the number of decimal places individually for specifying and displaying position set values, velocities, accelerations and jerk, select 0: User defined, rotational or 1: User defined, translational.
   3.2. If the units of measure and the number of decimal places for specifying and displaying position set values, velocities, accelerations and jerk are to be fixed, select 2: Rotational or 3: Translational.
4. B26 Motor encoder:
   Define the interface to which the motor encoder is connected.
5. I02 Position encoder (optional):
   Define the interface to which the position encoder is connected.
6. I00 Position range:
   Define whether the travel range of the axis is limited or endless (modulo).
7. If you have selected 1: Endless for I00, parameterize a revolution length (see Scale the axis [▶ 153]).

Information

When you parameterize I05 Type of axis, you can either use the selection 0: User defined, rotational or 1: User defined, translational to configure units of measure and the number of decimal places for the axis model individually or use the selections 2: Rotational and 3: Translational to revert to preset values.

Selection 0: User defined, rotational and selection 1: User defined, translational let you configure the unit of measure (I09) and the decimal places (I06) individually. Velocity, acceleration and jerk are represented as the derivative of the unit of measure with respect to time.

Selection 2: Rotational sets the following units of measure for the axis model: position in °, velocity in rpm, acceleration in rad/s^2, jerk in rad/s^3.

Selection 3: Translational sets the following units of measure for the axis model: position in mm, velocity in m/s, acceleration in m/s^2, jerk in m/s^3.

Information

If you do not parameterize it differently for I02 Position encoder, B26 Motor encoder is used for position control as standard.

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13.2.2.2 Scale the axis

1. Select the relevant drive controller in the project tree and click on the first projected axis in the Project menu > Wizard area.
2. Select the Axis model wizard > Axis: Scaling.
3. Scale the axis by configuring the overall gear ratio between the motor and output.
   To simplify this scaling for you, you are provided with the scaling calculator Conversion of positions, velocities, accelerations, torque/force, which calculates the effects of changed motion variables on the entire system.
4. I01 Circular length:
   If you have selected 1: Endless for I00 Position range, enter the revolution length.
5. I06 Decimal places position (optional):
   If you have selected 0: User defined, rotational or 1: User defined, translational for I05 Type of axis, define the desired number of decimal places.
6. I09 Measure unit (optional):
   If you have selected 0: User defined, rotational or 1: User defined, translational for I05 Type of axis, define the desired unit of measure.

Information

A change to parameter I06 moves the decimal separator for all axis-specific values!
Ideally, change I06 before parameterizing other axis-specific values and then check them afterwards.

Information

Parameter I297 Maximum speed position encoder must be parameterized according to your application case. If I297 is set too low, the permitted maximum speed is exceeded even at normal operating speeds. On the other hand, if I297 is set too high, measuring errors of the encoder can be overlooked.

I297 depends on the following parameters: I05 Type of axis, I06 Decimal places position, I09 Measure unit as well as I07 Distance factor numerator position and I08 Distance factor denominator position for applications of type Drive Based or PROFIdrive or A585 Feed constant for applications of type CiA 402. If you have made changes to one of the parameters listed, select I297 accordingly as well.

13.2.2.3 Parameterize the position and velocity window

Enter position limits and velocity zones for set values. To do so, parameterize boundary values for reaching a position or velocity.

1. Select the Axis model wizard > Window position, velocity.
2. C40 Velocity window:
   Parameterize a tolerance range for velocity tests.
3. I22 Target window:
   Parameterize a tolerance range for position tests.
4. I87 Actual position in window time:
   Parameterize how long a drive must stay in the specified position range before a corresponding status message is output.
5. Parameterize a tolerance range for lag tests.

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13.2.2.4 Limiting the axis

If necessary, limit the movement variables for position, velocity, acceleration, jerk as well as torque/force according to the applicable conditions for your axis model.

Limiting the position (optional)

1. Select the relevant drive controller in the project tree and click on the first projected axis in the Project menu > Wizard area.
2. Select the Axis model wizard > Limit: Position.
3. If necessary, limit the position of your axis using a software or hardware limit switch to secure the travel range.

Limiting velocity, acceleration, jerk (optional)

The default values are designed for slow velocities without gear units. For this reason, adapt the saved values.

For example, verify the maximum velocity of the motor (B83) against the velocity of the output (I10).

1. Select the Motor wizard.
2. Determine the maximum possible motor velocity in parameter B83 v-max motor.
3. Select the Axis model wizard > Axis: Scaling > Conversion of positions, velocities, accelerations, torque/force area.
4. Velocity line:
   Enter the maximum motor velocity from B83 in the Velocity line of the Motor column and confirm with ENTER.
   ⇨ The maximum velocity of the motor has been transferred to the output.
5. Repeat the procedure for other limits, such as for the gear unit input speed (C11).
6. Select the Axis model wizard > Limit: Velocity, acceleration, jerk.
7. I10 Maximal speed:
   Limit the maximum velocity of the output, taking into account the determined system limits and the maximum motor velocity B83.
8. Determine the limiting values for acceleration and jerk if necessary and enter them into the associated parameters.

Limiting torque/force (optional)

The default values take into account the rated operation together with the overload reserves.

1. Select the Axis model wizard > Limit: Torque/force.
2. If the motor force must be limited, adapt the saved values as necessary.

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13.3 Transmitting and saving the configuration

In order to transmit and save the configuration to one or more drive controllers, you must connect your PC and the drive controllers over the network.

⚠ WARNING!

Injury to persons and material damage due to axis movement!

If there is an online connection between DriveControlSuite and the drive controller, changes to the configuration can lead to unexpected axis movements.

- Only change the configuration if you have visual contact with the axis.
- Make sure that no people or objects are within the travel range.
- For access via remote maintenance, there must be a communication link between you and a person on site with eye contact to the axis.

Information

During the search, all drive controllers within the broadcast domain are found via IPv4 limited broadcast.

Requirements for finding a drive controller in the network:

- Network supports IPv4 limited broadcast
- All drive controllers and the PC are in the same subnet (broadcast domain)

Transmitting the configuration

✓ The drive controllers are switched on.

1. In the project tree, select the module under which you have recorded your drive controller and click Online connection in the project menu.
   ⇨ The Add connection dialog box opens. All drive controllers found via IPv4 limited broadcast are displayed.
2. Direct connection tab > IP address column:
   Activate the IP addresses in question and confirm your selection with OK.
   ⇨ The Online functions window opens. All drive controllers connected through the selected IP addresses are displayed.
3. Select the drive controller to which you would like to transfer the configuration. Change the selection of transmission type from Read to Send.
4. Change the selection Create new drive controller:
   Select the configuration that you would like to transfer to the drive controller.
5. Repeat steps 3 and 4 for all other drive controllers to which you would like to transfer your configuration.
6. Online tab:
   Click Establish online connections.

⇨ The configuration is transferred to the drive controllers.

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Saving a configuration

✓ You have successfully transmitted the configuration.

1. Online functions window:
   Click Save values (A00).
   ⇨ The Save values (A00) window opens.
2. Click Start action.
   ⇨ The configuration is stored on the drive controllers in non-volatile memory.
3. Close the Save values (A00) window.

Information

For the configuration to take effect on the drive controller, a restart is required when the configuration is saved on the drive controller for the first time or when changes are made to the firmware or process data mapping.

Restarting a drive controller

✓ You have stored the configuration on the drive controller in non-volatile memory.

1. Online functions window:
   Click Restart (A09).
   ⇨ The Restart (A09) window opens.
2. Select which of the connected drive controllers you want to restart.
3. Click Start action.
4. Confirm the safety instruction with OK.
   ⇨ The Restart (A09) window closes.

⇨ The fieldbus communication and connection between DriveControlSuite and drive controllers are interrupted.

⇨ The selected drive controllers restart.

13.4 Testing the configuration

Before you continue with the parameterization, we recommend testing your projected axis model using the jog control panel.

Check your projected axis model as well as your configured electrical and mechanical data for plausibility by transferring your configuration to one of your drive controllers for test purposes and controlling the drive using the jog control panel instead of using a controller.

Information

Check the suitability of the default values for your application before starting the test. If they appear too large or unsuitable compared with the results of the scaling calculator, replace them with values that are more suitable for test operation.

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13.4.1 Activating the control panel and testing the configuration

⚠ WARNING!

Injury to persons and material damage due to axis movement!

When you activate the control panel, DriveControlSuite gives you sole control of the motions of the axis. If you are using a controller, it no longer monitors the axis movements after the control panel is activated. The controller cannot intervene to prevent collisions. The controller takes over control again when the control panel is deactivated, which can cause unexpected axis movements.

- Do not switch to other windows when the control panel is active.
- Only use the control panel if you have visual contact with the axis.
- Make sure that no people or objects are within the travel range.
- For access via remote maintenance, there must be a communication link between you and a person on site with eye contact to the axis.

✓ You have successfully saved the configuration.

✓ There must not be any active safety function.

✓ The drive controller is switched on and connected to the network.

✓ There is an online connection between DriveControlSuite and the drive controller.

1. Select the relevant drive controller in the project tree and click on the first projected axis in the Project menu > Wizard area.
2. Select the Jog control panel wizard.
3. Click Control panel on and then Enable.
   ⇨ The drive is controlled using the activated control panel.
4. Move the axis step-by-step and test the direction of motion, velocity, distances, etc. using the Jog+, Jog–, Jog step+ and Jog step– buttons.
5. Optimize your project configuration based on your test results as necessary.
6. To deactivate the control panel, click on Control panel off.

Information

Jog+ and Jog– cause a continual manual movement in the positive or negative direction. Jog step+ and Jog step- move the axis relative to the current actual position by the increment specified in I14.

Jog+ and Jog– have a higher priority than Jog step+ and Jog step–.

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14 Communication

The following options are available for communicating with the SC6 drive controller:

- Communication between drive controller and controller
  - Fieldbus
  - Terminals
- Communication between drive controller and PC for commissioning, optimization and diagnostics
  - Direct connection
  - Fieldbus

The DriveControlSuite project configuration and commissioning software installed on the PC is able to handle multiple direct connections simultaneously.

14.1 Direct connection

A direct connection is a network connection in which all nodes are in the same network.

In its simplest form, a direct connection is a point-to-point cable connection between the network interface of the PC where DriveControlSuite is installed and the network interface of the drive controller. Switches or routers can also be used in place of a simple network cable.

The IP address required for direct connection is either assigned automatically by DriveControlSuite or using DHCP, or it is specified manually.

Requirements

Type of direct connection	Requirements
Automatic	The A166 parameter in DriveControlSuite must be set to 2: DHCP + DS6 for the direct connection to be established automatically. In addition, the network adapter used on the PC side should be set to "Obtain IP address automatically".
Manual	If the IP address of the drive controller was specified manually, the socket of the gateway device and the network connection of the PC must have IP addresses from the same subnet.

Tab. 151: Requirements for a direct connection

In addition, obey the requirements (see Communication requirements [▶ 321]).

Virtual machines

If you want to connect STOBER drive controllers to DriveControlSuite from a virtual machine, pay attention to the configuration information (see Configuring virtual machines [▶ 322]).

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14.1.1 Starting a drive controller in emergency operation

If you cannot establish a network connection to the drive controller via DriveControlSuite, DriveControlSuite cannot assign a network address to the drive controller or the drive controller is not displayed in DriveControlSuite, you can use an empty SD card to start the drive controller in emergency operation.

If an SD card is inserted when the drive controller is started, it is started from this card. Any existing configuration in the internal memory of the drive controller is ignored. If there is no configuration on the SD card or if it is invalid, the drive controller starts in emergency operation. For drive controllers with firmware V 6.5-A or higher, the fixed IP address 192.168.3.2 and fixed subnet mask 255.255.255.0 are used for service interface X9 in emergency operation.

Reading out the internal configuration

If you want to read out the internal configuration, save a file with the information on the desired IP address, subnet mask and address assignment to the SD card. The drive controller adopts these settings after reading the internal configuration for interface X9. You can then establish a manual direct connection to the drive controller.

1. Create a text file with the file name ParaWr.cmd and the following content:
   ```
   A164 = "192.168.3.2"
   A165 = "255.255.255.0"
   A166 = "0"
   ```
   Make sure that each line, including the last, ends with a line break (CR LF).
2. Create the \command directory on the SD card.
3. Save the text file to the newly created directory on the SD card.
4. Adjust the IP address and subnet mask of your PC.
5. Establish a manual direct connection to the drive controller in DriveControlSuite.

14.2 Fieldbus

For detailed information about the fieldbus connection, refer to the corresponding manual (see Detailed information [▶ 347]).

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15 Optimizing the control cascade

The following chapters describe the structure of the control cascade first as a basis, as well as the general procedure for optimizing it. Then, you learn how you can check your control cascade based on a few parameters for nearly 80% of all applications and, if necessary, optimize the pre-set values for your specific application case. Special cases are addressed at the end of the chapter.

15.1 Structure of the control cascade

The control cascade triggers the appropriate electrical actuation of the motor for a requested movement. The structure of the control cascade depends on the control mode set in B20.

The following graphic shows the control cascade using a motor with encoder in vector-controlled operation as an example. The representation of the control cascade follows the signal course: Position controller > Velocity controller > Current controller.

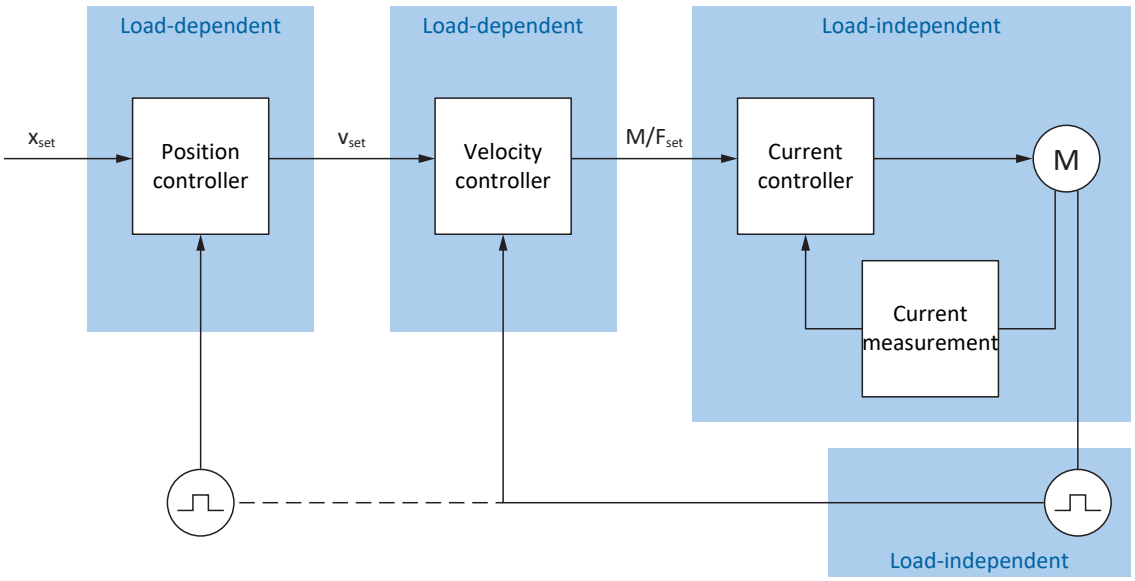

Fig. 35: Structure of the control cascade

Position controller

The position controller is a P controller (proportional controller) with feedforward control. The settings for the position controller are load-dependent.

The following applications use position control:

- Drive Based applications for the following commands:
  - MC_MoveAbsolute
  - MC_MoveRelative
  - MC_MoveAdditive
  - MC_MoveVelocity
- CiA 402 application in the following operating modes:
  - Cyclic synchronous position mode
  - Profile position mode
- PROFIdrive application in the following application classes:
  - Application class 3 (AC3)
- Application-independent with position control in jog mode

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Velocity controller

The velocity controller is a PI controller (proportional-integral controller). The settings for the velocity controller are load-dependent. Velocity control is always required for vector control.

Current controller

The current controller is a PID controller (proportional-integral-differential controller). The settings for the current controller are load-independent. The current controller is always required for vector control.

15.2 General procedure

Before making changes to your control cascade, observe the following information on the general procedure for optimization.

Defining the optimization goal

First, define the goal that you want to reach through optimization:

- High dynamics
- High energy efficiency
- Positioning accuracy
- Smooth operation
- Minimal control deviation
- High velocity

Some goals can only be combined under certain conditions or are mutually exclusive.

Hardware components as possible limits of optimization

An optimal drive train always consists of a coordinated system of all hardware components (gear unit, motor, encoder, drive controller and cable). Consequently, optimization depends not only on your parameter settings, but also on the hardware components used.

Drive controller presets

If you use components from STOBER, all data is transmitted to the corresponding parameters when reading out the electronic nameplate or upon selection of the motor from the motor database – eliminating the need for complex parameterization of the motor, encoder and brake. These default values are carefully selected and checked, and generally deliver good results. Only change the default values when necessary, taking the following points into consideration:

1. First, record the current behavior of your drive train with a scope image.
2. Carry out the optimization of your control cascade in the opposite order of the signal course: Current controller > velocity controller > position controller, i.e. from the motor back to the set value specification. However, do not make adjustments to the current controller if you are using components from STOBER.
3. If adjustments are necessary, only ever change one setting and then check every change with a scope image.

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15.3 Example project

The optimization described in the following chapters is based on the following general conditions and settings.

Specified goal

High dynamics with the highest possible velocity, but without the system overshooting.

System components

- 6th generation STOBER drive controller
- STOBER synchronous servo motor with absolute encoder and electronic nameplate
- DriveControlSuite commissioning software
- Load supplied to the motor

Application and device control

- Drive Based application
- Drive Based device control

15.3.1 Scope settings

For the scope image at the beginning and after each adjustment, we recommend the settings described below to be able to compare the different results with each other.

General settings

- Sampling time: 250 µs
- Pre-trigger: 5%

Channels

Using the Parameter selection and the associated picklists, define the relevant parameters for the scope image.

Trigger condition

- Simple trigger
- Source: Parameter E15 v-motor-encoder
- Absolute value: Yes
- Condition: Greater
- Edge: Yes
- Comparison value: 5.0 rpm

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15.3.2 Jog settings

During optimization, test each change using the Jog control panel with the following settings:

- I26 Jog control mode:
  - Optimization of the velocity controller: Select 0: Velocity control to receive pure velocity control without a higher-level position controller with the Jog+ and Jog− bit.
  - Optimization of the position controller: Select 1: Position control with the Jog step+ und Jog step− bit.
- I14 Jog step:
  Define the increment.
- I12 Jog velocity:
  Define the jog velocity.
- I13 Jog acceleration:
  For the jog acceleration, select a value that is higher than the velocity by a factor of 10.
- I45 Jog deceleration:
  For the jog deceleration, select a value that is higher than the velocity by a factor of 10.
- I18 Jog jerk:
  For the jog jerk, select a value that is higher than the acceleration by a factor of 10.

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15.4 Schematic sequence

The following graphic shows the schematic sequence for optimizing the control cascade. The specific steps that are required depend on the control mode. The chapters on optimization assume the following control modes:

- B20 = 64: SSM - vector control for synchronous servo motors
- B20 = 2: ASM - vector control for asynchronous motors
- B20 = 32: LM - sensorless vector control for Lean motors

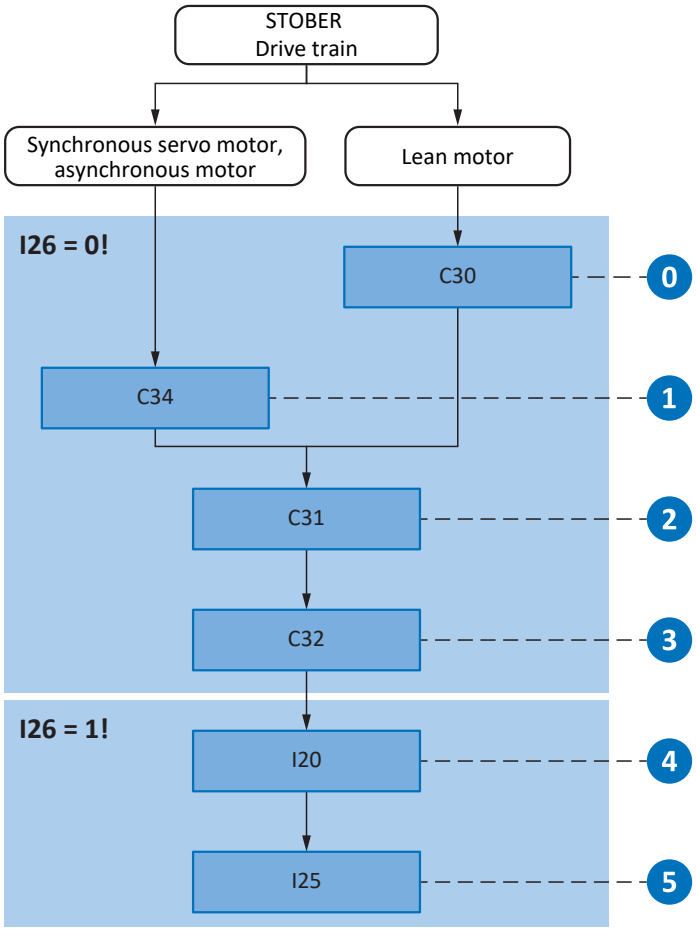

Fig. 36: Schematic sequence of optimization based on relevant parameters

0	Default Lean motors settings – Estimating the speed
1	Velocity controller – Defining filters for the actual velocity
2	Velocity controller – Defining the proportional coefficient
3	Velocity controller – Defining the integral coefficient
4	Position controller – Defining the proportional coefficient
5	Position controller – Defining the feedforward control of the velocity controller

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15.5 Current controller – Notes

The current controller settings depend exclusively on the motor type, not on the load or application.

Do not make any changes to the current controller if you are using components from STOBER!

The data of a STOBER motor is part of the DriveControlSuite motor database as well as the electronic nameplate. This data is transferred to the respective parameters during project configuration or when reading out the nameplate. All additional data on the brake and encoder is transferred at the same time. These settings were calibrated in the STOBER test bay and no longer need to be adjusted.

15.6 0: Default Lean motor settings – Speed estimation

When using a STOBER Lean motor, two methods are available in DriveControlSuite for determining the speed. An observer-based process is set by default in parameter B104 which is suitable for most applications. However, the specification of the mass inertia ratio of load to motor in parameter C30 is crucial for this process.

Effects

By specifying the mass inertia ratio, the speed determination of the model adjusts to the real conditions of the machine.

Procedure

1. Work with the default value of B104 = 0: Robust.
2. In C30, enter the mass inertia ratio of load to motor based on the estimated mass inertia at the motor shaft.

Information

Only change the setting of B104 if either the mass inertia cannot be determined or the load occurring is changing rapidly.

Information

For C30, note that a deviation up to factor 2 only has a slight influence on the dynamics. If more is still needed, you can optimize the value through a comparison with the actual velocity I88 during acceleration and braking.

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15.7 1: Velocity controller – Actual velocity filters

The following graphic shows the influence of the lowpass filter time constant on the velocity controller.

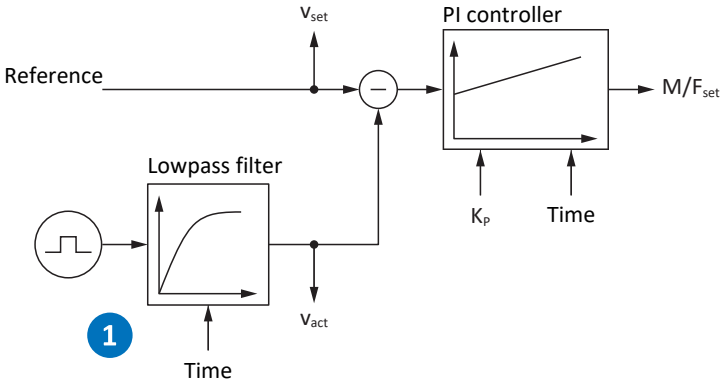

Fig. 37: Velocity controller – Filters for the actual velocity

The lowpass filter time constant for the actual velocity of the motor encoder is defined in C34.

Effects

C34 affects the smooth operation of the motor and the dynamics that can be achieved with the drive; as C34 increases, smooth operation rises and the dynamics drop.

Furthermore, C34 also has a direct influence on the maximum possible coefficient, since a large filter time also requires a large downtime.

Procedure

Select a value for C34 that is large enough to minimize the measurement and quantization noise, but is as small as possible to avoid unnecessary downtime, since this makes the system unstable and reduces dynamics.

Guide values for C34 when using a STOBER motor can be found in the following table.

Encoder model	Encoder interface	Guide value C34 [ms]
EBI 135	EnDat 2.2 digital	0.4 – 0.6
EBI 1135	EnDat 2.2 digital	0.4 – 0.6
ECI 119	EnDat 2.2 digital	0.4 – 0.6
ECI 1118-G1	EnDat 2.1 digital	1.4 – 1.8
ECI 1118-G2	EnDat 2.2 digital	0.4 – 0.6
ECI 1119	EnDat 2.2 digital	0.4 – 0.6
ECI 1319	EnDat 2.1 digital	1.2 – 1.8
ECN 1113	EnDat 2.1 digital	0.8 – 1.2
ECN 1123	EnDat 2.2 digital	0.2 – 0.4
ECN 1313	EnDat 2.1 digital	0.8 – 1.2
ECN 1313	EnDat 2.1 sin/cos	0.2 – 0.8
ECN 1325	EnDat 2.2 digital	0.0 – 0.2
EDM 35	HIPERFACE DSL	0.4 – 0.6
EDS 35	HIPERFACE DSL	0.4 – 0.6
EKM 36	HIPERFACE DSL	0.4 – 0.6

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Encoder model	Encoder interface	Guide value C34 [ms]
EKS 36	HIPERFACE DSL	0.4 – 0.6
EQI 1130	EnDat 2.1 digital	1.4 – 1.8
EQI 1131	EnDat 2.2 digital, EnDat 3	0.4 – 0.6
EQI 1329	EnDat 2.1 digital	1.2 – 1.8
EQI 1331	EnDat 2.1 digital	1.2 – 1.8
EQN 425	EnDat 2.1	0.8 – 1.2
EQN 425	SSI	0.8 – 1.2
EQN 1125	EnDat 2.1 digital	0.8 – 1.2
EQN 1125	EnDat 2.1 sin/cos	0.4 – 0.8
EQN 1135	EnDat 2.2 digital	0.2 – 0.4
EQN 1325	EnDat 2.1 digital	0.8 – 1.2
EQN 1325	EnDat 2.1 sin/cos	0.2 – 0.8
EQN 1337	EnDat 2.2 digital	0.0 – 0.2
Incremental; 1024 increments/revolution	HTL/TTL	2.0
Incremental; 2048 increments/revolution	HTL/TTL	1.4
Incremental; 4096 increments/revolution	HTL/TTL	0.8
Resolver; 2 poles	Analog	1.4 – 2.0
Resolver; 4 poles	Analog	1.2 – 1.8
Resolver; 6 poles	Analog	1.0 – 1.6
Resolver; 8 poles	Analog	0.8 – 1.4

Tab. 152: Guide values for C34

In Lean motors, the value is automatically taken from the drive controller firmware during the initial coupling of the motor and drive controller (prerequisite: B100 is not 0: User defined).

Scope image

Requirements:

- I26 = 0: Velocity control
- C34 = Guide value or value taken from firmware

Parameter for the scope image:

- E06 V-reference motor
- E15 v-motor-encoder

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15.8 2: Velocity controller – Proportional coefficient

The following graphic shows the influence of the proportional coefficient on the velocity controller.

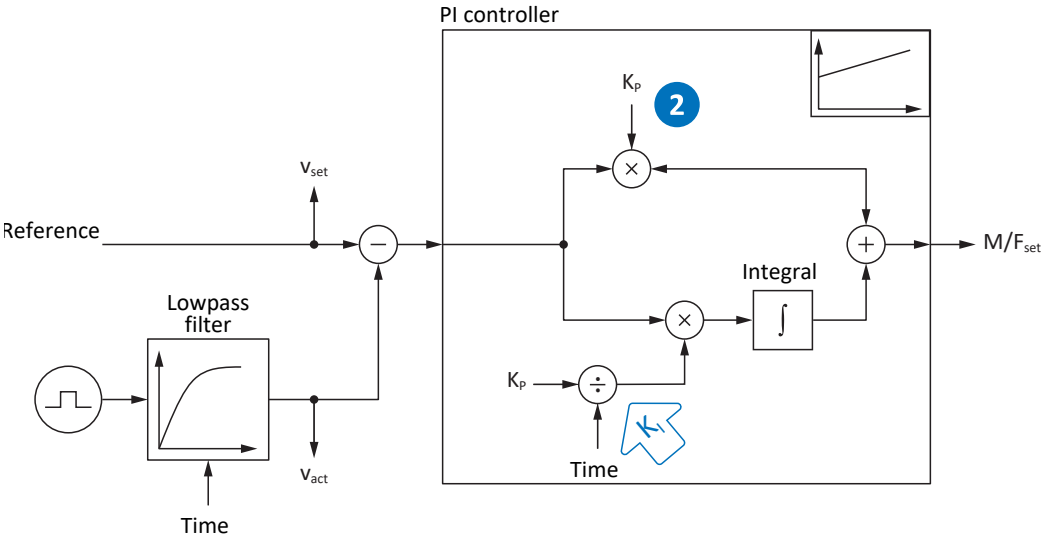

Fig. 38: Velocity controller – Proportional coefficient

The proportional coefficient K_P of the velocity controller can be defined in C31.

Effects

An adjustment of the P-share always has an effect on the I-share as well. The reason for this is the following dependency:

The integral coefficient K_I of the velocity controller results from the proportional coefficient K_P and reset time T_i ($K_I = K_P \div T_i$ = C31 × C35 ÷ C32).

Procedure

1. Start with the default value for C31.
2. First, enter the value 0 ms for the reset time in C32 to deactivate the I-share initially.
3. Increase the value of C31 up to the stability limit.
4. Define the value of C31 approximately 10% below the stability limit.

Scope image

Requirements:

- I26 = 0: Velocity control
- C34 = Guide value or value taken from firmware
- C32 = 0 ms
- C31 = e.g. 10, 20, 50, 150 and 200%

Parameter for the scope image:

- E06 V-reference motor
- E15 v-motor-encoder

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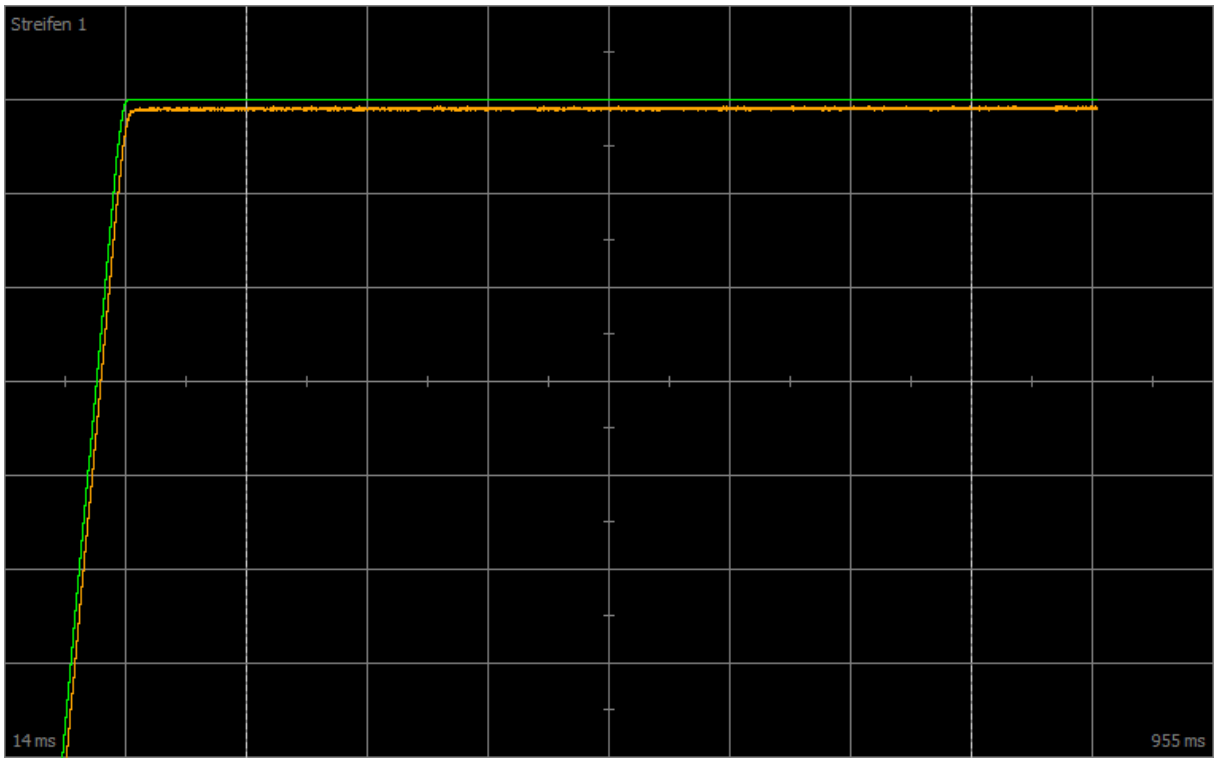

Fig. 39: Scope – Proportional coefficient of the velocity controller (C31), default value

Green	Set value
Brown	Actual value with default value

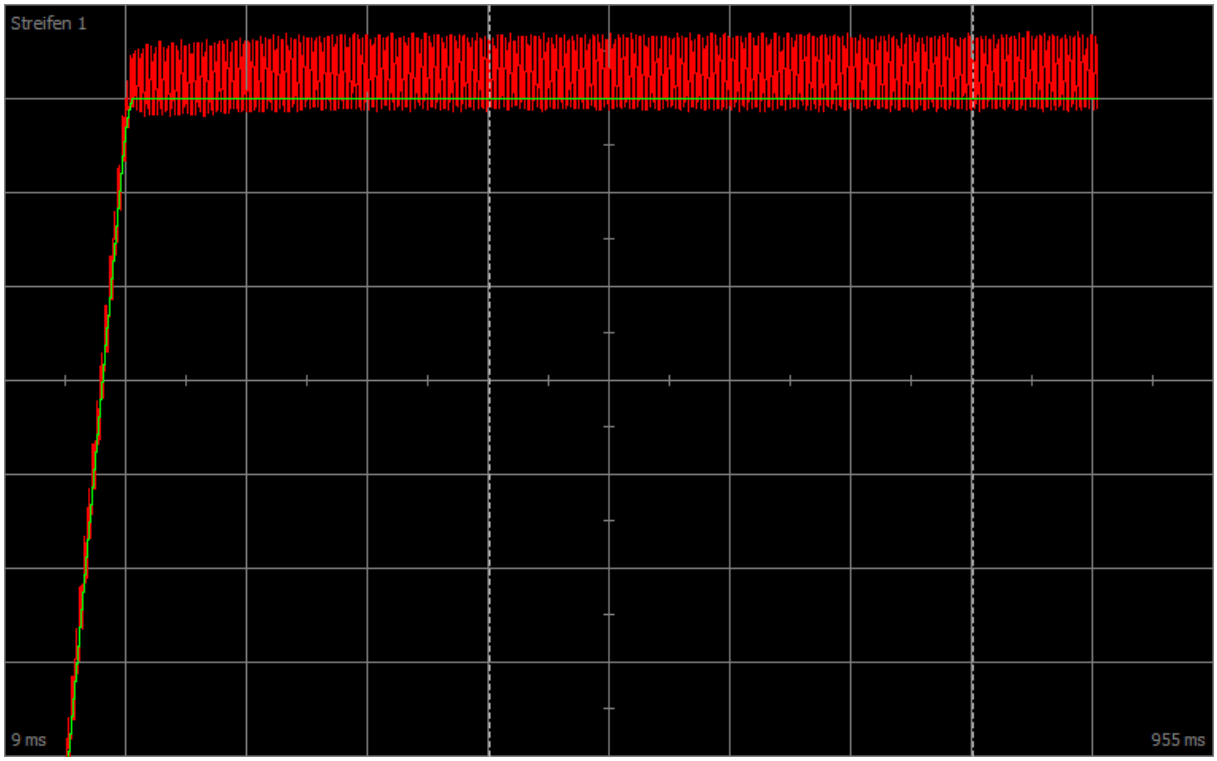

Fig. 40: Scope – Proportional coefficient of the velocity controller (C31), continuous oscillations

Green	Set value
Red	Actual value that exhibits continuous oscillation upon reaching the stability limit

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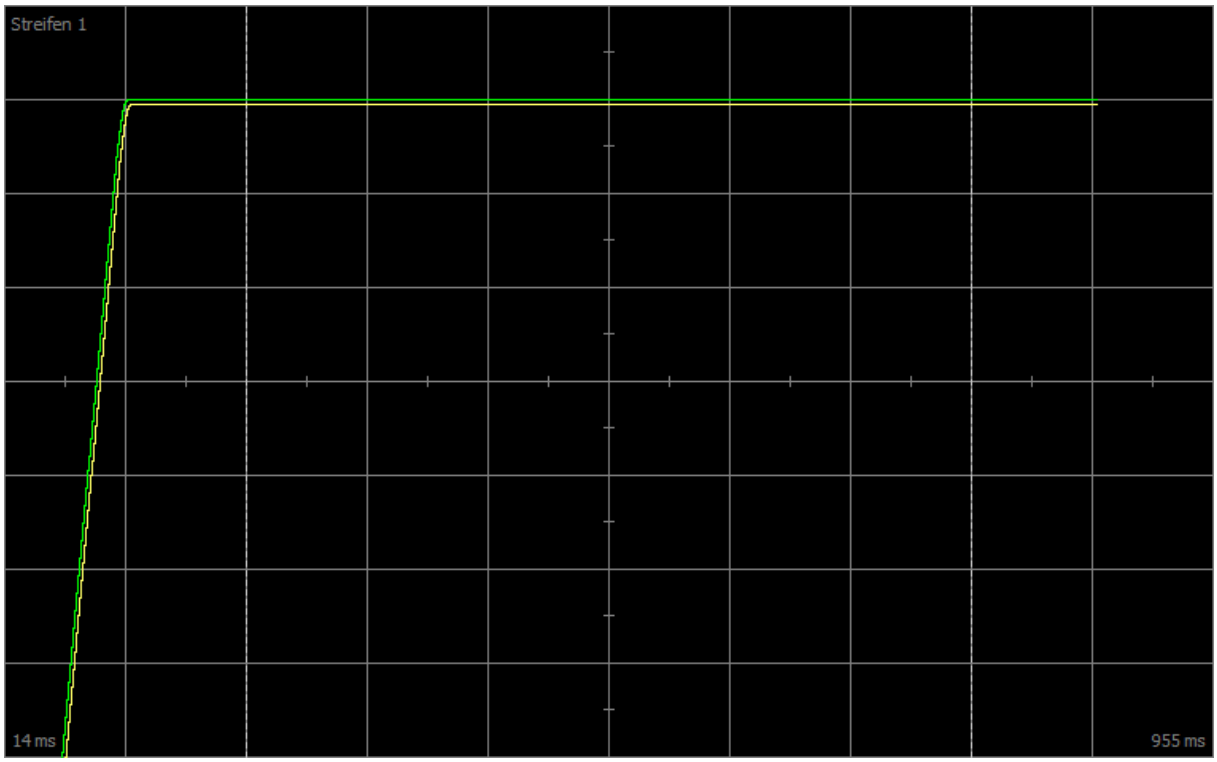

Fig. 41: Scope – Proportional coefficient of the velocity controller (C31), optimized value

Green	Set value
Yellow	Actual value with optimized coefficient

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The zoom factor was increased for the following scope image to show overshooting based on additional values, which devolves into continuous oscillations upon reaching the stability limit.

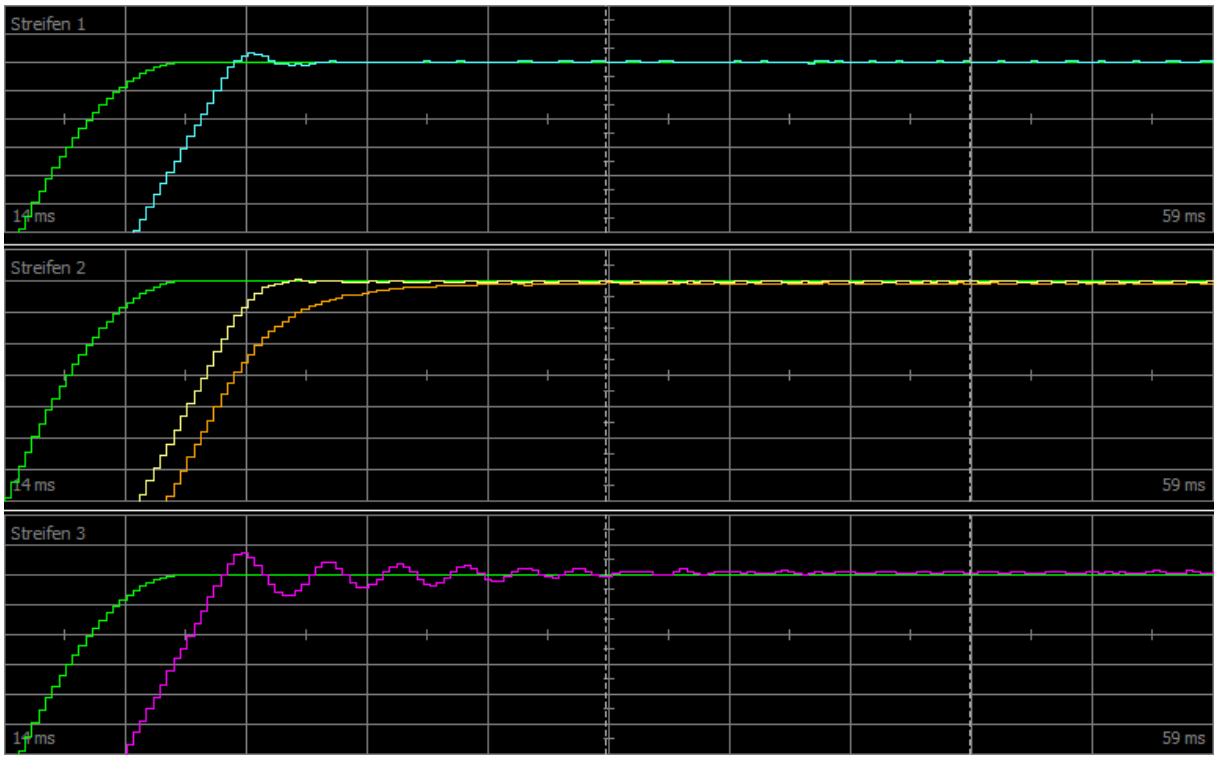

Fig. 42: Scope – Proportional coefficient of the velocity controller (C31), overshooting

Green	Set value
Turquoise	Actual value that shows brief overshooting
Yellow	Actual value with optimized coefficient
Brown	Actual value with default value
Pink	Actual value that shows long overshooting with phase-out

15.9 3: Velocity controller – Integral coefficient

The following graphic shows the influence of the integral coefficient on the velocity controller.

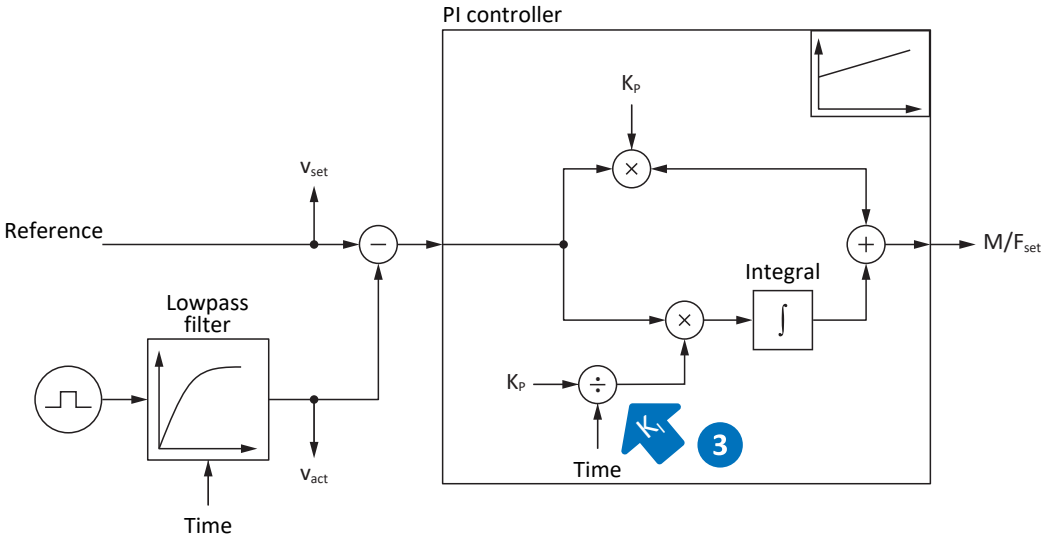

Fig. 43: Velocity controller – Integral coefficient

The integral coefficient K_I of the velocity controller results from the proportional coefficient K_P and reset time T_i ($K_I = K_P \div T_i$ = C31 × C35 ÷ C32).

Effects

Since the value of C31 was already optimized in the previous step, the integral coefficient is optimized in this step by adjusting the reset time in C32.

Procedure

1. Start with the default value for C32.
2. Reduce the value of C32 in order to recover more quickly. In this process, note that if C32 ≤ 1 ms, the I-share is deactivated.
3. Increase the value of C32 up to the stability limit.
4. Define the value of C32 approximately 10% above the stability limit.

Scope image

Requirements:

- I26 = 0: Velocity control
- C34 = Guide value or value taken from firmware
- C31 = Already optimized value
- C32 = e.g. 0, 5, 10 and 50 ms

Parameter for the scope image:

- E06 V-reference motor
- E15 v-motor-encoder

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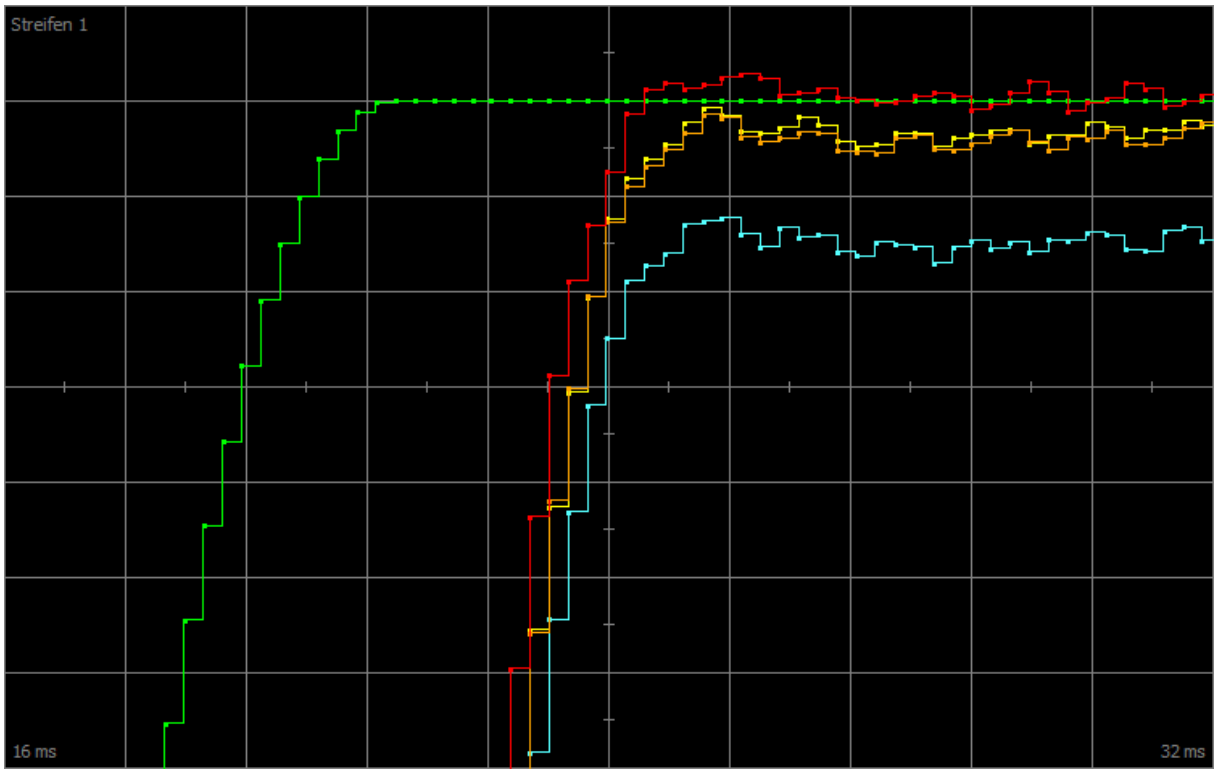

Fig. 44: Scope – Integral coefficient of the velocity controller (C32)

Green	Set value
Red	Actual value that exhibits overshooting
Yellow	Actual value with optimized coefficient
Brown	Actual value with default value
Turquoise	Actual value with deactivated coefficient (≤ 1)

15.10 Velocity controller – Summary

In summary, the following conclusions can be drawn for the optimization of the velocity controller:

- Simple encoders must be filtered more heavily.
- The maximum possible coefficient is lower with heavier filtering.
- The default coefficient is sufficient in simpler applications.
- You only require a higher coefficient in case of higher dynamics.
- Without the integral coefficient, you do not maintain any stationary accuracy, since the set velocity is not reached.

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15.11 4: Position controller – Proportional coefficient

The following graphic shows the influence of the proportional coefficient on the position controller.

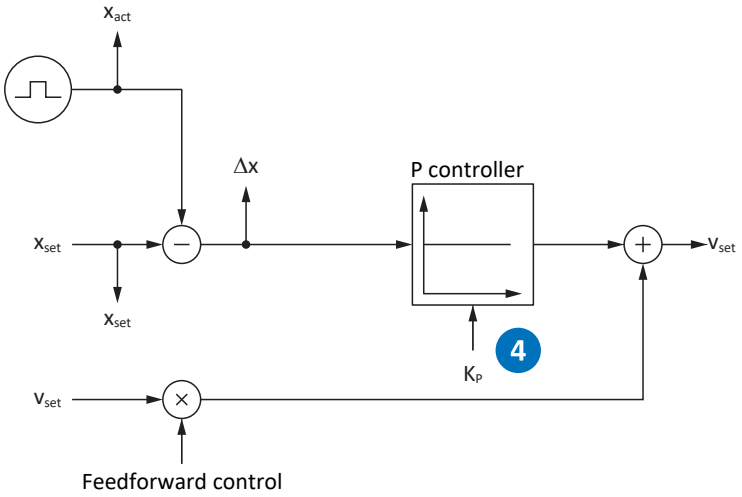

Fig. 45: Position controller – Proportional coefficient

The proportional coefficient K_P of the position controller can be defined in I20.

Effects

A higher coefficient produces a lower following error, but the system becomes more sensitive.

Procedure

1. Start with the default value for I20.
2. Increase the value of I20 up to the stability limit.
3. Define the value of I20 about 10% below the stability limit.

Scope image

Requirements:

- I26 = 1: Position control
- C34 = Guide value or value taken from firmware
- C31 = Already optimized value
- C32 = Already optimized value
- I20 = e.g. 10, 20, and 50

Parameter for the scope image:

- I96 Reference position
- I80 Current position
- I84 Following error
- E06 V-reference motor
- E15 v-motor-encoder

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15.12 5: Position controller – Velocity controller feedforward control

The following graphic shows the influence of the feedforward control on the position controller.

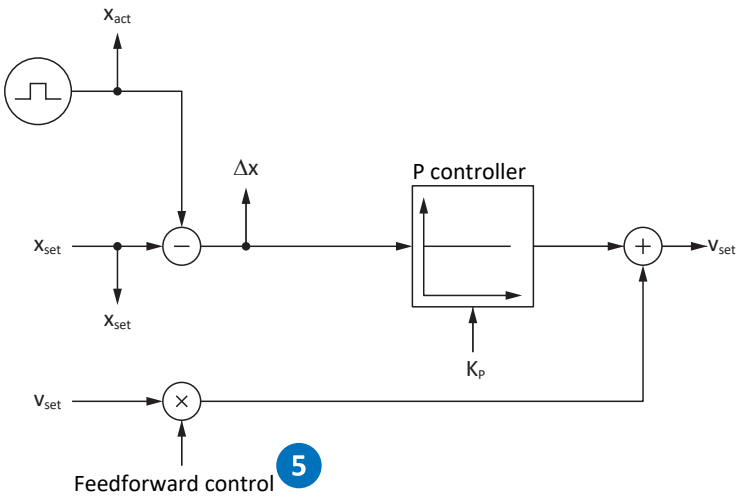

Fig. 46: Position controller – Feedforward control of the velocity controller

In case of external controller-generated or internal drive-generated feedforward control, the set velocity is also calculated in addition to the set position. In I25, you can define how much of that is directly communicated to the velocity controller.

Effects

Feedforward control reduces the load of the position controller and reduces the following error; however, stronger feedforward control makes the system more sensitive.

Procedure

1. Start with the default value of 95% for I25.
2. Reduce the value of I25 if the system is oscillating.

Scope image

Requirements:

- I26 = 1: Position control
- C34 = Guide value or value taken from firmware
- C31 = Already optimized value
- C32 = Already optimized value
- I20 = Already optimized value
- I25 = e.g. 50 and 95%

Parameter for the scope image:

- I96 Reference position
- I80 Current position
- I84 Following error
- E06 V-reference motor
- E15 v-motor-encoder

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15.13 Position controller – Summary

In summary, the following conclusions can be drawn for the optimization of the position controller:

- If the velocity controller is optimized, only small adjustments are required for the position controller.

15.14 Special cases

In the cases described below, additional parameters are relevant for optimization.

15.14.1 Current controller – Motor reaches saturation

Synchronous servo motors show a saturation effect at high currents.

Effects

Upon reaching the saturation limits, a higher motor current no longer generates higher field strength and it begins to fluctuate if the current continues to increase.

Procedure

1. Carry out the action B41 Calibrate motor.
   ⇨ The electrical data of the motor is calibrated and the coefficients of the saturation characteristic are defined (B60).
2. Activate current control tracking in B59.
   ⇨ The controller coefficients are tracked according to the saturation characteristic of the motor.

Scope image

Parameter for the scope image:

- E166 Iq-ref
- E93 Iq

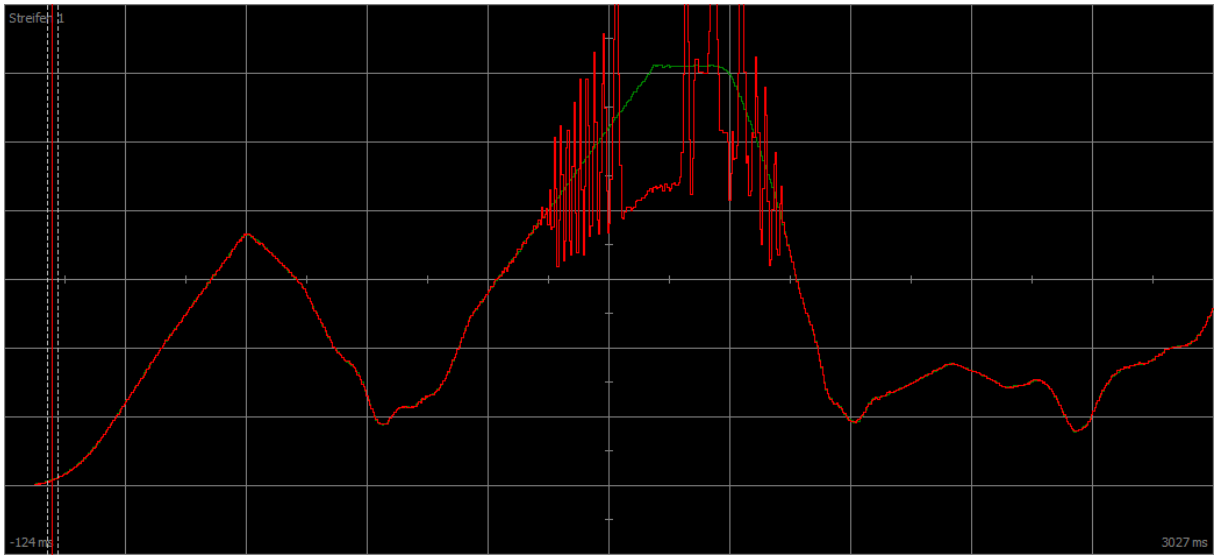

Fig. 47: Scope – Motor reaches saturation without tracking (B59)

Green	Set current
Red	Actual current

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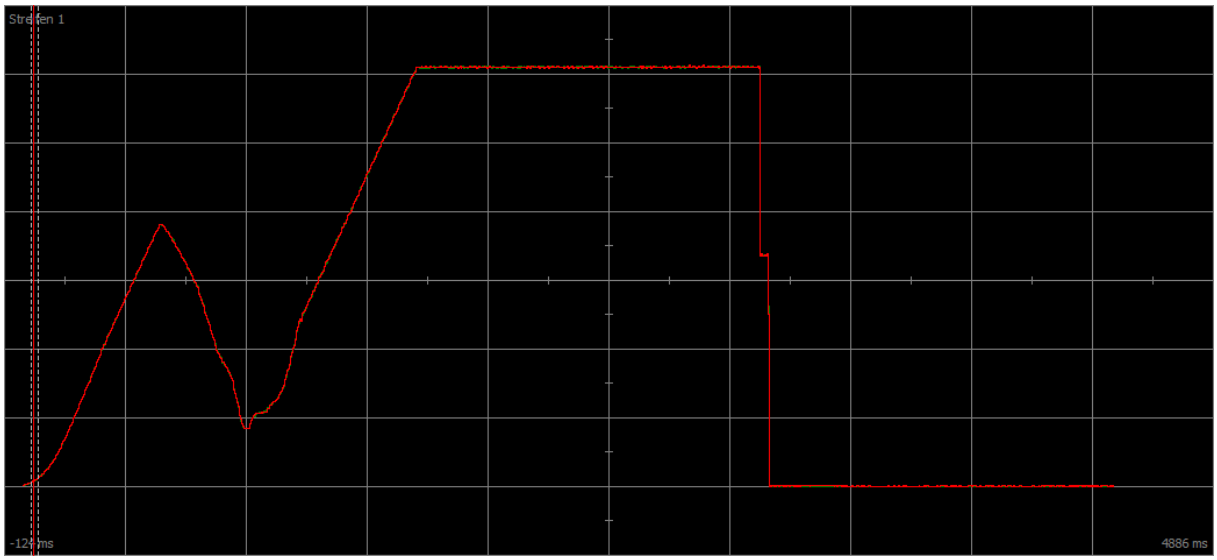

Fig. 48: Scope – Motor reaches saturation with tracking (B59)

Green	Set current
Red	Actual current

15.14.2 Velocity controller – High set torque

C36 Reference torque/force low pass:

If the set torque becomes very high, such as in case of maximum utilization of the drive controller, the set torque can be filtered using this parameter. The filter prevents the overshooting of the torque and thus the occurrence of overcurrents. The effect of C36 is defined using C37.

15.14.3 Position controller – Friction or play

I23 Position controller deadband:

To prevent control oscillations due to friction or play in the mechanics, the position control can be deactivated in a narrow range using this parameter.

15.14.4 Position controller – Poor resolution

C33 Lowpass reference speed:

Using this parameter, the set velocity can be smoothed if the calculation of the set or actual position is too rough due to one of the following conditions:

- In case of controller-based applications with poor or low quantization of the set value
- In case of drive-based applications with poor resolution of the master encoder

16 Brake

The following chapter describes the basic brake settings using the DriveControlSuite commissioning software and functional, non-safe brake management with one brake.

CiA 402 application and gravity-loaded axes

Information

If you are using a gravity-loaded axis and a brake, always use a quick stop to switch the drive (state transition 11 in accordance with the device state machine). This prevents the load from dropping until the brake is fully engaged.

For more detailed information on the CiA 402 application, refer to the corresponding manual (see Detailed information [▶ 347]).

16.1 Activating the brake

You activate the brake in parameter F00.

1. Select the relevant drive controller in the project tree and click on the first projected axis in the Project menu > Wizard area.
2. Select the Brake wizard.
3. F00 Brake:
   Select 1: Active if you are operating the motor in a regulated control mode and if the torque is to be saved at the time that the brake engages. In this case, the saved torque is restored before releasing the brakes. Select this option for gravity-loaded axes, for example.
   However, select 2: Do not save torque/force if only the motor magnetization is to be restored when the brake is released.
4. If necessary, store the release and engaging time of the brake (see Brake release time and brake engaging time [▶ 188]).

16.2 Activating functional brake management

✓ You have activated and parameterized the brake.

1. Select the relevant drive controller in the project tree and click on the first projected axis in the Project menu > Wizard area.
2. Select the Brake wizard > Brake control.
3. B310 Brake management:
   Select 1: Global.
4. B311 Timeout for brake test:
   Enter the time after which the drive controller is to output a message that a brake test is needed. You can set a maximum of 1 year = 52 weeks or 8760 hours of operating time.
5. Transmit the configuration to the drive controller and save it in non-volatile memory (A00).

⇨ Brake management is activated.

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16.3 Calibrate brake

For brakes with unknown release and engaging times, you can calibrate the release and engaging times, including the switching times of a contactor.

For more detailed information on the requirements as well as the exact procedure, see Calibrating the brake [▶ 190].

⚠ DANGER!

Risk of fatal injury due to gravity-loaded vertical axis!

During this action, the brakes are released and movement starts. The motor cannot generate any or can only generate limited torque/force during this time. This can cause a gravity-loaded vertical axis to drop.

- Make sure that safe movement in the specified travel range is possible.
- Secure the area extending beyond the travel range for the case of further lowering of the gravity-loaded vertical axis.

✓ The drive controller is switched on.

1. Select the relevant drive controller in the project tree and click on the first projected axis in the Project menu > Wizard area.
2. Select the Brake wizard > Test brake.
3. B306 Permitted direction for actions of the brake:
   Define the permitted travel direction. Calibration only takes place in one travel direction. If both directions of rotation are permitted, travel proceeds in the positive direction.
4. B307 Standstill window brake test:
   Enter the angle of rotation that the drive evaluates as a stall.
5. Select the Calibrate brake wizard.
6. Click Calibrate release/engaging time for brake.
   ⇨ Calibration of the brake is executed.
   ⇨ The determined times are stored in F04 and F05.
   ⇨ F96[1] indicates the progress.
   ⇨ F96[2] outputs the result of the action.
7. Afterwards, save the determined values in non-volatile memory (A00).

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16.4 Testing a functional brake

Using the brake test, check whether the brake can still apply the required holding torque or holding force.

For more information on the test and calculation of test torques, see Brake test [▶ 193] and Torque calculation [▶ 194].

⚠ DANGER!

Risk of fatal injury due to gravity-loaded vertical axis!

During this action, a test torque or test force is specified and the brakes are engaged. If the test torque/test force exceeds the holding torque/holding force of the brake, this results in movement of the axis. This can cause a gravity-loaded vertical axis to drop.

- Make sure that safe movement is possible.

✓ The drive controller is switched on.

✓ The brake is activated and parameterized.

1. Select the relevant drive controller in the project tree and click on the first projected axis in the project menu > Wizard area.
2. Select the Brake wizard > Test brake.
3. B304 Positive torque/force limit for brake test:
   Enter the test torque or test force that that brake must hold in case of a positive direction of rotation.
4. B305 Negative torque/force limit for brake test:
   Enter the test torque or test force that that brake must hold in case of a negative direction of rotation.
5. E65 Current maximum positive torque/force:
   Make sure that the limit in the drive controller permits the value stored in B304.
6. E66 Current maximum negative torque/force:
   Make sure that the limit in the drive controller permits the value stored in B305.
7. B306 Permitted direction for actions of the brake:
   Define the permitted travel direction. If both directions of rotation are permitted, travel first proceeds in the positive direction.
8. B307 Standstill window brake test:
   Enter the angle of rotation of the motor that the drive evaluates as a standstill.
9. Click on Test brake.

⇨ The brake test is executed.

⇨ B300[1] indicates the progress.

⇨ B300[2] outputs the result of the action.

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16.5 Bedding in the brake

By bedding in the brake, any deposits on the friction surface are removed that can negatively influence the holding function of the brake. For more information, see Bedding in the brake [▶ 196].

⚠ DANGER!

Risk of fatal injury due to gravity-loaded vertical axis!

During this action, the brakes are released and movement starts. The motor cannot generate any or can only generate limited torque/force during this time. This can cause a gravity-loaded vertical axis to drop.

- Make sure that safe movement in the specified travel range is possible.
- Secure the area extending beyond the travel range for the case of further lowering of the gravity-loaded vertical axis.

✓ The drive controller is switched on.

✓ The brake is activated and parameterized.

1. Select the relevant drive controller in the project tree and click on the first projected axis in the project menu > Wizard area.
2. Select the Brake wizard > Bend in brake.
3. B306 Permitted direction for actions of the brake:
   Define the permitted travel direction. If both directions of rotation are permitted, travel first proceeds in the positive direction.
4. B308 Number of intervals for grind:
   Enter how often the brake is to engage when rotating in one direction.
5. B309 Number of cycles for grind:
   Enter how often the drive is to bed in in any direction.
6. Click on Bed in brake.

⇨ The bedding in of the brake is executed.

⇨ B301[1] indicates the progress.

⇨ B301[2] outputs the result of the action.

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16.6 More about the brake?

The following chapters summarize the important terms and settings.

16.6.1 Brakes used

The functions described in the following chapters apply to internal brake control. For external brake control (CiA 402 or PROFIdrive), the brake is exclusively actuated by parameter and does not engage automatically in case of fault.

Information

To protect the holding brake, avoid engaging a brake when an axis is moving:

- Always carry out an SS1 before an STO for this reason.
- If you would like to deactivate the enable signal for a moving axis, select A44 = 1: Active (default) so that a quick stop is carried out with Enable-off.
- As a fault response, always select a quick stop (A29 = 1: Active, default) or emergency braking (U30 = 1: Active).

16.6.1.1 Operation with 1 brake

After Enable-on, the brake releases along with the first command and remains released until one of the following events occurs:

- Event with fault response:
  - The power unit is disabled and axis movement is no longer controlled by the drive controller
  - Quick stop
  - Emergency braking
- Enable-off
- Quick stop signal
- Brake is engaged at the end of the motion command (CiA 402 or PROFIdrive: I410 = 1: Active; DB: parameter depends on operating mode):
  - 1: MC_MoveAbsolute
  - 2: MC_MoveRelative
  - 3: MC_MoveAdditive
  - 5: MC_Stop
  - 6: MC_Home (requirement: I30 ≠ 5: Define home)
  - 11: MC_Halt

Regardless of this, the brake can be released long-term for commissioning or for service work by means of a release override. This must be defined in parameter F06 (signal: F07).

The 24 V_{DC} supply to the brake and the short circuit are monitored. Furthermore, the brake connection to terminal X2 is checked for plausibility. The internal brake control monitors adherence to the release time and engaging time.

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16.6.2 Direct and indirect brake connection

The SC6 drive controller provides the option of directly connecting a 24 V_{DC} brake with a current draw of up to 2.5 A. Brakes with a different supply voltage or higher current draw can be connected indirectly through a contactor.

You have the following options for the connection:

- Directly to X2 (with monitoring)
- Indirectly to X2 (with monitoring)

16.6.3 Internal and external brake control

For CiA 402 or PROFIdrive applications, parameter F92[0] offers the option of switching from internal (automatic) brake control through the drive controller to external brake control through a controller.

⚠ WARNING!

Injury to persons and material damage due to axis movement!

For external brake control, the brake does not engage automatically in the event of faults or Enable-off. For Enable-on or the start of a motion, the brake is not automatically released. The external brake control is independent of the device state and motion core through the controller.

- Guarantee a suitable process in the controller and take suitable measures to ensure safety.
- When releasing the brake, also take into account the motor-side requirements (e.g. required time for building up magnetization in the case of asynchronous motors or for position determination in the case of Lean motors).

In parameter F06, define the source of the digital signal through which the brakes are released unconditionally. In the CiA 402 and PROFIdrive applications, F06 = 2: Parameter is preset.

The controller can check whether the brakes are engaged or released (E201, bits 3 and 4) before position and speed set values are specified.

The following table shows the correlation between parameters F06 and F92[0].

F06 =	F92[0] =	Brake control
3: DI1 – 28: DI13 inverted	0: Internal (automatic)	Internal automatic system; release override through terminal input (source: E19)
3: DI1 – 28: DI13 inverted	1: External (plc)	Externally through terminal input (source: E19); no release override
2: Parameter	0: Internal (automatic)	Internal automatic system; release override through parameter (source: Drive Based A180, bit 6/CiA 402 A515, bit 14/PROFIdrive M515, bit 12)
2: Parameter	1: External (plc)	Externally through parameter (Drive Based A180, bit 6/CiA 402 A515, bit 14/ PROFIdrive M515, bit 12); no release override

Tab. 153: Correlation between F06 and F92[0]

In the CiA 402 application, bit 14 of parameter A515 is the source of F92[1]; for PROFIdrive, bit 12 of parameter M515 is the source of F92[1]. In the Drive Based application, bit 6 of parameter A180 serves as the source of F92[1].

F92[2] shows the current setting of the brake control.

16.6.4 Brake control based on control mode

The following chapters show the brake control depending on the control mode (B20) for one brake with internal brake control through the drive controller.

16.6.4.1 B20 = 0 or 1

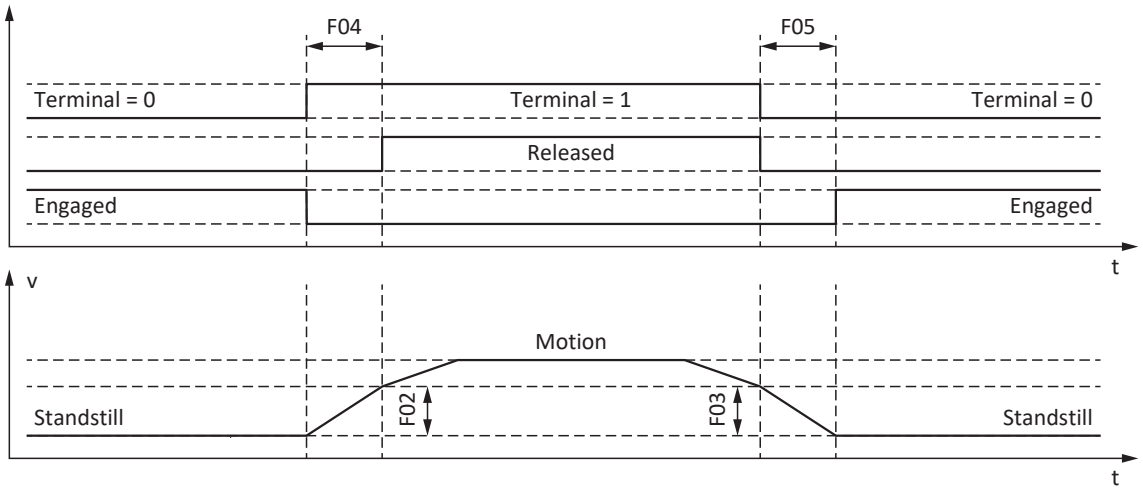

Fig. 49: Brake control for control mode B20 = 0: ASM - V/f-control or 1: ASM - V/f-slip compensated

In these control modes for asynchronous motors without a motor encoder, the axis is controlled to move within the release time F04.

Here, F02 is the velocity of the asynchronous motor that is built up during the release time F04. F03 is the velocity starting from which the brakes are controlled to engage.

During the release process, a set acceleration calculated from the velocity and release time takes effect (F02, F04). During the engaging process, a set deceleration calculated from the velocity and engaging time takes effect (F03, F05).

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16.6.4.2 B20 = 2

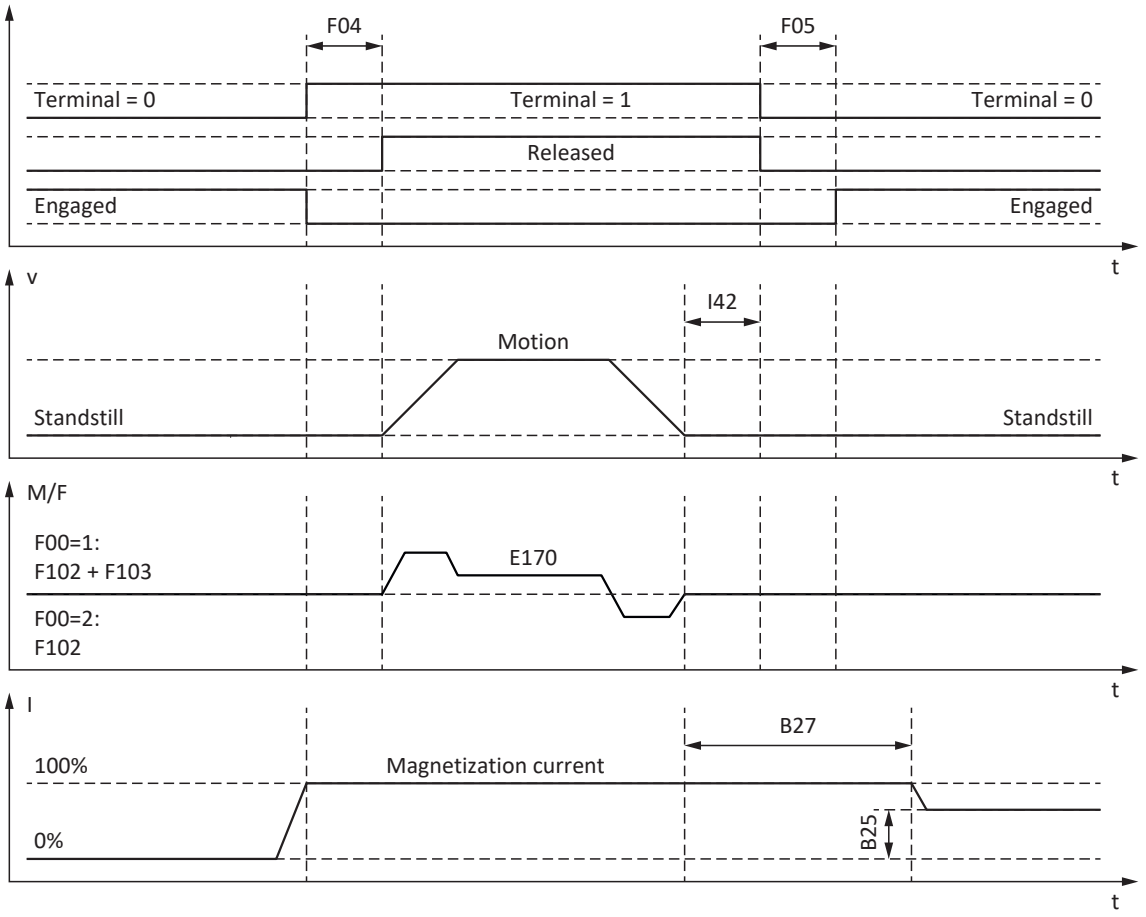

Fig. 50: Brake control for control mode B20 = 2: ASM - vector control

In this control mode for asynchronous motors with a motor encoder, the axis is controlled to move after the release time F04 has expired.

In the motion block and command operating modes, you can define a waiting time for the brake to engage at the end of the motion command in parameter I42 (J27, J53). When this is done, multiple motion commands can be executed in succession without interruption from the brake engaging.

For specification of torque/force, E170 is the currently required set torque or the currently required set force M/F_{set} of the motor control (limit: E65, E66).

In F102, define a static feedforward control for torque/force for the velocity controller if you would like to set a base load for gravity-loaded axes. Depending on the boundary conditions of the machine, it may make sense to use different settings. For commissioning recommendations for gravity-loaded axes, see Special case of load changes when the power unit is switched off [▶ 196].

The torque or force for the next brake release process F103 is determined automatically and can be stored in non-volatile memory.

F103 is determined only for steady-state control and a completely released brake (F09) if the actual velocity of the motor encoder is less than the velocity window (|E15| < |C40|).

The hold magnetization B25 ensures that the motor is still supplied with current when the brake is engaged. The magnetization is reduced as soon as the motor has come to a stop and the waiting time B27 has expired.

B25 influences the thermal machine utilization. The thermal machine utilization is reduced as B25 decreases, but the reaction time simultaneously increases as the brakes are released.

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16.6.4.3 B20 = 3

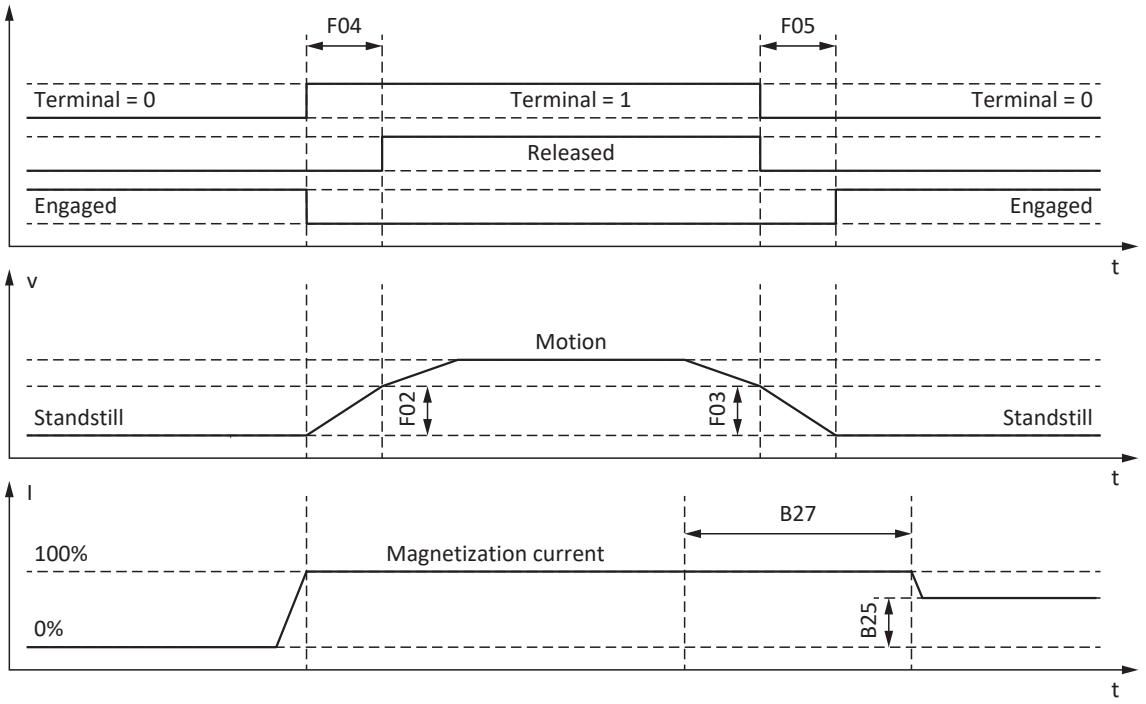

Fig. 51: Brake control for control mode B20 = 3: ASM - sensorless vector control

In this control mode for asynchronous motors without a motor encoder, the axis is controlled to move within the release time F04.

Here, F02 is the velocity of the asynchronous motor that is built up during the release time F04. F03 is the velocity starting from which the brakes are controlled to engage.

During the release process, a set acceleration calculated from the velocity and release time takes effect (F02, F04). During the engaging process, a set deceleration calculated from the velocity and engaging time takes effect (F03, F05).

The hold magnetization B25 ensures that the motor is still supplied with current when the brake is engaged. The magnetization is reduced as soon as the motor velocity has undershot the brake-engaging velocity F03 and the waiting time B27 has expired.

B25 influences the thermal machine utilization. The thermal machine utilization is reduced as B25 decreases, but the reaction time simultaneously increases as the brakes are released.

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16.6.4.4 B20 = 32, 48 or 64

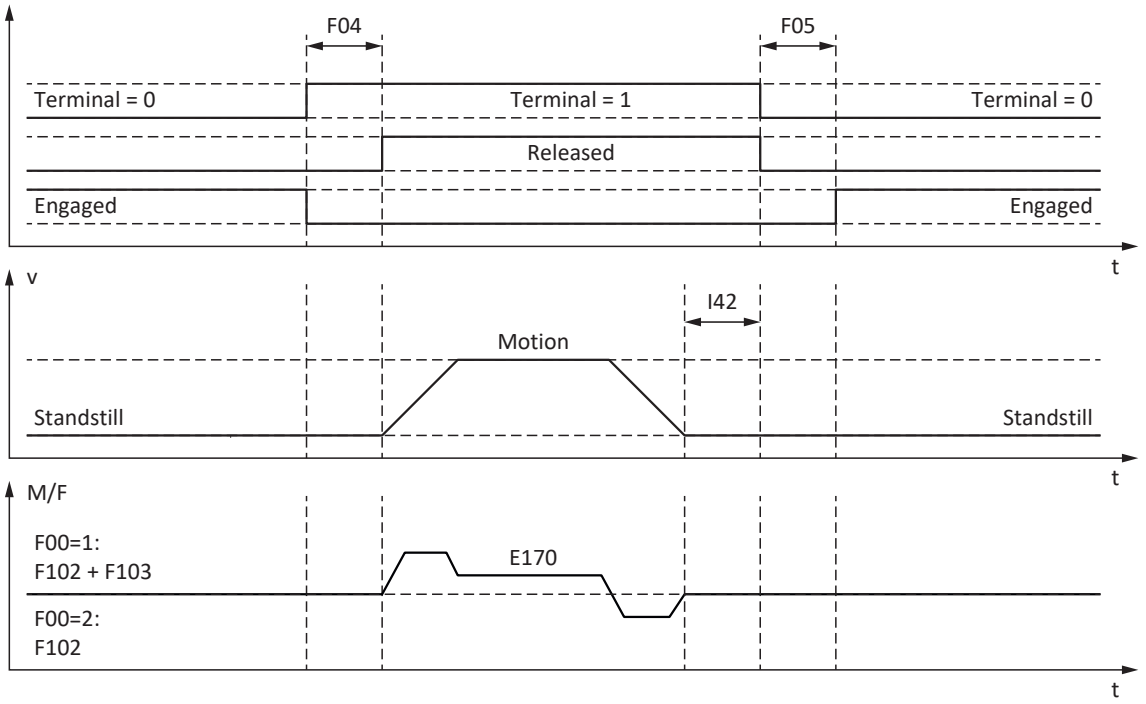

Fig. 52: Brake control for control mode B20 = 32: LM - sensorless vector control, 48: SSM-vector control incremental encoder or 64: SSM - vector control

In these control modes for synchronous servo motors with a motor encoder or Lean motors with sensorless vector control, the axis is controlled to move after the release time F04 has expired.

In the motion block and command operating modes, you can define a waiting time for the brake to engage at the end of the motion command in parameter I42 (J27, J53). When this is done, multiple motion commands can be executed in succession without interruption from the brake engaging.

For specification of torque/force, E170 is the currently required set torque or the currently required set force M/F_{set} of the motor control (limit: E65, E66).

In F102, define a static feedforward control for torque/force for the velocity controller if you would like to set a base load for gravity-loaded axes. Depending on the boundary conditions of the machine, it may make sense to use different settings. For commissioning recommendations for gravity-loaded axes, see Special case of load changes when the power unit is switched off [▶ 196].

The torque or force for the next brake release process F103 is determined automatically and can be stored in non-volatile memory.

F103 is determined only for steady-state control and a completely released brake (F09) if the actual velocity of the motor encoder is less than the velocity window (|E15| < |C40|).

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Commutation finding process using Wake and Shake in combination with a brake

⚠ DANGER!

Risk of fatal injury due to gravity-loaded vertical axis!

Gravity-loaded axes can sink during a commutation finding process using Wake and Shake because the brake for the commutation finding process has to be released.

- Use the 48: SSM-vector control incremental encoder control mode in combination with a commutation finding process using Wake and Shake only for axes without a gravity load.
- For gravity-loaded axes, use motors with an absolute encoder.

For a commutation finding process using Wake and Shake in combination with a brake, adhere to the following steps each time after restarting the drive controller:

1. Release brake using release override (F06)
2. Switch on the power unit (via Enable-on when G90 = 1: Position control or 2: Velocity control; with the first motion command when G90 = 0: Inactive)
3. Check E85 (2: Commutation OK = commutation succeeded; 0: Commutation unknown = commutation failed)
4. Use F06 to let the brake engage again

16.6.5 Brake release time and brake engaging time

The release time of the connected brake is defined in parameter F04 and the engaging time in parameter F05:

- F04[0]: Release time of the brake
- F05[0]: Engaging time of the brake

When the motion start is activated after Enable-on, the motion and the status signals are delayed by the time F04 to prevent motion against a brake that has not yet opened completely.

When the brake engages, the control still remains active for the time F05 to prevent a gravity-loaded axis from sinking. For STO, the brake engages immediately. The behavior for deactivation of the enable signal can be defined with A44 (brake engages immediately or after a quick stop).

Motors with an electronic nameplate

In motors with an electronic nameplate, the values during initial coupling of the motor and drive controller or when the action B06 is started are taken over from the electronic nameplate (prerequisite: B04 = 64: Active).

If the electronic nameplate contains the release time and engaging time of the brake integrated into the motor adapter (ServoStop), then these are taken into account. This also requires the following setting: B28 = 1: All data.

Sources for the values from the electronic nameplate:

- R50: nameplate release time of the motor brake
- R51: nameplate engaging time of the motor brake
- R67: nameplate release time of the motor adapter brake
- R68: nameplate engaging time of the motor adapter brake

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Motors without an electronic nameplate

Depending on the connection type, you have to calculate the release time and engaging time of the brake differently.

For a direct connection, the following guide values apply:

- F04 = 1.3 × t_{2B}
- F05 = 1.3 × t_{1B}

t_{2B} and t_{1B} refer to the technical data for the brake specified in the STOBER catalog.

For an indirect connection of the brake through a contactor, additionally take into account 1.2 × the switching time of the contactor for both the release time and the engaging time.

If you do not know the release time and engaging time of the brake, you can calibrate these using the action F96.

16.6.6 Time between 2 release processes

Information

The time between two brake release processes must be at least 1 s. If this is not observed, the 2nd release process will be delayed.

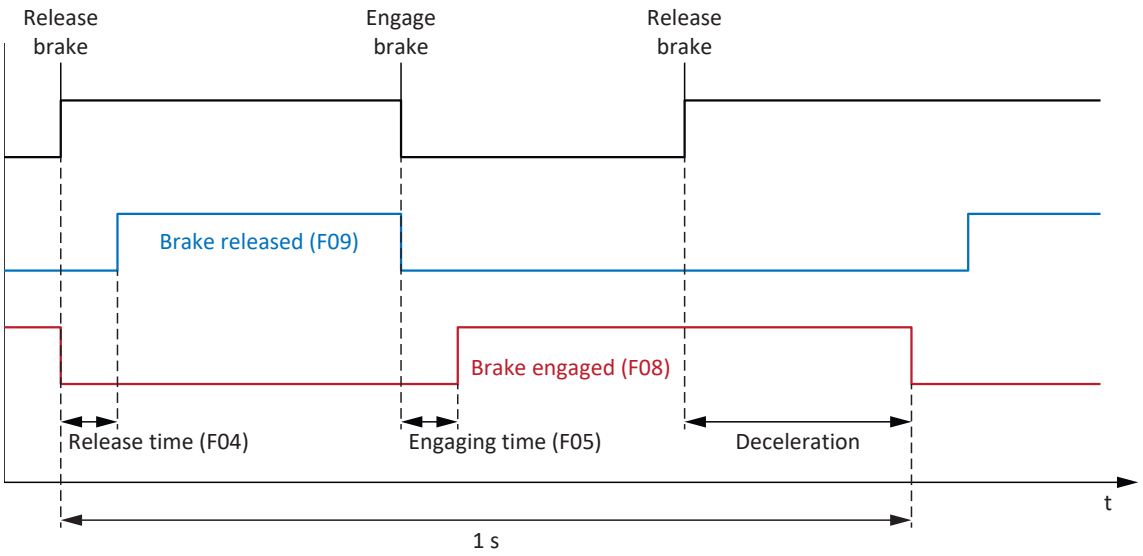

Fig. 53: Minimum time between two release processes for the brake

16.6.7 Calibrating the brake

With the action F96, you can calibrate the release and engaging times of the brake, including the switching times of a contactor. This action is not required for motors with an electronic nameplate because these values are taken over from the electronic nameplate during initial coupling of the motor for the drive controller.

⚠ DANGER!

Risk of fatal injury due to gravity-loaded vertical axis!

During this action, the brakes are released and movement starts. The motor cannot generate any or can only generate limited torque/force during this time. This can cause a gravity-loaded vertical axis to drop.

- Make sure that safe movement in the specified travel range is possible.
- Secure the area extending beyond the travel range for the case of further lowering of the gravity-loaded vertical axis.

Requirements

The action F96 requires a position encoder and is permitted only in the following control modes (B20):

- 2: ASM - vector control
- 3: ASM - sensorless vector control
- 32: LM - sensorless vector control
- 48: SSM-vector control incremental encoder
- 64: SSM - vector control

F96 can be carried out also for loaded axes. In this case, the velocity controller should be optimized and the load must not be more than 2/3 of the maximum torque or force currently permitted (E65, E66).

Required parameters

Define the permitted direction of motion for calibrating the brake in parameter B306, the standstill window in parameter B307.

The travel range is approximately 2.0 motor revolutions. To determine the travel path exactly, please include the gear unit and feed in the calculation.

Sequence of the action

During the action, the axis rotates at 20 rpm. Initially, for a released brake, a measurement run is carried out for the duration of 1 s. Then the axis moves against the engaging brake. After detection of the brake engaging (timeout 2 s), the axis stops. This is followed by a stall of 2 s (recovery phase). Then the axis moves against the releasing brake. After detection of the brake release (timeout 2 s), the axis continues moving for 0.5 s and then stops.

The determined times are stored in F04 and F05:

- F04[0]: Release time of the brake
- F05[0]: Engaging time of the brake

Saving values

For the measured values to be saved in non-volatile memory, the action A00 has to be carried out after this.

Alternatively, the action B06 can be used to retrieve the values from the electronic nameplate, provided that it contains the brake data.

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Results

After the action F96 is started, the progress can be observed in parameter F96[1], and after the action is completed, F96[2] can be used to call up the results of calibrating.

The action F96 evaluates the measured time with the safety factor of 1.2. This means that the values entered in F04 and F05 are 1.2 times greater than the actually measured values.

16.6.8 Functional brake management

The functional brake management monitors the regular performance of brake tests to check whether the brake is functioning properly. The drive controller offers the following options through the axis management:

- **Single-axis operation**:
  One axis projected in the DriveControlSuite is used on a connected motor
- **Multi-axis operation**:
  Two, three or four axes projected in the DriveControlSuite are used on a connected motor

Information

For **multi-axis operation**, you have to configure all settings in the parameters of Axis 1 in DriveControlSuite and select Axis 1 for actions.

The brake management can be used only if the following requirements are met:

- Self-engaging brakes are used, which brake in the de-energized state
- The drive has an encoder because no brake test can be carried out without an encoder

16.6.8.1 State machine of brake management

Brake management functions with the following state machine:

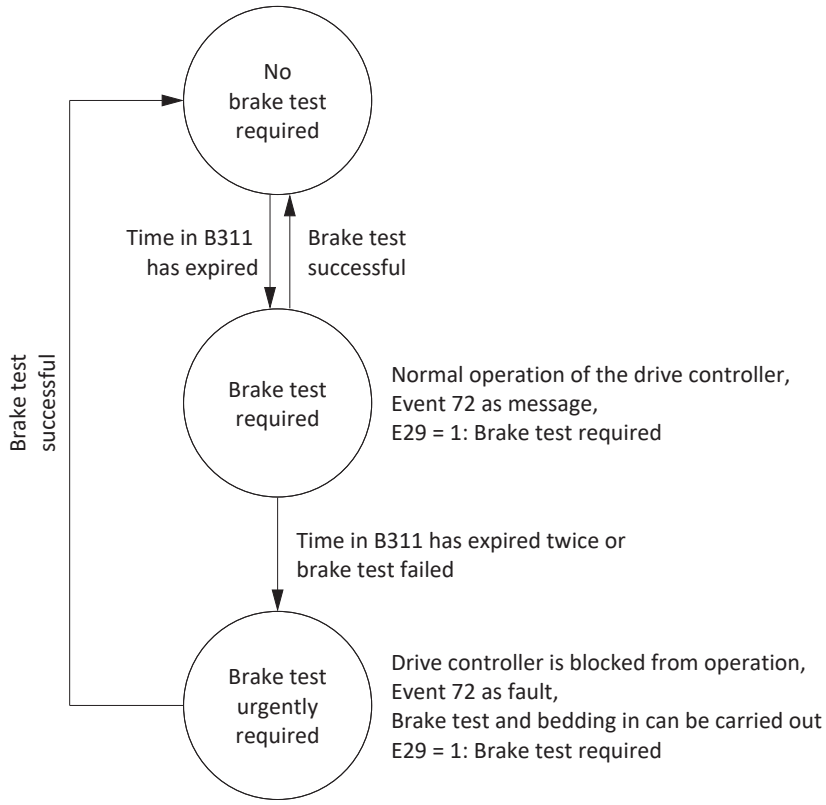

Fig. 54: State machine of brake management

The brake management time B311 begins to run starting from the time of activation. After the time expires, the brake management switches to the "Brake test required" state (E29 = 1: Brake test necessary, Event 72 as message with Cause 3). If you carry out a brake test successfully in this state, the brake management switches back to the "No brake test required" state (E29 = 0: Inactive) and the cycle B311 starts over.

If the state is "Brake test required" and the time B311 expires again without a brake test or the brake test was unsuccessful, the brake management switches to the "Brake test urgently required" state (fault E29 = 1: Brake test necessary, Event 72 as fault with Cause 1). To avoid interruption of the production process, the fault is not generated until the enable signal is switched off. The fault can be acknowledged to allow performance of the brake test and bedding in of the brake. However, if the brake test is not carried out successfully within 5 minutes after acknowledgment, the brake management switches back to the "Brake test urgently required" state. A successful brake test automatically leads back to the "No brake test required" state, and the cycle B311 starts over.

If a brake test is unsuccessful in the "Brake test urgently required" state, you can bed in the brakes and carry out the brake test again. If this brake test fails, too, then you have to replace the brake or the motor. The brake management remains in the "Brake test urgently required" state until a brake test has been carried out successfully after replacement of the brake or motor. The time that has passed since the last brake test is shown in parameter E177.

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16.6.9 Brake test

The action B300 Test brake checks whether the brake can still apply the required holding torque or holding force.

⚠ DANGER!

Risk of fatal injury due to gravity-loaded vertical axis!

During this action, a test torque or test force is specified and the brakes are engaged. If the test torque/test force exceeds the holding torque/holding force of the brake, this results in movement of the axis. This can cause a gravity-loaded vertical axis to drop.

- Make sure that safe movement is possible.

Requirements

The action B300 requires a position encoder and is permitted only in the following control modes (B20):

- 2: ASM - vector control
- 32: LM - sensorless vector control
- 48: SSM-vector control incremental encoder
- 64: SSM - vector control

Required parameters

Enter the test torque or test force in the parameters B304 and B305:

- B304[0]: Positive set torque/positive set force for the brake
- B305[0]: Negative set torque/negative set force for the brake

Define the permitted travel direction in B306. If both directions of rotation are permitted, travel first proceeds in the positive direction. Enter the angle of rotation of the motor that the drive evaluates as a standstill in B307.

To define the test torques or test forces, note that the motor torque is limited to the values in C03 and C05. If larger values are entered in B304 and B305, they cannot be achieved. Furthermore, make sure that the limit in the drive controller permits the stored values. To do so, check the parameters E65 and E66 during the brake test.

Travel path for brake test

If the brake can hold the test torque, then the maximum travel path is 0.125 motor revolutions.

Sequence of the action

If the brake is released, then the encoder is tested first. For the encoder test, the motor rotates at approximately 60 rpm at a maximum of 45° in both directions of rotation. Then the brake engages and a parameterizable test torque or test force is applied to the drive in each permitted direction of rotation. If the drive detects motion, then the brake was unable to apply the required holding torque or holding force and the test has failed.

Results

After the action B300 is started, the progress can be observed in parameter B300[1], and after the action is completed, B300[2] can be used to call up the test results.

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16.6.10 Torque calculation

In the following chapters, you will find information for calculating the torques that you have to enter in B304 and B305 for the brake test.

16.6.10.1 Torques for synchronous servo motors

To calculate the torques, you need the following values:

- M_B: Select the braking torque that you have designed and that is required for your application. Alternatively, perform a calculation using the static braking torque of the motor brake M_{Bstat} or of the motor adapter brake M_{1Bstat}
- M_0: Stall torque
- I_0: Stall current
- $I_{2N,PU}$: Nominal output current of the drive controller

In the first step, calculate the ratio of torques as a percentage:

$$K = \frac{M_B}{M_0} \times 100\ \%$$

In the next step, determine the current for M_B:

$I = I_0 \times K$

Compare I to $I_{2N,PU}$ of the drive controller:

If $I \leq 2 \times I_{2N,PU}$, then:
B304 = K and B305 = −K

If $I > 2 \times I_{2N,PU}$, then the drive controller cannot generate the test torque that you have designed.

Example

- M_B = 10 Nm
- M_0 = 6.6 Nm
- I_0 = 4.43 A
- $I_{2N,PU}$ = 6 A

$$K = \frac{10\ Nm}{6{,}6\ Nm} \times 100\ \% = 151\%$$

I = 4.43 A × 151% = 6.69 A

I = 6.69 A < 2 × $I_{2N,PU}$ = 12 A

Results: B304 = 151% and B305 = −151%

To define the test torques or test forces, note that the motor torque is limited to the values in C03 and C05. If larger values are entered in B304 and B305, they cannot be achieved. Furthermore, make sure that the limit in the drive controller permits the stored values. To do so, check the parameters E65 and E66 during the brake test.

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16.6.10.2 Torques for asynchronous motors

To calculate the torques, you need the following values:

- M_B: Select the braking torque that you have designed and that is required for your application. Alternatively, perform a calculation with the nominal braking torque of the motor brake $M_{N,B}$
- M_N: Nominal torque of the motor
- M_k/M_N: Ratio of breakdown torque to nominal torque
- $I_{2N,PU}$: Nominal output current of the drive controller
- $I_{d,ref}$ (E171): Magnetization-generating reference current in the d/q coordinate system
- $I_{q,ref}$ (E172): Torque/force-generating reference current in the d/q coordinate system

To obtain the correct values from E171 and E172, complete the project configuration of the motor, transfer the project to the drive controller and save it. Then read out the values in online operation.

In the first step, calculate the ratio of torques as a percentage:

$$K = \frac{M_B}{M_N} \times 100\ \%$$

If $M_k/M_N < 2$, select $K = M_k/M_N \times 100\ \%$.

In the next step, determine the current for M_B:

$$I = \sqrt{I_{d,ref}^{\ 2} + (K \times I_{q,ref})^2}$$

Compare I to $I_{2N,PU}$ of the drive controller:

If $I \leq 1.8 \times I_{2N,PU}$, then:
B304 = K and B305 = −K

If $I > 1.8 \times I_{2N,PU}$, then the drive controller cannot generate the test torque that you have designed.

Example

- M_B = 10 Nm
- M_0 = 5.12 Nm
- M_k/M_N = 2.3
- $I_{2N,PU}$ = 2.3 A
- $I_{d,ref}$ = 1.383 A
- $I_{q,ref}$ = 1.581 A

$$K = \frac{10\ \text{Nm}}{5{,}12\ \text{Nm}} \times 100\ \% = 195\ \%$$

$$I = \sqrt{(1{,}383\ \text{A})^2 + (195\ \% \times 1{,}581\ \text{A})^2} = 3{,}38\ \text{A}$$

$I = 3.38\ A < 1.8 \times I_{2N,PU} = 4.14\ A$

Results: B304 = 195% and B305 = −195%

To define the test torques or test forces, note that the motor torque is limited to the values in C03 and C05. If larger values are entered in B304 and B305, they cannot be achieved. Furthermore, make sure that the limit in the drive controller permits the stored values. To do so, check the parameters E65 and E66 during the brake test.

16.6.11 Bedding in the brake

For the action B301 Grind brake, the brake repeatedly engages for approximately 0.7 s and then is released for approximately 0.7 s while the motor rotates at approximately 20 rpm. This grinds off any deposits on the friction surface that can negatively influence the holding function of the brake.

⚠ DANGER!

Risk of fatal injury due to gravity-loaded vertical axis!

During this action, the brakes are released and movement starts. The motor cannot generate any or can only generate limited torque/force during this time. This can cause a gravity-loaded vertical axis to drop.

- Make sure that safe movement in the specified travel range is possible.
- Secure the area extending beyond the travel range for the case of further lowering of the gravity-loaded vertical axis.

Required parameters

You can define the following parameters:

- How often the brake engages while rotating in one direction (B308)
- How often the drive should rotate in each direction (B309)
- Whether a direction of rotation is blocked (B306)

Set speed and travel range

- Fixed set speed: 20 rpm
- Travel range: B308 × 0.5 motor revolutions

Results

After the action is started, the progress can be observed in parameter B301[1]. After the action is completed, the result can be called up using B301[2].

16.6.12 Special case of load changes when the power unit is switched off

Depending on the boundary conditions of the machine, it may make sense to use different settings.

Recommendation for commissioning with gravity-loaded axes

If load changes occur only when the power unit is switched on and the control is set to be vibration-free, leave the presets.

On the other hand, if load changes also occur when the power unit is switched off, reduce the correcting process when the brakes are released:

1. F00 Brake:
   Select 2: Do not save torque/force to save F103 only in volatile memory.
2. F102 Torque/force feed forward:
   Specify the determined value for the base load so that the automatic determination in the event of a load change yields only the difference.
3. Reduce the correcting process when releasing the brakes by optimizing the velocity controller.

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Determining the base load

1. F102 Torque/force feed forward:
   Set the value to 0.0%.
2. Load the axis with the base load.
3. Select the Jog control panel wizard.
4. Enable the axis and let it stand in one position with released brakes in active position control.
5. Determine a stable value for E02 using a scope image; this value corresponds to the base load.
6. Select the Jog control panel wizard.
7. Deactivate the enable signal of the axis.
8. F102 Torque/force feed forward:
   Enter the determined base load.
9. A00 Save values:
   Save the value in non-volatile memory.

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17 Predictive Maintenance

Predictive Maintenance (PMR) in the context of Industry 4.0 enables a machine to predict and signal the optimal time when components should be serviced or replaced.

Especially in industrial automation technology, geared motors are system-relevant components and therefore very important for predictive analysis. One way to infer the service life of a geared motor is based on the loads to which the gear unit is subjected during its lifetime.

STOBER Predictive Maintenance monitors your connected geared motor. Its life performance is calculated using a model-based analysis procedure and mapped in parameters. These parameters can be displayed via the higher-level controller or in the DriveControlSuite commissioning software. This allows you to plan maintenance optimally and proactively. The solution includes 3 essential components. The load matrix is a solid data base for recording the real-world load situations of your machine and improving quality and economic efficiency. The life performance indicator is the value for the calculated life performance of the geared motor. The recommendation to replace the geared motor can be displayed in DriveControlSuite and is also provided to the controller as a parameter that can be read out.

STOBER Predictive Maintenance is automatically active for STOBER geared motors with an electronic nameplate as of production date 04/2022. For geared motors from STOBER without an electronic nameplate or for older STOBER geared motors, monitoring can be activated manually in the DriveControlSuite commissioning software by using a wizard (V 6.5-G and later and associated firmware in V 6.5-G and later).

Your advantages at a glance

- Prognosis of the optimal time for maintenance
- Extension of the maintenance intervals
- Reduction of spare part inventories through controlled procurement
- Service concepts

STOBER Predictive Maintenance requires no additional external sensors, no additional wiring and no additional components.

17.1 Legal disclaimer

As of 2022 in DriveControlSuite in V 6.5-G or later, functions that estimate the aging and wear of the components used have been implemented in the STOBER system.

The estimates are used to make various kinds of predictions to provide support for decisions about preventative replacement. This computer-based support is usually called Predictive Maintenance or something similar.

As development matures, this support is expected to become increasingly precise. On the one hand, this is partly due to the growing statistical knowledge of STOBER. On the other hand, the algorithms are also refined over time and the number of sensors used increases.

Nevertheless, statistical errors are to be expected. In principle, there are two types of errors:

- False positive: The algorithm predicts failure in the future, although damage has already occurred in the system.
- False negative: The algorithm recommends replacement although the service life is evidently still long.

By using this function, it is acknowledged that the occurrence of statistical errors is typical of the system and is not cause for any liability on the part of the manufacturer. There is no entitlement to compensation for damages due to a miscalculation by the algorithm.

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17.2 Displaying the state

Open the corresponding wizard in DriveControlSuite if you want to check the state of Predictive Maintenance and the relevant parameters.

✓ The drive controller is switched on and connected to the network.

✓ There is an online connection between DriveControlSuite and the drive controller.

1. Select the respective drive controller in the project tree and in the Project menu > Wizard area click on the configured axis whose monitoring you would like to check.
2. Select the Predictive Maintenance wizard.

⇨ The state is displayed directly as an icon with a corresponding note.

⇨ R100 PM state:
Indicates the state of Predictive Maintenance; if R100 = 0: Inactive, you must manually configure STOBER Predictive Maintenance.

⇨ R101 PM life performance indicator:
Displays the calculated life performance of the geared motor; from a value ≥ 90%, replacement of the geared motor is recommended.

⇨ R112 PM gear unit designation:
Displays the type designation of the geared motor being monitored in Predictive Maintenance.

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17.3 Sending the load matrix

Open the associated wizard in DriveControlSuite and send the load matrix to STOBER, for example, if you need assistance with data analysis. With an existing online connection, parameter R118 is read from the drive controller and sent as a JSON file. In offline mode, you can send a load matrix already exported in JSON format.

Information

It is not possible to infer specific machine cycles based on the load matrix. The load matrix contains only highly condensed, statistical features.

Sending the load matrix

✓ The drive controller is switched on and connected to the network.

✓ There is an online connection between DriveControlSuite and the drive controller.

1. Select the relevant drive controller in the project tree and in the Project menu > Wizard area click on the configured axis whose load matrix you want to send to STOBER.
2. Select the Predictive Maintenance wizard.
3. Click Send load matrix.
   ⇨ The Send load matrix dialog box opens.
   ⇨ The source, destination and amount of data of the current load matrix are displayed.
4. Click Proxy settings.
   ⇨ The Proxy settings dialog box opens.
5. Select the desired option for the proxy setting.
   For manual proxy configuration:
   5.1. If you are using a proxy server, specify the name of the proxy server or the IP address in the address field and the port of the proxy server in the Port field.
   5.2. If you are using a proxy server with a login, also specify the username and password for login.
   5.3. Use Test connection to make sure that a connection to the proxy server is possible.
6. Confirm with OK.
   ⇨ The Proxy settings dialog box closes.
7. In the Send load matrix dialog box, click Send.
   ⇨ The sending process starts and the data is transmitted to STOBER.
8. Close the dialog box after sending has been completed successfully.

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Sending the load matrix (export)

✓ You have exported the load matrix in JSON format.

1. Select the relevant drive controller in the project tree and in the Project menu > Wizard area click on the projected axis whose exported load matrix you want to send to STOBER.
2. Select the Predictive Maintenance wizard.
3. Click Send load matrix (export).
   ⇨ The dialog box for selecting the file opens.
4. Navigate to the load matrix previously exported in JSON format and select it.
5. Click Open.
   ⇨ The Send load matrix (export) dialog box opens.
   ⇨ The source, destination and data volume of the current load matrix are displayed in the dialog box.
6. Click Proxy settings.
   ⇨ The Proxy settings dialog box opens.
7. Select the desired option for the proxy setting.
   For manual proxy configuration:
   7.1. If you are using a proxy server, specify the name of the proxy server or the IP address in the address field and the port of the proxy server in the Port field.
   7.2. If you are using a proxy server with a login, also specify the username and password for login.
   7.3. Use Test connection to make sure that a connection to the proxy server is possible.
8. Confirm with OK.
   ⇨ The Proxy settings dialog box closes.
9. In the Send load matrix dialog box, click Send.
   ⇨ The sending process starts and the data is transmitted to STOBER.
10. Close the dialog box after sending has been completed successfully.

17.4 Exporting the load matrix

If you want to review or analyze the data, use the associated DriveControlSuite wizard to export the load matrix. If an online connection exists, parameter R118 is read directly from the drive controller for export. If the data in your project is already available in DriveControlSuite, you can also export the data in offline mode.

1. Select the relevant drive controller in the project tree and in the Project menu > Wizard area click on the projected axis whose load matrix you want to export.
2. Select the Predictive Maintenance wizard.
3. Click Export load matrix.
   ⇨ The Export load matrix dialog box opens.
4. Select the directory to which you want to export the load matrix.
5. Select the desired file type (JSON or CSV).
6. Assign a file name and select `.json` or `.csv` as the file extension.
7. Confirm with Save.

⇨ The load matrix is saved as a JSON or CSV file (*.json, *.csv).

17.5 Configuring Predictive Maintenance

STOBER Predictive Maintenance is automatically active for STOBER geared motors with an electronic nameplate as of production date 04/2022. Configure monitoring in DriveControlSuite only in the following cases:

- STOBER geared motors with a manufacturing date prior to 04/2022
- STOBER geared motors without an electronic nameplate

In the cases mentioned above, Predictive Maintenance is inactive. First check the status of Predictive Maintenance with an existing online connection (see Displaying the state [▶ 199]). If R100 = 0: Inactive, you can then carry out the manual configuration in offline mode.

Configuring Predictive Maintenance via the serial number

✓ You have the serial number of the gear unit.

1. Select the relevant drive controller in the project tree and click on the first projected axis in the Project menu > Wizard area.
2. Select the Predictive Maintenance wizard.
3. Click Configure Predictive Maintenance (Internet).
   ⇨ The Configure Predictive Maintenance (Internet) dialog box opens.
4. Click Proxy settings.
   ⇨ The Proxy settings dialog box opens.
5. Select the desired option for the proxy setting.
   For manual proxy configuration:
   5.1. If you are using a proxy server, specify the name of the proxy server or the IP address in the address field and the port of the proxy server in the Port field.
   5.2. If you are using a proxy server with a login, also specify the username and password for login.
   5.3. Use Test connection to make sure that a connection to the proxy server is possible.
6. Confirm with OK.
   ⇨ The Proxy settings dialog box closes.
7. Enter the serial number of your gear unit in the Configure Predictive Maintenance (Internet) dialog box.
8. Click Start download.
   ⇨ The data is downloaded and automatically written to the associated parameters.
9. After a successful download, confirm with OK
10. Repeat the steps for the 2nd axis (only for double-axis controllers).

⇨ You have activated Predictive Maintenance.

Then transfer the configuration to the drive controller, save it and restart the drive controller (see Transmitting and saving the configuration [▶ 155]).

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Configuring Predictive Maintenance manually

If automatic configuration via the serial number fails, you can alternatively configure Predictive Maintenance manually.

Information

The required information can be found in the order confirmation for your gear unit, for example. Alternatively, you can scan the QR code on the nameplate or retrieve it online using the serial, delivery note or invoice number at: https://id.stober.com.

✓ The order confirmation is available to you or you have access to the electronic product ID of your gear unit.

1. Select the relevant drive controller in the project tree and click on the first projected axis in the Project menu > Wizard area.
2. Select the Predictive Maintenance wizard.
3. Click Configure Predictive Maintenance (local).
   ⇨ The Configure Predictive Maintenance (local) dialog box opens.
4. Click Proxy settings.
   ⇨ The Proxy settings dialog box opens.
5. Select the desired option for the proxy setting.
   For manual proxy configuration:
   5.1. If you are using a proxy server, specify the name of the proxy server or the IP address in the address field and the port of the proxy server in the Port field.
   5.2. If you are using a proxy server with a login, also specify the username and password for login.
   5.3. Use Test connection to make sure that a connection to the proxy server is possible.
6. Confirm with OK.
   ⇨ The Proxy settings dialog box closes.
7. Select the series of your gear unit.
8. Select the size of your gear unit.
9. Then select your gear unit from the list.
10. Confirm with OK.
11. Repeat the steps for the 2nd axis (only for double-axis controllers).

⇨ You have activated Predictive Maintenance manually.

Then transfer the configuration to the drive controller, save it and restart the drive controller (see Transmitting and saving the configuration [▶ 155]).

The following tables provide an overview of the abbreviations used for manual configuration.

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Bearing design

Abbreviation	Meaning
N	Standard bearing
V	Reinforced bearing (e.g: PH3 – PH5)
D	Axially reinforced bearing
Z	Radially reinforced bearing

Tab. 154: Bearing design features

Shaft design

Abbreviation	Meaning
A	Hollow shaft with keyway
S	Hollow shaft with shrink ring
SB	Hollow shaft S on both sides
V	Solid shaft with feather key
G	Solid shaft without a feather key
B	Solid shaft on both sides
Q	Solid shaft without key with transverse bore
P	Solid shaft with feather key
F	Flange shaft

Tab. 155: Shaft design features

Shaft/pinion position

Abbreviation	Meaning
00	Not applicable
A3	Hollow shaft entry side 3
A4	Hollow shaft entry side 4
G3	Solid shaft without a feather key side 3
G4	Solid shaft without a feather key side 4
S3	Shrink ring side 3
S4	Shrink ring side 4
S34	Shrink ring side 3 and 4
V3	Solid shaft side 3
V4	Solid shaft side 4

Tab. 156: Shaft/pinion position features

Gear unit option

Abbreviation	Meaning
00	Not applicable
T3	Crown gear side 3
T4	Crown gear side 4

Tab. 157: Gear unit option features

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17.6 Information on activation, operation and replacement

Pay attention to the following information on activating STOBER Predictive Maintenance and for operating and replacing components.

Activation

The following requirements apply for successful activation of STOBER Predictive Maintenance:

- STOBER system (consisting of drive controllers and geared motors from STOBER)
- Automatic activation for geared motors with a manufacturing date as of 04/2022
- Manual configuration required for geared motors with an older manufacturing date or geared motors without an electronic nameplate
- Plugged-in SD card for non-volatile storage of the load matrix
- Gear units not connected in series, as this is not supported by the life performance indicator

Operation

STOBER Predictive Maintenance is continued without interruption after restarting the drive controller if the following requirements are met:

- SD card permanently inserted in the drive controller
- Uninterrupted connection of drive controller and geared motor
- Constant gear ratio of the gear unit (Drive Based/PROFIdrive: C15, C16, CiA 402: A584)

Replacement

After replacing the geared motor, a new record is created. The existing data is not overwritten. With the original data, the drive controller is able to continue monitoring the geared motor after the geared motor has been replaced.

After the drive controller has been replaced, monitoring can be continued without interruption by transferring the data from the SD card.

17.7 More about Predictive Maintenance?

The following chapters summarize the essential terms of STOBER Predictive Maintenance and provide you with further relevant information on the subject.

17.7.1 Load matrix

The load matrix represents the data base for recording the real-world load situations of machines and improving the quality and economic efficiency. It represents the frequency distribution of speeds and torques that occurred at the output of the geared motor. The load matrix and other information are stored in DriveControlSuite in parameter R118. The information relevant for Predictive Maintenance is also made available to the controller via this parameter.

Information

The load matrix is only recorded if the axis is enabled (A900 = 1).

The load matrix is stored in non-volatile memory on the SD card along with the life performance indicator every 30 minutes.

Structure and scope

The load matrix divides speed and torque into equidistant classes. For the speed, 21 classes are available for both directions of rotation. The speed range covers -150% to +150% of the nominal speed. For the torque, 31 classes are available for the torque range from -250% to +250% of the nominal torque.

The nominal speed and nominal torque of the load matrix refer to the gear unit output of the geared motor.

The speed range includes:

$-1.5 \times n_{2N}$ to $+1.5 \times n_{2N}$

The speed is stored in rpm.

The torque range includes:

$-2.5 \times M_{2N}$ to $+2.5 \times M_{2N}$

The torque is stored in %. The reference value for the percentage torque value is C09.

Torques and speeds outside the respective specified range are assigned to the outermost class:
Values that fall below the lower limit are sorted into the lowest class. Values that exceed the upper limit are sorted into the highest class.

Scaling

The recorded speed classes are scaled as follows, with the label representing the average of the two class limits in each case:

-150 %	-135 %	-120 %	-105 %	-90 %	-75 %	-60 %	-45 %	-30 %	-15 %	0 %	15 %	30 %	45 %	60 %	75 %	90 %	105 %	120 %	135 %	150 %

Fig. 55: Scaling of the recorded speed classes

The recorded torque classes are scaled as follows, with the label representing the average of the two class limits in each case:

-250 %	-233,33 %	-216,67 %	-200 %	-183,33 %	-166,67 %	-150 %	-133,33 %	-116,67 %	-100 %	-83,33 %	-66,67 %	-50 %	-33,33 %	-16,67 %	0 %	16,67 %	33,33 %	50 %	66,67 %	83,33 %	100 %	116,67 %	133,33 %	150 %	166,67 %	183,33 %	200 %	216,67 %	233,33 %	250 %

Fig. 56: Scaling of the recorded torque classes

Data export or data transmission

From the DriveControlSuite commissioning software, the load matrix can be exported in JSON data format (*.json) or in CSV data format (*.csv).

Alternatively, you can send the load matrix to STOBER for analysis (see Reading out and transmitting the load matrix [▶ 211]).

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17.7.1.1 Information on the load matrix

The load matrix is stored in DriveControlSuite in parameter R118 along with the life performance indicator in JSON data format. The parameter contains all the information necessary to understand the load matrix:

Key	Value	Description
"version"	String	Version name of the JSON format
"id"	String	ID for the type of JSON document
"mcgm-database-id"	Number	Database ID of the parameterized geared motor
"paramodul-sn"	String	Number on the SD card (generated upon first use and acts as identification)
"encoder-type"	Number	Type of connected encoder (0: none, 1: incremental, 2: SSI, 3: EnDat, 4: HIPERFACE, 5: Resolver)
"gearmotor-type"	String	Geared motor type
"drive-controller-type"	String	Drive controller type
"reference"	String	Reference of the drive controller
"user"	String	Person who created the project configuration
"motor-type"	String	Motor type
"axis-number"	Number	Axis number (0/1)
"operating-time-h"	Number	Hour value of the operating time
"operating-time-m"	Number	Minute value of the operating time
"operating-time-s"	Number	Seconds value of the operating time
"operating-time"	Number	Operating hours
"motor-serial-number"	Number	Serial number of the motor
"gearbox-serial-number"	Number	Serial number of the gear unit
"encoder-serial-number"	Number	Encoder serial number
"drive-production-number"	Number	Production number of the drive controller according to nameplate (S/N)
"t-reference"	Number	Reference torque for "t-average" and "t-limits"
"t-reference-unit"	String	Unit of reference torque for "t-average" and "t-limits"
"t-limits"	Array of numbers	Load matrix: upper limits of the torque classes
"t-limit-unit"	String	Load matrix: unit of the upper limits of the torque classes
"n-limits"	Array of numbers	Load matrix: upper limits of the speed classes
"n-limit-unit"	String	Load matrix: unit of the upper limits of the speed classes
"t-average"	Array of numbers	Load matrix: mean value of the class limits of the torque classes
"t-average-unit"	String	Load matrix: unit of the mean value of the class limits of the speed classes
"n-average"	Array of numbers	Load matrix: mean value of the class limits of the speed classes
"n-average-unit"	String	Load matrix: unit of the mean value of the class limits of the torque classes
"t-bucket-count"	Number	Load matrix: number of torque classes
"n-bucket-count"	Number	Load matrix: number of speed classes
"time-resolution"	String	Load matrix: resolution
"life-work-indicator"	Number	Value of the life performance indicator
"load-matrix"	Array of numbers	Two-dimensional array containing the load matrix; torque is applied to the rows and speed to the columns

Tab. 158: Information on the load matrix

The following characters or control characters are not allowed in the values of the load matrix:

Symbol	Description
"	Quotation marks
\	Backslash
\b	Backspace
\f	Form feed
\n	Line feed
\r	Carriage return
\t	Horizontal tab character

Tab. 159: Load matrix: impermissible characters or control characters

17.7.1.2 Example of a load matrix in JSON format

The following example shows a load matrix in JSON format.


```
{
"version":"1.0",
"id":"LoadMatrix",
"mcgm-database-id":3156,
"paramodul-sn":"3522274995",
"gearmotor-type":"ZR330SPH531SFSS0050EZ505U",
"encoder-type":3,
"drive-controller-type": "SD6A36",
"reference": "T1",
"user": "gerhardt.gearhead",
"motor-type":"ED212U",
"axis-number":0,
"operating-time-h":2974,
"operating-time-m":1,
"operating-time-s":41,
"operating-time":11706624,
"motor-serial-number":183989938,
"gearbox-serial-number":183989938,
"encoder-serial-number":40925454,
"drive-production-number":7000561,
"t-reference":120.12345,
"t-reference-unit": "Nm",
"t-limits":
[-2.416667,-2.250000,-2.083333,-1.916667,-1.750000,-1.583333,-1.416667,-1.250000,-1
.083333,-0.916667,-0.750000,-0.583333,-0.416667,-0.250000,-0.083333,0.083333,0.2500
00,0.416667,0.583333,0.750000,0.916667,1.083333,1.250000,1.416667,1.583333,1.750000
,1.916667,2.083333,2.250000,2.416667,2.583333],
"t-limit-unit": "%",
"n-limits":
[-4275.000000,-3825.000000,-3375.000000,-2925.000000,-2475.000000,-2025.000000,-157
5.000000,-1125.000000,-675.000000,-225.000000,225.000000,675.000000,1125.000000,157
5.000000,2025.000000,2475.000000,2925.000000,3375.000000,3825.000000,4275.000000,47
25.000000],
"n-limit-unit": "rpm",
"t-average":
[-2.500000,-2.333333,-2.166667,-2.000000,-1.833333,-1.666667,-1.500000,-1.333333,-1
.166667,-1.000000,-0.833333,-0.666667,-0.500000,-0.333333,-0.166667,-0.000000,0.166
667,0.333333,0.500000,0.666667,0.833333,1.000000,1.166667,1.333333,1.500000,1.66666
7,1.833333,2.000000,2.166667,2.333333,2.500000],
"t-average-unit": "%",
"n-average":
[-900.000000,-810.000000,-720.000000,-630.000000,-540.000000,-450.000000,-360.00000
0,-270.000000,-180.000000,-90.000000,0.000000,90.000000,180.000000,270.000000,360.0
00000,450.000000,540.000000,630.000000,720.000000,810.000000,900.000000],
"n-average-unit":"rpm",
"t-bucket-count":31,
```


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```
"n-bucket-count":21,
"time-resolution":"1us",
"life-work-indicator":0.000280,
"load-matrix":
[
[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ],
[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ],
[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ],
[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ],
[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ],
[0, 0, 0, 0, 1000, 3000, 4000, 4000, 3000, 4000, 1000, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, ],
[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ],
[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 2000, 4000, 4000, 3000, 4000, 3000, 0, 0, 0, 0,
0, ],
[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ],
[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ],
[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ],
[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ],
[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ],
[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ],
[0, 0, 0, 0, 20000, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ],
[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 41000, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ],
[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 20000, 0, 0, 0, 0, ],
[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ],
[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ],
[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ],
[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ],
[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ],
[0, 0, 0, 0, 0, 3000, 4000, 4000, 3000, 4000, 2000, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, ],
[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ],
[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1000, 4000, 4000, 3000, 4000, 3000, 1000, 0, 0, 0,
0, ],
[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ],
[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ],
[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ],
[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ],
[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ],
]
}
```

17.7.2 Life performance indicator

The life performance indicator is the value for the calculated life performance of the geared motor. No additional external sensor is required to determine it. In DriveControlSuite, the life performance indicator is displayed in the Predictive Maintenance wizard (R101). Values below 100% mean that the geared motor is being operated within its life performance. For values above 100%, the probability of failure increases. From a value of 90%, it is recommended to replace the geared motor and a corresponding message is output in parameter R100.

Information

Increasing values do not mean that there is damage to the geared motor. Operation of the geared motor is also possible at values > 100%.

Information

The life performance indicator is calculated and updated only if the axis is enabled (A900 = 1).

The life performance indicator is stored in non-volatile memory in the drive controller every 10 minutes, and on the SD card together with the load matrix every 30 minutes. The A00 Save values action does not influence the calculation and updating of the life performance indicator.

The life performance indicator increases monotonically: faster with greater load, slower with lesser load.

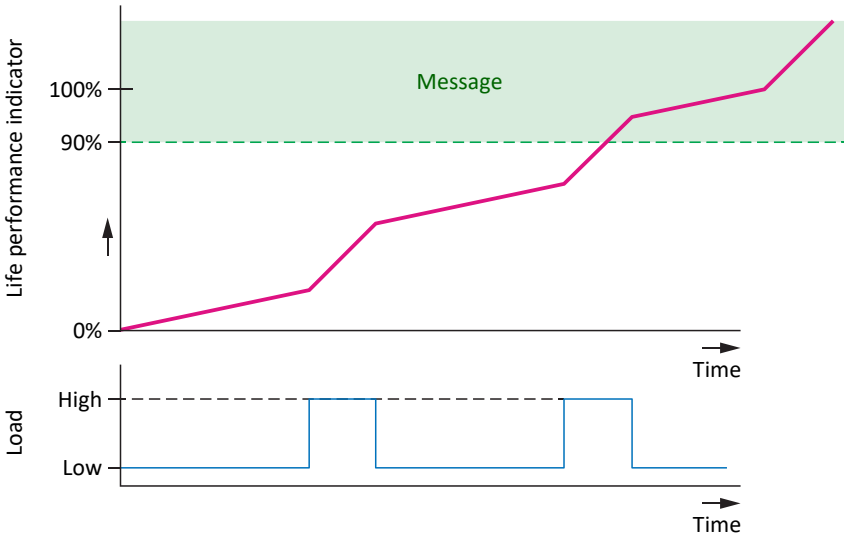

Fig. 57: Signaling area

The algorithm for the life performance indicator is continuously being developed by STOBER.

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17.7.3 Recommendation for geared motor replacement

The recommendation to replace the geared motor is displayed in DriveControlSuite in the Predictive Maintenance wizard (R100). The recommendation is triggered when STOBER Predictive Maintenance is active and the life performance indicator reaches a value ≥ 90% (R101).

17.7.4 Reading out and transmitting the load matrix

Would you like to know more about the real-world load situation of your machine and its optimization potential? Would you like to support the further development of our algorithm? If you send us your load matrix, we will help you in analyzing or visualizing your data. We will also be able to take your specific machine behavior into consideration for further development.

Information

It is not possible to infer specific machine cycles based on the load matrix. The load matrix contains only highly condensed, statistical features.

Reading out data

The following graphic describes the 3 options for reading out the data.

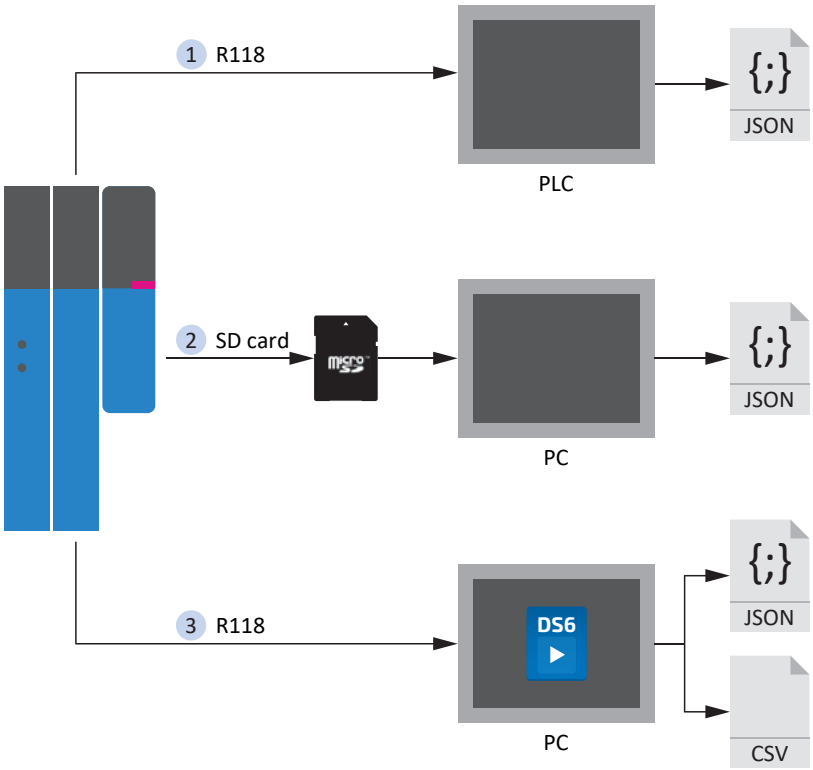

Fig. 58: Predictive Maintenance: Options for readout

1. Via the controller (in preparation)

STOBER provides a function block for controllers in accordance with IEC 61131-3. The function block enables the controller to read out parameter R118 and write it to a JSON file.

2. From the SD card

You can read out the data on your PC directly from the SD card.

The JSON files are stored in the following form:

- If a serial number is available for the motor, it is used for the file name
- If no serial number is available for the motor, the file name consists of 8 characters (hexadecimal)

File name	Example
PRM\[Serial number].PXX	03774434.P00
PRM\[8 characters].PXX	0BB5A846.P00

Tab. 160: Predictive Maintenance files on SD card

To avoid data loss, the files are each stored twice on the SD card.

The file extensions have the following meaning:

File extension	Meaning
P00	JSON for axis 1
P01	JSON for axis 1 (backup)
P10	JSON for axis 2
P11	JSON for axis 2 (backup)

Tab. 161: Meaning of file extensions on SD card

3. Via DriveControlSuite

Use the associated wizard in DriveControlSuite to export the load matrix. For the export, parameter R118 is read out from the drive controller (if an online connection exists) or from your project (in offline mode).

Transmitting the data

You can provide the data to STOBER via upload through DriveControlSuite or by email to prm_data@stober.de.

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18 Diagnostics

LEDs on the top and front give you initial information about the device state of the respective device as well as the states of the physical connection and the communication. In the event of an error or fault, you will receive detailed information through the DriveControlSuite commissioning software.

18.1 Drive controllers

STOBER drive controllers have diagnostic LEDs that visually indicate the state of the drive controller as well as the states of the physical connection and communication.

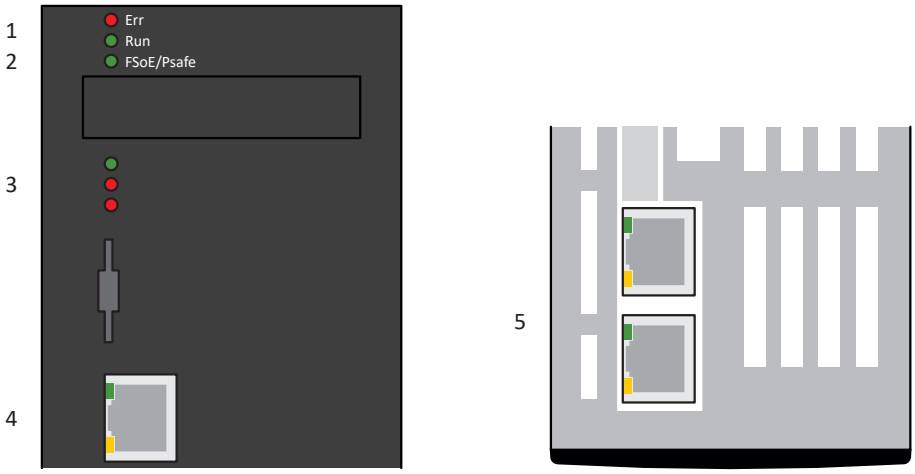

Fig. 59: Positions of the diagnostic LEDs on the front and top of the drive controller

1 Fieldbus state
2 FSoE or PROFIsafe state
3 Drive controller state
4 Service network connection
5 Fieldbus network connection

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18.1.1 State of the fieldbus and safety technology

The LEDs for diagnosing the fieldbus state and the safety technology vary depending on the fieldbus system and safety module used.

18.1.1.1 EtherCAT state

There are 2 LEDs on the front of the drive controller that provide information about the connection between EtherCAT master and slave and about the state of the data exchange. This information can also be read out in parameter A255. If the drive controller includes the SY6 safety module, the STO and SS1 safety functions are activated via EtherCAT FSoE. In this case, an additional LED on the front of the device provides information about the FSoE state.

Fig. 60: LEDs for the EtherCAT state

1 Red: Error
2 Green: Run

Red LED	Conduct	Error	Description
	Off	No Error	No error
	Flashing	Invalid Configuration	Invalid configuration
	Single flash	Unsolicited State Change	The EtherCAT slave changed operating states by itself
	2x flash	Application Watchdog Timeout	The EtherCAT slave did not receive new PDO data during the configured watchdog timeout

Tab. 162: Meaning of the red LED (error)

Green LED	Conduct	Operating state	Description
	Off	Init	No communication between the EtherCAT master and slave; the configuration starts, saved values are loaded
	Flashing	Pre-operational	No PDO communication; the EtherCAT master and slave exchange application-specific parameters via SDOs
	1x flash	Safe-operational	The EtherCAT slave sends the current actual values to the EtherCAT master, ignores its set values and refers to internal default values
	On	Operational	Normal operation: The EtherCAT master and slave exchange set and actual values

Tab. 163: Meaning of the green LED (Run)

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18.1.1.2 FSoE state

If the drive controller includes the SY6 safety module, the STO and SS1 safety functions are activated via EtherCAT FSoE. In this case, an LED on the front of the device provides information about the state of FSoE communication. This information can also be read out in parameter S20 FSoE status indicator.

Fig. 61: LED for the FSoE state

1 Green: FSoE

Green LED	Conduct	Description
	Off	Initialization
	Flashing	Ready for parameterization
	On	Normal operation
	Single blink	Failsafe command from FSoE master received
	Rapid flashing	Undefined connection error
	Rapid flashing with 1x flash	Error in the safety-related communication settings
	Rapid flashing with 2x flash	Error in the safety-related application settings
	Rapid flashing with 3x flash	Incorrect FSoE address
	Rapid flashing with 4x flash	Prohibited command received
	Rapid flashing with 5x flash	Watchdog error
	Rapid flashing with 6x flash	CRC error

Tab. 164: Meaning of the green LED (FSoE status indicator in accordance with IEC 61784-3)

18.1.1.3 PROFINET state

There are 2 LEDs on the front of the drive controller that provide information about the connection between controller and drive controller and about the state of the data exchange. This information can also be read out in parameter A271 PN state.

Fig. 62: LEDs for the PROFINET state

1 Red: BF (bus error)

2 Green: Run

Red LED	Conduct	Description
	Off	No error
	Rapid flashing	Data exchange with controller not active
	On	No network connection

Tab. 165: Meaning of the red LED (BF)

Green LED	Conduct	Description
	Off	No connection
	Single blink	Connection is set up to controller
	Single blink, inverse	Controller activates DHCP signal service
	Flashing	Existing connection to controller; data exchange expected
	On	Existing connection to controller

Tab. 166: Meaning of the green LED (Run)

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18.1.1.4 PROFIsafe status

If the drive controller includes the SU6 safety module, the STO and SS1 safety functions are activated via PROFIsafe. In this case, an LED on the front of the device provides information about the status of PROFIsafe communication. This information can also be read out in parameter S40 PROFIsafe state.

Fig. 63: LEDs for the PROFIsafe status

1 Green: PROFIsafe

Green LED	Conduct	Description
	Off	Initialization
	Flashing	Ready for parameterization by controller (F-CPU)
	On	Normal operation
	Rapid flashing with 1x flash	Error in the safety-related communication settings
	Rapid flashing with 2x flash	Error in the safety-related application settings
	Rapid flashing with 3x flash	Incorrect PROFIsafe destination address
	Rapid flashing with 5x flash	Interruption of the PROFIsafe connection (watchdog error)
	Rapid flashing with 6x flash	Error in the transmission of the PROFIsafe data (CRC error)

Tab. 167: Meaning of the green LED (PROFIsafe status indicator in accordance with IEC 61784-3)

Information

Parameter S40 PROFIsafe state contains detailed information about the PROFIsafe communication status. The value of S40 can be read off in PROFINET wizard > Monitoring: PROFIsafe in DriveControlSuite.

18.1.2 Drive controller state

3 LEDs on the front of the device provide information about the state of the drive controller.

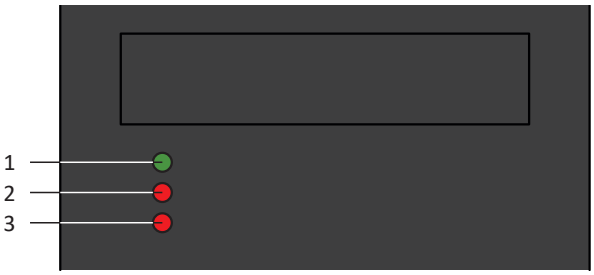

Fig. 64: LEDs for the state of the drive controller

1 Green: Run
2 Red: Error in axis controller A
3 Red: Error in axis controller B (only for double-axis controllers)

Green LED	Conduct	Description
	Off	No supply voltage or axis controller A or B faulty **With firmware version 6.5-H or later**: No supply voltage, axis controller A or B faulty or STO for axis controller A or B active
	Single blink	STO active for both axis controllers **With firmware version 6.5-H or later**: Green LED stops flashing
	Flashing	Both axis controllers ready to switch on (E48 = 2: Ready for switch-on); no axis controller faulty
	On	At least 1 axis controller enabled (E48 = 4: Enabled); no axis controller faulty
	Rapid flashing	Data is written to internal memory and the SD card

Tab. 168: Meaning of the green LED (Run)

Red LED	Conduct	Description
	Off	No error or event
	Single blink	**With firmware version 6.5-H or later**: STO for axis controller active
	Flashing	Axis controller has a warning
	On	Axis controller faulty **With firmware version 6.5-H or later**: Axis controller faulty, no STO active
	Single blink, inverse	**With firmware version 6.5-H or later**: Axis controller faulty, STO active
	Rapid flashing	No configuration active

Tab. 169: Meaning of the red LEDs (error)

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Pattern when starting the drive controller

LEDs: Green/Red/Red	Conduct	Description
	On	Short phase while the firmware starts up
	On	
	On	

Tab. 170: States of the LEDS when starting the drive controller

Pattern when transferring a firmware file using DriveControlSuite

The states of the green and red LEDs also apply as described during a firmware file transfer using DriveControlSuite.

Pattern when transferring a firmware file using an SD card

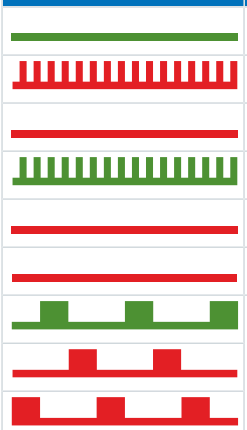
When a firmware file is being transferred using an SD card, the three LEDs flash in various combinations and frequencies:

LEDs: Green/Red/Red	Conduct	Description
	Off	Deleting the second firmware memory on the drive controller
	Rapid flashing	
	Rapid flashing	
	Rapid flashing	Copying the firmware from the SD card to the second firmware memory of the drive controller
	Rapid flashing	
	Rapid flashing	
	Single blink	Copying process completed successfully; drive controller has to be restarted
	Off	
	Off	
	Off	Error during copying process; remove card and restart drive controller
	Single blink	
	Off	

Tab. 171: States of the LEDs when using an SD card to transfer a firmware file

Pattern after transferring a firmware file and restarting the drive controller

After restarting the drive controller (see pattern when starting the drive controller) during a firmware update, the three LEDs flash in various combinations and frequencies:

LEDs: Green/Red/Red	Conduct	Description
	Off	Deleting the first firmware memory
	Rapid flashing	
	Off	
	Rapid flashing	Copying the second firmware memory into the first
	Off	
	Off	
	Chaser light	Error during firmware update; service required

Tab. 172: States of the LEDs after transferring a firmware file and restarting the drive controller

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18.1.3 Service network connection

The LEDs at X9 on the front of the device display the state of the service network connection.

Fig. 65: LEDs for the state of the service network connection

1 Green: Link
2 Yellow: Activity

Green LED	Behavior	Description
	Off	No network connection
	On	Network connection present

Tab. 173: Meaning of the green LED (link)

Yellow LED	Behavior	Description
	Off	No network connection
	Flashing	Individual data packets are sent or received
	On	Active data exchange

Tab. 174: Meaning of the yellow LED (act.)

18.1.4 Fieldbus network connection

The LEDs for communication diagnostics vary depending on implemented fieldbus system or communication module.

18.1.4.1 EtherCAT network connection

The LEDs LA $_{EC}$IN and LA $_{EC}$OUT at X200 and X201 on the top of the device indicate the state of the EtherCAT network connection.

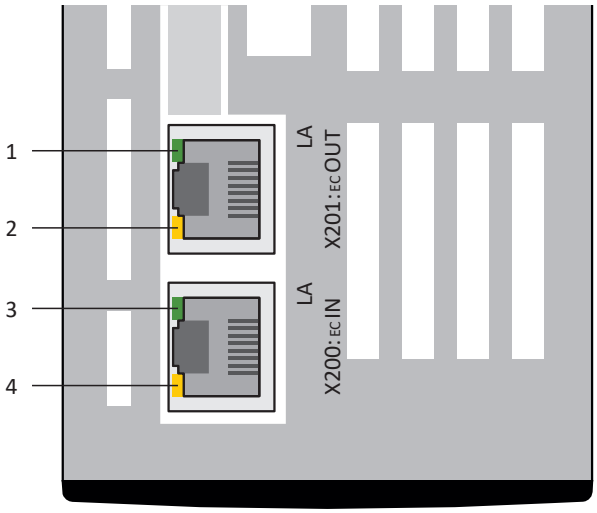

Fig. 66: LEDs for the state of the EtherCAT network connection

1 Green: LA $_{EC}$OUT at X201
2 Yellow: No function
3 Green: LA $_{EC}$IN at X200
4 Yellow: No function

Green LED	Behavior	Description
	Off	No network connection
	Flashing	Active data exchange with other EtherCAT nodes
	On	Network connection exists

Tab. 175: Meaning of the green LEDs (LA)

18.1.4.2 PROFINET network connection

The Act. and Link LEDs at X200 and X201 on the top of the device indicate the state of the PROFINET network connection.

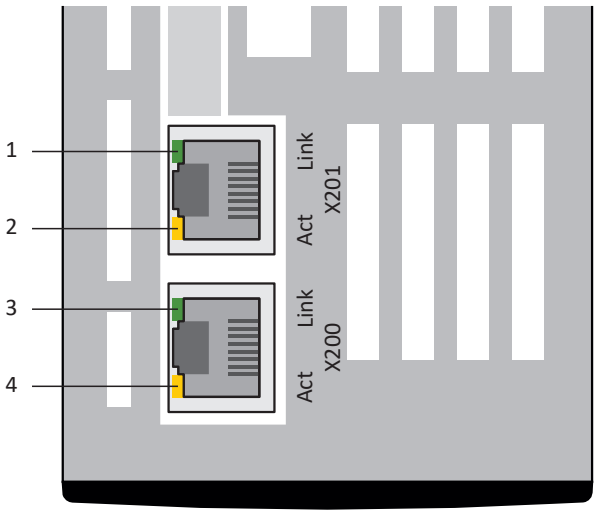

Fig. 67: LEDs for the state of the PROFINET network connection

1 Green: Link at X201
2 Yellow: Activity at X201
3 Green: Link at X200
4 Yellow: Activity at X200

Green LED	Conduct	Description
	Off	No network connection
	On	Network connection exists

Tab. 176: Meaning of the green LEDs (Link)

Yellow LED	Conduct	Description
	Off	No data exchange
	Flashing	Active data exchange with controller

Tab. 177: Meaning of the yellow LEDs (Act.)

18.1.5 Events

The drive controller has a self-monitoring system that uses test rules to protect the drive system from damage. Violating the test rules triggers a corresponding event. There is no possible way for you as the user to intervene in some events, such as the Short/ground event. In others, you can influence the effects and responses.

Possible effects include:

- Message: Information that can be evaluated by the controller
- Warning: Information that can be evaluated by the controller and becomes a fault after a defined time span has elapsed without the cause being resolved
- Fault: Immediate drive controller response; the power unit is disabled and axis movement is no longer controlled by the drive controller or the axis is brought to a standstill by a quick stop or emergency braking

ATTENTION!

Damage to property due to interruption of a quick stop or emergency braking!

If, when executing a quick stop or emergency braking, a fault occurs or STO is active, the quick stop or emergency braking is interrupted. In this case, the machine can be damaged by the uncontrolled axis movement.

Events, their causes and suitable measures are listed below. If the cause of the error is corrected, you can usually acknowledge the error immediately. If the drive controller has to be restarted instead, a corresponding note can be found in the measures.

Information

To make it easier for control programmers to set up the human-machine interface (HMI), a list of events and their causes can be found in the STOBER download center at http://www.stoeber.de/en/downloads/.

18.1.5.1 Overview

The following table shows the possible events at a glance.

Event
Event 31: Short/ground [▶ 227]
Event 32: Short/ground internal [▶ 227]
Event 33: Overcurrent [▶ 228]
Event 34: Hardware fault [▶ 229]
Event 35: Watchdog [▶ 229]
Event 36: High voltage [▶ 230]
Event 37: Motor encoder [▶ 231]
Event 38: Temperature drive controller sensor [▶ 234]
Event 39: Overtemperature drive controller i2t [▶ 235]
Event 40: Invalid data [▶ 236]
Event 41: Temp.MotorTMP [▶ 237]
Event 42: TempBrakeRes [▶ 238]
Event 44: External fault 1 [▶ 239]
Event 45: Overtemp.motor i2t [▶ 240]
Event 46: Low voltage [▶ 241]
Event 47: Torque/force-max. limit [▶ 242]
Event 50: Safety module [▶ 243]
Event 51: Virtual master software limit switch [▶ 244]
Event 52: Communication [▶ 245]
Event 53: Limit switch [▶ 246]
Event 54: Following error [▶ 247]
Event 56: Overspeed [▶ 248]
Event 57: Runtime requirement [▶ 249]
Event 59: Overtemperature drive controller i2t [▶ 250]
Event 60: Application event 0 – Event 67: Application event 7 [▶ 251]
Event 68: External fault 2 [▶ 252]
Event 69: Motor connection [▶ 253]
Event 70: Parameter consistency [▶ 254]
Event 71: Firmware [▶ 256]
Event 72: Brake test timeout [▶ 257]
Event 76: Position encoder [▶ 258]
Event 77: Master encoder [▶ 261]
Event 78: Position limit cyclic [▶ 263]
Event 79: Motor/position encoder plausibility [▶ 264]
Event 80: Illegal action [▶ 265]
Event 81: Motor allocation [▶ 266]
Event 83: Failure of one/ all phases (mains) [▶ 267]
Event 84: Drop in network voltage when power section active [▶ 268]

Event
Event 85: Excessive jump in reference value [▶ 269]
Event 86: Unknown LeanMotor record [▶ 270]
Event 87: Reference lostReference loss [▶ 271]
Event 88: Control panel [▶ 272]
Event 89: Maximum current LM [▶ 273]
Event 90: Motion block [▶ 274]

Tab. 178: Events

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18.1.5.2 Event 31: Short/ground

The drive controller is interrupted:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The behavior of the brakes depends on the configuration of the safety module and an optional release override (F06)

The brake chopper is switched off.

ATTENTION!

Material damage due to repeated activation and deactivation or new enable signal!

Repeated activation and deactivation or a new enable signal with an existing short circuit can lead to a device fault.

- Before the new activation or enable signal, the cause must be found and corrected.

Cause	Check and action
Connection error at the motor	Check the connection and correct it if necessary
Defective power cable	Check the cable and replace it if necessary
Short-circuit in the motor winding	Check the motor and replace it if necessary
Short-circuit in the braking resistor	Check the braking resistor and replace it if necessary
Short-circuit/ground fault inside the device	Check whether the fault occurs when switching on the power unit and replace the drive controller if necessary; the fault can only be acknowledged after 30 s

Tab. 179: Event 31 – Causes and actions

18.1.5.3 Event 32: Short/ground internal

The drive controller is interrupted:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The behavior of the brakes depends on the configuration of the safety module and an optional release override (F06)

The brake chopper is switched off.

ATTENTION!

Material damage due to repeated activation and deactivation!

Repeated activation and deactivation with an existing short circuit can lead to a device fault.

- Before the new activation or enable signal, the cause must be found and corrected.

Cause	Check and action
Short-circuit/ground fault inside the device	Replace the drive controller; the fault cannot be acknowledged

Tab. 180: Event 32 – Causes and actions

18.1.5.4 Event 33: Overcurrent

The drive controller is interrupted if:

- U30 = 0: Inactive

Response:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The brakes are applied in the event of an inactive release override (F06)

The drive controller is interrupted with emergency braking if:

- U30 = 1: Active and
- A29 = 1: Active for Drive Based or PROFIdrive device control
  or
- U30 = 1: Active and
- A540 = 2: Slow down on quick stop ramp for CiA 402 device controller

Response:

- The axis is stopped by emergency braking; the brakes are applied in the event of an inactive release override (F06)
- At the end of emergency braking, the power unit is disabled and axis movement is no longer controlled by the drive controller

Emergency braking is only possible for the synchronous servo, torque and Lean motor types.

Cause		Check and action
1: Normal (shutdown in software), 2: Fast (shutdown in hardware)	Short acceleration times	Check the actual current using the scope image and reduce the acceleration values if necessary (E00); the fault can only be acknowledged 3 s after the cause has been corrected
	Large torque/force limits	Check the actual current using the scope image (E00) and reduce the torque/force limits if necessary (C03, C05); the fault can only be acknowledged 3 s after the cause has been corrected
	Wrong drive controller design	Check the design and change the drive controller type if necessary; the fault can only be acknowledged 3 s after the cause has been corrected
	Short-circuit/ground fault	If cause 2 occurs repeatedly, check whether there is a short circuit/ground fault

Tab. 181: Event 33 – Causes and actions

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18.1.5.5 Event 34: Hardware fault

The drive controller is interrupted:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The behavior of the brakes depends on the configuration of the safety module and an optional release override (F06)

Cause		Check and action
1: FPGA, 2: NOV control unit, 3: NOV-Power Unit, 6: NOV safety module, 7: Current measurement, 8: power supply, 9: power supply, 10: power supply, 11: power supply, 12: Timer control board	Defective drive controller	Exchange drive controller; fault cannot be acknowledged
23: FPGA, 24: FPGA, 25: FPGA, 26: CPU, 27: CPU, 28: CPU, 29: Communication	Defective drive controller	Exchange drive controller; fault cannot be acknowledged
30: power supply	Defective drive controller	Check encoder power consumption; replace defective or incorrectly selected component; fault cannot be acknowledged
	Defective encoder	
	Power output of encoder interface outside specification	

Tab. 182: Event 34 – Causes and actions

18.1.5.6 Event 35: Watchdog

The drive controller is interrupted:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The behavior of the brakes depends on the configuration of the safety module and an optional release override (F06)

The brake chopper and brake release override are non-functional while the runtime system restarts.

Cause		Check and action
1: Core 0, 2: Core 1	Microprocessor at full load	Check the runtime utilization using the scope image (E191) and reduce it using a longer cycle time if necessary (A150)
	Microprocessor faulty	Check the connection and shielding and correct them if necessary; replace the drive controller if necessary

Tab. 183: Event 35 – Causes and actions

18.1.5.7 Event 36: High voltage

The drive controller is interrupted:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The behavior of the brakes depends on the configuration of the safety module and an optional release override (F06)

Cause	Check and action
Short delay times	Check the DC link voltage during the braking operation using the scope image (E03) and, if necessary, reduce the delay values, use a (larger) braking resistor or connect a DC link
Brake chopper deactivated	Check the values of the parameterized braking resistor and correct it if necessary (A21, A22, A23)
Braking resistor connection error	Check the connection to the braking resistor and drive controller and correct them if necessary
Pulse power of the braking resistor is too low	Check that the braking resistor pulse power is suitable for the application; replace the braking resistor if necessary
Brake chopper is defective	Check the DC link voltage during the braking operation using the scope image (E03); the brake chopper is defective if the DC link voltage exceeds the on limit of the brake chopper (R31) without the DC link voltage dropping; replace the drive controller if necessary
Supply voltage exceeded	Check the supply voltage for an overrun of the permitted input voltage and adjust it if necessary

Tab. 184: Event 36 – Causes and actions

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18.1.5.8 Event 37: Motor encoder

The drive controller is interrupted if:

- U30 = 0: Inactive

Response:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The brakes are applied in the event of an inactive release override (F06)

The drive controller is interrupted with emergency braking if:

- U30 = 1: Active and
- A29 = 1: Active for Drive Based or PROFIdrive device control
  or
- U30 = 1: Active and
- A540 = 2: Slow down on quick stop ramp for CiA 402 device controller

Response:

- The axis is stopped by emergency braking; the brakes are applied in the event of an inactive release override (F06)
- At the end of emergency braking, the power unit is disabled and axis movement is no longer controlled by the drive controller

Emergency braking is only possible for the synchronous servo, torque and Lean motor types.

Cause		Check and action
1: Parameter <-> encoder	Inconsistent parameterization	Compare the specification of the connected encoder to the corresponding values of the H parameters and correct them if necessary
2: X4 maximum speed	Exceeded encoder maximum velocity	Check the actual velocity during a movement using the scope image (I88) and adjust the permitted encoder maximum velocity if necessary (I297)
	Connection error	Check the connection and shielding and correct them if necessary
	Mass inertia ratio of load to Lean motor	Check the setting of the mass inertia ratio (C30) and reduce it if necessary
	Dynamic control of the Lean motor	Check the control settings; if necessary, reduce the gain (C31, I20) and increase the reset times (C32)
	Dynamic set values for the Lean motor	Check the dynamics of the application set values and reduce them if necessary
	Dynamic acceleration of the Lean motor	Use a scope image to check the actual velocity and shifting speed during a movement (E15, E959) and reduce the shifting filter time constant if necessary (B137)
6: X4 EnDat encoder found	Inconsistent parameterization	Compare the connected encoder to the parameterized encoder and correct it if necessary (H00)
7: X4 channel A/incremental	Connection error	Check the connection and correct it if necessary

Cause		Check and action
8: X4 no encoder found	Connection error	Check the connection and correct it if necessary
	Defective encoder cable	Check the cable and replace it if necessary
	Defective power supply	Check the encoder power supply and correct it if necessary
	Inconsistent parameterization	Compare the connected encoder to the parameterized encoder and correct it if necessary (H00)
10: X4 channel A/Clk, 11: X4 channel B/Dat	Defective encoder cable	Check the cable and replace it if necessary
13: X4-EnDat alarm	Defective EnDat encoder	Replace the motor; EnDat 2.1 digital, EnDat 2.2 digital, EnDat 3: Fault cannot be acknowledged
14: X4 EnDat CRC, 15: X4 double transmission	Connection error	Check the connection and correct it if necessary
	Electromagnetic interference	Take EMC recommendations into account [▶ 96] and, if necessary, increase the fault tolerance (B298)
16: X4 busy	Defective encoder cable	Check the cable and replace it if necessary
	Inconsistent parameterization	Compare the connected encoder to the parameterized encoder and correct it if necessary (H00)
	Incompatible encoder	Compare the specification of the encoder with the corresponding specifications from STOBER and replace the motor if necessary
17: EBI encoder low battery	Battery in battery module weak	Replace the battery; reference remains intact
18: EBI encoder battery empty	Battery in battery module empty	Replace the battery
	Initial connection	–
	Connection error	Check the connection and correct it if necessary
	Defective encoder cable	Check the cable and replace it if necessary
	Faulty battery module	Check the battery module and replace it if necessary
19: Alarm bit	Encoder fault	Check the specification of the encoder regarding the alarm bit
20: Resolver carrier, 21: Resolver sin/cos undervoltage, 22: Resolver sin/cos overvoltage	Defective encoder cable	Check the cable and replace it if necessary
	Incompatible encoder	Compare the specification of the encoder with the corresponding specifications from STOBER and replace the encoder or motor if necessary; fault cannot be acknowledged
21: Resolver sin/cos undervoltage	Incompatible encoder; phase search or calibration of the optimal resolver excitation failed	Compare the specification of the encoder with the corresponding specifications from STOBER; if necessary, calibrate the starting point for calibrating the optimal resolver excitation and the phase search (B40); fault cannot be acknowledged
24: Resolver failure	Defective encoder cable	Check the cable and replace it if necessary
48: X4 zero pulse missing	Defective encoder cable	Check the cable and replace it if necessary
	Connection error	Check the connection and correct it if necessary
	Late zero toe	Check number of encoder increments per rotation and correct it if necessary (H02)

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Cause		Check and action
49: X4 zero pulse distance too small	Defective encoder cable	Check the cable and replace it if necessary
	Connection error	Check the connection and correct it if necessary
	Early zero track	Check number of encoder increments per rotation and correct it if necessary (H02)
60: Hiperface synchronisation, 61: Hiperface timeout, 62: Hiperface signal quality, 63: Hiperface link	Defective encoder cable	Check the cable and replace it if necessary
	Connection error	Check the connection and correct it if necessary
	Electromagnetic interference	Take EMC recommendations into account [▶ 96] and, if necessary, increase the fault tolerance (B298)
64: EnDat3 Timeout, 65: EnDat3 invalid Request, 66: EnDat3 Position Check	Defective encoder cable	Check the cable and replace it if necessary
	Connection error	Check the connection and correct it if necessary
	Electromagnetic interference	Take EMC recommendations into account [▶ 96] and, if necessary, increase the fault tolerance (B298)

Tab. 185: Event 37 – Causes and actions

18.1.5.9 Event 38: Temperature drive controller sensor

The drive controller is interrupted if:

- A29 = 0: Inactive for Drive Based or PROFIdrive device control
  or
- A540 = 0: Disable drive motor coasting for CiA 402 device controller

Response:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The brakes are applied in the event of an inactive release override (F06)

The drive controller has a fault and a quick stop occurs if:

- A29 = 1: Active for Drive Based or PROFIdrive device control
  or
- A540 = 2: Slow down on quick stop ramp for CiA 402 device controller

Response:

- The axis is stopped by a quick stop; meanwhile, the brakes remain released
- At the end of the quick stop, the power unit is disabled and the axis movement is no longer controlled by the drive controller; the brakes engage if release override is inactive (F06)

Cause	Check and action
Surrounding temperatures too high or too low	Check the surrounding temperature of the drive controller and adjust it to the operating conditions of the drive controller if necessary; the fault can only be acknowledged 30 s after the cause has been corrected
Too little air circulation in the control cabinet	Check the minimum clearances and adjust them if necessary; the fault can only be acknowledged 30 s after the cause has been corrected
Defective or blocked fan	Switch on control unit supply; check that the fan starts and replace the drive controller if necessary; the fault can only be acknowledged 30 s after the cause has been corrected
Assembly protection film	Remove the assembly protection film
Wrong drive controller design	Check the design and change the drive controller type if necessary; the fault can only be acknowledged 30 s after the cause has been corrected
Increased or reduced mechanical friction	Check the service status of the mechanical system of all axes and service them if necessary; the fault can only be acknowledged 30 s after the cause has been corrected
Mechanical block	Check the output of all axes and remove the block if necessary
Short deceleration/acceleration times	Check the actual current during the braking process using the scope image (E00); reduce the deceleration and acceleration values if necessary; the fault can only be acknowledged 30 s after the cause has been corrected
Clock frequency too high	Check the utilization of the drive, taking into account derating and the configured clock frequency (E20, B24); reduce the configured clock frequency or replace the drive controller if necessary; the fault can only be acknowledged 30 s after the cause has been corrected

Tab. 186: Event 38 – Causes and actions

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18.1.5.10 Event 39: Overtemperature drive controller i2t

The possible effects depend on the configured level (U02):

- 0: Inactive
- 1: Message
- 2: Warning
- 3: Fault

The maximum permitted output current is limited to 100% of $I_{2N,PU}$ (R04). If the i^2t value (E24) increases to 105%, event 59: Overtemperature drive controller i2t is triggered.

The drive controller is interrupted if:

- A29 = 0: Inactive for Drive Based or PROFIdrive device control
  or
- A540 = 0: Disable drive motor coasting for CiA 402 device controller

Response:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The brakes are applied in the event of an inactive release override (F06)

The drive controller has a fault and a quick stop occurs if:

- A29 = 1: Active for Drive Based or PROFIdrive device control
  or
- A540 = 2: Slow down on quick stop ramp for CiA 402 device controller

Response:

- The axis is stopped by a quick stop; meanwhile, the brakes remain released
- At the end of the quick stop, the power unit is disabled and the axis movement is no longer controlled by the drive controller; the brakes engage if release override is inactive (F06)

Cause	Check and action
Wrong drive controller design	Check the design and change the drive controller type if necessary
Increased or reduced mechanical friction	Check the service status of the mechanical system of all axes and service them if necessary
Mechanical block	Check the output of all axes and remove the block if necessary
Short deceleration/acceleration times	Check the actual current during the braking process using the scope image (E00); reduce the deceleration and acceleration values if necessary
Clock frequency too high	Check the utilization of the drive, taking into account derating and the configured clock frequency (E20, B24); reduce the configured clock frequency or replace the drive controller if necessary

Tab. 187: Event 39 – Causes and actions

18.1.5.11 Event 40: Invalid data

The drive controller is interrupted:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The behavior of the brakes depends on the configuration of the safety module and an optional release override (F06)

Cause		Check and action
1: Fault, 2: Block missing, 3: Data security, 4: Checksum, 5: Read only, 6: Read error, 7: Block missing, 8: Wrong/illegal serial number	Invalid data in the internal memory of the drive controller	Determine the affected memory (Z730) and, based on that, replace the drive controller or motor; fault cannot be acknowledged
48: Reverse documentation	Defective memory in the SD card or internal memory of the drive controller	Replace the SD card or drive controller; fault cannot be acknowledged

Tab. 188: Event 40 – Causes and actions

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18.1.5.12 Event 41: Temp.MotorTMP

The possible effects depend on the configured level (U15):

- 2: Warning
- 3: Fault

The drive controller is interrupted if:

- A29 = 0: Inactive for Drive Based or PROFIdrive device control
  or
- A540 = 0: Disable drive motor coasting for CiA 402 device controller

Response:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The brakes are applied in the event of an inactive release override (F06)

The drive controller has a fault and a quick stop occurs if:

- A29 = 1: Active for Drive Based or PROFIdrive device control
  or
- A540 = 2: Slow down on quick stop ramp for CiA 402 device controller

Response:

- The axis is stopped by a quick stop; meanwhile, the brakes remain released
- At the end of the quick stop, the power unit is disabled and the axis movement is no longer controlled by the drive controller; the brakes engage if release override is inactive (F06)

Cause	Check and action
Motor temperature sensor connection error	Check the connection and correct it if necessary
Wrong sensor source for X2 – HIPERFACE DSL	Check the sensor settings and correct them if necessary (B35)
Wrong motor design	Check the design and change the motor type if necessary
Surrounding temperatures at the motor too high	Check the surrounding temperature and adjust it if necessary
Mechanical block of the motor	Check the output and remove the block if necessary
Increased or reduced mechanical friction	Check the service status of the mechanical system and service them if necessary

Tab. 189: Event 41 – Causes and actions

18.1.5.13 Event 42: TempBrakeRes

The drive controller is interrupted if:

- A29 = 0: Inactive for Drive Based or PROFIdrive device control
  or
- A540 = 0: Disable drive motor coasting for CiA 402 device controller

Response:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The brakes are applied in the event of an inactive release override (F06)

The drive controller has a fault and a quick stop occurs if:

- A29 = 1: Active for Drive Based or PROFIdrive device control
  or
- A540 = 2: Slow down on quick stop ramp for CiA 402 device controller

Response:

- The axis is stopped by a quick stop; meanwhile, the brakes remain released
- At the end of the quick stop, the power unit is disabled and the axis movement is no longer controlled by the drive controller; the brakes engage if release override is inactive (F06)

Cause	Check and action
Short deceleration/acceleration times	Check the DC link voltage during the braking process using the scope image (E03); reduce the deceleration and acceleration values if necessary
Braking resistor too low	Check that the maximum permitted braking resistor power loss is suitable for the application and replace the braking resistor if necessary

Tab. 190: Event 42 – Causes and actions

18.1.5.14 Event 44: External fault 1

The drive controller is interrupted if:

- A29 = 0: Inactive for Drive Based or PROFIdrive device control
  or
- A540 = 0: Disable drive motor coasting for CiA 402 device controller

Response:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The brakes are applied in the event of an inactive release override (F06)

The drive controller has a fault and a quick stop occurs if:

- A29 = 1: Active for Drive Based or PROFIdrive device control
  or
- A540 = 2: Slow down on quick stop ramp for CiA 402 device controller

Response:

- The axis is stopped by a quick stop; meanwhile, the brakes remain released
- At the end of the quick stop, the power unit is disabled and the axis movement is no longer controlled by the drive controller; the brakes engage if release override is inactive (F06)

Cause	Check and action
Application-specific	Application-specific

Tab. 191: Event 44 – Causes and actions

18.1.5.15 Event 45: Overtemp.motor i2t

The possible effects depend on the parameterized level (U10):

- 0: Inactive
- 1: Message
- 2: Warning
- 3: Fault

The drive controller is interrupted if:

- A29 = 0: Inactive for Drive Based or PROFIdrive device control
  or
- A540 = 0: Disable drive motor coasting for CiA 402 device controller

Response:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The brakes are applied in the event of an inactive release override (F06)

The drive controller has a fault and a quick stop occurs if:

- A29 = 1: Active for Drive Based or PROFIdrive device control
  or
- A540 = 2: Slow down on quick stop ramp for CiA 402 device controller

Response:

- The axis is stopped by a quick stop; meanwhile, the brakes remain released
- At the end of the quick stop, the power unit is disabled and the axis movement is no longer controlled by the drive controller; the brakes engage if release override is inactive (F06)

Cause	Check and action
Wrong motor design	Check the design and change the motor type if necessary
Mechanical block of the motor	Check the output and remove the block if necessary
Increased or reduced mechanical friction	Check the service status of the mechanical system and service them if necessary

Tab. 192: Event 45 – Causes and actions

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18.1.5.16 Event 46: Low voltage

The possible effects depend on the configured level (U00):

- 0: Inactive
- 1: Message
- 2: Warning
- 3: Fault

The drive controller is interrupted if:

- A29 = 0: Inactive for Drive Based or PROFIdrive device control
  or
- A540 = 0: Disable drive motor coasting for CiA 402 device controller

Response:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The brakes are applied in the event of an inactive release override (F06)

The drive controller has a fault and a quick stop occurs if:

- A29 = 1: Active for Drive Based or PROFIdrive device control
  or
- A540 = 2: Slow down on quick stop ramp for CiA 402 device controller

Response:

- The axis is stopped by a quick stop; meanwhile, the brakes remain released
- At the end of the quick stop, the power unit is disabled and the axis movement is no longer controlled by the drive controller; the brakes engage if release override is inactive (F06)

Cause	Check and action
Supply voltage does not correspond to the configured supply voltage	Check the supply voltage, parameterized supply voltage and undervoltage limit and correct them if necessary (A36, A35)
Supply voltage below undervoltage limit	Check undervoltage limit and correct it if necessary (A35)

Tab. 193: Event 46 – Causes and actions

18.1.5.17 Event 47: Torque/force-max. limit

The possible effects depend on the configured level (U20):

- 0: Inactive
- 1: Message
- 2: Warning
- 3: Fault

The drive controller is interrupted if:

- A29 = 0: Inactive for Drive Based or PROFIdrive device control
  or
- A540 = 0: Disable drive motor coasting for CiA 402 device controller

Response:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The brakes are applied in the event of an inactive release override (F06)

The drive controller has a fault and a quick stop occurs if:

- A29 = 1: Active for Drive Based or PROFIdrive device control
  or
- A540 = 2: Slow down on quick stop ramp for CiA 402 device controller

Response:

- The axis is stopped by a quick stop; meanwhile, the brakes remain released
- At the end of the quick stop, the power unit is disabled and the axis movement is no longer controlled by the drive controller; the brakes engage if release override is inactive (F06)

Cause	Check and action
Incorrectly selected torque/force limits	Check the general machine limit and adjust it if necessary (C03, C05); check the application limits and the parameters dependent on the operating mode and adjust them if necessary (Drive Based C132, C133 or CiA 402 A559)
Wrong motor design	Check the design and change the motor type if necessary
Mechanical block	Check the output and remove the block if necessary
Brake closed	Check the connection, supply voltage and parameterization and correct them if necessary (F00)
Connection error at the motor	Check the connection and correct it if necessary
Connection error at the encoder	Check the connection and correct it if necessary
Wrong encoder measurement direction	Compare the attachment and measurement direction of the encoder with the corresponding values of the H parameters and correct them if necessary

Tab. 194: Event 47 – Causes and actions

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18.1.5.18 Event 50: Safety module

The drive controller is interrupted:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The behavior of the brakes depends on the configuration of the safety module and an optional release override (F06)

Cause		Check and action
1: Inconsistent request (single channel)	Connection error	Check the connection and correct it if necessary; error cannot be acknowledged until both STO channels have been requested for at least 100 ms
2: Wrong safety module	The projected E53 safety module does not match the E54[0] detected by the system	Check the project configuration and drive controller and correct the project configuration or exchange the drive controller if necessary; fault cannot be acknowledged
3: Internal error	Defective safety module	Exchange drive controller; fault cannot be acknowledged

Tab. 195: Event 50 – Causes and actions

18.1.5.19 Event 51: Virtual master software limit switch

The possible effects depend on the configured level (U24).

- 0: Inactive
- 1: Message
- 3: Fault

The drive controller is interrupted if:

- A29 = 0: Inactive for Drive Based or PROFIdrive device control
  or
- A540 = 0: Disable drive motor coasting for CiA 402 device controller

Response:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The brakes are applied in the event of an inactive release override (F06)

The drive controller has a fault and a quick stop occurs if:

- A29 = 1: Active for Drive Based or PROFIdrive device control
  or
- A540 = 2: Slow down on quick stop ramp for CiA 402 device controller

Response:

- The axis is stopped by a quick stop; meanwhile, the brakes remain released
- At the end of the quick stop, the power unit is disabled and the axis movement is no longer controlled by the drive controller; the brakes engage if release override is inactive (F06)

Event 51: Virtual master software limit switch only affects the device control of the axis. A quick stop of the virtual master can also be triggered with G57.

Cause		Check and action
1: SW-limit switch positive, 2: SW-limit switch negative	End of the travel range reached	Move in the travel range in the direction opposite the limit switch
	Travel range too small	Check the positions of the software limit switch and correct them if necessary (G146, G147)
3: +/- 31 bit computing limit reached	Computing limit of the data type reached	Check the command sequences for multiple successive 3: MC_MoveAdditive commands without a breakpoint and the number of decimal places of the axis model and reduce them if necessary (G46)

Tab. 196: Event 51 – Causes and actions

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18.1.5.20 Event 52: Communication

The drive controller is interrupted if:

- A29 = 0: Inactive for Drive Based or PROFIdrive device control
  or
- A540 = 0: Disable drive motor coasting for CiA 402 device controller

Response:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The brakes are applied in the event of an inactive release override (F06)

The drive controller has a fault and a quick stop occurs if:

- A29 = 1: Active for Drive Based or PROFIdrive device control
  or
- A540 = 2: Slow down on quick stop ramp for CiA 402 device controller

Response:

- The axis is stopped by a quick stop; meanwhile, the brakes remain released
- At the end of the quick stop, the power unit is disabled and the axis movement is no longer controlled by the drive controller; the brakes engage if release override is inactive (F06)

Cause		Check and action
4: PZD-Timeout	Missing process data	Check the cycle time in the controller and tolerated failure time for monitoring the PZD communication in the drive controller and correct if necessary (A109)
6: EtherCAT PDO-Timeout	Missing process data	Check the task cycle time in the EtherCAT master and the timeout time in the drive controller and correct them if necessary (A258)
7: Reserved	Synchronization error	Check the synchronization settings in the EtherCAT master and correct them if necessary
	Connection error	Check the connection and shielding and correct them if necessary
14: PZD parameter figure faulty	Missing mapping	Check the mapping for unmappable parameters and correct them if necessary
15: Wrong firmware for applicataion	Projected fieldbus identification and that of the drive controller do not match	Check the projected fieldbus identification and the fieldbus identification of the drive controller and change the fieldbus if necessary (E59[2], E52[3])
16: PROFINET Sign-of-Life synchronisation failed	Synchronization error	Obey the information in the TIA Portal and update the GSD file if necessary; check the controller or technology object for clock synchronicity and correct if necessary

Tab. 197: Event 52 – Causes and actions

18.1.5.21 Event 53: Limit switch

The drive controller is interrupted if:

- A29 = 0: Inactive for Drive Based or PROFIdrive device control
  or
- A540 = 0: Disable drive motor coasting for CiA 402 device controller

Response:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The brakes are applied in the event of an inactive release override (F06)

The drive controller has a fault and a quick stop occurs if:

- A29 = 1: Active for Drive Based or PROFIdrive device control
  or
- A540 = 2: Slow down on quick stop ramp for CiA 402 device controller

Response:

- The axis is stopped by a quick stop; meanwhile, the brakes remain released
- At the end of the quick stop, the power unit is disabled and the axis movement is no longer controlled by the drive controller; the brakes engage if release override is inactive (F06)

Cause		Check and action
1: Hardware-Limit-Switch positive, 2: Hardware-Limit-Switch negative	End of the travel range reached	Move in the travel range in the direction opposite the limit switch
	Connection error	Check the connection and source parameters and correct them if necessary (I101, I102)
	Defective connection cable	Check the cable and replace it if necessary
3: SW-limit switch positive, 4: SW-limit switch negative	End of the travel range reached	Move in the travel range in the direction opposite the limit switch
	Travel range too small	Check the positions of the software limit switches and correct them if necessary (Drive Based I50, I51 or CiA A570[0], A570[1])
5: +/- 31 bit computing limit reached	Computing limit of the data type reached	Check the command sequences for multiple successive 3: MC_MoveAdditive commands without a breakpoint and the number of decimal places of the axis model and reduce them if necessary (I06)
7: Both limit switches not connected	Connection error	Check the connection and source parameters and correct them if necessary (I101, I102)
	Defective connection cable	Check the cable and replace it if necessary

Tab. 198: Event 53 – Causes and actions

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18.1.5.22 Event 54: Following error

The possible effects depend on the configured level (U22).

- 0: Inactive
- 1: Message
- 2: Warning
- 3: Fault

The drive controller is interrupted if:

- A29 = 0: Inactive for Drive Based or PROFIdrive device control
  or
- A540 = 0: Disable drive motor coasting for CiA 402 device controller

Response:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The brakes are applied in the event of an inactive release override (F06)

The drive controller has a fault and a quick stop occurs if:

- A29 = 1: Active for Drive Based or PROFIdrive device control
  or
- A540 = 2: Slow down on quick stop ramp for CiA 402 device controller

Response:

- The axis is stopped by a quick stop; meanwhile, the brakes remain released
- At the end of the quick stop, the power unit is disabled and the axis movement is no longer controlled by the drive controller; the brakes engage if release override is inactive (F06)

Cause	Check and action
Incorrectly selected torque/force limits	Check the general machine limit and adjust it if necessary (C03, C05); check the application limits and adjust them if necessary (Drive Based/PROFIdrive: C132, C133 and the parameters dependent on the operating mode; CiA 402: A559)
Maximum permitted lag is too small	Check the maximum permitted following error and correct it if necessary (Drive Based/PROFIdrive: I21; CiA 402: A546)
Mechanical block	Check the output and remove the block if necessary
Brake closed	Check the connection, supply voltage and parameterization and correct them if necessary (F00)

Tab. 199: Event 54 – Causes and actions

18.1.5.23 Event 56: Overspeed

The drive controller is interrupted if:

- U30 = 0: Inactive

Response:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The brakes are applied in the event of an inactive release override (F06)

The drive controller is interrupted with emergency braking if:

- U30 = 1: Active and
- A29 = 1: Active for Drive Based or PROFIdrive device control
  or
- U30 = 1: Active and
- A540 = 2: Slow down on quick stop ramp for CiA 402 device controller

Response:

- The axis is stopped by emergency braking; the brakes are applied in the event of an inactive release override (F06)
- At the end of emergency braking, the power unit is disabled and axis movement is no longer controlled by the drive controller

Emergency braking is only possible for the synchronous servo, torque and Lean motor types.

The event is only triggered if the checking rules for Enable-on are violated.

Cause		Check and action
1: Motor encoder, 2: Position encoder, 3: Motor & position encoder	Maximum permitted velocity too small	Check the maximum permitted velocity and increase it if necessary (I10)
	Overshooting control system	Check the actual velocity using the scope image (Sensing time: 250 µs, actual motor velocity: E15, E91; actual position velocity I88) and, if necessary, reduce the intensity of the control system (I20, C31)
1: Motor encoder, 3: Motor & position encoder	Wrong commutation offset	Check the commutation offset using the Test phase action (B40)
	Faulty motor encoder	Check the velocity display of the encoder at a standstill (E15, E91) and replace the encoder if necessary
2: Position encoder, 3: Motor & position encoder	Faulty position encoder	Check the velocity display of the encoder at a standstill (I88) and replace the encoder if necessary

Tab. 200: Event 56 – Causes and actions

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18.1.5.24 Event 57: Runtime requirement

The drive controller is interrupted if:

- A29 = 0: Inactive for Drive Based or PROFIdrive device control
  or
- A540 = 0: Disable drive motor coasting for CiA 402 device controller

Response:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The brakes are applied in the event of an inactive release override (F06)

The drive controller has a fault and a quick stop occurs if:

- A29 = 1: Active for Drive Based or PROFIdrive device control
  or
- A540 = 2: Slow down on quick stop ramp for CiA 402 device controller

Response:

- The axis is stopped by a quick stop; meanwhile, the brakes remain released
- At the end of the quick stop, the power unit is disabled and the axis movement is no longer controlled by the drive controller; the brakes engage if release override is inactive (F06)

Cause		Check and action
3: RT3, 2: RT2, 5: RT5	Exceeding the cycle time	Check the utilization (E191) and increase the cycle time if necessary (A150)

Tab. 201: Event 57 – Causes and actions

18.1.5.25 Event 59: Overtemperature drive controller i2t

The drive controller is interrupted if:

- A29 = 0: Inactive for Drive Based or PROFIdrive device control
  or
- A540 = 0: Disable drive motor coasting for CiA 402 device controller

Response:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The brakes are applied in the event of an inactive release override (F06)

The drive controller has a fault and a quick stop occurs if:

- A29 = 1: Active for Drive Based or PROFIdrive device control
  or
- A540 = 2: Slow down on quick stop ramp for CiA 402 device controller

Response:

- The axis is stopped by a quick stop; meanwhile, the brakes remain released
- At the end of the quick stop, the power unit is disabled and the axis movement is no longer controlled by the drive controller; the brakes engage if release override is inactive (F06)

Cause	Check and action
Wrong drive controller design	Check the design and change the drive controller type if necessary; the fault can only be acknowledged 30 s after the cause has been corrected
Increased or reduced mechanical friction	Check the service status of the mechanical system and service them if necessary; the fault can only be acknowledged 30 s after the cause has been corrected
Short deceleration/acceleration times	Check the actual current during the braking process using the scope image (E00); reduce the deceleration and acceleration values if necessary; the fault can only be acknowledged 30 s after the cause has been corrected
Clock frequency too high	Check the utilization of the drive, taking into account derating and the configured clock frequency (E20, B24); reduce the configured clock frequency or replace the drive controller if necessary; the fault can only be acknowledged 30 s after the cause has been corrected

Tab. 202: Event 59 – Causes and actions

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18.1.5.26 Event 60: Application event 0 – Event 67: Application event 7

The possible effects depend on the configured level (U100, U110, U120, U130, U140, U150, U160, U170):

- 0: Inactive
- 1: Message
- 2: Warning
- 3: Fault

The drive controller is interrupted if:

- A29 = 0: Inactive for Drive Based or PROFIdrive device control
  or
- A540 = 0: Disable drive motor coasting for CiA 402 device controller

Response:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The brakes are applied in the event of an inactive release override (F06)

The drive controller has a fault and a quick stop occurs if:

- A29 = 1: Active for Drive Based or PROFIdrive device control
  or
- A540 = 2: Slow down on quick stop ramp for CiA 402 device controller

Response:

- The axis is stopped by a quick stop; meanwhile, the brakes remain released
- At the end of the quick stop, the power unit is disabled and the axis movement is no longer controlled by the drive controller; the brakes engage if release override is inactive (F06)

Cause	Check and action
Application-specific	Application-specific

Tab. 203: Events 60 – 67 – Causes and actions

18.1.5.27 Event 68: External fault 2

The drive controller is interrupted if:

- A29 = 0: Inactive for Drive Based or PROFIdrive device control
  or
- A540 = 0: Disable drive motor coasting for CiA 402 device controller

Response:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The brakes are applied in the event of an inactive release override (F06)

The drive controller has a fault and a quick stop occurs if:

- A29 = 1: Active for Drive Based or PROFIdrive device control
  or
- A540 = 2: Slow down on quick stop ramp for CiA 402 device controller

Response:

- The axis is stopped by a quick stop; meanwhile, the brakes remain released
- At the end of the quick stop, the power unit is disabled and the axis movement is no longer controlled by the drive controller; the brakes engage if release override is inactive (F06)

Cause	Check and action
Application-specific	Application-specific

Tab. 204: Event 68 – Causes and actions

18.1.5.28 Event 69: Motor connection

The possible effects depend on the configured level (U12).

- 0: Inactive
- 3: Fault

The drive controller is interrupted if:

- A29 = 0: Inactive for Drive Based or PROFIdrive device control
  or
- A540 = 0: Disable drive motor coasting for CiA 402 device controller

Response:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The brakes are applied in the event of an inactive release override (F06)

The drive controller has a fault and a quick stop occurs if:

- A29 = 1: Active for Drive Based or PROFIdrive device control
  or
- A540 = 2: Slow down on quick stop ramp for CiA 402 device controller

Response:

- The axis is stopped by a quick stop; meanwhile, the brakes remain released
- At the end of the quick stop, the power unit is disabled and the axis movement is no longer controlled by the drive controller; the brakes engage if release override is inactive (F06)

Cause		Check and action
2: No motor connected	Connection error	Check the connection and correct it if necessary
	Defective power cable	Check the cable and replace it if necessary
3: Wake and Shake failed (Commutation finding with Wake and Shake failed)	Increased or reduced mechanical friction	Check the service status of the mechanical system and service them if necessary
	Mechanical block	Check the output and remove the block if necessary
4: Brake (Commutation finding with Wake and Shake failed)	Brake engaged	Check the control of the brakes and engage the brakes during Wake and Shake using release override if necessary (F06), see Brake control based on control mode [▶ 184]

Tab. 205: Event 69 – Causes and actions

18.1.5.29 Event 70: Parameter consistency

The drive controller is interrupted:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The behavior of the brakes depends on the configuration of the safety module and an optional release override (F06)

The event is only triggered if the checking rules for Enable-on are violated.

Cause		Check and action
1: Wrong encoder model	Encoder model unsuitable for control type	Check the control mode, motor encoder and encoder and correct them if necessary (B20, B26, H parameters)
3: B12<->B20	Nominal current of the motor exceeds the drive controller nominal current (4 kHz)	Check the motor nominal current against 150% of the drive controller nominal current at a clock frequency of 4 kHz and, if necessary, reduce the motor nominal current or change the drive controller type (B12, R04[0])
4: B10<->H31	Unsupported combination of resolver/motor number of poles	Check number of poles of the resolver and number of poles of the motor and correct them if necessary (H08, H148, B10)
5: Negative slip frequency	Negative slip	Check the nominal velocity, nominal frequency and number of poles of the motor and, if necessary, correct them (B13, B15, B10)
8: v-max (I10) exeeds maximum (B83)	Maximum permitted velocity exceeds the maximum motor velocity	Check the maximum permitted velocity and the maximum motor velocity and correct them if necessary (I10, B83)
	B83 parameterized too large	Reduce B83 to max. 6000 rpm
11: Reference retaining	Conditions for reference without tracking not met	Check that the reference is retained and that the measurement range covers the travel range and make corrections if necessary (I46, limited travel range I00: Software limit switch must be parameterized; infinite travel range I00: Measurement range must correspond to the revolution length Drive Based/PROFIdrive I01 or CiA 402 A568[1] or an entire multiple)
13: Motor temperature sensor	Unsupported temperature sensors	Check the motor temperature sensor type in the motor and the drive controller series and, if necessary, change the motor or drive controller series
14: Max. acceleration I11>B143	Maximum permitted velocity is above maximum motor acceleration	Check the maximum permissible velocity and maximum motor acceleration and correct them if necessary (Drive Based/PROFIdrive: I11; CiA 402: minimum values of A604 and A605, B143)

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Cause		Check and action
SY6 option: 15: Safety watchdog time	Monitoring of PDO timeout deactivated	Check the EtherCAT PDO timeout in the drive controller and activate it if necessary (A258 = 0 or 65535)
	SyncManager watchdog = 0	Check the EtherCAT SyncManager watchdog in the EtherCAT master and increase it if necessary (A258 = 65534, A259[0])
	Ratio of FSoE watchdog time to EtherCAT PDO timeout too small	Check the FSoE watchdog time in the FSoE master and EtherCAT PDO timeout in the drive controller; if necessary, increase the watchdog time or reduce the timeout (guide value: FSoE watchdog time = EtherCAT PDO timeout + 100 ms; S27, A258)
	Ratio of FSoE watchdog time to EtherCAT SyncManager watchdog too small	Check the FSoE watchdog time in the FSoE master and EtherCAT SyncManager watchdog in the EtherCAT master; if necessary, increase the watchdog time or reduce the SyncManager watchdog (guide value: FSoE watchdog time = EtherCAT SyncManager watchdog + 100 ms; S27, A258 = 65534, A259[0])
SU6 option: 15: Safety watchdog time	Monitoring of PZD timeout deactivated	Check the PZD timeout in the drive controller and activate it if necessary (A109 = 0 or 65535)
	Ratio of PROFIsafe watchdog time to PZD timeout too small	Check the PROFIsafe watchdog time in TIA Portal and PZD timeout in the drive controller; if necessary, increase the watchdog time or reduce the PZD timeout (guide value: PROFIsafe watchdog time = PZD timeout + PROFIsafe cycle time + 50 ms; S46 = A109 + S44 + 50 ms)
16: I10 > C11	Maximum permitted velocity is above maximum gear unit input speed	Check the maximum permitted velocity and the maximum gear unit input speed and correct them if necessary (I10, C11)

Tab. 206: Event 70 – Causes and actions

18.1.5.30 Event 71: Firmware

Cause 1:

The drive controller is interrupted:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The behavior of the brakes depends on the configuration of the safety module and an optional release override (F06)

Cause 3:

The drive controller is interrupted if:

- A29 = 0: Inactive for Drive Based or PROFIdrive device control
  or
- A540 = 0: Disable drive motor coasting for CiA 402 device controller

Response:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The brakes are applied in the event of an inactive release override (F06)

The drive controller has a fault and a quick stop occurs if:

- A29 = 1: Active for Drive Based or PROFIdrive device control
  or
- A540 = 2: Slow down on quick stop ramp for CiA 402 device controller

Response:

- The axis is stopped by a quick stop; meanwhile, the brakes remain released
- At the end of the quick stop, the power unit is disabled and the axis movement is no longer controlled by the drive controller; the brakes engage if release override is inactive (F06)

Cause		Check and action
1: Firmware defective	Defective firmware	Update the firmware; fault cannot be acknowledged
	Defective drive controller	Exchange drive controller; fault cannot be acknowledged
3: CRC-error	Defective firmware	Update the firmware; fault cannot be acknowledged
	Defective drive controller	Check for repeated triggering of the event after a restart; if necessary, replace the drive controller

Tab. 207: Event 71 – Causes and actions

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18.1.5.31 Event 72: Brake test timeout

The possible effects depend on the cause. Cause 1 and 2 lead to a fault, cause 3 is output as a message.

The drive controller is interrupted:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The behavior of the brakes depends on the configuration of the safety module and an optional release override (F06)

Cause		Check and action
1: B311timeout:B300 mandatory	Brake management is active and the timeout for the brake test runs out twice	Test the brake (B300, S18); can be acknowledged for a period of 5 min in order to be able to carry out the test brake action
2: Brake defective:B300 mandatory	Test holding torque not met during the test brake action	Bed in the brake (B301, B302) and repeat the brake test (B300, S18); can be acknowledged for a period of 5 min in order to be able to carry out the brake test
	Faulty encoder test run during test brake action	Replace the encoder or motor and repeat the brake test (B300, S18); can be acknowledged for a time period of 5 min in order to be able to carry out the brake test
3: Brake test necessary	Brake management is active and the timeout for the brake test runs out once	Carry out the test brake action (B300, S18); can be acknowledged for a period of 5 min in order to be able to carry out the brake test

Tab. 208: Event 72 – Causes and actions

18.1.5.32 Event 76: Position encoder

The drive controller is interrupted if:

- U30 = 0: Inactive and
- A29 = 0: Inactive for Drive Based or PROFIdrive device control
  or
- U30 = 1: Active and
- A540 = 0: Disable drive motor coasting for CiA 402 device controller

Response:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The brakes are applied in the event of an inactive release override (F06)

The drive controller has a fault and a quick stop occurs if:

- A29 = 0: Inactive for Drive Based or PROFIdrive device control
  or
- A540 = 2: Slow down on quick stop ramp for CiA 402 device controller

Response:

- The axis is stopped by a quick stop; meanwhile, the brakes remain released
- At the end of the quick stop, the power unit is disabled and the axis movement is no longer controlled by the drive controller; the brakes engage if release override is inactive (F06)

The drive controller is interrupted with emergency braking if:

- U30 = 1: Active and
- A29 = 1: Active for Drive Based or PROFIdrive device control
  or
- U30 = 1: Active and
- A540 = 2: Slow down on quick stop ramp for CiA 402 device controller

Response:

- The axis is stopped by emergency braking; the brakes are applied in the event of an inactive release override (F06)
- At the end of emergency braking, the power unit is disabled and axis movement is no longer controlled by the drive controller

Emergency braking is only possible for the synchronous servo, torque and Lean motor types.

The reference is deleted (I86).

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Cause		Check and action
1: Parameter <-> encoder	Inconsistent parameterization	Compare the specification of the connected encoder to the corresponding values of the H parameters and correct them if necessary
2: X4 maximum speed	Exceeded encoder maximum velocity	Check the actual velocity during a movement using the scope image (I88) and adjust the permitted encoder maximum velocity if necessary (I297)
	Connection error	Check the connection and shielding and correct them if necessary
	Mass inertia ratio of load to Lean motor	Check the setting of the mass inertia ratio (C30) and reduce it if necessary
	Dynamic control of the Lean motor	Check the control settings; if necessary, reduce the gain (C31, I20) and increase the reset times (C32)
	Dynamic set values for the Lean motor	Check the dynamics of the application set values and reduce them if necessary
	Dynamic acceleration of the Lean motor	Use a scope image to check the actual velocity and shifting speed during a movement (E15, E959) and reduce the shifting filter time constant if necessary (B137)
6: X4 EnDat encoder found	Inconsistent parameterization	Compare the connected encoder to the parameterized encoder and correct it if necessary (H00)
7: X4 channel A/incremental	Connection error	Check the connection and correct it if necessary
8: X4 no encoder found	Connection error	Check the connection and correct it if necessary
	Defective encoder cable	Check the cable and replace it if necessary
	Defective power supply	Check the encoder power supply and correct it if necessary
	Inconsistent parameterization	Compare the connected encoder to the parameterized encoder and correct it if necessary (H00)
9: Referencing failed	Reference set for inactive Lean motor position determination	Check device status (E48) and, if necessary, activate the enable signal
10: X4 channel A/Clk, 11: X4 channel B/Dat	Defective encoder cable	Check the cable and replace it if necessary
13: X4-EnDat alarm	Defective EnDat encoder	Replace the motor; EnDat 2.1 digital, EnDat 2.2 digital, EnDat 3: Fault cannot be acknowledged
14: X4 EnDat CRC, 15: X4 double transmission	Connection error	Check the connection and correct it if necessary
	Electromagnetic interference	Take EMC recommendations into account [▶ 96] and, if necessary, increase the fault tolerance (I298)
16: X4 busy	Defective encoder cable	Check the cable and replace it if necessary
	Inconsistent parameterization	Compare the connected encoder to the parameterized encoder and correct it if necessary (H00)
	Incompatible encoder	Compare the specification of the encoder with the corresponding specifications from STOBER and replace the encoder or motor if necessary

Cause		Check and action
17: EBI encoder low battery	Battery in battery module weak	Replace the battery; reference is not deleted by the event
18: EBI encoder battery empty	Battery in battery module empty	Replace the battery
	Initial connection	–
	Connection error	Check the connection and correct it if necessary
	Defective encoder cable	Check the cable and replace it if necessary
	Faulty battery module	Check the battery module and replace it if necessary
19: Alarm bit	Encoder fault	Check the specification of the encoder regarding the alarm bit
20: Resolver carrier, 21: Resolver sin/cos undervoltage, 22: Resolver sin/cos overvoltage	Defective encoder cable	Check the cable and replace it if necessary
	Incompatible encoder	Compare the specification of the encoder with the corresponding specifications from STOBER and replace the encoder or motor if necessary; fault cannot be acknowledged
21: Resolver sin/cos undervoltage	Incompatible encoder; phase search or calibration of the optimal resolver excitation failed	Compare the specification of the encoder with the corresponding specifications from STOBER; if necessary, calibrate the starting point for calibrating the optimal resolver excitation and the phase search (B40); fault cannot be acknowledged
24: Resolver failure	Defective encoder cable	Check the cable and replace it if necessary
48: X4 zero pulse missing	Defective encoder cable	Check the cable and replace it if necessary
	Connection error	Check the connection and correct it if necessary
	Late zero toe	Check number of encoder increments per rotation and correct it if necessary (H02)
49: X4 zero pulse distance too small	Defective encoder cable	Check the cable and replace it if necessary
	Connection error	Check the connection and correct it if necessary
	Early zero track	Check number of encoder increments per rotation and correct it if necessary (H02)
60: Hiperface synchronisation, 61: Hiperface timeout, 62: Hiperface signal quality, 63: Hiperface link	Defective encoder cable	Check the cable and replace it if necessary
	Connection error	Check the connection and correct it if necessary
	Electromagnetic interference	Take EMC recommendations into account [▶ 96] and, if necessary, increase the fault tolerance (I298)
64: EnDat3 Timeout, 65: EnDat3 invalid Request, 66: EnDat3 Position Check	Defective encoder cable	Check the cable and replace it if necessary
	Connection error	Check the connection and correct it if necessary
	Electromagnetic interference	Take EMC recommendations into account [▶ 96] and, if necessary, increase the fault tolerance (I298)

Tab. 209: Event 76 – Causes and actions

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18.1.5.33 Event 77: Master encoder

The drive controller is interrupted if:

- A29 = 0: Inactive for Drive Based or PROFIdrive device control
  or
- A540 = 0: Disable drive motor coasting for CiA 402 device controller

Response:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The brakes are applied in the event of an inactive release override (F06)

The drive controller has a fault and a quick stop occurs if:

- A29 = 1: Active for Drive Based or PROFIdrive device control
  or
- A540 = 2: Slow down on quick stop ramp for CiA 402 device controller

Response:

- The axis is stopped by a quick stop; meanwhile, the brakes remain released
- At the end of the quick stop, the power unit is disabled and the axis movement is no longer controlled by the drive controller; the brakes engage if release override is inactive (F06)

The reference is deleted (G89).

Cause		Check and action
1: Parameter <-> encoder	Inconsistent parameterization	Compare the specification of the connected encoder to the corresponding values of the H parameters and correct them if necessary
2: X4 maximum speed	Exceeded encoder maximum velocity	Check the actual velocity during a movement using the scope image (G105) and adjust the permitted encoder maximum velocity if necessary (G297)
	Connection error	Check the connection and shielding and correct them if necessary
6: X4 EnDat encoder found	Inconsistent parameterization	Compare the connected encoder to the parameterized encoder and correct it if necessary (H00)
7: X4 channel A/incremental	Connection error	Check the connection and correct it if necessary
8: X4 no encoder found	Connection error	Check the connection and correct it if necessary
	Defective encoder cable	Check the cable and replace it if necessary
	Defective power supply	Check the encoder power supply and correct it if necessary
	Inconsistent parameterization	Compare the connected encoder to the parameterized encoder and correct it if necessary (H00)
10: X4 channel A/Clk, 11: X4 channel B/Dat	Defective encoder cable	Check the cable and replace it if necessary
13: X4-EnDat alarm	Defective EnDat encoder	Replace the motor; EnDat 2.1 digital, EnDat 2.2 digital, EnDat 3: Fault cannot be acknowledged
14: X4 EnDat CRC, 15: X4 double transmission	Connection error	Check the connection and correct it if necessary
	Electromagnetic interference	Take EMC recommendations into account [▶ 96] and, if necessary, increase the fault tolerance (G298)

Cause		Check and action
16: X4 busy	Defective encoder cable	Check the cable and replace it if necessary
	Inconsistent parameterization	Compare the connected encoder to the parameterized encoder and correct it if necessary (H00)
	Incompatible encoder	Compare the specification of the encoder with the corresponding specifications from STOBER and replace the encoder if necessary
17: EBI encoder low battery	Battery in battery module weak	Replace the battery; reference is not deleted by the event
18: EBI encoder battery empty	Battery in battery module empty	Replace the battery
	Initial connection	–
	Connection error	Check the connection and correct it if necessary
	Defective encoder cable	Check the cable and replace it if necessary
	Faulty battery module	Check the battery module and replace it if necessary
19: Alarm bit	Encoder fault	Check the specification of the encoder regarding the alarm bit
20: Resolver carrier, 21: Resolver sin/cos undervoltage, 22: Resolver sin/cos overvoltage	Defective encoder cable	Check the cable and replace it if necessary
	Incompatible encoder	Compare the specification of the encoder with the corresponding specifications from STOBER and replace the encoder or motor if necessary; fault cannot be acknowledged
21: Resolver sin/cos undervoltage	Incompatible encoder; phase search or calibration of the optimal resolver excitation failed	Compare the specification of the encoder with the corresponding specifications from STOBER; if necessary, calibrate the starting point for calibrating the optimal resolver excitation and the phase search (B40); fault cannot be acknowledged
24: Resolver failure	Defective encoder cable	Check the cable and replace it if necessary
48: X4 zero pulse missing	Defective encoder cable	Check the cable and replace it if necessary
	Connection error	Check the connection and correct it if necessary
	Late zero toe	Check number of encoder increments per rotation and correct it if necessary (H02)
49: X4 zero pulse distance too small	Defective encoder cable	Check the cable and replace it if necessary
	Connection error	Check the connection and correct it if necessary
	Early zero track	Check number of encoder increments per rotation and correct it if necessary (H02)
60: Hiperface synchronisation, 61: Hiperface timeout, 62: Hiperface signal quality, 63: Hiperface link	Defective encoder cable	Check the cable and replace it if necessary
	Connection error	Check the connection and correct it if necessary
	Electromagnetic interference	Take EMC recommendations into account [▶ 96] and, if necessary, increase the fault tolerance (G298)
64: EnDat3 Timeout, 65: EnDat3 invalid Request, 66: EnDat3 Position Check	Defective encoder cable	Check the cable and replace it if necessary
	Connection error	Check the connection and correct it if necessary
	Electromagnetic interference	Take EMC recommendations into account [▶ 96] and, if necessary, increase the fault tolerance (G298)

Tab. 210: Event 77 – Causes and actions

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18.1.5.34 Event 78: Position limit cyclic

The drive controller is interrupted if:

- A29 = 0: Inactive for Drive Based or PROFIdrive device control
  or
- A540 = 0: Disable drive motor coasting for CiA 402 device controller

Response:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The brakes are applied in the event of an inactive release override (F06)

The drive controller has a fault and a quick stop occurs if:

- A29 = 1: Active for Drive Based or PROFIdrive device control
  or
- A540 = 2: Slow down on quick stop ramp for CiA 402 device controller

Response:

- The axis is stopped by a quick stop; meanwhile, the brakes remain released
- At the end of the quick stop, the power unit is disabled and the axis movement is no longer controlled by the drive controller; the brakes engage if release override is inactive (F06)

Cause		Check and action
1: Illegal direction	Cyclical set position outside of the software limit switch	Check the set position in the controller and software limit switch in the drive controller and correct it if necessary (PROFIdrive: I50, I51; CiA 402: A570)
2: Reference value invalid	Cyclical set position outside of the travel range	Check the set position in the controller and travel range in the drive controller and correct it if necessary (PROFIdrive: I01; CiA 402: A568)
3: Extrapolation time I423 exceeded	Missing update of the cyclical set position or cyclical set velocity	Check the task cycle time in the fieldbus master of the controller and maximum permitted extrapolation in the drive controller and correct it if necessary (I423)

Tab. 211: Event 78 – Causes and actions

18.1.5.35 Event 79: Motor/position encoder plausibility

The possible effects depend on the configured level (U28).

- 0: Inactive
- 1: Message
- 3: Fault

The drive controller is interrupted if:

- A29 = 0: Inactive for Drive Based or PROFIdrive device control
  or
- A540 = 0: Disable drive motor coasting for CiA 402 device controller

Response:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The brakes are applied in the event of an inactive release override (F06)

The drive controller has a fault and a quick stop occurs if:

- A29 = 1: Active for Drive Based or PROFIdrive device control
  or
- A540 = 2: Slow down on quick stop ramp for CiA 402 device controller

Response:

- The axis is stopped by a quick stop; meanwhile, the brakes remain released
- At the end of the quick stop, the power unit is disabled and the axis movement is no longer controlled by the drive controller; the brakes engage if release override is inactive (F06)

Cause	Check and action
Connection error	Check the connection and shielding and correct them if necessary
Slip	Check the mechanics between the motor and position encoder and maximum permitted slip and correct them if necessary (I291, I292)
Mechanical damage	Check the mechanics between the motor and position encoder and correct any damage if necessary

Tab. 212: Event 79 – Causes and actions

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18.1.5.36 Event 80: Illegal action

The drive controller is interrupted:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The behavior of the brakes depends on the configuration of the safety module and an optional release override (F06)

Cause		Check and action
1: Illegal	Not supported by the control type	Check the control type and correct it if necessary (B20)
2: Brake	Loaded axis	Remove the axis load and start the action again

Tab. 213: Event 80 – Causes and actions

18.1.5.37 Event 81: Motor allocation

The possible effects depend on the configured level (U04):

- 0: Inactive
- 1: Message
- 3: Fault

The drive controller is interrupted:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The behavior of the brakes depends on the configuration of the safety module and an optional release override (F06)

Depending on the cause, data for the motor (in the case of a change to the motor or motor type), current controller (in the case of a change to the motor type), brake (in the case of a change to the brake or motor type), temperature sensor (in the case of a change to the temperature sensor or motor type) or motor adapter, gear unit and geared motor (in the case of a change to the gear unit type) are read out of the electronic nameplate and entered in the respective parameters. In the event of a change to the motor, motor type or even just the commutation, the commutation offset (B05) is reset.

Cause		Check and action
1: Different motor type	Modified motor assignment	Check the change to the motor assignment and save the new motor assignment if necessary (A00)
	Modified gear unit assignment	Check the change to the gear unit assignment and save the new assignment if necessary (A00)
32: Different motor, 33: Different motor & brake, 34: Different motor & temperature sensor, 35: Different motor & brake & temperature sensor, 38: Different motor, temperature sensor & gear unit, 64: Different commutation, 65: Different commutation & brake, 66: Different commutation & temperature sensor, 67: Different commutation & brake & temperature sensor, 129: Different brake, 130: Different temperature sensor, 131: Different brake & temperature sensor	Modified motor assignment	Check the change to the motor assignment and save the new assignment if necessary (A00)
36: Different motor & gear unit 37: Different motor, brake & gear unit, 39: Different motor, brake, temperature sensor & gear unit	Modified motor and gear unit assignment	Check the change to the motor and gear unit assignment and save the new assignment if necessary (A00)
150: Temperature sensor unknown	Motor with unknown temperature sensor type	Update the firmware or change the motor

Tab. 214: Event 81 – Causes and actions

18.1.5.38 Event 83: Failure of one/ all phases (mains)

Upon the occurrence of an event, a warning is output initially, becoming a fault after a 10 s warning period.

The drive controller is interrupted if:

- A29 = 0: Inactive for Drive Based or PROFIdrive device control
  or
- A540 = 0: Disable drive motor coasting for CiA 402 device controller

Response:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The brakes are applied in the event of an inactive release override (F06)

The drive controller has a fault and a quick stop occurs if:

- A29 = 1: Active for Drive Based or PROFIdrive device control
  or
- A540 = 2: Slow down on quick stop ramp for CiA 402 device controller

Response:

- The axis is stopped by a quick stop; meanwhile, the brakes remain released
- At the end of the quick stop, the power unit is disabled and the axis movement is no longer controlled by the drive controller; the brakes engage if release override is inactive (F06)

Cause	Check and action
Failure of one or all line phases	Check the line fuse and connection and correct them if necessary

Tab. 215: Event 83 – Causes and actions

18.1.5.39 Event 84: Drop in network voltage when power section active

The drive controller is interrupted if:

- U30 = 0: Inactive and
- A29 = 0: Inactive for Drive Based or PROFIdrive device control
  or
- U30 = 1: Active and
- A540 = 0: Disable drive motor coasting for CiA 402 device controller

Response:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The brakes are applied in the event of an inactive release override (F06)

The drive controller has a fault and a quick stop occurs if:

- A29 = 0: Inactive for Drive Based or PROFIdrive device control
  or
- A540 = 2: Slow down on quick stop ramp for CiA 402 device controller

Response:

- The axis is stopped by a quick stop; meanwhile, the brakes remain released
- At the end of the quick stop, the power unit is disabled and the axis movement is no longer controlled by the drive controller; the brakes engage if release override is inactive (F06)

The drive controller is interrupted with emergency braking if:

- U30 = 1: Active and
- A29 = 1: Active for Drive Based or PROFIdrive device control
  or
- U30 = 1: Active and
- A540 = 2: Slow down on quick stop ramp for CiA 402 device controller

Response:

- The axis is stopped by emergency braking; the brakes are applied in the event of an inactive release override (F06)
- At the end of emergency braking, the power unit is disabled and axis movement is no longer controlled by the drive controller

Emergency braking is only possible for the synchronous servo, torque and Lean motor types.

A quick stop is not possible when the power supply returns.

Cause	Check and action
Decrease in supply voltage under load	Check the supply voltage for load stability and stabilize the network if necessary
Sporadic power failures	Check the supply voltage for stability and stabilize the network if necessary

Tab. 216: Event 84 – Causes and actions

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18.1.5.40 Event 85: Excessive jump in reference value

The drive controller is interrupted if:

- A29 = 0: Inactive for Drive Based or PROFIdrive device control
  or
- A540 = 0: Disable drive motor coasting for CiA 402 device controller

Response:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The brakes are applied in the event of an inactive release override (F06)

The drive controller has a fault and a quick stop occurs if:

- A29 = 1: Active for Drive Based or PROFIdrive device control
  or
- A540 = 2: Slow down on quick stop ramp for CiA 402 device controller

Response:

- The axis is stopped by a quick stop; meanwhile, the brakes remain released
- At the end of the quick stop, the power unit is disabled and the axis movement is no longer controlled by the drive controller; the brakes engage if release override is inactive (F06)

Cause		Check and action
1: Position	Fast set position change leads to acceleration that cannot be performed	Check the current set acceleration against the maximum permitted acceleration in the drive controller (E64, E69) and reduce the set value change in the controller or change the motor type if necessary
2: Velocity	Fast set velocity change leads to acceleration that cannot be performed	Check the current set acceleration against the maximum permitted acceleration in the drive controller (E64, E69) and reduce the set value change in the controller or change the motor type if necessary

Tab. 217: Event 85 – Causes and actions

18.1.5.41 Event 86: Unknown LeanMotor record

The drive controller is interrupted if:

- A29 = 0: Inactive for Drive Based or PROFIdrive device control
  or
- A540 = 0: Disable drive motor coasting for CiA 402 device controller

Response:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The brakes are applied in the event of an inactive release override (F06)

The drive controller has a fault and a quick stop occurs if:

- A29 = 1: Active for Drive Based or PROFIdrive device control
  or
- A540 = 2: Slow down on quick stop ramp for CiA 402 device controller

Response:

- The axis is stopped by a quick stop; meanwhile, the brakes remain released
- At the end of the quick stop, the power unit is disabled and the axis movement is no longer controlled by the drive controller; the brakes engage if release override is inactive (F06)

Cause		Check and action
1: Motor	Motor type not supported by firmware	Update the firmware or change the motor (B100)
2: Cable length	Cable length not supported by firmware	Update the firmware or change the cable (B101)

Tab. 218: Event 85 – Causes and actions

18.1.5.42 Event 87: Reference lostReference loss

The drive controller is interrupted if:

- A29 = 0: Inactive for Drive Based or PROFIdrive device control
  or
- A540 = 0: Disable drive motor coasting for CiA 402 device controller

Response:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The brakes are applied in the event of an inactive release override (F06)

The drive controller has a fault and a quick stop occurs if:

- A29 = 1: Active for Drive Based or PROFIdrive device control
  or
- A540 = 2: Slow down on quick stop ramp for CiA 402 device controller

Response:

- The axis is stopped by a quick stop; meanwhile, the brakes remain released
- At the end of the quick stop, the power unit is disabled and the axis movement is no longer controlled by the drive controller; the brakes engage if release override is inactive (F06)

Cause	Check and action
Power unit switched off on moving axis	Reference the drive again and, if necessary, only shut off the power unit when stationary (I199)
Actual position (motor) changes when power unit is shut off	Do not change the actual position (motor) when the power unit is shut off and, if applicable, switch to a motor with a brake (F00)

Tab. 219: Event 87 – Causes and actions

18.1.5.43 Event 88: Control panel

The drive controller is interrupted if:

- A29 = 0: Inactive for Drive Based or PROFIdrive device control
  or
- A540 = 0: Disable drive motor coasting for CiA 402 device controller

Response:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The brakes are applied in the event of an inactive release override (F06)

The drive controller has a fault and a quick stop occurs if:

- A29 = 1: Active for Drive Based or PROFIdrive device control
  or
- A540 = 2: Slow down on quick stop ramp for CiA 402 device controller

Response:

- The axis is stopped by a quick stop; meanwhile, the brakes remain released
- At the end of the quick stop, the power unit is disabled and the axis movement is no longer controlled by the drive controller; the brakes engage if release override is inactive (F06)

Cause	Check and action
Commissioning and parameterization computer heavily loaded	Check the number of open windows (DS6) and the number of active programs and reduce the number if necessary
Connection error	Check the connection and correct it if necessary
Defective network cable	Check the cable and replace it if necessary
Faulty network connection	Check the network settings and, if applicable, the switch, router or wireless connections and correct them or contact your network service provider if necessary

Tab. 220: Event 88 – Causes and actions

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18.1.5.44 Event 89: Maximum current LM

The drive controller is interrupted if:

- A29 = 0: Inactive for Drive Based or PROFIdrive device control
  or
- A540 = 0: Disable drive motor coasting for CiA 402 device controller

Response:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The brakes are applied in the event of an inactive release override (F06)

The drive controller has a fault and a quick stop occurs if:

- A29 = 1: Active for Drive Based or PROFIdrive device control
  or
- A540 = 2: Slow down on quick stop ramp for CiA 402 device controller

Response:

- The axis is stopped by a quick stop; meanwhile, the brakes remain released
- At the end of the quick stop, the power unit is disabled and the axis movement is no longer controlled by the drive controller; the brakes engage if release override is inactive (F06)

Cause		Check and action
1: Id, 2: Iq	Excessive controller gain at low speeds	Check the controller coefficients and speed controller factors and reduce them if necessary (I19, C31, B146, B147)

Tab. 221: Event 89 – Causes and actions

18.1.5.45 Event 90: Motion block

The drive controller is interrupted if:

- A29 = 0: Inactive for Drive Based or PROFIdrive device control

Response:

- The power unit is disabled and axis movement is no longer controlled by the drive controller
- The brakes are applied in the event of an inactive release override (F06)

The drive controller has a fault and a quick stop occurs if:

- A29 = 1: Active for Drive Based or PROFIdrive device control

Response:

- The axis is stopped by a quick stop; meanwhile, the brakes remain released
- At the end of the quick stop, the power unit is disabled and the axis movement is no longer controlled by the drive controller; the brakes engage if release override is inactive (F06)

Cause		Check and action
1: Next motion block missing	Subsequent motion block for motion block with final velocity is missing	Define buffered subsequent motion block
2: Target Position in reverse direction	Set position is in the opposite direction	A change of travel direction by the subsequent motion block is not permitted for motion blocks with final velocity; adjust the set position
	Set position cannot be reached without reversing	Check limiting values for velocity, deceleration and jerk and adjust if necessary

Tab. 222: Event 90 – Causes and actions

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19 Analysis

Scope and multi-axis scope in DriveControlSuite are two analysis tools that help you commission single axes or entire machines and troubleshoot.

You can select and record up to 12 parameters from the entire pool of drive controller parameters. The sampling time can be set from 250 µs to several seconds to be able to observe both highly dynamic as well as very slow processes. Like for an actual oscilloscope, there are a variety of trigger options and many statistical evaluation functions for the recorded data (minimum value, maximum value, average, RMS value, standard deviation, etc.).

Tool	Objectives	Application cases
Scope	Create multiple scope images of a single drive controller at different times.	Optimize or diagnose a drive controller
	Create multiple scope images with the same settings (channels, trigger, pre-trigger, sampling time), but differing values for individual parameters.	
	Combine multiple scope images for the analysis.	
	Create a temporary direct image.	
Multi-axis scope	Create individual scope images of multiple drive controllers or axes at the same time.	Check the machine utilization or diagnosis in synchronous operation
	Create an individual scope image with the same settings or individual settings (for each axis or for individual axes).	

Tab. 223: Application cases for scope and multi-axis scope

19.1 Scope and multi-axis scope

With the Scope and Multi-axis scope windows, you can create scope images for diagnostic purposes for one or more drive controllers if an online connection is established.

Information

The Scope window can be reached using the button in the project menu if you have selected a drive controller in the project tree.

The Multi-axis scope window can be reached using the button in the project menu if you have selected the project in the project tree.

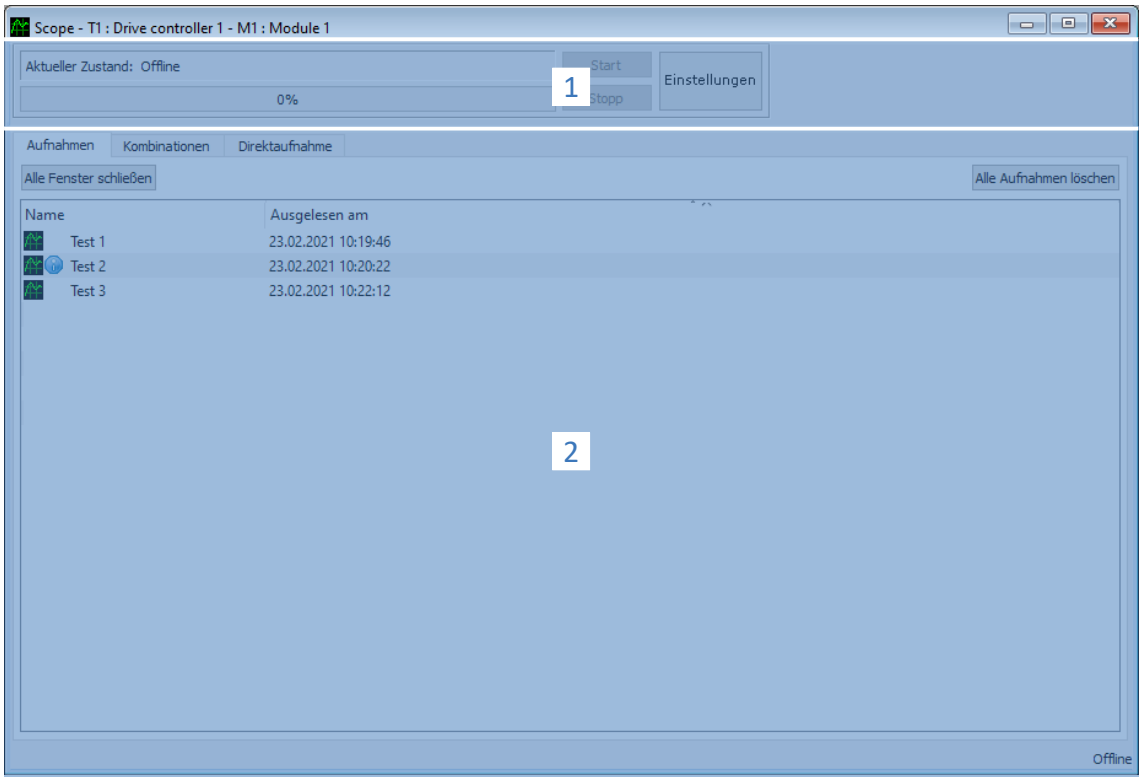

Fig. 68: Scope and multi-axis scope: Program interface

No.	Area	Description
1	Action area	In the Action area, you can define settings for the scope image, start and stop the scope image, and read information on the status, scope image progress and remaining recording time.
2	Scope images	In the Images area, you can open, delete, rename, comment on or export scope images that have already been read out. In the scope, the Combinations and Direct image tabs are also available in this area.

Action area

Button	Availability	Description
Start	Scope, multi-axis scope	Starts the scope image (prerequisite: online connection).
Stop	Scope, multi-axis scope	Stops the scope image (prerequisite: online connection).
Settings	Scope, multi-axis scope	Opens the Settings window where you can define the trigger condition, channel assignment, sampling time and, in the case of the multi-axis scope, the nodes for the scope image.

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Scope images

Tab	Availability	Description	Context menu
Scope images	Scope	On the Images tab, completed scope images are listed after being read out from the drive controller. Double-click to open the scope image. If you have created multiple scope images and select this, you can combine and open them via the context menu.	▪ Open ▪ Delete ▪ Rename ▪ Comment ▪ Export ▪ Combine and open
	Multi-axis scope	On the Images tab, completed scope images are listed after being read out from the drive controller. Double-click to open the scope image.	▪ Open ▪ Delete ▪ Rename ▪ Comment ▪ Export
Combinations	Scope	On the Combinations tab, combined scope images are listed that you can open by double-clicking.	▪ Open ▪ Delete ▪ Rename ▪ Comment ▪ Export
Direct image	Scope	In the Direct image tab, you can create a temporary scope image that is discarded with the start of the next scope image and use the set value generation to optimize the control cascade.	—

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19.1.1 Scope settings

In the Settings window, you define the settings for the scope image and the trigger before you start the scope image. The scope image settings are shown in the Channel assignment tab, the trigger settings in the Trigger condition tab (scope) or Node and trigger condition tab (multi-axis scope).

Information

The Settings window for scope images can be reached via the Settings button in the Scope or Multi-axis scope window.

Tab	Availability	Description
Channel assignment	Scope, multi-axis scope	With the scope image settings in the Channel assignment tab, you define which data of the respective axis you want to record in the scope image, in which time intervals the data is sampled and which time period is recorded before triggering the trigger.
Trigger condition	Scope	With the trigger settings in the Trigger condition tab, you define which event triggers the recording of a scope image.
Node and trigger condition	Multi-axis scope	With the trigger settings in the Node and trigger condition tab, you define which event triggers the recording of a scope image and for which axes a scope image is recorded.

Example: Trigger and scope image settings

Settings	Example	Results
Trigger settings	▪ Simple trigger ▪ Source: E15 v-motor-encoder ▪ Condition: greater ▪ Comparison value: 50 rpm	The trigger condition is met if the value of parameter E15 v-motor-encoder is greater than 50 rpm.
Scope image settings	▪ Recorded channels: 1 ▪ Sampling time: 1 ms ▪ Pre-trigger: 33%	The recording time calculated from the number of channels and the sampling time is 6.6 s. 2.2 s (33%) are recorded before the trigger is triggered and 4.4 s afterwards.

Information

Additional settings for your scope images can be made using parameters T25 Automatic start and T26 Retrigger scope.

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19.1.1.1 Trigger settings

With the trigger settings in the Trigger condition tab (scope) or Node and trigger condition tab (multi-axis scope), you define which event triggers the recording of a scope image. To do this, define the trigger for each axis and, if applicable, the trigger condition. The selection of the trigger influences which of the settings described below are available to you.

Information

The Settings window for the scope image can be reached via the Settings button in the Scope or Multi-axis scope window. For the scope, you can find the trigger settings directly in the Trigger condition tab. For the multi-axis scope, you can reach the trigger settings for the respective axis via the Settings button in the Node and trigger condition tab.

Trigger	Description
Manually at stop	The trigger is triggered by the Stop button, without taking the pre-trigger time into account.
Immediately at start	The trigger is triggered by the Start button as soon as the pre-trigger time has elapsed.
Simple trigger	The trigger is triggered automatically when the trigger condition is met and the pre-trigger time has elapsed.
Trigger logic	The trigger is triggered automatically when the trigger logic is satisfied and the pre-trigger time has elapsed.

Trigger conditions

A simple trigger consists of a single trigger condition, while trigger logic is composed of 2 trigger conditions logically linked by an operator. A trigger condition consists of the source, the condition and the comparison value.

Source	Description
Inactive	Default value if Manually at stop was selected as the trigger.
Immediately at start	Default value if Immediately at stop was selected as the trigger.
Parameter	Defines a parameter as the source for the trigger. You can enter the parameter either via ... and the Add parameter dialog box or directly into the text field with auto-completion by specifying the coordinate, name and, if applicable, axis number (example: 1.I80 Current position).
Signal name	Defines a signal as the source for the trigger. You have assigned a signal name for this signal in the graphical programming at the input or output of a block. If you have not yet assigned a signal name in the graphical programming, the list is empty.
Physical address	Defines a physical address in the drive controller memory as the source for the trigger. Physical addresses can be assigned as part of an extended diagnosis by the STOBER development team. They must be specified with the associated data type.

Setting	Description
Condition	Condition for the trigger condition with which the source and the comparison value are compared. ▪ less than ▪ less than or equal to ▪ greater than ▪ greater than or equal to ▪ equal to ▪ not equal to
Comparison value	Comparison value for the trigger condition that is compared to the source.
Minimum time	Time, in µs, in which the condition must at least be met for the trigger condition to be considered met.

Option	Description
Absolute value	The Absolute value option enables you to ignore the sign when comparing the source and comparison value.
Mask	The Mask option allows you to evaluate only a single bit of the source.
Edge	The Edge option activates/deactivates edge detection.

Operator	Description
AND	The trigger logic is satisfied if **both** trigger conditions are met.
OR	The trigger logic is satisfied if **one or both** trigger conditions are met.
XOR	The trigger logic is satisfied if **one** of the two trigger conditions is met, **not both**.
NAND	The trigger logic is satisfied if **neither or one** of the two trigger conditions is met, **not both**.
NOR	The trigger logic is satisfied if **neither** of the two trigger conditions is satisfied.
XNOR	The trigger logic is satisfied if **neither or both** of the two trigger conditions are met.
Trigger 1	The trigger logic is satisfied if **the first** trigger condition is met.
Trigger 2	The trigger logic is satisfied if **the second** trigger condition is met.

Button	Description
Export	Exports all settings (trigger and scope image settings) to a text file (*.txt).
Import	Imports all settings from a text file (*.txt).
Close	Closes the window. All settings are accepted.

Information

Export your settings if you want to reuse the same or similar settings in other projects or import existing settings and adjust them as necessary.

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19.1.1.2 Scope image settings

With the scope image settings in the Channel assignment tab, you define which data of the respective axis you want to record in the scope image, in which time intervals the data is sampled and which time period is recorded before triggering the trigger. To do this, define the channel assignment, the sampling time and the pre-trigger for each axis.

Information

The Settings window for the scope image can be reached via the Settings button in the Scope or Multi-axis scope window. For the scope and multi-axis scope, the scope image settings are shown in the Channel assignment tab.

Information

For a multi-axis scope, you must first select at least 2 nodes before you can specify the settings in the Channel assignment tab. You can specify identical channel assignments for all axes or use the Individual option to store differing settings for each axis. The calculation of the recording time and pre-trigger time relate to the axis with the shortest recording time.

Setting	Selection	Description
Channel assignment	Inactive	When Inactive is selected, no value is recorded in the scope image for the channel.
	Parameters	When Parameter is selected, the value of a parameter is recorded in the scope image for the channel.
	Signal names	When Signal name is selected, the value of a signal is recorded in the scope image for the channel. You defined a signal name for this signal in the graphic programming at the input or output of a block.
	Physical address	When Physical address is selected, the value of a physical address in the memory of the drive controller is recorded in the scope image for the channel.
Sampling time	250 µs - 100 ms	With the Sampling time setting, you define the time interval in which the signals are sampled for the scope image.
Pre-trigger	0 % – 100 %	With the Pre-Trigger setting, you define the percentage of the scope memory that must be occupied for the axis to be trigger-ready and thus the percentage of the recording time before the trigger.

Information

The scope memory has approximately 32 KB available for the scope image. The recording time is calculated from the sampling time, the number of recorded channels and the available disk space. The larger the number of recorded channels and the more frequently the channels are sampled, the faster the available disk space is occupied and the shorter the scope image becomes.

The pre-trigger time is calculated from the set pre-trigger and the recording time.

Information

If a large pre-trigger value is entered with a long recording time, the scope image may remain in the Started state for a period after the start until the pre-trigger is fulfilled and recording readiness is signaled by the Trigger-ready state. Status and progress of the scope image are displayed in DriveControlSuite. The scope image is then read out from the drive controller and transmitted to DriveControlSuite.

Button	Description
Export	Exports all settings (trigger and scope image settings) to a text file (*.txt).
Import	Imports all settings from a text file (*.txt).
Close	Closes the window. All settings are accepted.

Information

Export your settings if you want to reuse the same or similar settings in other projects or import existing settings and adjust them as necessary.

19.1.2 Image editor

The image editor contains all the functions you need to edit your scope images.

Information

The image editor can be reached by double-clicking a scope image or via the context menu of the respective scope image.

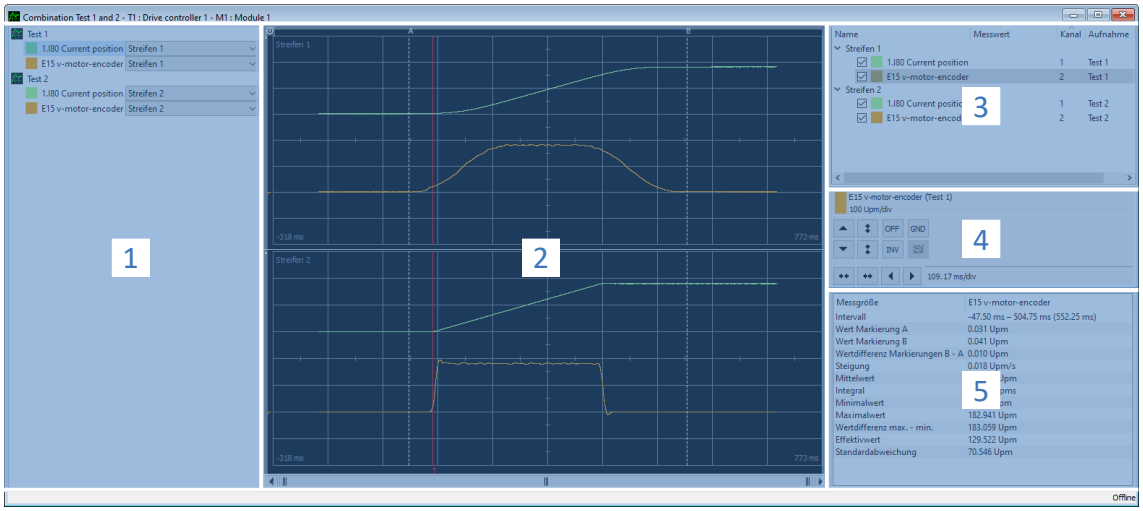

Fig. 69: Scope and multi-axis scope: Image editor

No.	Area	Description
1	Assignment of channel to band	For combinations or multi-axis scope images, you can change the assignment to a section within the scope image (= band) for each channel in the Channels and bands area.
2	Scope image	In the Scope image area, you see the graphical representation of the recorded and visible channels.
3	Channel selection	In the Channel selection area, you manage the bands and channels of a scope image.
4	Channel settings	In the Channel settings area, you can adjust the graphical representation of the channels.
5	Measured values	In the Measured values area, values for different measured variables are output with measuring points A and B for the selected channel. For scope images, there is also the option to carry out a frequency analysis.

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Assignment of channel to band

This area is only available in case of combinations or multi-axis scope images. By default, each scope image is assigned a band with the recorded channels. You can hide each channel (parameter, signal name or physical address) or change the assignment to a band via the corresponding picklist. However, new bands must be created beforehand in the Channel selection area.

Scope image

A scope image shows a graphical representation of the recorded and visible channels.

Icon/Button	Description	Context menu
A B	Left-clicking on measuring line A or B allows the line to be shifted to the left or right as desired.	—
[Right mouse button]	Right-clicking on any point of the scope image opens the context menu.	▪ Set marking A here ▪ Set marking B here ▪ Jump to marking A ▪ Jump to marking B
[Left mouse button]	Left-clicking on any point of the scope image activates the quick measurement. The values are output in the Channel selection area in the Measured value column.	—
	Marking the zero line of a channel.	—
	Marking the trigger line.	—

Icon	Description
	Opens the image editor settings for the coloring of the drawing area and channels.
	Opens the dialog box for storing a comment for the scope image.
	Opens the list of scope images in order to take over the channel scaling from a scope image that has already been adjusted. Button only available for scope images, not for combinations or multi-axis scope images.

Channel selection

In the Channel selection area, you manage the bands and the channels assigned to them. You can delete existing bands or create new bands. You can activate or deactivate the display of a channel. For each channel, a channel number and the name of the scope image is output. If you click any point within the scope image, the associated measured value is also displayed.

Element	Description	Context menu
Band	Section of a scope image	▪ Delete band ▪ Create new band
Channel	Recorded parameter, signal name or physical address	▪ Hide channel ▪ Only show this channel ▪ Show all channels ▪ Invert display of channels ▪ Create new band

Channel settings

The channel settings are used to adjust the graphical representation of the channels and scope image. In the display above the buttons, you see the color, complete designation and scaling of the selected channel. You can use the buttons to change the display of the channel or time axis. In the display next to the button for the time axis, the current scaling of the x-axis is displayed.

Button	Section	Description
	Channel display	Opens the color palette for changing the channel color.
	Channel settings	Moves the curve of the activated channel up or down by a grid interval: ▪ [Shift] + [button]: Moves curve up or down by a pixel ▪ [Ctrl] + [button]: Moves curve up or down to the next grid line ▪ [Shift] + [Ctrl] + [button]: Centers curve vertically
		Enlarges or reduces the channel scaling (fixed point = horizontal image center): ▪ [Shift] + [button]: Autoscaling
		Displays or hides the channel.
		Inverts the channel display.
		Indicates the zero line of the channel.
		Opens the list of parameter signals for selecting an individual bit. Button can only be used for whole-number parameters without decimal places (BYTE, WORD or DWORD data types), but not for selection parameters.
	Time axis settings	Enlarges or reduces the scaling of the x-axis: ▪ [Ctrl] + [button]: Autoscaling
		Moves the scope image left or right by a grid interval: ▪ [Shift] + [button]: Moves scope image left or right by a pixel ▪ [Ctrl] + [button]: Moves scope image left or right to the next grid line ▪ [Shift] + [Ctrl] + [button]: Centers scope image horizontally

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Measured values

In the Measured values area, values for different measured variables are output with measuring points A and B for the selected channel. For scope images, there is also the option to carry out temporary frequency analyses in the form of a discrete Fourier transform (DFT). When the image editor is closed, DFT calculations are discarded again.

Tab	Availability	Description
Scope	Scope, multi-axis scope	The Scope tab has a list of the values for various variables referring to measuring points A and B for the selected channel.
Frequency analysis	Scope	The Frequency analysis tab can be used for performing Fourier transforms on scope images.

19.1.3 Frequency analysis

Between measuring points A and B in the Frequency analysis tab of the image editor, a blue transparent window appears for which a discrete Fourier transform can be carried out. Interval and measured values (= number of sensing points between A and B) are displayed for you.

Information

You can reach the tab where you can carry out a frequency analysis in the image editor of a scope image through the Measured values area > Frequency analysis tab.

Setting	Selection	Description
Window function	Hamming	Minimizes the leakage effect for the Fourier transform.
	Without weighting	Calculation without correction.

Button	Description
Calculate DFT	The DFT is calculated and opened in a separate window.

DFT window

The calculated DFT opens in a separate window. When the window is closed, the calculation is discarded again. You can adjust the display:

- [Ctrl] + [Left mouse button]: Zoom in on section
- [Ctrl] + [Right mouse button]: Reset display to initial value (100%)

Button	Description
OFF	Displays or hides the selected channel.
Log	Logarithmically scales the y- or x-axis.
Lin	Linearly scales the y- or x-axis.

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19.2 Scope image

Scope image recording is divided into 3 steps:

- Preparation of the scope image in DriveControlSuite
  - Establish online connection
  - Configure channels of the participating axis
  - Define trigger settings
  - Start the recording
- Loading the data in the drive controller
  - Process of trigger communication (independent of DriveControlSuite)
  - Monitoring of recording by DriveControlSuite
- Reading out and displaying the scope image
  - Read the scope image out of the drive controller
  - Display the scope image in DriveControlSuite

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19.2.1 Creating a scope image

Create a scope image by specifying the scope image and trigger settings. Then start the scope image with an existing online connection.

Information

During the search, all drive controllers within the broadcast domain are found via IPv4 limited broadcast.

Requirements for finding a drive controller in the network:

- Network supports IPv4 limited broadcast
- All drive controllers and the PC are in the same subnet (broadcast domain)

Establishing an online connection (existing project)

Connect your PC and the drive controller to the network.

✓ The drive controller is switched on.

✓ A suitable project file for your drive system already exists.

1. Start DriveControlSuite.
2. Click on Open project.
3. Navigate to the directory and load the file.
4. In the project menu, click Online connection.
   ⇨ The Add connection window opens. All drive controllers found via IPv4 limited broadcast are displayed.
5. Direct connection tab > IP address column:
   Activate the IP address in question and confirm your selection with OK.
   ⇨ The Online functions window opens. The drive controller that is connected using the previously selected IP address is displayed.
6. Online tab:
   Click Set all to read in order to activate the drive controller for read data synchronization.
7. Click Assign all based on reference to assign the drive controller to the configured drive controller.
8. Then click Establish online connection.
   ⇨ The data connection is established and the project configuration data is compared; if the project configuration data is identical, only the parameter values are transmitted from the drive controller to the PC.
   ⇨ The drive controller in the project tree is active.

Optional: Establishing an online connection (new project)

Connect your PC and the drive controller to the network.

✓ The drive controller is switched on.

1. Start DriveControlSuite.
2. Click on Read project.
   ⇨ The Add connection window opens. All drive controllers found via IPv4 limited broadcast are displayed.
3. Direct connection tab > IP address column:
   Activate the IP address in question and confirm your selection with OK.
   ⇨ The Online functions window opens. The drive controller that is connected using the previously selected IP address is displayed.
4. Online tab:
   Click Set all to read in order to activate the drive controller for read data synchronization.
5. Click on Set all to create new drive controller to create the new drive controller in the project tree.
6. Then click Establish online connection.
   ⇨ The data connection is established and the project configuration data is transmitted from the drive controller to the PC.
   ⇨ The drive controller is created in the project tree and is active.

Define the settings for scope images and triggers

Define the scope image settings and the trigger settings before you start the scope image.

1. Select the relevant drive controller in the project tree and click Scope in the project menu.
   ⇨ The Scope window opens.
2. Action area:
   To define the settings for the scope image, click Settings.
   ⇨ The Settings window opens.
3. Trigger condition tab:
   Define which event triggers the scope image.
   3.1. Select Manual at stop to activate the trigger via the Stop button (without pre-trigger).
   3.2. Select Immediately at start to activate the trigger via the Start button (with pre-trigger).
   3.3. Select Simple trigger to activate the trigger automatically when a trigger condition occurs.
   3.4. Select Trigger logic to activate the trigger automatically when two logically linked trigger conditions occur.
4. Trigger condition tab:
   If you have selected Simple trigger or Trigger logic, define the Source, Condition and Comparison value for the trigger condition.
   4.1. If you have selected Single trigger, define the individual trigger condition.
   4.2. If you have selected Trigger logic, define both trigger conditions and the operator for the logical operation.

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5. Channel assignment tab:
   Select which data is to be recorded with the scope image.

   5.1. Parameter:
   To record the value of a parameter, enter the coordinate, name and, if applicable, axis number of the parameter with the Add parameter dialog box via ... or by writing directly into the text field and using auto-completion (example: 1.I80 Current position).

   5.2. Signal name:
   To record the value of a signal, select a signal for which you have assigned a signal name in the graphic programming.

   5.3. Physical address:
   To record the value of a physical address in the drive controller memory, select the data type and specify the address.

6. Channel assignment tab, Sampling time selection:
   Select the time interval at which the channel is to be sampled.

7. Channel assignment tab, Pre-trigger selection:
   Define the percentage of the recording time before the trigger.
   ⇨ The calculated recording time and pre-trigger time are displayed.

8. Confirm your settings with Close.

Creating a scope image

Start the scope image of the data in the drive controller and read out the scope image to DriveControlSuite according to the scope image and trigger settings.

✓ You are in the Scope window, Scope images tab.

✓ You have configured the settings for the scope image.

✓ There is an online connection between DriveControlSuite and the drive controller.

1. Action area:
   To start the scope image of the data in the drive controller, click Start.
   ⇨ The drive controller records the data in the scope memory in accordance with the scope image settings.
   ⇨ The Action area of DriveControlSuite displays information about the status of the scope image.

2. Optional: Click Stop if you use the Manually at stop trigger setting or if you want to stop the scope image early before the recording time expires.
   ⇨ When the trigger is triggered, DriveControlSuite reads the data from the scope memory according to the scope image settings.

⇨ The finished scope image is listed in the Scope images tab and can be opened via double-click.

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19.2.2 Combining scope images

Combine scope images with each other to easily compare the recorded data.

✓ You are in the Scope window, Scope images tab.

✓ You have created multiple scope images for a drive controller.

1. Scope images tab:
   Select the scope images you want to combine and choose Combine and open from the context menu.

⇨ Combinations tab:
The combined scope image is listed in the Combinations tab and opens in the image editor.

19.2.3 Creating a direct image

Create a scope image by specifying the scope image and trigger settings. Then start the scope image with an existing online connection.

Information

During the search, all drive controllers within the broadcast domain are found via IPv4 limited broadcast.

Requirements for finding a drive controller in the network:

- Network supports IPv4 limited broadcast
- All drive controllers and the PC are in the same subnet (broadcast domain)

Establishing an online connection (existing project)

Connect your PC and the drive controller to the network.

✓ The drive controller is switched on.

✓ A suitable project file for your drive system already exists.

1. Start DriveControlSuite.
2. Click on Open project.
3. Navigate to the directory and load the file.
4. In the project menu, click Online connection.
   ⇨ The Add connection window opens. All drive controllers found via IPv4 limited broadcast are displayed.
5. Direct connection tab > IP address column:
   Activate the IP address in question and confirm your selection with OK.
   ⇨ The Online functions window opens. The drive controller that is connected using the previously selected IP address is displayed.
6. Online tab:
   Click Set all to read in order to activate the drive controller for read data synchronization.
7. Click Assign all based on reference to assign the drive controller to the configured drive controller.
8. Then click Establish online connection.
   ⇨ The data connection is established and the project configuration data is compared; if the project configuration data is identical, only the parameter values are transmitted from the drive controller to the PC.
   ⇨ The drive controller in the project tree is active.

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Optional: Establishing an online connection (new project)

Connect your PC and the drive controller to the network.

✓ The drive controller is switched on.

1. Start DriveControlSuite.
2. Click on Read project.
   ⇨ The Add connection window opens. All drive controllers found via IPv4 limited broadcast are displayed.
3. Direct connection tab > IP address column:
   Activate the IP address in question and confirm your selection with OK.
   ⇨ The Online functions window opens. The drive controller that is connected using the previously selected IP address is displayed.
4. Online tab:
   Click Set all to read in order to activate the drive controller for read data synchronization.
5. Click on Set all to create new drive controller to create the new drive controller in the project tree.
6. Then click Establish online connection.
   ⇨ The data connection is established and the project configuration data is transmitted from the drive controller to the PC.
   ⇨ The drive controller is created in the project tree and is active.

Define the settings for scope images and triggers

Define the scope image settings and the trigger settings before you start the scope image.

1. Select the relevant drive controller in the project tree and click Scope in the project menu.
   ⇨ The Scope window opens.
2. Action area:
   To define the settings for the scope image, click Settings.
   ⇨ The Settings window opens.
3. Trigger condition tab:
   Define which event triggers the scope image.
   3.1. Select Manual at stop to activate the trigger via the Stop button (without pre-trigger).
   3.2. Select Immediately at start to activate the trigger via the Start button (with pre-trigger).
   3.3. Select Simple trigger to activate the trigger automatically when a trigger condition occurs.
   3.4. Select Trigger logic to activate the trigger automatically when two logically linked trigger conditions occur.
4. Trigger condition tab:
   If you have selected Simple trigger or Trigger logic, define the Source, Condition and Comparison value for the trigger condition.
   4.1. If you have selected Single trigger, define the individual trigger condition.
   4.2. If you have selected Trigger logic, define both trigger conditions and the operator for the logical operation.

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5. Channel assignment tab:
   Select which data is to be recorded with the scope image.

   5.1. Parameter:
   To record the value of a parameter, enter the coordinate, name and, if applicable, axis number of the parameter with the Add parameter dialog box via ... or by writing directly into the text field and using auto-completion (example: 1.I80 Current position).

   5.2. Signal name:
   To record the value of a signal, select a signal for which you have assigned a signal name in the graphic programming.

   5.3. Physical address:
   To record the value of a physical address in the drive controller memory, select the data type and specify the address.

6. Channel assignment tab, Sampling time selection:
   Select the time interval at which the channel is to be sampled.

7. Channel assignment tab, Pre-trigger selection:
   Define the percentage of the recording time before the trigger.
   ⇨ The calculated recording time and pre-trigger time are displayed.

8. Confirm your settings with Close.

Creating a direct image

Start the scope image of the data in the drive controller and read out the scope image to DriveControlSuite according to the scope image and trigger settings.

✓ You are in the Scope window, Direct image tab.

✓ You have configured the settings for the scope image.

✓ There is an online connection between DriveControlSuite and the drive controller.

1. Action area:
   To start the scope image of the data in the drive controller, click Start.
   ⇨ The drive controller records the data in the scope memory in accordance with the scope image settings.
   ⇨ The Action area of DriveControlSuite displays information about the status of the scope image.

2. Optional: Click Stop if you use the Manually at stop trigger setting or if you want to stop the scope image early before the recording time expires.
   ⇨ When the trigger is triggered, DriveControlSuite reads the data from the scope memory according to the scope image settings.

⇨ The finished scope image is displayed in the Direct image tab.

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19.3 Multi-axis scope images

Recording via multi-axis scope is divided into 3 steps:

- Preparation of the scope images in DriveControlSuite
  - Establish online connections
  - Select participating axes and define settings for triggering axes
  - Configure channels of the participating axes
  - Start recording
- Loading of the data in the drive controllers
  - Process of trigger communication (independent of DriveControlSuite)
  - Monitoring of individual recordings by DriveControlSuite
- Reading out and displaying the scope images
  - Read out scope images from the drive controllers
  - Display scope images in DriveControlSuite

19.3.1 Requirements

To find the participating drive controllers in the network and their communication with each other via broadcast, you must observe the following requirements:

- Network supports IPv4 limited broadcast
- All drive controllers are in the same subnet (broadcast domain)
- All drive controllers are connected with a switch via the X9 service interface
- Your PC with installed DriveControlSuite commissioning software is also connected with the switch
- Optional: EtherCAT-based controller takes over synchronization of the scope images via distributed clocks

The following graphic shows the basic network structure for multi-axis scope images.

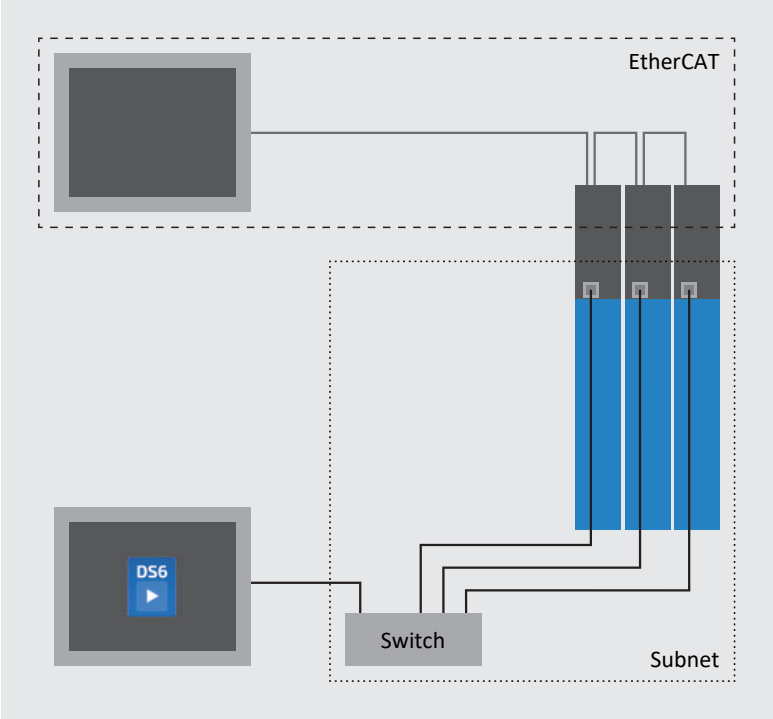

Fig. 70: Multi-axis scope: network structure

19.3.2 Creating a multi-axis scope image

Establish an online connection to the participating drive controllers, define the nodes, trigger settings and channels, and then start the recordings.

Information

During the search, all drive controllers within the broadcast domain are found via IPv4 limited broadcast.

Requirements for finding a drive controller in the network:

- Network supports IPv4 limited broadcast
- All drive controllers and the PC are in the same subnet (broadcast domain)

Establishing an online connection (existing project)

Connect your PC and the drive controllers to the network.

✓ The drive controllers are switched on.

✓ A suitable project file for your drive system already exists.

1. Start DriveControlSuite.
2. Click on Open project.
3. Navigate to the directory and load the file.
4. In the project menu, click Online connection.
   ⇨ The Add connection window opens. All drive controllers found via IPv4 limited broadcast are displayed.
5. Direct connection tab > IP address column:
   Activate the IP addresses in question and confirm your selection with OK.
   ⇨ The Online functions window opens. All drive controllers connected through the previously selected IP addresses are displayed.
6. Online tab:
   Click Set all to read in order to activate all drive controllers for read data synchronization.
7. Click Assign all based on reference to assign all drive controllers to the configured drive controllers.
8. Then click Establish online connection.
   ⇨ The data connection is established and the project configuration data is compared; if the project configuration data is identical, only the parameter values are transmitted from the drive controllers to the PC.
   ⇨ The drive controllers in the project tree are active.

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Optional: Establishing an online connection (new project)

Connect your PC and the drive controllers to the network.

✓ The drive controllers are switched on.

1. Start DriveControlSuite.
2. Click on Read project.
   ⇨ The Add connection window opens. All drive controllers found via IPv4 limited broadcast are displayed.
3. Direct connection tab > IP address column:
   Activate the IP addresses in question and confirm your selection with OK.
   ⇨ The Online functions window opens. All drive controllers connected through the previously selected IP addresses are displayed.
4. Online tab:
   Click Set all to read in order to activate all drive controllers for read data synchronization.
5. Click on Set all to create new drive controller to create the new drive controllers in the project tree.
6. Then click Establish online connection.
   ⇨ The data connection is established and the project configuration data is transmitted from the drive controllers to the PC.
   ⇨ The drive controllers are created in the project tree and are active.

Defining nodes and triggering axes

Define which axes are recorded for the multi-axis scope image and which of the axes can trigger the scope image.

1. Select the project in the project tree and click Multi-axis scope in the project menu.
   ⇨ The Multi-axis scope window opens.
2. Action area:
   To define the settings for the scope image, click Settings.
   ⇨ The Settings window opens.
3. Node and trigger condition tab, Node column:
   Activate all axes that you want to record with the multi-axis scope image.
4. Node and trigger condition tab, Distribute trigger column:
   Activate all axes for which you want to define a trigger that triggers the scope image for all participating axes.

⇨ The Settings button is displayed for each triggering axis.

Information

If you define more than one trigger for a multi-axis scope image, the scope image is triggered for all participating axes as soon as one of the trigger conditions occurs (logical OR operation).

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Define the settings for scope images and triggers

Define the scope image settings and the trigger settings before you start the scope image.

✓ You are in the Multi-axis scope window > Settings window.

1. Node and trigger condition tab:
   To define the trigger condition, click Settings next to the respective triggering axis.
   ⇨ The Settings window opens.
2. Node and trigger condition > Settings tab:
   For each triggering axis, define which event triggers the scope image.
   2.1. Select Manual at stop to activate the trigger via the Stop button (without pre-trigger).
   2.2. Select Immediately at start to activate the trigger via the Start button (with pre-trigger).
   2.3. Select Simple trigger to activate the trigger automatically when a trigger condition occurs.
   2.4. Select Trigger logic to activate the trigger automatically when two logically linked trigger conditions occur.
3. Node and trigger condition > Settings tab:
   If you have selected Simple trigger or Trigger logic, define the Source, Condition and Comparison value for the trigger condition.
   3.1. If you have selected Single trigger, define the individual trigger condition.
   3.2. If you have selected Trigger logic, define both trigger conditions and the operator for the logical operation.
4. Confirm your settings with Close.
   ⇨ The Settings window closes.
5. Node and trigger condition tab:
   If you have defined more than one triggering axis, repeat the procedure for the remaining triggering axes.
6. Channel assignment tab:
   Select which data is to be recorded with the scope image.
   6.1. Parameter:
   To record the value of a parameter, enter the coordinate, name and, if applicable, axis number of the parameter with the Add parameter dialog box via ... or by writing directly into the text field and using auto-completion (example: 1.I80 Current position).
   6.2. Signal name:
   To record the value of a signal, select a signal for which you have assigned a signal name in the graphic programming.
   6.3. Physical address:
   To record the value of a physical address in the drive controller memory, select the data type and specify the address.
7. Channel assignment tab, Sampling time selection:
   Select the time interval at which the channel is to be sampled.
8. Channel assignment tab, Pre-trigger selection:
   Define the percentage of the recording time before the trigger.
   ⇨ The calculated recording time and pre-trigger time are displayed.
9. Confirm your settings with Close.

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Information

In a multi-axis scope image, you can define per channel whether the same data is recorded for all participating axes or individual data per axis. To do this, activate the Individual option in the Channel assignment tab, click Open settings and define the data to be recorded per participating axis for the respective channel.

Creating a multi-axis scope image

Start the scope image of the data in the drive controller and read out the scope image to DriveControlSuite according to the scope image and trigger settings.

✓ You are in the Multi-axis scope window.

✓ You have configured the settings for the scope image.

✓ There is an online connection between DriveControlSuite and the drive controller.

1. Action area:
   To start the scope image of the data in the drive controller, click Start.
   ⇨ The drive controller records the data in the scope memory in accordance with the scope image settings.
   ⇨ The Action area of DriveControlSuite displays information about the status of the scope image.
2. Optional: Click Stop if you use the Manually at stop trigger setting or if you want to stop the scope image early before the recording time expires.
   ⇨ When the trigger is triggered, DriveControlSuite reads the data from the scope memory according to the scope image settings.

⇨ The finished scope image is listed in the Scope images tab and can be opened via double-click.

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19.4 Parameters

You can use the following parameters to configure additional settings for the scope images.

19.4.1 T25 | Automatic start | G6 | V0

Automatically starts scope image recording after the drive controller is restarted.

Scope image is started with the settings that were last saved by the A00 action.

- 0: Inactive
- 1: Active

Double-axis controller: 1.T25 also applies to axis B; 2.T25 has no function.

Prepare the automatic creation of a scope image as described below.

✓ You have established an online connection to the drive controller.

1. Select the relevant drive controller in the project tree and click on the button for the selected axis in the project menu > Parameter list area.
2. Group T > Parameters T25 Automatic start:
   Select 1: Active.
3. Click on Scope in the project menu.
   ⇨ The Scope window opens.
4. Click on Settings.
   ⇨ The Settings window opens.
5. Define the channel assignments and trigger conditions for the scope image, then close the window.
6. In the Scope window, click on Start to transmit the settings to the drive controller.
7. Save the settings in non-volatile memory (A00).

⇨ Scope image recording starts automatically after the next restart.

19.4.2 T26 | Retrigger scope | G6 | V1

Setting for the scope image.

- 0: Inactive
  Scope image is started by the user or once only by restarting the drive controller (T25 = 1: Active).
  The completed scope image is temporarily saved in the drive controller and can be read out by the DriveControlSuite (prerequisite: Scope window open).
- 3: Active
  Scope serial images are started initially by the user or by restarting the drive controller (T25 = 1: Active).
  The completed scope image is temporarily saved in the drive controller and can be read out by the DriveControlSuite (prerequisite: Scope window open).
  As long as T26 = 3: Active, the next scope image is triggered automatically after each completed scope image and the previous scope image is overwritten in the drive controller.

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20 Replacement

The following chapters describe the replacement of a drive controller and the available accessories.

20.1 Safety instructions for device replacement

Replacement work is permitted only when no voltage is present. Obey the 5 safety rules (see Working on the machine [▶ 19]).

When the power supply voltage is turned on, hazardous voltages may be present on the connection terminals and the cables connected to them.

The device and the cables connected to it are not necessarily de-energized when the supply voltage is switched off and all displays have gone out!

Information

Note the discharge time of the DC link capacitors in the general technical data for the devices. You can only determine the absence of voltage after this time period.

Protect the devices against falling parts (bits or strands of wire, pieces of metal, etc.) during installation or other work in the control cabinet. Parts with conductive properties may result in a short circuit inside the devices and device failure as a result.

Opening the housing, plugging in or unplugging connection terminals, connecting or removing a connecting wiring, and installing or removing accessories are prohibited while the voltage supply is switched on.

If you couple the drive controllers in the DC link, make sure that all Quick DC-Link modules are built over with a drive controller again after replacement.

The device housing must be closed before you turn on the supply voltage.

20.2 Notes on motor replacement

When replacing a STOBER synchronous servo motor with EnDat encoder and electronic nameplate, the drive controller detects that a motor replacement has been performed upon switching on the drive controller (prerequisite: B04 = 64: Active).

As a response, the drive controller reads out the changed data from the electronic nameplate, transmits this data to the corresponding parameters and reports the process using a fault of type 81: Motor allocation. Based on the cause of the fault, you can recognize what has changed.

In order to take over the changed data onto the SD card and thus save it in non-volatile memory, you must carry out the action Save values in parameter A00.

Otherwise, the next time the drive controller is switched on, the electronic nameplate is read out again and the changed data is reported using a fault of type 81: Motor allocation.

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20.3 Replacing the drive controller

⚠ WARNING!

Electrical voltage! Risk of fatal injury due to electric shock!

- Always switch off all power supply voltage before working on the devices!
- Note the discharge time of the DC link capacitors in the general technical data. You can only determine the absence of voltage after this time period.

ATTENTION!

Loss of absolute position!

The absolute position in the encoder is lost if the encoder cable is disconnected from the AES battery module.

- Do not disconnect the encoder cable from the AES during service work! Disconnect the AES from the drive controller.

Information

Note that the SD card from the drive controller being replaced can be re-used only for drive controllers of the same series.

Information

The safety module is a permanently integrated component in the drive controller where any design, technical and electrical modifications are prohibited!

Tools and material

You will need:

- Tool for loosening and tightening the fastening screws

Requirements and replacement

✓ Drive controllers of the same series and same power can be replaced interchangeably.

✓ The fieldbus variants of the firmware for the drive controller to be installed and to be replaced match. For information on differing fieldbus variants, see Changing the fieldbus using DS6 [▶ 304].

✓ The hardware and firmware of the drive controller to be installed is of the same or a newer version as that of the drive controller to be replaced. For information on firmware updates, see Updating firmware [▶ 301].

✓ Optional: The SD card is present in the drive controller being replaced; the original project is stored on the SD card.
Or: The control unit of the drive controller being replaced still works; copy the original project to the SD card before removing the drive controller.

1. Optional: If an AES battery module is present, disconnect the AES from the drive controller.
2. Remove all terminals from the drive controller being uninstalled.
3. Release the grounding conductor from the ground bolt.
4. Loosen the fastening screws and take the drive controller out of the control cabinet.
5. Optional: Insert the SD card with the original project into the drive controller being installed.
6. Install the new drive controller in the control cabinet.

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7. Connect the grounding conductor to the ground bolt. Obey the instructions and requirements for Protective grounding [▶ 93].
8. Reattach the terminals.
9. Optional: If an AES battery module was present, attach it to the drive controller with the associated encoder cable. Tighten the knurled screws so that AES is securely connected to the drive controller.
10. Optional: If you are using the SY6 or SU6 safety module, you must transfer its unique address in the FSoE or PROFIsafe network from the replaced drive controller to the new one via DIP switches in order to be able to identify it uniquely in the network. For further information, refer to the manual for the corresponding safety module.

⇨ The replacement of the drive controller is complete.

20.4 Replacing the SD card

STOBER recommends the use of cards with a storage capacity of 2 to 4 GB. The cards require FAT32 formatting (also refer to X700: SD slot [▶ 117]).

Preparation

To prepare the new, formatted card for operation in the drive controller, proceed as follows:

1. Switch on the 24 V_{DC} supply of the control unit.
2. Insert the formatted SD card.
3. Execute the action A00 and wait until saving is finished.

⇨ The preparation of the SD card is complete.

If an SD card is inserted when the drive controller is started, it is started from this card. Any existing configuration in the internal memory of the drive controller is ignored. If there is no configuration on the SD card or if it is invalid, the drive controller starts in emergency operation. For drive controllers with firmware V 6.5-A or higher, the fixed IP address 192.168.3.2 and fixed subnet mask 255.255.255.0 are used for service interface X9 in emergency operation.

In emergency operation, the internal configuration cannot be read out. If you require a data backup from the internal memory of the drive controller, you must save the information of the desired IP address, subnet mask and address assignment on the SD card (see Starting a drive controller in emergency operation [▶ 159]).

20.5 Updating firmware

Drive controllers from STOBER are normally delivered with the latest firmware version. You can use the DriveControlSuite commissioning software to update the firmware version of one or more drive controllers simultaneously and then monitor the successful update. On the other hand, if a PC with a network connection is not available at the drive controller location, you also have the option of using an SD card to transfer a more current firmware version.

20.5.1 Replacing or updating firmware using DS6

If you require a different firmware version or want to update the firmware of a drive controller, you can change the firmware using the DriveControlSuite commissioning software. You can prepare a live firmware update while the drive controller and machine are operating. The update does not take effect until after a restart. This dual firmware behavior prevents a firmware loss or appearance of a case of service, since it ensures, for example, that the existing firmware can be accessed if the connection is interrupted.

In order to perform a live firmware update, you must connect your PC and the drive controller over the network.

Information

During the search, all drive controllers within the broadcast domain are found via IPv4 limited broadcast.

Requirements for finding a drive controller in the network:

- Network supports IPv4 limited broadcast
- All drive controllers and the PC are in the same subnet (broadcast domain)

Carrying out a live firmware update

✓ The drive controller is switched on.

1. Start DriveControlSuite.
2. Click Assignment and live firmware update.
   ⇨ The Add connection dialog box opens.
3. Direct connection tab > IP address column:
   Activate the IP address in question and confirm your selection with OK.
   ⇨ The Online functions window opens. The drive controller that is connected by the selected IP address is displayed.
4. Live firmware update tab:
   By default, the newest firmware version suitable for the DriveControlSuite version is selected. Click Assign default version to all drive controllers.
   ⇨ The selection No live firmware update for the drive controller changes to Default version.
5. Optional: If you want to assign an alternative, locally saved firmware version to a drive controller, proceed as follows:
   5.1. Click on Add new firmware version, navigate to the directory and load the file.
   5.2. Then change the selection from Default version of the drive controller to Alternative version and select the previously uploaded firmware version from the associated picklist.
6. Live firmware update tab:
   Click Start live firmware update.
7. Confirm the safety instruction with OK.
   ⇨ The firmware update is transferred.
8. Since the firmware update only takes effect after the drive controller is restarted, click Restart all drive controllers after completing the transfer.
9. Confirm the restart with Yes.

⇨ The fieldbus communication and connection to DriveControlSuite are interrupted and the drive controller restarts.

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20.5.2 Updating firmware using an SD card

If you would like to update the firmware of a drive controller, but do not have access to a PC with a network connection, you can use an SD card to transfer a firmware version to the drive controller.

- ✓ The firmware of the drive controller is at least version 6.4-A.
- ✓ A more current version of DriveControlSuite is installed on your PC.
- ✓ Prepare an SD card with the more current firmware version: To do so, create the `firmware` directory on the SD card. Then use Windows Explorer to copy the `firmware.slf` file from the installation directory of DriveControlSuite (C:\Program Files (x86)\STOBER\DriveControlSuite\Suite) into this directory. For information on SD cards that can be used, see X700: SD slot [▶ 117].
- ✓ When a firmware file is being transferred by an SD card, the three LEDs flash in various combinations and frequencies. For information on this, see Drive controller state [▶ 218].

1. Insert the prepared SD card into the drive controller.
2. Start the drive controller.
   ⇨ The transfer of the firmware file begins.
3. Remove the SD card when the transfer is complete.
   ⇨ The copying process is successfully completed as soon as the green LED of the drive controller flashes with a single blink.
4. Since the firmware update only takes effect after the drive controller is restarted, restart the drive controller after completing the transfer.

Information

The fieldbus variant of the firmware (EC or PN) cannot be changed. The fieldbus variant of the firmware on the SD card must match the fieldbus variant of the drive controller firmware.

Information

You can also transfer an older firmware version to drive controllers with firmware version 6.5-H or later.

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20.6 Changing the fieldbus using DS6

Fieldbus communication is determined by the firmware. The SC6 drive controller is delivered with the firmware version in the required fieldbus variant. You can subsequently change the fieldbus using the DriveControlSuite commissioning software.

For warranty reasons, when changing the fieldbus, you are prompted to notify our service department by email about the change. The information relevant for this can be transferred directly from DriveControlSuite to your email program.

Information

Changing the fieldbus variant of the drive controller without contacting our Service department voids any warranty claims.

In order to perform a fieldbus change, you must connect your PC and the drive controller over the network.

Information

During the search, all drive controllers within the broadcast domain are found via IPv4 limited broadcast.

Requirements for finding a drive controller in the network:

- Network supports IPv4 limited broadcast
- All drive controllers and the PC are in the same subnet (broadcast domain)

✓ The drive controller is switched on.

1. Start DriveControlSuite.
2. Click Assignment and live firmware update.
   ⇨ The Add connection dialog box opens.
3. Direct connection tab > IP address column:
   Activate the IP address in question and confirm your selection with OK.
   ⇨ The Online functions window opens. The drive controller that is connected by the selected IP address is displayed.
4. Live firmware update tab:
   Change the drive controller selection of No live firmware update to Change fieldbus and click on Select fieldbus and start.
5. Confirm the safety instruction with OK.
   ⇨ The Select fieldbus and start dialog box opens.
6. Click on the Send email link to open your default email program. As an alternative, you can copy the information to the clipboard using the second link in order to paste it manually into your preferred email program.
7. Send the information to STOBER Service (replace@stoeber.de).
8. Then mark the option that indicates the email has been sent successfully in the dialog and click on Start live update.
   ⇨ The firmware update is transferred.
9. Since the firmware update only takes effect after the drive controller is restarted, click Restart all drive controllers after completing the transfer.
10. Confirm the restart with Yes.

⇨ The fieldbus communication and connection to DriveControlSuite are interrupted and the drive controller restarts.

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21 Service

You can find important information all about our range of services in this chapter.

21.1 Information about the product

You can find information about your product online at the following address: https://id.stober.com.

In the search field there, enter the serial number, delivery note number or invoice number of the product.

Alternatively, you can use a suitable mobile device to scan in the QR code on the front of the device in order to directly access product information that is available online.

21.2 STOBER electronics service

If you need support, please contact our service department (see Consultation, service and address [▶ 352]).

Please have the following descriptive information on hand so that we can provide you with quick, professional assistance.

Ordering a replacement device

If you would like to order a replacement device, our System Support requires the following information:

- MV and serial number of the drive controller being replaced (see Material variant [▶ 28])
- Information on subsequent changes (e.g. change in option modules, application or firmware)

The MV number indicates the ordered and delivered material variant, i.e. the device-specific combination of all hardware and software components. The serial number is used to determine your customer information. Both numbers are stored in the STOBER enterprise resource planning system and make reordering a drive controller easier in case of service.

Service request

If you need assistance or have any questions regarding commissioning, create reverse documentation for your project as your first step. This makes it easier for our System Support to process your request.

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21.3 Reverse documentation

If you have questions concerning commissioning and would like to contact our service department, start by first creating reverse documentation and send this to our System Support email address (see Consultation, service and address [▶ 352]).

21.3.1 Creating reverse documentation in a new project

In order to create reverse documentation, you must connect your PC and the drive controller over the network.

Information

During the search, all drive controllers within the broadcast domain are found via IPv4 limited broadcast.

Requirements for finding a drive controller in the network:

- Network supports IPv4 limited broadcast
- All drive controllers and the PC are in the same subnet (broadcast domain)

✓ The drive controller is switched on.

1. Start DriveControlSuite.
2. Click on Read project.
   ⇨ The Add connection dialog box opens.
3. Direct connection tab > IP address column:
   Activate the IP address in question. Confirm your selection with OK.
   ⇨ The Online functions window opens. The drive controller that is connected using the previously selected IP address is displayed.
4. Online tab:
   Click Establish online connection.
   ⇨ The data connection is established and the project configuration data is transmitted from the drive controller to the PC.
   ⇨ The drive controller is created in the project tree and is active.
5. Then in the Online connection window > Online tab, click on Set all drive controllers to offline (with reverse documentation).
6. Confirm the Reverse documentation dialog box with OK.
   ⇨ The connection is disconnected.
   ⇨ The drive controller is write-protected (lock status with red R).
7. Save the project in a local directory and send the file to us.

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21.3.2 Loading reverse documentation in an existing project

In order to create reverse documentation, you must connect your PC and the drive controller over the network.

Information

During the search, all drive controllers within the broadcast domain are found via IPv4 limited broadcast.

Requirements for finding a drive controller in the network:

- Network supports IPv4 limited broadcast
- All drive controllers and the PC are in the same subnet (broadcast domain)

✓ The drive controller is switched on.

✓ A project file for your drive system exists.

1. Start DriveControlSuite.
2. On the start screen, click Open project or select a project from the Last projects used list.
   ⇨ The existing project is opened.
3. In the project menu, click Online connection.
   ⇨ The Add connection dialog box opens.
4. Direct connection tab > IP address column:
   Activate the IP address in question. Confirm your selection with OK.
   ⇨ The Online functions window opens. The drive controller that is connected using the previously selected IP address is displayed. By default, it is ignored for the data synchronization.
5. Online tab:
   Click Set all to read in order to activate the drive controller for read data synchronization.
6. Click Assign all based on reference to assign the drive controller to the configured drive controller.
7. Then click Establish online connection.
   ⇨ The data connection is established and the project configuration data is compared; if the project configuration data is identical, only the parameter values are transmitted from the drive controller to the PC.
   ⇨ The drive controller is updated in the project and is active.
8. Then in the Online functions window > Online tab, click Set all drive controllers to offline (with reverse documentation).
9. Confirm the Reverse documentation dialog box with OK.
   ⇨ The connection is disconnected.
   ⇨ The drive controller is write-protected (lock status with red R).
10. Save the project in a local directory and send the file to us.

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22 Appendix

22.1 Weights

Description	Type	ID No.	Weight without packaging [g]	Weight with packaging [g]
Double-axis controller sz. 0	SC6A062	56690	3600	5200
Double-axis controller sz. 1	SC6A162	56691	5300	6700
Single-axis controller sz. 2	SC6A261	56692	5200	6400
Terminal set for drive controller	All	Diverse	100	100
Quick DC-Link for drive controller sz. 0	DL6B10	56655	440	480
Quick DC-Link for drive controller sz. 1 or 2 (single-axis controller)	DL6B11	56656	560	600
Quick DC-Link insulation end section	—	56659	50	50
Option module without safety technology	SZ6	56660	50	50
Safety module – STO using terminals	SR6	56661	50	50
Safety module – STO and SS1 using PROFIsafe	SU6	56696	50	50
Safety module – STO and SS1 using FSoE	SY6	56662	50	50
EtherCAT cable approx. 0.25 m	—	49313	15	15
EtherCAT cable approx. 0.5 m	—	49314	20	20
PC connecting cables	—	49857	190	190
USB 2.0 Ethernet adapter	—	49940	50	50
Braking resistor	FZMU 400×65	49010	2200	2200
	FZZMU 400×65	53895	4170	4170
	GVADU 210×20	55441	300	300
	GBADU 265×30	55442	930	930
	GBADU 335×30	55443	1200	1200
Battery module	AES	55452	60	60
HTL-to-TTL adapter	HT6	56665	30	30
Interface adapters	AP6A00	56498	30	30

Tab. 224: Weights of SC6 and accessories

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22.2 Terminal specifications

Relevant information for project configuration of the connecting wiring can be taken from the following chapters.

EN 60204-1 contains basic recommendations that should be taken into account when selecting conductors. The chapter "Conductors and cables" provides specifications for the maximum current carrying capacity of conductors based on the way they are laid as well as tips for derating, for example in the case of increased surrounding temperatures or lines with multiple loaded individual conductors.

⚠ WARNING!

Personal injury and material damage due to electric shock and thermal overload!

- Prepare the conductor ends according to the terminal specifications.
- In the case of pre-made cables and conductors, check the conductor ends and adjust them if necessary.

22.2.1 Overview

The following tables clarify which specifications must be observed for which connections depending on the type of drive controller and accessory.

Drive controller

Type	X2A, X2B	X10	X11, X300	X20A, X20B	X21	X22	X101, X103
SC6A062	BCF 3,81 180 SN [▶ 310]	GFKC 2,5 - ST-7,62 [▶ 312]	BLDF 5.08 180 SN [▶ 310]	GFKC 2,5 - ST-7,62 [▶ 312]	GFKIC 2.5 - ST-7.62 [▶ 312]	ISPC 5 - STGCL-7,62 [▶ 313]	FMC 1,5 - ST-3,5 [▶ 311]
SC6A162		SPC 5 - ST-7,62 [▶ 314]		SPC 5 - ST-7,62 [▶ 314]	ISPC 5 - STGCL-7,62 [▶ 313]	ISPC 16 - ST-10,16 [▶ 313]	
SC6A261							

Tab. 225: Terminal specifications for the base device

Safety technology

Type	X12
SR6	BCF 3,81 180 SN [▶ 310]

Tab. 226: Terminal specifications of the safety technology

Braking resistors

Type	Braking resistor
FZMU, FZZMU	G 10/2 [▶ 311]

Tab. 227: Terminal specifications for the braking resistors

22.2.2 BCF 3,81 180 SN

Feature	Line type	Value
Contact spacing	—	3.81 mm
Nominal current at ϑ_{amb} = 40 °C	—	CE/UL/CSA: 16 A/10 A/11 A
Max. conductor cross-section	Flexible without end sleeve	1.5 mm²
	Flexible with end sleeve without plastic collar	1.0 mm²
	Flexible with end sleeve with plastic collar	1.0 mm²
	2 conductors, flexible, with double end sleeve with plastic collar	—
	AWG according to UL/CSA	16
Min. conductor cross-section	Flexible without end sleeve	0.14 mm²
	Flexible with end sleeve without plastic collar	0.25 mm²
	Flexible with end sleeve with plastic collar	0.25 mm²
	2 conductors, flexible, with double end sleeve with plastic collar	—
	AWG according to UL/CSA	26
Insulation stripping length	—	10 mm
Tightening torque	—	—

Tab. 228: BCF 3.81 180 SN BK specification

22.2.3 BLDF 5.08 180 SN

Feature	Line type	Value
Contact spacing	—	5.08 mm
Nominal current at ϑ_{amb} = 40 °C	—	CE/UL/CSA: 14 A/10 A/10 A
Max. conductor cross-section	Flexible without end sleeve	2.5 mm²
	Flexible with end sleeve without plastic collar	2.5 mm²
	Flexible with end sleeve with plastic collar	2.5 mm²
	2 conductors, flexible, with double end sleeve with plastic collar	—
	AWG according to UL/CSA	12
Min. conductor cross-section	Flexible without end sleeve	0.2 mm²
	Flexible with end sleeve without plastic collar	0.2 mm²
	Flexible with end sleeve with plastic collar	0.25 mm²
	2 conductors, flexible, with double end sleeve with plastic collar	—
	AWG according to UL/CSA	26
Insulation stripping length	—	10 mm
Tightening torque	—	—

Tab. 229: BLDF 5.08 180 SN specification

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22.2.4 FMC 1,5 -ST-3,5

Feature	Line type	Value
Contact spacing	—	3.5 mm
Nominal current at ϑ_{amb} = 40 °C	—	CE/UL/CSA: 8 A
Max. conductor cross-section	Flexible without end sleeve	1.5 mm²
	Flexible with end sleeve without plastic collar	1.5 mm²
	Flexible with end sleeve with plastic collar	0.75 mm²
	2 conductors, flexible, with double end sleeve with plastic collar	—
	AWG according to UL/CSA	16
Min. conductor cross-section	Flexible without end sleeve	0.2 mm²
	Flexible with end sleeve without plastic collar	0.25 mm²
	Flexible with end sleeve with plastic collar	0.25 mm²
	2 conductors, flexible, with double end sleeve with plastic collar	—
	AWG according to UL/CSA	24
Insulation stripping length	—	10 mm
Tightening torque	—	—

Tab. 230: FMC 1,5 -ST-3,5 specification

22.2.5 G 10/2

Feature	Line type	Value
Contact spacing	—	17.5 mm
Nominal current at ϑ_{amb} = 40 °C	—	CE/UL/CSA: 57 A/65 A/65 A
Max. conductor cross-section	Flexible without end sleeve	10.0 mm²
	Flexible with end sleeve without plastic collar	16.0 mm²
	Flexible with end sleeve with plastic collar	16.0 mm²
	2 conductors, flexible, with double end sleeve with plastic collar	6.0 mm²
	AWG according to UL/CSA	6
Min. conductor cross-section	Flexible without end sleeve	0.5 mm²
	Flexible with end sleeve without plastic collar	0.5 mm²
	Flexible with end sleeve with plastic collar	0.5 mm²
	2 conductors, flexible, with double end sleeve with plastic collar	0.5 mm²
	AWG according to UL/CSA	24
Insulation stripping length	—	12 mm
Tightening torque	—	1.5 – 1.8 Nm

Tab. 231: G 10/2 specification

22.2.6 GFKC 2,5 -ST-7,62

Feature	Line type	Value
Contact spacing	—	7.62 mm
Nominal current at ϑ_{amb} = 40 °C	—	CE/UL/CSA: 12 A/10 A/10 A
Max. conductor cross-section	Flexible without end sleeve	2.5 mm²
	Flexible with end sleeve without plastic collar	2.5 mm²
	Flexible with end sleeve with plastic collar	2.5 mm²
	2 conductors, flexible, with double end sleeve with plastic collar	1.5 mm²
	AWG according to UL/CSA	12
Min. conductor cross-section	Flexible without end sleeve	0.2 mm²
	Flexible with end sleeve without plastic collar	0.25 mm²
	Flexible with end sleeve with plastic collar	0.25 mm²
	2 conductors, flexible, with double end sleeve with plastic collar	0.5 mm²
	AWG according to UL/CSA	24
Insulation stripping length	—	10 mm
Tightening torque	—	0.3 – 0.7 Nm

Tab. 232: GFKC 2,5 -ST-7,62 specification

22.2.7 GFKIC 2.5 -ST-7.62

Feature	Line type	Value
Contact spacing	—	7.62 mm
Nominal current at ϑ_{amb} = 40 °C	—	CE/UL/CSA: 12 A/10 A/10 A
Max. conductor cross-section	Flexible without end sleeve	2.5 mm²
	Flexible with end sleeve without plastic collar	2.5 mm²
	Flexible with end sleeve with plastic collar	2.5 mm²
	2 conductors, flexible, with double end sleeve with plastic collar	1.0 mm²
	AWG according to UL/CSA	12
Min. conductor cross-section	Flexible without end sleeve	0.2 mm²
	Flexible with end sleeve without plastic collar	0.25 mm²
	Flexible with end sleeve with plastic collar	0.25 mm²
	2 conductors, flexible, with double end sleeve with plastic collar	0.5 mm²
	AWG according to UL/CSA	26
Insulation stripping length	—	10 mm
Tightening torque	—	—

Tab. 233: Specification for GFKIC 2.5 -ST-7.62

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22.2.8 ISPC 5 -STGCL-7,62

Feature	Line type	Value
Contact spacing	—	7.62 mm
Nominal current at ϑ_{amb} = 40 °C	—	CE/UL/CSA: 32 A/35 A/35 A
Max. conductor cross-section	Flexible without end sleeve	6.0 mm²
	Flexible with end sleeve without plastic collar	6.0 mm²
	Flexible with end sleeve with plastic collar	4.0 mm²
	2 conductors, flexible, with double end sleeve with plastic collar	1.5 mm²
	AWG according to UL/CSA	8
Min. conductor cross-section	Flexible without end sleeve	0.2 mm²
	Flexible with end sleeve without plastic collar	0.25 mm²
	Flexible with end sleeve with plastic collar	0.25 mm²
	2 conductors, flexible, with double end sleeve with plastic collar	0.25 mm²
	AWG according to UL/CSA	24
Insulation stripping length	—	15 mm
Tightening torque	—	—

Tab. 234: ISPC 5 -STGCL-7,62 specification

22.2.9 ISPC 16 -ST-10,16

Feature	Line type	Value
Contact spacing	—	10.16 mm
Nominal current at ϑ_{amb} = 40 °C	—	CE/UL/CSA: 55 A/66 A/66 A
Max. conductor cross-section	Flexible without end sleeve	16.0 mm²
	Flexible with end sleeve without plastic collar	16.0 mm²
	Flexible with end sleeve with plastic collar	10.0 mm²
	2 conductors, flexible, with double end sleeve with plastic collar	4.0 mm²
	AWG according to UL/CSA	4
Min. conductor cross-section	Flexible without end sleeve	0.75 mm²
	Flexible with end sleeve without plastic collar	0.75 mm²
	Flexible with end sleeve with plastic collar	0.75 mm²
	2 conductors, flexible, with double end sleeve with plastic collar	0.75 mm²
	AWG according to UL/CSA	20
Insulation stripping length	—	18 mm
Tightening torque	—	—

Tab. 235: SPC 16 -ST-10,16 specification

22.2.10 SPC 5 -ST-7,62

Feature	Line type	Value
Contact spacing	—	7.62 mm
Nominal current at ϑ_{amb} = 40 °C	—	CE/UL/CSA: 32 A/35 A/35 A
Max. conductor cross-section	Flexible without end sleeve	6.0 mm²
	Flexible with end sleeve without plastic collar	6.0 mm²
	Flexible with end sleeve with plastic collar	4.0 mm²
	2 conductors, flexible, with double end sleeve with plastic collar	1.5 mm²
	AWG according to UL/CSA	8
Min. conductor cross-section	Flexible without end sleeve	0.2 mm²
	Flexible with end sleeve without plastic collar	0.25 mm²
	Flexible with end sleeve with plastic collar	0.25 mm²
	2 conductors, flexible, with double end sleeve with plastic collar	0.25 mm²
	AWG according to UL/CSA	24
Insulation stripping length	—	12 – 15 mm
Tightening torque	—	0.3 – 0.7 Nm

Tab. 236: SPC 5 -ST-7,62 specification

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22.3 Wiring examples

The following chapters show the basic connection using examples.

Information

For UL-compliant operation: The connections marked with PE are intended solely for the functional grounding.

22.3.1 Stand-alone operation with direct brake control

The following graphic shows a wiring example for stand-alone operation with direct brake control.

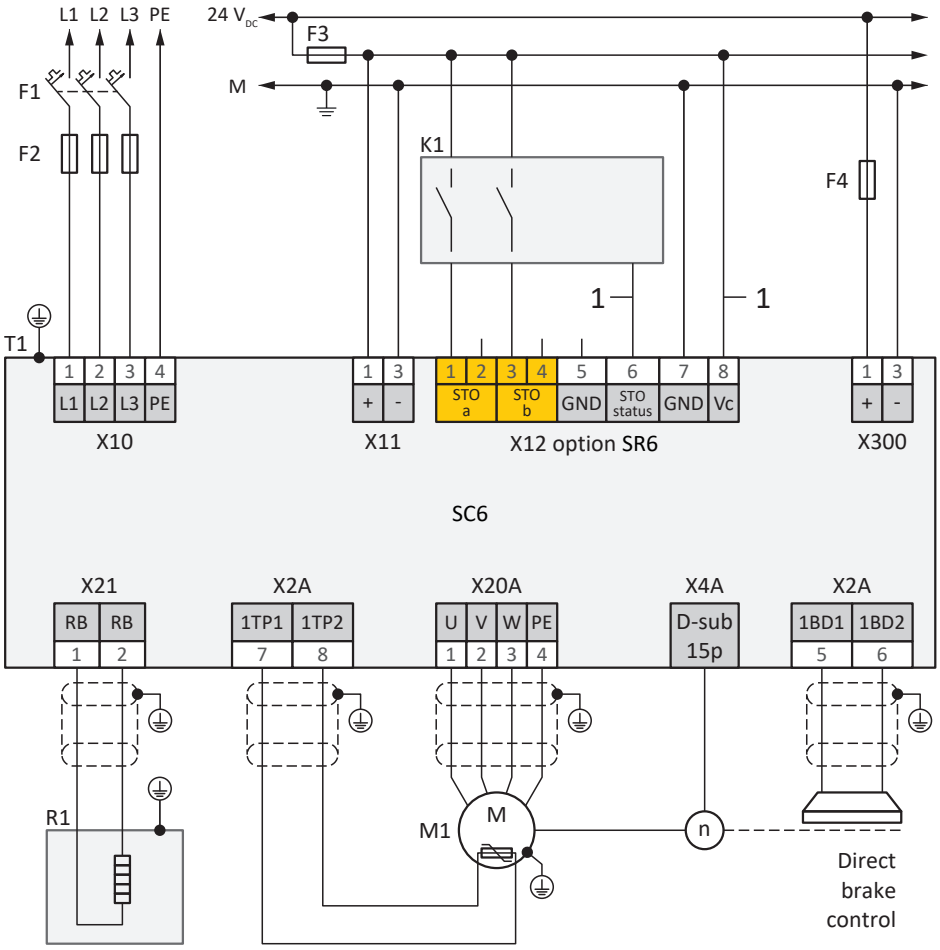

Fig. 71: Wiring example with direct brake control

F1 – F4	Fuse
K1	Safety relay
L1 – L3	Three-phase power supply
M	Reference potential
M1	Motor
R1	Braking resistor
T1	Supply module
T2	Drive controller
1	Optional connection

For UL-compliant operation:

The protective grounding of motors connected to the drive controller must not be connected using terminals X20A and X20B. The grounding conductor connection of the motor must be ensured for the respective application in accordance with the valid electrical standards.

22.3.2 DC link connection

The following graphic shows the basic connection of multiple SC6 drive controllers based on a DC link connection with Quick DC-Link DL6B.

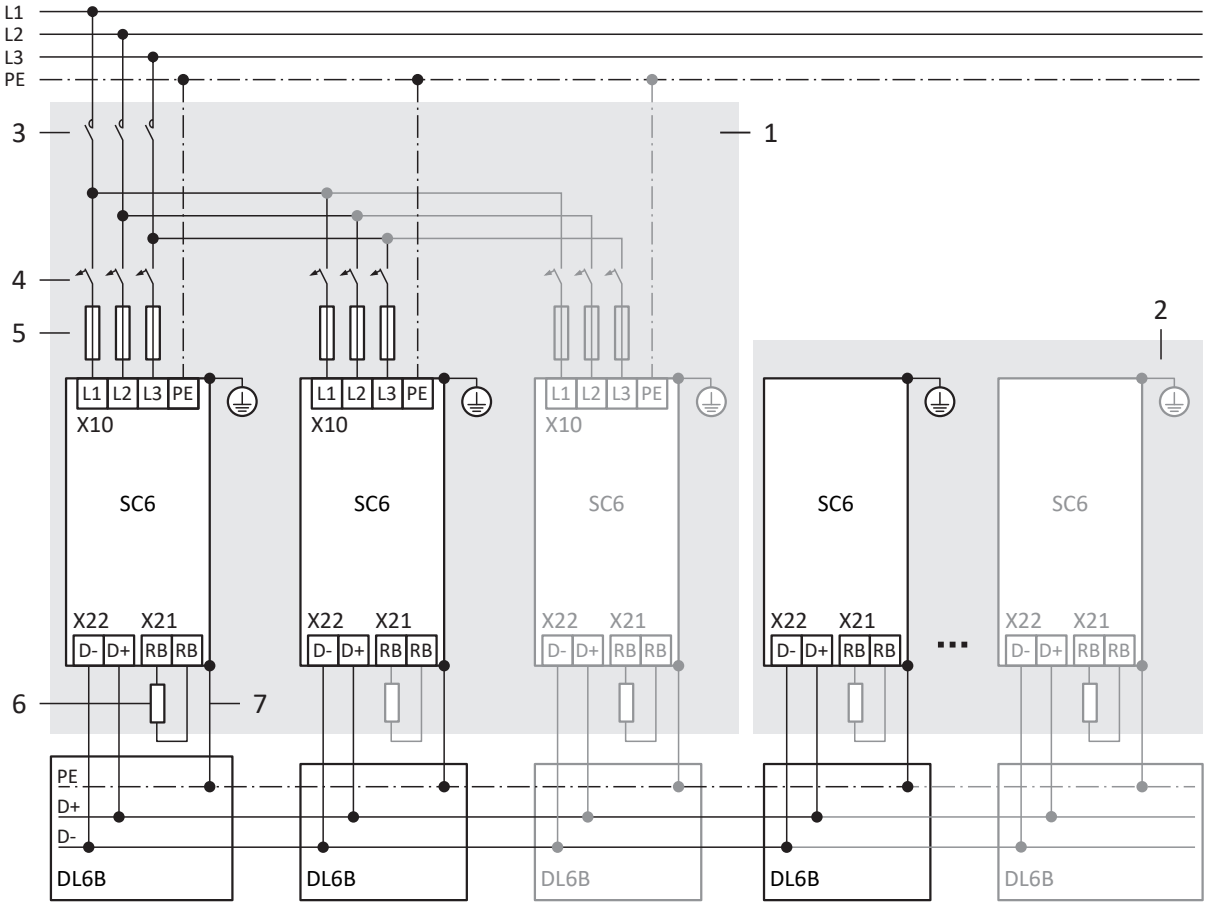

Fig. 72: Wiring example with Quick DC-Link

1 Group 1
2 Group 2
3 Contactor
4 Overload protection
5 Short-circuit protection
6 Braking resistor
7 Spring-loaded contact between DL6B and SC6

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22.4 Order overview of the hardware components

Note that the drive controller is delivered without terminals. Suitable terminal sets are available separately for each size.

Information

The drive controller is delivered in the standard design without safety technology (option SZ6). 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.

Drive controller		Safety technology	Terminal set
Type	ID No.	ID No.	ID No.
SC6A062	56690	56660[a)]	138652
		56696[b)]	
		56662[c)]	
		56661[d)]	138680
SC6A162	56691	56660[a)]	138653
		56696[b)]	
		56662[c)]	
		56661[d)]	138681
SC6A261	56692	56660[a)]	138654
		56696[b)]	
		56662[c)]	
		56661[d)]	138682

Tab. 237: Overview of hardware components with ID No.

a) SZ6 option: Without safety technology

b) SU6 safety module: STO and SS1 using PROFIsafe

c) SY6 safety module: STO and SS1 using FSoE

d) SR6 safety module: STO using terminals

22.5 Device addressing

MAC address

A MAC address consists of a fixed and a variable portion. The fixed portion designates the manufacturer and the variable portion distinguishes the individual network nodes and must be universally unique.

The MAC addresses of the interfaces are issued by STOBER and cannot be changed.

Information

The MAC address range of the STOBER hardware is: 00:11:39:00:00:00 – 00:11:39:FF:FF:FF

IP address – Value range

An IPv4 address always consists of 4 decimal numbers, each in a range from 0 to 255, and separated by periods. It must be unique within a (sub)network.

Subnet and subnet mask – Value range

Subnets are created in order to provide standalone networks with their own address range. Each IP address is divided into a network and host address. The subnet mask determines where this division takes place.

Like the IP address, the subnet mask consists of 4 decimal numbers, each in a range from 0 to 255, separated by periods.

Assignment for direct connection

In the default factory settings, both the IP address and the subnet mask are automatically assigned by DriveControlSuite or using DHCP for a direct connection. Alternatively, you can switch to manual parameterization using parameter A166.

The active address is displayed in parameter A157 and the active subnet mask in parameter A158.

Assignment for fieldbus connection

Note that the IP address and subnet mask are assigned by the controller for a fieldbus connection.

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22.6 DriveControlSuite

The DriveControlSuite commissioning software uses wizards to guide you step by step through the installation process. You can find more detailed information on the system requirements and installation in the following chapters.

22.6.1 System requirements

The following minimum requirements for the PC system apply to the installation and operation of the DriveControlSuite commissioning software, including the integrated PASmotion component, for configuring the SE6 safety module:

- Operating system: Windows 10 (32 bit, 64 bit *)
- Processor: Intel Pentium 4 (2 GHz, Dual Core) or equivalent
- Memory: 2 GB
- Free disk space on the hard disk: 1 GB
- Graphics: 1024 × 768 pixel resolution, 65536 colors
- Font size: 100% (default)
- Interfaces: 100 Mbps Ethernet (Fast Ethernet, copper)
- Display of documentation: Adobe Acrobat Reader version 7.1.0 or later**

*) Only DriveControlSuite

**) Only PASmotion

22.6.2 Installation types

To install the DriveControlSuite commissioning software, select one of two installation types.

Default installation

Select this installation type if you want to install the latest version of DriveControlSuite. DriveControlSuite is installed in the version-independent .../Programs/STOBER/DriveControlSuite/ directory. During the installation process, you do not need to specify any additional installation instructions.

Provided that you are connected to the Internet, a check is performed prior to installation to determine if a newer software version is available. If a newer version is already available, it is downloaded and installed in place of the started version.

If an older software version is already installed on your PC, it is deleted prior to installation. However, if the latest version is already installed on your PC, a new installation is not performed.

User-defined installation

Select this installation type if you want to install a specific version of DriveControlSuite or if you still need an older version that is already installed on your PC. You can use this installation type to change the default installation directory and manage the version-dependent destination folders.

Checking whether the software version is up-to-date before installation is optional.

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22.6.3 Installing DriveControlSuite

Current versions of the DriveControlSuite commissioning software can be found in our download center at http://www.stoeber.de/en/downloads/.

Information

If you use the expanded safety function via the SE6 safety module, you also need the PASmotion component integrated into DriveControlSuite. To this end, the PASmotion installation wizard starts at the end of the DriveControlSuite installation process. You can either perform installation of the component for the safety configuration or cancel it if you do not need it.

✓ You have administrator rights.

✓ The DriveControlSuite software is currently not running.

✓ You have downloaded the setup file from the STOBER Download Center and saved it locally.

1. Start the installation via the setup file.
2. Select the language for the installation and confirm with OK.
3. Select Default as the installation type.
   ⇨ If an Internet connection is available, the recency of the setup file is checked and, if necessary, the latest version is downloaded.
   ⇨ The latest DriveControlSuite version is installed.
   ⇨ After successful installation, DriveControlSuite checks the access to the network.
   ⇨ If a firewall is active, a safety instruction opens according to the firewall settings.
4. If applicable, allow DriveControlSuite to communicate on public and private networks.
5. PASmotion:
   If you are using the SE6 safety module, follow the steps in the PASmotion installation wizard.

⇨ After successful installation, DriveControlSuite opens automatically.

22.6.4 Updates

In the Help menu of the DriveControlSuite commissioning software, you can search for a newer version and, if available, download and install it.

Information

If the DriveControlSuite version is outdated, but the latest version is already installed on the computer, the check will yield the result that no newer version is available.

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22.6.5 Communication requirements

Note the following requirements for the direct connection.

22.6.5.1 Personal firewall

For communication, both DriveControlSuite and the SATMICL communication service must be enabled in the PC's firewall.

Test communication is initiated during the installation of DriveControlSuite that opens a dialog box for enabling communication in case of an activated firewall. Note that operation on public networks must also be enabled for communication using mobile network adapters.

The required setup file for installing DriveControlSuite can be found in the STOBER Download Center at http://www.stoeber.de/en/downloads/.

Program/service	Path
DS6A.exe (DriveControlSuite)	Standard installation: C:\Program Files (x86)\STOBER\DriveControlSuite\bin Parallel installation of different versions (version 6.X-X): C:\Program Files (x86)\STOBER\DriveControlSuite (V 6.X-X)\bin
SATMICLSVC.exe (SATMICL service)	32-bit Windows 7 or 32-bit Windows 10: C:\Windows\System32 64-bit Windows 7 or 64-bit Windows 10: C:\Windows\SysWOW64

Tab. 238: Programs and services

22.6.5.2 Protocols and ports for communication using routers

For communication using routers, the protocols and ports used by DriveControlSuite and the SATMICL communication service must be enabled in the routers, if applicable.

Protocol	Port	Use	Program/service
UDP/IP	37915	Connection test (inquiry)	SATMICL service
UDP/IP	37916	Node search	SATMICL service
UDP/IP	30001	Primary port for connection response (response)	SATMICL service
	30002 – 39999	Alternative ports for connection response (response)	
UDP/IP	40000	Primary port for IP address specification	DriveControlSuite
	40001 – 50000	Alternative ports for IP address specification	
TCP/IP	37915	Data transmission	DriveControlSuite

Tab. 239: Protocols and ports for a direct connection

22.6.6 Configuring virtual machines

If you would like to connect STOBER drive controllers to the DriveControlSuite commissioning software from a virtual machine, you have to configure the communication between the virtual machine and host so that, from the perspective of the network, the virtual machine is no different from a physical PC.

VMware, Inc. VMware

If you use the VMware software from the company of the same name as a virtual machine, configure it in the VMware Workstation. For the direct connection, the virtual network card is operated as a network bridge.

Microsoft Windows Virtual PC

If you use the Windows Virtual PC software from Microsoft as a virtual machine, configure it in the Virtual PC software and in the Virtual Server. In both components, the name of the virtual network card has to match the physical network card.
For Virtual PC network connections, Microsoft distinguishes between the **Public** and **Private** types. For the direct connection, the virtual network card is operated on the Virtual Server with the Public connection type.

Microsoft Hyper-V

If you use the Hyper-V software from Microsoft as a virtual machine, configure a Virtual Switch Manager in the Hyper-V Manager.
For network connections through Virtual Switch, Microsoft distinguishes between the **External**, **Internal** and **Private** types. For the direct connection, the virtual network card is operated with the External connection type.

Oracle VirtualBox

If you use the VirtualBox software from Oracle as a virtual machine, configure the network directly in VirtualBox. For the direct connection, a virtual network adapter is operated in bridge mode.

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22.6.7 Script mode

Script mode is an automation function of the DriveControlSuite commissioning software. In Script mode, commands can be processed automatically. For example, this includes opening and closing project files or changing parameters. Processing commands can be used for executing various actions, such as transmitting a firmware update to multiple drive controllers.

When Script mode is called up from DriveControlSuite, a window with the same name opens. Here, you can transfer commands to DriveControlSuite in the form of a command script.

When you switch from Script mode to DriveControlSuite, the instance of DriveControlSuite being run in the background becomes visible.

22.6.7.1 Script mode window

In the DriveControlSuite – Script mode window, you can execute a command script and view information about the status of the script.

Information

The DriveControlSuite – Script mode window can be reached via the keyboard shortcut [Ctrl] + [F9] when DriveControlSuite is open and by executing a command script by double-clicking the batch file when DriveControlSuite is closed.

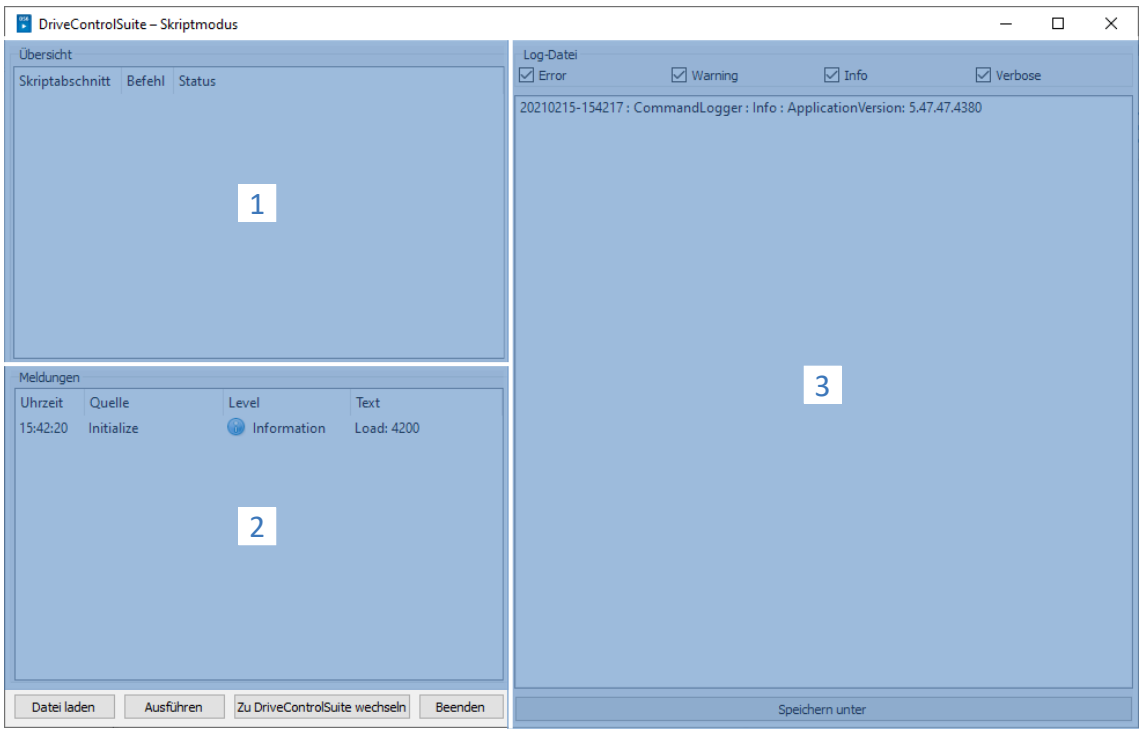

Fig. 73: Script mode: Program interface

No.	Area	Description
1	Overview	The Overview area informs you about the progress of the individual script sections.
2	Messages	The entries in the messages log the connection and communication status of the drive controllers, incorrect inputs caught by the system, errors when opening a project or rule violations in the graphical programming.
3	Log file	The Log file area shows the entries that are written to the log file while the command script is running. Each entry is output with a time stamp and source and can be filtered by its level through use of the options above the entries (Error, Warning, Info, Verbose). You can use Save as to save the log file locally.

Button	Description
Load file	Loads a command script in Script mode.
Run	Runs a loaded command script.
Switch to DriveControlSuite	Exits Script mode and switches to DriveControlSuite.
Exit	Exits Script mode and, where applicable, DriveControlSuite.

22.6.7.2 Command script structure

The command script is structured in the JSON data format (*.json) with UTF-8 encoding with BOM. You can find an introduction to JSON at:
https://www.json.org/json-en.html

Information

To create a script for DriveControlSuite, use a JSON editor such as JSON Editor Online, JSONViewer or Visual Studio Code.

Three data types are used in the script based on the standard JSON RFC-7159:

- Boolean
- String
- Integer

The command script is divided into three sections: settings, sequence and commands.

Script section	Description
settings	In the settings section, you define basic settings for executing the command script.
sequence	In the sequence section, you define the sequence of the individual commands.
commands	In the commands section, you define the individual commands of the command script.

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22.6.7.2.1 "settings" script section

In the settings section, you define basic settings for executing the command script. You specify whether a log file is created when the script is executed and whether DriveControlSuite is closed after the script ends. The settings section is optional.

Attributes

- "logFilePath": Path of the log file, <optional> <string>
- "quitWhenDone": Behavior of DriveControlSuite after script end, <optional> <string>

Example

```
"settings": {
      "logFilePath": "%COMMANDFILE%/LoadNewConfig.log",
      "quitWhenDone": "never"
},
```

Creating a log file (logFilePath)

The log file logs the progress of a command script in chronological order. You create a log file by using the logFilePath attribute to specify the file path under which the log file is to be created. If you specify a file path for the log file, the command script will be executed only if the log file could be created successfully.

You can specify the file path for the log file either absolutely or relative to the command script directory (`%COMMANDFILE%`), `\\` or `/` serve as separators of the path. By specifying `%TIMESTAMP%`, you can add the current time stamp (format: YYYYMMDD-hhmmss) to the file name and thus create a new log file each time the command script is executed. Without a time stamp in the file name, the log file will be overwritten each time the command script is executed.

Quit when done (quitWhenDone)

quitWhenDone can have three values assigned to it, which determine the behavior after the script is done.

"never"	DriveControlSuite remains open after the script has ended (default value).
"noErrors"	DriveControlSuite is closed after the script has ended, insofar as no errors have occurred.
"always"	DriveControlSuite is closed after the script has ended in every case.

22.6.7.2.2 "sequence" script section

In the sequence section, you define the sequence of the individual commands. The commands are specified as an array of strings with the key "sequence" and the name you specify in the commands section. A command can occur any number of times in the array.

The order in the array corresponds to the order in which the commands are executed in the command script. Set a reasonable order for the commands so that the command script does not abort with an error if a command cannot be executed. For example, you must first open a project (openProject) before you can change a parameter in it (setParameter).

Example

```
"sequence": [
      "commandName 1",
      "commandName 2",
      "commandName 1",
      "commandName 3"
],
```

22.6.7.2.3 "commands" script section

In the commands section, you define the individual commands of the command script. A command consists at least of a name and the "command" attribute, which determines the command and the further attributes of the command.

Example

```
"commandName1": {
      "command": "commandName",
      "attributeKey": "attributeValue"
},
```

22.6.7.3 Script mode commands

In the following, all available commands are described with the corresponding attributes.

The following table shows an overview of the available commands.

Command	Description
openProject [▶ 327]	Open project file
closeProject [▶ 327]	Close project file
connect [▶ 328]	Establish connection
disconnect [▶ 329]	Disconnect connection
setOnline [▶ 329]	Send/read out configuration
setOnlineByPreset [▶ 331]	Send/read out configuration according to the presets
setOffline [▶ 331]	Set offline
updateFirmware [▶ 332]	Multiple live firmware updates
setParameter [▶ 333]	Modify parameters
performAction [▶ 334]	Execute action
openMessageBox [▶ 334]	Open message window
wait [▶ 335]	Wait
exportParameter [▶ 335]	Export parameters
importParameter [▶ 336]	Import parameters
updateTemplates [▶ 337]	Update project configuration
takeSnapShot [▶ 337]	Read out reverse documentation
discardReverseDocumentation [▶ 338]	Discard reverse documentation

Tab. 240: Script mode commands

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22.6.7.3.1 openProject

With the command openProject, you can open a project in Script mode, which is required for many commands. When you open a project with openProject, closeProject is automatically called for the current project.

Attributes

- "filePath": directory of the project file (*.ds6), <binding> <string>

Description

In the filePath attribute, you specify the name of the project file to be opened. The specification can be made either as an absolute value or relative to the command script directory (`%COMMANDFILE%`).

Example

```
"openProjectfile": {
      "command": "openProject",
      "filePath": "<your path>"
},
```

22.6.7.3.2 closeProject

With the closeProject command, you can close an open project in Script mode. When you open a project with openProject, closeProject is automatically called for the current project.

Attributes

- "saveAs": Storage directory of the project file (*.ds6), <optional> <string>
- "saveBeforeClose": <optional> <Boolean>

Description

saveAs specifies the storage location of the project. Alternatively, the project can be saved at the path specified in the filePath attribute before it is closed with `saveBeforeClose: true`. By default, a dialog box opens if the project has been modified.

Example

```
"closeProjectfile": {
      "command": "closeProject",
      "saveBeforeClose": true
},
```

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22.6.7.3.3 connect

With the connect command, you can establish a direct connection to the drive controllers of a module in Script mode.

Requirements for communication with the drive controllers include a direct connection to the drive controller and assignment to the module within the project under which this drive controller is recorded.

Attribute

- "module": Reference of the module in the project, <binding> <string>

One of the attributes listed below must be specified for the assignment. The IP address can always be used. The production number can be used only if the drive controller can be found by searching in a network. The reference can be used only if the drive controller can be found by searching in a network and a unique reference is defined for each drive controller that is found:

- "ipAddress": IPv4 address of the direct connection, <optional> <string>
- "serialNumber": Production number of the drive controller, <optional> <integer>
- "reference": Reference of the drive controller, <optional> <string>

Information

During the search, all drive controllers within the broadcast domain are found via IPv4 limited broadcast.

Requirements for finding a drive controller in the network:

- Network supports IPv4 limited broadcast
- All drive controllers and the PC are in the same subnet (broadcast domain)

Description

The command establishes a direct connection to the drive controller with the corresponding IP address, production number or reference.

Example

```
"ipConnect": {
      "command": "connect",
      "module": "M1",
      "ipAddress": "192.168.3.2"
},
"serialnumberConnect": {
      "command": "connect",
      "module": "M1",
      "serialNumber": 70012345
},
"referenceConnect": {
      "command": "connect",
      "module": "M1",
      "reference": "T123"
},
```

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22.6.7.3.4 disconnect

With the disconnect command, you can disconnect all existing direct connections in Script mode (without reverse documentation).

Example

```
"DisconnectAll": {
      "command": "disconnect"
},
```

22.6.7.3.5 setOnline

With the setOnline command, you can establish an online connection in Script mode to send a configuration from the project to the drive controller or to read it from the drive controller into the project.

Attributes

- "direction": Read or send access; read or write, <optional> <string>
- "reference": Reference of the drive controller in the project, <optional> <string>
- "targetId": Reference, production number or IGB position of the physical drive controller, <optional> <string> or <integer>
- "targetType": igbPosition, serialNumber or reference, <optional> <string>
- "connectAndAssignMethod": serialNumber or reference, <optional> <string>

Description of single connection

The configuration of the active project file specified with "reference" is loaded into the specified drive controller or vice versa. The specification must be unique. Based on the content of targetType, a decision is made about how to interpret the content of targetId. The online connection is established in the reading or sending direction according to the attribute.

Value set of targetType:

1. "igbPosition": For position 0 (zero), the assignment is made using the most recently connected drive controller
2. "serialNumber": The assignment is made using the production number of the drive controller
3. "reference": The assignment is made based on the reference already existing in the drive controller (E120); this was assigned during the most recently executed project configuration

It is always a prerequisite that a drive controller with this igbPosition, production number or reference must be in the established connection.

Description of multi-connection

When using the connectAndAssignMethod attribute with the values serialNumber or reference (see example 4), the configurations of the active project file are loaded to the corresponding drive controllers most recently connected or vice versa. The online connection is established in the reading or sending direction according to the attribute.

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Examples

Example 1

The configuration of the projected drive controller T1 is loaded into the device with the production number 7000026.

```
"sendConfigFromT1to7000026": {
      "command": "setOnline",
      "direction": "write",
      "reference": "T1",
      "targetId": 7000026,
      "targetType": "serialNumber"
},
```

Example 2

```
"readConfigOutOfIgb5intoT2": {
      "command": "setOnline",
      "direction": "read",
      "reference": "T2",
      "targetId": 5,
      "targetType": "igbPosition"
},
```

Example 3

```
"writeFromT3ToArAlt": {
      "command": "setOnline",
      "direction": "write",
      "reference": "T3",
      "targetId": "ArAlt",
      "targetType": "reference"
},
```

Example 4

```
"setOnline": {
      "command": "setOnline",
      "direction": "write",
      "connectAndAssignMethod": "reference"
},
```

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22.6.7.3.6 Sending/reading out a configuration according to the presets (setOnlinebyPreset)

With the setOnlineByPreset command, you can establish an online connection in Script mode to send a configuration from the project to the drive controller or to read it from the drive controller into the project. The command uses the presets stored in the project to establish the connection. If you do not specify any specific drive controllers via the attributes, an online connection is established for all drive controllers in the project.

If you store presets for the connection setup in the project, you can easily store a command script or reuse it for multiple projects. For more information on the presets, see Presetting connections [▶ 340].

Attributes

- "module": Reference of the module, <optional> <string>
- "reference": Reference of the drive controller, <optional> <string>
- "direction": Read of send access; read or write; overwrites the preset transmission direction, <optional> <string>

Description

The transmission applies to one individual drive controller based on the specification of module and reference (see example 1), but it can also be defined for all drive controllers pre-defined in the project (see example 2).

Examples

Example 1

```
"singleConnectByPresets": {
      "command": "setOnlineByPreset", "module": "m1", "reference": "T1"
},
```

Example 2

```
"multiConnectByPresets": {
      "command": "setOnlineByPreset"
},
```

22.6.7.3.7 setOffline

With the setOffline command, you can disconnect the online connection to all connected drive controllers in Script mode (with or without reverse documentation). You can save changes to the parameter values of the drive controller before disconnecting.

Attribute

- "reverseDocumentation": For true or false, reverse documentation is either created or not, <optional> <Boolean> <default = false>
- "saveValues": For true, the parameter A00 is set to active before setOffline is carried out, <optional> <Boolean> <default = false>

Example

```
"setOfflineAndSaveValues":
{
      "command": "setOffline",
      "reverseDocumentation": false,
      "saveValues": true
},
```

22.6.7.3.8 Updating firmware (updateFirmware)

With the updateFirmware command, you can perform a live firmware update in Script mode for a defined list of drive controllers in the network.

Attributes

- "ipAddresses": List of IP addresses of the drive controllers at the gateways
- "serialNumbers": List of production numbers of the drive controllers at the gateways, <integer>
- "references": List of references of the drive controllers at the gateways
- "connectByMethod": serialNumber, reference or presets, <optional> <string>
  - "serialNumber": In the open project, all drive controllers are provided with a firmware update whose production number matches the production number defined in the project
  - "reference": In the open project, all drive controllers are provided with a firmware update whose references matches the reference defined in the project
  - "presets": In the open project, all drive controllers are provided with a firmware update that corresponds to the drive controllers defined in the presets
- "firmwarePath": Directory in which the firmware files are stored, <optional>
- "firmware": Firmware version
  - "default": In this value, the version of the target firmware corresponds to the DriveControlSuite version (highest firmware version that was loaded)
- "restart": Restart after the update is finished, <optional> <Boolean> <default = false>
- "waitForRenewedAvailability": Wait until the update has been completed and the drive controllers are available again in the network, <optional> <Boolean> <default = false>

Example

```
"updateFirmwareToV_6_4_D": {
      "command": "updateFirmware",
      "firmware": "V 6.4-D",
      "firmwarePath": "<your path>",
      "ipAddresses": ["192.168.3.101",
            "192.168.3.102",
            "192.168.3.103"
],
      "restart": true,
      "waitForRenewedAvailability": true
},
```

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22.6.7.3.9 setParameter

With the setParameter command, you can change the value of a parameter in Script mode. You can execute the command both offline and with an existing online connection.

Attributes

- "module": Reference of the module, <binding> <string>
- "reference": Reference of the drive controller, <binding> <string>
- "coordinate": Coordinate of the parameter, <binding> <string>
- "value": Value of the parameter, <binding> <string>

Example

```
"setA10[3]:" {
      "command": "setParameter",
      "module": "M1",
      "reference": "T2",
      "coordinate": "A10[3]",
      "value": "2"
},
```

22.6.7.3.10 performAction

With the performAction command, you can perform an action in Script mode. You can only execute the command if there is an existing online connection.

Attributes

- "reference": Reference of the drive controller, <optional> <string>
  - If the specification is missing, the action is executed on all connected drive controllers
- "module": Reference of the module, <optional> <string>
  - If the specification is missing, the action is executed on all connected drive controllers
- "coordinate": Coordinate of the action parameter, <binding> <string>
- "waitForDone": Wait until the action has been completed, <optional> <Boolean> <default=true>
- "timeout", <optional> <integer><default = 60> (timeout in seconds):
  - If waitForDone is true: If the timeout is reached before the action has been fully completed, the command was unsuccessful and the sequence has been interrupted
  - If waitForDone is false: After the action is started, there is a wait until the timeout has expired; then the sequence is continued; the command is considered successfully processed
- "livingSpace": Axis (in the case of multiple axes, those to which a parameter is assigned), <optional> <string><default=Global>
  Possible values:

```
"livingSpace": "Global",
"livingSpace": "Axis1",
"livingSpace": "Axis2",
"livingSpace": "Axis3",
"livingSpace": "Axis4",
```

Example

```
"restartSIAx1": {
      "command": "performAction",
      "module": "M1",
      "reference": "SIAx1",
      "coordinate": "A09",
      "livingSpace": "Global",
      "waitForDone": false,
      "timeout": 10
},
```

22.6.7.3.11 Opening a message (openMessageBox)

With the openMessageBox command, you can open a message in Script mode that displays the specified text. The command script is stopped until the message is confirmed with OK.

Attributes

- "text": text of the message, <binding> <string>

Example

```
"ShowMsgBox": {
      "command": "openMessageBox",
      "text": "Please press OK!",
},
```

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22.6.7.3.12 wait

With the wait command, you can pause the command script in Script mode for the specified time.

Attribute

- "seconds": Waiting time in seconds, <binding> <integer>

Example

```
"Wait15Secs": {
      "command": "wait",
      "seconds": 15
},
```

22.6.7.3.13 Exporting parameter values (exportParameter)

With the exportParameter command, you can export the parameter values of a drive controller, a module or the entire project in Script mode. If you do not define any specific drive controller or module via the attributes, the parameter values of the entire project are exported. You can work with the variables listed below to have unique file names when exporting the entire project. These are replaced by the actual values during export.

Attributes

- "exportPath": Directory to which the parameter values are exported as a text file, <binding> <string>
- "module": Reference of the module, <optional> <string>
- "reference": Reference of the drive controller, <optional> <string>

Variables

Variable	Description
%m%	Module reference
%M%	Designation of the module
%r%	Reference of the drive controller
%d%	Designation of the drive controller
%i%	Iteration over the number of drive controllers

Tab. 241: Script mode: Variables for importing and exporting parameters

Example

```
      "ExportSingle": {
            "command": "exportParameter",
            "module": "M1",
            "reference": "T2",
            "exportPath": "%COMMANDFILE%/parameters_%r%-%d%_ProjectName.txt"
      },
,
      "ExportMulti": {
            "command": "exportParameter",
            "exportPath": "%COMMANDFILE%/parameters_%r%-%d%_ProjectName.txt"
      },
,
```

22.6.7.3.14 Importing parameter values (importParameter)

With the importParameter command, you can import previously exported parameter values for a drive controller, a module or the entire project in Script mode. If you do not define a specific drive controller or module via the attributes, the parameter values of the entire project are imported. You can work with the variables listed below to have unique file names when exporting the entire project. These are replaced by the actual values during export.

Attributes

- "importPath": Path to the text file from which the parameter values are imported, <binding> <string>
- "module": Reference of the module, <optional> <string>
- "reference": Reference of the drive controller, <optional> <string>
- "deleteAfter": If true, the text file with the parameter values will be deleted after import <optional> <Boolean><default = true>
- "reportPath": Path under which the change overview (*.html) is saved, <binding> <string>

Variables

Variable	Description
%m%	Module reference
%M%	Designation of the module
%r%	Reference of the drive controller
%d%	Designation of the drive controller
%i%	Iteration over the number of drive controllers

Tab. 242: Script mode: Variables for importing and exporting parameters

Example

```
      "ImportSingle": {
            "command": "importParameter",
            "module": "M1",
            "reference": "T2",
            "importPath": "%COMMANDFILE%/parameters_%r%-%d%_ProjectName.txt",
            "reportPath": "%COMMANDFILE%/parameterImportReport_ ProjectName.html",
            "deleteAfter": false
      },
,
      "ImportMulti": {
            "command": "importParameter",
            "importPath": "%COMMANDFILE%/parameters_%r%-%d%_ProjectName.txt",
            "reportPath": "%COMMANDFILE%/parameterImportReport_ ProjectName.html",
            "deleteAfter": false

      },
,
```

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22.6.7.3.15 updateTemplates

With the updateTemplates command, you can update the project configuration of the drive controllers to the latest version in Script mode (templates and system parameter version).

Attributes

- "reportPath": Generates an overview (*.html) of the changes in the project configuration, <optional> <string>

Example

```
"updateTemplates": {
      "command": "updateTemplates",
      "reportPath": "%COMMANDFILE%/updateReport.hmtl"
},
```

22.6.7.3.16 Creating reverse documentation (takeSnapShot)

With the takeSnapShot command, you can establish an online connection in Script mode to read out the configurations of the connected drive controllers into the project and to create reverse documentation when disconnecting. The configurations are read out into a new module in the project tree. If you do not use the attributes to specify any specific drive controllers, the configuration is read out for all drive controllers in the network and reverse documentation is created.

If no project is open, the command creates a new, empty project.

Attributes

- "ipAddresses": List of IP addresses of the drive controllers at the gateways, <optional> <string array>
- "serialNumbers": List of production numbers of the drive controllers at the gateways, <optional> <integer array>
- "references": List of references of the drive controllers at the gateways, <optional> <string array>

Information

During the search, all drive controllers within the broadcast domain are found via IPv4 limited broadcast.

Requirements for finding a drive controller in the network:

- Network supports IPv4 limited broadcast
- All drive controllers and the PC are in the same subnet (broadcast domain)

Description

The command establishes a direct connection to the gateway drive controllers with the corresponding IP addresses, production numbers or references.

Example 1

```
"takeSnapShot": {
      "command": "takeSnapShot"
},
```

Example 2

```
"takeSnapShotIpAddresses": {
      "command": "takeSnapShot",
      "ipAddresses": ["192.168.3.4","192.168.3.139"]
},
```

Example 3

```
"takeSnapShotReferences": {
      "command": "takeSnapShot",
      "references": ["T3","T4"]
},
```

Example 4

```
"takeSnapShotSerialNumbers": {
      "command": "takeSnapShot",
      "serialNumbers": [9011564,9012296]
},
```

22.6.7.3.17 Deleting reverse documentation (discardReverseDocumentation)

With the discardReverseDocumentation command, you can delete one or all instances of reverse documentation in Script mode. If you do not define any specific drive controller via the attributes, the reverse documentation of all drive controllers in the project is deleted.

Attributes

- "reference": Reference of the drive controller, <optional> <string>
- "module": Reference of the module, <optional> <string>

Example

```
"discardReverseDocu": {
      "command": "discardReverseDocumentation",
      "reference": "T1"
      "module": "M1"
},
```

22.6.7.4 Executing a command script

To execute a command script, in addition to the actual script, you need a batch file with which you pass the command script to DriveControlSuite. You can execute the command script either when DriveControlSuite is opened from the DriveControlSuite – Script mode window or when DriveControlSuite is closed by double-clicking on the corresponding batch file.

Information

Place all the files you need to execute a command script in the same directory. To execute a command script, you need at least 2 files (command script and batch file). If you want to log the script execution, you also need a log file. Depending on the application, you may also need a project file if you want to create or import a backup, for example.

Information

For application examples for the Script mode, go to the STOBER Download Center at http://www.stoeber.de/en/downloads/ and search for `Script mode`. The application examples contain sample files for the 3 following use cases: update firmware (firmware update), save configuration (backup) and import configuration (restore). You can adapt the sample files to your application by changing the number and addressing of the drive controllers and also the file names and path specifications.

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Creating a command script

Create a command script (*.json) that contains the appropriate commands and attribute values for your application.

✓ You are in the directory for the command script files.

1. Create a new text file via the Windows Explorer context menu.
2. Assign a suitable file name and change the file extension from *.txt to *.json.
   2.1. Example: `FirmwareUpdate.json`.
3. Open the file.
4. Write the command script for your application by defining the settings, sequence and commands script sections.
   4.1. Example:

```
{
    "settings": {
            "logFilePath": "%COMMANDFILE%/FirmwareUpdate.log",
            "quitWhenDone": "never"
},
    "sequence": [
            "UpdateFirmware"
],
"UpdateFirmware": {
    "command": "updateFirmware",
    "firmware": "V 6.4-D",
    "ipAddresses":
            [ "200.0.0.1",
            "200.0.0.2",
            "200.0.0.3"
    ],
    "restart": true
}
}
```

5. Save the command script.

Creating a batch file

Create a batch file (*.bat) with which you pass the command script to DriveControlSuite.

✓ You are in the directory for the command script files.

1. Create a new text file via the Windows Explorer context menu.
2. Assign a suitable file name and change the file extension from *.txt to *.bat.
   2.1. Example: `FirmwareUpdate.bat`.
3. Open the file.
4. Specify the path to the EXE file of DriveControlSuite and assign the command script.
   4.1. Example:

```
"C:\Program Files (x86)\STOBER\DriveControlSuite\bin\DS6A.exe"
FirmwareUpdate.json
```

5. Save the batch file.

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Executing a command script

Execute a command script with DriveControlSuite closed or open.

✓ You are in DriveControlSuite.

1. Use the keyboard shortcut [Ctrl] + [F9].
   ⇨ The DriveControlSuite – Script mode window opens.
2. Click Load file.
   ⇨ The Open file dialog box opens.
3. Navigate to the desired command script and click Open.
4. To run the command script, click Run.

⇨ The command script will be executed.

⇨ The DriveControlSuite – Script mode window displays information about the status of the command script in the Overview, Messages and Log file areas.

Information

You can execute a command script even when DriveControlSuite is closed by double-clicking the associated batch file. Double-clicking the batch file executes the command script and the DriveControlSuite - Script Mode window will open to display information about the status of the command script.

22.6.7.5 Presetting connections

You need the presets for the connection setup for the setOnlineByPreset command in Script mode. If you store presets for the connection setup in the project, you can easily store a command script or reuse it for multiple projects.

✓ You are in DriveControlSuite.

✓ Your project is open.

1. Select the project in the project tree and choose Preset connections from the context menu.
   ⇨ The Preset connections window opens.
2. Direction selection:
   Select whether read or send access to the drive controllers is to be made when the connection is established.
3. Target selection:
   Select how the configuration and drive controller are to be assigned to each other when the connection is established (IP address, reference, production number, PLC device name).
4. Confirm the presets with OK.

⇨ The presets are taken into account in the next execution of the setOnlineByPreset command.

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22.6.7.6 Application examples for EtherCAT

Examples are provided to illustrate how Script mode functions and how you can use it.

The files required for running the application examples can be found at http://www.stoeber.de/en/downloads/.
Enter `Script mode` in the search field.

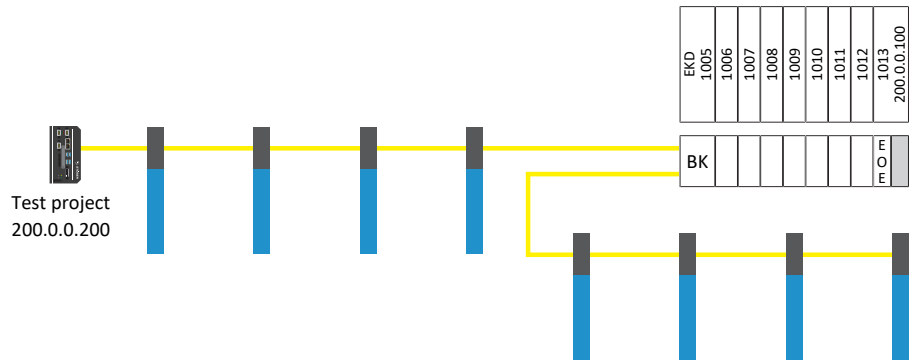
The package contains the example files for the following actions:

- Carry out a firmware update (FirmwareUpdate) (also refer to Running a script).
- Load the prepared configuration (Restore)
- Saving the current configuration (Backup)

The requirements for executing the actions are almost identical for all example files (see Running a script).

If you would like to use the example files, you must adapt them (file names and paths, addressing of the drive controllers).

Test setup



	Drive Controller 1	Drive Controller 2	Drive Controller 3	Drive Controller 4	Drive Controller 5	Drive Controller 6	Drive Controller 7	Drive Controller 8
ECAT address:	1001	1002	1003	1004	1014	1015	1016	1017
IP address:	200.0.0.1	200.0.0.2	200.0.0.3	200.0.0.4	200.0.0.5	200.0.0.6	200.0.0.7	200.0.0.8
Type:	SI6A162	SI6A162	SI6A162	SI6A162	SI6A162	SI6A161	SI6A161	SI6A161
S/N:	9004034	9004002	9004029	9001837	9004016	9008011	9001135	9001151
Reference:	T1	T2	T3	T4	T5	T6	T7	T8

Fig. 74: Test setup of the application examples

Eight drive controllers of the SI6 series with fixed IP addresses 200.0.0.1 - 200.0.0.8 assigned by the EtherCAT master.

Variant 1

The DriveControlSuite runs on the same IPC as the EtherCAT master.

Variant 2

The DriveControlSuite runs on a PC or laptop. The PC or laptop are on the same network as the IPC, but not on the same network as the EoE device group. A route must also be set here. For more information, see Network route [▶ 343].

22.6.7.6.1 Carrying out a firmware update

Requirements

- DriveControlSuite version 6.4-D or later is the default installation
- All drive controllers are operated with firmware version 6.4-A or later
- All drive controllers can be reached through a direct connection using IP addresses 200.0.0.1 to 200.0.0.8

Behavior of the script

The script for the drive controllers with the IP addresses 200.0.0.1 - 200.0.0.8 transfers a firmware update to firmware version 6.4-D. The drive controllers are then restarted.

Information

Be aware that values that have been changed or only stored in volatile memory are lost and that fieldbus communication and the connection to DriveControlSuite are interrupted in the event of a drive controller restart.

22.6.7.6.2 Load the prepared configuration (Restore)

Requirements

- DriveControlSuite version 6.4-D or later is the default installation
- All drive controllers are operated with firmware version 6.4-A or later
- All drive controllers can be reached through a direct connection using IP addresses 200.0.0.1 to 200.0.0.8
- A project file Restore.ds6 with the drive controllers

Behavior of the script

The configurations of the drive controllers projected in the Restore.ds6 project are transferred to the drive controllers with the parameterized IP addresses by a script.

Information

Be aware that values that have been changed or only stored in volatile memory are lost and that fieldbus communication and the connection to DriveControlSuite are interrupted in the event of a drive controller restart.

ATTENTION!

Machine damage from uncontrolled stopping!

Note that sending a configuration includes a brief stop of the device configuration. Communication with the EtherCAT master is interrupted. For this reason, the script may be run only in the pre-operational state.

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22.6.7.6.3 Saving the current configuration (Backup)

Requirements

- DriveControlSuite version 6.4-D or later is the default installation
- All drive controllers are operated with firmware version 6.4-A or later
- All drive controllers can be reached through a direct connection using IP addresses 200.0.0.1 to 200.0.0.8
- A project file Backup.ds6 with the drive controllers.

Behavior of the script:

The configurations of the drive controllers with the parameterized IP addresses are saved in the Backup.ds6 file by a script.

22.6.7.6.4 Network route

The Internet Protocol (IP) ensures that data packets are communicated across network boundaries. Routing is the determination of a suitable path for transferring the data packets.

Particularly when EoE is used, it is often necessary to create a route manually.

Information

Note that manually routing to the controller will function only if the IP address of the controller and the IP address of the PC in question are in the same network. Otherwise, the network administration has to add a static route to the router's routing table.

Creating a network route

In Windows, the route is created as follows:

```
route ADD 200.0.0.0 MASK 255.0.0.0 192.168.12.36
```

Explanation:

200.0.0.0 is the EoE network with a network mask of 255.0.0.0.
192.168.12.36 is the address of the controller that connects to the EoE network.

Deleting a network route

In Windows, the route is deleted as follows:

```
route delete 200.0.0.0
```

22.6.8 Simple Network Time Protocol (SNTP)

An SNTP client is implemented in the drive controller in accordance with RFC4330. This client sets the internal clock of the drive controller to the current time, which it obtains from an external time server. The internal clock runs with an (inaccurate) controllable internal clock in the drive controller. As a result, the time is queried from the server in intervals. It is compared with the internal time and the clock for the internal clock is readjusted accordingly. You define the settings in parameter A199.

Two NTP servers can be defined as time sources, both of which are used as possible time servers. In the case of data traffic via the service interface, the computer through which the drive controller is connected via DriveControlSuite automatically counts as one of the possible time servers. The time servers must be accessible either via EoE, service interface X9 or terminals X200 and X201. Make sure that the time server is accessible from the drive controller. It may be necessary to set the gateway parameter A175 accordingly.

The time is always requested from the same NTP server and then cyclically repeated by the server to track the synchronicity control loop. If the current server fails, the next one in the list is used. A server that was once active is discarded only in case of connection failure to this server or server unavailability.

After the drive controller is switched on, it takes a random time of 1 to 5 minutes (in accordance with RFC4330) until the SNTP client sends its first request to one of the time servers.

The cyclic repetition of a request occurs approximately every 5 to 6 hours.

22.6.8.1 Setting up time service on the computer

On a Windows PC with DriveControlSuite, you can use the registry editor to set up the time service. You must stop the time server in advance and restart it after changing the registry. Proceed as follows:

1. Open the command prompt, e.g. as follows:
   1.1. Click the [Windows]+[r] key combination to open the Run dialog box.
   1.2. Enter the command `cmd` and confirm with OK.
   ⇨ The command prompt opens.
2. Stop the time server by using the command `net stop w32time`.
3. Open the registry editor, e.g. as follows:
   3.1. Click the [Windows]+[r] key combination to open the Run dialog box.
   3.2. Enter the command `regedit` and confirm with OK.
   ⇨ The registry editor opens.
4. Select HKEY_LOCAL_MACHINE > SYSTEM > CurrentControlSet > Services > W32Time > TimeProvider > NtpServer.
5. Set Enable to the value `1` and confirm with OK.
6. Close the registry editor.
7. Open the command prompt again.
8. Start the time server in the command prompt by using the command `net start w32time`.

⇨ The time service is set up on the PC.

Automation using a command script

If you want to change the registry on the PC via a command script, create a *.reg file by creating an empty text file and renaming the file extension. Then open the file and enter the following content:

```
[HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\W32Time\TimeProviders\NtpServer] "Enabled"=dword:00000001
```

Run the file in the command line of the command prompt.

More commands

If you want to query the status on the current PC, use the following command in the command prompt:

```
w32tm /query /status
```

To query the IP address by PC name, use the following command at the command prompt:

```
nslookup <name>
```

Example:

```
nslookup ptbtime1.ptb.de
Name: ptbtime1.ptb.de
Addresses: 2001:638:610:be01::108 192.53.103.108
```

The IP address is: 192.53.103.108.

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22.6.9 Information for SSI encoders

The following chapters provide you with more detailed information on setting SSI encoders with the help of the DriveControlSuite commissioning software.

22.6.9.1 SSI encoder at X4 with free setting (H00 = 78)

Obey the instructions described below if you use X4 as the connection for SSI encoders and want to use the free setting option for the encoder function (H00 = 78: SSI free setting).

Information

The free setting of SSI encoders is supported by drive controllers in firmware V 6.5-G or higher.

Notes on settings for rotational single-turn SSI encoders at X4

1. The number of data bits corresponds to the sum of the single-turn bits and alarm bit of the encoder (H14 = number of single-turn bits + alarm bit)
2. Set mechanical value to 1 revolution (H121 = 1)
3. Set raw encoder value to $2^{\text{Number of single-turn bits (encoder)}}$ (H122 = $2^{\text{number of single-turn bits}}$)

Notes on settings for rotational multi-turn SSI encoders at X4

1. The number of data bits corresponds to the sum of the multi-turn bits, single-turn bits and alarm bit of the encoder (H14 = number of single-turn bits + number of multi-turn bits + alarm bit)
2. Set mechanical value to 1 revolution (H121 = 1)
3. Set raw encoder value to $2^{\text{Number of single-turn bits (encoder)}}$ (H122 = $2^{\text{number of single-turn bits}}$)

Interpretation

The interpretation of the data bits as the position is carried out using the H01 and H02 parameters.

Relationship between resolution, clock frequency and double transmission in SSI encoders

Ideally, a new, valid position value in high resolution is available in every cycle of the control.

With a higher resolution of the position value, the amount of data to be transmitted (H14) increases and thus so does the transmission time. The same applies if the position is read out twice to enable better detection of transmission errors (H11) for increasing data security.

The transmission time of the position value should not exceed the cycle time of the control. To compensate for the increased transmission time, you can transmit the bits at a higher clock frequency (H15) if the SSI encoder supports this function. From approx. 600 kHz, cable lengths of 100 m are no longer possible.

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22.6.9.2 SSI encoder at X4 (H00 = 65)

Obey the instructions described below if you use X4 as the connection for SSI encoders and use the setting H00 = 65: SSI for the function of the encoder.

Notes on settings for rotational single-turn SSI encoders at X4

1. If possible, set the number of data bits equal to the number of single-turn bits of the encoder (H10);
   If none of the available data bit options are identical to the number of single-turn bits, then use the next largest data bit option; if the number of single-turn bits is larger than the largest available data bit option, then use the largest available data bit option
2. Set mechanical value to 1 revolution (H01 = 1)
3. Set raw encoder value to $2^{\text{Number of data bits (H10)}}$ (H02 = 2^{H10})

Notes on settings for rotational multi-turn SSI encoders at X4

1. If possible, set the number of data bits equal to the sum of the number of multi-turn and single-turn bits of the encoder (H10);
   If none of the available data bit options are identical to the sum, then use the next largest data bit option; if the sum is larger than the largest available data bit option, then use the largest available data bit option
2. Set mechanical value to 1 revolution (H01 = 1)
3. Set raw encoder value to $2^{\text{Number of data bits (H10) - Number of multi-turn bits (encoder)}}$ (H02 = $2^{\text{H10 - Number of multi-turn bits}}$)

Number of single-turn bits	Number of multi-turn bits	Guide value H10	Guide value H01	Guide value H02
Up to 12	–	2: 13 bit short	1	$8192 = 2^{13}$
13	–	2: 13 bit short	1	$8192 = 2^{13}$
14 – 23	–	1: 24	1	$16777216 = 2^{24}$
24	–	1: 24	1	$16777216 = 2^{24}$
25	–	0: 25	1	$33554432 = 2^{25}$
Starting from 26	–	0: 25	1	$33554432 = 2^{25}$
12	12	1: 24	1	$4096 = 2^{24 - 12 = 12}$
13	12	0: 25	1	$8192 = 2^{25 - 12 = 13}$
14	12	0: 25	1	$8192 = 2^{25 - 12 = 13}$
13	13	0: 25	1	$4096 = 2^{25 - 13 = 12}$
13	14	0: 25	1	$2048 = 2^{25 - 14 = 11}$

Tab. 243: Examples of rotational SSI encoders at X4

Interpretation

The interpretation of the data bits as the position is carried out using the H01 and H02 parameters.

Relationship between resolution, clock frequency and double transmission in SSI encoders

Ideally, a new, valid position value in high resolution is available in every cycle of the control.

With a higher resolution of the position value, the amount of data to be transmitted (H10) increases and thus so does the transmission time. The same applies if the position is read out twice to enable better detection of transmission errors (H11) for increasing data security.

The transmission time of the position value should not exceed the cycle time of the control. To compensate for the increased transmission time, you can transmit the bits at a higher clock frequency (H06) if the SSI encoder supports this function and the cable length permits it.

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22.7 Detailed information

The documentation listed below provides you with further relevant information on the 6th STOBER drive controller generation. You can find the current status of the documentation in the STOBER download center at http://www.stoeber.de/en/downloads/, if you enter the ID of the documentation in the search.

The grouping of the documentation is intended to provide you with assistance, but is only relevant if you control the drive controller using a fieldbus.

PROFINET

Title	Documentation	Contents	ID
PROFINET communication – SC6, SI6	Manual	Installation, electrical installation, data transfer, commissioning, detailed information	443039
PROFIdrive application – SC6, SI6	Manual	Project configuration, configuration, parameterization, function test, detailed information	443270
Drive Based (DB) application	Manual	Project planning, configuration, parameterization, function test, detailed information	442706
Drive Based Synchronous (DBS) application	Manual	Project planning, configuration, parameterization, function test, detailed information	443046
SU6 safety technology – STO and SS1 via PROFIsafe	Manual	Technical data, installation, commissioning, diagnostics	443258
SR6 safety technology – STO via terminals	Manual	Technical data, installation, commissioning, diagnostics	442741
Connection method	Manual	Selection of encoder, power and hybrid cables, accessories, technical data, connection	443102

EtherCAT

Title	Documentation	Contents	ID
EtherCAT communication – SC6, SI6	Manual	Installation, electrical installation, data transfer, commissioning, detailed information	443025
CiA 402 application – SC6, SI6	Manual	Project planning, configuration, parameterization, function test, detailed information	443080
Drive Based (DB) application	Manual	Project planning, configuration, parameterization, function test, detailed information	442706
Drive Based Synchronous (DBS) application	Manual	Project planning, configuration, parameterization, function test, detailed information	443046
SY6 safety technology – STO and SS1 via FSoE	Manual	Technical data, installation, commissioning, diagnostics	442744
SR6 safety technology – STO via terminals	Manual	Technical data, installation, commissioning, diagnostics	442741
Connection method	Manual	Selection of encoder, power and hybrid cables, accessories, technical data, connection	443102

Additional information and sources that form the basis of this documentation or are referenced by the documentation:

EtherCAT Technology Group (ETG), 2012. *ETG.1300: EtherCAT Indicator and Labeling*. ETG.1300 S (R) V1.1.0. Specification. 2012-01-27.

22.8 Symbols in formulas

Symbol	Unit	Explanation
C_{1max}	F	Maximum input capacitance
C_{maxPU}	F	Maximum charging capacity of the power unit
$C_{N,PU}$	F	Nominal 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
E_{2max}	J	Maximum switch-off energy at the output
f_{1max}	Hz	Maximum input frequency
f_{2max}	Hz	Maximum output frequency
f_{2PU}	Hz	Output frequency of the power unit
f_N	Hz	Rotating magnetic field frequency at nominal speed
$f_{PWM,PU}$	Hz	Frequency of the pulse width modulation of the power unit
I_0	A	Stall current
I_{1max}	A	Maximum input current
I_{1maxCU}	A	Maximum input current of the control unit
I_{1maxPU}	A	Maximum input current of the power unit
$I_{1N,PU}$	A	Nominal input current of the power unit
I_{2max}	A	Maximum output current
I_{2maxPU}	A	Maximum output current of the power unit
$I_{d,ref}$	A	Magnetization-generating reference current in the d/q coordinate system
$I_{2PU(A)}$	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_{LINE}	A	Supply current
$I_{maxLINE}$	A	Maximum supply current
$I_{minLINE}$	A	Required supply current
I_N	A	Nominal current
$I_{N,MF}$	A	Nominal current of the choke or motor filter
$I_{q,ref}$	A	Torque/force-generating reference current in the d/q coordinate system
K_I	—	Integral coefficient
K_P	—	Proportional coefficient
λ_{LINE}	–	Power factor of the supply grid
M/F_{set}	Nm/N	Set torque or set force
M_0	Nm	Stall torque
M_{1Bstat}	Nm	Static braking torque of the brake in the motor adapter (tolerance +40%, −20%)
M_{2N}	Nm	Nominal torque on the gear unit output (relative to n_{1N})
M_B	Nm	Braking torque
M_{Bstat}	Nm	Static braking torque of the motor brake at 100 °C
M_k	Nm	Permitted tilting torque on the output
M_N	Nm	Nominal torque

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Symbol	Unit	Explanation
$M_{N,B}$	Nm	Nominal braking torque
n_{1N}	rpm	Nominal speed at the gear unit input
n_{2N}	min^{-1}	Nominal speed at the gear unit output
n_{fed}	–	Number of drive controllers connected to the grid
n_N	rpm	Nominal speed: The speed for which the nominal torque M_N is specified
p	–	Number of pole pairs
P_{effRB}	W	Effective power at the external braking resistor
P_{LINE}	W	Power output
P_{maxRB}	W	Maximum power at the external braking resistor
P_{MOT}	W	Motor rating
$P_{totalMOT}$	W	Total rating of all motors
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
ϑ_{amb}	°C	Surrounding temperature
$\vartheta_{amb,max}$	°C	Maximum surrounding temperature
T_M	Year, a	Mission time
T_i	ms	Reset time
t_{min}	ms	Minimum cycle time of the application
τ_{th}	°C	Thermal time constant
U_1	V	Input voltage
U_{1CU}	V	Input voltage of the control unit
U_{1max}	V	Maximum input voltage
U_{1PU}	V	Input voltage of the power unit
U_2	V	Output voltage
U_{2PU}	V	Output voltage of the power unit
$U_{2PU,ZK}$	V	Output voltage of the power unit for the DC link connection (typical values: 400 V_{AC} corresponds to 560 V_{DC}, 480 V_{AC} corresponds to 680 V_{DC})
U_{max}	V	Maximum voltage
U_{maxMOT}	V	Maximum motor voltage
U_{MOT}	V	Motor voltage
U_{offCH}	V	Switch-off threshold of the brake chopper
U_{onCH}	V	On limit of the brake chopper
v_{act}	m/min	Actual velocity
v_{set}	m/min	Set velocity
x_{act}	m	Actual position
x_{set}	m	Set position

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22.9 Abbreviations

Abbreviation	Meaning
AC	Alternating Current
AEH	Aderendhülse (end sleeve)
AWG	American Wire Gauge
BAT	Battery
BG	Baugröße (size)
CiA	CAN in Automation
CNC	Computerized Numerical Control
CSA	Canadian Standards Association
csp	Cyclic synchronous position mode
cst	Cyclic synchronous torque mode
csv	Cyclic synchronous velocity mode
DC	Direct Current
DHCP	Dynamic Host Configuration Protocol
DI	Digital Input
DMZ	Demilitarized zone
EMC	Electromagnetic Compatibility
ETG	EtherCAT Technology Group
EtherCAT	Ethernet for Control Automation Technology
FAT	File Allocation Table
IE	International Efficiency
IE class	Energy efficiency class
FSoE	Fail Safe over EtherCAT
HTL	High Threshold Logic
ip	Interpolated position mode
IP	International Protection
IP	Internet Protocol
NAT	Nennansprechtemperatur (nominal response temperature)
NTP	Network Time Protocol
P controller	Proportional controller
PE	Protective Earth (grounding conductor)
PELV	Protective Extra Low Voltage
PI controller	Proportional-Integral controller
PID controller	Proportional-Integral-Differential controller
PL	Performance Level
pp	Profile position mode
PRM	Predictive Maintenance
pt	Profile torque mode
PTC	Positive Temperature Coefficient
pv	Profile velocity mode
RCD	Residual Current protective Device

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Abbreviation	Meaning
RCM	Residual Current Monitoring device
RFC	Request For Comments
RoHS	Restriction of Hazardous Substances
SD	Secure Digital (memory card)
SDHC	Secure Digital High Capacity (memory card)
S/FTP	Screened/Foiled Twisted Pair
SF/FTP	Screened Foiled/Foiled Twisted Pair
SF/UTP	Screened Foiled/Unshielded Twisted Pair
SIL	Safety Integrity Level
SNTP	Simple Network Time Protocol
PLC	Programmable Logic Controller
SS1	Safe Stop 1
SSI	Serial Synchronous Interface
STO	Safe Torque Off
TCP	Transmission Control Protocol
TTL	Transistor-Transistor Logic
UL	Underwriters Laboratories

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23 Contact

23.1 Consultation, service and address

We would be happy to help you!

We offer a wealth of information and services to go with our products on our website:
http://www.stoeber.de/en/service

For additional or personalized information, contact our consultation and support service:
http://www.stoeber.de/en/support

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23.2 Your opinion is important to us

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Thank you for your interest.
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Glossary

100Base-TX

Ethernet network standard based on symmetrical copper cables in which the nodes are connected to a switch via copper cables twisted in pairs (shielded twisted pair, CAT 5e quality level). 100Base-TX is the subsequent progression from 10Base-T and includes those properties with the option of a transfer speed of 100 Mbps (Fast Ethernet).

Band

In the context of a scope, a section in the display of a scope image. The recorded channels can be individually assigned, each to one such section.

Braking resistor

Electrical resistor that is switched on by a brake chopper in order to avoid a hazard to electrical components in the event of significant brake energy by limiting the DC link voltage. Braking energy, which is usually only present for brief periods, is converted into heat in the resistor.

Broadcast domain

Logical grouping of network devices within a local network that reaches all nodes via broadcast.

Channel (scope, multi-axis scope)

The reserved disk space for recording a signal in DriveControlSuite. As part of a scope image, up to 12 channels can be recorded simultaneously.

Channel assignment

Source of the data that is recorded with/by/in a channel. For example, this may involve parameters that are transmitted in a cyclical fieldbus communication channel or a parameter that is recorded in a measurement channel.

Circuit breakers

Current-limiting switches for motor or starter protection. They guarantee safe shut-off in the event of a short circuit and protect loads and systems from overload.

Control cascade

Complete model of the control structure with the position controller, velocity controller and current controller components.

Current controller

Controller that is part of the control cascade and makes sure the deviation between the set and actual torque/force is small. In addition, it uses the deviation to calculate a value for the set current and transfers this to the power unit. The controller has a part that controls torque/force and a part that controls the magnetic flux.

DC link discharge time

Time until the DC link capacitors are discharged enough that the device can be worked on safely.

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Defense in depth

In accordance with DIN EN IEC 62443-4-1, an approach to defend the system against any kind of attack using multiple independent methods.

Demilitarized zone (DMZ)

Specially controlled network located between the external network (Internet) and internal network. It represents a kind of buffer zone that separates the networks from each other through strict communication rules and firewalls.

Differential (HTL/TTL)

In the context of signal transmission, a process for being able to transmit signals with the highest possible fault tolerance even with longer transmission paths. In this approach, transmission takes place using a pair of signal conductors instead of just one signal conductor. The actual signal is transmitted on one line and the inverse signal on the other.

Discrete Fourier transform (DFT)

Maps a time-discrete signal onto a periodic, discrete frequency spectrum. A Fourier transform can be carried out on a scope image in DriveControlSuite. The spectrum display of the scope image shows all occurring frequencies. The amplitude of a frequency stands for its frequency of occurrence.

Electronic nameplate

STOBER synchronous servo motors are generally equipped with absolute encoders that provide special memory. This memory includes the electronic nameplate, i.e. all type-relevant master data as well as special mechanical and electronic values of a motor. When you operate a drive controller with a STOBER synchronous servo motor and an absolute encoder, the electronic nameplate is read and all motor data transferred if the drive controller is connected online. The drive controller automatically determines the associated limit values and control parameters from this data.

Emergency stop

An energy supply to the machine drives that could cause a dangerous situation must either be immediately interrupted (stop category 0) or controlled so that the dangerous movement is stopped as quickly as possible (stop category 1) without creating other risks.

Fail Safe over EtherCAT (FSoE)

Protocol for transferring safety-related data via EtherCAT using a FSoE master and an indefinite number of FSoE slaves (i.e. devices that have a Safety over EtherCAT interface). The protocol enables the realization of functional safety via EtherCAT. FSoE and its implementation are TÜV-certified and comply with the SIL 3 requirements in accordance with IEC 61508.

Firewall

Network security device that monitors incoming and outgoing network traffic and decides whether to allow or block specific traffic based on a set of defined security rules. It is based either on hardware, software or a combination of both.

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Frequency analysis

Method for investigating how frequently certain events occur in a certain time span, or how strongly which frequency components are represented in a signal.

IPv4 limited broadcast

Type of broadcast in a network with IPv4 (Internet Protocol version 4). The IP address 255.255.255.255 is entered as the destination. The content of the broadcast is not forwarded by a router, which limits it to the local network.

I-share

Integral share of the controller that acts on the manipulated variable through the temporal integration of the control deviation with the weighting caused by the reset time: the longer the control difference is present, the stronger the response is.

Life performance indicator

Value for the calculated life performance of the geared motor.

Load matrix

Recording of the frequency distribution of speeds and torques that occurred at the output of the geared motor.

Miniature circuit breakers

Special switch that protects electrical systems from overload and short circuits. It is specifically used for the fuse protection of individual cores or cables. The switch has different triggering characteristics (A, B, C, D) and, thus, serves all application areas in industrial, functional and residential construction.

Multi-axis scope

Analysis tool of DriveControlSuite with graphical output. It can be used to create synchronized scope images of multiple drive controllers or axes in order to measure and depict the progress of parameter values, signal names or physical addresses over time.

MV number

The number of the material variant ordered and delivered as stored in the enterprise resource planning system, i.e. the device-specific combination of all hardware and software components.

Network Time Protocol (NTP)

Standard for synchronizing clocks in computer systems via packet-based communication networks. The protocol uses the connectionless transport protocol UDP or the connection-based TCP. It is specifically designed to provide reliable timing over networks with variable packet runtime.

Output choke

This type of choke is used to reduce high-frequency currents on electric lines and thus increase the interference immunity and availability of drive systems. They reduce current peaks caused by line capacity at the power output of the drive controller. It makes long power cables possible and increases the motor service life.

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P controller

Controller type in which the manipulated variable is always proportional to the recorded control difference. As a result of this, the controller responds to the control deviation without a delay and only creates a manipulated variable if a deviation is present. It is a fast and stable controller with a permanent control deviation that can be used for non-critical controls where permanent control deviation can be accepted when faults occur, e.g. pressure, flow, fill level and temperature control.

Performance Level (PL)

In accordance with DIN EN ISO 13849-1: Measure for the reliability of a safety function or a component. The Performance Level is measured on a scale of a – e (lowest – highest PL). The higher the PL, the safer and more reliable the function in question is. The PL can be assigned to a specific SIL. A reversed inference from a SIL to a PL is not possible.

PI controller

Controller type that results from a parallel connection of a P and an I controller. With the right layout, it combines the advantages of both types (stable and fast, no permanent control deviation) and compensates for the disadvantages simultaneously.

PID controller

Universal controller type with a P-, I- and D-share. These three adjustment parameters make the controller flexible and ensure exact and highly dynamic control. However, by implication, it also necessitates a wide variety of variants. It is that much more important to ensure careful construction that is well-coordinated to the system. The application areas for this controller type are control circuits with systems of the second order and higher, which must be stabilized quickly and do not allow for any permanent control deviation.

Plug connectors

Component for disconnecting and connecting cables. The connecting parts are appropriately aligned by the positive locking of the plug pieces, feature detachable, positive attachment by spring force (pin) and are often also secured against unintended disconnection by a screw connection.

Position controller

Controller that is part of the control cascade and makes sure the deviation between the set and actual position is small. To do so, it calculates a set velocity from the deviation and passes it to the velocity controller.

Predictive Maintenance (PRM)

Proactive maintenance process based on permanent monitoring and evaluation of machine and process data. The aim here is to predict future maintenance requirements, thereby avoiding faults and making maintenance processes more efficient.

Pre-trigger

Percentage portion of the recording time that takes place before the trigger and that defines the starting time of the scope image.

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Pre-trigger time

Portion of the recording time that takes place before the trigger and that defines the starting time of the scope image.

PROFIdrive

Standardized drive interface for PROFIBUS and PROFINET open standard buses. It defines the device behavior and the procedure for accessing internal device data for electrical drives on PROFINET and PROFIBUS. The interface is specified by PROFIBUS and PROFINET International (PI) user organizations, and is specified as the future-proof standard by standard IEC 61800-7-303.

PROFINET

Open Ethernet standard of PROFIBUS Nutzerorganisation e. V. (PNO) for automation.

PROFINET IRT

Transmission method for high-precision as well as synchronized processes in a PROFINET IO system.

PROFINET RT

Transmission method for time-critical process data in a PROFINET IO system.

PROFIsafe

Communication standard for safety standard IEC 61508 that includes both standard as well as fail-safe communication. The standard enables reliable communication for PROFIBUS and PROFINET open standard buses based on standard network components, and is defined as the international standard in standard IEC 61784-3-3.

P-share

Proportional share of the controller gain: the greater this share is, the stronger the influence on the manipulated variable.

PTC thermistor

Thermistor whose resistance significantly changes with the temperature. When a PTC reaches its defined nominal response temperature, the resistance increases dramatically, by two or more times the original resistance, to several kOhms. Since PTC triplets are used, each thermistor monitors one phase of the motor winding. For 3 thermistors, this means all 3 phases are monitored, achieving effective motor protection.

Quantization

Conversion of analog signals into numbers and measurable variables. For this purpose, the analog signals are scanned in regular intervals at the sampling rate and their voltage rating is converted at each of these scanning points to a digital value. The analog signal can only be expressed in a finite number of digital values.

Recording time

Recording of an image, occurrence, acoustic event or other event on a corresponding medium. In the context of a scope, the display of the calculated duration of scope image recording. The memory size, sampling time and channels used form the basis of the calculation.

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Reforming

Protective measure for drive controllers. In case of a longer storage time, the oxide layer of the capacitors reacts with the electrolytes. This influences the electrical strength and capacitance. The process, which is to be performed before commissioning, re-establishes the dielectric in the capacitors.

Reverse documentation

Refers to a read-only file read out by a drive controller that includes the fault memory in addition to the configuration of a drive controller. This file is a snapshot of the time that the connection between the PC and drive controller was interrupted. The information it contains is used for diagnostics as well as for processing service requests.

RFC

Proposed and published Internet standards, reviewed by the Internet Engineering Task Force (IETF), as consensus-building body that facilitates discussion, and eventually a new standard is established.

Safe Stop 1 (SS1)

In accordance with DIN EN 61800-5-2: Procedure for stopping a PDS(SR). With the SS1 safety function, the PDS(SR) performs one of the following functions: a) Triggering and controlling the motor delay variable within defined limits and triggering the STO function if the motor speed falls below a specified limit value (SS1-d), or b) triggering and monitoring the motor delay variable within defined limits and triggering the STO function if the motor speed falls below a specified limit value (SS1-r), or c) triggering the motor delay and triggering the STO function after an application-specific delay (SS1-t). In this case, SS1(-t) corresponds to the time-controlled stop in accordance with IEC 60204-1, stop category 1(-t).

Safe Torque Off (STO)

In accordance with DIN EN 61800-5-2: Procedure for stopping a PDS(SR). The STO safety function prevents the motor from being supplied with any energy that could cause rotation (or motion in a linear motor). The PDS(SR) does not supply the motor with any energy that could generate torque (or force in a linear motor). STO is the most fundamental drive-integrated safety function. It corresponds to an uncontrolled stop in accordance with DIN EN 60204-1, stop category 0.

Safety Integrity Level (SIL)

In accordance with DIN EN 61800-5-2: Probability of a safety function failure. SIL is divided into levels 1 – 4 (lowest – highest level). SIL precisely assesses systems or subsystems based on the reliability of their safety functions. The higher the SIL, the safer and more reliable the function in question is.

Sampling time

In signal processing, the time after which an analog signal (also called a continuous-time signal) is scanned again, i.e. measured and converted into a discrete-time signal.

Scope

Analysis tool of DriveControlSuite with graphical output. It can be used to create scope images of a drive controller in order to measure and depict the progress of parameter values, signal names or physical addresses over time. The term stems from traditional scope-type measuring instruments.

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Scope memory

Disk space in the drive controller that records the data of a scope image.

Security

Term for the protection and safety of components and systems with regard to confidentiality, integrity and availability.

Self-discharge

Passive running process that causes the capacitors to discharge even when no electrical load is connected.

Serial number

Consecutive number stored for a product in the enterprise resource planning system and used for individual identification of the product and for determining the associated customer information.

Simple Network Time Protocol (SNTP)

Simplified version of the Network Time Protocol (NTP). The structure of the protocol is identical to that of NTP. SNTP clients can thus also obtain the time from NTP servers. The main difference lies in the algorithms used for time synchronization. While NTP usually uses multiple time servers for time synchronization, SNTP uses only one time server.

Single-ended (HTL/TTL)

In the context of signal transmission, electrical signal transmission takes place using a voltage that changes in relation to a constant reference potential.

Synchronous operation

Synchronous movement of the individual axes in multi-axis systems.

System parameter

Parameter that is defined by the firmware. Examples include parameters for motor control, for encoders or parameters of the control cascade.

Template

In the context of the DriveControlSuite commissioning software, a template for graphical programming. This template can be selected in the configuration dialog for device control, communication (fieldbus) or application in a certain version.

Time between two energizing processes

Specified time span between two switching-on processes.

Trigger

Switch or software function that generates a pulse or a switching operation during a triggering event.

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Trigger condition

Triggering event that generates a pulse or switching operation.

Velocity controller

Controller that is part of the control cascade and makes sure the deviation between the set and actual velocity is small. In addition, it uses the deviation to calculate a value for the set torque/force and transfers this to the current controller.

Window function

Auxiliary function for minimizing the leakage effect for the Fourier transform.

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