SEW EURODRIVE

Product Manual



Application Inverter
MOVIDRIVE® system

Edition 8/2024

31972098/EN

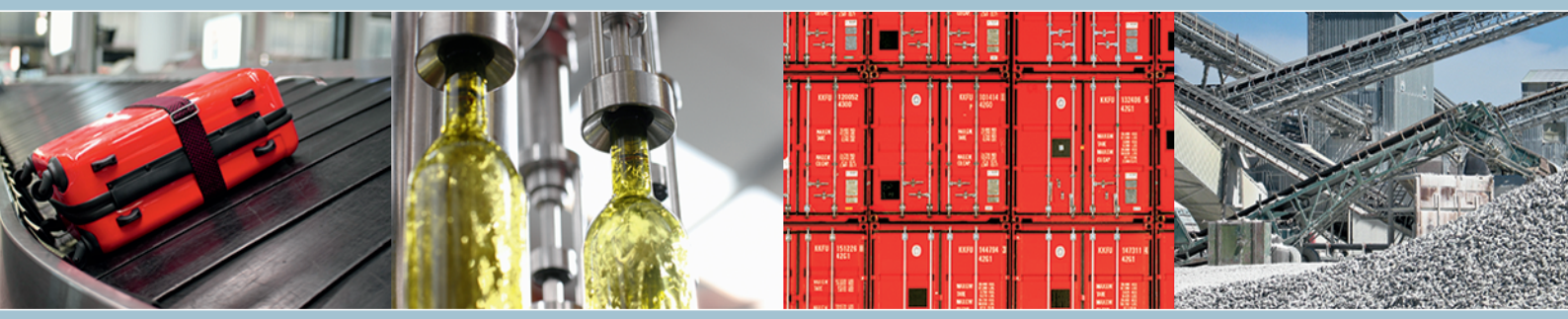


Table of Contents

1 General information 7
1.1 About this documentation 7
1.2 Other applicable documentation 7
1.3 Structure of the safety notes 7
1.4 Decimal separator in numerical values 9
1.5 Rights to claim under limited warranty 9
1.6 Recycling, reprocessing, reuse 9
1.7 Product names and trademarks 9
1.8 Copyright notice 9

2 Safety notes 10
2.1 Preliminary information 10
2.2 Duties of the user 10
2.3 Target group 11
2.4 IT security 11
2.5 Designated use 12
2.6 Transport 14
2.7 Creating a safe working environment 16
2.8 Installation/assembly 19
2.9 Protective separation 19
2.10 Electrical installation 19
2.11 Startup/operation 20

3 Product description 21
3.1 MOVI-C® modular automation system 21
3.2 MOVIDRIVE® system 22
3.3 MOVI-C® CONTROLLER 23
3.4 Technologies 27
3.5 Setpoint processing 30
3.6 Control topologies 32
3.7 Motor control 33
3.8 Technology functions 35

4 Technical data 36
4.1 Markings 36
4.2 General technical data 39
4.3 Environmental conditions 40
4.4 Technical data of the MDX9.A.. basic device 3 × AC 380 – 500 V 43
4.5 Technical data of the MDX9.A.. basic device 3 × AC 200 – 240 V 48
4.6 Electronics data MDX9.A.. 50
4.7 CIO21A and CID21A input/output cards 52
4.8 CES11A multi-encoder card 54
4.9 Multi-encoder card with incremental encoder simulation CES12A 55
4.10 CS..A safety options 57
4.11 Technical data – functional safety 60
4.12 USM21A interface adapter 77

31972098/EN – 8/2024

4.13 Braking resistors BW.../BW...-T ... 78
4.14 NF.. line filter ... 92
4.15 ND.. line chokes ... 94
4.16 HF.. output filters ... 96
4.17 HD.. output chokes ... 98
4.18 ZD.. DC link choke ... 100
4.19 Standard accessories ... 103
4.20 Connectors ... 104
4.21 Dimension drawings ... 105

5 Project planning of the device ... 113
5.1 SEW-Workbench ... 113
5.2 Schematic workflow for project planning ... 113
5.3 Control mode ... 115
5.4 Drive selection ... 121
5.5 Recommendations for motor and inverter selection ... 127
5.6 Motor/inverter characteristic curves ... 133
5.7 Inverter selection ... 133
5.8 Braking resistor selection ... 138
5.9 Supply system cables and motor cables ... 143
5.10 EMC-compliant installation according to EN 61800-3 ... 146
5.11 Line components ... 148
5.12 Components on the output side ... 150
5.13 24 V supply voltage selection ... 153
5.14 Energy-saving functions ... 155
5.15 FCB concept ... 156
5.16 UL-compliant installation ... 163

6 Project planning for functional safety ... 170
6.1 Definitions ... 170
6.2 Underlying standards ... 170
6.3 Integrated safety technology ... 171
6.4 Safety requirements ... 188
6.5 Safe digital inputs (F-DI..) ... 206
6.6 Safe digital outputs (F-DO..) ... 209
6.7 "Brake test" diagnostics function ... 213
6.8 Data exchange with higher-level controller ... 225
6.9 Response times ... 252

7 Prefabricated cables ... 263
7.1 Meaning of the symbols ... 263
7.2 Power cable ... 264
7.3 Encoder cable ... 275
7.4 Cables for MOVILINK® DDI ... 284
7.5 Module bus cable ... 295
7.6 System bus cable ... 296

8 Device structure ... 299

31972098/EN – 8/2024

8.1 Inverter ... 299
8.2 MOVISAFE® CS..A device structure safety option ... 314
8.3 Nameplates ... 321
8.4 Type designation ... 323
8.5 Card slots ... 324

9 Mechanical installation ... 325
9.1 Installation notes ... 325
9.2 Installation requirements ... 325
9.3 Minimum clearance and mounting position ... 325
9.4 Preparing the control cabinet back panel ... 326
9.5 Installing inverter sizes 1 – 8 ... 327
9.6 Installing the shield plate for the power section ... 328
9.7 Installing the shield plate for signal cables ... 329
9.8 Removing and attaching the safety cover ... 331
9.9 Removing and reinstalling the touch guards ... 332
9.10 Installing a card ... 336
9.11 Installing braking resistors ... 338
9.12 Installing the line choke ... 342
9.13 Installing the line filter ... 343
9.14 Mounting the output filter ... 344
9.15 Mounting the output choke ... 345

10 Electrical installation ... 346
10.1 Installation planning considering EMC aspects ... 346
10.2 Installation instructions ... 350
10.3 Connection to power terminals ... 355
10.4 24 V supply voltage ... 358
10.5 Line fuses ... 359
10.6 Brake chopper output ... 359
10.7 Temperature evaluation ... 360
10.8 Brake control output ... 360
10.9 Inputs/outputs ... 360
10.10 System bus and module bus cabling ... 361
10.11 Encoders ... 363
10.12 MOVILINK® DDI ... 364
10.13 CIO21A and CID21A input/output card ... 367
10.14 BW.. braking resistors ... 369
10.15 ND.. line choke ... 373
10.16 NF.. line filter ... 373
10.17 Terminal assignment ... 373
10.18 Electrical installation – functional safety ... 384
10.19 Wiring diagrams ... 401
10.20 PC connection ... 413

11 Startup ... 415
11.1 Startup information ... 415
11.2 Startup requirements ... 417

31972098/EN – 8/2024

11.3 Setting the EtherCAT® ID ... 418
11.4 Startup with "ex works parameters" ... 418
11.5 Startup of third-party motors ... 418
11.6 Startup with MOVISUITE® engineering software ... 420
11.7 Setting the "module bus" operating mode ... 420
11.8 Startup of motors with the MOVILINK® DDI interface ... 421
11.9 Control options ... 421
11.10 Application-related startup ... 423
11.11 Startup of the MOVISAFE® CS..A safety option ... 434

12 Operation ... 501
12.1 Operation - Functional safety ... 501
12.2 IT security ... 506

13 Service ... 507
13.1 Evaluating fault messages ... 507
13.2 Resetting fault messages ... 508
13.3 Fault responses ... 508
13.4 Fault messages with parameterizable response ... 509
13.5 Responses to fault acknowledgement ... 512
13.6 Status and operating displays of the 7-segment display ... 512
13.7 Status and operating displays of the LEDs ... 515
13.8 Fault description on basic device ... 518
13.9 Power section fault description ... 600
13.10 Device replacement ... 609
13.11 Service – functional safety ... 609
13.12 SEW-EURODRIVE Service ... 620
13.13 Shutdown ... 620
13.14 Extended storage ... 621
13.15 IT security guidelines for secure disposal ... 621
13.16 Waste disposal ... 622

14 Inspection and maintenance ... 623

15 Appendix ... 624
15.1 Abbreviation key ... 624

16 Contacting SEW-EURODRIVE ... 626

Index ... 627

31972098/EN – 8/2024

1 General information

1.1 About this documentation

The documentation at hand is the original.

This documentation is an integral part of the product. The documentation is intended for all employees who perform work on the product.

Make sure this documentation is accessible and legible. Ensure that persons responsible for the systems and their operation as well as persons who work on the product independently have read through the documentation carefully and understood it. If you are unclear about any of the information in this documentation or if you require further information, contact SEW-EURODRIVE.

1.2 Other applicable documentation

Refer to the corresponding documentation for all other components.

Always use the latest edition of the documentation and the software.

The SEW-EURODRIVE website (www.sew-eurodrive.com) provides a wide selection of documents for download in various languages. If required, you can also order printed and bound copies of the documentation from SEW-EURODRIVE.

1.3 Structure of the safety notes

1.3.1 Meaning of signal words

The following table shows the graduation and meaning of the signal words in the safety notes.

Signal word	Meaning	Consequences if not observed
⚠ **DANGER**	Imminent danger	Death or severe injuries
⚠ **WARNING**	Possibly dangerous situation	Death or severe injuries
⚠ **CAUTION**	Possibly dangerous situation	Minor injuries
NOTICE	Possible damage to property	Damage to the product or its environment
INFORMATION	Useful information or tip: Simplifies handling of the product.	

31972098/EN – 8/2024

1.3.2 Structure of section-related safety notes

Section-related safety notes do not apply to a specific action but to several actions pertaining to one subject. The hazard symbols used either indicate a general hazard or a specific hazard.

This is the formal structure of a safety note for a specific section:



SIGNAL WORD

Type and source of hazard.

Possible consequence(s) if disregarded.

- Measure(s) to prevent the hazard.

1.3.3 Meaning of the hazard symbols

The hazard symbols in the safety notes have the following meaning:

Hazard symbol	Meaning
	General hazard
	Warning of dangerous electrical voltage
	Warning of hot surfaces
	Warning of automatic restart

1.3.4 Structure of embedded safety notes

Embedded safety notes are directly integrated into the instructions just before the description of the dangerous step.

This is the formal structure of an embedded safety note:

⚠ **SIGNAL WORD!** Type and source of danger. Possible consequence(s) if disregarded. Measure(s) to prevent danger.

31972098/EN – 8/2024

1.4 Decimal separator in numerical values

In this document, a period is used to indicate the decimal separator.

Example: 30.5 kg

1.5 Rights to claim under limited warranty

Read the information in this documentation. This is essential for fault-free operation and fulfillment of any rights to claim under limited warranty. Read the documentation before you start working with the product.

1.6 Recycling, reprocessing, reuse

When manufacturing products, SEW-EURODRIVE makes sure to keep the use of new natural resources in the interests of the circular economy to a minimum. Key aspects here are the recycling of materials as well as the inspection and/or processing of returned components and their reuse in new products. These processes are only used at SEW-EURODRIVE if the resulting materials and components correspond to the quality of new products.

1.7 Product names and trademarks

The product names mentioned in this documentation are trademarks or registered trademarks of the respective titleholders.

1.8 Copyright notice

© 2024 SEW-EURODRIVE. All rights reserved. Copyright law prohibits the unauthorized reproduction, modification, distribution and use of this document – in whole or in part.

31972098/EN – 8/2024

2 Safety notes

2.1 Preliminary information

The following general safety notes serve the purpose of preventing injury to persons and damage to property. They primarily apply to the use of products described in this documentation. If you use additional components, also observe the relevant warning and safety notes.

2.2 Duties of the user

As the user, you must ensure that the basic safety notes are observed and complied with. Make sure that persons responsible for the machinery and its operation as well as persons who work on the device independently have read through the documentation carefully and understood it.

As the user, you must ensure that all of the work listed in the following is carried out only by qualified specialists:

- Setup and installation
- Installation and connection
- Startup
- Maintenance and repairs
- Shutdown
- Disassembly

Ensure that the persons who work on the product pay attention to the following regulations, conditions, documentation, and information:

- The national and regional regulations governing safety and the prevention of accidents
- Product safety label on the product
- All other associated project planning documents, installation and startup instructions, as well as wiring diagrams
- Do not assemble, install or operate damaged products
- All system-specific specifications and regulations

Ensure that systems in which the product is installed are equipped with additional monitoring and protection devices. Observe the applicable safety regulations and legislation governing technical work equipment and accident prevention regulations.

31972098/EN – 8/2024

2.3 Target group

Specialist for mechanical work

Any mechanical work may be performed only by adequately qualified specialists. Specialists in the context of this documentation are persons who are familiar with the design, mechanical installation, troubleshooting, and maintenance of the product, and who possess the following qualifications:

- Qualifications in the field of mechanics in accordance with the national regulations
- Familiarity with this documentation

Specialist for electrotechnical work

Any electrotechnical work may be performed only by electrically skilled persons with a suitable education. Electrically skilled persons in the context of this documentation are persons who are familiar with electrical installation, startup, troubleshooting, and maintenance of the product, and who possess the following qualifications:

- Qualifications in the field of electrical engineering in accordance with the national regulations
- Familiarity with this documentation

Additional qualifications

In addition to that, these persons must be familiar with the valid safety regulations and laws, as well as with the requirements of the standards, directives, and laws specified in this documentation.

The persons must have the express authorization of the company to operate, program, parameterize, label, and ground devices, systems, and circuits in accordance with the standards of safety technology.

Instructed persons

All work in the areas of transport, storage, installation, operation and waste disposal may only be carried out by persons who are trained and instructed appropriately. These instructions must enable the persons to carry out the required activities and work steps safely and in accordance with regulations.

2.4 IT security

2.4.1 Contact



If you need support with the configuration, contact SEW-EURODRIVE Service. You can obtain information about the latest security-related problems via e-mail or by visiting the Product Security Management webpage. Here you will find various contact options for reporting security-related problems.

2.4.2 IT security of the product



The product can be set to different access levels. Certain parameters are protected by these access levels. Authentication is implemented by using static access data. This data is not used to defend against attacks on IT security but to protect against unintentional modification.

31972098/EN – 8/2024

2.4.3 IT security of the environment



For drive and control components that are integrated in a network (e.g., fieldbus, WLAN or Ethernet network), settings can even be made from more remote locations. This brings with it the risk of a parameter change not visible externally resulting in unexpected, but not uncontrolled system behavior and this may impact negatively on operational safety and reliability, system availability or data security.

With WLAN or Ethernet-based networked systems and engineering interfaces in particular, make sure that unauthorized access is not possible. Using IT-specific security standards, such as network segmentation, adds to the protection of access to the ports. For an overview of the ports and of the services provided by the communication interfaces, refer to Online Support. The IT security of the product is only guaranteed when used in an environment secured by defense-in-depth strategies.

Ensure that clear responsibility for security is guaranteed during operation. SEW-EURODRIVE recommends an IT security management system in accordance with ISO/IEC 27001 and ISO/IEC 62443-2-4.

2.5 Designated use

The product is intended for control cabinet installation in electrical systems or machines.

In case of installation in electrical systems or machines, startup of the product is prohibited until it is determined that the machine meets the requirements stipulated in the local laws and directives. For Europe, Machinery Directive 2006/42/EC as well as the EMC Directive 2014/30/EU apply. Observe EN 60204-1 (Safety of machinery - electrical equipment of machines). The product meets the requirements stipulated in the Low Voltage Directive 2014/35/EU.

The standards given in the declaration of conformity apply to the product.

The systems can be mobile or stationary.

Only connect ohmic/inductive loads.

The product can be used to operate the following motors in industrial and commercial systems:

- AC asynchronous motors
- AC synchronous motors

Technical data and information on the connection conditions are provided on the nameplate and in chapter "Technical data" in the documentation. Always comply with the data and conditions.

Unintended or improper use of the product may result in severe injury to persons and damage to property.

31972098/EN – 8/2024

2.5.1 Designated use of the MOVISAFE® CS..A safety option

The MOVISAFE® CS..A safety option is a parameterizable safety controller that can be used to realize safety shutdowns and safety functions. The product is intended for use:

- In emergency stop devices
- As a safety-related component pursuant to Machinery Directive 2006/42/EC
- As a PE system for risk reduction pursuant to EN 61508
- In safety circuits according to EN 60204-1
- As a PE system for functional safety pursuant to EN 62061
- As a SRP/CS pursuant to EN ISO 13849
- As a device for implementing the safety functions according to EN 61800-5-2

2.5.2 Restrictions under the European WEEE Directive 2012/19/EU

Options and accessories from SEW-EURODRIVE may only be used in combination with products from SEW-EURODRIVE.

2.5.3 Lifting applications

To avoid danger of fatal injury due to falling hoists, observe the following points when using the product in lifting applications:

- Use mechanical protection devices.

Application in ELSM® control mode

When the inverter is operated in ELSM® control mode, using it in lifting applications and inclining tracks is not permitted.

2.5.4 Restrictions of use

The following applications are prohibited unless the device is explicitly designed for such use:

- Use in potentially explosive areas.
- Use in areas exposed to harmful oils, acids, gases, vapors, dust, and radiation.
- Operation in applications with impermissibly high mechanical vibration and shock loads in excess of the regulations stipulated in EN 61800-5-1.
- Use at an elevation of more than 3800 m above sea level.

In addition, observe the restrictions of use in the **product manual** > chapter "Technical data" > "General technical data" (→ 🗎 40).

31972098/EN – 8/2024

2.6 Transport

Inspect the shipment for damage as soon as you receive the delivery. Inform the shipping company immediately about any damage. If the product or the packaging is damaged, do not assemble, install, connect, or start up the product. If the packaging is damaged, the product itself may also be damaged.

Observe the following notes when transporting the device:

- Ensure that the product is not subject to mechanical impact.
- Only place the product lying on the heat sink during transport.
- Always use all attachment points if available. The attachment points are designed to carry only the mass of the product. Do not apply any additional loads.

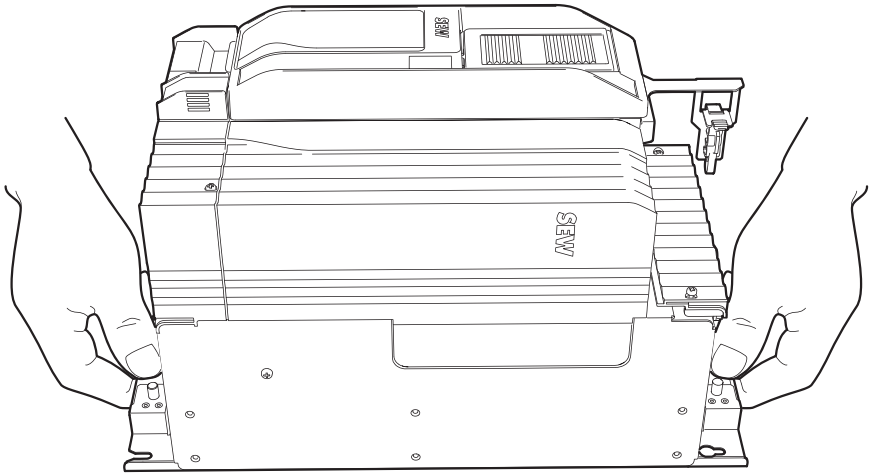
If necessary, use suitable, adequately dimensioned transport aids.

Observe the notes on the climatic conditions in accordance with chapter "Technical data" in the corresponding product manual.

2.6.1 Transport information - size 5

Observe the following information:

- Hold inverters of size 5 by the handling points provided on the rear panel of the housing.



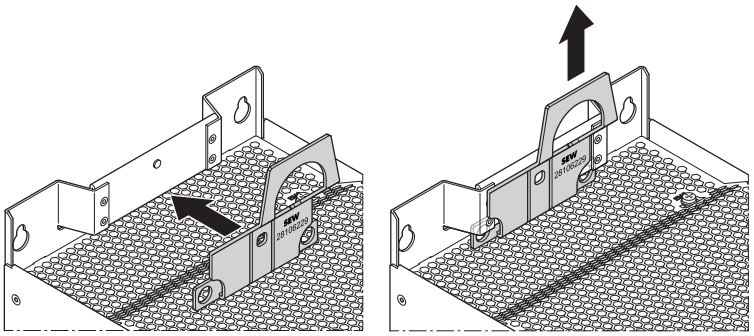
21435628299

31972098/EN – 8/2024

2.6.2 Transport information - size 6

Observe the following information:

- Hook in the lifting eye at the top of the housing.
- Attach the lifting eye to lifting devices using suitable slings.

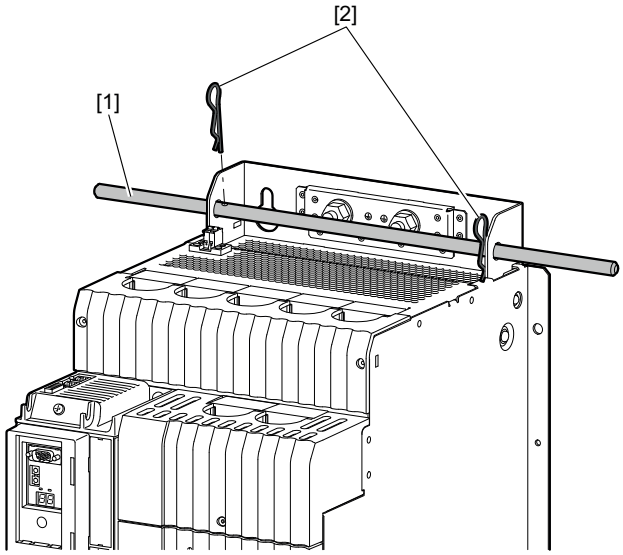


24550948491

2.6.3 Transport information - size 7

Observe the following information:

- Transport the inverter using the carrying bar [1] included in the scope of delivery.
- Secure the carrying bar against axial displacement using both split pins [2].

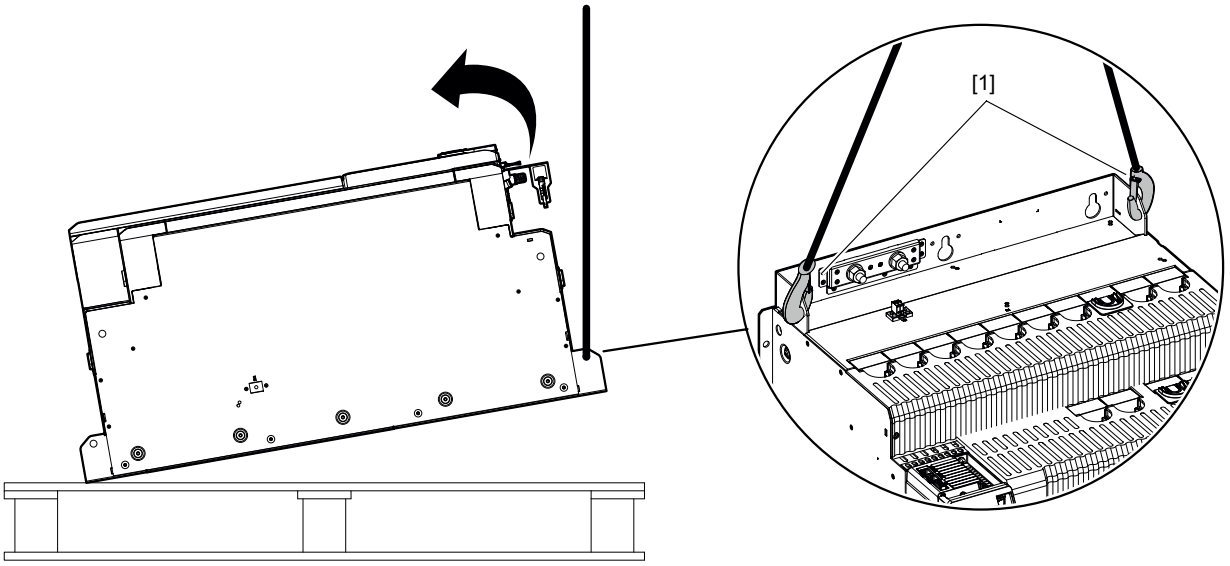


35809245451

2.6.4 Transport information - size 8

Observe the following information:

- Only transport size 8 inverters lying on their rear panel on the transport pallet.
- Only set up size 8 inverters from the transport pallet using a suitable lifting device. Use the recesses [1] provided on the housing for this purpose.
- Only place size 8 inverters on the transport pallet lying on their rear panel.



9007238288236555

2.7 Creating a safe working environment

Before you work on the product, ensure a safe working environment. Observe the following basic safety note:

2.7.1 Performing work on the product safely

Defective or damaged product

Never install defective or damaged products. Observe the following information to avoid injuries or damage:

- Before installation, check the product for external damage and replace a damaged product.

Hot surfaces

The surfaces of the product can become very hot during operation. Observe the following information to avoid burns:

- Let the product and its accessories cool down before touching it.
- Do not touch any surfaces of the product during operation, except for the control elements.
- Also observe the labels and hazard symbols on the product.

31972098/EN – 8/2024

Falling load

Observe the following information to avoid death or severe injury due to falling loads:

- Do not stand under the load.
- Secure the area where loads can fall down.
- Use personal protective equipment (such as helmet and safety shoes).
- Use a suitable lifting tool (chain hoist, forklift) and transport protection.

Rotating parts

When working on the product, there may be a risk of exposed rotating parts and uncontrolled movement of the components. Observe the following information to avoid body parts getting crushed or pulled in:

- Switch off the product before you start working on it.
- Observe all technical data of the product.
- Do not reach into the hazard zone.
- Follow the 5 safety rules in chapter: "Performing electrical work safely" (→ 🗎 17).

Sharp edges

Observe the following information to avoid cuts caused by sharp or non-deburred cutting edges:

- Wear safety gloves.

2.7.2 Performing electrical work safely

Observe the following information to perform electrical work safely:

Electrical work may only be performed by an electrically skilled person or an electronically instructed person under the supervision of an electrically skilled person.

The fact that the operation or display elements are no longer illuminated does not indicate that the product has been disconnected from the supply system and no longer carries any voltage.

Live parts

Always adhere to the 5 safety rules for all work on electrical components:

1. Disconnect.
2. Secure the device against a restart.
3. Check that no voltage is applied.
4. Ground and short-circuit.
5. Cover or isolate neighboring live parts.

Depending on the situation, it is possible to deviate from rules 4 and 5. Observe standard EN 50110-1.

31972098/EN – 8/2024

Dangerous voltage

When the system is switched on, dangerous voltages are present at all power connections as well as any cables and terminals that are connected. This is also the case even if the product is inhibited. Observe the following information to avoid the risk of electric shock:

- Do not touch any exposed live parts (e.g. male contacts, plug connectors, terminals).
- Secure all open live components with a touch guard.
- Before applying the supply voltage, make sure that all required covers are mounted.

Danger due to electric arc

An electric arc may occur when plug-in connections are disconnected or connected while voltage is applied (e.g. connection between drive and inverter). In order to avoid damaging electrical components, observe the following information:

- Do not disconnect power connections during operation.
- Do not connect power connections during operation.
- Ensure that the product is de-energized before disconnecting and connecting the plug-in connections.

Damage to property due to damaged or loose cables

To avoid damaging electrical components (e.g. cables and plug-in connections), observe the following information:

- Do not insert plug-in connections if cables are subjected to tensile stress.
- Do not kink cables when connecting plug-in connections.
- Replace loose or defective plug-in connections.
- Make sure that cables are not pinched or crushed.
- Do not run cables near or along a sharp edge.

Dangerous voltage due to charged capacitors

Voltage from charged capacitors can still be present in live components or power connections after disconnecting from the supply voltage. Observe the following information:

- Observe the following waiting period after disconnecting the supply voltage and before performing any electrical work: **10 minutes**.
- Ensure that the unit is de-energized.
- Also observe the labels and hazard symbols on the product.

31972098/EN – 8/2024

2.8 Installation/assembly

Ensure that the product is installed and cooled in accordance with the regulations in the documentation.

Protect the product from excessive mechanical strain. The product and its mounted components must not protrude into the path of persons or vehicles. Ensure that no components are deformed or no insulation spaces are modified, particularly during transportation. Electrical components must not be mechanically damaged or destroyed.

2.9 Protective separation

The product meets all requirements for protective separation of power and electronics connections in accordance with IEC 61800-5-1. The connected signal circuits must meet requirements according to SELV (**S**afety **E**xtra **L**ow **V**oltage) or PELV (**P**rotective **E**xtra **L**ow **V**oltage) to ensure protective separation. The installation must meet the requirements for protective separation.

In order to avoid exceeding the permitted contact voltages in SELV or PELV power circuits in the event of a fault, continuous equipotential bonding is required in the vicinity of these power circuits. If this is not possible, other preventive measures must be taken. These preventive measures are described in IEC 61800-5-1.

2.10 Electrical installation

Ensure that all of the required covers are correctly attached after the electrical installation.

Make sure that preventive measures and protection devices comply with the applicable regulations (e.g. EN 60204-1 or EN 61800-5-1).

2.10.1 Stationary application

The necessary preventive measure for the product is:

Type of energy transfer	Preventive measure
Direct power supply	Ground connection

2.10.2 Regenerative operation

The drive is operated as a generator due to the kinetic energy of the system/machine. Before opening the connection box, secure the output shaft against rotation.

31972098/EN – 8/2024

2.11 Startup/operation

Make sure the connection boxes are closed and screwed before connecting the supply voltage.

Depending on the degree of protection, products may have live, uninsulated, and sometimes moving or rotating parts as well as hot surfaces during operation.

Additional preventive measures may be required for applications with increased hazard potential. Be sure to check the effectiveness of the protection devices after every modification.

In the event of deviations from normal operation, switch off the product. Possible deviations are increased temperatures, noise, or vibration, for example. Determine the cause. Contact SEW-EURODRIVE if necessary.

Risk of burns due to arcing: Do not disconnect power connections during operation. Do not connect power connections during operation.

When the system is switched on, dangerous voltages are present on all voltage-controlled product parts as well as any cables and terminals that are connected. This also applies even when the product is inhibited and the motor is in an idle state. Do not touch the components during operation.

If you disconnect the product from the voltage supply, do not touch any live components or power connections because capacitors might still be charged. Observe the following minimum switch-off time:

10 minutes.

Observe the corresponding information signs on the product.

The fact that the operation or display elements are no longer illuminated does not indicate that the product has been disconnected from the supply system and no longer carries any voltage.

Mechanical blocking or internal protective functions of the product can cause a motor standstill. Removing the cause of this problem or performing a reset can result in the machine or the system re-starting on its own. First, disconnect the product from the supply system before you start troubleshooting.

Risk of burns: The surface temperature of the product can exceed 60 °C during operation. Do not touch the product during operation. Let the product cool down before touching it.

31972098/EN – 8/2024

3 Product description

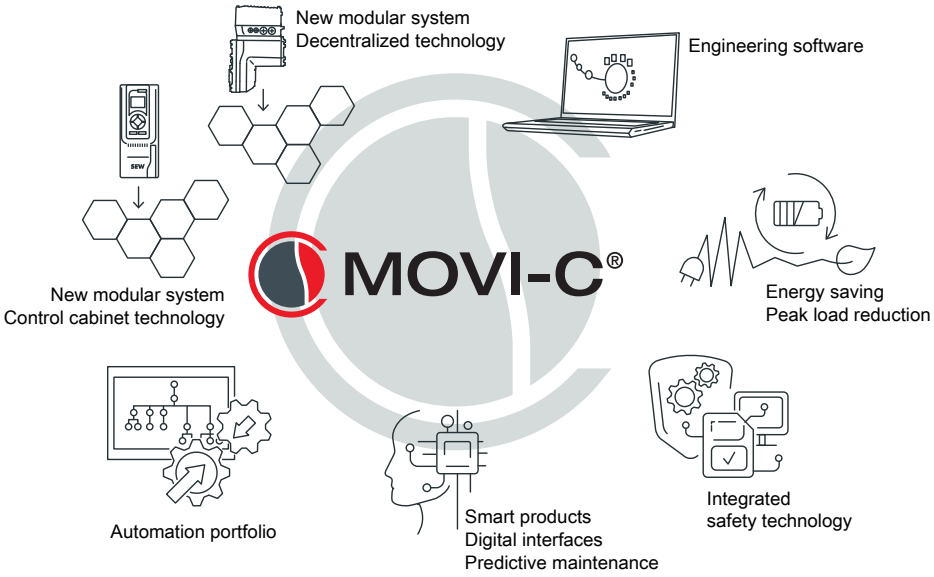
3.1 MOVI-C® modular automation system

MOVI-C® is the modular automation system that allows for the highest level of plant and machine automation. MOVI-C® comprises drive technology, Motion Control, control technology and visualization.

Modular, end-to-end, and scalable: The MOVI-C® modular automation system is your one-stop shop for every automation task. One manufacturer – one end-to-end solution: including services, hardware and software, from planning and startup to operation and servicing. SEW-EURODRIVE offers you maximum relief, future-proofing and the reassuring feeling of always having a contact person you can rely on.

3.1.1 Overview

MOVI-C® is a holistic concept consisting of the following building blocks:



40084650507

3.1.2 End-to-end

The MOVI-C® modular automation system represents a consistent and complete solution for automation tasks.

We understand an end-to-end solution to mean:

- Uniform operating concept
- Uniform control concept
- Use of accessories across various devices, e.g. keypads
- MOVIKIT® software modules across various devices

This end-to-end solution offers you the following advantages:

- Easy changeover between control cabinet technology and decentralized technology
- Fast and simple startup
- Low training complexity

31972098/EN – 8/2024

3.1.3 Our promise

SEW-EURODRIVE offers you 3 × 3 reasons to enter the new MOVI-C® automation world:

- **Simplicity**
  - THREE steps: Plan – Connect – Move
- **Future-proofing**
  - THREE promises: Customized solutions – Today – and Tomorrow
- **Consulting and service**
  - THREE success factors: Delivery capability – Consulting – Worldwide

3.2 MOVIDRIVE® system

3.2.1 Overview

MOVIDRIVE® system is the inverter for direct line connection, suited for various types of applications, ranging from open-loop speed control to servo drives with kinematic model.

The inverter comprises the following components:

- Inverter basic device
- Application level for using MOVIKIT® software modules of the Drive category
- Option cards for upgrading digital and analog inputs and outputs
- Option cards for functional safety in functionally different versions
- Option cards for connecting additional distance encoders
- Accessories for EMC-compliant installation
- Accessories for connecting and controlling motors and brakes
- Prefabricated motor and encoder cables

For use in harsh environments, the inverters can be supplied with painted PCBs. The coating of the printed circuit boards increases their resistance against environmental influences.

3.2.2 Options

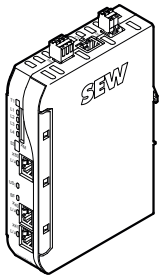
Options	Chapter
Input/output cards CIO21A, CID21A	"Description and technical data" (→ 🗎 52)
CES11A multi-encoder card	"Description and technical data" (→ 🗎 54)
Multi-encoder card with incremental encoder simulation CES12A	"Description and technical data" (→ 🗎 55)
Safety options CSS31A, CSS21A, CSB31A, CSB21A, CSA31A	"Description and technical data" (→ 🗎 57)

31972098/EN – 8/2024

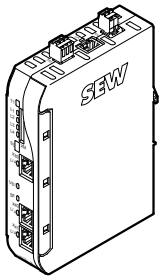
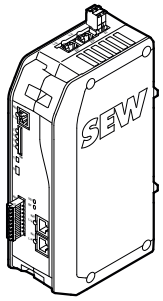
3.2.3 Accessories

Accessories	Chapter
Braking resistors BW.../BW...-T	"Description and technical data" (→ 🗎 78)
NF.. line filter	"Description and technical data" (→ 🗎 92)
ND.. line choke	"Description and technical data" (→ 🗎 94)
HF.. output filter	"Description and technical data" (→ 🗎 96)
HD.. output choke	"Description and technical data" (→ 🗎 98)
ZD.. DC link choke	"Description and technical data" (→ 🗎 100)
Prefabricated cables	"Description and technical data" (→ 🗎 263)
Module bus cable	"Overview and cable assignment" (→ 🗎 295)
System bus cable	"Overview and cable assignment" (→ 🗎 296)
Usable motor encoders	"Overview" (→ 🗎 126)

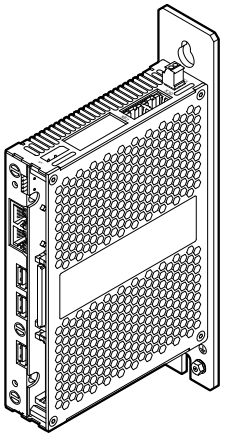
3.3 MOVI-C® CONTROLLER

MOVI-C® CONTROLLER	
MOVI-C® CONTROLLER UHX15A 	**Properties:** • DualCore ARM processor • Maximum of 3 connectable axes • EtherCAT®/SBus^{PLUS} system bus (maximum number of stations: 128) • Device connection via EtherNet/IP™, Modbus TCP, PROFINET IO • Safe PD routing – PROFIsafe: maximum 3 axes • Ethernet interface for engineering tasks and TCP/IP and UDP via IEC 61131-3 • Memory: SD memory card with 512 MB for quick change • Web visualization via IEC • Large selection of MOVIKIT® software modules for motion control Further information can be found in the following documents: • "MOVI-C® CONTROLLER UHX15A" manual • "MOVI-C® – Automation with MOVI-C® CONTROLLER" manual

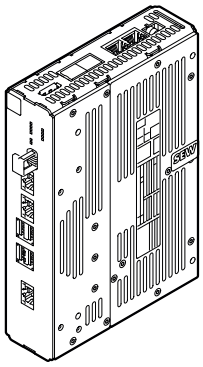
31972098/EN – 8/2024

MOVI-C® CONTROLLER	
MOVI-C® CONTROLLER UHX25A 	**Properties:** • DualCore ARM processor • 2 interpolating axes recommended • Up to 6 auxiliary axes recommended • EtherCAT®/SBus^{PLUS} system bus (maximum number of stations: 128) • Device connection via EtherNet/IP™, Modbus TCP, PROFINET IO • Safe PD routing – PROFIsafe: maximum 8 axes • Ethernet interface for engineering tasks and TCP/IP and UDP via IEC 61131-3 • Memory: SD memory card with 512 MB for quick change • Web visualization via IEC • Large selection of MOVIKIT® software modules for motion control Further information can be found in the following documents: • "UHX25A MOVI-C® CONTROLLER standard" manual • "MOVI-C® – Automation with MOVI-C® CONTROLLER" manual
MOVI-C® CONTROLLER UHX45A 	**Properties:** • DualCore ARM processor • Maximum of 8 connectable interpolating axes[1)] • Additional 8 connectable auxiliary axes[1)] • EtherCAT®/SBus^{PLUS} system bus (maximum number of stations: 128) • Device connection via EtherNet/IP™, Modbus TCP, PROFINET IO • Safe PD routing – PROFIsafe: maximum 8 axes • Ethernet interface for engineering tasks and TCP/IP and UDP via IEC 61131-3 • Memory: SD memory card with 512 MB for quick change • Web visualization via IEC • Large selection of MOVIKIT® software modules for motion control Further information can be found in the following documents: • "MOVI-C® CONTROLLER advanced UHX45A" manual • "MOVI-C® – Automation with MOVI-C® CONTROLLER" manual

31972098/EN – 8/2024

MOVI-C® CONTROLLER	
MOVI-C® CONTROLLER UHX65A 	**Properties:** • Intel Atom processor optionally with 1, 2 or 4 cores • Connected by Hypervisor technology, a 2nd Windows 10 IoT operating system (for the 4-core variant) with corresponding Ethernet interface (optional) • Ethernet interface for engineering tasks or TCP/IP and UDP via IEC 61131-3 • Maximum of 16 connectable interpolating axes[1)] • Additional 16 connectable auxiliary axes[1)] • System bus EtherCAT®/SBus^{PLUS} (maximum number of stations: 256) • Device connection via EtherNet/IP™, Modbus TCP, PROFINET IO (optional) • Connection as EtherNet/IP™ scanner or PROFINET IO controller (optional) • Safe PD routing – PROFIsafe: maximum 24 axes • Memory: CFast memory card with 2 GB for quick change • Visualization via Windows or web visualization via IEC • Large selection of MOVIKIT® software modules for motion control Further information can be found in the following documents: • "MOVI-C® CONTROLLER progressive UHX65A" manual • "MOVI-C® – Automation with MOVI-C® CONTROLLER" manual

31972098/EN – 8/2024

MOVI-C® CONTROLLER	
MOVI-C® CONTROLLER UHX86A 	**Features:** • Processor selection depending on the application: – Intel Core™ i3 or Celeron, 25 W, passively cooled – Intel Core™ i3 or i7, 45 W, actively cooled • Second operating system connected by hypervisor technology with 2 corresponding Ethernet interfaces (optional) • Ethernet interface for engineering tasks or TCP/IP and UDP via IEC 61131-3 • Maximum of 32 connectable interpolating axes[1] (Celeron processor) • Additional 32 connectable auxiliary axes[1] (Celeron processor) • System bus EtherCAT®/SBus^{PLUS} (maximum number of stations: 256) • Device connection via EtherNet/IP™, Modbus TCP, PROFINET IO (optional) • Connection as EtherNet/IP™ scanner or PROFINET IO controller (optional) • Safe PD routing – PROFIsafe: maximum 24 axes • Memory: CFast memory card with 2 GB for quick change • Memory for Windows 10 IoT: SSD card with 128/256/480 GB (optional) • Visualization via Windows or web visualization via IEC • Large selection of MOVIKIT® software modules for motion control • Integrated Safety over EtherCAT® controller S05A (optional) Further information can be found in the following documents: • "MOVI-C® CONTROLLER UHX86A" manual (in preparation) • "MOVI-C® – Automation with MOVI-C® CONTROLLER" manual

1) Roughly recommended guide value for the "parameterizing instead of programming" approach: Number of axes subject to the size of the user program in MOVIRUN® flexible and not strictly limited if the minimum task cycle time is not specified.

31972098/EN – 8/2024

3.4 Technologies

Various technologies are used for inverters in the MOVI-C® modular automation system.

3.4.1 MOVI-C® CONTROLLER

The control technology is based on a shared platform for control cabinet and decentralized controllers with the same functions and an identical variety of interfaces. Whether they are used for motion control, automation control or cyber-physical control tasks, MOVI-C® CONTROLLER units can be linked to the higher-level controller of a machine cell or system using classic PROFINET, EtherNet/IP™ or Modbus TCP fieldbus systems. Alternatively, they can be used as stand-alone controllers for machines or lines. MOVI-C® CONTROLLERs then take over smooth communication with the lower-level devices – e.g., MOVIDRIVE® inverters – via EtherCAT®/SBus^{PLUS} and their clock-synchronous connection to the motion/application.

The performance class of a MOVI-C® CONTROLLER depends on the number of inverters and the number of synchronous axes and auxiliary axes that are required for the motion and need to be configured. Four performance classes are available for selection. All versions have a compact design, meaning they can fit into even small machine control cabinets.

The added value that really counts in terms of reducing complexity comes from the integrated software of the centralized and decentralized controllers – parameterizing rather than programming. This software gives you, as a user, more freedom to customize parameters while reducing your outlay on programming. Our control technology and software also give you the option of doing the programming yourself. If you want to write your own programs for your application, e.g., for PLC functions or certain controls, our software platform offers you the corresponding options here. This allows you to better differentiate yourself from your competitors.

3.4.2 Functional safety

Safety technology is a fully integral part of the MOVI-C® modular automation system. Safe inputs and outputs, safe stop functions, safe motion functions, safe position functions, safe braking, safe communication – from a single source, in one tool, and with one contact person from planning right through to acceptance.

3.4.3 Digital motor integration

The MOVILINK® DDI digital interface transmits performance, brake and diagnostic data between the inverter and the motor. Single-cable technology forms the basis for the energy supply and seamless data exchange.

No matter how extensive your system is, you only need one hybrid cable to supply the motor with power and establish communication with the frequency inverter. This saves time and money during installation, because the exceptionally robust and high-performance design of the cable with coaxial signal cable makes it possible to implement compact installations with ease.

This motor integration has the following characteristics:

- Digital single-cable technology for synchronous motors, asynchronous motors, linear motors as well as decentralized drive technology
- Hybrid single-cable technology with uniform plug connector for power supply and data transfer
- Cable lengths up to 200 m

31972098/EN – 8/2024

- Exceptionally robust, high-performance design with coaxial signal cable – enables extremely compact installation and a high degree of protection
- Fully integrated digital motor encoder in various designs
- Fully integrated brake control with wear measuring function
- The signal cable is linked to the inverter using a series-standard coaxial connector
- One channel: quick startup thanks to the electronic nameplate and detailed operating status display at all times, indicating data such as motor power, motor temperature monitoring, brake supply, brake wear, encoder information and other sensors

3.4.4 Condition monitoring/asset management

When it comes to preserving or even increasing a system's value, the top priorities are excellent system availability and improved productivity. Digitalization can help reduce manual work and optimize the use of resources. Our DriveRadar® IoT Suite keeps working for you 24/7. The digitalized condition monitoring system automatically monitors your system and drives, so you have reliable, detailed information about the state of your components at your fingertips at all times. If there are any relevant changes in condition, the system will notify you and provide you with initial recommendations for action, so you can take steps at an early stage and prevent downtime.

Early warning

Thanks to automated condition monitoring, you receive prompt notification of any critical changes to the condition of your system and drives and any abnormal operating behavior.

Recognize trends

Continuous monitoring and an intelligent clear display allow you to detect deviations and plan ahead.

Prevent downtimes

Thanks to greater transparency regarding the condition and operating behavior of your system and drives, you can vastly increase your level of protection against unplanned downtimes.

Operate efficiently

The forecasts calculated by the system mean you can plan service and maintenance activities preventively. What's more, you can control the length of your maintenance cycles as needed.

Save resources

You can make full and optimum use of your drive components' service life, thanks to the condition-based recommendations for action.

Capture components

In order to record components easily and completely, all components carry a product label (QR code according to IEC 61406) in addition to the nameplate. Use the QR code to access the Digital Services of SEW-EURODRIVE. Product-specific information and functions are available here. The main function of the product labels with QR codes and the Digital Services Cockpit is to provide quick access to Online Support when you are directly at a machine or system. The selection of functions is always the same: technical product data, documentation, spare parts, troubleshooting and contact. That's exactly what you need for your product right now.

31972098/EN – 8/2024

3.4.5 Free text on the nameplate

The system nameplate of the inverters in the MOVI-C® modular automation system can display text selected by the customer when ordering. This maximum 50-character text can be, for example, the company name or the purchase order number of the customer. This information text is saved to the inverter in two indices with 25 characters each and can be read out.

3.4.6 Security

The importance of protection concepts is growing in the course of increasing networking and thus external access. Operators of critical infrastructures must therefore comply with minimum IT security standards and protect their facilities against cyber attacks. In all relevant process steps, SEW-EURODRIVE applies methods to protect industrial systems in line with the IEC 62443-4-1:2018 international series of standards.

3.4.7 Tools

To support planning, ordering, delivery, startup, operation and maintenance through to shutdown, SEW-EURODRIVE offers tools for online operation or for installation on the on-site computer.

MOVISUITE®

The engineering software MOVISUITE® is the central module of the MOVI-C® modular automation system. This software allows for intuitive operation with modern operating concepts. MOVISUITE® can be downloaded free of charge from the SEW-EURODRIVE website.

The central functions of MOVISUITE® are:

- Network scan
- Device startup and parameterization
- Data storage and data management
- Scope and diagnostics
- Programming environment for MOVI-C® CONTROLLER
- Parameterization for functional safety
- Parameterization and diagnostics environment for software modules

SEW-Workbench

The SEW-Workbench is the central configuration software for drives, inverters and accessories from SEW-EURODRIVE. It can process any required configurations, from entering the application to gear unit, motor and inverter calculations. Optimization of the various axis cycles including accessory selection and error check of the entire drive system design are further features.

Online Support

On the SEW-EURODRIVE homepage, the Online Support section offers a wealth of product-related information on the following topics:

Engineering and selection

Drive selection, product configuration, motor-inverter characteristics, energy efficiency tools, Safety Configuration Library for easy planning of functionally safe concepts

31972098/EN – 8/2024

Inquiries and orders

Offers, quotations, purchase orders, overview of existing processes

Delivery and material flow

Order status, delivery notification, delivery time overview

Startup and maintenance

Spare parts, Pick-Up and Delivery Service, software license management, DriveRadar® IoT Suite

Data and documents

CAD data for products, product documentation, description files for communication systems, sample programs for PLCs, CAE data, e.g. EPLAN

3.5 Setpoint processing

3.5.1 MOVIKIT® Drive

MOVIKIT® software modules are standardized control programs with a defined process data interface and a user-friendly configuration and diagnostics interface.

The "Drive" category includes MOVIKIT® software modules that provide single-axis functionalities and are operated directly on the inverter.

As a rule, the MOVIKIT® software modules are operated by a higher-level third-party controller via process data and cover a wide range of applications from speed-controlled applications, for example in materials handling technology, to positioning applications. No programming knowledge is required to use the MOVIKIT® software modules. There is guided startup and a user-friendly operating and diagnostics interface is available.

Properties:

- Wide range of functions
- User-friendly user interface
- Input of parameters required only for the application
- Guided parameterization instead of complicated programming
- No programming experience required
- Simple training, therefore quick project planning and startup
- All motions are controlled directly in the inverter

The inverter can be ordered with a specific application level. The use of different MOVIKIT® software modules in the "Drive" category is allocated to every application level.

Application level	MOVIKIT® "Drive" category software module
0	Standard delivery state: Enabling, e.g., for MOVIKIT® Velocity Drive, MOVIKIT® Torque Drive..
1	Enabling, e.g., for MOVIKIT® Positioning Drive, MOVIKIT® RapidCreepPositioning Drive..
2	Enabling for customer-specific MOVIKIT® software modules

31972098/EN – 8/2024

3.5.2 FCB concept

The FCB (function control block) concept describes the modular firmware design of inverters from the MOVI-C® modular automation system. This feature ensures that a wide range of drive functions can be selected or deselected quickly and easily using control words. All primary functions, i.e. functions that move or control the motor, are designed as individual FCBs that have to be selected to perform a specific task, e.g. positioning. You can switch between different FCBs at any time. Switching to another FCB takes place with a maximum delay of 0.5 ms. Different priorities are assigned to the FCBs. If an FCB with a higher priority than the currently active FCB is selected, the FCB with the higher priority is activated.

3.5.3 CiA402 profile

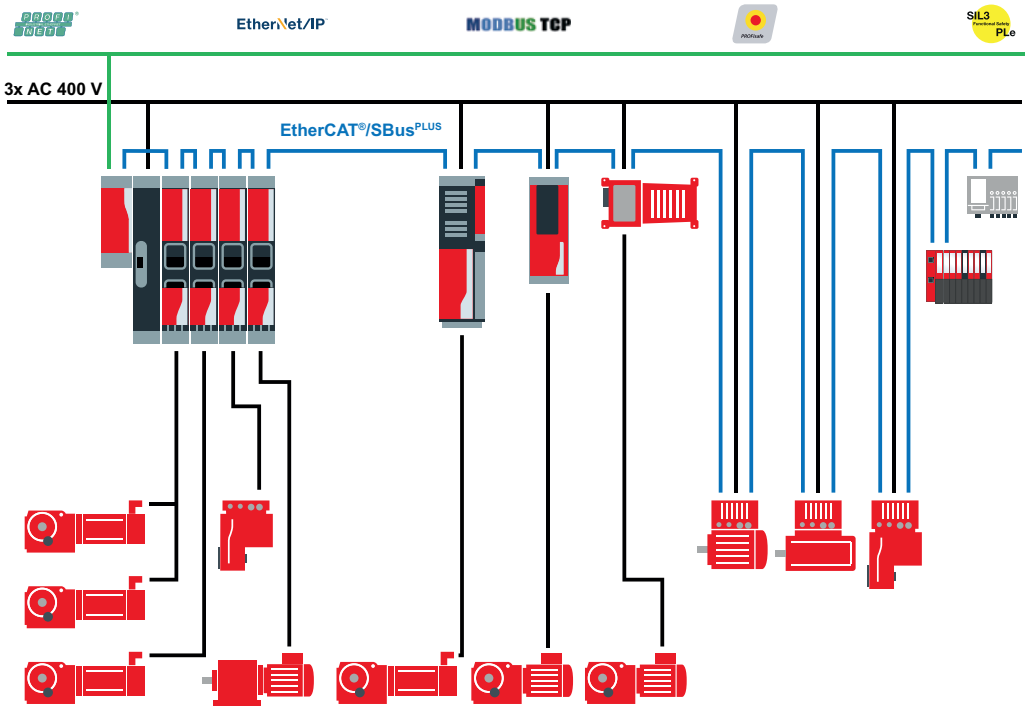
The CiA402 drive profile offers functions that are required for motion control. It standardizes the communication and behavior of different drives. The CiA402 drive profile is often used especially for direct control of the inverter from an external PLC with motion control functionality and EtherCAT® master. The CiA402 drive profile offers standardized functions such as cyclic synchronous torque (CST), cyclic synchronous velocity (CSV) or cyclic synchronous position (CSP).

31972098/EN – 8/2024

3.6 Control topologies

The inverters can be controlled in different ways depending on the requirements.

3.6.1 Motion control or module automation



18014434280935307

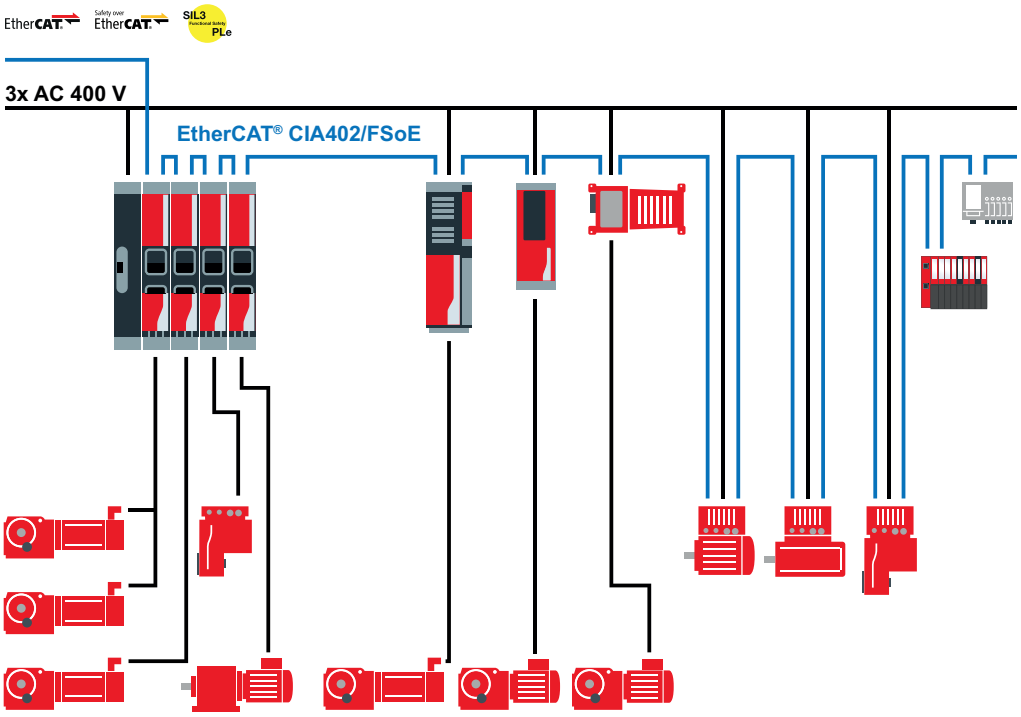
The control cabinet inverters of the MOVI-C® modular automation system are connected to the MOVI-C® CONTROLLER via EtherCAT®/SBus^{PLUS} with real-time capability.

The MOVI-C® CONTROLLER receives target values for single-axis motions or coordinated motions from the higher-level master via the fieldbus. The MOVI-C® CONTROLLER determines the setpoints for the connected inverters, thereby taking care of tasks such as phase-synchronous operation, electronic cam function and kinematics.

Predefined MOVIKIT® software modules are used to implement the motion control drive function quickly and reliably with the aid of graphic editors. Thanks to more than 50 kinematic models, a large number of mechanical configurations are already covered. New functions for kinematic models can be custom-made by SEW-EURODRIVE. Data is stored via a data exchange function on a memory card in the MOVI-C® CONTROLLER.

31972098/EN – 8/2024

3.6.2 Motion control with CiA402 profile



18014434280929675

The CiA402 drive profile offers functions that are required for motion control. It standardizes the communication and behavior of different drives. The CiA402 drive profile is often used especially for direct control of the inverter from an external PLC with motion control functionality and EtherCAT® master. The CiA402 drive profile offers standardized functions such as cyclic synchronous torque (CST), cyclic synchronous velocity (CSV) or cyclic synchronous position (CSP).

A design with CiA402 drive profile is available for inverters. This version is a device variant. If this version is used, the MOVI-C® CONTROLLER is not required. The functionality that can be generated by MOVIKIT® software modules is performed by the PLC in this case.

3.7 Motor control

3.7.1 Operable motors

Operable motors include:

- Asynchronous motors with and without encoder
- Synchronous motors with and without encoder

For further information, refer to chapter "Project planning of the device" (→ 🗎 113).

3.7.2 Control mode

The characteristics of the motor connected to the inverter are influenced by the control modes used.

U/f

U/f control is intended for easy controlled operation of asynchronous motors without encoder feedback. The procedure operates an asynchronous machine on a parameterizable voltage/frequency characteristic. The U/f control mode is suitable for applications with a limited speed setting range, where no dynamic step changes in load occur and where there are low requirements regarding the control characteristics.

VFC^{PLUS}

VFC^{PLUS} is a high-performance control mode that is able to operate asynchronous motors with very high torque dynamics with or without rotary encoder.

The control mode can be operated as speed or torque control. This control mode calculates all important state variables for controlling the motor by using a motor model. Typical applications for the VFC^{PLUS} control mode are speed-controlled asynchronous machines with high demands on the speed and torque stability.

CFC

The CFC control mode is a current-controlled control mode. The CFC control mode allows the operation of asynchronous and synchronous motors with maximum torque dynamics. The control mode requires information about the rotor angle and the motor speed. For this reason, an encoder feedback (motor encoder) is always necessary. The CFC control mode is suitable for drives with highly dynamic motion control.

ELSM®

The ELSM® control mode allows the operation of permanent-field synchronous motors without an encoder. This method is intended for applications in the field of horizontal materials handling technology or for pumps, fans or saws.

3.7.3 Motor protection

The inverters of the MOVI-C® modular automation system offer thermal motor protection with sensorless motor protection models or with temperature sensors in the motor.

For further information, refer to chapter "Thermal motor protection" (→ 🗎 122).

3.7.4 Encoder

The use of encoders on the motor can improve motor control:

- Position control
- Increased quality of torque and speed control

The inverters offer corresponding interfaces for the evaluation of analog and digital encoder signals.

3.7.5 Energy-saving function

The inverters of the MOVI-C® modular automation system offer various functions for saving energy:

- Application-specific speed adjustment
- Standby mode
- Reduced motor losses due to innovative control modes (flux optimization)
- Utilization of braking energy through energy recovery

31972098/EN – 8/2024

3.7.6 Group drives

The inverters of the MOVI-C® modular automation system enable parallel connection and operation of several motors with identical speed.

3.8 Technology functions

The basic functions of the inverters can be adapted to the application via the parameter settings. Technology functions can be used to extend the basic functions.

3.8.1 Touchprobe

The "touchprobe" function can be used to record process values in a controlled manner when a specific switching event occurs, such as an edge change during a zero pulse of the encoder or at a digital input. For example, a light barrier signal can record the actual position of a distance encoder. The inverter passes this value on to a higher-level controller.

3.8.2 Cam switch

The "cam switch" function simulates a mechanical cam switch. A cam switch can be used to control actuators or machine sequences during a motion sequence. A cam switch consists of several cam tracks. Each cam track is assigned a binary switching signal. A cam track is divided into cam windows. A cam window is a value range within which the switching signal of the cam track assumes a certain, defined value. A total of 16 cam windows can be defined for these inverters, each of which can be assigned to 4 cam tracks. Each cam track generates a binary switching signal that is set as soon as the actual position is within one of the assigned cam windows. The cam tracks are processed with a cycle time of 500 µs. The switching signal can be output at a digital output or on a process data bit.

3.8.3 Counter function

The counter function counts edge changes at a digital input of the inverter. By setting parameters, you can define which edges are counted in which direction. The counter increases or decreases the value by 1 with each edge change. The counter value is stored in volatile memory. The counter is reset to 0 after the inverter is switched off and on again.

3.8.4 PID controller

The PID controller acts as an independent controller that calculates a control difference on the basis of a setpoint and actual value, and compensates for it. You can use the PID controller for temperature control, pressure control or other applications, for example. The PID controller can be switched on and off.

31972098/EN – 8/2024

4 Technical data

4.1 Markings

4.1.1 Basic device

Mark	Definition
CE	The CE marking indicates compliance with the following European directives: • Low Voltage Directive 2014/35/EU[1)] • EMC Directive 2014/30/EU • Machinery Directive 2006/42/EC • Directive 2011/65/EU for limiting the use of certain hazardous substances in electrical and electronic equipment • Ecodesign Regulation 2019/1781
	The waste disposal of this product is performed in compliance with the WEEE Directive 2012/19/EU.
EAC	The EAC mark indicates compliance with the requirements of the technical regulations of the Customs Union (Eurasian Economic Union), Armenia, Belarus, Kazakhstan, Kyrgyzstan, and Russia.
	The RCM mark indicates compliance with the technical regulations of the Australian Communications and Media Authority (ACMA).
	The China RoHS mark indicates compliance with the directive SJ/ T 11364-2014 regarding the restriction of use of certain hazardous substances in electrical and electronic equipment and its packaging.
	The NM mark states compliance with the following Moroccan directives[2)]: • Low Voltage Directive no. 2573-14 (July 16, 2015) • EMC Directive N° 2574-14 (July 16, 2015)
	The UA.TR mark declares conformity with the technical regulations of Ukraine.
	The KC mark declares compliance with §3 of Article 58-2 for the Korean Radio Wave Act.
UKCA	The UKCA mark indicates compliance with British directives (see UK declaration of conformity or UK declaration of incorporation).
cULus LISTED	The UL and cUL mark indicates UL approval. cUL is equally eligible for approval by the CSA.

1) For products with functional safety, the requirements from the Low Voltage Directive are fulfilled by the Machinery Directive.
2) The selectable approvals UKCA (Great Britain) and NM (Morocco) are mutually exclusive.

31972098/EN – 8/2024

4.1.2 Accessories

BW.. braking resistors

Mark	Definition
CE	The CE mark states compliance with the following European directives: • Low Voltage Directive 2014/35/EU • Directive 2011/65/EU for limiting the use of certain hazardous substances in electrical and electronic equipment
	The waste disposal of this product is performed in compliance with the WEEE Directive 2012/19/EU.
25 50 e	The China RoHS mark declares compliance with the Directive SJ/T 11364-2014 regarding the restriction of use of certain hazardous substances in electrical and electronic equipment and its packaging.
UK CA	The UKCA mark states the compliance with the following British guidelines: • Low Voltage Directive S. I. 2016/1101 • Directive S. I. 2012/3032 for limiting the use of certain hazardous substances in electrical and electronic equipment
c UR us	The cUR mark states the UL approval for this component.

NF.. line filters

Mark	Definition
CE	The CE mark states compliance with the following European directives: • Low Voltage Directive 2014/35/EU • Directive 2011/65/EU for limiting the use of certain hazardous substances in electrical and electronic equipment
	The waste disposal of this product is performed in compliance with the WEEE Directive 2012/19/EU.
e	The China RoHS mark declares compliance with the directive SJ/T 11364-2014 regarding the restriction of use of certain hazardous substances in electrical and electronic equipment and its packaging.
UK CA	The UKCA mark states the compliance with the following British guidelines: • Low Voltage Directive S. I. 2016/1101 • Directive S. I. 2012/3032 for limiting the use of certain hazardous substances in electrical and electronic equipment
c UL us LISTED	The UL and cUL mark indicates UL approval. cUL is equally eligible for approval by the CSA.

ND.. line chokes

Mark	Definition
CE	The CE mark states compliance with the following European directives: • Low Voltage Directive 2014/35/EU • Directive 2011/65/EU for limiting the use of certain hazardous substances in electrical and electronic equipment
	The waste disposal of this product is performed in compliance with the WEEE Directive 2012/19/EU.
	The China RoHS mark declares compliance with the directive SJ/T 11364-2014 regarding the restriction of use of certain hazardous substances in electrical and electronic equipment and its packaging.
UKCA	The UKCA mark states the compliance with the following British guidelines: • Low Voltage Directive S. I. 2016/1101 • Directive S. I. 2012/3032 for limiting the use of certain hazardous substances in electrical and electronic equipment
c US	The cUR mark states the UL approval for this component.

HF.. output filters

Mark	Definition
CE	The CE mark states compliance with the following European directives: • Low Voltage Directive 2014/35/EU • Directive 2011/65/EU for limiting the use of certain hazardous substances in electrical and electronic equipment
	The waste disposal of this product is performed in compliance with the WEEE Directive 2012/19/EU.
	The China RoHS mark declares compliance with the directive SJ/T 11364-2014 regarding the restriction of use of certain hazardous substances in electrical and electronic equipment and its packaging.
UKCA	The UKCA mark states the compliance with the following British guidelines: • Low Voltage Directive S. I. 2016/1101 • Directive S. I. 2012/3032 for limiting the use of certain hazardous substances in electrical and electronic equipment
c UL us LISTED	The UL and cUL marks state UL approval. cUL is equivalent to CSA approval.

31972098/EN – 8/2024

HD.. output chokes

Mark	Definition
CE	The CE mark states compliance with the following European directives: • Low Voltage Directive 2014/35/EU • Directive 2011/65/EU for limiting the use of certain hazardous substances in electrical and electronic equipment
	The waste disposal of this product is performed in compliance with the WEEE Directive 2012/19/EU.
	The China RoHS mark declares compliance with the directive SJ/T 11364-2014 regarding the restriction of use of certain hazardous substances in electrical and electronic equipment and its packaging.
UKCA	The UKCA mark states the compliance with the following British guidelines: • Low Voltage Directive S. I. 2016/1101 • Directive S. I. 2012/3032 for limiting the use of certain hazardous substances in electrical and electronic equipment
c UL us LISTED	The UL and cUL marks state UL approval. cUL is equivalent to CSA approval.

ZD.. DC link chokes

Mark	Definition
CE	The CE mark states compliance with the following European directives: • Low Voltage Directive 2014/35/EU • Directive 2011/65/EU for limiting the use of certain hazardous substances in electrical and electronic equipment
	The waste disposal of this product is performed in compliance with the WEEE Directive 2012/19/EU.
	The China RoHS mark declares compliance with the directive SJ/T 11364-2014 regarding the restriction of use of certain hazardous substances in electrical and electronic equipment and its packaging.
UKCA	The UKCA mark states the compliance with the following British guidelines: • Low Voltage Directive S. I. 2016/1101 • Directive S. I. 2012/3032 for limiting the use of certain hazardous substances in electrical and electronic equipment
c UR us	The cUR mark states the UL approval for this component.

4.2 General technical data

Interference immunity	meets EN 61800-3; 2. Environment

Interference emission	Limit value class C2 according to EN 61800-3. From size 4, a line filter is required for limit class C2. The interference suppression level can be improved using appropriate measures. For further information, refer to chapter "EMC-compliant installation according to EN 61800-3" (→ 🗎 146).
Ambient temperature ϑ_{amb}	0 – 40 °C without derating 40 – 60 °C with derating[1)] For further information, refer to chapter "Project planning" > "Selection of an inverter" > "Power reduction factors" (→ 🗎 136) in the product manual.
Type of cooling	Increased air cooling due to an installed, temperature-controlled fan
Short-circuit current	The uninfluenced short-circuit current according to EN 61800-5-1 is 65 kA.
Degree of protection	Sizes 1 – 4: IP20 in accordance with EN 60529 From size 5: IP10 in accordance with EN 60529 (IP20 optional)
Pollution class	2 in accordance with IEC 60664-1
Overvoltage category	III in accordance with IEC 60664-1
Installation altitude above sea level:	No restrictions apply to altitudes ≤ 1000 m. The following restrictions apply to altitudes > 1000 m: • From 1000 m to max. 3800 m: I_N reduction by 1% per 100 m • From 2000 m to max. 3800 m: To maintain protective separation and the air gaps and creepage distances according to EN 61800-5-1, an overvoltage protection device must be connected upstream to reduce the overvoltages from category III to category II.

1) When using a CS..A safety option, the ambient temperature is limited to a maximum of 55 °C.

4.3 Environmental conditions

4.3.1 Climatic conditions

Extended storage	Weatherproof IEC 60721-3-1; class 1K21, non-condensing, no condensation Deviating from the standard: Temperature -25 °C to +70 °C
Transport	Weatherproof IEC 60721-3-2; class 2K11, non-condensing, no condensation Deviating from the standard: Temperature -25 °C to +70 °C
Operation	Stationary use, weatherproof IEC 60721-3-3; class 3K22, non-condensing, no condensation Deviating from the standard: Temperature 0 °C to +40 °C

31972098/EN – 8/2024

4.3.2 Special climatic conditions

Extended storage	Weatherproof IEC 60721-3-1 class 1Z1
Operation	Stationary use, weatherproof IEC 60721-3-3 class 3Z1

4.3.3 Biological conditions

Extended storage	Weatherproof IEC 60721-3-1 class 1B1
Transport	Weatherproof IEC 60721-3-2 class 2B1
Operation	Stationary use, weatherproof IEC 60721-3-3 class 3B1

4.3.4 Chemically active substances

Extended storage	Weatherproof IEC 60721-3-1 class 1C2 Deviating from the standard: no corrosive gases, no salt mist
Transport	Weatherproof IEC 60721-3-2 class 2C2, no sea water Deviating from the standard: no corrosive gases, no salt mist
Operation	Stationary use, weatherproof ISO 9223 class C3 Deviating from the standard: no corrosive gases, no salt mist

4.3.5 Mechanically active substances

Extended storage	Weatherproof IEC 60721-3-1 class 1S10, no conductive dust
Transport	Weatherproof IEC 60721-3-2 class 2S1, no conductive dust
Operation	Stationary use, weatherproof IEC 60721-3-3 class 3S5, no conductive dust

4.3.6 Mechanical requirements

The specifications are characteristic values for the device test. The specifications are based on the test characteristic values according to IEC 60721-3-3 and correspond to class 3M5 according to EN 60721-3-3:1995.

The tests carried out in this context are time-limited vibration cycles.

31972098/EN – 8/2024

Vibration (sinusoidal)	2 – 200 Hz: 1 g
Vibration (noise)	10 – 200 Hz: 0.3 m^2/s^3 200 – 500 Hz: 0.1 m^2/s^3 Corresponds to approx. 0.95 g_{rms} (g_{rms} = r.m.s. acceleration value)
Shocks (half sine)	10 g at 11 ms shock duration

31972098/EN – 8/2024

4.4 Technical data of the MDX9.A.. basic device 3 × AC 380 – 500 V

4.4.1 Sizes 1 – 2

Input

	Unit	MDX9.A-....-5.3-4..						
Size		1				2		
Type		0020	0025	0032	0040	0055	0070	0095
Nominal line voltage (according to EN 50160) V_{line}	V	3 × AC 380 – 500						
Nominal current AC I_N	A	1.8	2.25	2.88	3.6	4.95	6.3	8.55
Line frequency f_{line}	Hz	50 – 60 ±5%						
Controlled rectifier	–	No						
Connection contacts X1	–	"Plug connector " (→ 🖹 351)						

Output

	Unit	MDX9.A-....-5.3-4..						
Size		1				2		
Type		0020	0025	0032	0040	0055	0070	0095
Output voltage U_{out}	V	0 – V_{line} [1)]						
Motor power ASM P_{Mot}	kW	0.55	0.75	1.1	1.5	2.2	3	4
Nominal output current I_N at the smallest possible PWM frequency	A	2	2.5	3.2	4	5.5	7	9.5
Overload capacity	–	200% I_N: max. 3 s at f_{PWM} = 4 kHz						
Continuous output current at f = 0 Hz	–	100% × I_N at f_{PWM} = 4 kHz						
Apparent output power S_N	kVA	1.4	1.7	2.2	2.8	3.8	4.8	6.6
Nominal DC link voltage V_{DCL_nom}	V	DC 560 at V_{line} = 400 V						
Maximum DC link voltage U_{DCL_max}	V	DC 980						
PWM frequency f_{PWM}	kHz	4, 8, 16 (adjustable)						
Maximum output frequency f_{max}	Hz	599 See chapter "Characteristics of the control modes" (→ 🖹 118)						
Connection contacts X2	–	"Plug connector " (→ 🖹 351)						

1) In inverter operation, it is technically impossible to provide the full line voltage (with direct power supply) at the output. The output voltage is generated from the DC link circuit and depends, among other things, on the level of its voltage, the control mode, and the operating point. Typically, the maximum output voltage in motor operation is approx. 8% below the line voltage.

Brake chopper

	Unit	MDX9.A-....-5.3-4..						
Size		1				2		
Type		0020	0025	0032	0040	0055	0070	0095
Minimum braking resistance value R_{BR_min}	Ω	90				42		
Brake chopper continuous power	kW	1.4	1.7	2.2	2.8	3.8	4.8	6.6
Brake chopper peak power	kW	200% × apparent output power S_N						
Connection contacts X2	–	"Plug connector " (→ 🖹 351)						

31972098/EN – 8/2024

General

	Unit	MDX9.A-....-5.3-4..						
Size		1				2		
Type		**0020**	**0025**	**0032**	**0040**	**0055**	**0070**	**0095**
Power section nominal power loss[1]	W	16	20	27	34	45	58	83
Power consumption 24 V	W	20						
Interference suppression	–	EMC filter limit value category C2 according to EN 61800-3						
PE connection	–	M4 screw						
Permitted number of times power may be switched on/off per minute	min^{-1}	1						
Minimum switch-off time for power off	s	10						
Mass	kg	4.1				4.4		

1) To calculate the thermal power loss, add the values of "24 V power consumption" and "Nominal power loss of the power section".

4.4.2 Sizes 3 – 5

Input

	Unit	MDX9.A-....-5.3-4..						
Size		3		4		5		
Type		**0125**	**0160**	**0240**	**0320**	**0460**	**0620**	**0750**
Nominal line voltage (in accordance with EN 50160) V_{line}	V	3 × AC 380 – 500						
Nominal current AC I_N	A	11.3	14.4	21.6	28.8	41.4	55.8	67.5
Line frequency f_{line}	Hz	50 – 60 ±5%						
Controlled rectifier	–	No		Yes				
Connection contacts X1	–	"Plug connector " (→ 🖹 351)				M8 bolt		

Output

	Unit	MDX9.A-....-5.3-4..						
Size		3		4		5		
Type		**0125**	**0160**	**0240**	**0320**	**0460**	**0620**	**0750**
Output voltage U_{out}	V	0 – V_{line}[1]						
Motor power ASM P_{Mot}	kW	5.5	7.5	11	15	22	30	37
Nominal output current I_N at the smallest possible PWM frequency	A	12.5	16	24	32	46	62	75
Overload capacity	–	200% I_N: max. 3 s at f_{PWM} = 4 kHz						
Continuous output current at f = 0 Hz	–	100% × I_N at f_{PWM} = 4 kHz						
Apparent output power S_N	kVA	8.7	11.1	16.6	22.2	31.9	43	52
Nominal DC link voltage $V_{DCL\ nom}$	V	DC 560 at V_{line} = 400 V						
Maximum DC link voltage $U_{DCL\ max}$	V	DC 980						
PWM frequency f_{PWM}	kHz	4, 8, 16 (adjustable)						
Maximum output frequency f_{max}	Hz	599 See chapter "Characteristics of the control modes" (→ 🖹 118)						
Connection contacts X2	–	"Plug connector " (→ 🖹 351)				M8 bolt		

1) In inverter operation, it is technically impossible to provide the full line voltage (with direct power supply) at the output. The output voltage is generated from the DC link circuit and depends, among other things, on the level of its voltage, the control mode, and the operating point. Typically, the maximum output voltage in motor operation is approx. 8% below the line voltage.

31972098/EN – 8/2024

Brake chopper

	Unit	MDX9.A-....-5.3-4..						
Size		**3**		**4**		**5**		
Type		**0125**	**0160**	**0240**	**0320**	**0460**	**0620**	**0750**
Minimum braking resistance value R_{BR_min}	Ω	24		13		9	5.4	
Brake chopper continuous power	kW	8.7	11.1	16.6	22.2	31.9	43	52
Brake chopper peak power	–	200% × apparent output power S_N						
Connection contacts X2	–	"Plug connector " (→ 🗎 351)				M8 bolt		

General

	Unit	MDX9.A-....-5.3-4..						
Size		**3**		**4**		**5**		
Type		**0125**	**0160**	**0240**	**0320**	**0460**	**0620**	**0750**
Power section nominal power loss[1)]	W	112	147	202	282	419	600	760
Power consumption 24 V	W	20		30		15		
Interference suppression	–	EMC filter limit value category C2 according to EN 61800-3		Basic interference suppression integrated				
PE connection	–	M4 screw and M6 bolt		M6 bolt		M8 bolt		
Permitted number of times power may be switched on/off per minute	min^{-1}	1						
Minimum switch-off time for power off	s	10						
Mass	kg	6		6.6		12.7		

1) To calculate the thermal power loss, add the values of "24 V power consumption" and "Nominal power loss of the power section".

4.4.3 Sizes 6 – 7

Input

	Unit	MDX91A-....-5.3-4..						
Size		**6**			**7**			
Type		**0910**	**1130**	**1490**	**1770**	**2200**	**2500**	**3000**
Nominal line voltage (in accordance with EN 50160) V_{line}	–	380 – 500 V						
Nominal current AC I_N	A	81.9	102	134	159	198	225	270
Line frequency f_{line}	Hz	50 – 60 ±5%						
Controlled rectifier	–	Yes						
Connection contacts X1	–	M10 bolt			M12 bolt			

Output

	Unit	MDX91A-....-5.3-4..						
Size		**6**			**7**			
Type		**0910**	**1130**	**1490**	**1770**	**2200**	**2500**	**3000**
Output voltage U_{out}	V	0 – V_{line}[1)]						
Motor power ASM P_{Mot}	kW	45	55	75	90	110	132	160
Nominal output current I_N at the smallest possible PWM frequency	A	91	113	149	177	220	250	300
Overload capacity	–	200% I_N: max. 3 s at f_{PWM} = 4 kHz			200% I_N: max. 3 s at f_{PWM} = 4 kHz		200% I_N: max. 3 s at f_{PWM} = 2.5 kHz	150% I_N: max. 30 s at f_{PWM} = 2.5 kHz
Continuous output current at f = 0 Hz	–	100% × I_N at f_{PWM} = 4 kHz					100% × I_N at f_{PWM} = 2.5 kHz	
Apparent output power S_N	kVA	63	78	103	123	152	173	208

	Unit	MDX91A-....-5.3-4..						
Size		**6**			**7**			
Type		**0910**	**1130**	**1490**	**1770**	**2200**	**2500**	**3000**
Nominal DC link voltage V_{DCL_nom}	V	DC 560 at V_{line} = 400 V						
Maximum DC link voltage U_{DCL_max}	V	980						
PWM frequency f_{PWM}	kHz	4, 8, 16 (adjustable)			4, 8 (adjustable)		2.5, 4, 8 (adjustable)	
Maximum output frequency f_{max}	Hz	599 See chapter "Characteristics of the control modes" (→ 🗎 118)						
Connection contacts X2	–	M10 bolt			M12 bolt			

1) In inverter operation, it is technically impossible to provide the full line voltage (with direct power supply) at the output. The output voltage is generated from the DC link circuit and depends, among other things, on the level of its voltage, the control mode, and the operating point. Typically, the maximum output voltage in motor operation is approx. 8% below the line voltage.

Brake chopper

	Unit	MDX91A-....-5.3-4...						
Size		**6**			**7**			
Type		**0910**	**1130**	**1490**	**1770**	**2200**	**2500**	**3000**
Minimum braking resistance value R_{BR_min}	Ω	4.2	2.7		2			
Brake chopper continuous power	kW	63	78	103	123	152	173	208
Brake chopper peak power	kW	200% × apparent output power S_N						150% × apparent output power S_N
Connection contacts X2	–	M10 bolt			M12 bolt			

General

	Unit	MDX91A-....-5.3-4..						
Size		**6**			**7**			
Type		**0910**	**1130**	**1490**	**1770**	**2200**	**2500**	**3000**
Power section nominal power loss[1)]	W	931	968	1332	1725	2164	2131	2631
Power consumption 24 V	W	20						
Interference suppression	–	Basic interference suppression integrated						
PE connection	–	M10 bolt			M12 bolt			
Permitted number of times power may be switched on/off per minute	min^{-1}	1						
Minimum switch-off time for power off	s	10						
Mass	kg	25			84			

1) To calculate the thermal power loss, add the values of "24 V power consumption" and "Nominal power loss of the power section".

4.4.4 Size 8

Input

	Unit	MDX91A-....-5.3-4..		
Size		**8**		
Type		**3800**	**4700**	**5880**
Nominal line voltage (in accordance with EN 50160) V_{line}	V	380 – 500 V		
Nominal current AC I_N	A	342	423	529
Line frequency f_{line}	Hz	50 – 60 ±5%		
Controlled rectifier	–	Yes		
Connection contacts X1	–	M12, each terminal is available twice.		

31972098/EN – 8/2024

Output

	Unit	MDX91A-....-5.3-4..		
Size		8		
Type		**3800**	**4700**	**5880**
Output voltage U_{out}	V	0 – V_{line} [1]		
Motor power ASM P_{Mot}	kW	200	250	315
Nominal output current I_N at the smallest possible PWM frequency	A	380	470	588
Overload capacity	–	150% I_N max. 30 s at f_{PWM} = 2.5 kHz		
Continuous output current at f = 0 Hz	–	100% × I_N at f_{PWM} = 2.5 kHz		
Apparent output power S_N	kVA	264	326	408
Nominal DC link voltage V_{DCL_nom}	V	DC 560		
Maximum DC link voltage U_{DCL_max}	V	DC 980		
PWM frequency f_{PWM}	kHz	2.5, 4 (adjustable)		
Maximum output frequency f_{max}	Hz	599 See chapter "Characteristics of the control modes" (→ 🗎 118)		
Connection contacts X2	–	M12, each terminal is available twice.		

1) In inverter operation, it is technically impossible to provide the full line voltage (with direct power supply) at the output. The output voltage is generated from the DC link circuit and depends, among other things, on the level of its voltage, the control mode, and the operating point. Typically, the maximum output voltage in motor operation is approx. 8% below the line voltage.

Brake chopper

	Unit	MDX91A-....-5.3-4..		
Size		8		
Type		**3800**	**4700**	**5880**
Minimum braking resistance value R_{BR_min}	Ω	0.9		
Brake chopper continuous power	kW	263	326	407
Brake chopper peak power		150% × apparent output power S_N		
Connection contacts X2		M12, each terminal is available twice.		

General

	Unit	MDX91A-....-5.3-4..		
Size		8		
Type		**3800**	**4700**	**5880**
Power section nominal power loss[1]	W	2939	3780	4983
Power consumption 24 V	W	25		
Interference suppression	–	Basic interference suppression integrated		
PE connection	–	M12 bolt		
Permitted number of times power may be switched on/off per minute	min^{-1}	1		
Minimum switch-off time for power off	s	10		
Mass	kg	148		

1) To calculate the thermal power loss, add the values of "24 V power consumption" and "Nominal power loss of the power section".

31972098/EN – 8/2024

4.5 Technical data of the MDX9.A.. basic device 3 × AC 200 – 240 V

4.5.1 Sizes 2 – 3

Input

	Unit	MDX9.A-....-2.3-4..		
Size		**2**		**3**
Type		**0070**	**0093**	**0140**
Nominal line voltage (in accordance with EN 50160) V_{line}	V	3 × AC 200 – 240		
Nominal current AC I_N	A	6.3	8.4	12.6
Line frequency f_{line}	Hz	50 – 60 ±5%		
Controlled rectifier	–	No		
Connection contacts X1	–	"Plug connector " (→ 🗎 351)		

Output

	Unit	MDX9.A-....-2.3-4..		
Size		**2**		**3**
Type		**0070**	**0093**	**0140**
Output voltage U_{out}	V	0 – V_{line} [1)]		
Motor power ASM P_{Mot}	kW	1.5	2.2	3.7
Nominal output current I_N at the smallest possible PWM frequency	A	7	9.3	14
Overload capacity	–	200% I_N: max. 3 s at f_{PWM} = 4 kHz		
Continuous output current at f = 0 Hz	–	100% × I_N at f_{PWM} = 4 kHz		
Apparent output power S_N	kVA	2.8	3.7	5.6
Nominal DC link voltage V_{DCL_nom}	V	DC 325 at V_{line} = 230 V		
Maximum DC link voltage U_{DCL_max}	V	DC 650		
PWM frequency f_{PWM}	kHz	4, 8, 16 (adjustable)		
Maximum output frequency f_{max}	Hz	599 See chapter "Characteristics of the control modes" (→ 🗎 118)		
Connection contacts X2	–	"Plug connector " (→ 🗎 351)		

1) In inverter operation, it is technically impossible to provide the full line voltage (with direct power supply) at the output. The output voltage is generated from the DC link circuit and depends, among other things, on the level of its voltage, the control mode, and the operating point. Typically, the maximum output voltage in motor operation is approx. 8% below the line voltage.

Brake chopper

	Unit	MDX9.A-....-2.3-4..		
Size		**2**		**3**
Type		**0070**	**0093**	**0140**
Minimum braking resistance value R_{BR_min}	Ω	24		13
Brake chopper continuous power	kW	2.8	3.7	5.6
Brake chopper peak power	kW	200% × apparent output power S_N		
Connection contacts X2	–	"Plug connector " (→ 🗎 351)		

General

	Unit	MDX9.A-....-2.3-4..		
Size		**2**		**3**
Type		**0070**	**0093**	**0140**
Power section nominal power loss[1)]	W	51	72	105
Power consumption 24 V	W	20		
Interference suppression	–	EMC filter limit value category C2 according to EN 61800-3		
PE connection	–	M4 screw		M4 screw and M6 bolt

31972098/EN – 8/2024

	Unit	MDX9.A-....-2.3-4..		
Size		**2**		**3**
Type		**0070**	**0093**	**0140**
Permitted number of times power may be switched on/off per minute	min^{-1}	1		
Minimum switch-off time for power off	s	10		
Mass	–	4.4		5.7

1) To calculate the thermal power loss, add the values of "24 V power consumption" and "Nominal power loss of the power section".

4.5.2 Sizes 4 – 6

Input

	Unit	MDX9.A-....-2.3-4..				MDX91A-....-2.3-4..	
Size		**4**		**5**		**6**	
Type		**0213**	**0290**	**0420**	**0570**	**0840**	**1080**
Nominal line voltage (in accordance with EN 50160) V_{line}	V	3 × AC 200 – 240					
Nominal current AC I_N	A	19.2	26.1	37.8	51.3	75.6	97.2
Line frequency f_{line}	Hz	50 – 60 ±5%					
Controlled rectifier	–	Yes					
Connection contacts X1	–	"Plug connector " (→ 🗎 351)		M8 bolt		M10 bolt	

Output

	Unit	MDX9.A-....-2.3-4..				MDX91A-....-2.3-4..	
Size		**4**		**5**		**6**	
Type		**0213**	**0290**	**0420**	**0570**	**0840**	**1080**
Output voltage U_{out}	V	0 – V_{line} [1)]					
Motor power ASM P_{Mot}	kW	5.5	7.5	11	15	22	30
Nominal output current I_N at the smallest possible PWM frequency	A	21.3	29	42	57	84	108
Overload capacity	–	200% I_N: max. 3 s at f_{PWM} = 4 kHz					
Continuous output current at f = 0 Hz	–	100% × I_N at f_{PWM} = 4 kHz					
Apparent output power S_N	kVA	8.5	11.6	16.7	22.7	33.5	43
Nominal DC link voltage V_{DCL_nom}	V	DC 325 at V_{line} = 230 V					
Maximum DC link voltage U_{DCL_max}	V	DC 650					
PWM frequency f_{PWM}	kHz	4, 8, 16 (adjustable)					
Maximum output frequency f_{max}	Hz	599 See chapter "Characteristics of the control modes" (→ 🗎 118)					
Connection contacts X2	–	"Plug connector " (→ 🗎 351)		M8 bolt		M10 bolt	

1) In inverter operation, it is technically impossible to provide the full line voltage (with direct power supply) at the output. The output voltage is generated from the DC link circuit and depends, among other things, on the level of its voltage, the control mode, and the operating point. Typically, the maximum output voltage in motor operation is approx. 8% below the line voltage.

Brake chopper

	Unit	MDX9.A-....-2.3-4..				MDX91A-....-2.3-4..	
Size		**4**		**5**		**6**	
Type		**0213**	**0290**	**0420**	**0570**	**0840**	**1080**
Minimum braking resistance value R_{BR_min}	Ω	6.7		4.7	3	2	
Brake chopper continuous power	kW	8.5	11.6	16.7	22.7	33.5	43
Brake chopper peak power	kW	200% × apparent output power S_N					
Connection contacts X2	–	"Plug connector " (→ 🗎 351)		M8 bolt		M10 bolt	

General

	Unit	MDX9.A-....-2.3-4..				MDX91A-....-2.3-4..	
Size		**4**		**5**		**6**	
Type		**0213**	**0290**	**0420**	**0570**	**0840**	**1080**
Power section nominal power loss[1)]	W	152	218	315	459	729	764
Power consumption 24 V	W	30		15		20	
Interference suppression	–	Basic interference suppression integrated					
PE connection	–	M6 bolt		M8 bolt		M10t bolt	
Permitted number of times power may be switched on/off per minute	min^{-1}	1					
Minimum switch-off time for power off	s	10					
Mass	–	6.6		12.1		24.1	

1) To calculate the thermal power loss, add the values of "24 V power consumption" and "Nominal power loss of the power section".

4.6 Electronics data MDX9.A..

4.6.1 X5: Input DC 24 V voltage supply

	Specification
Quantity	1
DC 24 V voltage supply	Connection of external power supply unit 24 V according to IEC 61131 DC 24 V -10%, +20%
Connection	X5: 24 V X5: GND
Connection contacts	"Plug connector" (→ 🗎 351)

4.6.2 X20: Digital inputs

	Specification
Quantity	MDX9.A-....-5.3-4-**S**00: 6 MDX9.A-....-5.3-4-**T**..: 8
Design	Types 1 and 3 according to IEC 61131-2
Cycle time	1 ms
Response time	100 µs plus cycle time
Current consumption	3 mA at 30 V
Maximum output current 24 V Auxiliary voltage output X21:1	50 mA
MDX9.A-....-5.3-4-**S**00: 1 – 6 MDX9.A-....-5.3-4-**T**..: 1 – 8	DI00: "Output stage enable" permanently assigned DI01 – DI05/07: Selection option, see parameter menu All inputs are suitable for touchprobe functionality, latency < 100 µs, maximum 2 touchprobe inputs simultaneously. DI04, DI05: HTL low-resolution encoder connection DI04: Counter input or master frequency input, maximum 120 kHz
Connection contacts	"Plug connector" (→ 🗎 351)
Maximum cable length	30 m

4.6.3 X21: Digital outputs

If inductive loads are connected to digital outputs, you must install an external protective element (freewheeling diode).

	Specification
Quantity	4
Design	Type 2 according to IEC 61131-2
Cycle time	1 ms
Response time	175 ms plus cycle time
Maximum output current	50 mA

31972098/EN – 8/2024

	Specification
Short-circuit protection	Yes
X21:2 – X21:5	DO00 – DO03: Selection option, see parameter menu
Connection contacts	"Plug connector" (→ 🗎 351)
Maximum cable length	30 m

4.6.4 X10: Brake control

	Specification
Quantity	1
Output voltage	Depending on external DC 24 V voltage supply
Current-carrying capacity	150 mA, 3.6 W (no inductive loads)
Connection	X10:1 DB0/DB00 X10:2 GND
Connection contacts	"Plug connector" (→ 🗎 351)
Maximum cable length between inverter and brake control	30 m

4.6.5 X10: Sensor input for temperature evaluation of the motor

	Specification
Quantity	1
Temperature sensors with evaluation capability	PTC thermistor (TF) Bimetallic temperature switch (TH) Temperature sensor KTY84 –130 (KY) Pt1000 (PK or PI)
Response threshold TF	1830 Ω
Connection	X10:3 TF1 X10:4 GND
Connection contacts	"Plug connector" (→ 🗎 351)

4.6.6 X15: Encoder interface

	Specification
Quantity	1
Supported encoders, maximum cable length	Resolver, max. 100 m sin/cos encoder 1 V_{pp} (differential), max. 100 m TTL encoder (differential), max. 100 m TTL encoder EK8R (differential), max. 300 m HTL encoder 12/24 V (differential), max. 200 m HTL encoder ES7C, EG7C, EK8C, max. 300 m HIPERFACE® encoder with sin/cos signals 1 V_{pp}, max. 100 m SEW-EURODRIVE encoder (RS485) with sin/cos signals 1 V_{pp}, max. 100 m Encoder with RS422 signals, max. 100 m
Encoder supply voltage 1 (X15:15)	DC 12 V, ±10%
Encoder supply voltage 3 (X15:13)	DC 24 V, -10%, +20%
Maximum output current I_{max}	500 mA
Peak current I_{peak} for 150 µs	1000 mA
Short-circuit protection for encoder supply	Yes, a permanent short circuit is not permitted
Maximum input frequency	HTL/TTL sin/cos: 250 kHz Resolver: 200 Hz
Temperature sensors with evaluation capability	PTC thermistor (TF) Bimetallic temperature switch (TH) Temperature sensor KTY84 –130 (KY) Pt1000 (PK or PI)
Connection	D-sub plug connector, 15-pin socket contact

4.6.7 X16: MOVILINK® DDI interface

	Specification
Quantity	1

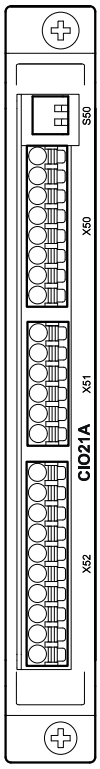
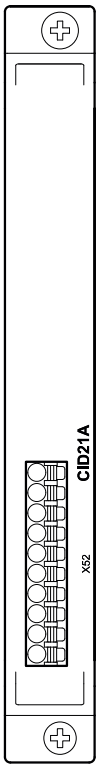
	Specification
Output voltage	DC 24 V, -10%, +20%
Maximum output current I_{max}	500 mA
Short-circuit protection for encoder supply	Yes, a permanent short circuit is not permitted
Connection	FAKRA plug connector, socket contact
Maximum cable length	200 m

4.6.8 X30: Module/system bus connection

	Specification
Quantity	2
Connection	RJ45 socket

4.7 CIO21A and CID21A input/output cards

4.7.1 Description

CIO21A	CID21A	Description
		**Input/output card CIO21A** is used to increase the number of digital and analog inputs and outputs of the basic device: • 4 digital inputs • 4 digital outputs • 2 analog inputs (current/voltage) • 2 analog outputs (current/voltage) **Input/output card CID21A** is used to increase the number of digital inputs and outputs of the basic device: • 4 digital inputs • 4 digital outputs

31972098/EN – 8/2024

4.7.2 Technical data

General

	Specification	
	CID21A	CIO21A
Part number	28229487	28229495
Power consumption 24V[1)]	0.4 W	1.2 W
Cycle time	1 ms	
Connection contacts X52	"Plug connector" (→ 🗎 351)	

1) Exclusively the total power at the outputs.

Analog inputs CIO21A

	Specification
Quantity	2
Input type	Selectable as voltage or current input via switch S50, differential, earthed
Voltage input	Range of values: 0 – +10 V; -10 – +10 V Resolution: 0 – +10 V = 11 bit, -10 – +10 V = 12 bit Tolerance: ±0.5% Internal resistance: ≥10 kΩ Dielectric strength: DC -20 – +20 V
Reference voltage output	Output voltage: REF1: DC +10 V; REF2: DC -10 V Output current: 3 mA Tolerance: ±0.5% Noise: ≤ 10 mV Capacitive load: ≤ 300 nF Inductive load: ≤ 500 µH Short-circuit protection: Yes
Current input	Range of values: 0 – 20 mA; 4 – 20 mA Resolution: 11 bit Tolerance: ±2% Internal resistance: 250 Ω Overvoltage immunity: DC -10 – +10 V

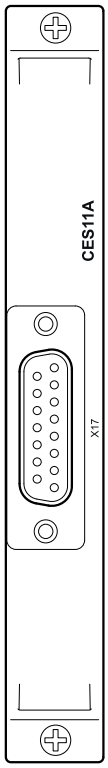
Analog outputs CIO21A

	Specification
Quantity	2
Short-circuit protection	Yes
Output type	Analog voltage output AOV2/AOV3 Analog current output AOC2/AOC3
Voltage output	Range of values: -10 – +10 V, max. 10 mA Resolution: 12 bit Tolerance: ±5% Load resistance: ≥1 kΩ Capacitive load: ≤ 300 nF Inductive load: ≤ 500 µH Reset status: 0 V
Current output	Range of values: 0 – 20 mA; 4 – 20 mA Resolution: 11 bit Tolerance: ±3% Load resistance: 500 Ω Capacitive load: ≤ 300 nF Inductive load: none Reset status: 0 mA

31972098/EN – 8/2024

4.8 CES11A multi-encoder card

4.8.1 Description

CES11A	Description
	The CES11A multi-encoder card enables evaluation of an additional encoder. The additional encoder can be used as a distance encoder or as a motor encoder. For more information, refer to chapters "Terminal assignment" > "CES11A/CES12A multi-encoder card" (→ 🗎 380) and "Applicable motor encoders from SEW-EURODRIVE" (→ 🗎 126).

4.8.2 Technical data

Voltage supply

The multi-encoder card is supplied by the basic device.

Encoder supply

	Unit	Specification
Encoder supply voltage 1 (X17:15)	V	DC 12, ±10%
Encoder supply voltage 2 (X17:13)	V	DC 24, -10%, +20%
Maximum output current I_{max}	mA	500
Peak current I_{peak} for 150 µs	mA	1000
Capacitive load	µF	< 220
Inductive load	µH	< 500
Short-circuit protection for encoder supply	–	Yes, a permanent short circuit is not permitted

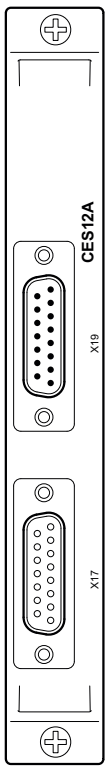
31972098/EN – 8/2024

General

	Unit	Specification
Part number	–	28229479
Supported encoders, Maximum cable length	–	sin/cos encoder 1 V_{pp} (differential), max. 100 m TTL encoder (differential), max. 100 m TTL encoder EK8R (differential), max. 300 m HTL encoder 12/24 V (differential), max. 200 m HTL encoder ES7C, EG7C, EK8C, max. 300 m HIPERFACE® encoder with sin/cos signals 1 V_{pp}, max. 100 m SEW-EURODRIVE encoder (RS485) with sin/cos signals 1 V_{pp}, max. 100 m Encoder with RS422 signals, max. 100 m EnDat-2.1 encoder with sin/cos signals 1 V_{pp}, max. 100 m SSI encoder with or without sin/cos signals 1 V_{pp}, max. 100 m CANopen encoder, max. 100 m
Power consumption 24 V	W	0.8
Maximum power consumption 24 V (including encoder supply)	W	12.8
Maximum input frequency	kHz	250
Temperature sensors with evaluation capability	–	PTC thermistor (TF) Bimetallic temperature switch (TH) Temperature sensor KTY84 –130 (KY) Pt1000 (PK or PI)
Connection	–	D-sub plug connector, 15-pin socket contact

4.9 Multi-encoder card with incremental encoder simulation CES12A

4.9.1 Description

CES12A	Description
	The CES12A multi-encoder card enables evaluation of an additional encoder. The additional encoder can be used as a distance encoder or as a motor encoder. The CES12A multi-encoder card also has an RS422 output for an incremental encoder simulation based on the motor encoder or distance encoder. The simulated incremental encoder signal can be evaluated by a control system, for example. The tracks A, $\overline{A}$, B, $\overline{B}$, C, $\overline{C}$ are formed. For more information, refer to chapters "Terminal assignment" > "CES11A/CES12A multi-encoder card" (→ 🗎 380) and "Applicable motor encoders from SEW-EURODRIVE" (→ 🗎 126).

31972098/EN – 8/2024

4.9.2 Technical data

Voltage supply

The multi-encoder card with incremental encoder simulation is supplied with voltage by the basic device.

X17: Encoder input

	Unit	Specification
Encoder supply voltage 1 (X17:15)	V	DC 12, ±10%
Encoder supply voltage 2 (X17:13)	V	DC 24, -10%, +20%
Maximum output current I_{max}	mA	500
Peak current I_{peak} for 150 µs	mA	1000
Capacitive load	µF	< 220
Inductive load	µH	< 500
Short-circuit protection for encoder supply	–	Yes, a permanent short circuit is not permitted
Supported encoders X17, Maximum cable length	–	sin/cos encoder 1 V_{pp} (differential), max. 100 m TTL encoder (differential), max. 100 m TTL encoder EK8R (differential), max. 300 m HTL encoder 12/24 V (differential), max. 200 m HTL encoder ES7C, EG7C, EK8C, max. 300 m HIPERFACE® encoder with sin/cos signals 1 V_{pp}, max. 100 m SEW-EURODRIVE encoder (RS485) with sin/cos signals 1 V_{pp}, max. 100 m Encoder with RS422 signals, max. 100 m EnDat-2.1 encoder with sin/cos signals 1 V_{pp}, max. 100 m SSI encoder with or without sin/cos signals 1 V_{pp}, max. 100 m CANopen encoder, max. 100 m
Maximum input frequency	kHz	250
Temperature sensors with evaluation capability	–	PTC thermistor (TF) Bimetallic temperature switch (TH) Temperature sensor KTY84 –130 (KY) Pt1000 (PK or PI)
Connection	–	D-sub plug connector, 15-pin socket contact

X19: Incremental encoder simulation

	Unit	Specification
Signal level or type	V	RS422 (differential)
Source for incremental encoder simulation	V	X15 or X17
Supported encoders for incremental encoder simulation	–	Resolver Encoders with RS422 signals TTL encoder HTL encoder Sin/cos encoder 1 V_{SS} HIPERFACE® encoder with sin/cos signals 1 V_{SS} SEW encoder (RS485) with sin/cos signals 1 V_{SS} EnDat 2.1 encoder with sin/cos signals 1 V_{SS} SSI encoder with sin/cos signals 1 V_{SS}
PPR count	–	Depending on the leading encoder: • Resolver: 1024 pulses per revolution • Other encoders: Corresponds to the encoder resolution (max. 4096 pulses per revolution)[1)]
Maximum output frequency	kHz	250
Time delay	µs	2.2
Connection	–	D-sub plug connector, 15-pin connector

1) Periods per revolution of common encoders: 128 periods per revolution (AK0H), 1024 periods per revolution (AK1H, AK8H, EG7C, EG7R, EG7S, EH7R, EH7S, EI8C, EI8R, EK1H, EK8C, EK8R, EK8S, ES7C, ES7R, ES7S, resolver, RH1M), 2048 periods per revolution (AG7W, AG7Y, AH7Y, AK8W, AK8Y, AS7W, AS7Y).

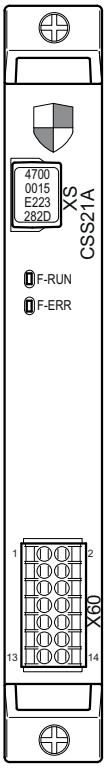
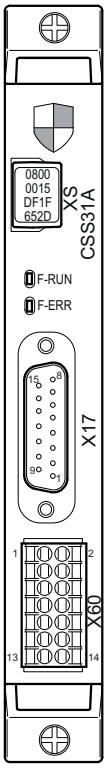
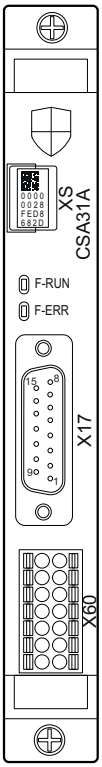
31972098/EN – 8/2024

General

	Unit	Specification
Part number	–	28307380
Power consumption 24 V	W	1.2
Maximum power consumption 24 V (including encoder supply)	W	12 + 1.2

4.10 CS..A safety options

4.10.1 Description

CSS21A/CSB21A	CSS31A/CSB31A	CSA31A
		

The basic device already contains the STO safety sub-function with activation via safe inputs. Higher-level functional safety requirements can be added by inserting a CS.. safety option. Safety sub-functions of varying quality are implemented in 5 different variants.

Properties:

- SIL3 according to EN 61800-5-2, EN 61508
- PL e according to EN ISO 13849-1
- Internal connection to the motor encoder, the external encoder, safe communication, and the STO
- Parameters of the safety option are included in the device data set
- Easy to replace during servicing via pluggable safety key on the safety option
- Parameterization and diagnostics using MOVISUITE® engineering software
- Process data and safety data in the same Scope recording
- Safe output for controlling functionally safe braking systems

31972098/EN – 8/2024

The MOVISAFE® CS..A safety options provide further safety sub-functions according to EN IEC 61800-5-2 in addition to the STO function. The MOVISAFE® CS..A safety options and the CES11A and CES12A multi-encoder card are intended to be used in the same slot and thus cannot be used simultaneously. For this reason, there are CS.31A safety options with an additional multi-encoder input.

	CSB21A	CSB31A	CSS21A	CSS31A	CSA31A
Safe inputs	4	4	4	4	4
Safe outputs	–	2	2	2	2
Safe stop functions	STO, SS1-t	STO, SS1-t	STO, SS1-t	STO, SS1-t	STO, SS1-t
Safe motion functions	–	–	SOS, SS1-r, SS2, SLS, SSR, SLA, SSM, SDI	SOS, SS1-r, SS2, SLS, SSR, SLA, SSM, SDI	SOS, SS1-r, SS2, SLS, SSR, SLA, SSM, SDI
Safe positioning functions	–	–	SLI	SLI	SLI, SLP, SCA
Other functions	–	SBC, EDM	EDM, SBC, SBT	EDM, SBC, SBT	EDM, SBC, SBT
Multi-encoder input	–	Yes	–	Yes	Yes
Safe communication	PROFIsafe, Safety over EtherCAT®				

For more information, refer to the **Product manual** > chapter "Project planning for functional safety" (→ 🗎 170).

31972098/EN – 8/2024

4.10.2 Technical data

For more information, refer to the **Product manual** > chapter "Project planning for functional safety" (→ 🗎 170).

General technical data

	Specification
Ambient temperature for storage of the safety option	-25 °C to 85 °C
Ambient temperature, all sizes Derating, see chapter "Project planning of the device" (→ 🗎 113)	• with MOVISAFE® CS..A: 0 °C – 40 °C without derating • with MOVISAFE® CSB..A, CSS..A: 40 °C – 55 °C with derating • with MOVISAFE® CSA31A: 40 °C – 50 °C with derating
Installation altitude	Maximum 3800 m above sea level

Part numbers of the safety options

Safety options	Part number
MOVISAFE® CSB21A	28233360
MOVISAFE® CSS21A	28233379
MOVISAFE® CSB31A	28233387
MOVISAFE® CSS31A	28233395
MOVISAFE® CSA31A	28266412

31972098/EN – 8/2024

4.11 Technical data – functional safety

4.11.1 General electrical data

The safety option is supplied with voltage by the basic device. The safety option must remain switched on for at least 30 minutes after switching on.

The supply voltage connected externally to the device must be DC 24 V (-10%, +20%) and must have a peak current-carrying capacity of min. 12 A for 45 µs. Furthermore, the voltage source must comply with the regulations according to PELV.

4.11.2 STO safety sub-function

The following table shows the technical data of the STO safety sub-function.

The safe digital inputs F_STO_P1 and F_STO_P2 correspond to type 3 according to IEC 61131-2.

Reference potential for F_STO_P1 and F_STO_P2 is STO_M (contact at terminal X6:2).

		Terminal	Technical data		
STO safety contact		X6	–		
Electrical data of the safe digital inputs F_STO_P1, F_STO_P2			**Minimum**	**Typical**	**Maximum**
Input voltage range		X6:1 and X6:3	DC -3 V	DC 24 V	DC 30 V
Input capacitance against STO_M			–	300 pF	500 pF
Input capacitance against GND			–	300 pF	500 pF
Power consumption at DC 24 V:	F_STO_P1		–	150 mW	200 mW
	F_STO_P2		–	150 mW	200 mW
	Sum[1)]		–	300 mW	400 mW
Input voltage for ON state (STO)			DC 11 V	–	–
Input voltage for OFF state (STO)			–	–	DC 5 V
Permitted leakage current of the external safety controller			–	–	1 mA
Connection contacts			Plug connectors - 1 conductor: 0.25 – 1.5 mm^2[5)] - 2 conductors: 0.25 – 0.5 mm^2 (Twin conductor end sleeve)		
Maximum cable length			30 m		

1) Each drive unit always requires a power consumption of 300 mW.

31972098/EN – 8/2024

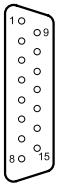
4.11.3 Encoder port of the CSA31A safety option

X17: SSI and sin/cos combi encoders

The following table provides information about this connection:

Function
Connection for SSI and sin/cos combi encoders

Connection type
D-sub plug connector, 15-pin socket contact

Connection diagram


Assignment		
Contact	**Function**	
1	cos+	Cosine (+)/clock signal (+) signal track for encoder 3
2	sin+	Sine (+)/signal cable (+) signal track for encoder 3
3	PULSE+	Clock signal (+) for encoder 2
4	DATA+	Signal cable (+) for encoder 2
5	res.	Reserved
6	Tempera-ture sensor-	Reference potential, temperature sensor TF/TH/KTY/PK
7	res.	Reserved
8	GND	Reference potential encoder supply
9	cos-	Cosine (-)/clock signal (-) signal track for encoder 3
10	sin-	Sine (-)/signal cable (-) signal track for encoder 3
11	PULSE-	Clock signal (-) for encoder 2
12	DATA-	Signal cable (-) for encoder 2
13	V_{S24VG}	DC 24 V encoder supply
14	Tempera-ture sensor+	Temperature sensor TF/TH/KTY/PK
15	V_{S12VG}	DC 12 V encoder supply

Sin/cos encoder interface (encoder 1 and/or encoder 2)

- Encoder 1: Connection to inverter: X15
- Encoder 2: Connection to MOVISAFE® CSA31A: X17

31972098/EN – 8/2024

Sin/cos encoder interface (encoder 1 and/or encoder 2)	
Pulses per revolution	128 – 8192
Input frequency	≤ 205 kHz
Signal level per individual signal	< 0.65 V
Differential signal level	• 0.34 – 0.59 V (Ax7W, Ex7S, AK8W, EK8S) • 0.22 – 0.65 V (all others typically 0.5 V)
Level difference A – B	0.1 V
Offset track A/track B	≤ ±20 mV
Phase angle track A to B	90° ± 4°
Maximum absolute value of the permanently applied input voltage on each encoder signal against GND	+5.8 V
Temporary for maximum 10 ms applied maximum value of input voltage on each encoder signal against GND	15 V
Minimum absolute value of the permanently applied input voltage on each encoder signal against GND	-10 V
Differential input resistance of each individual input signal of the encoder interface against GND	≤ 1 kΩ
Terminating resistance of encoder signal tracks $\overline{A}$/A, $\overline{B}$/B, $\overline{C}$/C and of the data track (data+, data-)	120 Ω (-5%/+10%)
Maximum length of the encoder cable	100 m

HTL encoder interface (encoder 1)

- Encoder 1: Connection to inverter: X15

HTL encoder interface (encoder 1)	
Pulses per revolution	24
Input frequency	< 1520 Hz
Signal level	• Encoder signal LOW (logical "0"): 0 V – +3 V • Encoder signal HIGH (logical "1"): Encoder supply voltage -3.5 V – +30 V
Maximum length of the encoder cable	30 m

SSI encoder interface (encoder 2)

Connection options for encoder 2:

- Directly to MOVISAFE® CSA31A:X17
- To UEA31A:X18 combi-box, further to MOVISAFE® CSA31A:X17

31972098/EN – 8/2024

SSI encoder interface (encoder 2)		
Interface type	Point-to-point connection between inverter and encoder. RS422 (clock and data).	One encoder per interface.
SSI clock frequency	• 125 kHz • 250 kHz (Default) • 500 kHz • 1 MHz	The frequency of the clock signal controlled by the inverter within a pulse train.
SSI pause time	20 – 200 µs	The pause time t_P controlled by the inverter is the minimum waiting time between the end of a pulse train and the start of the subsequent pulse train. The pause time resolution is 1 µs. The pause time must be greater than the monoflop time specified by the encoder manufacturer.
SSI frame repetition rate basic device	• 4 kHz (default) • 2.5 kHz • 2.5 – 4 kHz ("noise", i.e. frequency-modulated)	Rate at which the inverter polls the position from the encoder. Depends on the control mode and is synchronized with it. The CSA31A safety option does not evaluate all frames.
SSI frame rate	1 ms or 2 ms	Rate at which the CSA31A safety option receives and evaluates SSI frames.
Startup time	0 – 32 s	Required time until an SSI encoder can supply data after the supply voltage is switched on.
Refresh time	0 – 30 ms	Encoders need time to update the SSI position. The time between 2 updated positions is the refresh time. The resolution is 1 µs.
Static tolerance band	10^8 (≈10% of the entire range of values)	Static tolerance band for monitoring the absolute position. Setting value in encoder increments.
Speed filter time	1 – 300 ms	Time interval in which position changes of the encoder are added up to obtain the speed by division. Also sets the response time of the speed-related safety sub-functions.
Acceleration filter time	10 – 100 ms	Time interval in which position changes of the encoder are added up to obtain the acceleration by dividing twice. Also sets the response time of the acceleration-related safety sub-functions.

SSI encoder interface (encoder 2)		
SSI fault tolerance	1 – 10	Number of faulty SSI frames that are still accepted by the system without triggering a fault.
SSI frame length	≥ 48 bits	Number of all data bits and status bits.
Position data	≥ 32 bits	Number of data bits.
Coding of position data	as binary code and Gray code	
Maximum length of the encoder cable	100 m	

SSI encoder interface (encoder 3)

Connection options for encoder 3:

- Directly to MOVISAFE® CSA31A:X17
- To UEA31A:X19 combi-box, further to MOVISAFE® CSA31A:X17

SSI encoder interface (encoder 3)		
SSI clock frequency	200 kHz (fixed value)	Frequency of the clock signal within a pulse train controlled by the CSA31A safety option.
SSI pause time	20 – 200 µs	The pause time t_P controlled by the inverter is the minimum waiting time between the end of one pulse train and the start of the next pulse train. The pause time resolution is 1 µs. The pause time must be greater than the monoflop time specified by the encoder manufacturer.
SSI frame rate	1 ms	Rate at which the position is polled from the encoder.
Startup time	0 – 32 s	Required time until an SSI encoder can supply data after the supply voltage is switched on.
Refresh time	0 – 30 ms	Encoders need time to update the SSI position. The time between 2 updated positions is the refresh time. The resolution is 1 µs.
Static tolerance band	10^8 (≈10% of the entire range of values)	Static tolerance band for monitoring the absolute position. Setting value in encoder increments.
Speed filter time	1 – 300 ms	Time interval in which position changes of the encoder are added up to obtain the speed by division. Also sets the response time of the speed-related safety sub-functions.

31972098/EN – 8/2024

SSI encoder interface (encoder 3)		
Acceleration filter time	10 – 100 ms	Time interval in which position changes of the encoder are added up to obtain the acceleration by dividing twice. Also sets the response time of the acceleration-related safety sub-functions.
SSI fault tolerance	1 – 10	Number of faulty SSI frames that are still accepted by the system without triggering a fault.
SSI frame length	≥ 48 bits	Number of all data bits and status bits.
Position data	≥ 32 bits	Number of data bits.
Coding of position data	as binary code and Gray code	
Maximum length of the encoder cable	100 m	

4.11.4 UEA31A SSI combi-box

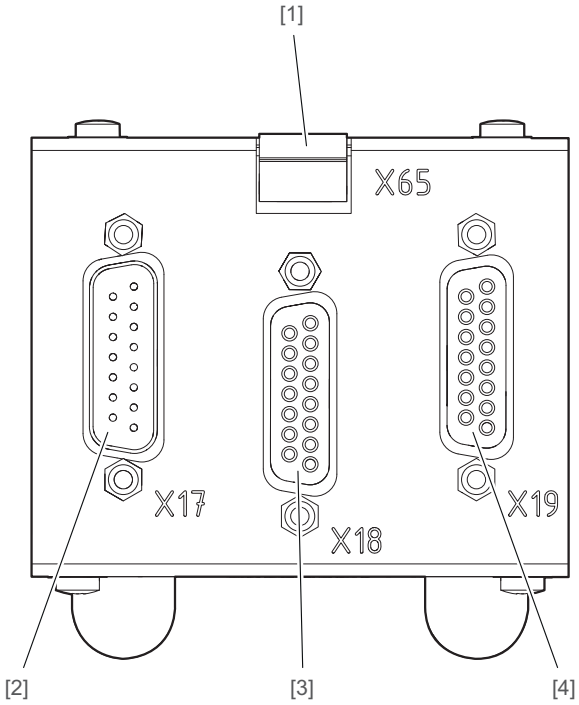
Description

With the UEA31A SSI combi-box, it is possible to connect 2 SSI distance encoders to the CSA31A safety option of a MOVIDRIVE® modular/system/technology. To do this, connect X17 of the CSA31A safety option to X17 of the UEA31A SSI combi-box. Use only the connection cable approved and assembled by SEW-EURODRIVE for this purpose. The length of the connection cable can be configured from 0.5 m to 6 m.

- Part number of the UEA31A SSI combi-box: 28269667
- Part number of the connection cable (plug connector D-Sub15 to D-Sub15): 28128907

31972098/EN – 8/2024

The UEA31A combi-box has degree of protection IP54 and can be installed in the control cabinet on a mounting rail.



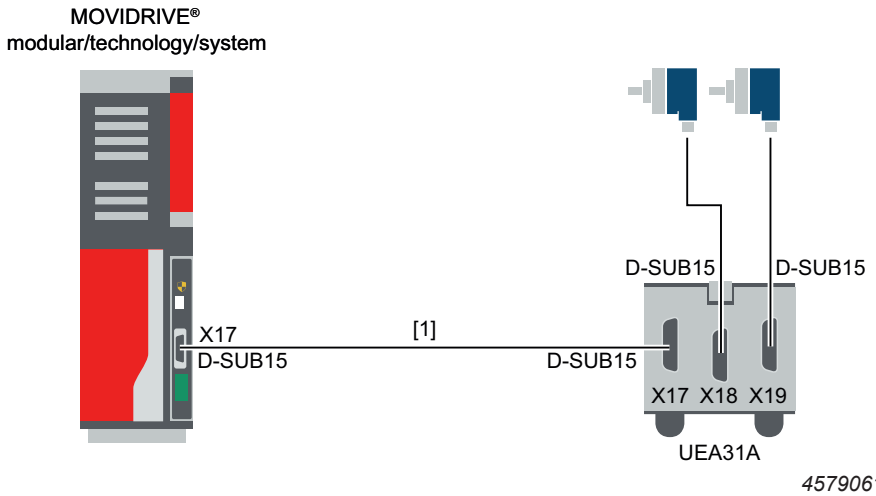
32412351499

[1] X65: Connection of the external DC 24 V encoder supply voltage
[2] X17: Connection to X17 of the safety option only with connection cable 28128907
[3] X18: Connection for SSI encoder 2
[4] X19: Connection for SSI encoder 3

If the total current consumption of the two SSI encoders exceeds 500 mA, the SSI encoders must be supplied with an external DC 24 V voltage. The external DC 24 V voltage can be connected to X65.

Installation topology

The following figure shows a basic installation topology with the device:



45790615179

[1]Part number of the connection cable (D-Sub15 to D-Sub15): 28128907

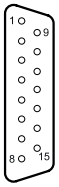
Terminal assignment

X18, X19: Connection of external SSI encoders (encoder 2, encoder 3) to UEA31A SSI combi-box

The following table provides information about this connection:

Function
Connection for SSI encoder 2/encoder 3

Connection type
D-sub plug connector, 15-pin socket contact

Connection diagram


Assignment		
Contact	**Function**	
1	res.	Reserved
2	res.	Reserved
3	CLK +	Clock line
4	Data +	Signal cable (+)
5	res.	Reserved
6	res.	Reserved
7	res.	Reserved
8	GND	Reference potential
9	res.	Reserved
10	res.	Reserved
11	CLK -	Negated clock line
12	Data -	Signal cable (-)
13	+24 V	DC 24 V output Total current load of DC 24 V encoder supply ≤ 400 mA
14	res.	Reserved
15	12 V	DC 12 V output Total current load of DC 12 V encoder supply ≤ 400 mA

An assembled connection cable with open end and conductor end sleeves (part number: 18182240) is available for connecting external distance encoders.

X65: Connection of external SSI encoder supply voltage to UEA31A SSI combi-box

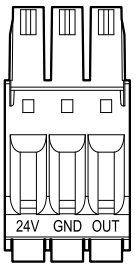
An external DC 24 V encoder supply voltage must be connected to X65:24V if the current consumption of the two SSI encoders exceeds 500 mA in total. There is a bridge between X65:24V and X65:OUT in the delivery state.

31972098/EN – 8/2024

The following table provides information about this connection:

Function
Connection for external SSI encoder supply voltage

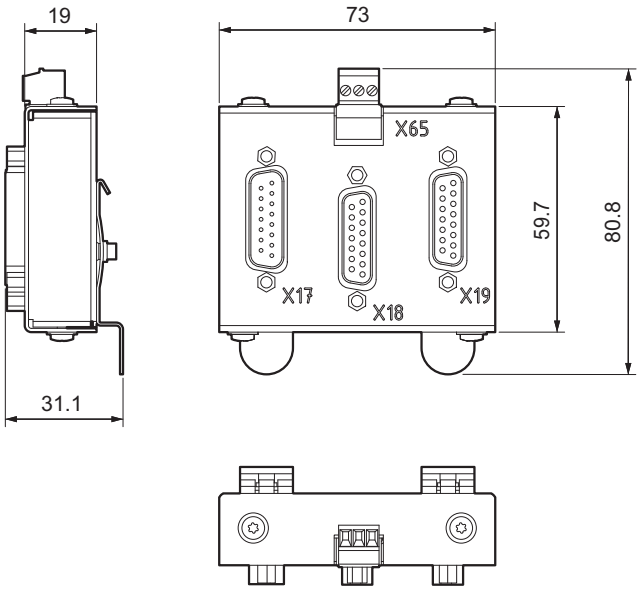
Connection type
Pluggable terminal block (push-in spring connection), 3.5 mm, 3-pole

Connection diagram


Assignment	
Contact	**Function**
24 V	Connection of external DC 24 V encoder supply voltage
GND	Reference potential
OUT	DC V 24 encoder voltage supply from CSA31A

Dimension drawing

All dimensions in mm.



9007234806261899

31972098/EN – 8/2024

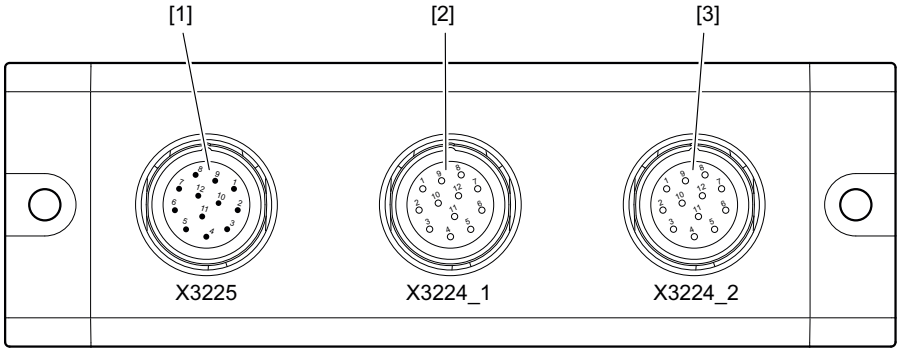
4.11.5 Decentralized FEA31A SSI combi-box

Description

With the decentralized FEA31A SSI combi-box, it is possible to connect 2 SSI distance encoders to the CSA31A safety option of a MOVIDRIVE® modular/system/technology. To do this, connect X17 of the CSA31A safety option to X3225 of the FEA31A SSI combi-box. Only the prefabricated connection cable from SEW-EURODRIVE is permissible for this. The length of the connection cable can be configured from 0.5 m to 30 m.

- Part number of the decentralized FEA31A SSI combi-box: 29676053
- Part number of the connection cable (M23 plug connector to D-Sub15 plug connector): 28174496

The decentralized FEA31A SSI combi-box is designed with degree of protection IP54 and can be installed outside of the control cabinet (for example, mounted on the wall).



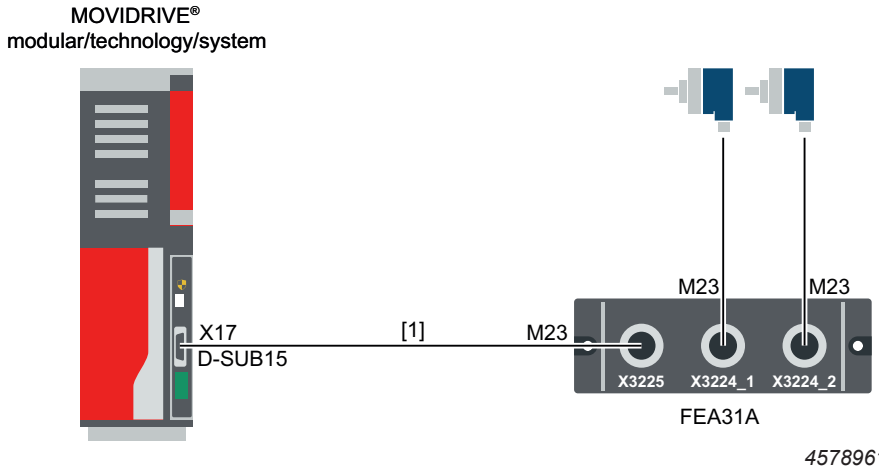
45307758603

[1] X3225: Connection to X17 of the safety option only with connection cable 28174496
[2] X3224_1: Connection for SSI encoder 2 via M23 plug connector
[3] X3224_2: Connection for SSI encoder 3 via M23 plug connector

If the total current consumption of the two SSI encoders exceeds 500 mA, the SSI encoders must be connected to an external voltage supply.

Installation topology

The following figure shows a basic installation topology with the device:



45789611531

[1] Part number of the connection cable (M23 to D-Sub15): 28174496

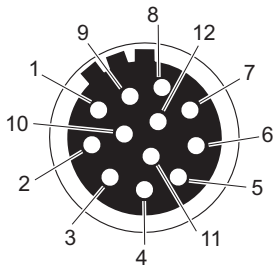
Plug connector assignment

X3224_1: Connection of external SSI encoder (encoder 2) to FEA31A SSI combi-box

The following table provides information about this connection:

Function
Connection for SSI encoder 2

Connection type
M23, insulator, P part 12-pin, female, +20°-coded

Connection diagram


Assignment		
Contact	**Function**	
1	CLK +, encoder 2	Clock line
2	CLK -, encoder 2	Negated clock line
3	res.	Reserved
4	res.	Reserved
5	res.	Reserved
6	res.	Reserved
7	Data-, encoder 2	Signal cable (-)
8	Data+, encoder 2	Signal cable (+)
9	GND	Reference potential
10	+24V	DC 24 V output Total current load of DC 24 V encoder supply ≤ 400 mA
11	res.	Reserved
12	res.	Reserved

X3224_2: Connection of external SSI encoder (encoder 3) to FEA31A SSI combi-box

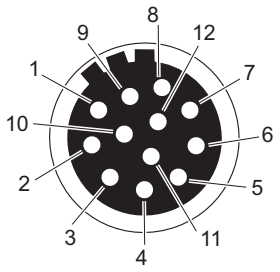
The following table provides information about this connection:

Function
Connection for SSI encoder 3

31972098/EN – 8/2024

Connection type
M23, insulator, P part 12-pin, female, +20°-coded

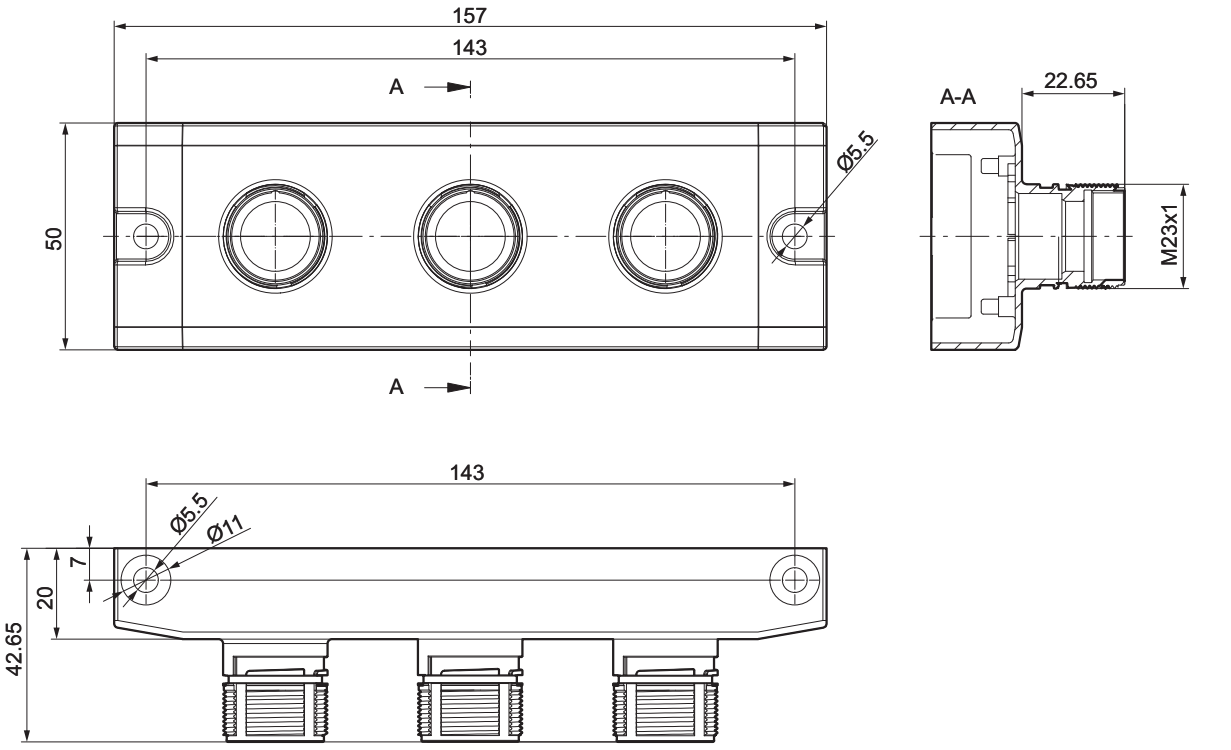
Connection diagram



Assignment

Contact	Function	
1	CLK +, encoder 3	Clock line
2	CLK -, encoder 3	Negated clock line
3	res.	Reserved
4	res.	Reserved
5	res.	Reserved
6	res.	Reserved
7	Data-, encoder 3	Signal cable (-)
8	Data+, encoder 3	Signal cable (+)
9	GND	Reference potential
10	+24V	DC 24 V output Total current load of DC 24 V encoder supply ≤ 400 mA
11	res.	Reserved
12	res.	Reserved

Dimension drawing



45606112011

All dimensions in mm.

4.11.6 Encoder interface X17 of the safety options CSS31A and CSB31A

INFORMATION

The encoder interface X17 is not used for functional safety with the safety options CSS31A and CSB31A. For more information, see chapter "CES11A multi-encoder card".

4.11.7 Safe digital inputs

Safe digital inputs F-DI00 – F-DI03	
Properties	DC 24 V input pursuant to EN 61131-2, type 3
Signal level	• Logic "0" = LOW input: ≤ 5 V or ≤ 1.5 mA • Logic "1" = HIGH input: ≥ 11 V and ≥ 2 mA
Reference ground	GND
Input current	≤ 15 mA
Input resistance	≤ 4 kΩ at DC 24 V
Input filter time, parameterizable	4 ms – 250 ms
Permitted cable length	30 m
Fault response time for single-pole connection	No greater than the response time without fault

31972098/EN – 8/2024

Safe digital inputs F-DI00 – F-DI03	
Edge steepness of input signal	> 120 V/s
Input capacitance	< 500 pF
Polarity reversal protection	Up to DC 30 V

4.11.8 Sensor supply

Sensor supply F-SS0, F-SS1	
Properties	• DC 24 V output according to EN 61131-2 • Short circuit and overload protection • no galvanic isolation
Rated current	150 mA per sensor supply
Inrush current (≤ 10 ms)	300 mA
Short-circuit protection	1.2 A
Internal voltage drop	< DC 1.3 V
Pulsed voltage supply (if activated)	• 2 ms open (LOW) • Period duration, pulsed voltage supply: 8 ms
Permitted cable length	30 m per sensor
Leakage current (F-SSx disabled)	< 0.1 mA

4.11.9 Safe digital outputs

Safe digital outputs F-DO00_P/M, F-DO01_P/M	
Properties	• DC 24 V output according to EN 61131-2 • Short circuit and overload protection
Rated current	150 mA
Inrush current (≤ 10 ms)	300 mA
Leakage current (F-DOx disabled)	< 0.1 mA
Maximum switching frequency	• 10 Hz during operation < 1 minute • 0.5 Hz during operation > 1 minute
Overload protection	210 mA
Minimum current for wire break monitoring	15 mA
Permitted cable length	30 m
Load capacitance (max. test pulse duration)	≤ 300 nF
Load capacitance (1 ms test pulse duration)	≤ 50 nF

31972098/EN – 8/2024

Safe digital outputs F-DO00_P/M, F-DO01_P/M	
Capacitance to GND/PE (sourcing/sinking only)	≤ 10 nF
Load capacitance with diode decoupling	≤ 12 µF
Load inductance	≤ 100 µH
Load inductance with overrunning clutch	≤ 40 H
Minimum load resistance	> 130 Ω

4.11.10 Characteristic safety values STO

	Characteristic values	
	EN 61800-5-2	**EN ISO 13849-1**
Tested safety class/standard basis	Safety Integrity Level SIL 3	Performance level e/category 3
Probability of dangerous failure per hour (PFH_D value)	2.5×10^{-9} 1/h	
Service life	20 years, after which the component must be replaced with a new one.	
Proof test interval	> 20 years	–
Safe state	Safe Torque Off (STO)	
Safety sub-function	STO, SS1[1)] according to EN 61800-5-2	

1) With suitable external control

INFORMATION

In the case of single-pole wiring, the achievable performance level according to EN ISO 13849-1 is reduced to PL d, and the achievable Safety Integrity Level according to EN 61800-5-2 is reduced to SIL 2. A fault exclusion is necessary for the wiring between the safety relay and the STO input.

4.11.11 Characteristic safety values of MOVISAFE® CSB..A and CSS..A

Safety sub-functions without encoder evaluation

	Characteristic values	
	EN 62061/EN 61800-5-2	**EN ISO 13849-1**
Tested safety class/standard basis	SIL 3	PL e
Probability of dangerous failure per hour (PFH_D value)	4.5×10^{-9} 1/h	
Mission time/service life	20 years, after which the component must be replaced with a new one.	
Proof test interval	20 years	–
Safe state	Value "0" for all safe F-DO process values (output disabled)	

31972098/EN – 8/2024

	Characteristic values	
	EN 62061/EN 61800-5-2	EN ISO 13849-1
Safety sub-function	• STO, SS1-t, SBC • Safe digital inputs/outputs • Safe communication	

INFORMATION

In the case of single-pole wiring of the safe digital inputs/outputs, the feasible safety integrity level pursuant to EN 62061/EN 61800-5-2 is reduced to SIL 2 or the performance level pursuant to EN ISO 13849-1 is reduced to PL d. Continue to observe the installation requirements.

When using the F-DO0x outputs in the single-channel, sourcing output connection variant, the PFH value increases to 5.3 × 10^{-9} 1/h.

Safety sub-functions with encoder evaluation

	Characteristic values	
	EN 62061/EN 61800-5-2	EN ISO 13849-1
Tested safety class/standard basis	SIL 2	PL d
Probability of dangerous failure per hour (PFH_D value)	4.5 × 10^{-9} 1/h	
Mission time/service life	20 years, after which the component must be replaced with a new one.	
Proof test interval	20 years	–
Safe state	Value "0" for all safe F-DO process values (output disabled)	
Safety sub-function	SS1, SS2, SOS, SLS, SSM, SSR, SDI, SLI, SLA	

INFORMATION

In the case of single-pole wiring of the safe digital inputs/outputs, the feasible safety integrity level pursuant to EN 62061/EN 61800-5-2 is reduced to SIL 2 or the performance level pursuant to EN ISO 13849-1 is reduced to PL d. Continue to observe the installation requirements.

When using the F-DO0x outputs in the single-channel, sourcing output connection variant, the PFH value increases to 5.3 × 10^{-9} 1/h.

4.11.12 MOVISAFE® CSA31A characteristic safety values

	Characteristic values	
	EN 62061/EN 61800-5-2	EN ISO 13849-1
Tested safety class/standard basis	SIL 3	PL e
Probability of dangerous failure per hour (PFH_D value)	8.5 × 10^{-9} 1/h	
Mission time/ service life	20 years, after which the component must be replaced with a new one.	

	Characteristic values	
	EN 62061/EN 61800-5-2	EN ISO 13849-1
Proof test interval	20 years	–
Safe state	Value "0" for all safe F-DO process values (output disabled)	
Safety sub-function	SS1, SS2, SOS, SLS, SSM, SSR, SDI, SLI, SLA, SCA, SLP	

The following encoder combinations are permitted.

Encoder 1	Encoder 2	Encoder 3	PL	See chapter
FS motor encoder	–	–	d	1-encoder concept – FS motor encoder
FS motor encoder[1)]	Sin/cos	–	e[2)]	2-encoder concept (with MOVISAFE® CSA31A only)
FS motor encoder[1)]	SSI	–	e[2)]	
FS motor encoder[1)]	–	SSI	e[2)]	
Sin/cos	SSI	–	d	
EI7C FS	SSI	–	d	
HIPERFACE®	SSI	–	d	
Sin/cos	–	SSI	d	
EI7C FS	–	SSI	d	
–	SSI	SSI	d	
–	SSI	SSI	e[3)]	1-encoder concept – FS distance encoder

1) Only the sin/cos signals are evaluated for safety reasons.
2) For speed and relative position.
3) For speed and absolute position.

Key:

- Encoder 1: Motor encoder
- Encoder 2: External encoder
- Encoder 3: 2nd External encoder
- PL: Maximum performance level that can be achieved

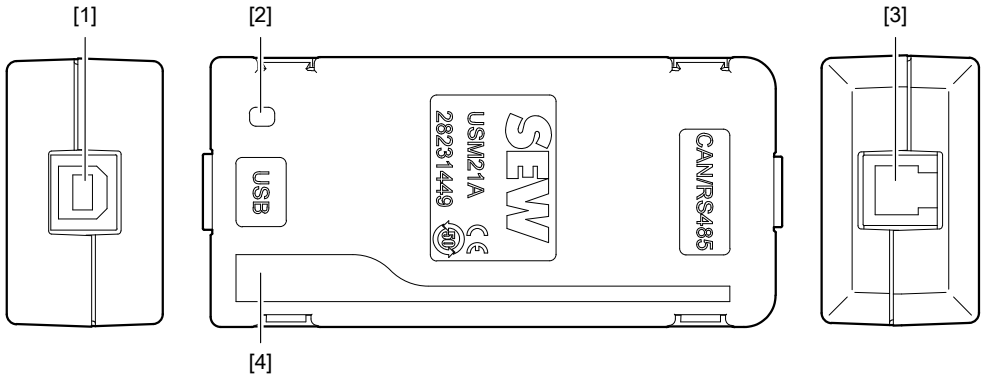
31972098/EN – 8/2024

4.12 USM21A interface adapter

4.12.1 Description

With the USM21A interface adapter, it is possible to connect a PC with a USB interface to the X32 Service interface of the inverter.

The following figure shows the USM21A interface adapter:



18014432680689163

[1] USB socket type B
[2] Bus status display
[3] RJ10 socket
[4] Interface adapter status display

4.12.2 Technical data

USM21A interface adapter	
Part number	28231449
Interference immunity	Complies with EN 61800-3
Ambient temperature	0 – 40 °C
Storage temperature	-25 – 70 °C according to EN 60721-3-3, class 3K3
Degree of protection	IP20 in accordance with EN 60529
Interfaces	RJ10 socket (device connection) USB socket type B (PC connection)
Mass	200 g
Dimensions in mm (L × W × H)	92.5 × 43 × 25

An order using part number 28231449 includes the following parts:

- USM21A interface adapter
- USB connection cable for the USM21A – PC connection
- Serial interface cable with 2 RJ10 connectors

31972098/EN – 8/2024

4.13 Braking resistors BW.../BW...-T

4.13.1 Description

The BW../BW..-T braking resistors are adapted to the technical characteristics of the inverter. Braking resistors with different continuous and peak braking powers are available.

The braking resistors can be protected against overload and overtemperature by the customer when a thermal overload relay is used. The tripping current is set to the value I_F. For further information, refer to chapter "Technical data and assignment to an inverter" (→ 🗎 79).

A flat-type resistor has internal thermal protection (fuse cannot be replaced) that interrupts the current circuit in the event of overload. The configuration guidelines and the documented assignments of the drive inverter and braking resistor must be adhered to.

A PTC braking resistor protects itself (reversible) against regenerative overload by changing abruptly to high resistance and no longer consuming any more energy. The inverter then switches off and signals an "overvoltage" fault.

INFORMATION

Use only the following protection devices:

- Internal temperature switch T
- External thermal overload relay

→ Further information can be found in the chapter "Protecting braking resistors against thermal overload" (→ 🗎 370).

4.13.2 Parallel connection of braking resistors

2 identical braking resistors are connected in parallel for some inverter/resistor combinations. In this case, protect each braking resistor against overload and overtemperature using a thermal overload relay.

The temperature switches must be connected in series for braking resistors in the BW..-T series.

31972098/EN – 8/2024

4.13.3 Technical data and assignment to an inverter

Technical data

Braking resistor		Unit	BW120-001	BW100-001	BW100-002	BW100-002/M	BW100-006-T
Part number		–	18176011	08281718	08281653	25664514	18204198
Peak braking power		kW	6.9			9.4	6.9
Current-carrying capacity	100% cdf	kW	0.03	0.1	0.2	0.15	0.6
	50% cdf	kW	0.06	0.15	0.3	0.27	1.1
	25% cdf	kW	0.1	0.3	0.6	0.45	1.9
	12% cdf	kW	0.18	0.5	1	0.75	3.6
	6% cdf	kW	0.3	0.9	1.8	1.23	5.7
	Observe the regenerative power limit of the device, see chapter "Technical data" (→ 🗎 36) (peak power of brake chopper 200% × apparent output power × 0.9).						
Resistance value R_{BW}		Ω	117	100	100 ±10%		
Tripping current of external monitoring device I_F [1]		A	–	0.8	1	1.2	2.4
Design		–	PTC submounting resistor	Flatpack resistor		Submounting resistor in flat design	Wire resistor
Power connections		mm^2	Single conductors				Ceramic terminal 2.5
Conductor length at the braking resistor		mm	170	510		300	
Cable cross section		mm^2	0.5	1.3		2.1	0.5 – 10
Tightening torque		Nm	–				0.5
PE connection		–	–			M4 bolt	
Tightening torque PE		Nm	–			1.5 – 1.8	
Degree of protection according to EN 60529		–	IP20	IP54		IP40	IP20
Ambient temperature ϑ_{amb}		°C	-20 – 40	-25 – 40		-20 – 40	-30 – 40
Derating at ambient temperature > 40 °C		–	-4% P_N/10 K up to maximum 60 °C				
Thermal overload protection		–	Self-protection	Fuse			Temperature switch
Noise characteristics		–	Unobtrusive				Low
Mass		kg	0.95	0.3	0.6	1.4	3

1) The tripping current must be reduced by 2% / 10 K at an ambient temperature above 40 °C.

Assignment

The assignment considers the maximum possible peak braking power of the inverter.

Braking resistor	BW120-001	BW100-002/M	BW100-001	BW100-002	BW100-006-T
MDX9.A-....-5.3..	0020 0025 0032 0040		0020 0025 0032 0040		

31972098/EN – 8/2024

Technical data

Braking resistor		Unit	BW047-010-T	BW147-T	BW247-T
Part number		–	17983207	18201342	18200842
Peak braking power		kW	14.6		
Current-carrying capacity	100% cdf	kW	1	1.2	2
	50% cdf	kW	1.8	2.2	3.6
	25% cdf	kW	3.2	3.8	6.4
	12% cdf	kW	6	7.2	12
	6% cdf	kW	9.5	11.4	14.6
	Observe the regenerative power limit of the inverter, see chapter "Technical data" (→ 🗎 36).				
Resistance value R_{BW}		Ω	47 ±10%		
Tripping current of external monitoring device I_F [1)]		A	4.6	5.1	6.5
Design		–	Wire resistor		
Power connections		–	Screw terminal		
Cable cross section		mm^2	0.5 – 10		
Tightening torque		Nm	1.5 – 1.8		
PE connection		–	M4 bolt		
Tightening torque PE		Nm	1.5 – 1.8		
Degree of protection according to EN 60529		–	IP20		
Ambient temperature ϑ_{amb}		°C	-30 – 40		
Derating at ambient temperature > 40 °C			-4% P_N/10 K up to maximum 60 °C		
Thermal overload protection		–	Temperature switch		
Noise characteristics		–	Low		
Mass		kg	4	4.9	6.7

1) The tripping current must be reduced by 2% / 10 K at an ambient temperature above 40 °C.

Assignment

The assignment considers the maximum possible peak braking power of the inverter.

Braking resistor	BW047-010-T	BW147-T	BW247-T
MDX9.A-....-5.3..		0055 0070 0095	

31972098/EN – 8/2024

Technical data

Braking resistor		Unit	BW027-016-T	BW027-024-T	BW027-042-T
Part number		–	17983215	17983231	19155301
Peak braking power		kW	25.4		
Current-carrying capacity	100% cdf	kW	1.6	2.4	4.2
	50% cdf	kW	2.9	4.3	7.6
	25% cdf	kW	5.1	7.7	13.3
	12% cdf	kW	9.6	14.4	23.9
	6% cdf	kW	15.2	22.8	25.4
	Observe the regenerative power limit of the device, see chapter "Technical data" (→ 🗎 36).				
Resistance value R_{BW}		Ω	27 ±10%		
Tripping current of external monitoring device I_F [1]		A	7.7	9.4	12.5
Design		–	Wire resistor		Frame resistor
Power connections		–	Screw terminal		
Cable cross section		mm^2	0.5 – 10		Max. 4
Tightening torque		Nm	1.5 – 1.8		Max. 2
PE connection		–	M4 bolt		M5 bolt
Tightening torque PE		Nm	1.5 – 1.8		2 – 2.5
Degree of protection according to EN 60529		–	IP20		
Ambient temperature ϑ_{amb}		°C	-30 – 40		
Derating at ambient temperature > 40 °C		–	-4% P_N/10 K up to maximum 60 °C		
Thermal overload protection		–	Temperature switch		
Noise characteristics		–	Low		
Mass		kg	5.8	8	10

1) The tripping current must be reduced by 2% / 10 K at an ambient temperature above 40 °C.

Assignment

The assignment considers the maximum possible peak braking power of the inverter.

Braking resistor	BW027-016-T	BW027-024-T	BW027-042-T
MDX9.A-....-5.3..	0125 0160		
MDX9.A-....-2.3..	0070 0093		

31972098/EN – 8/2024

Technical data

Braking resistor		Unit	BW015-016	BW015-042-T	BW015-075-T	BW915-T
Part number		–	17983258	19155328	19155271	18204139
Peak braking power		kW	45.7			
Current-carrying capacity	100% cdf	kW	1.6	4.2	7.5	16
	50% cdf	kW	2.9	7.6	12.8	27.2
	25% cdf	kW	5.1	13.3	22.5	45.7
	12% cdf	kW	9.6	23.9	33.8	45.7
	6% cdf	kW	15.2	41.8	45.7	45.7
	Observe the regenerative power limit of the device, see chapter "Technical data" (→ 🗎 36).					
Resistance value R_{BW}		Ω	15 ±10%			
Tripping current of external monitoring device I_F [1]		A	10.3	16.7	22.4	32.7
Design		–	Wire resistor	Frame resistor	Grid resistor mounting position 1	
Power connections		–	Screw terminal		M8 bolt	
Cable cross section		mm^2	0.5 – 10	Max. 4	5 – 6	
Tightening torque		Nm	1.5 – 1.8	Max. 2	6	
PE connection		–	M4 bolt	M5 bolt	M6 bolt	
Tightening torque PE		Nm	1.5 – 1.8	2 – 2.5	2.5 – 3	
Degree of protection according to EN 60529		–	IP20			
Ambient temperature ϑ_{amb}		°C	-30 – 40			
Derating at ambient temperature > 40 °C		–	-4% P_N/10 K up to maximum 60 °C			
Thermal overload protection		–	–	Temperature switch		
Noise characteristics		–	Low		Pronounced	
Mass		kg	5.8	10	12	32

1) The tripping current must be reduced by 2% / 10 K at an ambient temperature above 40 °C.

Assignment

The assignment considers the maximum possible peak braking power of the inverter.

Braking resistor	BW015-016	BW015-042-T	BW015-075-T	BW915-T
MDX9.A-....-5.3..	0240 0320 0620 (Parallel connection of 2 braking resistors) 0750 (Parallel connection of 2 braking resistors)			
MDX9.A-....-2.3..	0140 0213 (Parallel connection of 2 braking resistors) 0290 (Parallel connection of 2 braking resistors)			

31972098/EN – 8/2024

Technical data

Braking resistor		Unit	BW010-024	BW010-050-T	BW010-108-T
Part number		–	17983266	17983274	19155298
Peak braking power		kW	57.2		
Current-carrying capacity	100% cdf	kW	2.4	5	10.8
	50% cdf	kW	4.3	8.5	18.4
	25% cdf	kW	7.7	15.0	32.4
	12% cdf	kW	14.4	22.5	48.6
	6% cdf	kW	22.8	38.0	57.2
	Observe the regenerative power limit of the device, see chapter "Technical data" (→ 🗎 36).				
Resistance value R_{BW}		Ω	10 ±10%		
Tripping current of external monitoring device I_F [1]		A	15.5	22.4	32.9
Design		–	Wire resistor	Grid resistor mounting position 1	
Power connections		–	Screw terminal	M8 bolt	
Cable cross section		mm^2	0.5 – 10	–	
Tightening torque		Nm	1.5 – 1.8	5 – 6	
PE connection		–	M4 bolt	M6 bolt	
Tightening torque PE		Nm	1.5 – 1.8	2.5 – 3	
Degree of protection according to EN 60529		–	IP20		
Ambient temperature ϑ_{amb}		°C	-30 – 40		
Derating at ambient temperature > 40 °C		–	-4% P_N/10 K up to maximum 60 °C		
Thermal overload protection		–	Overload relay	Temperature switch	
Noise characteristics		–	Low	Pronounced	
Mass		kg	8	12	17.5

1) The tripping current must be reduced by 2% / 10 K at an ambient temperature above 40 °C.

Assignment

The assignment considers the maximum possible peak braking power of the inverter.

Braking resistor	BW010-024	BW010-050-T	BW010-108-T
MDX9.A-....-5.3..	0460 0910 (Parallel connection of 2 braking resistors) 1130 (Parallel connection of 2 braking resistors)		
MDX9.A-....-2.3..	0213 0290 0420 (Parallel connection of 2 braking resistors)		

31972098/EN – 8/2024

Technical data

Braking resistor		Unit	BW006-025-01[1]	BW006-050-01[1]	BW106-T	BW206-T
Part number		–	18200117	18200125	18200834	18204120
Peak braking power		kW	114.3			
Current-carrying capacity	100% cdf	kW	2.5	5	13.5	18
	50% cdf	kW	4.3	8.5	23.0	30.6
	25% cdf	kW	7.5	15.0	40.5	54.0
	12% cdf	kW	11.3	22.5	60.8	81.0
	6% cdf	kW	19.0	38.0	102.6	114.3
	Observe the regenerative power limit of the device, see chapter "Technical data" (→ 🗎 36).					
Resistance value R_{BW}		Ω	5.8 ±10%		6 ±10%	
Tripping current of external monitoring device I_F[2]		A	20.4	28.9	47.4	54.8
Design		–	Grid resistor mounting position 1			
Power connections		–	M8 bolt			
Tightening torque		Nm	5 – 6			
PE connection		–	M6 bolt			
Tightening torque PE		Nm	2.5 – 3			
Degree of protection according to EN 60529		–	IP20			
Ambient temperature ϑ_{amb}		°C	-30 – 40			
Derating at ambient temperature > 40 °C		–	-4% P_N/10 K up to maximum 60 °C			
Thermal overload protection		–	Overload relay		Temperature switch	
Noise characteristics		–	Pronounced		Unobtrusive	
Mass		kg	7.5	12	30	40

1) The braking resistor has a 1 Ω tap.

2) The tripping current must be reduced by 2% / 10 K at an ambient temperature above 40 °C.

Assignment

The assignment considers the maximum possible peak braking power of the inverter.

Braking resistor	BW006-025-01	BW006-050-01	BW106-T	BW206-T
MDX9.A-....-5.3..	0620 0750 1490 (Parallel connection of 2 braking resistors)			
MDX9.A-....-2.3..	0570 (Parallel connection of 2 braking resistors)			

31972098/EN – 8/2024

Technical data

Braking resistor		Unit	BW005-070	BW005-170-T	BW004-050-01	BW004-070-01
Part number		–	17983282	17983290	18200133	17967678
Peak braking power		kW	146		190.6	
Current-carrying capacity	100% cdf	kW	7	17	5	7
	50% cdf	kW	11.9	28.9	8.5	11.9
	25% cdf	kW	21.0	51.0	15.0	21.0
	12% cdf	kW	31.5	76.5	22.5	31.5
	6% cdf	kW	53.2	129.2	38.0	53.2
	Observe the regenerative power limit of the device, see chapter "Technical data" (→ 🗎 36).					
Resistance value R_{BW}		Ω	4.7 ±10%		3.6 ±10%	
Tripping current of external monitoring device I_F [1]		A	38.6	60.1	37.3	44.1
Design		–	Grid resistor mounting position 1			
Power connections		–	M8 bolt			
Tightening torque		Nm	5 – 6			
PE connection		–	M6 bolt			
Tightening torque PE		Nm	2.5 – 3			
Degree of protection according to EN 60529		–	IP20			
Ambient temperature ϑ_{amb}		°C	-30 – 40			
Derating at ambient temperature > 40 °C		–	-4% P_N/10 K up to maximum 60 °C			
Thermal overload protection		–	Overload relay	Temperature switch	Overload relay	
Noise characteristics		–	Pronounced			
Mass		kg	13	33	12	13

1) The tripping current must be reduced by 2% / 10 K at an ambient temperature above 40 °C.

Assignment

The assignment considers the maximum possible peak braking power of the inverter.

Braking resistor	BW005-070	BW005-170-T	BW004-050-01	BW004-070-01
MDX9.A-....-5.3..	0910 1130 1770 (Parallel connection of 2 braking resistors) 2200 (Parallel connection of 2 braking resistors) 2500 (Parallel connection of 2 braking resistors) 3000 (Parallel connection of 2 braking resistors)		1490	
MDX9.A-....-2.3..	0420 0840 (Parallel connection of 2 braking resistors) 1080 (Parallel connection of 2 braking resistors)		0570	

Technical data

Braking resistor		Unit	BW003-420-T	BW002-070
Part number		–	13302345	17983304
Peak braking power		kW	274.4	298.3
Current-carrying capacity	100% cdf	kW	42	7
	50% cdf	kW	71.4	11.9
	25% cdf	kW	126.0	21.0
	12% cdf	kW	189.0	31.5
	6% cdf	kW	274.4	53.2
	Observe the regenerative power limit of the device, see chapter "Technical data" (→ 36) (peak power of brake chopper 200% × apparent output power × 0.9).			
Resistance value R_{BW}		Ω	2.5 ±10%	2.3 ±10%
Tripping current of external monitoring device I_F [1)]		A	129	55.2
Design		–	Grid resistor mounting position 2	Grid resistor mounting position 1
Power connections		–	M12 bolt	M8 bolt
Tightening torque		Nm	14 – 15.5	5 – 6
PE connection		–	M10 bolt	M6 bolt
Tightening torque PE		Nm	8 – 10	2.5 – 3
Degree of protection according to EN 60529		–	IP20	
Ambient temperature ϑ_{amb}		°C	-30 – 40	
Derating at ambient temperature > 40 °C		–	-4% P_N/10 K up to maximum 60 °C	
Thermal overload protection		–	Temperature switch	Overload relay
Noise characteristics		–	Pronounced	
Mass		kg	93	13

1) The tripping current must be reduced by 2% / 10 K at an ambient temperature above 40 °C.

Assignment

The assignment considers the maximum possible peak braking power of the inverter.

Braking resistor	BW003-420-T	BW002-070
MDX9.A-....-5.3..	1770 2200 2500 3000 3800 (Parallel connection of 2 braking resistors) 4700 (Parallel connection of 2 braking resistors) 5880 (Parallel connection of 2 braking resistors)	
MDX9.A-....-2.3..	0840 1080	

31972098/EN – 8/2024

Technical data

Braking resistor		Unit	BW1.0-170
Part number		–	17985455
Peak braking power		kW	686
Current-carrying capacity	100% cdf	kW	17
	50% cdf	kW	28.9
	25% cdf	kW	51.0
	12% cdf	kW	76.5
	6% cdf	kW	129.2
	Observe the regenerative power limit of the device, see chapter "Technical data" (→ 🗎 36).		
Resistance value R_{BW}		Ω	1 ±10%
Tripping current of external monitoring device I_F [1)]		A	130
Design		–	Grid resistor mounting position 2
Power connections		–	M12 bolt
Tightening torque		Nm	14 – 15.5
PE connection		–	M10 bolt
Tightening torque PE		Nm	8 – 10
Degree of protection according to EN 60529		–	IP20
Ambient temperature ϑ_{amb}		°C	-30 – 40
Derating at ambient temperature > 40 °C		–	-4% P_N/10 K up to maximum 60 °C
Thermal overload protection		–	Overload relay
Noise characteristics		–	Pronounced
Mass		kg	45

1) The tripping current must be reduced by 2% / 10 K at an ambient temperature above 40 °C.

Assignment

The assignment considers the maximum possible peak braking power of the inverter.

Braking resistor	BW1.0-170
MDX9.A-....-5.3..	3800 4700 5880

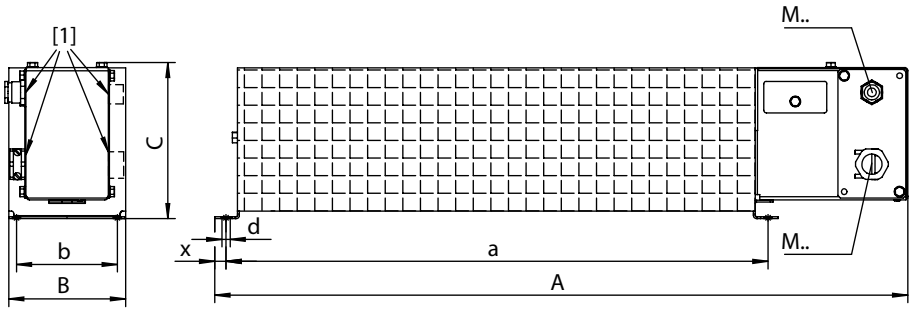
Technical data BW..-T signal contact

Signal contact BW..-T	Unit	General electronics data
Cross section	mm^2	0.75 – 2.5
Tightening torque	Nm	1
Switching capacity	V	DC 2 A / DC 24 V (DC 11) and AC 2 A / AC 230 V (AC 11)
Switch contact (NC contact)	–	according to EN 60730

31972098/EN – 8/2024

4.13.4 Dimension drawings and dimensions

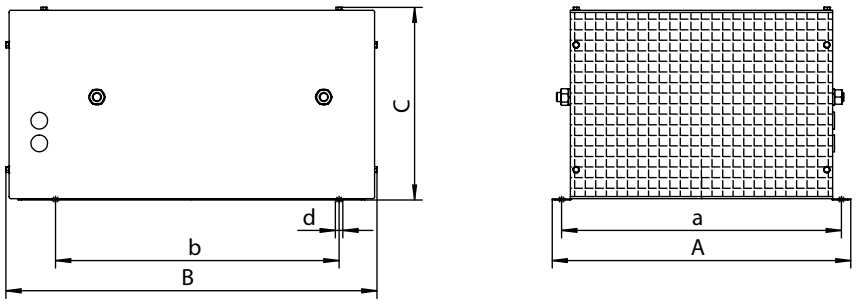
Wire resistor



9007218129604875

Braking resistor	Main dimensions in mm			Mounting dimensions in mm				Cable gland
	A	B	C	a	b	d	x	
BW100-006-T	549	92	125	430	80	6.5	8	M25 + M12
BW047-010-T	749	92	125	630	80	6.5	8	M25 + M12
BW147-T	549	185	125	430	150	6.5	8	M25 + M12
BW247-T	749	185	125	630	150	6.5	8	M25 + M12
BW027-016-T	649	185	125	530	150	6.5	8	M25 + M12
BW027-024-T	649	275	125	530	240	6.5	8	M25 + M12
BW015-016	649	185	125	530	150	6.5	8	M25
BW010-024	649	275	125	530	240	6.5	8	M25

Grid resistor mounting position 1

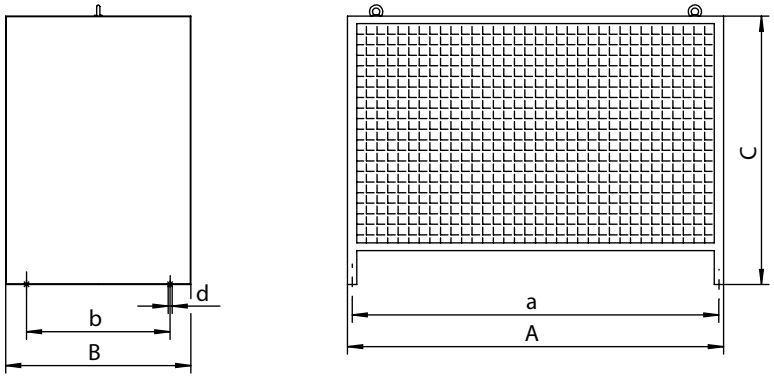


18874868747

Braking resistor	Main dimensions in mm			Mounting dimensions in mm				Cable gland
	A	B	C	a	b	d	x	
BW015-075-T	415	500	270	395	380	9	–	–
BW106-T	795	490	270	770	380	10.5	–	–
BW206-T	995	490	270	970	380	10.5	–	–
BW915-T	795	490	270	770	380	10.5	–	–
BW010-050-T	395	490	260	370	380	10.5	–	–
BW010-108-T	525	500	270	505	380	9	–	–
BW004-050-01	395	490	260	370	380	10.5	–	–
BW005-070	395	490	260	370	380	10.5	–	–
BW002-070	395	490	260	370	380	10.5	–	–
BW005-170-T	490	795	270	380	770	10.5	–	–
BW006-025-01	295	490	260	270	380	10.5	–	–
BW006-050-01	395	490	260	370	380	10.5	–	–

31972098/EN – 8/2024

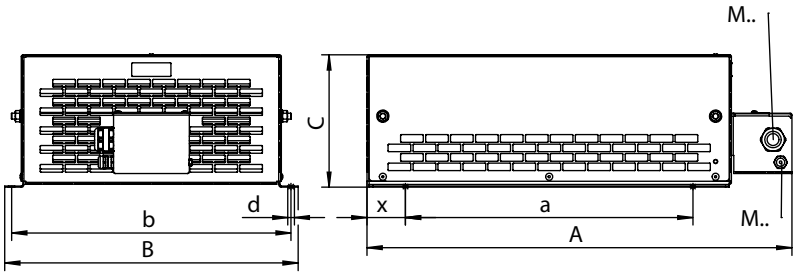
Grid resistor mounting position 2



18874876043

Braking resistor	Main dimensions in mm			Mounting dimensions in mm				Cable gland
	A	B	C	a	b	d	x	
BW003-420-T	995	490	710	970	380	10.5	–	–
BW1.0-170	490	795	490	380	770	10.5	–	–

Frame resistor

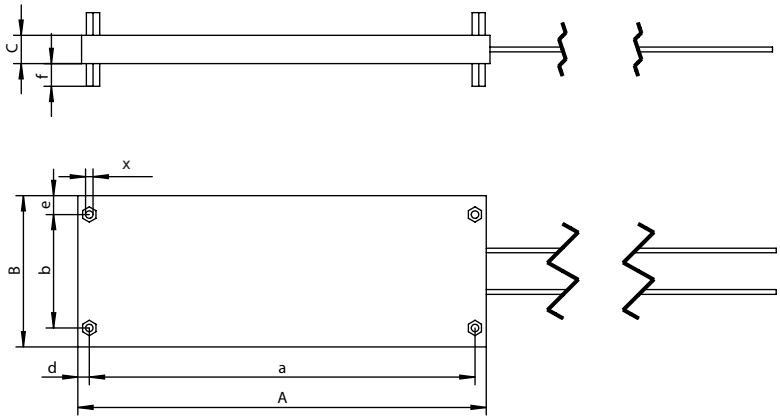


9007218129614603

Braking resistor	Main dimensions in mm			Mounting dimensions in mm				Cable gland
	A	B	C	a	b	d	x	
BW027-042-T	570	390	180	380	370	6.5	55	M25 + M12
BW015-042-T	570	390	180	380	370	6.5	55	M25 + M12

31972098/EN – 8/2024

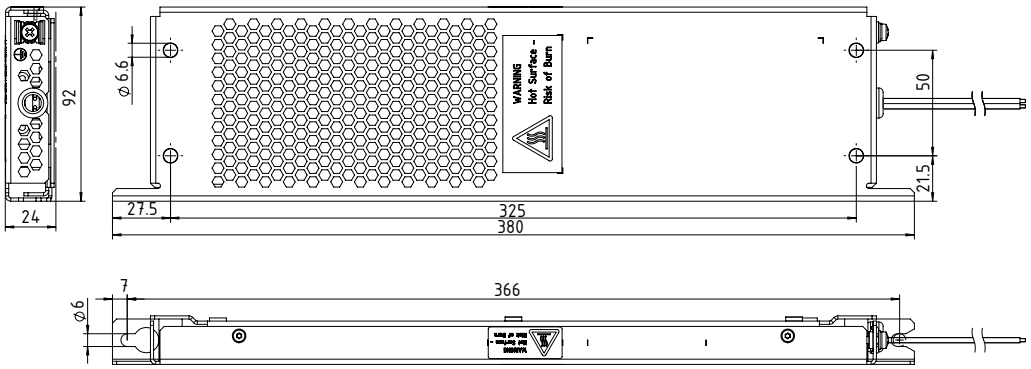
Flat-type resistor



9007218129619467

Braking resistor	Main dimensions in mm			Mounting dimensions in mm				Connection length in mm
	A	B	C	a	b	d	x	
BW100-001	110	80	15	98	60	–	–	300
BW100-002	216	80	15	204	60	–	–	300

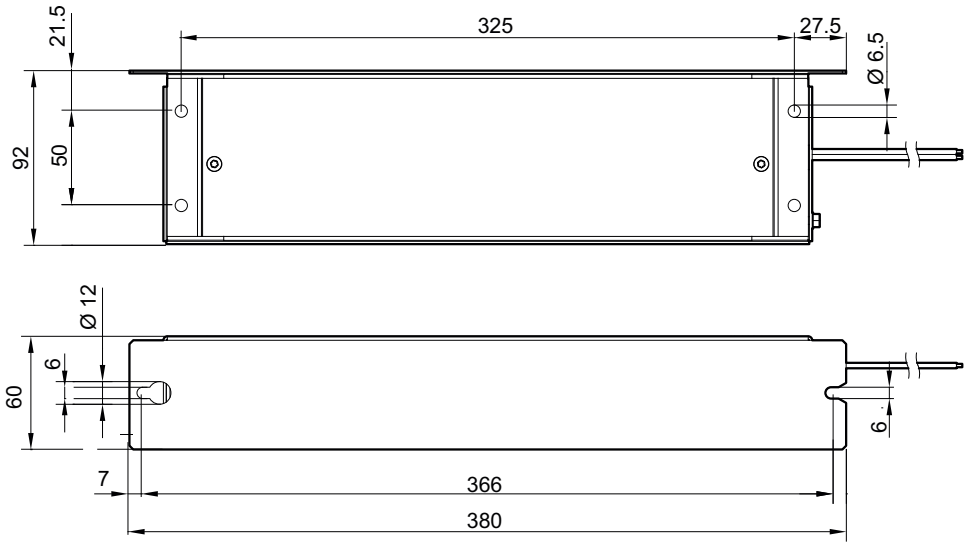
BW120-001 resistor



Length of connections: 130 mm

31972098/EN – 8/2024

BW100-002/M resistor



18014432925587851

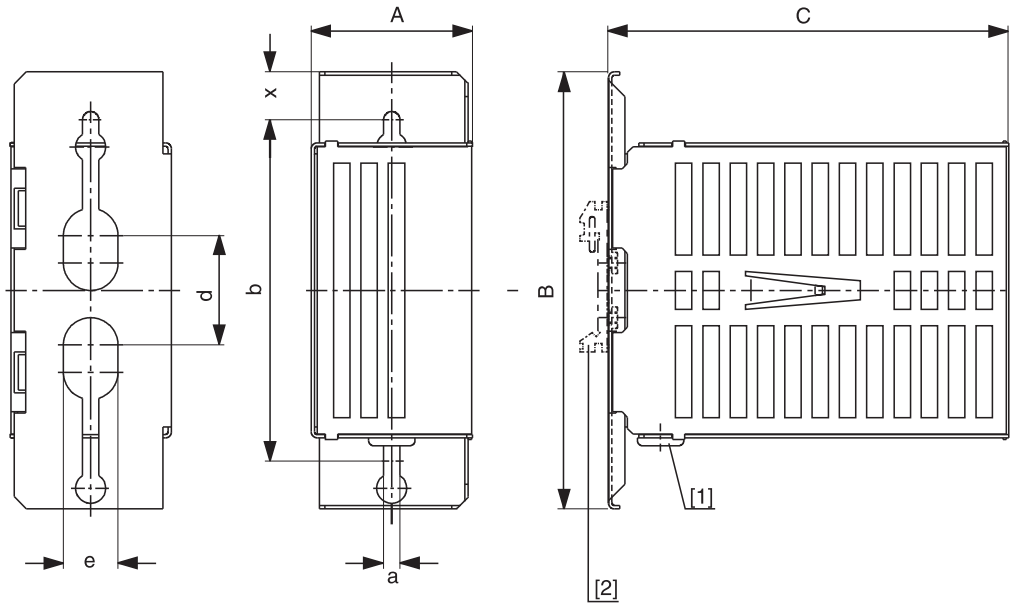
BS.. touch guard

Description

A BS.. touch guard is available for flatpack resistors.

Touch guard	Part number	Braking resistor
BS003	8131511	BW100-001
BS005	813152X	BW100-002

Dimension sheet and dimensions



1455849867

[1] Grommet
[2] Mounting rail fastening HS001 for mounting rail installation (can be ordered separately, part number 8221944)

Type	Main dimensions in mm			Mounting dimensions in mm					Mass in kg
	A	B	C	b	d	e	a	x	
BS003	60	160	146	125	40	20	6	17.5	0.35
BS005	60	160	252	125	4	20	6	17.5	0.5

4.14 NF.. line filter

4.14.1 Description

NF.. line filters are used to suppress electromagnetic interference between the supply system and the inverter. Line filters are required to comply with the interference emissions of limit class C2 according to EN 61800-3.

INFORMATION

Do not switch between the NF.. line filter and inverter.

4.14.2 Technical data

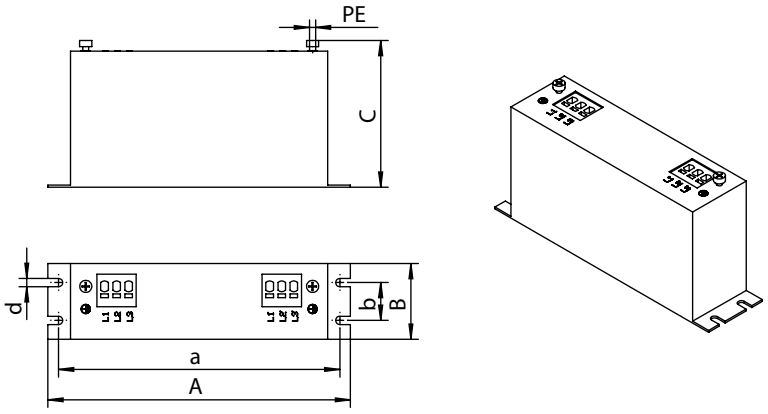
Line filter	Unit	NF0055-503	NF0120-503	NF0220-503	NF0420-513	NF0910-523	NF1800-523	NF2700-503	NF5400-503
Part number	–	17984319	17984270	17984300	17983789	17987504	17987865	18000576	29655331
Nominal line voltage (according to EN 50160) V_{line}	V	3 × AC 200 – 500 V							
Line frequency f_{line}	Hz	50 – 60 ±5%							
Nominal current I_N	A	5.5	12	22	42	91	180	270	540
Nominal power loss	W	4	6	30	30	51.5	89	103	In preparation
Ambient temperature ϑ_{amb}	°C	0 – 45							
Derating at ambient temperature > 45 °C	–	-3% I_N/K up to maximum 60 °C							
Connection contact L1/L2/L3 – L1'/L2'/L3'	–	Cage clamp terminals			Screw terminal			M12 bolt	
Cross section L1/L2/L3 – L1'/L2'/L3'	mm^2	Max. 6			2.5 – 16	16 – 50	16 – 120	–	
Tightening torque L1/L2/L3 – L1'/L2'/L3'	Nm	–			2 – 4	3.5 – 6	12 – 20	14 - 20	
PE connection contact	–	M4 screw		M5 screw	M6 bolt	M8 bolt	M10 bolt	M12 bolt	
Tightening torque PE	Nm	1.5		3	6	12	23	30	
Degree of protection according to EN 60529	–	IP20						IP00	
Mass	kg	1	1	1.4	3	5	9	13.2	In preparation

4.14.3 Assignment to an inverter

Line filter	NF0055-503	NF0120-503	NF0220-503	NF0420-513	NF0910-523	NF1800-523	NF2700-503	NF5400-503
MDX9.A-....-5.3..	0020 – 0040	0055 – 0095	0125 – 0160	0240 – 0320	0460 – 0750	0910 – 1490	1770 – 3000	3800 – 5880
MDX9.A-....-2.3..	–	0070 – 0093	0140	0213 – 0290	0420 – 0570	0840 – 1080	–	–

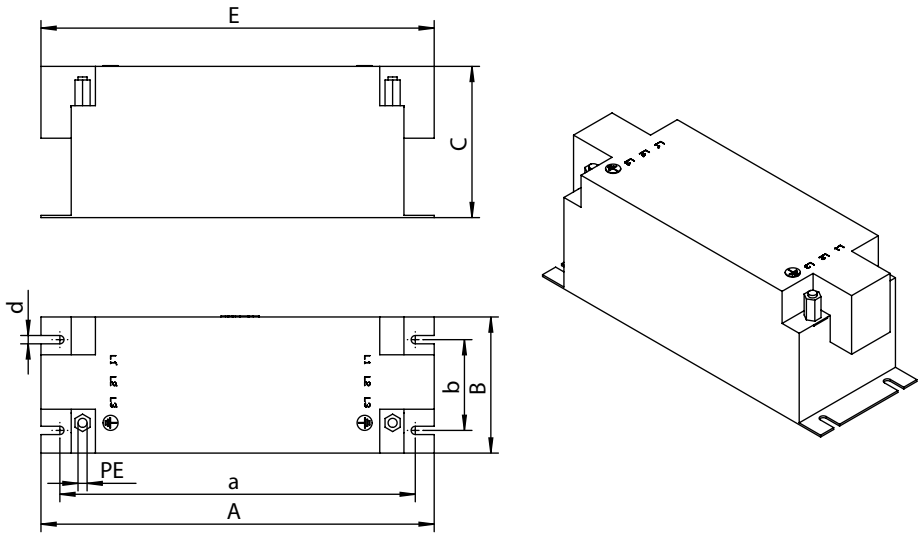
31972098/EN – 8/2024

4.14.4 Dimension drawings and dimensions



18891135115

Line filter	Main dimensions in mm				Mounting dimensions in mm			Connection
	A	B	C	E	a	b	d	PE
NF0055-503	200	50	97	–	186	25	5.5	M4
NF0120-503	200	50	97	–	186	25	5.5	M4
NF0220-503	230	55	102	–	216	30	5.5	M5



9007218145873675

Line filter	Main dimensions in mm				Mounting dimensions in mm			
	A	B	C	E	a	b	d	PE
NF0420-513	250	88	97	255	235	60	5.5	M6
NF0910-523	270	97	152	322	255	65	6.5	M8
NF1800-523	380	131	182	464	365	102	6.5	M10
NF2700-503	450	231	284	463	435	172	6.5	M12
NF5400-503	670	338	285	630	648.5	280	8.5	M12

4.15 ND.. line chokes

4.15.1 Description

A line choke ND... can be used as an option:

- To support overvoltage protection
- To smoothen the line current, to reduce harmonics
- For protection in the event of distorted line voltage
- Limiting the charging current when several inverters are connected together in parallel on the input end with a shared line contactor (nominal current of line choke = total of inverter currents)

Sizes 7 and 8 have an integrated line choke. An additional line choke is only required for a DC link connection of several devices, see manual MOVI-C® DC link connection.

4.15.2 Technical data

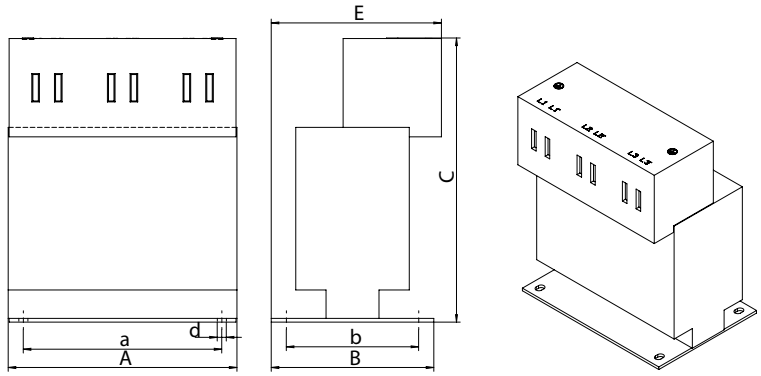
Line choke	Unit	ND0070-503	ND0160-503	ND0300-503	ND0420-503	ND0910-503	ND1800-503	ND3000-503
Part number	–	17984173	17984181	17983800	17983819	17987520	17987539	18001211
Nominal line voltage (in accordance with EN 50160) V_{line}	V	3 × AC 200 – 500						
Line frequency f_{line}	Hz	50 – 60 ±5%						
Nominal current I_N	A	7	16	30	42	91	180	300
Nominal inductance	mH	0.36	0.2	0.1	0.045	0.035	0.018	0.05
Nominal power loss	W	4	9	11	13	53	116	280
Ambient temperature ϑ_{amb}	°C	-10 – 45 Derating at ambient temperature > 45 °C: -3% I_N/K up to maximum 60 °C						
Connection contact L1/L2/L3 – L1'/L2'/L3'	–	Screw terminal						M12 bolt
Cross section L1/L2/L3 – L1'/L2'/L3'	mm^2	0.2 – 4		0.2 – 16		16 – 50	16 – 120	–
Tightening torque L1/L2/L3 – L1'/L2'/L3'	Nm	0.5 – 1		1.2 – 2		3.5 – 6	12 – 20	30
PE connection contacts	–	M4 screw		M5 screw		M8 bolt	M10 bolt	2 × M10 bolts
Tightening torque PE	Nm	1.5		3		12	20	
Degree of protection according to EN 60529	–	IPXXB				IPXXA		IPXXA with terminal cover provided
Mass	kg	0.5	1.3	1.95	1.82	4.4	10	36

4.15.3 Assignment to an inverter

Line choke	ND0070-503	ND0160-503	ND0300-503	ND0420-503	ND0910-503	ND1800-503	ND3000-503
MDX9.A-....-5.3..	0020 – 0055	0070 – 0125	0125 – 0160	0240 – 0320	0460 – 0750	0910 – 1490	–
MDX9.A-....-2.3..	–	0070 – 0093	0140	0213 – 0290	0420 – 0570	0840 – 1080	–

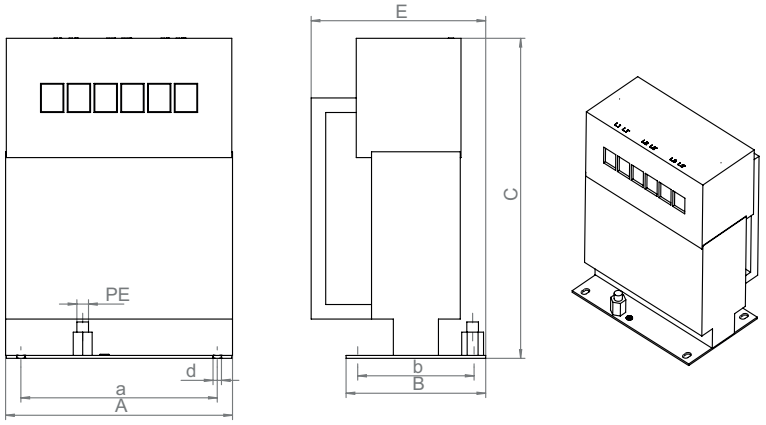
31972098/EN – 8/2024

4.15.4 Dimension drawings and dimensions



18891130251

Line choke	Main dimensions in mm				Mounting dimensions in mm			Connection
	A	B	C	E	a	b	d	PE
ND0070-503	78	57	105	56	65	40	4.8	M4
ND0160-503	96	70	120	65	71	54	4.8	M4
ND0300-503	121	86	145	86	105	70	4.8	M5
ND0420-503	121	86	150	90	105	70	4.8	M5



20917778571

Line choke	Main dimensions in mm				Mounting dimensions in mm			Connection
	A	B	C	E	a	b	d	PE
ND0910-503	156	96	220	120	135	80	5.8	M8
ND1800-503	187	121	260	153	166	93	6.2	M10
ND3000-503	280	–	286	188	255	144	11 × 22 slotted hole	M10

4.16 HF.. output filters

4.16.1 Description

The HF.. output filter is a sine filter used to smooth the output voltages of inverters:

- Discharge currents in the motor cables are suppressed.
- Motor winding insulations of third-party motors that are not suitable for inverters are protected.
- For long motor cables (> 100 m), overvoltage peaks are prevented.

4.16.2 Technical data

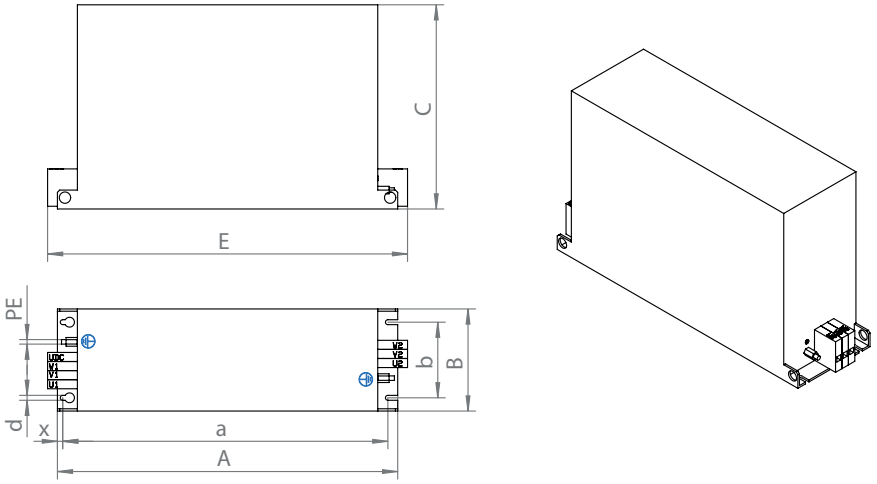
Output filter	Unit	HF0055-503	HF0125-503	HF0240-503	HF0460-503	HF0650-503	HF1150-503
Part number	–	17985110	17985129	17985137	17985145	17991277	17991269
Nominal voltage	V	3 × 0 – 500 V					
Nominal current I_N	A	5.5	12.5	24	46	65	115
Nominal power loss	W	80	120	200	400	500	900
Ambient temperature ϑ_{amb}	°C	0 – 45 Derating at ambient temperature > 45 °C: -3% I_N/K up to maximum 60 °C					
Connection contacts U1/V1/W1/UDC – U2/V2/W2	–	Screw terminal					
Cross section U1/V1/W1/UDC – U2/V2/W2	mm^2	0.2 – 10		2.5 – 16		16 – 50	16 – 95
Tightening torque U1/V1/W1/UDC – U2/V2/W2	Nm	1.2 – 2		2 – 4		3 – 6	12 – 20
PE connection contacts	–	M6 bolt				M8 bolt	M10 bolt
Tightening torque PE	Nm	6				12	23
Degree of protection according to EN 60529	–	IPXXB				IPXXA	
Mass	kg	8	18	25	40	48	68

4.16.3 Assignment to an inverter

Output filter	HF0055-503	HF0125-503	HF0240-503	HF0460-503	HF0650-503	HF1150-503
MDX9.A-....-5.3..	0020 – 0040	0055 – 0095	0125 – 0160	0240 – 0320	0460 0910 (parallel connection of 2 filters)	0620 – 0750 1130 – 1490 (parallel connection of 2 filters)
MDX9.A-....-2.3..	–	0070 – 0093	0140	0213 – 0290	0420	0570

31972098/EN – 8/2024

4.16.4 Dimension drawings and dimensions



9007218523812619

Output filter	Main dimensions in mm				Mounting dimensions in mm				Connection PE
	A	B	C	E	a	b	d	x	
HF0055-503	310	105	160	–	290	75	6.5	7	M6
HF0125-503	390	120	215	–	370	90	6.5	7	M6
HF0240-503	450	135	270	–	430	100	6.5	7	M6
HF0460-503	450	160	310	–	430	120	6.5	7	M6
HF0650-503	635	210	285	637	610	174	8.5	10	M8
HF1150-503	725	260	273	755	700	224	8.5	10	M10

31972098/EN – 8/2024

4.17 HD.. output chokes

4.17.1 Description

The HD.. output choke suppresses interference emission from the unshielded motor cable.

4.17.2 Technical data

Output choke	Unit	HD0125-503	HD0240-503	HD0460-503	HD1000-503	HD2000-503	HD6000-503	HD6001-503
Part number		17985153	17985188	17985161	17991307	17991250	17963362	–[1]
Nominal voltage	V	3 × 0 – 500 V						
Nominal current I_N	A	12.5	24	46	100	200	600	–[1]
Nominal power loss	W	2.9	6	14	37	83	162	–[1]
Ambient temperature ϑ_{amb}	°C	0 – 45 Derating at ambient temperature > 45 °C: -3% I_N/K up to maximum 60 °C						
Connection contacts U1/V1/W1/UDC – U2/V2/W2		Screw terminal					Copper rail	–[1]
Cross section U1/V1/W1/UDC – U2/V2/W2	mm^2	0.2 – 10	2.5 – 16		16 – 50	16 – 150	30 × 8, bore ØM12 mm	–[1]
Tightening torque U1/V1/W1/UDC – U2/V2/W2	Nm	1.2 – 2	2 – 4		6 – 8	12 – 20	–	–[1]
PE connection contacts		M6 bolt			M8 bolt	M10 bolt	M12 × 50	–[1]
Tightening torque PE	Nm	6			12	23	30	–[1]
Degree of protection according to EN 60529		IPXXB			IPXXA		IP00	–[1]
Mass	kg	0.85	1.46	2.35	3	6.5	16	–[1]

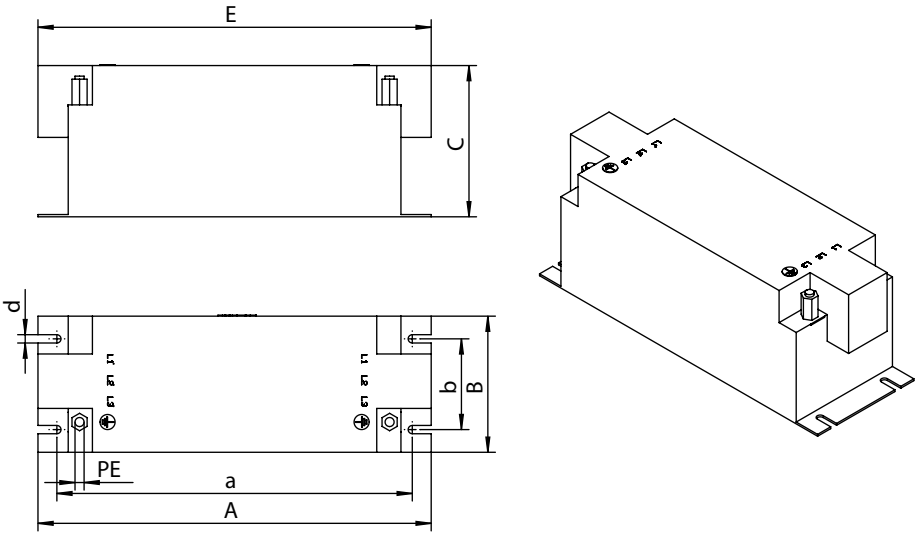
1) Values in preparation.

4.17.3 Assignment to an inverter

Output choke	HD0125-503	HD0240-503	HD0460-503	HD1000-503	HD2000-503	HD6000-503	HD6001-503
MDX9.A-....-5.3..	0020 – 0095	0125 – 0160	0240 – 0320	0460 – 0750	0910 – 1490	1770 – 3000	–
MDX9.A-....-2.3..	0070 – 0093	0140	0213 – 0420	0420 – 0840	1080	–	–

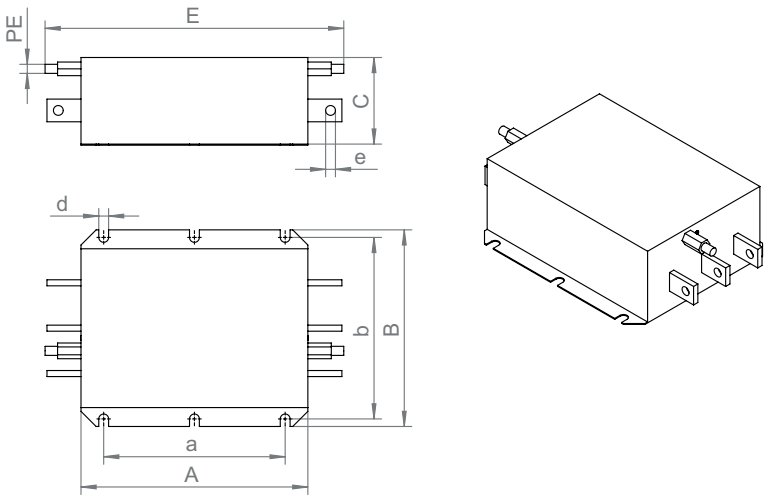
31972098/EN – 8/2024

4.17.4 Dimension drawings and dimensions



9007218145873675

Output choke	Main dimensions in mm				Mounting dimensions in mm			Connection
	A	B	C	E	a	b	d	PE
HD0125-503	153	62.5	72.5	151	138	40	5.5	M6
HD0240-503	173	92.5	82.5	178	158	65	5.5	M6
HD0460-503	185	122.5	112.5	189	170	90	5.5	M6
HD1000-503	255	116	143.5	265	240	82	6.5	M8
HD2000-503	300	178	175	330	286	120	6.5	M10



35975896715

Output choke	Main dimensions in mm				Mounting dimensions in mm				Connection
	A	B	C	E	a	b	d	e	PE
HD6000-503	300	260	116	395	240	240	13	13	M12

31972098/EN – 8/2024

4.18 ZD.. DC link choke

4.18.1 Description

The ZD.. DC link choke suppresses the oscillations when the inverter is supplied via the DC link connection.

4.18.2 Technical data

DC link choke	Unit	ZD010-0200	ZD040-0070	ZD140-0020	ZD330-0006
Part number	–	17968437	17968402	17968410	17968429
Nominal current DC I_N	A	10	40	140	330
Power loss at I_N P_V	W	7	17	29	40
Ambient temperature ϑ_{amb}	°C	-10 – 40 Derating at ambient temperature > 40 °C: -3% I_N/K up to maximum 60 °C			
Connection contact $+U_Z$ /$-U_Z$/$+U_Z'$/$-U_Z'$	–	Terminal strips	M6 bolt	M10 bolt	M12 bolt
Cross section $+U_Z$ /$-U_Z$/$+U_Z'$/$-U_Z'$	mm^2	4	–	–	–
Tightening torque $+U_Z$ /$-U_Z$/$+U_Z'$/$-U_Z'$	Nm	–	3	10	15.5
PE connection contact	–	M5 bolt	M6 bolt	M8 bolt	
Tightening torque PE	Nm	0.6 – 0.8	3	6	
Degree of protection according to EN 60529	–	IP10			

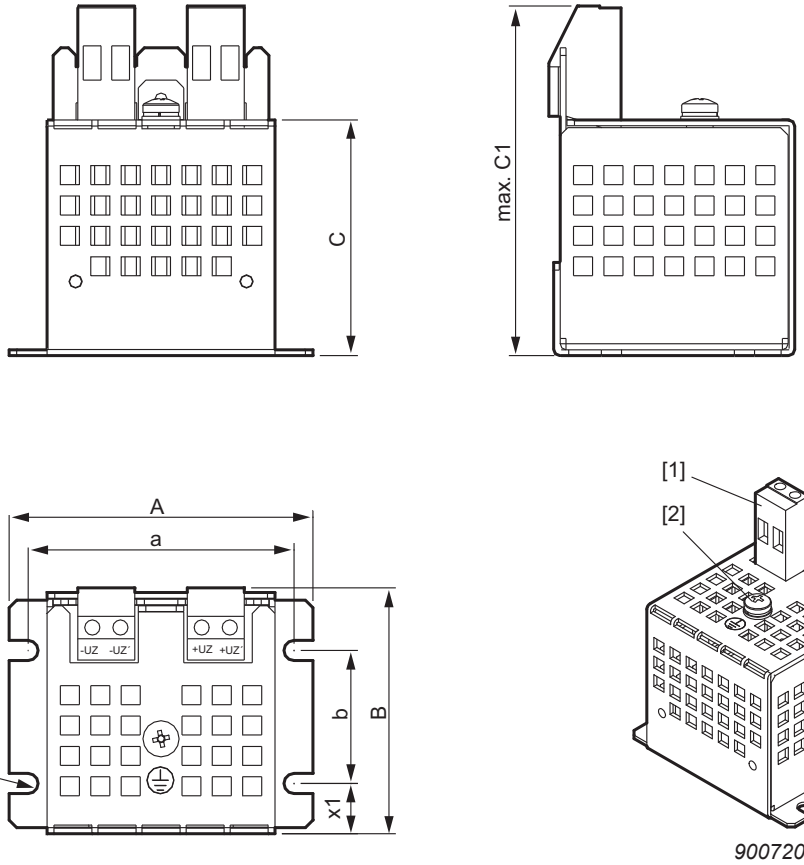
4.18.3 Assignment to inverter

DC link choke	ZD010-0200	ZD040-0070	ZD140-0020	ZD330-0006
MDX9.A-....-5.3..	0020 – 0070	0095 – 0240	0320 – 0750	0910 – 1490
MDX9.A-....-2.3..	0070	0093 – 0213	0290 – 0570	0840 – 1080

31972098/EN – 8/2024

4.18.4 Dimension drawings and dimensions

DC link choke ZD010..



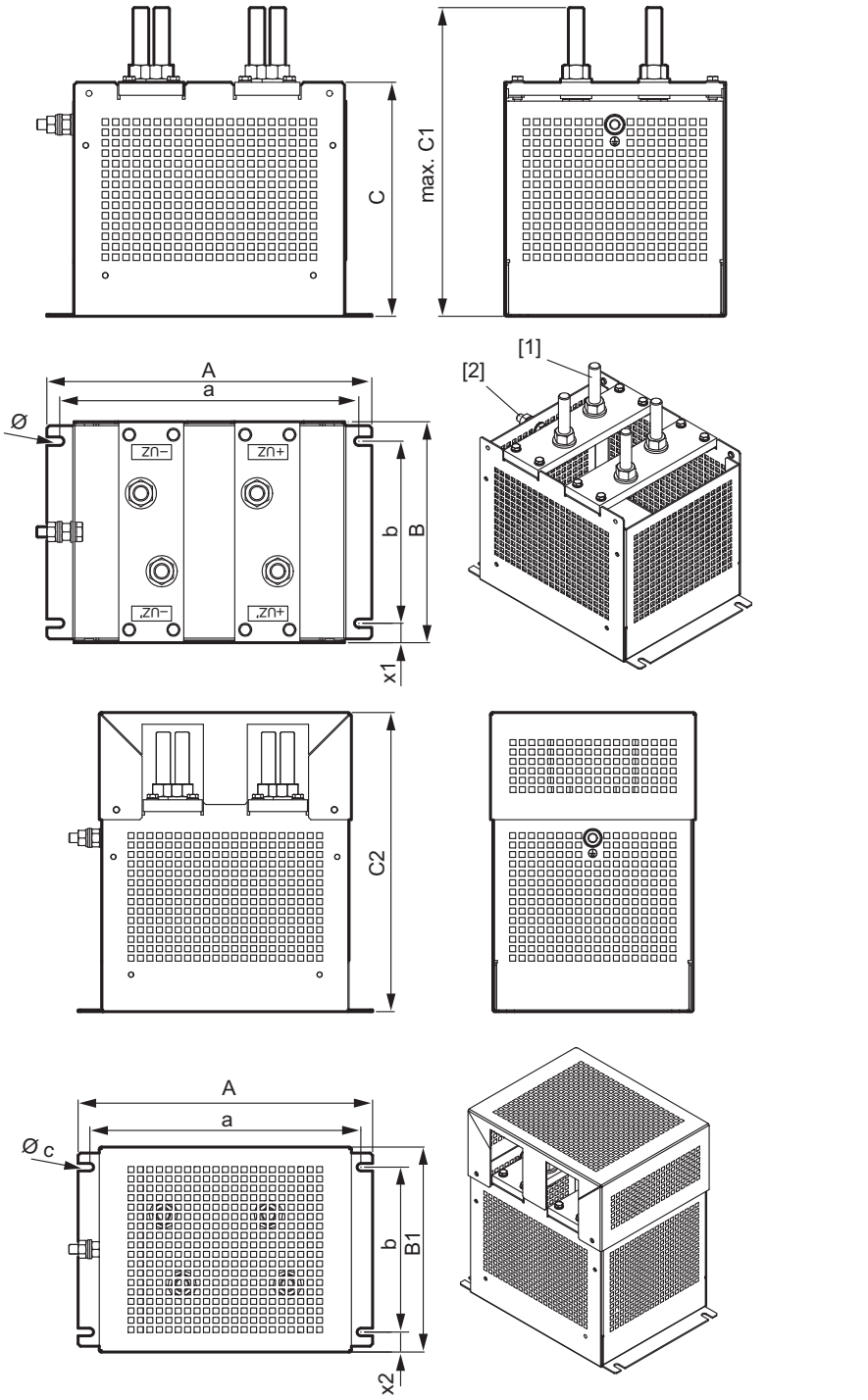
9007203134416907

[1] Connecting terminal
[2] Ground stud

DC link choke	Main dimensions in mm				Mounting dimensions in mm				Mass
	A	B	C	C1	a	b	x1	c	kg
ZD010-0200	80	64.75	62	95	70	35	13.25	5.3	0.56

31972098/EN – 8/2024

DC link choke ZD040.. / ZD140.. / ZD330.. with and without cover



9007203134363787

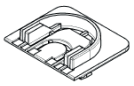
[1] Terminal stud

[2] Ground stud

DC link choke	Main dimensions in mm						Mounting dimensions in mm					Mass
	A	B	B1	C	C1	C2	a	b	c	x1	x2	kg
ZD040-0070	130	94	98	116	145	156	120	60	5.3	15	17	2
ZD140-0020	190	130	134	110	150	164.5	170	100	6.5	15	17	4.5
ZD330-0006	250	170	174	180	240	254	230	140	6.5	15	17	8.8

31972098/EN – 8/2024

4.19 Standard accessories

Inverter	Plastic cover	Quantity	Scope of delivery	Description	Part number
Size 5		10	Not included in the scope of delivery	"Cover to increase the degree of protection" (→ 🗎 355)	28243625
Size 6		10			28244540
Size 7		12			28257677
Size 8		24			28296222

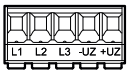
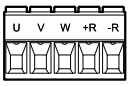
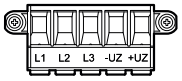
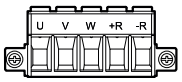
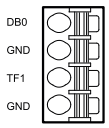
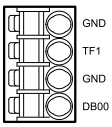
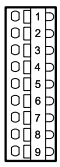
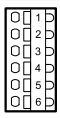
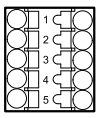
Inverter	Carrying aid	Quantity	Scope of delivery	Description	Part number
Size 6		1	Included in the scope of delivery	"Auxiliary tools for assembly" (→ 🗎 14)	28106229
Size 7					28257685

Inverter	Shield plate	Quantity	Scope of delivery	Description	Part number accessory pack
Sizes 1 – 8	Shield plate on control unit for control cables	1	Included in the scope of delivery	Shield plate for shield support and strain relief	28220250
Sizes 1 – 2	Shield plate for motor and control cables				28209060
Sizes 3 – 4					28222725
Size 5	Shield plate for coaxial cable of the MOVILINK® DDI cable				28270789
Sizes 6 – 8	Shield plate for coaxial cable of the MOVILINK® DDI cable				28297040

31972098/EN – 8/2024

4.20 Connectors

The following list is used for re-ordering connectors:

Representation	Slot	Function	Size	Part number
	X1	Line connection	1 – 3	19148429
	X2	Motor connection	1 – 3	19148437
	X1	Line connection	4	19148496
	X2	Motor connection	4	19148380
	X5	DC 24 V supply voltage	All	19148410
	X10	Brake control	1 – 4	19151314
	X10	Brake control	5 – 8	19147392
	X20	Signal connection 1	All	19148615
	X21	Signal connection 2	All	19148623
	X6	STO single connector (without jumpers)	All	19155611
		STO-E connector (with jumpers)	All	18177905

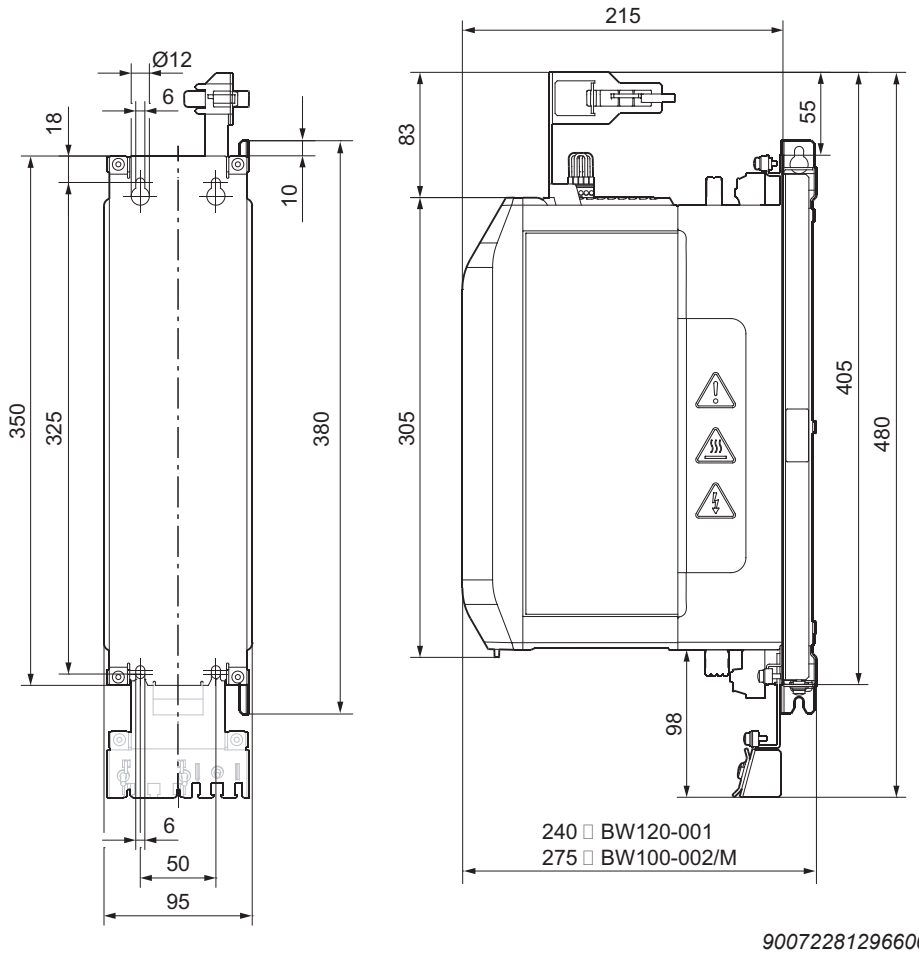
31972098/EN – 8/2024

4.21 Dimension drawings

4.21.1 Size 1



43256102795

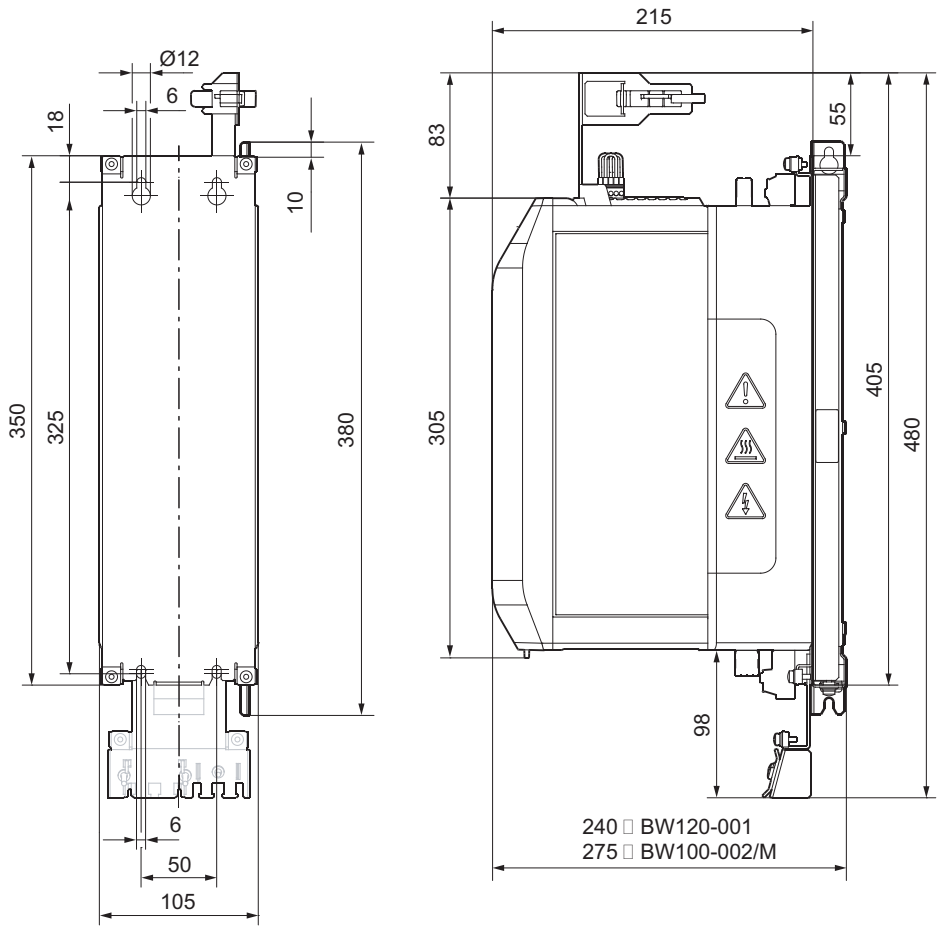


9007228129660043

4.21.2 Size 2



43256682635



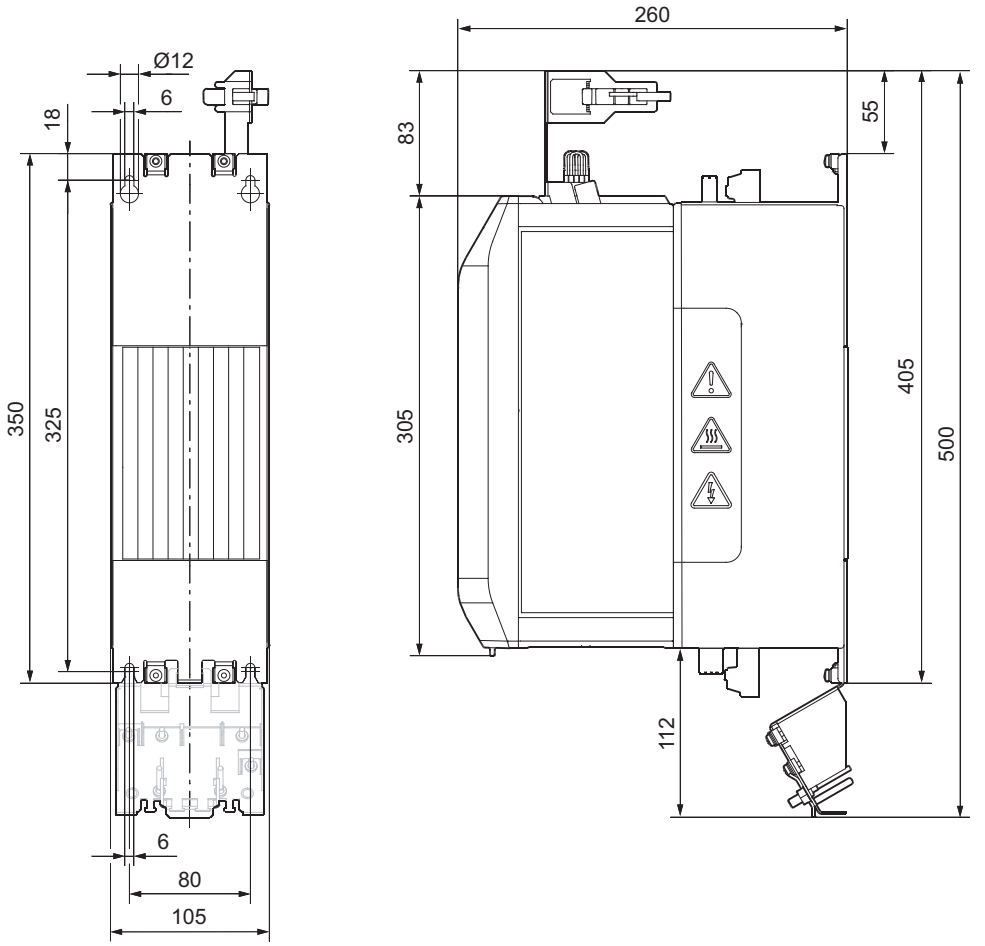
9007228129263883

31972098/EN – 8/2024

4.21.3 Size 3



43256685963

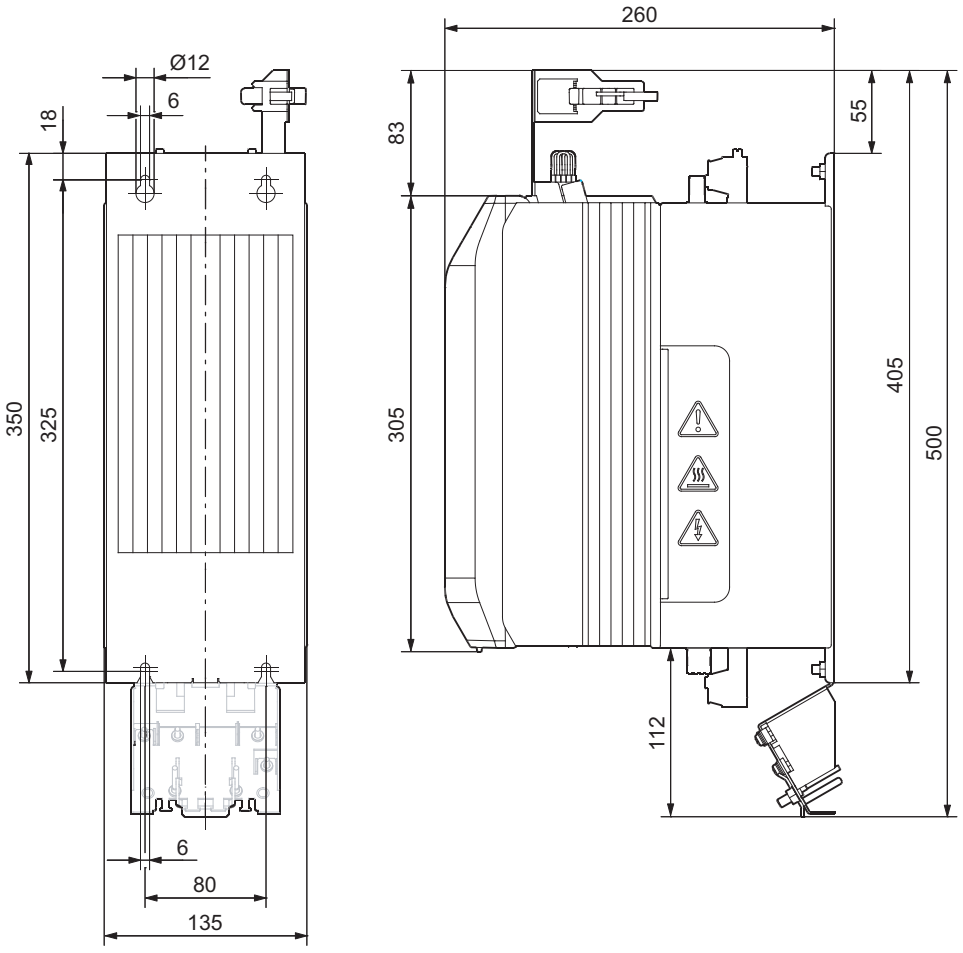


9007228129266315

4.21.4 Size 4



43256689291



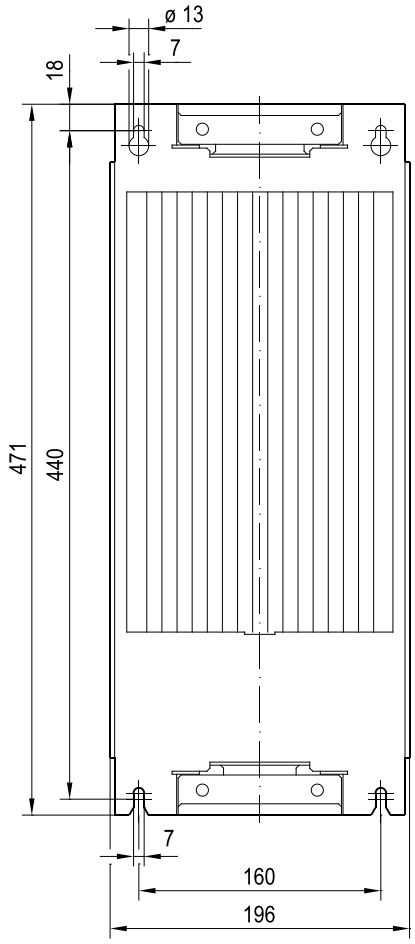
9007228129268747

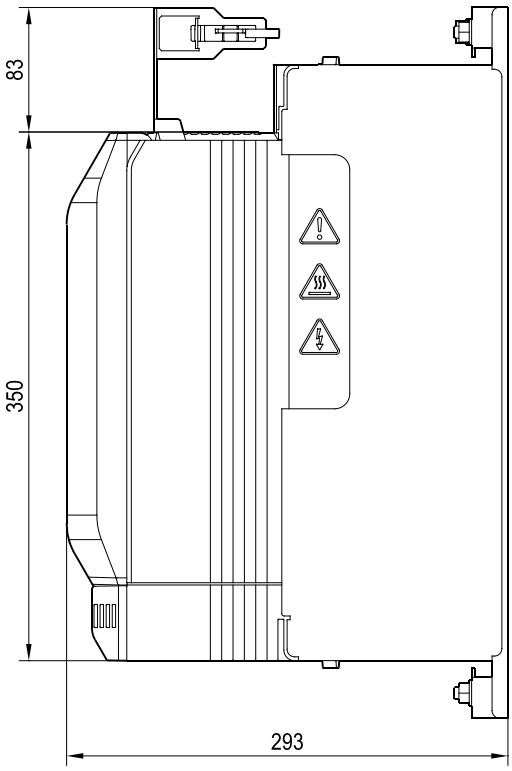
31972098/EN – 8/2024

4.21.5 Size 5



43256692619



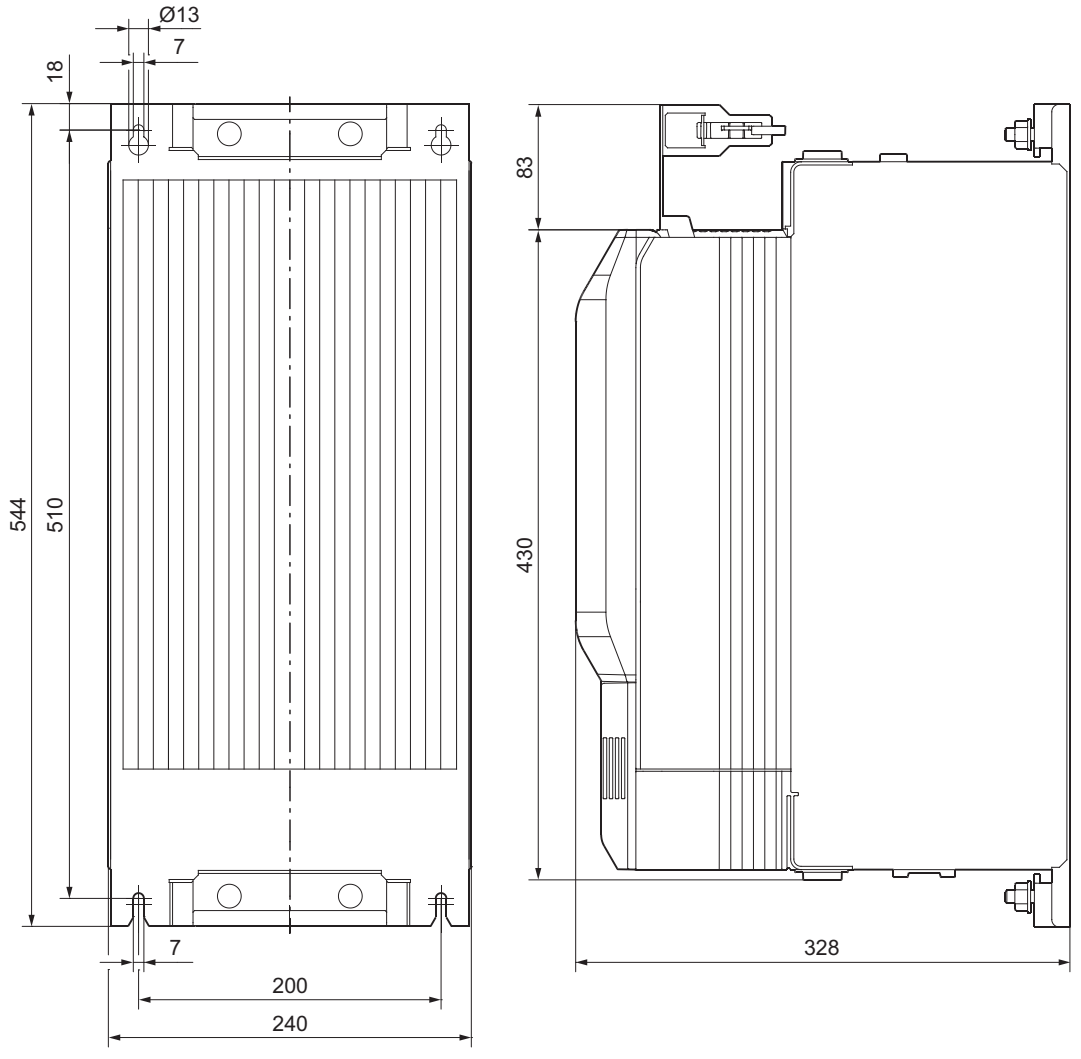


9007228129271179

4.21.6 Size 6



42922236171



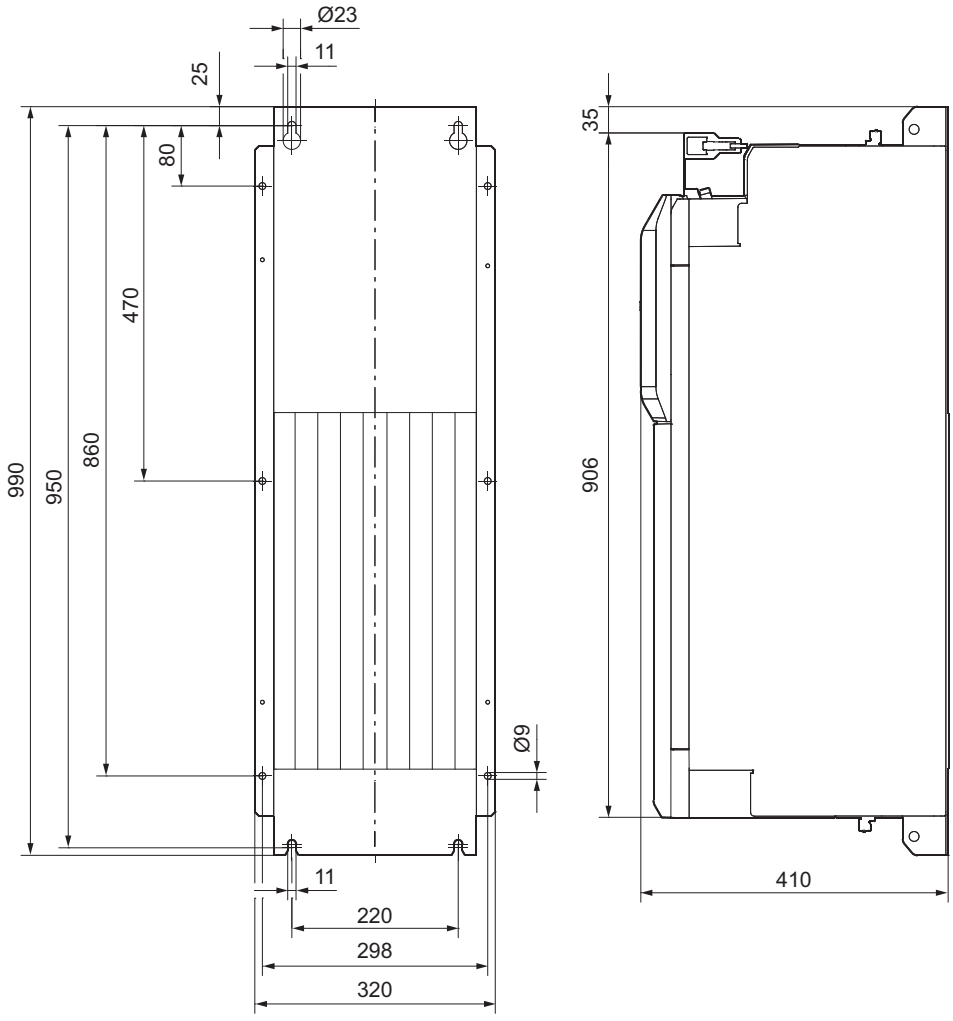
9007228129273611

31972098/EN – 8/2024

4.21.7 Size 7

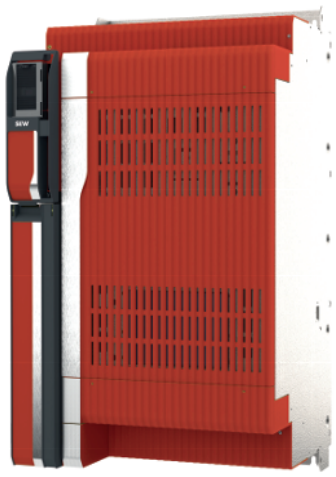


43268166923

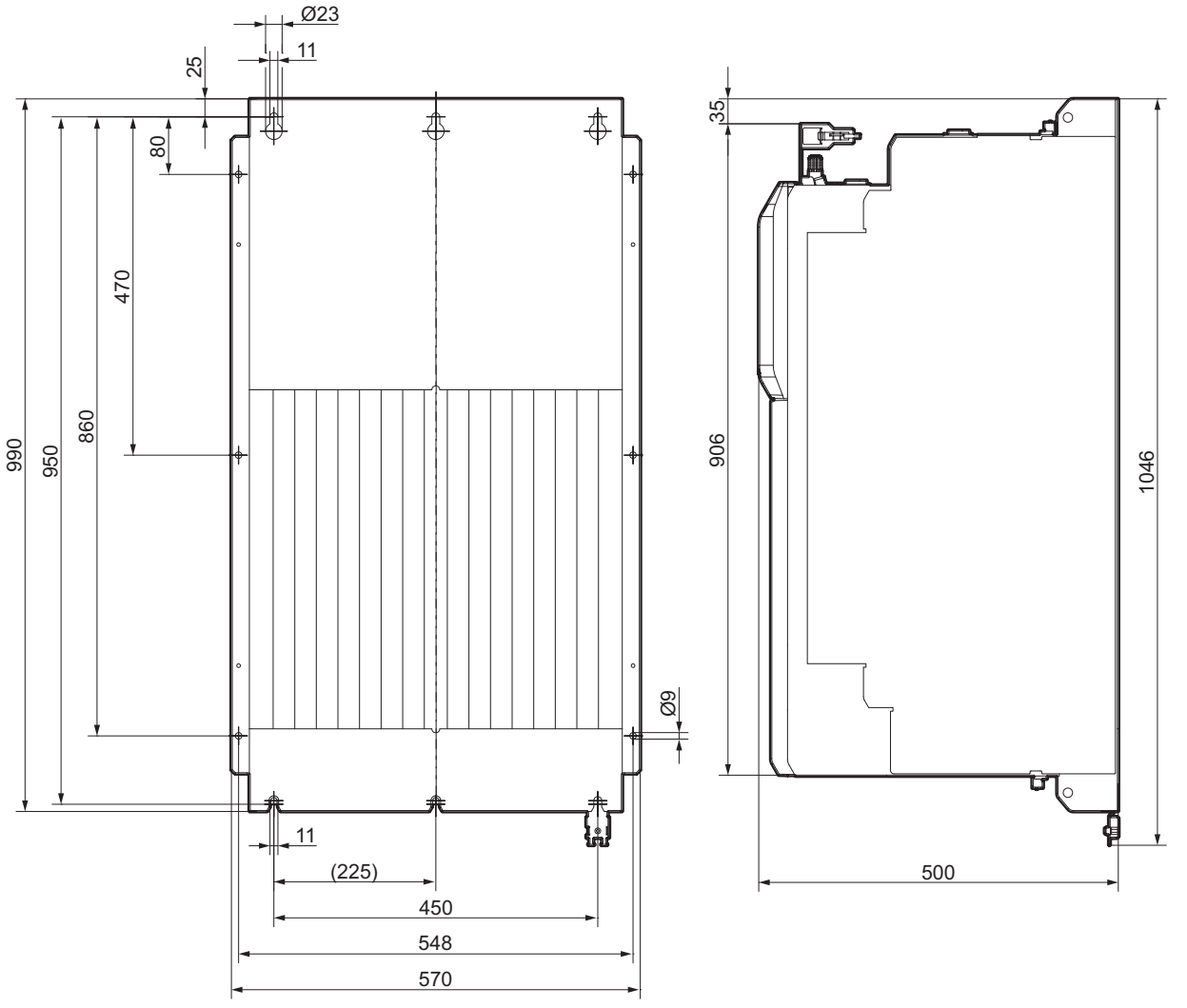


9007234990992651

4.21.8 Size 8



42922239499



42205426315

31972098/EN – 8/2024

5 Project planning of the device

5.1 SEW-Workbench

The SEW-Workbench is the central configuration software for inverters from SEW-EURODRIVE.

It can process any required configurations, from entering the application to gear unit, motor and inverter calculations. Optimization of the various axis cycles including accessory selection and error check of the entire drive system design are further features.

Of course, the Workbench can also be used to select and dimension all other products from SEW-EURODRIVE, such as decentralized drives and gearmotors. This means SEW-Workbench allows for dimensioning drive solutions from the entire product range from SEW-EURODRIVE. The straightforward operation saves a great deal of time and minimizes complexity.

The key features of the SEW-Workbench are:

- Application selection
- Gear unit and motor calculation
- Price-optimized configuration
- Comparison of different solutions
- Inverter calculation
- Multi-axis optimization
- Parameterization of cable and accessories selection
- Dimensioning error check
- Parts list generation
- The electronic catalog with all products

The SEW-Workbench configuration software is available for download from the official SEW-EURODRIVE website.

To use SEW-Workbench, all you need to do is to register via the Online Support once you have downloaded and installed the software or received the data DVD. An Internet update service ensures that the products and functions are always up-to-date.

5.2 Schematic workflow for project planning

The following flow diagram illustrates the drive selection procedure for a positioning drive. The drive consists of a gearmotor that is supplied by an inverter.

Required information about the machine to be driven

- Technical data and ambient conditions
- Positioning accuracy
- Speed setting range
- Calculation of the travel cycle

↓

31972098/EN – 8/2024

Calculate the relevant application data
- Travel diagram
- Rotational speeds
- Static, dynamic torques
- Regenerative power

↓

Gear unit selection
- Define the gear unit size, gear unit ratio, and gear unit design
- Check the positioning accuracy.
- Check the gear unit load.
- Check the input speed.

↓

Motor selection
- Maximum torque
- With dynamic drives: effective torque at medium speed
- Maximum speed
- Observe dynamic and thermal torque curves.
- Motor equipment (brake, plug connector, thermal motor protection, etc.)

↓

Inverter selection
- Determine the control mode.
- Motor/inverter assignment
- Determine the PWM frequency.
- Check if the inverters fulfill the duration and overload requirements.

↓

Select the braking resistor
- Check if the braking resistor fulfills the duration and overload requirements.
- Observe braking resistor assignment.

↓

Select other system components
- Option cards
- Motor and supply system cables
- Signal and encoder cables
- EMC measures

↓

Select the 24 V voltage supply
- Determine the current demand of the 24 V voltage supply.
- Observe the requirements for the voltage tolerance.

↓

Ensure that all requirements have been met.

31972098/EN – 8/2024

5.3 Control mode

The characteristics of the motor connected to the inverter are influenced by the control modes used.

5.3.1 U/f

U/f control is for simple controlled operation of asynchronous motors without encoder feedback and motors with LSPM technology[1] provided by SEW-EURODRIVE. The procedure operates an asynchronous machine on a parameterizable voltage/frequency characteristic. To keep the magnetizing current on a constant level, the voltage (V) is adjusted in proportion to the frequency (f).

The actual slip is estimated and can be compensated.

U/f control is suitable for applications with a limited speed setting range, where no dynamic step changes in load occur and where there are small requirements regarding the control characteristics.

U/f control is suitable for group drives. A group drive is an electrical parallel connection of several identical or different motors at one inverter. The motors do not have a rigid mechanical connection.

1) Guided startup in preparation.

Speed control

The V/f mode is an encoder-less mode and calculates the actual speed value. The calculation is always based on the electrical values of the motor; information from a potentially existing encoder system is not used.

If an encoder is parameterized in the encoder assignment as "Actual speed source", the speed measured by this encoder is issued as the actual speed by the inverter. Otherwise, the model speed calculated by the V/f mode based on stator frequency and slip is issued as the actual speed.

The V/f mode does not have a higher-level speed controller; speed controller parameterization is not possible. An acceleration and torque precontrol is not possible either.

5.3.2 VFC^{PLUS}

VFC^{PLUS} is a high-performance control mode that is able to operate asynchronous motors with very high torque dynamics with or without rotary encoder and synchronous reluctance motors[1] .

The control mode can be operated as speed or torque control.

This control mode calculates all important state variables for controlling the motor by using a motor model. As a result, optimal magnetic conditions are always achieved for the motor.

For applications with a large speed setting range (especially for low speeds through to idle state) and high requirements regarding the control characteristics or for drives with high dynamic step changes in load, a rotary encoder is absolutely necessary.

For applications with low requirements regarding the speed control characteristics and the torque dynamics, an encoder is not necessary. Without a rotary encoder, the electric rotor frequency is calculated in a model. In this case, stable stationary operation of the mode at < 0.5 Hz is not possible.

31972098/EN – 8/2024

Due to the good torque dynamics, the VFC^{PLUS} control mode remains stable even in the event of sudden load changes and has a high torque accuracy. Typical applications for the VFC^{PLUS} control mode are speed-controlled asynchronous machines with high demands on the speed and torque stability.

Switching to a rotating motor is possible (flying start function).

1) Guided startup in preparation.

Speed control

A higher-level speed control loop that has to be parameterized accordingly is always used for speed control.

If the control mode is operated without an encoder, the actual speed of the motor is calculated by the control mode.

If an encoder is used, the angle information of this encoder is used for the control mode. The actual speed of the motor is calculated from this encoder. The maximum dynamics of the speed control loop are reached with a high-resolution encoder.

Torque control

The torque control operating mode can be selected independently of an encoder and does not need an encoder. With an encoder, stable stationary operation at a stator frequency of 0 Hz is also possible.

A higher-level speed control loop that has to be parameterized accordingly is always used for torque control.

Position control

Position-controlled operation is only possible with an encoder, as the actual position is calculated from the parameterized encoder. This encoder can be mounted on the track or on the motor.

The accuracy of the position control can be increased with a motor encoder.

5.3.3 CFC

The CFC control mode is a current-controlled control mode. The CFC control mode allows the operation of asynchronous and synchronous motors with maximum torque dynamics. For this purpose, the current components for the magnetic flux and for the torque generation are controlled separately.

The control mode requires information about the rotor angle and the motor speed. For this reason, an encoder feedback (motor encoder) is always necessary.

For asynchronous motors, only the relative rotor angle is necessary. Thus, an incremental encoder is sufficient.

The control mode requires the absolute position for synchronous motors. In the case of encoder types that do not provide an absolute value, a commutation must be performed before every first enable after booting the system (FCB 18).

The advantage of the CFC control mode is the very high dynamics that can be achieved, as a control reserve for reaching the dynamic maximum torque is always available. For this reason, the CFC control mode is suitable for drives with highly dynamic motion control.

31972098/EN – 8/2024

5.3.4 ELSM®

The ELSM® control mode enables operation of permanent-field synchronous motors without an encoder.

This procedure is exclusively intended for applications in horizontal materials handling technology with one single motor. It is not permitted to use it in vertical drives, inclining tracks or as a group drive.

Make sure that the inverter can deliver at least 150% I_0 of the motor.

Switching to a rotating motor is possible (flying start function). Continuous operation is only permitted above a transition speed of approx. 2% of the nominal motor speed.

Rotor adjustment or rotor position measurement

When the inverter is enabled in ELSM® control mode, the rotor position of the permanent-field synchronous motor is unknown. For this reason, the rotor position has to be determined first or the rotor has to be adjusted by turning so that its angular position is defined.

Measuring the rotor position

The rotor position of the synchronous motor is measured with test pulses for each enable. This occurs at idle state. If a brake is used, this brake remains applied. The measurement is finished after a maximum of 50 ms. After the measurement is completed, the synchronous motor accelerates to the setpoint speed.

Adjusting the rotor

If the rotor position cannot be determined by measuring, the rotor is pulled into a defined position at each enable. During adjustment, a motor movement takes place depending on the number of poles of the motor. If a brake is used, this brake is released. The adjustment is completed after one second.

Speed control

For operation of synchronous motors in the ELSM® control mode, there are 2 modes, i.e. open-loop and closed-loop operation.

Open-loop operation is active when starting from an idle state and below a transition speed. The transition speed is about 2% of the nominal speed. Above this transition speed value, the drive is operated in closed-loop operation.

The time during which the drive is in open-loop operation should be as short as possible since the position of the rotor is not detected in this mode and the drive is only operated in speed-controlled mode.

If the drive is in open-loop operation, a current of at least 150% of the standstill current of the connected motor is impressed to stabilize the drive, which is why the motor heats up significantly at idle state and at low speeds.

Torque control

The ELSM® control mode enables the "Torque control" operating mode; however, only above the transition speed in closed-loop operation.

Practical meaning: The FCB 07 "Torque control" can only be activated when the flying start function is active and above the transition speed (example: winding drive). If the speed is too low, the system shuts down with a fault message.

The transition speed can be reached either by an external drive or by speed control of the inverter in the FCB 05.

31972098/EN – 8/2024

5.3.5 Characteristics of the control modes

Overview of the control modes

	V/f	VFC^{PLUS}		CFC		ELSM®
Principle	Voltage controlled according to characteristic curve	Field-oriented, voltage-controlled, stator flux controller, torque controller		Field-oriented, current controller		Field-oriented, current controller
Motor	ASM/LSPM	ASM	ASM	ASM	SM	SM
Encoder	Without	Without	With	With	With	Without
Dynamics	+	+++	++++	+++++	+++++	++
Energy efficiency	+	+++	+++	++	+++++	++++++
Speed control	✓[1]	✓		✓		✓
Torque control	–	✓		✓		✓
Positioning	–	–	✓	✓		–
Flying start	– [2]	✓		✓		✓
Typical applications	Group drives, multi-motor drives	General materials handling technology, horizontal drives, vertical drives, pumps/ fans, winding drives		Packaging technology, handling technology, highly-dynamic positioning		Horizontal materials handling technology
Characteristics	Maximum robustness	Maximum precision		Maximum dynamics		Maximum energy efficiency

1) Open-loop speed control
2) DC braking

Characteristic values for dynamics

	V/f	VFC^{PLUS}	CFC	ELSM®
Torque control time	–	≥ 2 ms[1]	≥ 150 µs	
Time constant speed controller	–	≥ 4 – 6 ms	≥ 2 ms	≥ 6 ms
Rotational speed ripple	The speed ripple is mainly determined by the total mass moment of inertia, the torque ripple, and in particular the mechanical structure. It is therefore not possible to specify a general value.			

1) Valid in voltage control range, in field weakening range < 5 ms.

Characteristic values for setpoint resolution

	V/f	VFC^{PLUS}	CFC	ELSM®
Torque	–	32 bit (0.001% M_{NMot})		
Rotational speed	32 bit (0.0001 min^{-1})			

31972098/EN – 8/2024

	V/f	VFC^{PLUS}	CFC	ELSM®
Position (increment/revolution)	–	16 bit		–
Position (increment absolute)	–	32 bit		–

Characteristic values for accuracy of torque and speed

	VFC^{PLUS} without encoder	VFC^{PLUS} with encoder	
		Motor temperature sensor	
		None	with
Accuracy of the calculated torque	depends on the accuracy of the motor parameters **INFORMATION:** The more accurate the motor parameters, the more accurate the torque. For greater torque accuracy, measure the motor parameters with FCB25.		
Deviation with FCB25	< 5% M_N		
Typical deviation	< 10% M_N		
Maximum deviation[1)]	< 15% M_N	< 25% M_N	< 15% M_N

1) If n is permanently < 20% of the nominal speed.

	CFC without motor temperature sensor	CFC with motor temperature sensor
Accuracy of the calculated torque	depends on the accuracy of the motor parameters and motor temperature	depends on the accuracy of the motor parameters, typical deviation: < 5% M_N

	VFC^{PLUS} without encoder	All control modes with encoders
Accuracy of the calculated speed[1)]	depends on the accuracy of the motor parameters, typical deviation: 0.2 × $f_{nominal\ slip}$.	Maximum deviation: 0.007% n_{nom}, 10^{-4} min^{-1}

1) Stationary inaccuracy is the deviation between the mean value of the exact physical speed and the speed setpoint.

Recommended maximum output frequency

SEW-EURODRIVE recommends not exceeding the output frequency of $f_{PWM}/10$ for all control modes.

f_{PWM}	U/f	VFC^{PLUS}	CFC	ELSM®
2.5 kHz	250 Hz			
4 kHz	400 Hz	250 Hz	400 Hz	
≥ 8 kHz	599 Hz	250 Hz	500 Hz	

FCBs that can be activated for selected control mode

FCB	Designation	U/f	VFC^{PLUS}	CFC	ELSM®
01	Output stage inhibit	✓	✓	✓	✓

31972098/EN – 8/2024

FCB	Designation	U/f	VFC^{PLUS}	CFC	ELSM®
02	Default stop	✓	✓	✓	✓
04	Manual mode	✓	✓	✓	✓
05	Speed control	✓	✓	✓	✓
06	Interpolated speed control	✓	✓	✓	✓
07	Torque control	–	✓	✓	✓
08	Interpolated torque control	–	✓	✓	✓
13	Stop at application limits	✓	✓	✓	✓
14	Emergency stop	✓	✓	✓	✓
25	Motor parameter measurement	✓	✓	✓	✓
26	Stop at user limits	✓	✓	✓	✓
FCBs requiring a position encoder:					
09	Position control	–	✓	✓	–
10	Interpolated position control	–	✓	✓	–
12	Reference travel	–	✓	✓	✓
18	Rotor position identification	–	–	✓	–
19	Position hold control	–	✓	✓	–
20	Jog	–	✓	✓	–
21	Brake test	–	✓	✓	–

31972098/EN – 8/2024

5.4 Drive selection

For drive selection, in addition to the travel diagram that describes the exact travel cycle, a large number of additional specifications must be made about the operating and ambient conditions.

It is first necessary to have data for the machine to be driven such as mass, setting range, speed, information about the mechanical design and so on in order to select the drive correctly. The appropriate drive can be determined with the calculated torques and speeds of the drive while taking other mechanical requirements such as environmental and operating conditions into account.

For selecting the drive, a decision is to be taken if an asynchronous motor or a synchronous motor is to be used. The extensive product range of SEW-EURODRIVE is available for this purpose.

The basis for motor selection are the limit characteristic curves of the motors in inverter operation. The limit characteristic curve states the torque characteristic of the motor depending on the speed.

The dynamic and thermal limits must be observed when selecting the motor.

5.4.1 General requirements for motors

The technical data of the motors must lie within the following ranges:

Nominal motor speed	0 – 40 000 1/min
Nominal motor current	0 – 10 000 A
Nominal motor torque	0 – 50 000 Nm
Nominal motor frequency	0 – 600 Hz
Number of pole pairs	1 – 64

Motors that can be connected

Motors that can be connected include:

- Asynchronous motors
- Permanent-field synchronous motors
- Synchronous reluctance motors[1)]
- Synchronous motors with LSPM technology[2)]
- with and without motor encoder

When third-party motors are operated with inverters, SEW-EURODRIVE cannot ensure that the specified performance data is reached.

1) Guided startup in preparation.
2) Guided startup in preparation.

Dielectric strength of the motor

The operation of an AC motor with a frequency inverter places a much greater load on the motor winding than in the case of operation on the supply system. All AC motors from SEW-EURODRIVE have the required voltage endurance.

The connected third-party motor has to be designed in inverter mode for these DC link voltages.

31972098/EN – 8/2024

At a line voltage of AC 3 × 400 V, the nominal DC link voltage is DC 560 V. In regenerative operation, the DC link voltage can rise to higher values, see chapter "Technical data" (→ 🗎 36).

The inverters pulse the DC voltage of the DC link U_{DC} from the supply cable to the motor. At SEW-EURODRIVE, the pulsed voltage supply is available with 2.5 kHz, 4 kHz, 8 kHz, or 16 kHz. As a result, the motor is loaded with voltage peaks, high amplitude and very short rise times.

For operation of third-party motors on inverters from SEW-EURODRIVE, their suitability must be checked.

Thermal motor protection

Thermal motor protection avoids overheating and, therefore, prevents irreparable damage to the motor. For this purpose, temperature sensors detect the winding temperature. As standard, the inverters can evaluate the following temperature sensors.

Motor protection	Number of sensors	SEW-EURODRIVE designation
PTC thermistor	3	TF
Bimetallic temperature switch	3	TH
Semiconductor temperature sensor KTY84 – 130	1	KY/KTY
Pt1000 platinum temperature sensor, mounted in winding	1	PK
Pt1000 platinum temperature sensor, mounted in stator housing	1	PI

Motor series	Temperature sensor	Motor protection
CM..	KTY84 – 130, Pt1000	Comprehensive protection[1)]
CM..	TF	Limited protection[2)]
DR..	TF, TH	Comprehensive protection[3)]
DR..	KTY84 – 130	Limited protection[4)]
DR..	Pt1000 (PK)	Limited protection[4)]
DR..	Pt1000 (PI)	Comprehensive protection[1)]
Third-party motors	PTC thermistor, bimetallic temperature switch	Comprehensive protection[3)]
Third-party motors	KTY84 – 130, Pt1000	Limited protection[4)]

1) Comprehensive protection, as a thermal model protects the winding in addition to the measured value.
2) Depending on the motor size.
3) Comprehensive protection due to one sensor per motor phase.
4) If the temperature measured by the temperature sensor exceeds the limit temperature of the set thermal class of the motor, the inverter issues a fault message. There is no evaluation of the motor model. Thermal overload of windings is possible since the sensor is only installed in one winding.

For additional information on the thermal motor protection, refer to the documentation of the motors.

31972098/EN – 8/2024

Thermal motor protection without temperature sensor

Thermal motor protection without a temperature sensor is an inverter function that can protect motors from thermal overload. The level of protection is similar to that of a thermal overload relay. However, the reduced cooling is taken into account, especially at lower speeds.

- Insufficient cooling conditions and increased ambient temperature are influencing factors that cannot be taken into account.
- In the event of overloads in the low speed range, it cannot be ruled out that increased winding temperatures may occur which may damage the winding or lead to premature aging of the motor.
- The cooling of the motor is stronger at low temperatures. A temperature sensor only measures and triggers an overtemperature at increased motor utilization. This increased motor utilization is not possible with thermal motor protection without a sensor.

This means that thermal motor protection without a temperature sensor only represents basic protection. For complete thermal motor protection, SEW-EURODRIVE recommends using a temperature sensor.

Requirements

The following table shows the prerequisites that must be met in order to be able to use thermal motor protection without a temperature sensor:

Category	Prerequisites
Motor series	DRN.., DR2S..
Motor size	63 – 132M
Number of poles	4

Boundary conditions

The following table shows the boundary conditions that must be met in order to be able to use thermal motor protection without a temperature sensor:

Category	Boundary conditions
Type of cooling	Fan-cooled
Ambient temperature	-20 – 40 °C
Thermal class of winding	155(F), 180(H)
Installation altitude	<1000 m

For motors with forced cooling fans as well as fan-free and non-ventilated motors, the thermal motor protection must not be used without a temperature sensor.

In the case of multi-motor drives and group drives, as well as third-party motors, it is not possible to use the thermal motor protection without a temperature sensor.

Further information

The thermal motor protection without temperature sensor is active as long as the inverter is in operation and supplied with at least DC 24 V.

31972098/EN – 8/2024

The thermal motor protection without temperature sensor has no memory, i.e. it does not take the current motor temperature into account after a switch-on/switch-off process. Consequently, avoid subjecting an overheated motor to another overload immediately by switching the inverter off and on. SEW-EURODRIVE recommends performing a fault reset in the event of a fault message of the thermal motor protection without temperature sensor, instead of switching on or off.

5.4.2 Group drive and multi-motor drive

Group drive of asynchronous motors

A group drive is a group of asynchronous motors of any power rating. The motors do not have a rigid mechanical connection or only have a connection that is subject to slip and are connected to an electrically parallel inverter. Operation of a group drive is only possible in the U/f operating mode.

Multi-motor drive of asynchronous motors

Multi-motor drive means the electrical parallel connection of several identical asynchronous motors at 1 inverter, that are rigidly and mechanically coupled and drive a load.

Parallel operation of several identical asynchronous motors is possible provided the strict compliance with the following conditions:

- Only use gearmotors of the same type and with the same winding data.
- The rotor position of the individual motors must not differ by more than the following mechanical angle:

  $Z_p \times \Delta\varphi_{mech_max} < 20°$

  Z_p = Number of motor pole pairs

  $\Delta\varphi_{mech_max}$ = Maximum torsion angle of the shaft connection in regard of the motor shaft

  This must be ensured by the mechanics, even for maximally different torque loads of the motor shafts.
- If encoder feedback is used, just one of the motors needs to be equipped with an encoder. This encoder must be installed on the gearmotor which has the greatest clearance or elasticity with respect to the load inertia.

The maximum number of motors depends on the control mode:

Control mode	Number of motors
V/f	64
VFC^{PLUS}	10
CFC	10

Temperature evaluation for group and multi-motor drives

Observe the following additional notes for group and multi-motor drives:

- Preferably use bimetallic temperature switches TH.
- The series connection of the TH contacts (normally closed) is not subject to any restriction if joint monitoring is provided.
- If the TF temperature sensors are available in motors, the temperature sensors of up to 3 motors can be connected in series.

31972098/EN – 8/2024

Permissible cable length for group and multi-motor drives

Note the permitted length of all motor cables connected in parallel:

$$l_{tot} \leq \frac{l_{max}}{n} \qquad l_{tot} = \sum_{i=1}^{n} l_i$$

l_{tot} = Maximum total length of motor cables connected in parallel

l_{max} = Permitted motor cable length

l_i = Cable length of the inverter to the motor

n = Number of motors connected in parallel

5.4.3 Connecting explosion-protected AC motors

Observe the following information:

- Install the inverter outside the potentially explosive atmosphere.
- Observe industry and country-specific regulations.
- Observe the regulations and information of the motor manufacturer with regard to operation on a frequency inverter, e.g. mandatory sine filter.
- All operating resources used in potentially explosive atmospheres must adhere to the relevant standards, such as Directive 2014/34/EU or IEC 60079.
- The sensor input of the motor's temperature monitoring must not be used in potentially explosive atmospheres. For thermal monitoring, use a monitoring device approved for potentially explosive atmospheres.
- In case of motors with speed feedback, the speed sensor must also be approved for potentially explosive atmospheres. The speed sensor can be directly connected to the inverter.

INFORMATION

For further information, refer to the associated catalogs and the operating instructions of the explosion-protected motors.

5.4.4 General requirements for encoders

Applicable motor encoders from SEW-EURODRIVE

The following overview shows the motor encoders that can be used. For information on the respective encoder cables, refer to chapter "Prefabricated cables" (→ 🗎 263).

Encoder designation	Interface/signal type	Interface on the inverter		
		X15	X16	X17
A..H, E..H	HIPERFACE®	✓	–	✓
A..W	RS485	✓	–	✓
A..Y	SSI combination encoder	–	–	✓
A..Z, E..Z	MOVILINK® DDI	–	✓	–
E..C	HTL	✓	–	✓
E..R	HTL/TTL	✓	–	✓
E..S	sin/cos	✓	–	✓
E..T[1)]	TTL	✓	–	✓
R..M	Resolver	✓	–	–

1) Only via DWI11A.

Motor and encoder with electronic nameplate

Electronic nameplates can only be evaluated with encoders and motors from SEW-EURODRIVE.

The advantages of the electronic nameplate are:

- Complete and correct identification of motor and gear unit
- Automatic data input
- Easy drive identification, even with drives that are difficult to access
- Significant time savings during startup
- Optional transmission of other drive information such as temperature or vibration data of the motor

5.4.5 General requirements for brake control

Refer to the motor catalogs for extensive information and technical data regarding the brakes.

Brake control

Brakes are controlled via terminal X10 Brake output DB0/DB00 on the inverter or via the assigned safe digital output F-DOx (if available). It is not permitted to control them via other electronic devices or via controllers.

The digital output (DB0; DB00) is designed as an output for operating a relay with protection circuit with a DC 24 V control voltage, a maximum current of 150 mA and a power rating of 3.6 W.

As a result, a power contactor with DC 24 V coil voltage or a suitable brake rectifier from SEW-EURODRIVE can be controlled directly. The brake is switched with this power contactor.

31972098/EN – 8/2024

The technical data of the safe digital outputs can be found in chapter "Project planning for functional safety" (→ 🗎 170).

Direct switching of the brake via (DB0; DB00; D-DOx) is not permitted.

Three-wire brake with accelerator coil (BE, BM, BMG)

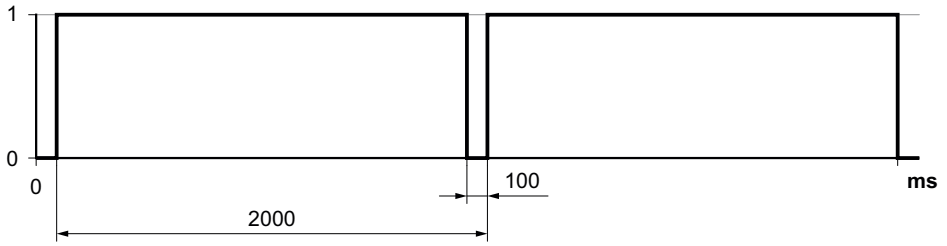
With this brake type, the brakes are controlled using brake control units.

24 V holding brake (BP, BK)

In every application, a 24 V holding brake can be controlled via a customer relay with varistor overvoltage protection or via the BMV brake control unit from SEW-EURODRIVE.

Permitted load of brake control and brake

One complete switching sequence (opening and closing) must not be repeated more often than a maximum of every 2 seconds. SEW-EURODRIVE brakes must remain closed for at least 100 ms before they are allowed to be applied again.



41736392203

5.4.6 Operation in noise-sensitive environments

Consider the following points to realize the quietest possible operation:

- Gearmotor (fan, gear ratio, oil, brake)
- Motor control

  Noise is generated in the filter during operation with output filter depending on the clock frequency. In environments susceptible to noise, SEW-EURODRIVE recommends to increase the clock frequency. This must be taken into account when designing the inverter.
- generator mode (low-noise braking resistor, energy recovery, power and energy Solutions)

5.5 Recommendations for motor and inverter selection

The basis for motor selection are the limit characteristic curves of the motors in inverter operation. The limit characteristic curve states the torque characteristic of the motor depending on the speed.

The dynamic and thermal limits must be observed when selecting the motor.

31972098/EN – 8/2024

5.5.1 Thermal limit characteristic curve

The mean motor speed and the effective torque are calculated during drive selection to determine the thermal loading of the motor. The operating point of the motor must be below the limit characteristic curve of the motor, otherwise the motor will be thermally overloaded.

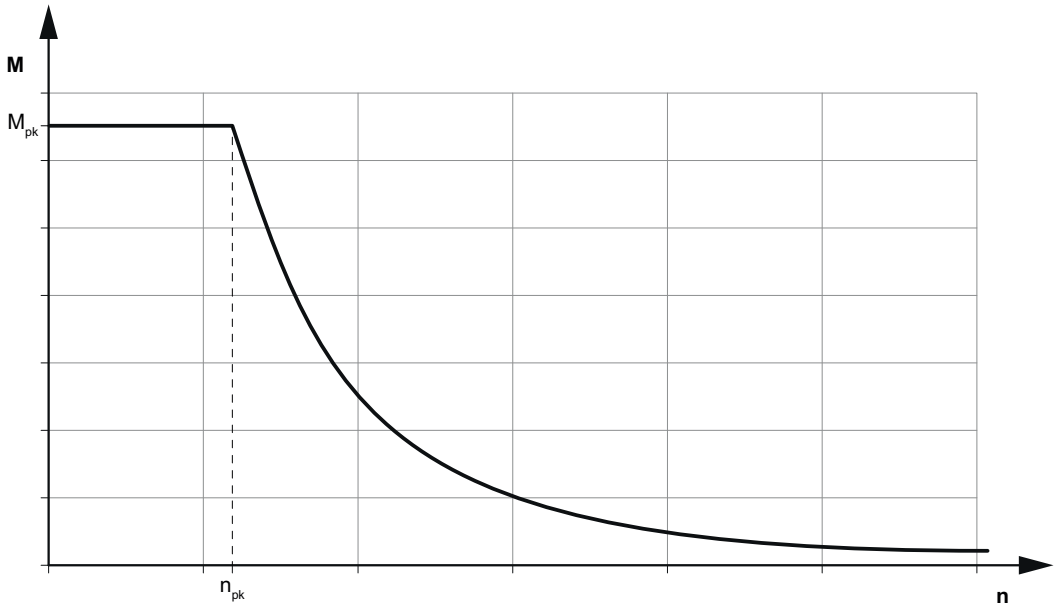
5.5.2 Dynamic limit characteristic curve

The dynamic limit characteristic curve depicts the maximum torque the motor can generate at a certain speed. Note that the inverter must supply sufficient current for the motor to reach its maximum torque.

The base speed is especially important for configuration. The base speed is the available speed up to the maximum motor torque. In inverter operation, the base speed indicates the beginning of field weakening. The motor torque is limited by the voltage limit characteristic curve in the field weakening range, and decreases with increasing speed.

M_N is determined by the motor. M_{pk} and n_{pk} depend on the motor/inverter combination. The values for M_{pk} and n_{pk} in the VFC^{PLUS}, CFC, ELSM® control modes can be found on the website sew-eurodrive.de.

Typical dynamic limit characteristic of an asynchronous motor in the VFC^{PLUS}/CFC control mode

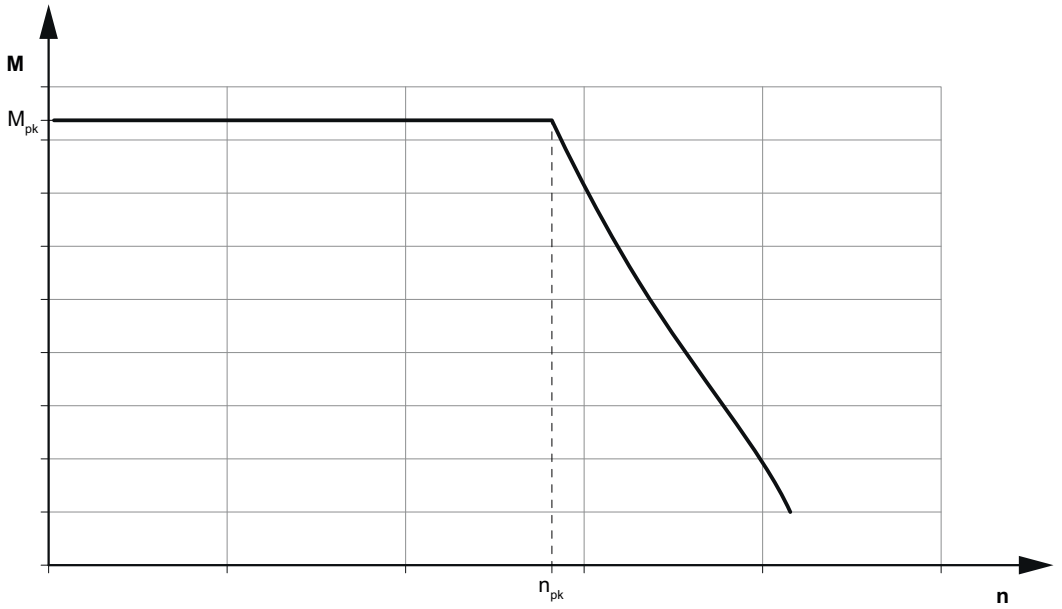


9007238743734155

M_{pk} Maximum torque for the motor-inverter combination
n_{pk} Rotational speed until the maximum torque M_{pk} of the motor-inverter combination is available.

31972098/EN – 8/2024

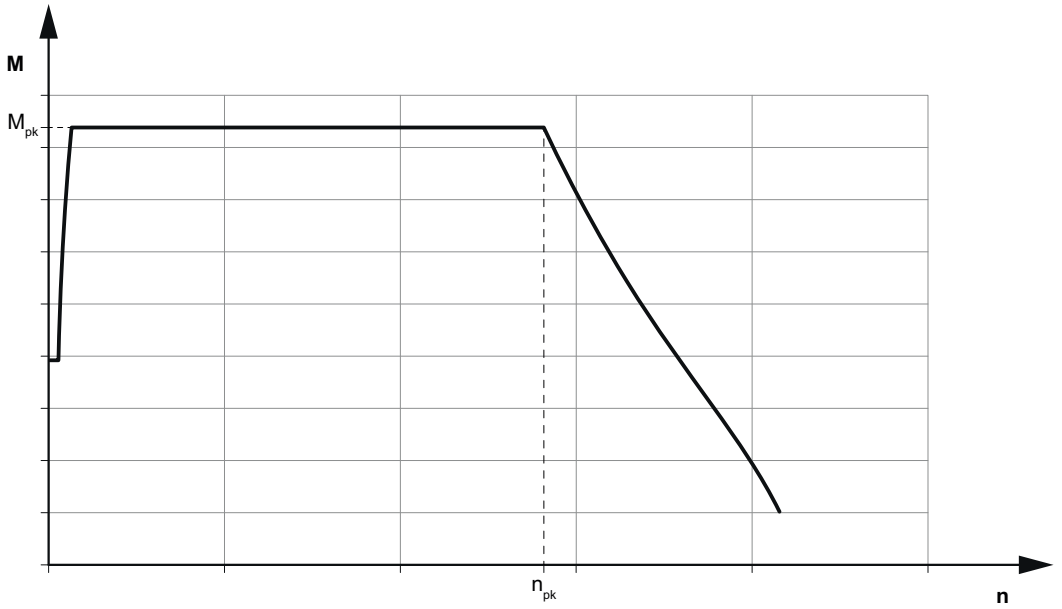
Typical dynamic limit characteristic of a synchronous motor in CFC control mode



9007238743738251

M_{pk} Maximum torque for the motor-inverter combination
n_{pk} Rotational speed until the maximum torque M_{pk} of the motor-inverter combination is available.

Typical dynamic limit characteristic of a synchronous motor in ELSM® control mode



9007238743740171

M_{pk} Maximum torque for the motor-inverter combination
n_{pk} Rotational speed until the maximum torque M_{pk} of the motor-inverter combination is available.

5.5.3 Motor selection for asynchronous motors

In this case, the mechanical resistance of the motor against the overload, which might exceed the permitted threshold values, must always be checked.

M_{pk} and n_{pk} depend on the motor/inverter combination, as well as on the used control mode.

Asynchronous motors are mainly operated in VFC^{PLUS} control mode. The control mode efficiently adjusts the motor magnetization to the respective operating point. It simultaneously enables dynamic responses to load shocks on the drive train.

Asynchronous motors in VFC^{PLUS} control mode

The VFC^{PLUS} control mode without encoder allows dynamic use of the entire speed range of the drive. Reversing and moving through the speed 0 are also possible.

However, continuous operation of asynchronous motors without encoder at low speeds is not possible. The minimum speeds that must not be permanently undercut during operation without encoder are:

- Motoring operation: 1% of the asynchronous motor nominal speed
- Regenerative operation: 10% of the asynchronous motor nominal speed

INFORMATION

Lifting application with encoder

The control must be designed in such a way that the direction of rotation can only be changed when it is at a standstill (with the brake applied).

If the direction of rotation should be changed without standstill, a motor encoder must be used.

The described restrictions do not apply in the VFC^{PLUS} control mode with encoder. In comparison to operation without encoder, higher dynamic properties can be achieved with an encoder.

When determining the maximum speed, observe that the breakdown torque M_K is reduced in a quadratic relationship in the field weakening range.

Asynchronous motors in U/f control mode

The U/f control mode is intended for easy open-loop operation of asynchronous motors without encoder feedback. The procedure operates an asynchronous machine on a parameterizable voltage/frequency characteristic.

To keep the magnetizing current on a constant level, the voltage (V) is adjusted in proportion to the frequency (f). The actual slip is estimated and can be compensated.

Control mode is suitable for applications with a limited speed setting range, where no dynamic step changes in load occur and where there are small requirements regarding the control characteristics.

Control mode is suitable for multi-motor drives.

Slip compensation may only be activated with rigidly coupled drives.

Speed control

The U/f control mode is an encoder-less mode and calculates the actual speed value. The calculation is always based on the electrical values of the motor. Therefore, information from a potentially existing encoder system is not used.

31972098/EN – 8/2024

If an encoder is parameterized in the encoder assignment as "Actual speed source", the speed measured by this encoder is issued as the actual speed by the inverter.

Otherwise, the model speed calculated by the control mode based on stator frequency and slip is issued as the actual speed.

The control mode does not have a higher-level speed controller, therefore speed controller parameterization is not possible. An acceleration and torque precontrol is also not possible.

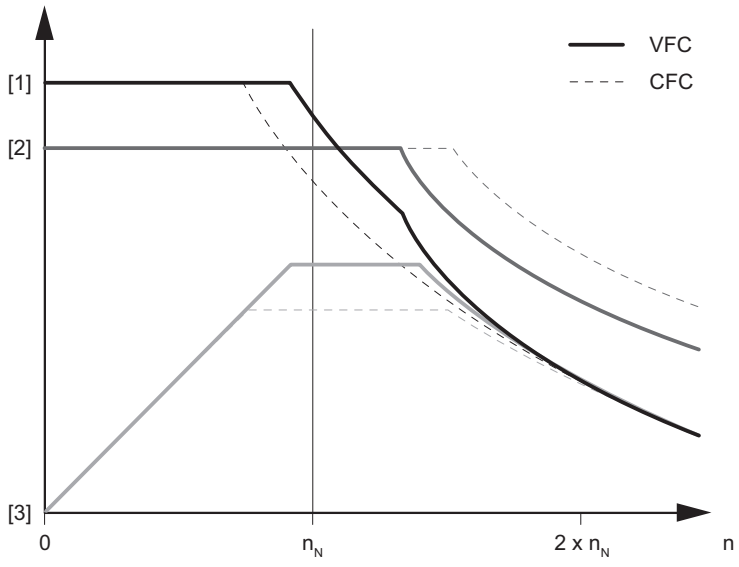
Asynchronous motors in CFC control mode

Either standard asynchronous motors (e.g. DRN.. motors) or asynchronous servomotors (e.g. DR2L../DRL.. motors) can be used in the CFC control mode. A prerequisite for the CFC operating modes is that the motor must always be equipped with an encoder.

Standard asynchronous motors in CFC control mode

In comparison to the VFC^{PLUS} control mode, higher dynamic properties can be achieved using CFC. The full motor magnetization is maintained in each operating state, so that the highest dynamic requirements are met. Due to the voltage reserves required for this, standard asynchronous motors are operated with a lower base speed in this operating mode than in the VFC^{PLUS} operating mode. Power yield and energy efficiency are consequently lower.

Speed/torque characteristic for VFC^{PLUS} and CFC in comparison



19531895051

[1] Torque [2] Current [3] Power n_N Nominal speed

Asynchronous servomotors in CFC control mode

DRL../DR2L.. series asynchronous servomotors have such a high-quality mechanical design to allow dynamic overload values to be achieved that exceed the values of the standard asynchronous motor in line or inverter operation. Due to these characteristics, the values of a synchronous servomotor are almost reached.

31972098/EN – 8/2024

SEW-EURODRIVE provides the DRL../DR2L.. motors in two dynamics packages:

Package	Overload capacity in relation to the nominal torque
Dynamics package 1 (D1)	190 – 220%
Dynamics package 2 (D2)	300 – 350%

To obtain an optimal adjustment of the motor speed to the required controller output limit of the application, SEW-EURODRIVE offers DRL../DR2L.. servomotors with the following 4 rated speeds:

- 1200 min^{-1}
- 1700 min^{-1}
- 2100 min^{-1}
- 3000 min^{-1}

Do not configure the maximum speed of the motor higher than 1.4 times the base speed.

5.5.4 Motor selection for synchronous motors

The demands made on a servo drive include speed dynamics, stable speed, and positioning accuracy. As a rule, the synchronous servomotors and the corresponding inverters are designed for a high short-time overload. This allows a multiple of the nominal torque.

Synchronous motors in CFC control mode

Technically speaking, these are synchronous motors with permanent magnets on the rotor and an integrated encoder. The mass moment of inertia of the synchronous motor is lower than that of the asynchronous motor. For this reason, these motors are optimally suited to applications requiring dynamic speeds.

Do not configure the maximum speed higher than the rated speed of the motor.

SEW-EURODRIVE recommends a PWM frequency of 8 kHz or 16 kHz for the following motors:

- CMP40/..50/..63 for speeds above 4500 min^{-1}
- CMP71/..80/..100 for speeds above 3000 min^{-1}
- CM3C63/..71/..80/..100 for speeds above 3000 min^{-1}

SEW-EURODRIVE recommends using the following temperature sensors:

- KTY84 – 130 (SEW-EURODRIVE designation: KY)
- Pt1000 (SEW-EURODRIVE designation: PK)

31972098/EN – 8/2024

Synchronous motors in ELSM® control mode

For operation of synchronous motors in the ELSM® control mode, there are 2 modes, i.e. open-loop and closed-loop operation.

Open-loop operation is active when starting from an idle state and below a transition speed. The transition speed is about 2% of the nominal speed. In this range, the available torque is limited. In open-loop control, the rated output current of the inverter is 1.5 times the standstill current I_0 of the connected motor, regardless of the load. It is therefore necessary to check whether the inverter can also provide this current at low output frequencies. Check whether the thermal characteristics of the motor are suitable for this. Permanent operation below the transition speed is not permitted.

Above this transition speed value, the drive is operated in closed-loop operation. In closed-loop control, the usable torque depends on the motor as well as on the motor-inverter combination.

The values for the transition speed, base speed and maximum dynamic torque in open-loop and closed-loop control can be found in the speed-torque characteristics. For motor/inverter characteristic curves, refer to the SEW-EURODRIVE website.

The ELSM® control mode allows dynamic use of the entire speed range of the drive. Reversing and moving through the speed 0 are also possible.

Do not configure the maximum speed higher than the rated speed of the motor.

Using the ELSM® control mode for hoists and inclining tracks is not permitted.

SEW-EURODRIVE recommends a PWM frequency of 8 kHz or 16 kHz for the following motors:

- CMP40/..50/..63 for speeds above 4500 min^{-1}
- CMP71/..80/..100 for speeds above 3000 min^{-1}
- CM3C63/..71/..80/..100 for speeds above 3000 min^{-1}

SEW-EURODRIVE recommends using the following temperature sensors:

- KTY84 – 130 (SEW-EURODRIVE designation: KY)
- Pt1000 (SEW-EURODRIVE designation: PK)

5.5.5 Motor encoder requirements

When using motor encoders in VFC^{PLUS} or CFC control mode, we recommend using encoders from SEW-EURODRIVE with at least 128 sine cycles or 1024 inc/revolution.

5.6 Motor/inverter characteristic curves

For motor/inverter characteristic curves, refer to the SEW-EURODRIVE website.

5.7 Inverter selection

The inverter is selected based on the course of the output current over time. The required current has to be determined from the required torque characteristic of the connected motor.

The inverters are dimensioned for a nominal output current I_N. In many applications, there is a demand for short-time overload operation. For this purpose, the inverters can be operated with a higher nominal output current for a short period of time.

31972098/EN – 8/2024

For overload operation, make sure that the inverter is not thermally overloaded. For protection of the power components, inverters have various monitoring mechanisms.

The following thermal monitoring functions are available:

- Dynamic utilization

  The periodic current load of the switching power semiconductors lets them heat and cool down cyclically. Due to the different thermal time constants, large temperature differences can occur between the power semiconductors and the heat sink. Dynamic utilization monitors the permitted temperature of the barrier layer of the power semiconductors.

- Thermal utilization

  The power semiconductors are limited by the maximum permitted temperature during operation. Thermal utilization monitors the heat sink temperature of the power semiconductors.

- Electromechanical utilization (I^2t utilization)

  Electromechanical utilization protects the components that have a large thermal time constant compared to the power semiconductors.

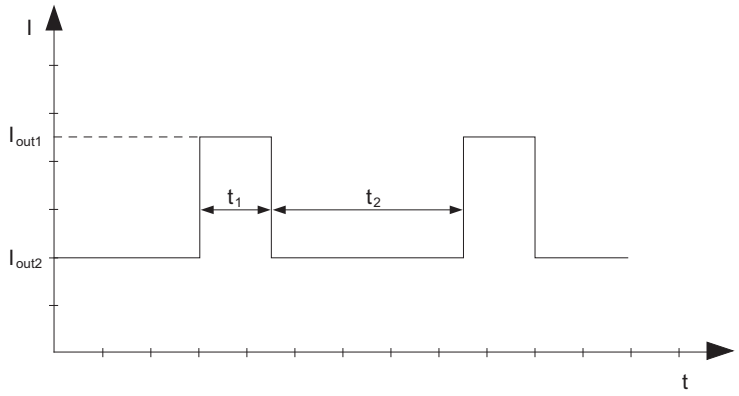
Due to the complexity of the utilization curves, the calculation can only be performed using software. The SEW-Workbench software offers support for dimensioning an inverter.

For a rough selection of the inverter without using software, characteristic load cycles are provided in the following sub-chapters.

5.7.1 Overload capacity

Load cycle with base load current – typical for the selection of asynchronous motors and servomotors

The characteristic load cycle consists of a base load and an overload period. In the base load period, the output current must not exceed the specified value. After the base load period, overload is possible again.



18014415982173963

Examples of permitted current profiles

Overload capacity at V_{line} = 400 V, smallest possible PWM frequency, $f_A \geq 3$ Hz, ϑ_{amb} = 40 °C

The table below applies to inverter sizes 1 to 6 (exception: BG5 MDX9.A-0750-...):

Overload current $I_{out\,1}/I_N$	Overload time t_1	Base load current $I_{out\,2}/I_N$	Required base load time t_2
200%	3 s	50%	7 s
200%	3 s	100%	17 s
150%	60 s	100%	60 s
150%	60 s	50%	30 s

Overload capacity at V_{line} = 400 V, smallest possible PWM frequency, $f_A \geq 3$ Hz, ϑ_{amb} = 40 °C

The table below applies to size 5 MDX9.A-0750-... inverters:

Overload current $I_{out\,1}/I_N$	Overload time t_1	Base load current $I_{out\,2}/I_N$	Required base load time t_2
200%	3 s	50%	7 s
200%	3 s	100%	17 s
150%	60 s	25%	60 s

Overload capacity at V_{line} = 400 V, smallest possible PWM frequency, $f_A \geq 3$ Hz, ϑ_{amb} = 40 °C

The table below applies to size 7 inverters up to MDX91A-2500-..:

Overload current $I_{out\,1}/I_N$	Overload time t_1	Base load current $I_{out\,2}/I_N$	Required base load time t_2
150%	60 s	50%	60 s

Overload capacity at V_{line} = 400 V, smallest possible PWM frequency, $f_A \geq 3$ Hz, ϑ_{amb} = 40 °C

The table below applies to size 7 MDX91A-3000-.. inverters and to size 8:

Overload current $I_{out\,1}/I_N$	Overload time t_1	Base load current $I_{out\,2}/I_N$	Required base load time t_2
150%	30 s	50%	150 s

31972098/EN – 8/2024

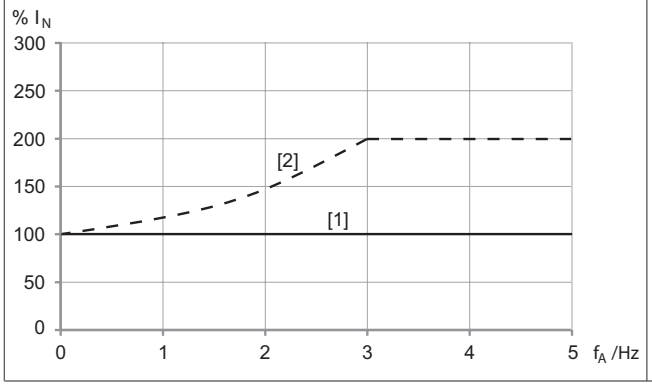
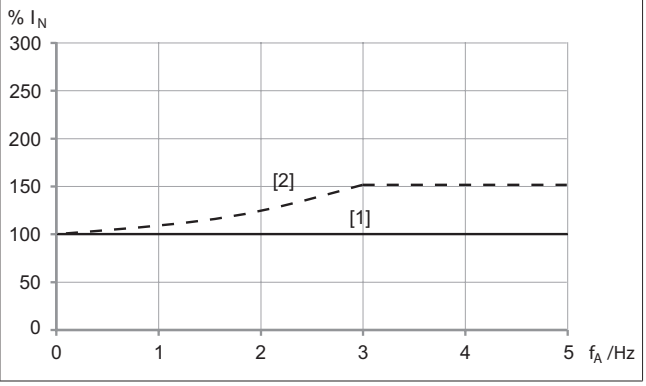
5.7.2 Power reduction factors

Due to the following operating and ambient conditions, a reduction of the output current may be necessary.

Derating due to the rotary field frequency

The specified nominal output current I_N of the inverter is the effective value. The increased load on the power semiconductors has to be considered especially for slow rotating fields and rotating fields at standstill. In case of a rotating field at standstill, direct current that can correspond to the peak value of the sine current depending on the phase position is flowing.

It is particularly important to consider output frequencies f_A < 3 Hz.

Sizes 1 to 7 (up to MDX91A-2500-...)	Size 7 (from MDX91A-3000-...) and size 8
	

[1] Continuous output current at the smallest possible PWM frequency

[2] Time-limited overload current

Derating due to the installation altitude

Frequency inverters by SEW-EURODRIVE are designed for overvoltage category III and for altitudes up to 2000 m according to EN 61800-5-1. The air pressure and the air density decrease depending on the installation altitude. This leads to a reduced cooling capacity and to a reduced electrical isolation effect of the air.

No restrictions apply to altitudes < 1000 m.

The following restrictions apply to altitudes ≥ 1000 m:

- From 1000 m to max. 3800 m: I_N reduction by 1% per 100 m
- From 2000 m to max. 3800 m: To maintain protective separation and the air gaps and creepage distances according to EN 61800-5-1, an overvoltage protection device must be connected upstream to reduce the overvoltages from category III to category II.

31972098/EN – 8/2024

Derating due to the line voltage and temperature

INFORMATION

Interpolate linearly for voltages between 400 V and 500 V.

The following table shows the values for derating as a function of the line voltage U_{line} and ambient temperature T:

Inverter	f_{PWM}	Continuous current I_{cont}	
		V_{line}: 3 × 400 V	V_{line}: 3 × 500 V
Size 1	4 kHz	I_{cont}/I_N = 125% - (T - 40 °C) × 2.5%	I_{cont}/I_N = 114% - (T - 40 °C) × 2.3%
	8 kHz	I_{cont}/I_N = 94% - (T - 40 °C) × 2.15%	I_{cont}/I_N = 81% - (T - 40 °C) × 1.85%
	16 kHz	I_{cont}/I_N = 63% - (T - 40 °C) × 1.5%	I_{cont}/I_N = 50% - (T - 40 °C) × 1.7%
Size 2	4 kHz	I_{cont}/I_N = 132% - (T - 40 °C) × 2.65%	I_{cont}/I_N = 120% - (T - 40 °C) × 2.45%
	8 kHz	I_{cont}/I_N = 99% - (T - 40 °C) × 2.25%	I_{cont}/I_N = 86% - (T - 40 °C) × 2%
	16 kHz	I_{cont}/I_N = 66% - (T - 40 °C) × 1.6%	I_{cont}/I_N = 53% - (T - 40 °C) × 1.8%
Size 3	4 kHz	I_{cont}/I_N = 128% - (T - 40 °C) × 2.55%	I_{cont}/I_N = 116% - (T - 40 °C) × 2.35%
	8 kHz	I_{cont}/I_N = 96% - (T - 40 °C) × 2.2%	I_{cont}/I_N = 83% - (T - 40 °C) × 1.9%
	16 kHz	I_{cont}/I_N = 64% - (T - 40 °C) × 1.55%	I_{cont}/I_N = 51% - (T - 40 °C) × 1.7%
Size 4	4 kHz	I_{cont}/I_N = 133% - (T - 40 °C) × 2.65%	I_{cont}/I_N = 121% - (T - 40 °C) × 2.45%
	8 kHz	I_{cont}/I_N = 100% - (T - 40 °C) × 2.25%	I_{cont}/I_N = 87% - (T - 40 °C) × 2%
	16 kHz	I_{cont}/I_N = 67% - (T - 40 °C) × 1.6%	I_{cont}/I_N = 53% - (T - 40 °C) × 1.8%
Size 5	4 kHz	I_{cont}/I_N = 121% - (T - 40 °C) × 2.4%	I_{cont}/I_N = 110% - (T - 40 °C) × 2.25%
	8 kHz	I_{cont}/I_N = 91% - (T - 40 °C) × 2.05%	I_{cont}/I_N = 79% - (T - 40 °C) × 1.85%
	16 kHz	I_{cont}/I_N = 51% - (T - 40 °C) × 1.6%	I_{cont}/I_N = 41% - (T - 40 °C) × 1.55%
Size 6	4 kHz	I_{cont}/I_N = 119% - (T - 40 °C) × 2.4%	I_{cont}/I_N = 108% - (T - 40 °C) × 2.2%
	8 kHz	I_{cont}/I_N = 89% - (T - 40 °C) × 2%	I_{cont}/I_N = 77% - (T - 40 °C) × 1.75%
	16 kHz	I_{cont}/I_N = 59% - (T - 40 °C) × 1.4%	I_{cont}/I_N = 48% - (T - 40 °C) × 1.65%
Size 7 MDX91A-1770 – 2200-...-5.3..	4 kHz	I_{cont}/I_N = 114% - (T - 40 °C) × 2.7%	I_{cont}/I_N = 103% - (T - 40 °C) × 2.5%
	8 kHz	I_{cont}/I_N = 80% - (T - 40 °C) × 2.25%	I_{cont}/I_N = 72% - (T - 40 °C) × 2.05%
Size 7 MDX91A-2500-...-5.3..	2.5 kHz	I_{cont}/I_N = 120% - (T - 40 °C) × 2.45%	I_{cont}/I_N = 109% - (T - 40 °C) × 2.25%
	4 kHz	I_{cont}/I_N = 104% - (T - 40 °C) × 2.25%	I_{cont}/I_N = 95% - (T - 40 °C) × 2.1%
	8 kHz	I_{cont}/I_N = 72% - (T - 40 °C) × 1.85%	I_{cont}/I_N = 65% - (T - 40 °C) × 1.7%
Size 7 MDX91A-3000-...-5.3..	2.5 kHz	I_{cont}/I_N = 100% - (T - 40 °C) × 2.05%	I_{cont}/I_N = 91% - (T - 40 °C) × 1.9%
	4 kHz	I_{cont}/I_N = 87% - (T - 40 °C) × 1.9%	I_{cont}/I_N = 79% - (T - 40 °C) × 1.75%
	8 kHz	I_{cont}/I_N = 60% - (T - 40 °C) × 1.55%	I_{cont}/I_N = 54% - (T - 40 °C) × 1.4%
Size 8	2.5 kHz	I_{cont}/I_N = 100% - (T - 40 °C) × 1.75%	I_{cont}/I_N = 98% - (T - 40 °C) × 1.85%
	4 kHz	I_{cont}/I_N = 86% - (T - 40 °C) × 1.65%	I_{cont}/I_N = 80% - (T - 40 °C) × 1.65%

Inverter	f_{PWM}	V_{line}: 3 × 230 V
		Continuous current I_{cont}
Size 2	4 kHz	I_{cont}/I_N = 132% - (T - 40 °C) × 2.65%
	8 kHz	I_{cont}/I_N = 99% - (T - 40 °C) × 2.25%
	16 kHz	I_{cont}/I_N = 66% - (T - 40 °C) × 1.6%
Size 3	4 kHz	I_{cont}/I_N = 128% - (T - 40 °C) × 2.55%
	8 kHz	I_{cont}/I_N = 96% - (T - 40 °C) × 2.2%
	16 kHz	I_{cont}/I_N = 64% - (T - 40 °C) × 1.55%
Size 4	4 kHz	I_{cont}/I_N = 133% - (T - 40 °C) × 2.65%
	8 kHz	I_{cont}/I_N = 100% - (T - 40 °C) × 2.25%
	16 kHz	I_{cont}/I_N = 67% - (T - 40 °C) × 1.6%
Size 5	4 kHz	I_{cont}/I_N = 121% - (T - 40 °C) × 2.4%
	8 kHz	I_{cont}/I_N = 91% - (T - 40 °C) × 2.05%
	16 kHz	I_{cont}/I_N = 51% - (T - 40 °C) × 1.6%

Inverter	f_{PWM}	V_{line}: 3 × 230 V
		Continuous current I_{cont}
Size 6	4 kHz	I_{cont}/I_N = 119% - (T - 40 °C) × 2.4%
	8 kHz	I_{cont}/I_N = 89% - (T - 40 °C) × 2%
	16 kHz	I_{cont}/I_N = 59% - (T - 40 °C) × 1.4%

5.8 Braking resistor selection

5.8.1 General Information

Using a braking resistor is only required if generator mode is reached during operation. A braking resistor is not required if the device is operated solely in motor mode.

5.8.2 Derating due to the ambient temperature

The following derating applies at ambient temperatures of > 40 °C:

- Reduction of the continuous power by 4% per 10 K
- Reduction of the tripping current by 2% per 10 K

Do not exceed a maximum ambient temperature of 60 °C.

5.8.3 Selection criteria

The braking resistor is selected in the SEW Workbench. The necessary selection parameters for the braking resistor are calculated during the project planning procedure. Depending on these selection parameters, a braking resistor is selected from the table.

The selection parameters in the following sections are the basis for selecting the braking resistor.

Continuous braking power

The minimum required continuous braking power (braking power at 100% cdf) of the braking resistor for load cycles can be calculated using the relative cyclic duration factor cdf and the overload factor k.

If the cyclic duration factor cdf is unknown, it can be calculated from the cycle duration t_{tot} and the braking time t_B using the following formula.

$$cdf = \frac{t_B}{t_{tot}} x\ 100\ \%$$

9007219434171531

cdf	Cyclic duration factor
t_B	Braking time
t_{tot}	Cycle duration

INFORMATION

The cycle duration must not exceed 120 s.

The overload factor k can be determined using the diagrams in chapter "Overload factor k" (→ 🗎 140) and the cyclic duration factor cdf.

31972098/EN – 8/2024

The value of the average braking power P_B is taken from the project planning data of the application.

$$P_B = \frac{\sum_{i=1}^{n} P_i}{\sum_{i=1}^{n} t_i}$$

9007219434177547

P_B Average braking power
P_i Braking power section i
t_i Braking time section i
n Number of braking sections

The minimum required braking power at 100% cdf is calculated using the following formula:

$$P_{100\%ED} = \frac{P_B}{k}$$

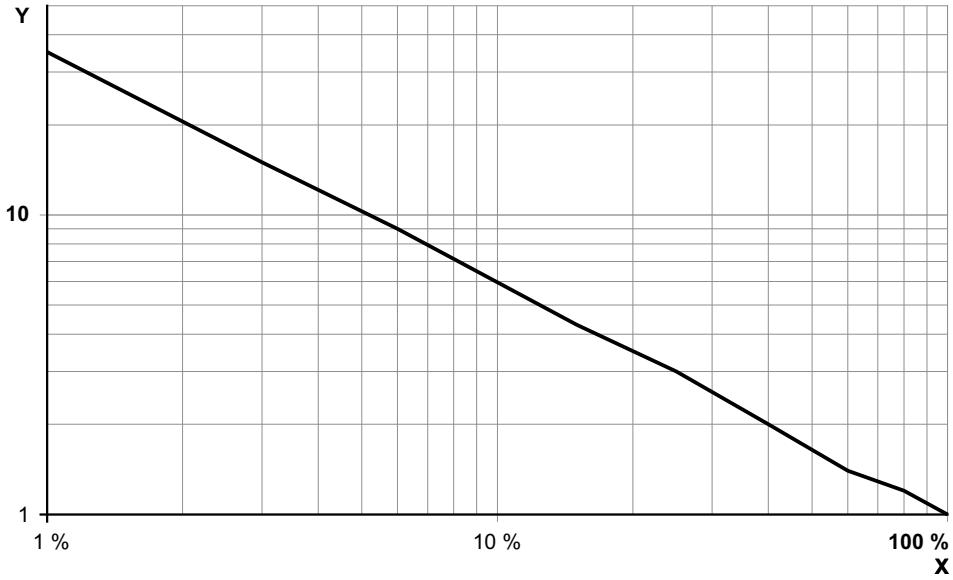
20179441035

$P_{100\%cdf}$ Braking power at 100% cdf
P_B Average braking power
k Overload factor

The braking power required by the application at 100% cdf must be smaller than or equal to the typical braking power at 100% cdf (continuous braking power) of the braking resistor.

Overload factor k

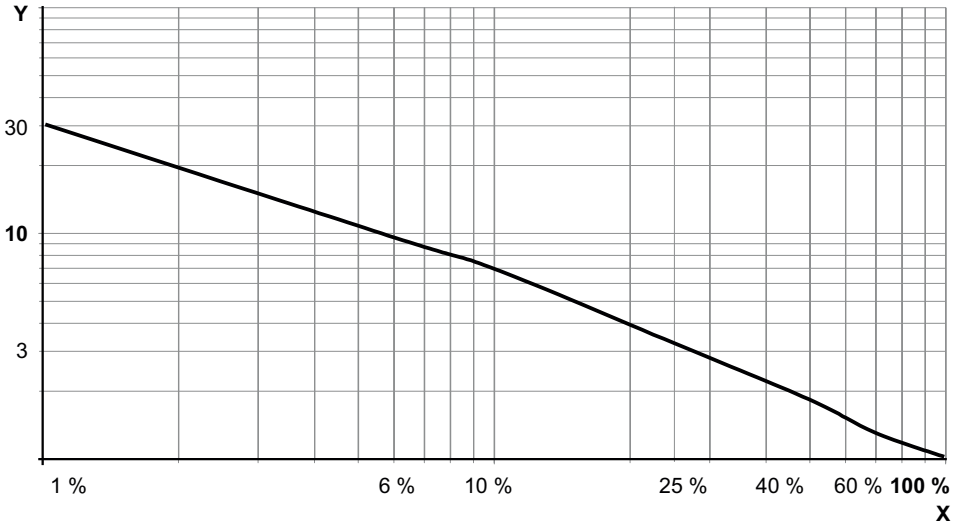
Flatpack resistors



18014419041960715

X	Cyclic duration factor in %	1	3	6	15	25	40	60	80	100
Y	Overload factor k	35	15	9	4.3	3	2	1.4	1.2	1

Wire resistors, frame resistors

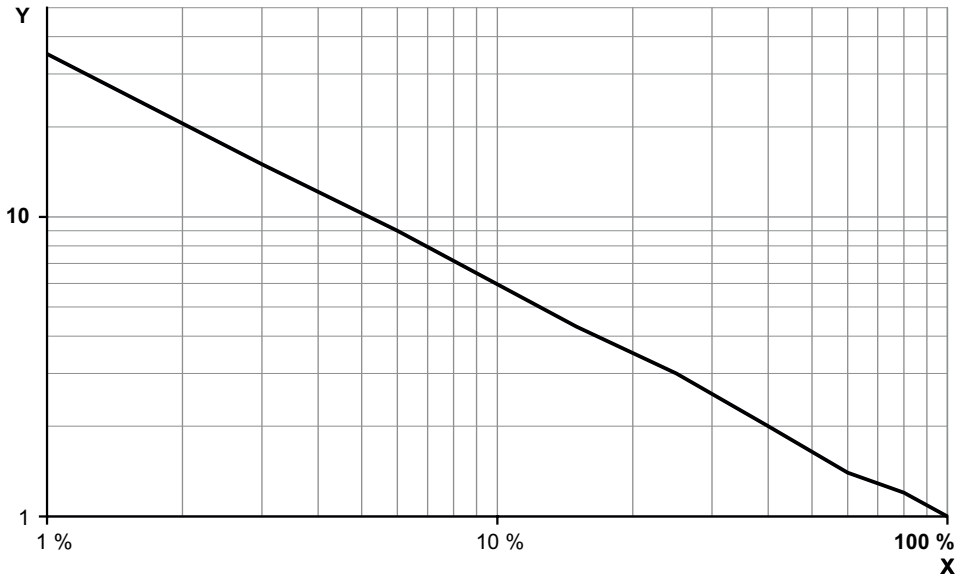


9007242996955915

X	Cyclic duration factor in %	1	3	6	15	25	40	60	80	100
Y	Overload factor k	30	15	9.5	5	3.2	2.2	1.5	1.12	1

31972098/EN – 8/2024

Grid resistors



18014401500012171

X	Cyclic duration factor in %	1	3	6	15	25	40	60	80	100
Y	Overload factor k	20	12	7.6	4	3	2.2	1.5	1.12	1

Peak braking power

The maximum peak braking power that can be achieved is specified by the resistance value and the DC link voltage. It is calculated as follows:

$$P_{max} = \frac{V_{DCL\,max}^2}{R \times 1.4}$$

P_{max}	Maximum peak braking power that the braking resistor can absorb
U_{DCL_max}	Maximum DC link voltage; see chapter "Technical data" (→ 🗎 36).
R	Braking resistance value

The maximum peak braking power required by the application is calculated from the regenerative parts within a cycle.

The peak braking power required by the application must be lower than the maximum peak braking power that can be achieved and absorbed by the braking resistor.

The peak braking power for each braking resistor is specified in chapter "Braking resistors".

Current-carrying capacity of the brake chopper

The resistance value of the braking resistor R_{BR} must not be lower than the minimum permitted braking resistance R_{BRmin}, see chapter "Technical data" (→ 🗎 36). This ensures that the brake chopper is not damaged.

$$R_{BR} \geq R_{BRmin}$$

The continuous braking power toward the braking resistor must not exceed the apparent output power of the inverter.

5.8.4 Calculation example

Given:

Peak braking power: 13 kW

Average braking power: 6 kW

Braking time: 7 s

Cycle duration: 28 s

Minimum permissible braking resistor value of the inverter: 47 ohm, see chapter "Technical data" (→ 🗎 36).

Required:

BW.. braking resistor

Calculation:

1) Determine the cyclic duration factor

Cyclic duration factor cdf = braking time/cycle duration

Cyclic duration factor cdf = (7 s/28 s) × 100% = 25%

When selecting the braking resistor, note the assignment of inverter and braking resistor, see chapter "Technical data and assignment to an inverter" (→ 🗎 79).

2) Determine the overload capacity

Determine the overload factor, e.g., for a wire resistor at a cyclic duration factor cdf of 25% from the respective diagram.

Overload factor k = 3.2

3) Calculate the braking power at 100% cdf

Braking power 100% cdf = average braking power/overload factor

Braking power 100% cdf = 6 kW/3.2 = 1.88 kW

The braking power of the braking resistor at 100% cdf must be ≥ 1.88 kW.

4) Select the braking resistor

Selected braking resistor: BW247-T.

Resistance value R_{BR} = 47 Ω

Peak braking power: 14.3 kW, see chapter "Technical data and assignment to an inverter" (→ 🗎 79).

Current-carrying capacity at 100% cdf: 2 kW

31972098/EN – 8/2024

5.8.5 Supply cable for braking resistor

Use only shielded or twisted cables.

The cable cross section depends on the tripping current I_F.

The nominal voltage of the cable must be at least U_0/U = 450 V/750 V.

The maximum permitted cable length between the inverter/power supply module and the braking resistor is 100 m.

The temperature resistance of the braking resistor cables must be ≥ 90 °C.

When the braking resistor is connected to its protection device, the shield of the supply cable must be routed via an additional shield terminal.

5.8.6 Protection against thermal overload of the braking resistor

To avoid thermal damage of the braking resistor as well as subsequent damage, the braking resistor has to be thermally monitored. SEW-EURODRIVE suggests the following options:

- **Integrated temperature switch -T**

  Braking resistors with the label –T are equipped with an integrated temperature switch. The temperature switch is thermally coupled to the braking resistor and switches an NC contact in case of overtemperature of the braking resistor. The braking resistor-inverter connection is not interrupted. In case of thermal overload, the regenerative operation has to be terminated. SEW-EURODRIVE recommends shielding the connection cable of the temperature switch.

- **Thermal overload relay**

  A thermal overload relay is installed in the control cabinet, connected to the supply cable to the braking resistor and set to the tripping current of the braking resistor. If the measured mean current exceeds the tripping current, an NC contact switches and reports an overload of the braking resistor. The braking resistor-inverter connection is not interrupted. In case of thermal overload, the regenerative operation has to be terminated.

You can find wiring diagrams for the situations described above in the chapter "Electrical installation" > "BW.. braking resistors" (→ 🗎 369).

5.8.7 Parallel connection of braking resistors

It is permitted to connect several identical braking resistors in parallel. The following applies:

- The power connections of the braking resistors must be connected to +R and -R in parallel.
- Each braking resistor requires separate protection against thermal overload.
- The signal contacts (NC contacts) of the protection devices must be connected in series.

5.9 Supply system cables and motor cables

5.9.1 Supply system cable

The supply system cable is generally dimensioned system-specifically and depends on the design of the line connection. The structure of a line connection is described in chapter "Power connection" (→ 🗎 401). Observe the country-specific and system-specific regulations when selecting the cross section of the supply system cable.

31972098/EN – 8/2024

Recommended cross section for nominal operation

The cross section of the supply system cables must be dimensioned based on the nominal line current I_{line}.

SEW-EURODRIVE suggests the following cable cross sections. These cable cross sections apply under the following conditions:

- The conductors are made of copper with PVC insulation, operating temperature 70 °C.
- The cables are routed in cable ducts according to IEC 60204-1 installation type C at an ambient temperature of 40 °C, accumulation 1.

MDX9.A-….-5.3..	Unit	Size												
		1				2			3		4		5		
		0020	0025	0032	0040	0055	0070	0095	0125	0160	0240	0320	0460	0620	0750
Nominal line current AC I_{line}	A	1.8	2.3	2.9	3.6	5	6.3	8.6	11.3	14.4	22	32	41.4	55.8	67.5
Supply system cable L1/L2/L3	mm^2	1.5						2.5			6	10	16	25	35
Fuse/miniature circuit breaker	A	10						16		20	32	50	63	80	100

MDX9.A-….-5.3..	Unit	Size									
		6			7				8		
		0910	1130	1490	1170	2200	2500	3000	3800	4700	5880
Nominal line current AC I_{line}	A	81.9	102	134	159	198	225	270	342	423	529
Supply system cable L1/L2/L3	mm^2	50	70	120		150	240		[1]		
Fuse/miniature circuit breaker	A	125	160	200		250	315		400	500	630

1) The supply system cable must be configured according to project-specific requirements. Generally, the supply system cable is made up of single conductors routed in parallel.

MDX9.A-….-2.3..	Unit	Size							
		2		3	4		5		6
		0070	0093	0140	0213	0290	0420	0570	0840	1080
Nominal line current AC I_{line}	A	6.3	8.4	12.6	19.2	26.1	37.8	51.3	75.6	97.2
Supply system cable L1/L2/L3	mm^2	1.5	2.5		6	10		25	35	50
Fuse/miniature circuit breaker	A	10	16	20	32	40	50	80	100	125

INFORMATION

Recommended cross section

The values are only recommendations. They are no substitute for detailed project planning of the cables depending on the concrete application and considering the applicable regulations.

31972098/EN – 8/2024

INFORMATION

Securing the supply system cable

- Secure the supply system cable with appropriate safety elements.
- When selecting the supply system cable, make sure that the selected cross section is in the range of the connectable cross section of the terminals.

INFORMATION

Use of a residual current device

If using a residual current device is not mandatory according to the standards, SEW-EURODRIVE recommends not using a residual current device. Leakage currents caused by cable capacitances can lead to false tripping.

5.9.2 Motor cable

Cable length

A maximum motor cable length must not be exceeded when connecting a motor.

The following configuration guidelines must be observed:

- When shielded motor cables are used, a capacitance core/shield of maximum 280 pF/m must not be exceeded.

MDX9.A-....-5.3..	Size									
	1	2			3		4 – 6	7		8
	0020 – 0040	0055	0070	0095	0125	0160	0240 – 1490	1770 – 2200	2500 – 3000	3800 – 5880
	Maximum motor cable length in m for shielded cables									
PWM frequency										
2.5 kHz	–	–	–	–	-	–	–	–	400	400
4 kHz	120	200	250	300	300	400	400	400	300	300
8 kHz	80	120	150	250	250	300	300	300	200	-
16 kHz	40	60	100	150	150	200	200	-	-	-

MDX9.A-....-5.3..	Size									
	1	2			3		4 – 6	7		8
	0020 – 0040	0055	0070	0095	0125	0160	0240 – 1490	1770 – 2200	2500 – 3000	3800 – 5880
	Maximum motor cable length in m for unshielded cable									
PWM frequency										
2.5 kHz	–	–	–	–	–	–	–	–	1200	1200
4 kHz	360	600	750	900	900	1200	1200	1200	900	900
8 kHz	240	360	450	750	750	900	900	900	600	-
16 kHz	120	180	300	450	450	600	600	-	-	-

MDX9.A-....-2.3..	Size				
	2		3	4	5 – 6
	0070	0093	0140	0213 – 0290	0420 – 1080
	Maximum motor cable length in m for shielded cables				
PWM frequency					
4 kHz	120	200	250	300	400
8 kHz	80	120	150	250	300
16 kHz	40	60	100	150	200

MDX9.A-....-2.3..	Size				
	2		3	4	5 – 6
	0070	0093	0140	0213 – 0290	0420 – 1080
	Maximum motor cable length in m for unshielded cables				
PWM frequency					
4 kHz	360	600	750	900	1200
8 kHz	240	360	450	750	900
16 kHz	120	180	300	450	600

Voltage drop

Select the cable cross section of the motor cable in a way that a maximum of 5% voltage drop occurs at nominal current of the motor. Read the information in the relevant motor catalogs. An excessively high voltage drop means that the full motor torque is not achieved.

5.10 EMC-compliant installation according to EN 61800-3

The inverters are designed for use as components for installation in machinery and systems. They comply with the EMC product standard EN 61800-3 "Adjustable-speed electrical drives".

Provided the EMC-compliant installation is observed, the appropriate requirements for a CE marking are met on the basis of the EMC Directive 2014/30/EU.

5.10.1 Interference emission

The cable length must be as short as possible for EMC-compliant installation. SEW-EURODRIVE recommends using low-capacity cables. To comply with limit classes C1, C2 or C3 according to EN 61800-3, the measures listed below must be taken.

Limit value class C1

Inverter	Measures		
	On the line side	On the motor side	
	NF.. line filter	HF.. output filter HD.. output choke	Shielded cables
Sizes 1 – 3	✓	–	✓

Limit value class C2

Inverter	Measures		
	On the line side	On the motor side	
	NF.. line filter	HF.. output filter HD.. output choke	Shielded cables
Sizes 1 – 3	–	–	✓
Sizes 1 – 3	–	HD.. or HF..	–
Sizes 1 – 7	✓	–	✓
Sizes 1 – 6	✓	HD.. or HF..	–
Size 7	✓	HD..	–

31972098/EN – 8/2024

INFORMATION

Size 8 with limit class C2 is in preparation.

Limit value class C3

Inverter	Measures		
	On the line side	On the motor side	
	NF.. line filter	HD.. output choke	Shielded cables
Size 8	✓	–	✓

INFORMATION

Select the use of an output filter during startup.

INFORMATION

The EMC limit values for interference emission are not specified for voltage supply systems without grounded star point (IT systems). The efficiency of filters is severely limited.

31972098/EN – 8/2024

5.11 Line components

5.11.1 Line fuses and miniature circuit breakers

Line fuses and miniature circuit breakers are used for protecting the supply system cables. For fusing, use fuses and miniature circuit breakers with the following properties:

Type class	Prerequisite
Fuses in utilization categories gL, gG	Fusing voltage ≥ nominal line voltage
Miniature circuit breaker with characteristics B, C, D	• Nominal miniature circuit breaker voltage ≥ nominal line voltage • Nominal currents of the miniature circuit breaker must be at least 10% higher than the nominal current of the inverter.

If necessary, observe the country-specific and system-specific regulations in the chapter "UL-compliant installation" for fusing.

5.11.2 Line contactor

A line contactor is used to separate the inverter from the supply system in the event of a fault and to switch the power supply on and off.

For more information, refer to chapter "Installation instructions" (→ 🗎 350) > "Using the line contactor".

5.11.3 NF.. line filters

A line filter reduces interference emission via the supply system cable, which is generated by the inverter. The line filter mainly serves to meet interference voltage limit requirements in the frequency range from 150 kHz to 30 MHz at the line connection. In addition, a line filter dampens the interference from the grid affecting the inverter. The choice of line filter depends on the nominal line current and the line voltage of the inverter.

31972098/EN – 8/2024

5.11.4 ND.. line chokes

A line choke ND... can be used as an option:

- To support overvoltage protection
- To smoothen the line current, to reduce harmonics
- For protection in the event of distorted line voltage
- Limiting the charging current when several inverters are connected together in parallel on the input end with a shared line contactor (nominal current of line choke = total of inverter currents)

Connect a line choke for limiting the inrush current:

- With 5 or more 3-phase devices

5.11.5 Selecting the residual current device

The inverter can cause a direct current in the PE conductor.

Proceed as follows to select the residual current device:

1. If using a residual current device is not mandatory according to the standards, SEW-EURODRIVE recommends not using a residual current device.
2. ⚠ **WARNING!** No protection against electric shock if an incorrect type of residual current device is used. Severe or fatal injuries.
   If a residual current device (residual current device RCD or residual current monitor RCM) is provided, use an all-current-sensitive RCD or RCM of type B.
3. If a residual current device is required, select the residual current device according to the requirements for protecting persons, fire protection or system protection. Observe the tripping characteristic, the deceleration and the rated tripping current of the residual current device during selection.
4. During project planning, note that leakage currents which are as low as possible occur in the system for operational reasons.
5. If the operational leakage currents are too high, you can distribute the current supply among several RCDs.

31972098/EN – 8/2024

5.12 Components on the output side

5.12.1 HD.. output chokes

SEW-EURODRIVE recommends using output chokes to suppress interference emission when using unshielded motor cables.

5.12.2 HF.. output filters

Observe the following notes if you use an output filter:

- Output filters may only be used in inverter operating modes V/f and VFC^{PLUS}.
- Calling up the FCB 25 is not permitted when the output filter is connected. Otherwise, the FCB 25 provides incorrect results because of the output filter inductance.
- Output filters may be used up to a maximum inverter output frequency of 250 Hz.
- When selecting the output filter, make sure that it is assigned correctly to the inverter.
- Maintain a ventilation clearance of at least 100 mm below and above the output filter. There is no need for a clearance on the side.
- Limit the length of the cable between the inverter and the output filter to the required length. Maximum permitted length:
  - 1 m with unshielded cable
  - 10 m with shielded cable
- An unshielded motor supply cable is sufficient when using an output filter.

Operating modes of output filters

Output filters can be operated with or without DC link connection. The recommended operation with DC link connection improves the filter effect between the phases and PE. This increases the device utilization.

Please note the following restrictions:

- Operation with DC link connection
  - Nominal filter current ≥ 65 A: Set the minimum clock frequency = 8 kHz.
  - Nominal filter current < 65 A: The minimum clock frequency can be set as required.
- Operation without DC link connection
  - The maximum clock frequency is 8 kHz.
  - The maximum shielded motor cable length is 200 m.

Voltage drop

When configuring hoists in particular, take the following voltage drop at the output filter into account:

- at 200 V: Voltage drop V_{drop} ≤ 13%
- at 400 V: Voltage drop V_{drop} ≤ 6.5%
- at 500 V: Voltage drop V_{drop} ≤ 5%

These values refer to an output frequency of 50 Hz.

31972098/EN – 8/2024

Derating

Derating refers to the current dependency of the following operating parameters.

- Operating parameters: Line voltage, clock frequency, ambient temperature
  - The output filters do not require derating beyond that of the inverter if the permitted control modes are observed.
- Operating parameters: Output frequency

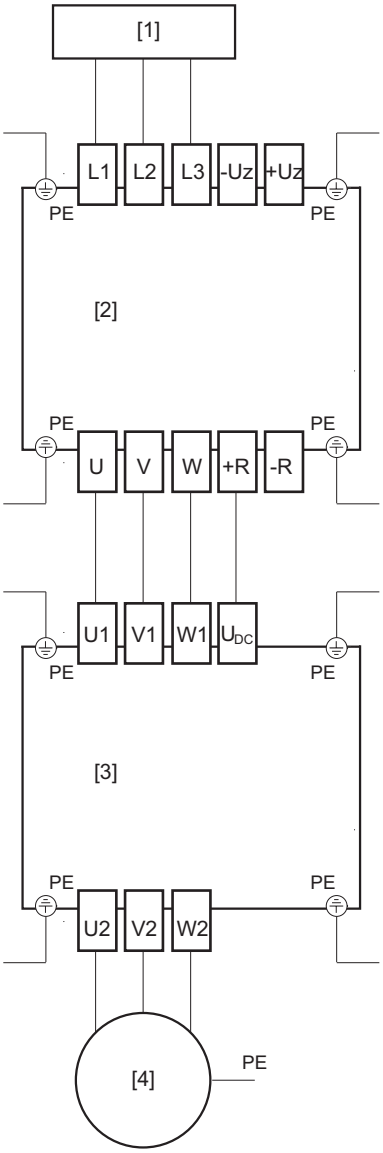
Output frequency	Permissible filter current I/I_N	
	Nominal filter current ≤ 46 A	Nominal filter current ≤ 65 A
0 – 10 Hz		
- without UZ connection at 400 V	100%	100%
- with UZ connection at 400 V	100%	100%
- without UZ connection at 500 V	100%	100%
- with UZ connection at 500 V	70% + 1.5% × output frequency	10% + 9% × output frequency
11 – 20 Hz		
- without UZ connection at 400 V	100%	100%
- with UZ connection at 400 V	100%	100%
- without UZ connection at 500 V	100%	100%
- with UZ connection at 500 V	70% + 1.5% × output frequency	100%
21 – 149 Hz		
- with and without UZ connection	100%	100%
150 – 250 Hz		
- with and without UZ connection	100%	100%

Short-time operation without speed derating, e.g., startup

- Filter current 100% for 5 min every 60 min permitted

31972098/EN – 8/2024

Wiring diagram



33412335115

[1] Grid
[2] Inverter
[3] Output filter
[4] Motor

5.13 24 V supply voltage selection

5.13.1 Description

The MDX90A.. inverter requires an external 24 V voltage supply for the electronics.

The MDX91A.. inverter has an internal 24 V voltage supply of 80 W that can also be supported externally.

5.13.2 Project planning for 24 V supply power

For dimensioning the 24 V supply voltage, it is necessary to know the power and current consumption of the inverter.

INFORMATION

Commercially available switched-mode power supplies can reliably switch on the maximum occurring capacities.

5.13.3 Power consumption of the 24 V supply

Inverter

The following table shows the power consumption of the 24 V supply depending on the used modules and the installed options:

Inverter	Unit	Power consumption without I/O, encoder, motor brake
Sizes 1 – 3	W	20
Size 4		30
Size 5		15
Sizes 6 – 7		20
Size 8		25

Cards

The following table shows the power consumption of the 24 V supply depending on the used cards and installed options:

Cards	Unit	Power consumption without I/O, encoder	Maximum power consumption
CIO21A	W	1.2	6.5
CID21A		0.4	5.2
CES11A		0.8	12.8
CES12A		1.2	13.2

31972098/EN – 8/2024

Safety options

The following table shows the power consumption of the 24 V supply depending on the used cards and installed options:

Safety options	Unit	Power consumption without I/O, encoder	Maximum power consumption
CSB21A	W	17.7	17.7
CSS21A			26.4
CSB31A			38.4
CSS31A			38.4
CSA31A			38.4

Motors with MOVILINK® DDI

The following table shows the power consumption of the 24 V supply via MOVILINK® DDI:

MOVILINK® DDI	Unit	Power consumption
EZ2Z, AZ2Z, EZ4Z, AZ4Z	W	1.5
EI8Z		2.6
EK8Z, AK8Z		2.6
BG1Z, BS1Z[1)]		0.9
Motor with MOVILINK® DDI without encoder and without integrated brake control for MOVILINK® DDI		1.5

1) The power consumption of the 24 V brake must be considered separately.

5.13.4 Project planning example

The following configuration example shows the configuration of the 24 V voltage supply on the MDX9.A-0040-5E3-4-.00 inverter with multi-encoder card CES11A and I/O extension CID21A.

The inverter supplies the DI00 digital input (output stage enable) with voltage.

The motor brake is controlled via DB00. The coil of the brake relay requires DC 100 mA at DC 24 V.

The 4 outputs of the CID21A option are each subject to a load of DC 50 mA.

Power demand of the basic unit: 20 W + 1 × motor encoder: 5 W

Power demand of the CES11A option without encoder: 0.8 W

1 × external encoder: 12 W

Power demand of the CID21A option without terminals: 0.4 W

Power demand of the inputs (basic device): 1 × 0.1 W = 0.1 W

Power demand of the brake control at DB00: 24 V × 0.1 A = 2.4 W

Power demand of the binary outputs: 4 × 24 V × 0.05 A = 4.8 W

Total power demand: 45.6 W

31972098/EN – 8/2024

5.14 Energy-saving functions

5.14.1 Flux optimization

Flux optimization is a function that allows operation of an asynchronous motor in VFC^{PLUS} control mode with minimal losses. Depending on the torque setpoint, the magnetic flux is managed in such a way that the motor is operated with minimum current. In partial load operation, as well as in case of overload, the total losses of the motor can be significantly reduced. This function has no influence in the range of the nominal torque or a bit below, as the motor is usually operated at almost optimum conditions.

For system-related reasons, the torque control times are longer with flux optimization than without flux optimization, due to necessary changes in flux. The flux optimization is especially suitable for applications with little dynamics, such as fans, pumps, escalators, and conveyor systems with constant speed.

Flux optimization can reduce magnetization losses in the motor.

5.14.2 Standby mode

Description

Standby mode is intended for times in which operation is paused. The significant difference between disconnection of the DC 24 V supply voltage and standby mode is that switching from standby mode to operation only takes approx. 500 ms, and that bus communication is maintained. This allows for reducing the energy consumption even in short pauses.

The following functions are deactivated in standby mode:

- 7-segment display
- Digital outputs
- Analog outputs
- Power section control
- Fan in power section
- Encoder supply and encoder evaluation (optional)

The STO function is activated when a safety option CS..A is used. For the state of the STO function, the external wiring is relevant without safety option.

Standby operation can be activated via a digital input or via a control word bit. The bus communication is active without restrictions in standby operation.

Energy consumption in standby mode

The "Standby mode" energy-saving function reduces the DC 24 V power consumption. For further information, refer to chapter "Power consumption of the 24 V supply" (→ 🗎 153).

31972098/EN – 8/2024

5.15 FCB concept

FCB = Function control block

The FCB concept describes the modular firmware design of inverters from the MOVI-C® modular automation system with which it is ensured that a wide range of drive functions can be selected or deselected quickly and easily using control words.

All primary functions are selected as FCBs. For example, positioning control requires the FCB 09, while speed control is implemented with FCB 05.

You can switch between different FCBs at any time. Switching to another FCB takes place with a maximum delay of 0.5 ms.

Different priorities are assigned to the FCBs. If an FCB with a higher priority than the currently active FCB is selected, the FCB with the higher priority is activated.

5.15.1 List of FCBs

The FCBs are sorted in descending order of their priority in the following list:

- FCB 01 Output stage inhibit
- FCB 14 Emergency stop
- FCB 13 Stop at application limits
- FCB 18 Rotor position identification
- FCB 25 Motor parameter measurement
- FCB 12 Reference travel
- FCB 04 Manual mode
- FCB 20 Jog mode
- FCB 19 Position hold control
- FCB 21 Brake test
- FCB 10 Interpolated position control
- FCB 09 Position control
- FCB 06 Interpolated speed control
- FCB 05 Speed control
- FCB 08 Interpolated torque control
- FCB 07 Torque control
- FCB 26 Stop at user limits
- FCB 02 Default stop

5.15.2 Description of the FCBs

FCB 01 Output stage inhibit

Activating FCB 01 stops the connected motor via the motor brake. If no brake is installed, the motor coasts to a stop.

FCB 02 Default stop

FCB 02 stops the drive with the preset profile value "Maximum deceleration". This value is limited by the "Application limit – deceleration".

FCB 02 is active (default) when no other FCB is selected.

FCB 02 is selected by the system, not by the operator.

31972098/EN – 8/2024

FCB 04 Manual mode

The function block can be selected and activated via the function "Manual mode" using the MOVISUITE® engineering software. Manual mode is used for startup or for setup mode without a higher-level controller.

FCB 04 is selected by the system, not by the operator.

FCB 05 Speed control

The inverter can be operated as a speed-controlled axis.

The user can specify profile values for acceleration, deceleration, and jerk as the basic condition for speed control. The actual speed setpoint for the drive controller is generated in the controller cycle with the specified limit values by a profile generator integrated in the inverter.

FCB 06 Interpolated speed control

FCB 06 is used for cyclic speed setpoint inputs from higher-level controllers.

In multi-axis applications, a controller often calculates a path profile for several drive axes. The axis is only assigned setpoints (speed/torque and torque limits/precontrol values/inertia) that it has to follow. The axis limits the setpoints using the application limits. The path curve profile is controlled by the controller.

The setpoint cycle of the controller usually does not correspond to the setpoint cycle of the axis. If the axis were to "see" the same setpoint for several cycles, a step-shaped actual value would result. To prevent this from happening, the axis interpolates intermediate values. To do so, the setpoint cycle of the controller has to be known.

FCB 07 Torque control

The inverter can be operated as a torque-controlled axis.

The user can specify profile values for deceleration and jerk as the basic conditions for torque control. The actual torque setpoint for the drive controller is generated in the controller cycle with the specified limit values by a profile generator integrated in the inverter.

During torque control, the maximum speed is restricted by the speed limits so that the drive cannot permanently accelerate with the preset setpoint torque while the countertorque is too low.

FCB 08 Interpolated torque control

FCB 08 is used for cyclic torque setpoint inputs from a higher-level controller.

This higher-level controller usually calculates a track profile for several drive axes. The axis is then assigned just one setpoint (torque, torque limits, precontrol values, inertia) that it has to follow.

The inverter limits the setpoints using the application limits. The path curve profile is controlled by the controller.

The cycle in which the controller sends the setpoints to the axis normally does not correspond to the setpoint processing cycle of the inverter. If the inverter were to "see" the same controller setpoint for several cycles, a step-shaped actual torque value would result.

To prevent this from happening, the axis can calculate intermediate values (interpolate) if it knows the controller cycle. The inverter can be set to different cycle times of higher-level controllers.

31972098/EN – 8/2024

FCB 09 Position control

FCB 09 is used for positioning to make it possible to use a position profile for reaching the target position. This position profile is parameterized by the profile generator. The inverter additionally provides the following positioning modes:

Absolute positioning

The position setpoint in user units is interpreted as an absolute target and is converted and executed in system units.

The travel range in system units is -2^{31} to 2^{31} -1. If this travel range is exceeded after conversion, the FCB issues an error.

Relative positioning

The position setpoint in user units is interpreted as the offset for the last setpoint that was transferred. After it has been converted into system units, it is added to the last setpoint. If the time calculated in system units is outside the travel range of -2^{31} to 2^{31} -1, the FCB issues an error.

Modulo in positive direction with absolute position specification

The position setpoint in user units is interpreted as the absolute position. It must be within the modulo range of the active drive:

- Lower limit = "Modulo min."
- Upper limit = "Modulo max."

If the position setpoint is outside this range, a fault is issued.

The drive always turns in a positive direction to reach the target.

Modulo in negative direction with absolute position specification

The position setpoint in user units is interpreted as the absolute position. It must be within the modulo range of the active drive:

- Lower limit = "Modulo min."
- Upper limit = "Modulo max."

If the position setpoint is outside this range, a fault is issued.

The drive always turns in a negative direction to reach the new target.

Modulo with shortest distance with absolute position specification

The position setpoint in user units is interpreted as the absolute position. It must be within the modulo range of the active drive:

- Lower limit = "Modulo min."
- Upper limit = "Modulo max."

If the position setpoint is outside this range, a fault is issued.

The direction of the drive is determined using the last setpoint position (= current actual position after activation without an "In position" message) and the current setpoint position. From here, the shortest distance is determined and the direction of rotation for positioning is specified accordingly.

FCB 10 Interpolated position control

FCB 10 is used for cyclic preselected position setpoints from higher-level controllers.

31972098/EN – 8/2024

In multi-axis applications, a higher-level controller usually calculates a track profile for several drive axes. The axis only receives setpoints (position, speed, torque, torque limits, precontrol values, inertia), which it must follow directly. The axis limits the setpoints using the application limits. The path curve profile is controlled by the controller. The setpoint cycle of the controller usually does not correspond to the setpoint cycle of the axis. If the axis were to "see" the same setpoint for several cycles, a step-shaped actual value would result. To prevent this from happening, the axis interpolates intermediate values. To do so, the setpoint cycle of the controller has to be known.

FCB 12 Reference travel

To perform positioning operations, a drive has to be referenced to a defined start or reference position within the permitted travel distance. From this reference position, positions such as the machine zero can be specified and approached. With each restart of the inverter, referencing the position encoders is always necessary if position encoders do not have an absolute position detection. When using absolute encoders, the absolute position is immediately known when starting the system. An absolute encoder still has to be referenced to match the displayed position with the plant's reference system. Several reference travel types are available for referencing and for finding the reference point:

0: Deactivated

1: Zero pulse – negative end

2: Reference cam – negative end

3: Reference cam – positive end

4: Positive limit switch

5: Limit switch negative

6: Reference cam flush – limit switch positive

7: Reference cam flush – limit switch negative

8: Referencing to reference travel

9: Fixed stop positive

10: Fixed stop negative

11: Absolute position of encoder

FCB 13 Stop at application limits

When FCB 13 is activated, the drive stops with speed control using the preset application limit deceleration.

FCB 14 Emergency stop

When FCB 14 is activated, the drive stops with the preset emergency stop deceleration.

The emergency stop deceleration should always be greater than or equal to the "Application limit deceleration". If a smaller deceleration value than the "Application limit deceleration" is specified for the emergency stop deceleration, the "Application limit deceleration" is used as the emergency stop deceleration.

FCB 18 Rotor position identification

For the operation of permanent magnet synchronous motors, the exact position information of the rotor is required for closed-loop control.

31972098/EN – 8/2024

FCB 18 is required for the encoder calibration of rotary and linear synchronous motors with encoder. FCB 18 requires an electrical startup of the drive.

The drive must be separated from the load, i.e. also from the gear unit.

For a third-party motor, it is recommended to run FCB 25 before performing rotor position identification.

FCB 19 Position hold control

When FCB 19 is activated, the drive stops with speed control. After the drive reaches an idle state, the position is kept with position control as long as FCB 19 is active.

FCB 20 Jog mode

FCB 20 is used for the setup mode when a higher-level controller is used.

FCB 20 can only be activated in operating modes with encoder feedback.

FCB 20 allows the user to move an axis in a positive and negative direction.

Control is performed via control signals that are specified by means of control words, via digital inputs of a higher-level controller or via input terminals.

For startup or for setup mode without a higher-level controller, use the manual mode of the MOVISUITE® engineering software, see "FCB 04 Manual mode" (→ 🗎 157).

FCB 21 Brake test

FCB 21 tests the function and performance of up to 2 brakes. The function separately applies an adjustable torque (static test) to the applied brakes.

The brake test can be adapted to various requirements. The test result "passed" (test result OK) or "failed" (test result not OK) is available as feedback for each brake. Other measured values are also available.

An application-specific load torque must be taken into account when specifying the torque. The user can specify values. Alternatively, FCB 21 can determine the current load situation itself, which simplifies startup and offers more flexibility.

FCB 21 works with drive train 1. An encoder feedback (motor encoder or distance encoder) that matches the used VFC^{PLUS} or CFC control mode is required.

When testing a brake, the brake control is integrated via DB0/DB00.

When testing 2 brakes, additional wiring is required in the brake control.

FCB 25 Motor parameter measurement

FCB 25 is used for determining the necessary parameters from the electric equivalent wiring diagram during startup.

The nameplate data of the connected motor is required for motor parameter measurement.

After the motor parameter measurement has been completed, the motor is completely started up electrically. Values that are not yet final at this stage, such as maximum speed and maximum torque, are estimated. The values have to be corrected at a later time to reach the full performance of the motor.

FCB 25 should only be called up if no output filter is used. Otherwise, the FCB provides incorrect results because of the output filter inductance.

Calling up FCB 25 is generally recommended for third-party motors. FCB 18 must be executed afterward for encoder calibration with synchronous motors, if required.

31972098/EN – 8/2024

FCB 26 Stop at user limits

FCB 26 is used for stops at user limits. The user limits are either available as local set-points or initiate the deceleration ramp set via the fieldbus. You can choose between a speed-controlled ramp and a position-controlled ramp. Unlike the other stop FCBs (FCB 13/FCB 14), FCB 26 has a very low priority.

This allows you to select FCB 26 as default (e.g., bit in the control word that selects this FCB is always TRUE). This means that FCB 26 is always active when all other FCBs are deselected. This makes it possible to always stop in a position-controlled manner.

In position-controlled mode, FCB 26 has lag error monitoring. When the stop is reached, the brake remains released and the motor remains energized.

31972098/EN – 8/2024

5.15.3 Setpoints and limits in the FCBs

Setpoint connection

The following table shows which setpoints are used by which FCBs.

Parameter	FCB						
	05	06	07	08	09	10	20
Position	–	–	–	–	✓	✓	–
Speed	✓	✓	–	–	–	o	o
Torque	–	–	✓	✓	–	–	–
Acceleration precontrol	–	o	–	–	–	o	–
Mass moment of inertia	–	o	–	✓	–	o	–
Torque precontrol	–	o	–	✓	–	o	–
Correcting value of external position controller	–	o	–	–	–	–	–

✓ Always active

o Depending on FCB setting

– Inactive

INFORMATION

In the U/f control mode, only the "Speed" setpoint is used.

Profile value connection

The following table shows which profile values are used by which FCBs.

Parameter	FCB										
	02	05	06	07	08	09	10	13	14	20	26
Maximum positive speed	–	–	–	✓	✓	✓	–	–	–	–	–
Maximum negative speed	–	–	–	✓	✓	✓	–	–	–	–	–
Maximum acceleration	–	✓	–	–	–	✓	–	–	–	o	–
Maximum deceleration	✓	✓	–	–	–	✓	–	–	–	o	✓
Jerk time	–	✓	–	✓	–	✓	–	–	–	o	✓
Maximum torque Q1 to Q4	–	✓	✓	✓	✓	✓	✓	o	o	–	–

✓ Always active

o Depending on FCB setting

– Inactive

31972098/EN – 8/2024

INFORMATION

In the U/f control mode, the "Maximum torque Q1 to Q4" profile value is not used.

Limit values

The following table shows which limit values are used by which FCBs.

Parameter	FCB														
	02	04	05	06	07	08	09	10	12	13	14	19	20	21	26
Positive speed	–	✓	✓	✓	✓	✓	✓	✓	✓	–	–	–	✓	–	–
Negative speed	–	✓	✓	✓	✓	✓	✓	✓	✓	–	–	–	✓	–	–
Acceleration	–	✓	✓	–	–	–	✓	–	✓	–	–	✓	✓	–	–
Deceleration	✓	✓	✓	–	–	–	✓	–	✓	✓	–	✓	✓	o	✓
Jerk time	✓	✓	✓	–	✓	–	✓	–	✓	✓	✓	✓	✓	o	✓
Torque	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	o	✓
Apparent output current	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Voltage limit	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Emergency stop deceleration	–	–	–	–	–	–	–	–	–	–	✓	–	–	–	–

✓ Always active

o Only active if FCB 21 is activated with a rotating drive. With these parameters, the drive is stopped before FCB 21 is executed.

– Inactive

INFORMATION

In the U/f control mode, the "Torque" limit value is not used.

5.16 UL-compliant installation

INFORMATION

Due to UL requirements, the following chapter is always printed in English and in some cases in French, regardless of the language of this documentation.

⚠ CAUTION

- Use only tested units with a limited output voltage (V_{max} = DC 30 V) and limited output current (I_{max} = 8 A) as an external DC 24 V voltage source.

- UL certification does not apply to operation in voltage supply systems with a non-grounded star point (IT systems).

5.16.1 Field wiring power terminals

- Use 60/75 °C copper wire only.
- Tighten terminals to in-lbs (Nm) as follows:

<table>
<tr><th colspan="2" rowspan="3">Connection</th><th colspan="8">Tightening torque in-lbs (Nm)</th></tr>
<tr><th colspan="8">Frame size</th></tr>
<tr><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th></tr>
<tr><td>Line connection</td><td>X1</td><td colspan="3" rowspan="2">4.4 – 5.3</td><td rowspan="2">15.0 – 15.9</td><td rowspan="3">75.2 – 84.1</td><td rowspan="3">88.5 – 132.8</td><td colspan="2" rowspan="3">123.9 – 177.0</td></tr>
<tr><td>Motor and braking resistor terminal</td><td>X2</td></tr>
<tr><td>PE connection</td><td>–</td><td colspan="2">10.6 – 13.3</td><td>M4: 10.6 – 13.3
or
M6: 22.1 – 26.6</td><td>22.1 – 26.6</td></tr>
<tr><td>Terminal screw for TN/IT systems</td><td>EMC</td><td colspan="8">8.9 – 10.6</td></tr>
<tr><td>Fastening of cards</td><td>–</td><td colspan="8">5.3 – 7.1</td></tr>
</table>

5.16.2 Short circuit current rating

Suitable for use on a circuit capable of delivering not more than

- 5000/10 000 rms symmetrical amperes when protected by circuit breakers and type E combination motor controllers as described in the tables below.
- 65 000 rms symmetrical amperes when protected by fuses, circuit breakers and type E combination motor controllers as described in the tables below.

Max. voltage is limited to 240 V (230 V units only) or 500 V (400 V units only).

5.16.3 Branch circuit protection

Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the National Electrical Code and any additional local codes (US) or Canadian Electrical Code, Part 1 (CA).

WARNING - The opening of the branch-circuit protective device may be an indication that a fault current has been interrupted. To reduce the risk of fire or electric shock, current-carrying parts and other components of the controller should be examined and replaced if damaged. If burnout of the current element of an overload relay occurs, the complete overload relay must be replaced.

ATTENTION - LE DÉCLENCHEMENT DU DISPOSITIF DE PROTECTION DU CIRCUIT DE DÉRIVATION PEUT ÊTRE DÛ À UNE COUPURE QUI RÉSULTE D'UN COURANT DE DÉFAUT. POUR LIMITER LE RISQUE D'INCENDIE OU DE CHOC ÉLECTRIQUE, EXAMINER LES PIÈCES PORTEUSES DE COURANT ET LES AUTRES ÉLÉMENTS DU CONTRÔLEUR ET LES REMPLACER S'ILS SONT ENDOMMAGÉS. EN CAS DE GRILLAGE DE L'ÉLÉMENT TRAVERSÉ PAR LE COURANT DANS UN RELAIS DE SURCHARGE, LE RELAIS TOUT ENTIER DOIT ÊTRE REMPLACÉ.

31972098/EN – 8/2024

For maximum branch circuit protection see tables below.

Three-phase 380 – 500 V voltage range (SCCR: 5 kA)			
Model (frame size)	**Non-semiconductor fuses (currents are maximum values)**	**Inverse-time circuit breaker (currents are maximum, voltages minimum values)**	**Type E combination motor controller, mfd by Siemens, type Sirius (rated 480 V/277 V)**
MDX9.A-0020-5.3-4-.. (1)	–	50 A/500 V	3RV2011-1CA10, 2.5 A
MDX9.A-0025-5.3-4-.. (1)	–	50 A/500 V	3RV2011-1CA10, 2.5 A
MDX9.A-0032-5.3-4-.. (1)	–	50 A/500 V	3RV2011-1EA10, 4 A
MDX9.A-0040-5.3-4-.. (1)	–	50 A/500 V	3RV2011-1EA10, 4 A
MDX9.A-0055-5.3-4-.. (2)	–	50 A/500 V	3RV2011-1GA10, 6.3 A
MDX9.A-0070-5.3-4-.. (2)	–	50 A/500 V	3RV2011-1HA10, 8 A
MDX9.A-0095-5.3-4-.. (2)	–	50 A/500 V	3RV2011-1JA10, 10 A
MDX9.A-0125-5.3-4-.. (3)	–	50 A/500 V	3RV2011-4AA10, 16 A
MDX9.A-0160-5.3-4-.. (3)	–	50 A/500 V	3RV2011-4AA10, 16 A
MDX9.A-0240-5.3-4-.. (4)	–	60 A/500 V	3RV2021-4DA10, 25 A
MDX9.A-0320-5.3-4-.. (4)	–	60 A/500 V	3RV2031-4EA10, 32 A
MDX9.A-0460-5.3-4-.. (5)	–	125 A/500 V	3RV2031-4VA10, 45 A
MDX9.A-0620-5.3-4-.. (5)	–	125 A/500 V	3RV2041-4JA10, 63 A
MDX9.A-0750-5.3-4-.. (5)	–	125 A/500 V	3RV2041-4KA10, 75 A

Three-phase 380 – 500 V voltage range (SCCR: 10 kA)			
Model (frame size)	**Non-semiconductor fuses (currents are maximum values)**	**Inverse-time circuit breaker (currents are maximum, voltages minimum values)**	**Type E combination motor controller, mfd by Siemens, type Sirius (rated 480 V/277 V)**
MDX9.A-0910-5.3-4-.. (6)	–	225 A/500 V	3RV2041-4YA10, 93 A
MDX9.A-1130-5.3-4-.. (6)	–	225 A/500 V	–
MDX9.A-1490-5.3-4-.. (6)	–	225 A/500 V	–

Three-phase 380 – 500 V voltage range (SCCR: 65 kA)			
Model (frame size)	**Non-semiconductor fuses (currents are maximum values)**	**Inverse-time circuit breaker (currents are maximum, voltages minimum values)**	**Type E combination motor controller, mfd by Siemens, type Sirius (rated 480 V/277 V)**
MDX9.A-0020-5.3-4-.. (1)	50 A/600 V Class: CA, CB, CD, CF, G, J, K-1, K-5, RK1, RK5, T	50 A/500 V	3RV2011-1CA10, 2.5 A
MDX9.A-0025-5.3-4-.. (1)	50 A/600 V Class: CA, CB, CD, CF, G, J, K-1, K-5, RK1, RK5, T	50 A/500 V	3RV2011-1CA10, 2.5 A

31972098/EN – 8/2024

Three-phase 380 – 500 V voltage range (SCCR: 65 kA)			
Model (frame size)	**Non-semiconductor fuses (currents are maximum values)**	**Inverse-time circuit breaker (currents are maximum, voltages minimum values)**	**Type E combination motor controller, mfd by Siemens, type Sirius (rated 480 V/277 V)**
MDX9.A-0032-5.3-4-.. (1)	50 A/600 V Class: CA, CB, CD, CF, G, J, K-1, K-5, RK1, RK5, T	50 A/500 V	3RV2011-1EA10, 4 A
MDX9.A-0040-5.3-4-.. (1)	50 A/600 V Class: CA, CB, CD, CF, G, J, K-1, K-5, RK1, RK5, T	50 A/500 V	3RV2011-1EA10, 4 A
MDX9.A-0055-5.3-4-.. (2)	50 A/600 V Class: CA, CB, CD, CF, G, J, K-1, K-5, RK1, RK5, T	50 A/500 V	3RV2011-1GA10, 6.3 A
MDX9.A-0070-5.3-4-.. (2)	50 A/600 V Class: CA, CB, CD, CF, G, J, K-1, K-5, RK1, RK5, T	50 A/500 V	3RV2011-1HA10, 8 A
MDX9.A-0095-5.3-4-.. (2)	50 A/600 V Class: CA, CB, CD, CF, G, J, K-1, K-5, RK1, RK5, T	50 A/500 V	3RV2011-1JA10, 10 A
MDX9.A-0125-5.3-4-.. (3)	50 A/600 V Class: CA, CB, CD, CF, G, J, K-1, K-5, RK1, RK5, T	50 A/500 V	3RV2011-4AA10, 16 A
MDX9.A-0160-5.3-4-.. (3)	50 A/600 V Class: CA, CB, CD, CF, G, J, K-1, K-5, RK1, RK5, T	50 A/500 V	3RV2011-4AA10, 16 A
MDX9.A-0240-5.3-4-.. (4)	60 A/600 V Class: CA, CB, CD, CF, G, J, K-1, K-5, RK1, RK5, T	60 A/500 V	3RV2021-4DA10, 25 A
MDX9.A-0320-5.3-4-.. (4)	60 A/600 V Class: CA, CB, CD, CF, G, J, K-1, K-5, RK1, RK5, T	60 A/500 V	3RV2031-4EA10, 32 A
MDX9.A-0460-5.3-4-.. (5)	125 A/600 V Class: J, K-1, RK1, T	125 A/500 V	3RV2031-4VA10, 45 A
MDX9.A-0620-5.3-4-.. (5)	125 A/600 V Class: J, K-1, RK1, T	125 A/500 V	3RV2041-4JA10, 63 A
MDX9.A-0750-5.3-4-.. (5)	125 A/600 V Class: J, K-1, RK1, T	125 A/500 V	3RV2041-4KA10, 75 A

31972098/EN – 8/2024

Three-phase 380 – 500 V voltage range (SCCR: 65 kA)			
Model (frame size)	**Non-semiconductor fuses (currents are maximum values)**	**Inverse-time circuit breaker (currents are maximum, voltages minimum values)**	**Type E combination motor controller, mfd by Siemens, type Sirius (rated 480 V/277 V)**
MDX9.A-0910-5.3-4-.. (6)	225 A/600 V Class: J, T	225 A/500 V	3RV2041-4YA10, 93 A
MDX9.A-1130-5.3-4-.. (6)	225 A/600 V Class: J, T	225 A/500 V	–
MDX9.A-1490-5.3-4-.. (6)	225 A/600 V Class: J, T	225 A/500 V	–
MDX9.A-1770-5.3-4-.. (7)	225 A/600 V Class: J, T	225 A/500 V	–
MDX9.A-2200-5.3-4-.. (7)	600 A/600 V Class: J, K-1, L, RK1, T	600 A/500 V	–
MDX9.A-2500-5.3-4-.. (7)	600 A/600 V Class: J, K-1, L, RK1, T	600 A/500 V	–
MDX9.A-3000-5.3-4-.. (7)	600 A/600 V Class: J, K-1, L, RK1, T	600 A/500 V	–
MDX9.A-3800-5.3-4-.. (8)	800 A/600 V Class: T	800 A/500 V	–
MDX9.A-4700-5.3-4-.. (8)	800 A/600 V Class: T	800 A/500 V	–
MDX9.A-5880-5.3-4-.. (8)	800 A/600 V Class: T	800 A/500 V	–

Three-phase 200 – 240 V voltage range (SCCR: 5 kA)			
Model (frame size)	**Non-semiconductor fuses (currents are maximum values)**	**Inverse-time circuit breaker (currents are maximum, voltages minimum values)**	**Type E combination motor controller, mfd by Siemens, type Sirius (rated 480 V/277 V)**
MDX9.A-0070-2.3-4-.. (2)	–	50 A/240 V	3RV2011-1HA10, 8 A
MDX9.A-0093-2.3-4-.. (2)	–	50 A/240 V	3RV2011-1JA10, 10 A
MDX9.A-0140-2.3-4-.. (3)	–	50 A/240 V	3RV2011-4AA10, 16 A
MDX9.A-0213-2.3-4-.. (4)	–	60 A/240 V	3RV2021-4DA10, 25 A
MDX9.A-0290-2.3-4-.. (4)	–	60 A/240 V	3RV2031-4EA10, 32 A
MDX9.A-0420-2.3-4-.. (5)	–	125 A/240 V	3RV2031-4VA10, 45 A
MDX9.A-0570-2.3-4-.. (5)	–	125 A/240 V	3RV2041-4JA10, 63 A
MDX9.A-0840-2.3-4-.. (6)	–	225 A/240 V	3RV2041-4YA10, 93 A
MDX9.A-1080-2.3-4-.. (6)	–	225 A/240 V	3RV2041-4YA10, 93 A

31972098/EN – 8/2024

Three-phase 200 – 240 V voltage range (SCCR: 65 kA)			
Model (frame size)	**Non-semiconductor fuses (currents are maximum values)**	**Inverse-time circuit breaker (currents are maximum, voltages minimum values)**	**Type E combination motor controller, mfd by Siemens, type Sirius (rated 480 V/277 V)**
MDX9.A-0070-2.3-4-.. (2)	50 A/240 V Class: CA, CB, CD, CF, G, J, K-1, K-5, RK1, RK5, T	50 A/240 V	3RV2011-1HA10, 8 A
MDX9.A-0093-2.3-4-.. (2)	50 A/240 V Class: CA, CB, CD, CF, G, J, K-1, K-5, RK1, RK5, T	50 A/240 V	3RV2011-1JA10, 10 A
MDX9.A-0140-2.3-4-.. (3)	50 A/240 V Class: CA, CB, CD, CF, G, J, K-1, K-5, RK1, RK5, T	50 A/240 V	3RV2011-4AA10, 16 A
MDX9.A-0213-2.3-4-.. (4)	60 A/240 V Class: CA, CB, CD, CF, G, J, K-1, K-5, RK1, RK5, T	60 A/240 V	3RV2021-4DA10, 25 A
MDX9.A-0290-2.3-4-.. (4)	60 A/240 V Class: CA, CB, CD, CF, G, J, K-1, K-5, RK1, RK5, T	60 A/240 V	3RV2031-4EA10, 32 A
MDX9.A-0420-2.3-4-.. (5)	125 A/240 V Class: J, K-1, RK1, T	125 A/240 V	3RV2031-4VA10, 45 A
MDX9.A-0570-2.3-4-.. (5)	125 A/240 V Class: J, K-1, RK1, T	125 A/240 V	3RV2041-4JA10, 63 A
MDX9.A-0840-2.3-4-.. (6)	225 A/240 V Class: J, T	225 A/240 V	3RV2041-4YA10, 93 A
MDX9.A-1080-2.3-4-.. (6)	225 A/240 V Class: J, T	225 A/240 V	3RV2041-4YA10, 93 A

5.16.4 Motor overload protection

The units are provided with load and speed-sensitive overload protection and thermal memory retention upon shutdown or power loss.

The trip current is adjusted to 150% of the rated motor current.

5.16.5 Surrounding air temperature rating

For surrounding air temperature rating, refer to chapter "General technical data".

5.16.6 Derating

For derating, refer to chapter "Selecting an inverter" of the product manual.

31972098/EN – 8/2024

5.16.7 Other ratings

Type rating	Open type
Pollution degree	2
Max. altitude	2000 m

5.16.8 Wiring diagrams

For wiring diagrams, refer to chapter "Wiring diagrams".

31972098/EN – 8/2024

6 Project planning for functional safety

6.1 Definitions

- The designation "F-DI" stands for a safe digital input.
- The designation "F-DO" stands for a safe digital output.
- The designation "DB00" stands for the digital output brake output of the inverter.
- The designation "CS..A" is used as a generic term for all derivatives of the MOVISAFE® CS..A product series. If a particular derivative is referred to in the documentation, then the complete designation is used.
- The term "safe" used in this manual refers to the classification as a safe function according to EN ISO 13849-1.
- PROFIsafe, Safety over EtherCAT® and CIP Safety™ are technology standards for a safe fieldbus system (safety protocol). If a particular safety protocol is referred to in the documentation, then the complete designation is used.
- MOVISUITE® is the startup/engineering software of the MOVI-C® modular automation system.
- The "Assist CS.." parameterization tool is the parameterization interface in MOVISUITE® for the MOVISAFE® CS..A safety option.
- Parameter names are shown in *italics*.
- The SS1 safety sub-function is described according to the currently applicable EN 61800-5-2 as follows:
  - SS1-t corresponds to the former presentation of SS1(c)
  - SS1-r corresponds to the former presentation of SS1(b)
- The SS2 safety sub-function is described according to the currently applicable EN 61800-5-2 as follows:
  - SS2-t corresponds to the former presentation of SS2(c)
  - SS2-r corresponds to the former presentation of SS2(b)

6.2 Underlying standards

The safety assessment of the device is based on the following standards and safety classes:

Underlying standards	
Safety class/ underlying standard	• Performance Level (PL) according to EN ISO 13849-1 • Safety Integrity Level (SIL) according to EN 61800-5-2, EN 61508 and EN 62061

Note the versions of the relevant standards on the declaration of conformity or on the TÜV certificate.

31972098/EN – 8/2024

6.3 Integrated safety technology

6.3.1 Overview of firmware versions

Firmware version	New functions
V1.05	Initial firmware.
V2.05	• The Safety over EtherCAT® safety protocol is supported. • The PROFIsafe safety protocol (V2.6) with address type 2 is supported. • Newer authentication mechanism (reading the safety key ID by means of a flashing sequence) when establishing a connection to the CS..A safety option. • Backward compatibility with future firmware versions improved. • "Emergency mode" function via CBG21A keypad (safety option error muting).
V3.02	The CSA31A safety option is supported.
V4.02/V4.03	• If safe communication is interrupted, a fault response can be parameterized. • New EDM safety sub-function.
V5.01	• If the device is not accepted, a warning is issued. • The safety encoders with MOVILINK® DDI are supported. • The "Muting" error response is supplemented with the EDM safety sub-function. • The SOS safety sub-function has been extended.

6.3.2 Overview of the safety options

In the device, the STO safety sub-function is always available and can be extended with the following 5 safety options.

- Safety option MOVISAFE® CSB21A
  - 4 safe single-channel digital inputs or 2 safe two-channel digital inputs

  The safety option MOVISAFE® CSB21A provides the safety sub-functions STO and SS1-t. The functions can be controlled via safe communication and safe digital inputs.
- Safety option MOVISAFE® CSB31A
  - 4 safe single-channel digital inputs or 2 safe two-channel digital inputs
  - 2 safe two-channel digital outputs
  - 2nd encoder slot (not used for functional safety)

  The SBC, STO and SS1-t safety sub-functions are available with the MOVISAFE® CSB31A safety option. The functions can be controlled via safe communication and safe digital inputs. Furthermore, an external encoder can be connected which is evaluated by the inverter.
- Safety option MOVISAFE® CSS21A
  - 4 safe single-channel digital inputs or 2 safe two-channel digital inputs

31972098/EN – 8/2024

  - 2 safe two-channel digital outputs

  The safety option MOVISAFE® CSS21A provides the safety sub-functions SBC, STO and SS1-t. When a safe motor encoder is being used, the SS1-r, SS2, SOS, SLS, SSM, SSR, SLA, SLI and SDI safety sub-functions and the SBT brake diagnostics are available for motion monitoring. The functions can be controlled via safe communication and safe digital inputs.

- Safety option MOVISAFE® CSS31A
  - 4 safe single-channel digital inputs or 2 safe two-channel digital inputs
  - 2 safe two-channel digital outputs
  - 2nd encoder slot (not used for functional safety)

  The safety option MOVISAFE® CSS31A provides the safety sub-functions SBC, STO and SS1-t. When a safe motor encoder is being used, the SS1-r, SS2, SOS, SLS, SSM, SSR, SLA, SLI and SDI safety sub-functions and the SBT brake diagnostics are available for motion monitoring. The functions can be controlled via safe communication and safe digital inputs. Furthermore, an external encoder can be connected which is evaluated by the inverter.

- Safety option MOVISAFE® CSA31A
  - 4 safe single-channel inputs or 2 safe two-channel inputs
  - 2 safe two-channel outputs
  - 2nd encoder slot (to be used for functional safety)

  The safety option MOVISAFE® CSA31A provides the safety sub-functions SBC, STO and SS1-t. When a safe encoder system is being used, the SS1-r, SS2, SOS, SLS, SSM, SSR, SLA, SLI, SDI, SCA and SLP safety sub-functions and the SBT brake diagnostics are available for motion and position monitoring. The functions can be controlled via safe communication and safe digital inputs. Furthermore, up to 2 external encoders can be connected, which are evaluated by the inverter and the safety option in addition to the motor encoder.

The PROFIsafe and Safety over EtherCAT® profiles are available for safe communication.

The described safety technology of the device (STO safety sub-function and safety options MOVISAFE® CS..A) has been developed and tested according to the following safety requirements:

- SIL 3 according to EN 61800-5-2, EN 61508
- PL e according to EN ISO 13849-1
- The device with the integrated STO safety sub-function is suitable for applications according to EN 81-20, chapter 5.9.2.5.4, section d) and chapter 5.9.3.4.2, section d). The STO safety sub-function meets the SIL 3/HFT=1 requirement according to IEC 61800-5-2/61508 and PL e/cat. 3 according to EN ISO 13849.

This was certified by TÜV Rheinland. A copy of the TÜV certificate can be requested from SEW-EURODRIVE.

6.3.3 Safe condition

The safety concept is based on a safe state existing for all safe process values. For safety-related operation of the device, the switched-off torque is defined as a safe state.

A safe state of the MOVISAFE® CS..A safety option is defined as follows:

- The internal safe digital output F-DO_STO is disabled. This activates the STO safety sub-function.

31972098/EN – 8/2024

- All other existing safe digital outputs are disabled.
- If safe communication is parameterized, either substitute values are sent for the data (i.e. all data is "0"), or the communication is interrupted.

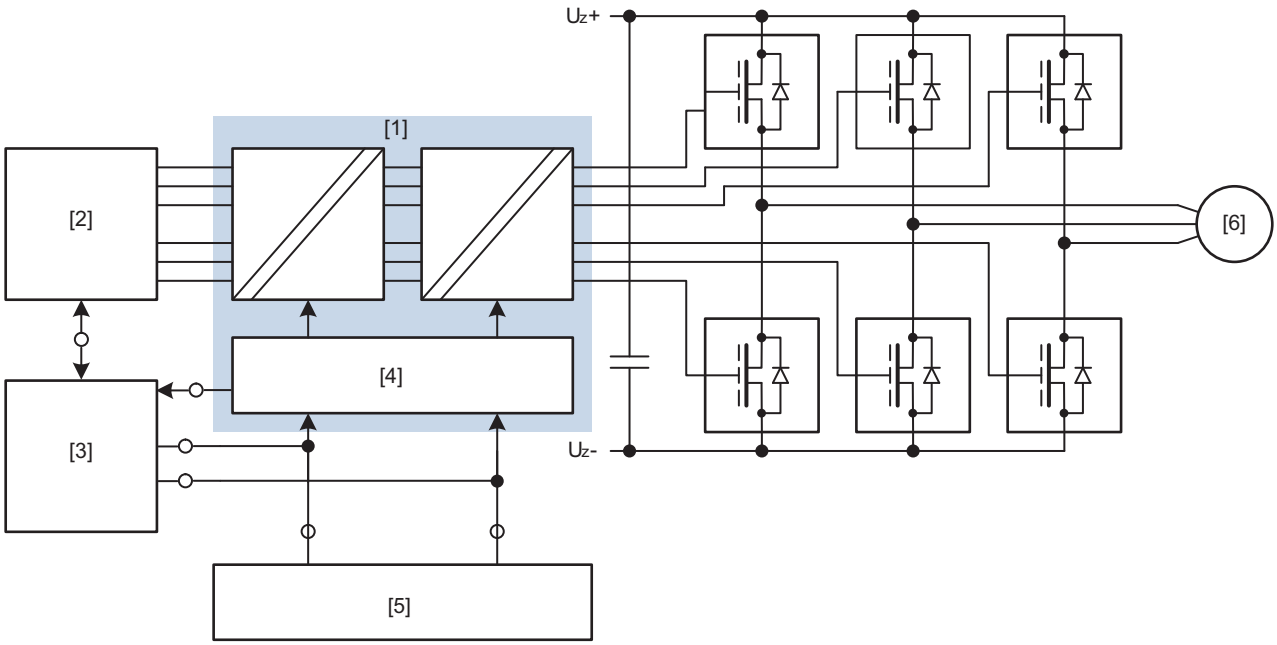
6.3.4 STO safety concept

The device is supposed to be able to perform the safety sub-function "Safe Torque Off" according to EN 61800-5-2:

- The device is characterized by the optional connection of an external safety controller/safety relay. This external safety controller/safety relay disconnects the safety-related STO input via a two-pole 24 V switching signal (e.g., sourcing/sinking) when a connected command device (e.g., emergency stop button with latching function) is activated. This activates the STO function of the device. As an alternative to an external safety controller/safety relay, the STO function can also be implemented with the optional MOVISAFE® CS..A safety option.
- An internal, dual-channel structure with diagnostics prevents the generation of pulse trains at the power output stage (IGBT).
- Instead of a galvanic isolation of the drive from the supply system by means of contactors or switches, the disconnection of the STO input described here safely prevents the activation of the power semiconductors in the output stage. The rotary-field generation for the respective motor is deactivated even though the line voltage is still present.
- When the STO safety sub-function is activated, the generated PWM signals from the device are interrupted by the STO circuit and are not transmitted to the power output stage (IGBTs).
- If the internal diagnostics of the STO circuit detects an error or discrepancy between the two channels, the PWM signals are locked, i.e. STO is activated. This locking requires a reset by switching the DC 24 V supply voltage of the device or the DC 24 V switching signal at the STO inputs F_STO_P1 and F_STO_P2 off and back on.

31972098/EN – 8/2024

6.3.5 Schematic representation of the STO safety concept



23543720971

[1] STO function
[2] Drive controller
[3] Internal safety option (optional)
[4] Diagnostics and inhibiting unit
[5] External safety device (optional)
[6] Motor

6.3.6 MOVISAFE® CS..A safety concept

Information concerning the stop categories in accordance with EN 60204-1

- The STO safety sub-function corresponds to stop category 0.
- The SS1-t and SS1-r safety sub-functions correspond to stop category 1.
- The SS2-t and SS2-r safety sub-functions correspond to stop category 2.

Pluggable safety key

The safety key must be inserted when activating the MOVISAFE® CS..A safety option and must not be removed while the safety option is active.

The parameterization data of the MOVISAFE® CS..A safety option is divided into application data and the key data set. The key data set ensures data integrity.

The application data is stored in the device. The application data is enabled with the aid of the key data set on the pluggable safety key. The safety option becomes operational only if the key data set on the pluggable safety key matches the parameterization.

31972098/EN – 8/2024

The pluggable safety key is also used to establish a location reference in the system. Since the application-related data set is enabled only with the matching key data set on the pluggable safety key, the location reference can be established in this way. It is the user's responsibility to save the location reference of the pluggable safety key in the system.

The data for safe communication as well as safe referencing is also stored on the pluggable safety key because this data has the same location reference.

This ensures that the application-related data and the communication data is available again immediately in the event of a device replacement.

If a system error occurs while saving referencing data, replace the safety key (see chapter "Replacing the safety key").

⚠ WARNING



After switching the safety option off and on again, the error is no longer signaled.

Severe or fatal injuries.

- Make sure that the position reference between the safety option and the application is correct.

The safety key contains the following data:

- Checksum of the application data set
- Checksum of the accepted data set
- Checksum bus (ParCRCBus)
- Parameter of the F-protocol
- Referencing data

Identification and authentication

In the "Assist CS.." parameterization tool, unique identification of the device and an authentication of the user is necessary for the steps "Parameterize", "Create report" and "Confirm validation". To identify the device, enter the ID of the pluggable safety key in the login dialog of the parameterization tool. The safety key ID is printed on the safety key. Alternatively, the safety key ID can be read by the "Assist CS.." parameterization tool. To do this, perform an identity verification using the LED display of the device. This mechanism with the safety key ID ensures that the Assist CS.. parameterization tool is connected to the correct device. The user is authenticated via the entry of a password.

INFORMATION



It is essential to ensure unique identification of the device to be parameterized.

Report and safety check

When downloading the parameters to the safety option CS..A, both the application data set and the checksum of the application data of the safety key set are created. The safety option goes into operation if all tests are fault-free. From this moment on, all parameterized functions are active.

31972098/EN – 8/2024



⚠ WARNING

Depending on the parameter setting, the safety option does not control the STO safety sub-function. This can cause the drive to start unexpectedly.

Severe or fatal injuries.

- Make sure that the drive does not restart automatically after parameterization of the safety option (e.g., set start inhibit, remove travel commands).

The acceptance report can be created once the parameters are downloaded. During this process, the new ParCRC value of the "application data" set is made known to the F-protocol host. The new ParCRC value must be transferred to the F-protocol host. The acceptance report must be used to perform the acceptance of the "application data" set in combination with the safety option within the system.

After acceptance, the performed acceptance can be published via the safety option. The publication of the acceptance does not replace the acceptance itself to be carried out. For the publication of the acceptance, the "checksum of the acceptance report" of the safety option is made known.

The publication of the acceptance is not implemented in a safety-related manner and is not necessary for the safety-related operation of the safety option. The publication of the acceptance is a supporting function for the user of the safety option.

6.3.7 Safety sub-functions according to EN 61800-5-2

Introduction

The following table shows the availability of the safety sub-functions described below, depending on the MOVISAFE® CS..A safety option used in each case:

CS..A safety option	Safety sub-function														
	Idle state			Motion										Position	
	STO	SBC	SS1-t	SS1-r	SS2-t	SS2-r	SOS	SLS	SSM	SSR	SDI	SLI	SLA	SLP	SCA
				Only with FS encoder											
Without CS..A	✓	–	✓[1]	–	–	–	–	–	–	–	–	–	–	–	–
CSB21A	✓	–	✓	–	–	–	–	–	–	–	–	–	–	–	–
CSS21A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–
CSB31A[2]	✓	✓	✓	–	–	–	–	–	–	–	–	–	–	–	–
CSS31A[2]	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–
				With one FS encoder or 2-encoder concept											
CSA31A[3]	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

1) With suitable control

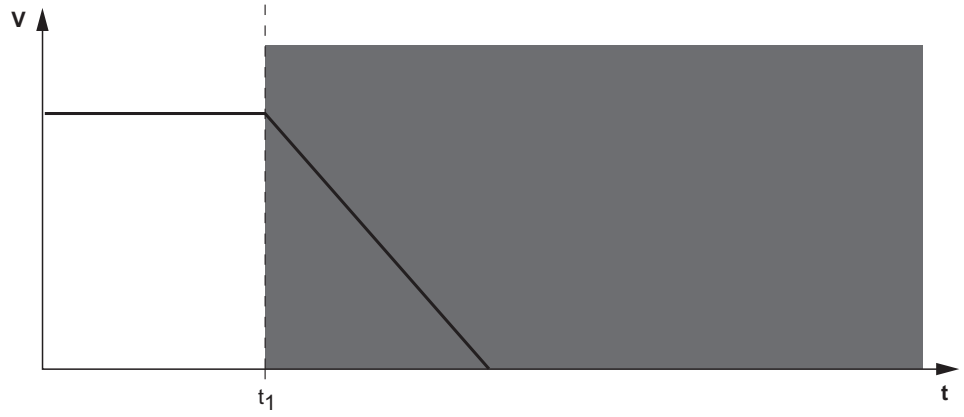
2) Has a second encoder connection (not used for functional safety)

3) Has a second encoder connection that can be used for functional safety

31972098/EN – 8/2024

STO – Safe Torque Off

When the STO safety sub-function is active, the power supply to the motor is interrupted and the drive cannot generate any torque. The STO safety sub-function corresponds to a non-controlled stop according to EN 60204-1, stop category 0.



18014400480354315

= STO safety sub-function active
v = Speed
t = Time
t_1 = Point in time at which STO is activated.

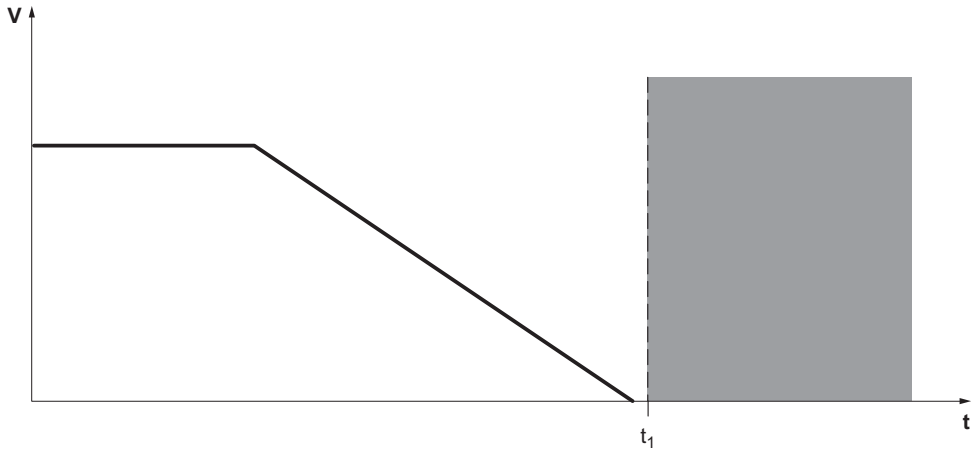
INFORMATION

The motor coasts to a halt or is stopped mechanically.

Controlled standstill is preferred, if possible.

SBC – Safe Brake Control

The SBC safety sub-function provides a safe output signal for controlling a mechanical brake.



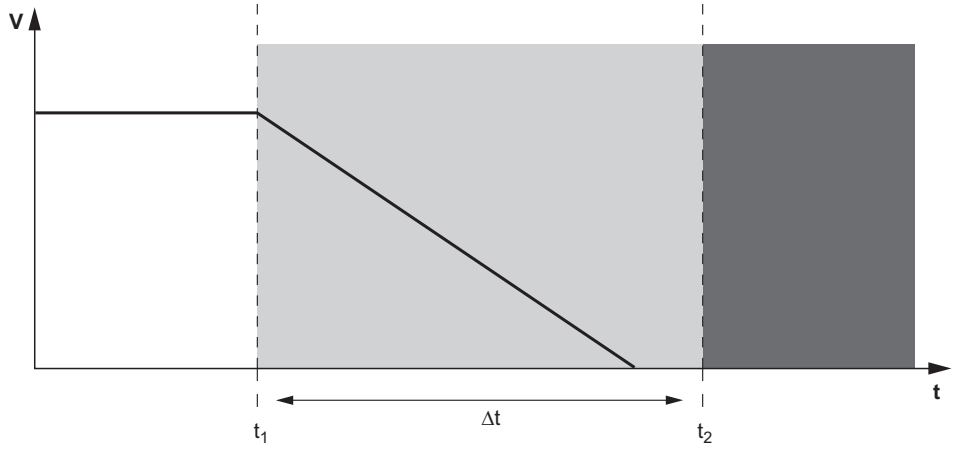
27021600043191563

= SBC safety sub-function active
v = Speed
t = Time
t_1 = Point in time when SBC is triggered.

SS1-t – Safe Stop 1 with time control

When the SS1-t safety sub-function is active, the motor is brought to a standstill electrically. The STO safety sub-function will be triggered after a specified, safety-related time.

The SS1-t safety sub-function corresponds to a controlled stop of the drive according to EN 60204-1, stop category 1.



18014400480359435

= SS1-t safety sub-function monitored
= STO safety sub-function active
v = Speed
t = Time
t_1 = Point of time when SS1-t is activated and motor deceleration is triggered.
t_2 = Point in time at which STO is activated.
Δt = Safety-related period of time

INFORMATION

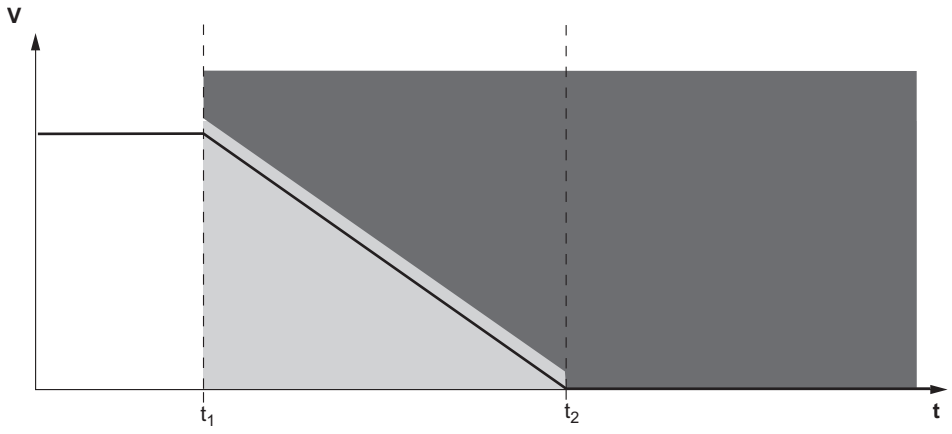
- The SS1-t function does not monitor the stopping of the drive.
- The safety-relevant period of time Δt allows the drive to come to a stop. In the event of a fault, the drive does not come to a stop and becomes de-energized at the time t_2 (STO).

31972098/EN – 8/2024

SS1-r – Safe Stop 1 with monitoring of the deceleration ramp

When the SS1-r safety sub-function is active, the motor is brought to a standstill electrically. The deceleration is monitored. The STO safety sub-function is triggered when the monitored deceleration is exceeded or when standstill is reached.

The SS1-r safety sub-function corresponds to a controlled stop of the drive according to EN 60204-1, stop category 1.



27021599735097995

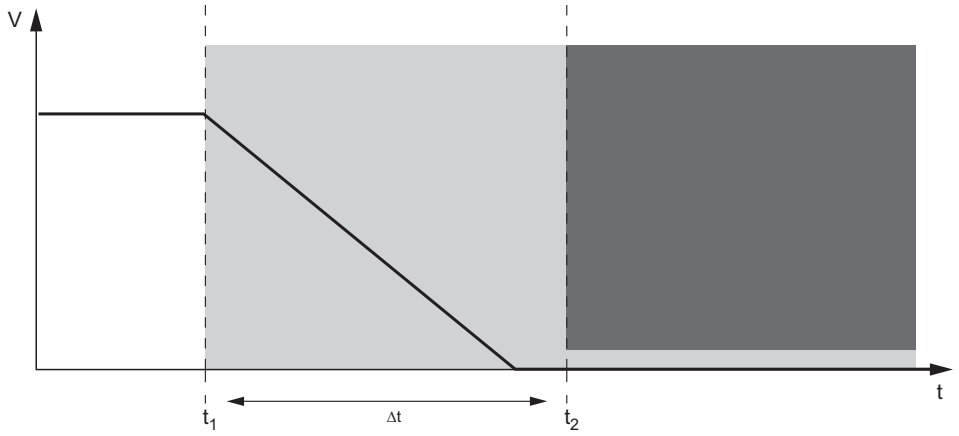
= SS1-r safety sub-function monitored
= STO safety sub-function active
v = Speed
t = Time
t_1 = Point of time when SS1-r is activated and motor deceleration is triggered.
t_2 = Point in time at which STO is activated.

31972098/EN – 8/2024

SS2-t – Safe Stop 2 with time control

When the SS2-t safety sub-function is active, the motor is brought to a standstill electrically. In the idle state, the motor is held in position. The position must be safely monitored after a specified, safety-related time has elapsed (SOS function according to EN 61800-5-2). Any movement at standstill triggers the STO safety sub-function. After the STO safety sub-function has been triggered, the idle state has to be ensured, for example, by a mechanical brake.

The SS2-t safety sub-function corresponds to a controlled stop of the drive according to EN 60204-1, stop category 2.



18014400684678283

= SS2-t safety sub-function monitored
= STO safety sub-function active
v = Speed
t = Time
t_1 = Point of time when SS2-t is activated and motor deceleration is triggered.
t_2 = Point in time at which SOS is activated.
Δt = Safety-related period of time

INFORMATION

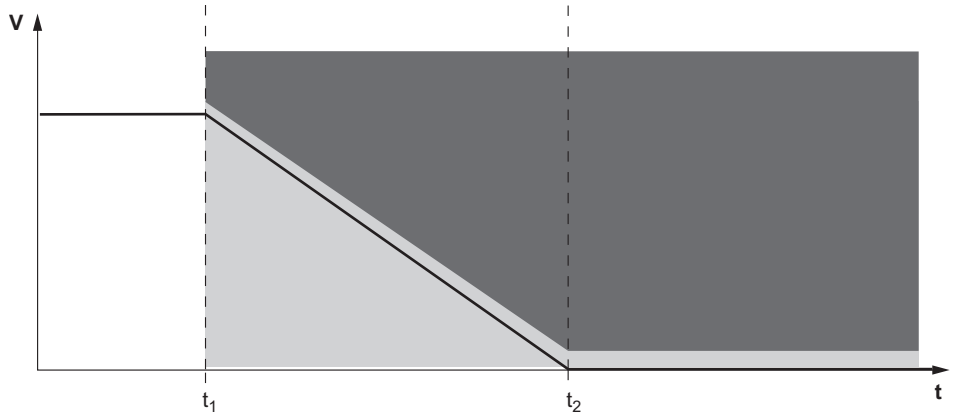
- The SS2-t safety sub-function does not monitor the stopping of the drive.
- The safety-relevant period of time Δt allows the drive to come to a stop. In the event of a fault, the drive does not come to a stop and only becomes de-energized at the time t_2 (STO).

31972098/EN – 8/2024

SS2-r – Safe Stop 2 with monitoring of the deceleration ramp

When the SS2-r safety sub-function is active, the motor is brought to a standstill electrically. The deceleration is monitored. The position must be safely monitored after standstill (SOS function according to EN 61800-5-2). The STO safety sub-function will be triggered if the deceleration value is exceeded while stopping or movement occurs in an idle state. After the STO safety sub-function has been triggered, the idle state has to be ensured, for example, by a mechanical brake.

The SS2-r safety sub-function corresponds to a controlled stop of the drive according to EN 60204-1, stop category 2.



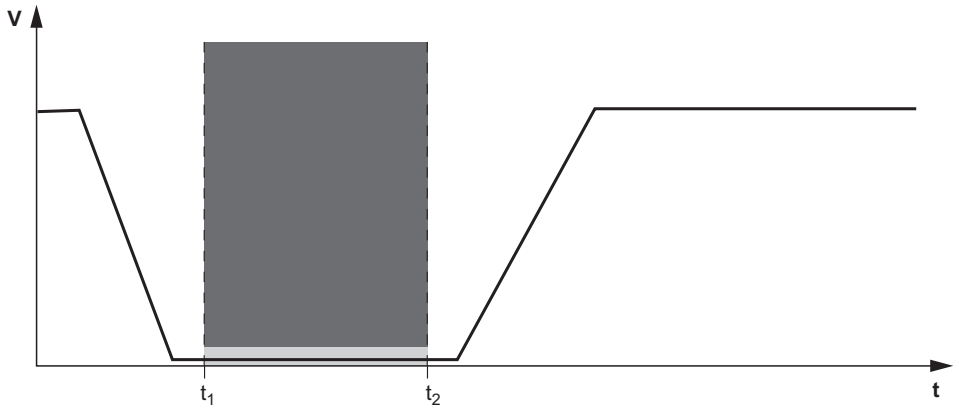
18014400480439051

= SS2-r safety sub-function monitored
= STO safety sub-function active
v = Speed
t = Time
t_1 = Point in time when SS2-r is activated and motor deceleration is triggered.
t_2 = Point in time at which SOS is activated.

31972098/EN – 8/2024

SOS – Safe Operating Stop

The SOS safety sub-function prevents the motor from deviating from the stop position by more than a specified absolute value. The drive delivers the power to keep the motor in position. If the specified absolute value is exceeded, the SOS safety sub-function will be triggered and a fault response (STO) will be initiated at the same time.



18014400480441483

= SOS safety sub-function monitored
= STO safety sub-function active
v = Speed
t = Time
t_1 = Point in time at which SOS is activated.
t_2 = Point in time at which SOS is deactivated.

SLS – Safely Limited Speed

The SLS safety sub-function prevents the drive from exceeding a set speed. If the permitted speed is exceeded, the SLS safety sub-function will be triggered and a fault response will be initiated at the same time (usually SS1).



18014400480443915

= SLS safety sub-function monitored
= SLS safety sub-function is triggered
v = Speed
t = Time
t_1 = Point in time at which SLS is activated.
t_2 = Point in time at which SLS is deactivated.

31972098/EN – 8/2024

SSM – Safe Speed Monitoring

The SSM safety sub-function monitors whether the drive exceeds a set speed. An exceeding of the allowed speed is signaled.

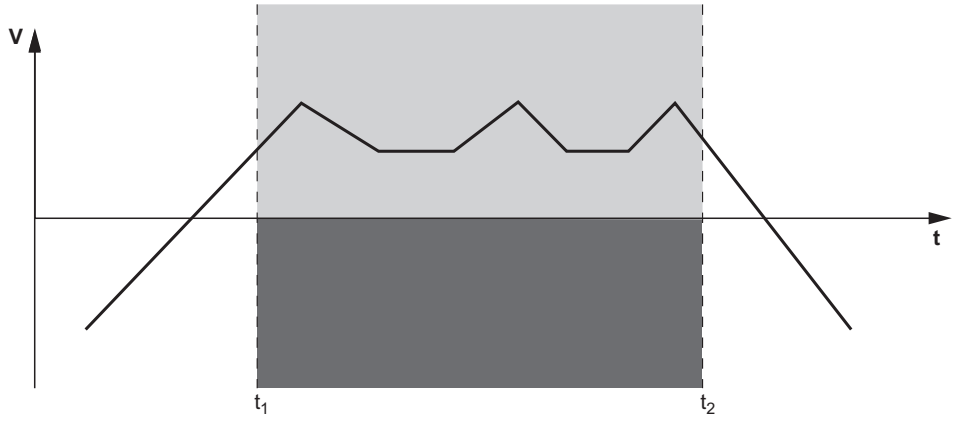


18014400480443915

= SSM safety sub-function monitored
= SSM safety sub-function is triggered
v = Speed
t = Time
t_1 = Point in time at which SSM is activated.
t_2 = Point in time at which SSM is deactivated.

SDI – Safe Direction

The SDI safety sub-function prevents movement in an unintended direction. If this condition is violated, the SDI safety sub-function will be triggered and a fault response will be initiated at the same time (usually STO or SS1).



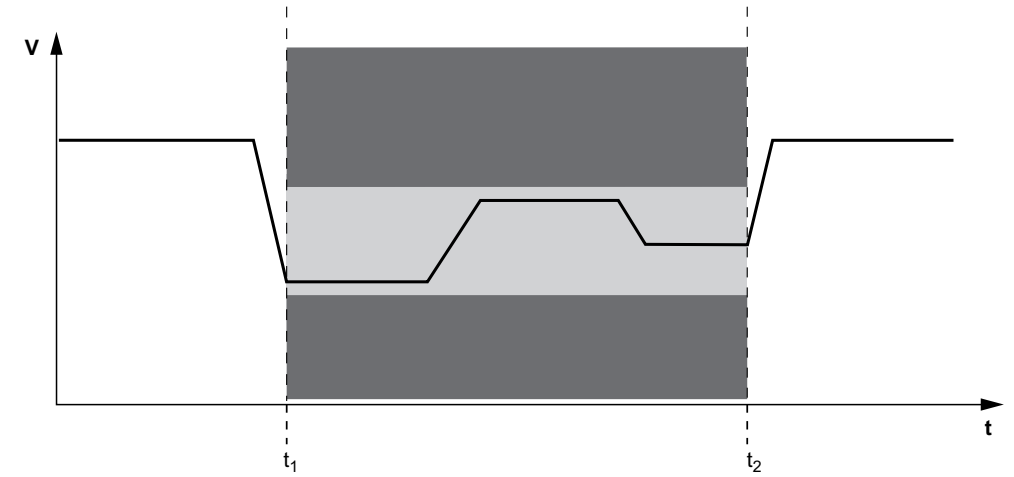
18014400480458635

= SDI safety sub-function monitored
= SDI safety sub-function is triggered
v = Speed
t = Time
t_1 = Point in time at which SDI is activated.
t_2 = Point in time when SDI is deactivated.

31972098/EN – 8/2024

SSR – Safe Speed Range

The SSR safety sub-function prevents the speed of the drive from leaving a specified range. If the permitted speed is exceeded or undershot, the SSR safety sub-function will be triggered and a fault response will be initiated at the same time (usually SS1).

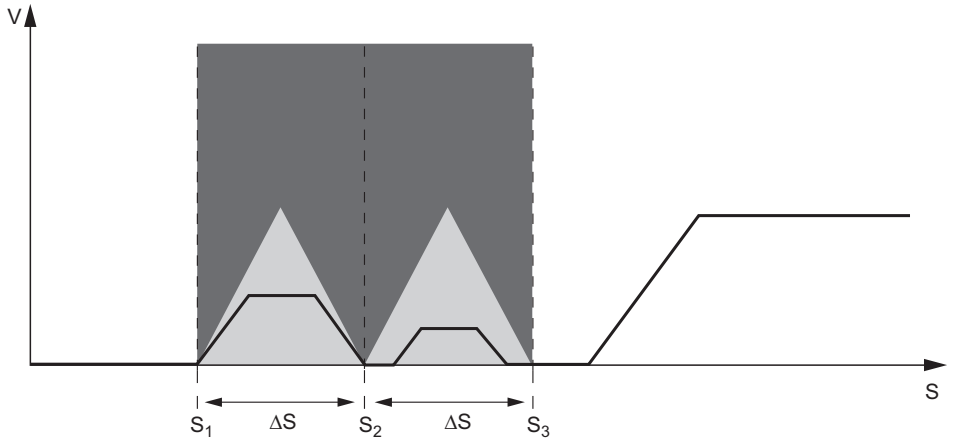


18014400914727819

= SSR safety sub-function monitored
= SSR safety sub-function is triggered
v = Speed
t = Time
t_1 = Point in time at which SSR is activated.
t_2 = Point in time at which SSR is deactivated.

SLI – Safely Limited Increment

The SLI safety sub-function prevents a movement from exceeding a specified increment. If the limit value of the increment is violated, the SLI safety sub-function will be triggered and a fault response will be initiated at the same time (usually STO).



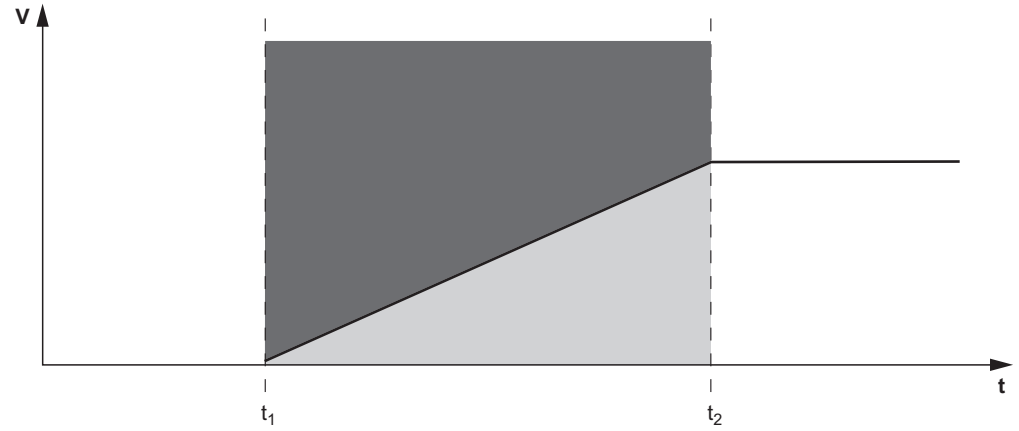
18014400480461451

= SLI safety sub-function monitored
= SLI safety sub-function is triggered
v = Speed
s = Distance
s_1, s_2 = Point at which SLI is activated.
s_2, s_3 = Point at which SLI is deactivated.
Δs = Safe increment

31972098/EN – 8/2024

SLA – Safely Limited Acceleration

The SLA safety sub-function prevents a movement from exceeding a specified acceleration. If the permitted acceleration limit is exceeded, the SLA safety sub-function will be triggered and a fault response will be initiated at the same time (usually STO).

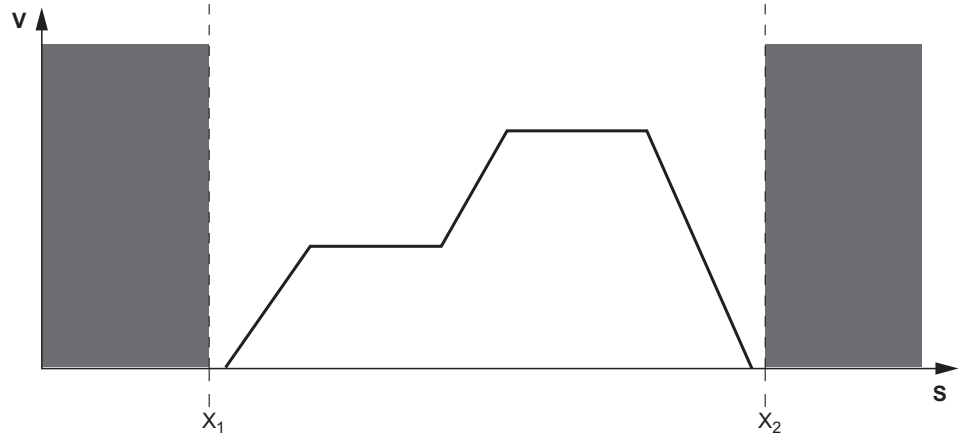


18014400480446347

= SLA safety sub-function monitored
= SLA safety sub-function is triggered
v = Speed
t = Time
t_1 = Point in time at which SLA is activated.
t_2 = Point in time at which SLA is deactivated.

SCA – Safe Cam

The SCA safety sub-function provides a safe signal to indicate whether the drive is located in a specific position range. This signal can be displayed or used further in programming. Violation of the defined position range will disable the safe signal.



18014400686852363

= SCA safety sub-function is triggered
v = Speed
s = Distance
x_1 = Lower limit of the position range
x_2 = Upper limit of the position range

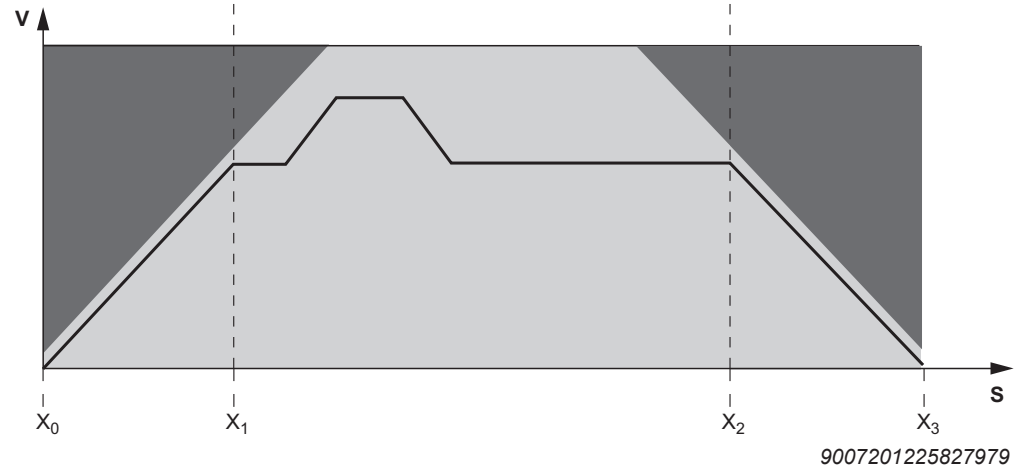
31972098/EN – 8/2024

INFORMATION

The SCA function does not require acknowledgment.

SLP – Safely Limited Position

The SLP safety sub-function prevents a movement from exceeding a specified absolute position. If the limit value of the absolute position is violated, the SLP safety sub-function will be triggered and a fault response will be initiated at the same time (usually STO).



= SLP safety sub-function monitored
= SLP safety sub-function is triggered
v = Speed
s = Distance
X_0 = Minimum (lower) absolute position
X_1 = Position at which stopping must begin in order to come to an idle state before X_0.
X_2 = Position at which stopping must begin in order to come to an idle state before X_3.
X_3 = Maximum (upper) absolute position

6.3.8 Restrictions

- It is to be noted that if the drive does not have a mechanical brake or if the brake is defective, the drive may coast to a halt (depending on the friction and mass moment of inertia of the system). In the event of regenerative loads or with axes that are loaded with gravitational forces or driven externally, the drive can even accelerate. This must be taken into account in a risk assessment of the system/machine. Additional safety measures might have to be implemented (e.g. safety brake system).

  In the case of application-related safety sub-functions that require stopping the hazardous motion safely, an additional safety brake system may be necessary on an application-specific basis.

31972098/EN – 8/2024

- When using the SS1-t function, the deceleration ramp of the drive is not monitored with respect to safety. In the case of an error, the drive might not be decelerated during the delay time, or the drive can accelerate in the worst case. In this case, the safety-related deactivation via the STO function only occurs after the set delay time has passed. The resulting hazard must be taken into account in the risk assessment of the system/machine and may need to be covered through additional safety measures, if necessary.
- The STO function cannot prevent a possible jerk or DC braking.

⚠ WARNING



When the STO signal is disconnected, voltage is still present at the DC link of the device.

Death or severe injuries

- Before working on the electric part of the drive system, disconnect it from the supply voltage using an appropriate external disconnecting device and secure it against unintentional reconnection.

⚠ WARNING



Electric shock due to incompletely discharged capacitors.

Severe or fatal injuries.

- Observe a minimum switch-off time of 10 minutes after disconnecting the power supply.

INFORMATION



If a brake is connected to the device, the *FCB 01 Output stage inhibit* function block must be selected in the MOVISUITE® parameter tree under [Functions] > [Drive functions]. In *FCB 01 Output stage inhibit*, the *Apply brake in event of STO* parameter is set to "On" and must not be deactivated. In the event of a safety-related disconnection of the DC 24 V supply voltage at the STO connection, the brake control is thus switched off. The brake control in the device is not safety-related.

6.3.9 Safety concept of Assist CS..

Safety parameters

For parameterization of the safety sub-functions, MOVISAFE® CS.. A has adjustable safety parameters.

The safety parameters determine the behavior of the corresponding safety sub-functions and are therefore safety-related. All safety parameters are combined in the parameter set.

The following actions are performed when downloading the parameters in the Assist CS.. tool:

- Parameterization of the safety option.
- Generation of the "application data" checksum of the key data set on the safety key.
- A modified parameter setting clears the "validation" status.

As a result, the safety key is connected with the respective parameterization by downloading the parameters.

Test concept and test procedure

The parameters of the MOVISAFE® CS..A safety option are set using an engineering PC with "Assist CS.." parameterization tool. As the PC and the "Assist CS.." parameterization tool are not safety-related and therefore possibly not fault-free, the safety concept prescribes the following measures:

- Identification of MOVISAFE® CS..A.
- When establishing a connection to the MOVISAFE® CS..A safety option, the safety key ID must be entered in a dialog.
- Guided parameter setting procedure with the "Assist CS.." parameterization tool with integrated safety features such as plausibility check of entries during data transmission to the device.
- Completion of parameterization with subsequent provision of an acceptance report to validate the safety sub-functions.

6.4 Safety requirements

6.4.1 Introduction

The requirement for safe operation is that the safety sub-functions of the device are properly integrated into an application-specific, higher-level safety sub-function. A system/machine-specific risk assessment must be carried out without fail by the system/machine manufacturer and taken into account for the use of the drive system with the device.

The system/machine manufacturer and the user are responsible for the compliance of the system/machine with the applicable safety regulations.

The following requirements are mandatory when installing and operating the device in safety-related applications:

- Use of the approved devices
- Installation requirements
- Requirements for external safety controllers and safety relays
- Startup requirements
- Requirements for operation

6.4.2 Approved devices

The MOVIDRIVE® system device variant is permitted in all sizes for safety-related applications (STO function).

The following MOVISAFE® CS..A safety options can be used in MOVIDRIVE® system:

Device	MOVISAFE®	
	CS.21A	CS.31A
MOVIDRIVE® system	Yes	Yes

31972098/EN – 8/2024

6.4.3 Installation requirements

- The components must be protected against conductive dirt, e.g. by installing them in a control cabinet with degree of protection IP54 in accordance with EN 60529.

  Assuming that the presence of conductive dirt can be excluded at the installation site, a control cabinet with a correspondingly lower degree of protection is also permitted if in accordance with the applicable standards, e.g. EN 60204-1. The same also applies to temporary condensation, e.g. due to rapid ambient temperature changes.
- The wiring technology must comply with the EN 60204-1 standard.
- The safe control cables must be routed in accordance with the EMC requirements. The following points must therefore be observed:
  - Single conductors can be routed within an installation space.
  - Outside a closed installation space: shielded cables must be routed permanently (fixed) and protected against external damage, or equivalent measures must be taken.
  - Adhere to the regulations in force for the application.
  - If the safe outputs and inputs are wired in a 2-channel configuration, the corresponding cables must be routed closely together.
  - The cables must have the same length. A difference in length ≤ 3% of the two cables is permitted.
  - The following maximum cable lengths must be observed:

    STO: 30 m

    F-DI: 30 m

    F-DOx: 30 m

    F-SSx: 30 m
- You must use suitable measures to ensure that the safe control cables are routed separately from the power lines of the drive. This does not apply to cables approved by SEW-EURODRIVE specifically for this application case.
- The STO function does not detect short circuits or interference voltage in the supply line, so you must ensure the following:
  - No parasitic voltages can occur in the STO control cables
  - The external safety controller can detect a crossfault from an external potential to the STO control cables.
- The values specified for the safety components must be strictly adhered to when designing the safety circuits.
- The STO signals must not be used for feedback.
- Only grounded voltage sources with protective electrical separation (PELV) in accordance with EN 61131-2 and EN 60204-1 may be used for safety controllers/ safety relays/external sensors.
- When planning the installation, observe the technical data of the device.
- The 0V24_Out and 24V_Out supply voltages of the device may only be used to supply the device-internal STO input. The cable length must not exceed 30 m.

  This connection variant is not permitted for STO group disconnection.

31972098/EN – 8/2024

- For safety-related applications with the STO safety sub-function, the jumper plug at the STO input must be removed. In the devices with the integrated CS..A safety option, the STO function is performed exclusively via the safety option.
- When an EI7C FS built-in encoder is connected to the unit, the encoder cable must not carry a TF signal.

6.4.4 Startup requirements

- To validate the implemented safety sub-functions, the safety sub-functions must be checked and documented after successful startup.
- When doing so, the restrictions for the safety sub-functions in chapter "Restrictions" must be taken into consideration. Non-safety-related parts and components which affect the test result (e.g. motor brake) must be deactivated.
- In order to use the device in safety-related applications, it is essential that you perform and record startup checks for the disconnecting device and correct wiring.
- For the CS..A safety options, the startup check and logging is supported by the "Assist CS.." parameterization tool with an acceptance report.

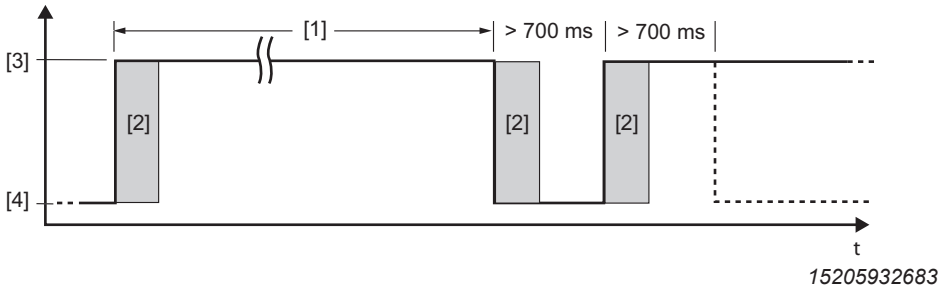
INFORMATION

- In order to avoid a hazard in the intended application when a fault occurs, the user must check whether the fault response time of each safety sub-function is shorter than the maximum permissible fault response time of the application. The maximum permissible fault response time must not be exceeded!
- The user must ensure implementation of the requirements of the required safety integrity level (SIL) in accordance with EN 61508 or performance level (PL) pursuant to EN ISO 13849-1.

6.4.5 Requirements for the operation of the STO safety sub-function

- Operation is only permitted within the limits specified on the data sheets. This applies to the external safety controller as well as to the device and the approved safety options.
- The built-in diagnostic function is limited in the case of a permanently enabled or permanently disabled STO input. Advanced diagnostic functions are performed only upon a level change of the STO signal. The safety sub-function must therefore be requested via the STO input for PL d in accordance with EN ISO 13849-1 and SIL 2 in accordance with EN 61800-5-2 at least once every 12 months, and for PL e in accordance with EN ISO 13849-1 and SIL 3 in accordance with EN 61800-5-2 at least once every 3 months with the line voltage applied in order to achieve full test coverage. Adhere to the following test procedure for this purpose.

31972098/EN – 8/2024



[1] Maximum 12 months for PL d/SIL 2
Maximum 3 months for PL e/SIL 3
[2] Internal diagnostics
[3] High: No STO
[4] Low: STO active

- To achieve complete test coverage after a device reset (e.g. after switching on the supply voltage), the test transition (STO active → STO not active) may be started after > 700 ms at the earliest. The device signals the "ready for operation" or "STO – Safe Torque Off" state if it is not in fault state.
- A detected hardware fault in the internal switch-off channels for STO will lead to a locking fault state in the device. If the fault is reset (e.g. by switching the supply voltage on/off or by a low level at the STO input for at least 30 ms), a complete test with internal diagnostics according to the above-mentioned test procedure must be performed. If the fault occurs again, replace the device or contact SEW-EURODRIVE Service.

6.4.6 External safety controller requirements

Without the CS..A safety option, a safety controller or a safety relay must be used. The following requirements apply analogously:

- The safety controller and all other safety-related subsystems must be approved for at least the safety class required in the overall system for the respective application-related safety sub-function.

The following table shows an example of the required safety class of the safety controller:

Application	Requirement for safety controller
Performance level d according to EN ISO 13849-1, SIL 2 according to EN 62061	Performance level d according to EN ISO 13849-1 SIL 2 according to EN 61508
Performance level e according to EN ISO 13849-1, SIL 3 according to EN 62061	Performance level e according to EN ISO 13849-1 SIL 3 according to EN 61508

- The wiring of the safety controller must be suitable for the endeavored safety class (see manufacturer's documentation). The STO input of the device can be switched with 2 poles (sourcing output, sourcing/sinking, or serial sourcing), or with 1 pole (sourcing output).
- The values specified for the safety controller must be strictly adhered to when designing the circuit.
- Only guards with back-step protection may be used at the STO input of the device. The guards must be connected to the CS..A safety option via a safety relay or a safety controller.

- To stop the drive in an emergency in accordance with EN 60204-1, emergency stop control devices must be connected to the STO input of the device as follows:
  - via the CS..A safety option
  - via a safety relay
  - via a safety controller
- To ensure protection against an unexpected restart in accordance with EN ISO 14118, the safe control system must be designed and connected in such a way that resetting the command device alone does not lead to a restart. This means that a restart may only be carried out after a manual reset of the safety circuit.
- If no fault exclusion is used for the STO wiring in accordance with EN ISO 13849-2 or EN 61800-5-2, the external safety device must detect the following faults in the STO wiring within 20 s depending on the connection type:
  - Two-pole sourcing output:

    Short circuit of 24 V at F_STO_P1 or F_STO_P2 (Stuck-at 1)

    Crossfault between F_STO_P1 and F_STO_P2
  - Two-pole sourcing/sinking:

    Short circuit of 24 V at F_STO_P1 (Stuck-at 1)

    Short circuit of 0 V at F_STO_M (Stuck-at 0)
  - Dual-channel serial sourcing output:

    Fault exclusion is mandatory
  - Single-pole sourcing:

    Short circuit of 24 V at F_STO_P (Stuck-at 1)
- Test pulses can take place in the switched on or switched off condition with connection type "Two-pole sourcing output".
  - The test pulses on both sourcing channels must be switched with a time delay. However, additional switch-off test pulses may occur simultaneously.
  - The test pulses in both sourcing channels must not exceed 1 ms.
  - The next switch-off test pulse in one sourcing channel must only occur after a 2 ms time period.
  - A maximum of 3 switch-on test pulses may be generated in sequence at an interval of 2 ms. Wait for at least 500 ms after any packet before you generate another switch-on test pulse or another switch-on test pulse packet.
  - The signal levels must be read back by the safety controller and compared to the expected value.
  - The signal levels may have a maximum temporal discrepancy of 130 ms. In case of a larger temporal discrepancy, the device changes to the STO fault state (F20.11).
- Test pulses can take place in the switched on or switched off condition with connection type "Two-pole sourcing/sinking".
  - The test pulses in the sourcing and sinking channel must not exceed 1 ms.
  - The next switch-off test pulse in the sourcing or sinking channel must only occur after a 2 ms time period.
  - A maximum of 3 switch-on test pulses may be generated in sequence at an interval of 2 ms. Wait for at least 500 ms after any packet before you generate another switch-on test pulse or another switch-on test pulse packet.

31972098/EN – 8/2024

  - The signal levels must be read back by the safety controller and compared to the expected value.
- Test pulses can take place in the switched on or switched off condition with connection type "Single-pole sourcing output".
  - The test pulse on the sourcing channel must not exceed 1 ms.
  - The next switch-off test pulse may only occur after a time period of 2 ms at the earliest.
  - A maximum of 3 switch-on test pulses may be generated in sequence at an interval of 2 ms. Wait for at least 500 ms after any packet before you generate another switch-on test pulse or another switch-on test pulse packet.
  - The signal levels must be read back by the safety controller and compared to the expected value.

6.4.7 Sensor and actuator requirements

- The project planner and the user of the system or machine are responsible for the number and utilization of external sensors and actuators for connection with the safe inputs and outputs of the MOVISAFE® CS..A safety option.
- In order to achieve the required safety level (PL/SIL), you must use suitable and appropriately qualified sensors and actuators and observe the permissible wiring diagrams and information in chapters "Connection examples for safe digital inputs (F-DI.)" and "Connection examples for safe digital outputs (F-DO.)". The permissible encoders are described in chapter "Encoder requirements".

6.4.8 Requirements for stopping in an emergency according to EN 60204-1 (emergency stop)

The MOVISAFE® CS..A safety option, in combination with an emergency stop command device and the external control, is suitable for implementing an emergency stop in accordance with EN 60204-1.

⚠ WARNING



In the case of a pending travel command, the drive restarts after acknowledgment of the safety option.

Severe or fatal injuries.

- Cancel the travel command before acknowledging the safety option.

6.4.9 Encoder requirements

General requirements

The user must assess the effects of the following scenarios for all encoders not approved by SEW-EURODRIVE:

- Overvoltage at the encoder
- Short circuit at the encoder interface

Users can perform this assessment with the aid of the respective product documentation or by testing.

Furthermore, it must be ensured that the system moves at a speed greater than the minimum speed at least every 3 months.

The minimum speed at the motor shaft must have the following values:

- EI7C FS built-in encoder: 50 min-1
- All other encoders: 10 min-1

This also limits the minimum speed in user units.

Safety encoders approved by SEW-EURODRIVE



⚠ WARNING

Loss of the safety sub-function due to use of outdated AS7W or AG7W safety encoders, e.g. in existing systems.

Death or severe injuries

✓ Using the following safety encoders with MOVISAFE® CS..A safety options is not permitted:

- AS7W: Part numbers 13630733 and 13630768
- AG7W: Part number 13630849

→ Use the latest version of the AS7W/AG7W safety encoders.

The following safety encoders from SEW-EURODRIVE are permissible for use with MOVISAFE® CS..A safety options. For further information on the safety encoders, refer to the corresponding documentation.

AC motors/asynchronous servomotors

- ES7S/EG7S
- AS7W/AG7W
- EK8S/AK8W
- EK8Z/AK8Z
- EI7C FS

The EK8S/EK8Z and AK8W/AK8Z safety encoders must be turned on and off every 12 months so that the encoder performs internal diagnostics.

Servomotors

- EK0H
- AK0H
- AK1H

In order to implement a safety sub-function with AK0H or AK1H encoders, the motor must be started with SERVO control mode.

The following inverter settings are recommended:

- Activation of lag error monitoring
- Activation of speed monitoring
- Activation of encoder monitoring

31972098/EN – 8/2024

Quantization error

Position

The actual position value is formed directly from the encoder increments. On the basis of one encoder revolution, this results in the following quantization error for the actual position value, which is included in all position functions:

- EK0H: 4.3°
- AK0H: 4.3°
- AK1H: 0.53°
- E..7S: 0.53°
- A..7W: 0.27°
- EK8S: 0.53°
- AK8W: 0.27°
- EK8Z: 0.53°
- AK8Z: 0.27°

Speed

The speed calculation determines the mean speed in the time range set via the filter time speed:

Quantization error_v in min-1 =

(15 s x min-1) × scaling_factor_denominator / (scaling_factor_numerator x parameterized_filter_time)

Parameters involved (CSA31A):

- *Scaling_factor_numerator*:
  - 8381.2 (encoder 1)
  - 8382.2 (encoder 2)
- *Scaling_factor_denominator*:
  - 8381.3 (encoder 1)
  - 8382.3 (encoder 2)
- *Parameterized_filter_time*:
  - 8708.3 (encoder 1)
  - 8713.3 (encoder 2)

Parameters involved (CSS..A):

- *Scaling_factor_numerator* (= PPR count of the selected encoder):
  - 8708.1 (encoder 1)
- *Scaling_factor_denominator*: 1

  The scaling factor is fixed based on the configured encoder type.
- *Parameterized_filter_time*:
  - 8708.3 (encoder 1)

In the case of safety encoders with sin/cos interface, an additional error of 0.3% of the actual speed is added to the process-related quantization error:

Error_v_SinCos = Actual speed x 0.3% + Quantization error_v

In the case of safety encoders with MOVILINK® DDI, an additional error of 0.4% of the actual speed is added to the process-related quantization error:

31972098/EN – 8/2024

Error_v_DDI = Actual speed x 0.4% + Quantization error_v

The speed calculation for the EI7C FS encoder determines the average speed over the last 4 recorded encoder increments. The response time of the encoder evaluation is thus dependent on the actual speed. The fault in the calculated speed value equals a maximum of 1% of the actual speed:

Fault_v_EI7C FS = Actual speed x 1%

Setting the *Filter time speed HTL (8708.4)* parameter makes it possible to filter the calculated speed via a sliding average value filter with the parameterized length.

Acceleration

The acceleration calculation determines the mean acceleration in the time range set via the filter time acceleration. The quantization error decreases with increasing filter time. In return, the response time increases in accordance with the filter time.

Quantization error_a in min-1 s =

(120 s x min-1) × scaling_factor_denominator / (scaling_factor_numerator x (parameterized_filter_time)^2)

Parameters involved (CSA31A):

- *Scaling_factor_numerator*:
  - 8381.2 (encoder 1)
  - 8382.2 (encoder 2)
- *Scaling_factor_denominator*:
  - 8381.3 (encoder 1)
  - 8382.3 (encoder 2)
- *Parameterized_filter_time*:
  - 8708.2 (encoder 1)
  - 8713.2 (encoder 2)

Parameters involved (CSS..A):

- *Scaling_factor_numerator* (= PPR count of the selected encoder):
  - 8708.1 (encoder 1)
- *Scaling_factor_denominator*: 1

  The scaling factor is fixed based on the configured encoder type.
- *Parameterized_filter_time*:
  - 8708.3 (encoder 1)

In the case of safety encoders with sin/cos interface, an additional error of 0.5% of the actual acceleration is added to the process-related quantization error:

Error_a_SinCos = Actual acceleration x 0.5% + Quantization error_a

In the case of safety encoders with MOVILINK® DDI, an additional error of 0.6% of the actual acceleration is added to the process-related quantization error:

Error_a_DDI = Actual acceleration x 0.6% + Quantization error_a

Counting direction

For the process values to have identical signs in the inverter as well, the encoder parameter *Counting direction (8708.6)* of the MOVISAFE® CSS..A safety options must be set as follows, depending on the inverter parameters *Direction of rotation reversal (8362.2)* and *Counting direction (8381.6)*.

31972098/EN – 8/2024

Encoder parameter: • *Counting direction (8708.6)*	Inverter parameters: • *Direction of rotation reversal (8362.2)* • *Counting direction (8381.6)*	
8708.6 = Normal	8362.2 = Off 8381.6 = Normal	8362.2 = On 8381.6 = Inverted
8708.6 = Inverted	8362.2 = On 8381.6 = Normal	8362.2 = Off 8381.6 = Inverted

For the CSA31A safety option, these values must match the settings of the drive train.

Preventing the mechanical limit speed from being exceeded

To prevent the mechanical limit speed of the encoder from being exceeded, the following overspeed limits are monitored by the MOVISAFE® CSS..A safety options:

Encoder type	Overspeed limit in min^{-1}	Mechanical encoder limit speed in min^{-1}
EI7C FS	3800	5700
AK0H, EK0H	6329	9000
AK1H	6445	12000
E.7S, EK8S	5500	6000
A.7W, AK8W	5500	6000
EK8Z/AK8Z	5500	6000

The overspeed limit for the CSA31A safety option can be parameterized in the Assist CS.. tool in the "Encoder functions" tab.

INFORMATION

Exceeding the overspeed limit results in a fault message in the safety option with the fault response "STO" within 11 ms for sin/cos encoders, 13 ms for the EI7C FS built-in encoder or 17 ms for safety encoders with MOVILINK® DDI. The fault response is executed by the STO circuit within another 2 ms.

Measures in the application must ensure that the mechanical limit speeds are not reached during this time (11 ms/13 ms/17 ms).

Permitted encoders for MOVISAFE® CSA31A

The limit for overspeed detection has a quantization error for sin/cos encoders, which has the following magnitude (relating to the encoder shaft):

Error = 3000/pulses per revolution in min-1

The maximum operating speed must remain below the set value by the quantization factor.

The maximum angular error of the position value formed by the sin/cos encoder evaluation, relating to the motor shaft, results as follows:

- 2160° × *scaling_factor_denominator* / *scaling_factor_numerator*

Parameters involved:

- Scaling_factor_numerator

  - 8381.2 (encoder 1)
  - 8382.2 (encoder 2)
- Scaling_factor_denominator
  - 8381.3 (encoder 1)
  - 8382.3 (encoder 2)

To increase the robustness of the incremental signal evaluation, the fault tolerance can be increased via the following parameter:

- 8708.24 (encoder 1)
- 8713.24 (encoder 2)

Fault tolerance sin/cos evaluation

The maximum number of successive faulty diagnostic cycles (500 µs) that should not yet lead to a fault response is set.

A fault response occurs in the following cases:

- The set number of consecutive faulty diagnostic cycles is exceeded.
- The ratio of faulty to fault-free diagnostic cycles over a longer period is ≥ 1/5.

Information

Increments can be lost when fault tolerance is enabled. This means the calculated position value could be incorrect. This must be detected via a second encoder channel when calculating the position value.

If a safety-rated encoder is evaluated as encoder 1 and the safety functions of the application depend exclusively on this encoder, then the fault tolerance for encoder 1 must be deactivated or set to the value "0".

The following safety encoders are permitted for use with the MOVISAFE® CSA31A safety option:

- CDV75/CDH75 from TR electronic
- FBPS617i from Leuze electronics

For further information on the safety encoders, refer to the corresponding documentation.

Requirements for SSI encoders

- The SSI encoders that comply with the technical data of the encoder interface for SSI encoders (encoder 2 and encoder 3) are permissible. Observe the information in chapter "Safety requirements" regarding cable length and SSI clock frequency and, if necessary, reduce the clock frequency to 250 kHz or 125 kHz for long cable lengths.
- The MOVISAFE® CSA31A safety option supports the evaluation of error bits and warning bits. SEW-EURODRIVE recommends activating the error bits and warning bits in the encoders as a means of additional fault detection.
- For single-turn encoders and encoders with few multi-turn bits (< 3 bits), make sure that the range of values does not overflow within one SSI evaluation cycle. This applies in particular to encoders that are directly connected with the motor shaft.

  For single-turn encoders, the following maximum speeds apply under the respective conditions (see following tables).

- 2000 min^{-1}

31972098/EN – 8/2024

Frame rate	Update time	Fault tolerance
1 ms	≥ 5 ms	1
Encoder 2 (8713.52)	Encoder 2 (8382.29)	Encoder 2 (8713.51)
Encoder 3 fixed to 1 ms	Encoder 3 (8599.29)	Encoder 3 (8714.51)

- 1750 min^{-1}

Frame rate	Update time	Fault tolerance
2 ms	≥ 5 ms	1
Encoder 2 (8713.52)	Encoder 2 (8382.29)	Encoder 2 (8713.51)

- 1750 min^{-1}

Frame rate	Update time	Fault tolerance
1 ms	≥ 5 ms	2
Encoder 2 (8713.52)	Encoder 2 (8382.29)	Encoder 2 (8713.51)
Encoder 3 fixed to 1 ms	Encoder 3 (8599.29)	Encoder 3 (8714.51)

- 1400 min^{-1}

Frame rate	Update time	Fault tolerance
2 ms	≥ 5 ms	2
Encoder 2 (8713.52)	Encoder 2 (8382.29)	Encoder 2 (8713.51)

- For single-turn SSI encoders that are mounted directly on the motor, the SSI fault tolerance parameter is allowed to be set to a maximum of 2.
- Single-turn SSI encoders with an update time of > 5 ms must not be mounted directly on the motor.
- The frame rate, i.e. the polling cycle of the safety option to the SSI encoder, can be set to 1 ms or 2 ms (default: 2 ms). The shorter the polling cycle, the more accurately the position, speed, and acceleration are calculated.

  A frame rate of 1 ms can be selected under the following conditions:

  – PWM frequency of the inverter: 4 kHz, set to "no noise".
  – Pause time: maximum 0.08 ms
  – Clock frequency: ≥ 250 kHz
  – Frame length: maximum 27 bits
- PROFIsafe safe communication profile
- The MOVISAFE® CSA31A safety option does not evaluate 3 encoders.

Requirements for the barcode encoder

If jumps in position are present in the code tape used, the following restrictions apply:

- The barcode encoder is used for determining the "position" process value:

  In the event of a position jump, the safety sub-functions SOS, SS2, SDI, SLI, SLP, and SCA cannot be used.
- The barcode encoder is used for determining the "speed" process value:

  In the case of position jumps, the calculated speed is incorrect and can lead to false tripping of the safety sub-functions or to a critical fault.

31972098/EN – 8/2024

- Safe position:

  The raw position or the absolute position of the encoder should be used.

- Safe speed:

  The safe speed is not determined correctly in the event of position jumps. The range size depends on the speed filter time and the maximum possible speed.

Requirements for safe absolute encoders

CDx75

You must select the CDx75 safe absolute encoder via the designation to enable the CRC evaluation to function properly. Connect the master system of the CDx75 to encoder 2 and the safety system of the CDx75 to encoder 3. Any existing incremental tracks must not be connected.

The fault tolerance of CDx75 must not exceed 2 on encoder 2 and encoder 3.

FBPS617i

In order to ensure that correct CRC evaluation takes place, you must select the safe distance encoder FBPS617i via the designation. Connect encoder 2 to port SSI_1 and encoder 3 to port SSI_2.

The fault tolerance of the FBPS617i in relation to encoder 2 and encoder 3 must not exceed 2.

Also note the error messages and troubleshooting measures for the encoder in case of encoder error E14.x in the inverter and for encoder faults E14.x and E15.x on the safety option.

Note the extended run-up time when using the encoder in applications with very low temperatures. This can result in an error in the inverter and in the safety option that must be acknowledged.

Proceed as follows to prevent this error:

- **First** enable the supply voltage of the encoder and afterwards the supply voltage of the inverter.

  The 24 V supply voltage of the encoder is provided externally via a separate M12 connector. The 24 V supply voltage of the encoder must not be fed in via the following voltage sources:

  – via the internal supply voltage of the safety option

  – via port X65 of the UEA31A combi-box

  You must set the external 24 V for encoder 2/3 to "No" in the "Assist CS.." parameterization tool.

- Increase the run-up time of the encoder in the MOVISUITE® engineering software according to the encoder's documentation.

Encoder concepts

Permitted encoder combinations

The following encoder combinations are permitted:

Encoder 1	Encoder 2	Encoder 3	PL	See chapter
FS motor encoder	–	–	d	1-encoder concept – FS motor encoder

31972098/EN – 8/2024

Encoder 1	Encoder 2	Encoder 3	PL	See chapter
FS motor encoder[1)]	Sin/cos	–	e[2)]	2-encoder concept (with MOVISAFE® CSA31A only)
FS motor encoder[1)]	SSI	–	e[2)]	
FS motor encoder[1)]	–	SSI	e[2)]	
Sin/cos	SSI	–	d	
EI7C FS	SSI	–	d	
HIPERFACE®	SSI	–	d	
Sin/cos	–	SSI	d	
EI7C FS	–	SSI	d	
	SSI	SSI	d	
	SSI	SSI	e[3)]	1-encoder concept – FS distance encoder

1) Only the sin/cos signals are evaluated for safety reasons.
2) For speed and relative position.
3) For speed and absolute position.

Key:

- Encoder 1: Motor encoder
- Encoder 2: Distance encoder
- Encoder 3: 2nd distance encoder
- PL: Maximum performance level that can be achieved

1-encoder concept – FS motor encoder

The motion variables required by the system are derived from a single motor encoder certified to a recognized FS standard for this purpose.

INFORMATION

Only safe motor encoders with sin/cos or HTL interface are supported. The safe motor encoder must be connected to encoder interface X15 of the device. Alternatively, safety encoders with MOVILINK® DDI can be used and connected to X16 on the device.

Relative position and speed from FS motor encoder

The safe motor encoder provides an incremental signal from which the speed, direction of rotation, relative position, and acceleration can be derived. The SS1, SS2, SOS, SLS, SSM, SSR, SDI and SLI safety sub-functions are supported. If the EI7C FS is used as a safe motor encoder, the SS1, SLS, SSM, SSR and SDI safety sub-functions are supported.

Absolute position and speed from FS motor encoder

In addition to the relative position described above, MOVISAFE® CSA31A can be used to monitor the absolute position with additional referencing at a known, defined position from the time of referencing. The HIPERFACE® encoders must be parameterized to "Only incremental tracks" in the encoder evaluation in the *HIPERFACE® evaluation* parameter.

INFORMATION

The safety option must be re-referenced in the following cases:

- after switching on the voltage supply
- after deactivating the standby function
- in the event of any errors that reset the "Referenced" status

Referencing defines the reference point for the absolute position and is therefore part of the safety chain. The components involved in referencing, such as reference switches, must comply with the safety level (PLr or SIL) required for the safety subfunction (SLP, SCA).

2-encoder concept (with MOVISAFE® CSA31A only)

The motion variables required by the system are derived from 2 independent non-safe encoders installed on the same drive train.

Sin/cos encoders or HIPERFACE® encoders can be connected to X15 on the device for the **motor encoder**.

Alternatively, safety encoders with MOVILINK® DDI can be used and connected to X16 on the device.

Sin/cos and HIPERFACE® encoders as well as SSI encoders and encoders with sin/cos and SSI signals can be used as **distance encoders** and connected to X17 of the safety option. With HIPERFACE® encoders, only the sin/cos signals are evaluated.

For the safe position, the HIPERFACE® position of the motor encoder and, via a distance encoder, the position of an SSI encoder can be used.

The user is responsible for the suitability and use of the encoder system within the framework of functional safety. The user must ensure that the requirements for the required safety level PL r or SIL are met in accordance with the relevant standards such as EN ISO 13849 and EN 62061.

If a two-channel encoder system is set up with non-safety-rated encoders, PL d in accordance with EN ISO 13849 and SIL 2 in accordance with EN 61508 can be achieved. For this purpose, it is necessary to prove that the encoders are technologically diverse. If one of the following requirements has been fulfilled, the two encoders can be regarded as technologically diverse:

1. Embedded software is involved in the first encoder. The second encoder is completely implemented in hardware without embedded software.
2. Both encoders use diverse embedded software, e.g. different operating systems on the same or different hardware.
3. Both encoders use different hardware. It is assumed that the programming of the associated embedded software has taken place in a different development environment.

The demand for diversity is a fundamental part of this consideration. A vague assessment of this diversity is not permitted. It must be clearly provable that the encoder combination meets one of the listed requirements.

31972098/EN – 8/2024

In addition, the independence of the encoders used must also be guaranteed with regard to their mounting and dimensional scale. A fault, such as shaft breakage, must not affect the speed or position detection of the encoders involved. The encoder combination must be operated within its specified ambient conditions (e.g. climate, EMC, contamination, vibration). Common-cause failures can be avoided by selecting appropriate diverse encoder types. If, despite the diversity due to the ambient conditions, a source of common cause failure still exists, the source must be examined and suitable measures applied.

The two encoders are mutually monitored for plausibility. To ensure the safety-related function of the encoder system and the availability of the system, the deviation of the encoders must not exceed a parameterized tolerance value. This can be achieved by a slip-free and low-backlash design. Alternatively, the slip adjustment that is integrated in MOVISAFE® CSA31A (see chapter "Slip adjustment function" (→ 🗎 471)) can be used for systems with slip. The encoders of the basic device must be configured in the drive train in such a way that the same effective counting direction results for all evaluated encoders, taking into account the configured encoder counting direction as well as the direction of rotation reversal.

Relative position and speed

There are 2 incremental encoders on the drive train, which are connected to the encoder 1 and encoder 2 interfaces of the device. The encoders are evaluated in parallel by the device and the safety option.

The speed, direction of rotation, relative position, and acceleration can be derived from each of the incremental encoder signals, which are then combined into common process values after appropriate scaling.

Absolute position and speed from 2 incremental encoders

There are 2 incremental encoders mounted to the drive train, which are connected to the encoder 1 and encoder 2 interfaces of the inverter.

Referencing takes place analogously as described in chapter "1-encoder concept – FS motor encoder". A redundant reference switch is used that is crossed over during the reference travel controlled by the device. Both encoders are referenced simultaneously by adopting the parameterized value of the reference position for both position counters.

Absolute position and speed from 2 absolute encoders

There are 2 absolute encoders attached to the drive train, which are connected to the encoder 1 and encoder 2 interfaces of the device. The encoders are evaluated in parallel by the device and the safety option.

The absolute positions are retrieved from both absolute encoders with regard to the application, which are then combined into a common process value after appropriate scaling.

The two encoders are used to determine the speed. A speed value, the direction of movement and an acceleration value are calculated from the signals of each encoder, which are combined into common process values after appropriate scaling.

If encoder 1 has a safety-related sin/cos part, this alone can be used for determining the speed.

Absolute position from an incremental encoder and an absolute encoder

There is an incremental encoder and an absolute encoder attached to the drive train, which are connected to the encoder 1 and encoder 2 interfaces of the device. The two encoders are evaluated in parallel by the device and the safety option.

31972098/EN – 8/2024

When the system is switched on, only the absolute encoder supplies an absolute position, while the incremental encoder is not yet referenced. The initial value for the position is therefore not redundantly available. To obtain a safe absolute position, the incremental encoder must be referenced using a suitable measure.

2-encoder concept – 2 distance encoders (with MOVISAFE® CSA31A only)

There are 2 absolute encoders mounted to the drive train, which are connected to the encoder 2 and encoder 3 interfaces of the inverter. Encoder 2 is evaluated in parallel by the inverter and the safety option. Encoder 3 is evaluated exclusively by the safety option. When the system is switched on, the two absolute encoders provide a position value, so no referencing is required after switching on. During startup, the reference to the position of the application must be established once for each absolute encoder.

Both the "position" process value and the "speed" process value are calculated from the two encoders. As an alternative, an FS motor encoder or a standard motor encoder can be connected to encoder 1 and evaluated for the "speed" process value (see chapter "1-encoder concept – FS motor encoder" (→ 🗎 201) and "2-encoder concept (with MOVISAFE® CSA31A only)" (→ 🗎 202).

The user is responsible for the suitability and use of the encoder system within the framework of functional safety. The user must ensure that the requirements of the required safety level (PLr or SIL) are fulfilled in accordance with the relevant standards such as EN ISO 13849 and EN 62061.

1-encoder concept – FS distance encoder (with MOVISAFE® CSA31A only)

The motion variables required by the system are derived from a single distance encoder certified to a recognized FS standard for this purpose.

The encoder concept can be used for non-slip, slip, and non-linear applications.

Safe double SSI encoder

There is a functionally safe double SSI encoder with 2 separate SSI interfaces on the travel path. Both interfaces are connected to the encoder interface of the safety option via the UEA31A SSI combi-box or a suitable cable.

The encoder has a safe internal functional design and provides an absolute position. This position is transmitted separately for evaluation via both SSI interfaces.

The encoder can be rotary or linear. The connection between encoder and application must be fail-safe and slip-free.

The encoders require additional diagnostics, which are described in the chapter for the respective encoder. All diagnostics for SSI single encoders remain active.

On the drive train, the absolute encoder is configured as encoder 2 and encoder 3. Encoder 2 is evaluated in parallel by the inverter and the safety option, encoder 3 is evaluated exclusively by the safety option.

31972098/EN – 8/2024

Certification of the safe double SSI encoder is only ensured if both channels are involved in the process value calculation. Encoder 2 and encoder 3 can be set to process value calculation, or only encoder 2 can be set to process value calculation and encoder 3 set to comparison value. This applies both to the "Position" process value and the "Speed" process value.

There is no general restriction for safe double SSI encoders with regard to the safety sub-functions. In a planned application, it must be checked whether the resolution and accuracy are sufficient to obtain suitable values for position, speed, and acceleration with Safety over EtherCAT®.

Restrictions with Safety over EtherCAT®

The following encoder combinations are not possible with the safe communication protocol Safety over EtherCAT®:

- EI7C FS with additional encoders

  Use a sin/cos encoder as encoder 1 or determine the process value speed from encoder 2 and encoder 3. Encoder 1 is therefore not used by the CSA31A safety option.

- Encoder 1 with CDx75 or FBPS617i

  Determine the process value speed from encoder 2 and encoder 3. Encoder 1 is therefore not used by the CSA31A safety option.

6.4.10 Encoder cable requirements

General requirements

- Use a shielded encoder cable. Connect the shield at both ends.
- Max. length of the encoder cable: 100 m
- Use the prefabricated encoder cables from SEW-EURODRIVE. Observe the following requirements if you use other encoder cables:
  - Encoder cable length ≤ 50 m

    The cross section of each core of the encoder cable must be ≥ 0.25 mm^2. The resistance load per unit length of the cores must not exceed 78 Ω/km (at 20 °C).
  - Encoder cable length > 50 m:

    The cross section of the cores for the encoder voltage supply and GND must be ≥ 0.5 mm^2. The resistance load per unit length of these cores must not exceed 39 Ω/km. The resistance load per unit length of the signal cores must not exceed 78 Ω/km (at 20 °C).
  - The encoder cable may have the following maximum capacitances per unit length:

    Capacitance per unit length core/core: CA' = 70 pF/m

    Capacitance per unit length core/shield: CS' = 120 pF/m
  - In the signal path from the encoder to the inverter, the encoder signals must not branch off to other devices.

SINE/COSINE encoder cable

Differential signal pairs (e.g. the track signals A and $\overline{A}$, B and $\overline{B}$, C and $\overline{C}$, data+ and data-) must be routed via twisted conductors.

HTL encoder cable

The encoder cable may not conduct any signals other than the encoder signals, i.e. the encoder signals must not be conducted with other signals in the same cable. The cores of encoder signals must be in twisted pairs as follows:

- U_B and GND
- A+ and A-
- B+ and B-

SSI encoder cable

- Differential signal pairs (e.g. the track signals clock+ and clock-, data+ and data-) must be routed via twisted pair cables.
- SEW-EURODRIVE recommends routing the encoder cables in a continuous manner.

  If interruptions are necessary, then the connectors must be suitable for the corresponding environment and continuous uninterrupted shielding of the signals must be ensured.

6.4.11 Acceptance

The system manufacturer must perform an overall evaluation in order to determine the safety of a machine or a system. The effectiveness of each risk minimization must be checked. It must also be checked if the required safety integrity (SIL and/or PL) is reached for each implemented safety function.

To validate the safety integrity level, you can use the "SISTEMA" calculation tool from the "Institut für Arbeitsschutz" (Institute for Occupational Safety and Health of the German Social Accident Insurance).

6.5 Safe digital inputs (F-DI..)

The safe digital inputs (F-DI.) are connected at terminal X60. The following sections explain and describe the permitted connection options.

- Sensors that either switch the sensor supply F-SSx with active pulsed voltage supply through to a safe digital input (F-DIx) or block it. The time behavior of the pulsed voltage supply must not be influenced by the sensor.
- Electronic sensors or evaluation devices that automatically generate test pulses (switch-on or switch-off pulses) on the input signals, the duration of which is < 1 ms.
- Any signal sources that generate a DC input signal within the scope of the specification of F-DIx.

Note the wiring diagrams in chapter "Electrical installation" > "Connection examples for safe digital inputs (F-DI..)". The range of connection variants might be limited depending on the sensor type. Note in addition chapter "Requirements for external sensors and actuators" (→ 🗎 193) as well as the general installation regulations.

Possible contact bounce and interference can be filtered out by a parameterizable input filter. Contact bounces and interferences that are shorter than the set filter time are removed from the signal.

Unassigned inputs need not be wired. An open input is always read as a "0" signal. The safe state of the safe digital inputs is the output of "logical 0" on the associated process values.

31972098/EN – 8/2024

The MOVISAFE® CS..A safety option evaluates the safe digital inputs as follows:

Single-channel connection type (NC contact):

Logic level input terminal F-DI.	Process value F-DI.
0	0
1	1

Connection type two-channel equivalent (NC contact/NC contact):

Logic level input terminal F-DI.	Logic level input terminal F-DI. + 1	Process value F-DI.
0	0	0
0	1	0
1	0	0
1	1	1

Connection type two-channel non-equivalent (NC contact/NO contact):

Logic level input terminal F-DI.	Logic level input terminal F-DI. + 1	Process value F-DI.
0	0	0
0	1	0
1	0	1
1	1	0

With paired evaluation, 2 safe digital inputs F-DI. are combined into one input pair, which has an effect on a common process value.

The assignment is made according to the following table:

Input terminal	Input pair	Assigned process value
F-DI0	F-DI0/1	F-DI0
F-DI1		
F-DI2	F-DI2/3	F-DI2
F-DI3		

Within the MOVISAFE® CS..A safety option, signal processing of the safe digital inputs is performed in two-channel mode. The safe digital inputs are therefore suitable for applications up to SIL 3 pursuant to EN 61508 and Performance Level e pursuant to EN ISO 13849-1. The following external sensors to be connected and their wiring must be in compliance with the required safety class.

6.5.1 Discrepancy time monitoring

The safety option carries out discrepancy time monitoring for input pairs in the two-channel equivalent and two-channel non-equivalent connection types. The discrepancy time monitoring verifies whether the two input signals are delivering fault-free levels that match the switching state of the sensor. A deviation is tolerated for the parameterized discrepancy time. An input fault occurs if the deviation from the expected signal state exceeds the discrepancy time. The discrepancy time can be adjusted for each input pair via a parameter.

31972098/EN – 8/2024

The safety option carries out a switch test function for input pairs in the two-channel equivalent and two-channel non-equivalent connection types in order to verify the connected switch for correct switching behavior following a detected discrepancy fault. The switch test function can be activated and deactivated for each input pair via a parameter. The switch test function assumes that the switch contacts are moved into the opened/activated state after the occurrence of the discrepancy fault so that the two input signals assume the required state for the switch test:

- Connection type two-channel equivalent
  - F-DI. = logical "0"
  - F-DI. + 1 = logical "0"
- Connection type two-channel non-equivalent
  - F-DI. = logical "0"
  - F-DI. + 1 = logical "1"

Only in this case can the discrepancy fault be acknowledged; acknowledgment is otherwise impossible and the input remains in the discrepancy fault.

6.5.2 Interlocking

An interlocking function is available for the safe digital inputs. This function can be activated via a parameter using the "Assist CS.." parameterization tool. Interlocking prevents a safety sub-function, which is activated via the safe digital inputs, from being deactivated without user intervention via the change in input signals from the "0" state to the "1" state. The interlocking sets the process value of the safe digital input to logical "0" until an acknowledgment has occurred.

Unlatching can occur as follows:

- Via a safe digital input that is parameterized as "Acknowledge interlocking safe digital input".
- Via a safe digital input that is parameterized as "Acknowledge interlocking safe digital input and fault".
- Via the "Acknowledge F-DI" bit in the safe process output data.

The inputs with active parameterization remain at logical "0" after each activation of the safety option until an acknowledgment has been carried out.

Unlatching is performed by a 0 → 1 edge. If a permanent high signal is present on the F-DI to which the unlatching function has been assigned, this is indicated by a warning after 20 seconds. The safe digital inputs with active parameterization remain at logical "0" after each activation of the safety option until an acknowledgment has been carried out.

If one of the following functions is assigned to the safe digital input, the interlocking function of an F-DI must not be activated:

- Acknowledge faults
- Unlatch F-DI
- Unlatch F-DI and acknowledge faults
- Muting
- SLI increment enable
- SBT clearance
- Test mode

31972098/EN – 8/2024

6.5.3 Signal monitoring

The signal monitoring detects when the input signal is in an undefined state (unstable state) for too long. The maximum duration for which an unstable state is permitted is calculated from the set filter time multiplied by the parameter value of the parameter *Signal monitoring* (Index 8704, Subindex 8). The function can also be deactivated with the value "0" via the *Signal monitoring* parameter. The safety option responds with an input fault if the signal monitoring is active and the maximum duration has been exceeded.

6.5.4 Pulsed voltage supply and crossfault monitoring

For information about parameter setting and operating principles, refer to chapter "Startup".

If crossfault monitoring is used for a safe digital input F-DI.., the following assignment between the sensor supply F-SS.. and the safe digital input F-DI.. must be adhered to:

- F-DI00, F-DI02 via the respective sensor to F-SS0.
- F-DI01, F-DI03 via the respective sensor to F-SS1.

Crossfault monitoring can be selected separately for each input.

If crossfault monitoring is not active (e.g., for sensors with OSSD output), the sensors can be supplied either from F-SS0 / F-SS1 or from another +24 V supply that has the same ground reference.



⚠ WARNING

Danger due to incorrect setting of the parameter *connection type* when connecting two-channel sensors. There is no redundancy or discrepancy check with the "one-channel" setting.

Severe or fatal injuries.

- When connecting two-channel sensors, you must set the parameter *connection type* to "two-channel (non-equivalent/equivalent)".

Only the connection variants shown below are permitted for safe applications! Also note the assignment of the connection variants of the safe digital inputs to the category structures pursuant to EN ISO 13849-1.

6.6 Safe digital outputs (F-DO..)

6.6.1 General information

Signal processing of the safe digital outputs within the MOVISAFE® CS..A safety option is performed in two channels. The safe digital outputs can therefore achieve SIL 3 pursuant to EN 61508 and Performance Level e pursuant to EN ISO 13849-1. The external actuators to be connected and their wiring must comply with the respective required safety class.

The actuators can be connected to the safe digital outputs F-DO00 and F-DO01 (not with MOVISAFE® CSB21A) via two poles, sourcing/sinking output, two poles, double-sinking output or single-pole, sourcing output.

The following functions can be assigned to the safe digital outputs:

- None

  Control of the safe digital output F-DO takes place via the safe process data. If no safe process data has been activated, the safe digital output is open (logically "0").

31972098/EN – 8/2024

- STO

  F-DO behaves like F-DO_STO. Control via safe process data is not possible.

- SBC

  The safe digital outputs take over the brake control DB0 function by assigning the SBC function. In this way, the safe digital outputs are simultaneously switched with brake output DB00. The brake application delay that is parameterized in the drive train is taken into consideration when this takes place. This means that the DB00 brake output does not need to be connected separately to the SBM, but this option is possible.

  A prerequisite for the SBT brake test is that at least one safe digital output is parameterized to SBC. If both F-DO.. safe digital outputs are parameterized to SBC, the brake test is first carried out for brake 1 at F-DO00 and then for brake 2 at F-DO01.

Set the respective configuration during startup using the "Assist CS.." parameterization tool.

One-pole, sinking digital outputs are not permitted.

It is not necessary to use shielded cables for all safe digital outputs.

Note the dependency of the achieved performance level (PL) and SIL on the selected connection variant of the safe digital outputs. A maximum switching frequency of 10 Hz is possible for each of the two safe digital outputs F-DO00 and F-DO01. The switching state of the safe digital outputs must be stable for at least 2 seconds at least once within 60 seconds. If a fault is detected by diagnostics, the "Output error" error response occurs, which disables all outputs. The consequence of this is that the respective digital output is switched to the safe state "open".

Diagnostics can be activated optionally for safe digital outputs F-DO00 and F-DO01. Diagnostics safely detects a wire break in the interrupted output current circuit.

If a wire break is detected, the "Output error" error response occurs, which disables all outputs.

The outputs F-DO00 and F-DO01 are equipped with an optional wire break monitoring. Wire break monitoring checks whether the connected actuator is consuming a minimum current. If the actuator current is below the minimum value, the MOVISAFE® CS..A safety option detects this as an open circuit.

Activate wire break monitoring only if you are sure that the current consumption of the actuator is always above the minimum current (see chapter "Technical data > Safe digital outputs" (→ 🗎 73)).

In standalone operation, the outputs of the safety option can be safely disabled. This means that the safe outputs are switched at the same time as the internal STO output or with a time delay, depending on the parameterization. The outputs can also be set safely via a safe fieldbus, e.g. to unlock a door lock when the machine is in the idle state.

One safe F-DO digital output can be used to control up to 10 STO inputs on units of the MOVI-C® modular system or one STO input and one safe SBM brake module.

⚠ CAUTION



Thermal overload of the brake rectifiers BMK/BMV due to test pulses of the safe digital output F-DO.

Destruction of the brake rectifier BMK/BMV.

- Do not connect the brake rectifier BMK/BMV to the safe digital output F-DO.
- Connect the brake rectifier exclusively to the brake output DB00 of the unit.

31972098/EN – 8/2024

6.6.2 Capacitive loads

- A capacitive load of no more than 10 nF is allowed to be connected to the output without any additional measures. Capacitive loads often occur in electronic assemblies as buffer capacitors.

  If the capacitive load has a diode in series to its input, the maximum load capacity permitted is 12 µF. This diode is often installed as polarity protection diode in electronic assemblies.
- If the capacitive load is not known or is higher than 10 nF, the inrush current must be limited to the permitted values of the output pursuant to EN 61131-2.

INFORMATION

Due to the thermal load of the output components, the maximum switching frequency of the digital outputs in the presence of capacitive loads must be limited to the value specified in chapter "Technical data - Functional safety" > "Safe digital outputs".

6.6.3 Inductive loads

Inductive loads are, for example, relays, contactors, valves.

- Inductive loads always must be connected between sourcing and sinking outputs.
- The energy stored in the load inductance, which depends on the inductance value and the current, may not exceed the values specified in chapter "Technical data" (→ 🗎 36).

NOTICE

Operation of inductive loads without freewheeling diode can damage the MOVISAFE® CS..A safety option.

Damage to the MOVISAFE® CS..A safety option

- Inductive loads must always be connected via a freewheeling diode. The safe digital outputs of the MOVISAFE® CS..A safety option do not have a freewheeling diode.
- Varistors and other protection elements are not permitted.

6.6.4 Ohmic loads

Light bulbs are examples of ohmic loads.

- Lamps can be connected to display statuses. Note that incandescent and halogen lamps have an increased cold current when switched on. The cold current must not exceed the permitted output current pursuant to EN 61131-2.

6.6.5 Information about line diagnostics and test pulses

For monitoring of the cabling, the output circuit uses test pulses and thus detects faults in the external wiring. This means the output voltage is interrupted briefly (pulsed). The maximum duration of the interruption can be set in the F-DO parameter *Maximum test duration*. The required duration of test pulses is determined by the capacitances in the connected load, which affect the line diagnostics.

A test pulse duration of 1 ms is to be used for the safe disconnection of MOVISAFE® CS..A with a maximum of 10 MOVIDRIVE® modular, MOVIDRIVE® system, and MOVIDRIVE® technology units.

31972098/EN – 8/2024

Total capacitance must not exceed 1 µF with the maximum test pulse duration (5000 µs).

For the 24 V switching outputs F-DO00 and F-DO01, line diagnostics is always active regardless of the parameter setting.

⚠ WARNING

When line diagnostics is deactivated, the MOVISAFE® CS..A safety option cannot detect a short circuit between a sourcing output (F-DO.._P) and the +24 V supply voltage, or between a sinking output (F-DO.._M) and the reference potential.

Severe or fatal injuries.

Install the wiring in such a way that no short circuit is possible:

- Between a sourcing output (F-DO.._P) and the +24 V supply voltage.
- Or between a sinking output (F-DO.._M) and the reference potential.

The safe digital outputs F-DO00 and F-DO01 are equipped with an optional wire break monitoring. Wire break monitoring checks whether the connected actuator is consuming a minimum current. If the actuator current is below the minimum value, the MOVISAFE® CS..A safety option detects this as an open circuit.

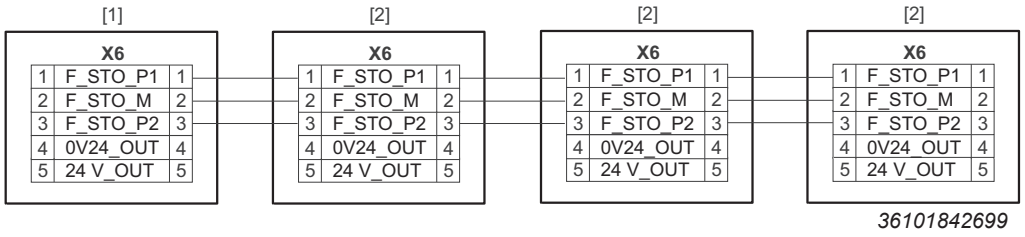
Activate wire break monitoring only if you are sure that the current consumption of the actuator is always above the minimum current (see chapter "Safe digital outputs" (→ 🗎 73)).

6.6.6 Internal safe digital output F-DO_STO

The safety option has an internal safe digital output for switching the inverter's internal STO function as well as 3 additional axes of the MOVIDRIVE® modular/system/technology application inverter. No other components may be connected to the inverter's STO terminal X6.

The following conditions apply for shutting down the 3 additional axes:

- The cable length is limited to a maximum of 3 m up to the last axis.
- Cabling is permitted only within a control cabinet.
- The M-terminal of the individual axes must also be connected.
- No CS..A safety option is allowed to be installed in the additional axes.
- F-DO_STO's advanced diagnostics is available only for the device's internal STO circuit of the axis with a plugged CS..A safety option.
- For the additional axes, only short circuits of the cabling are detected.
- A connection according to the following figure is permissible:



[1] STO terminal X6 of a MOVI-C® MOVIDRIVE® with a CS..A safety option
[2] STO terminal X6 of a MOVI-C® MOVIDRIVE® without a CS..A safety option

31972098/EN – 8/2024

A maximum switching frequency of 10 Hz is permitted for the internal safe digital output. The switching state of the internal safe digital output must be stable "1" for at least 2 seconds or stable "0" for 2.5 seconds (with activated extended diagnostics) at least once within 60 seconds.

The internal safe digital output F-DO_STO is always operated in the connection type "2-pole sourcing output" and must only be used for the STO function of the inverter. If the diagnostics implemented for the internal safe digital output F-DO_STO detects a fault, the error response "output error" occurs, which disables all outputs.

Additional extended diagnostics can be activated for the internal safe digital output F-DO_STO. If a fault is detected by diagnostics, the "output error" error response occurs, which disables all outputs.

The following settings can be made for extended diagnostics:

- Setting "Test when deactivated"

  If this setting is active, the functionality of diagnostics in the STO connection of the inverter is tested right after the STO function is deactivated.

- "Test when deactivated and time monitoring" setting

  This setting is identical to the "Test when deactivated" option. If diagnostics has not been performed within 8 hours, the safety option will additionally issue a warning. Time monitoring works properly only if the safety option deactivates the STO function before the diagnostics interval of 8 hours has elapsed. The test is not performed when switching on the safety option.

  Switching the safety option on/off cyclically is not allowed when using the time monitoring because when it is switched on again the time monitoring is reset and no test is performed. The safety option outputs a warning signal 8 hours after the last test after being switched on.

6.7 "Brake test" diagnostics function

6.7.1 System description

Introduction

The "brake test" diagnostic function supplements a safe braking system that consists of several system components and sets requirements for the interfaces between the respective components.

You can find the "Brake test" diagnostic function in MOVISUITE® in the "Assist CS.." parameterization tool.

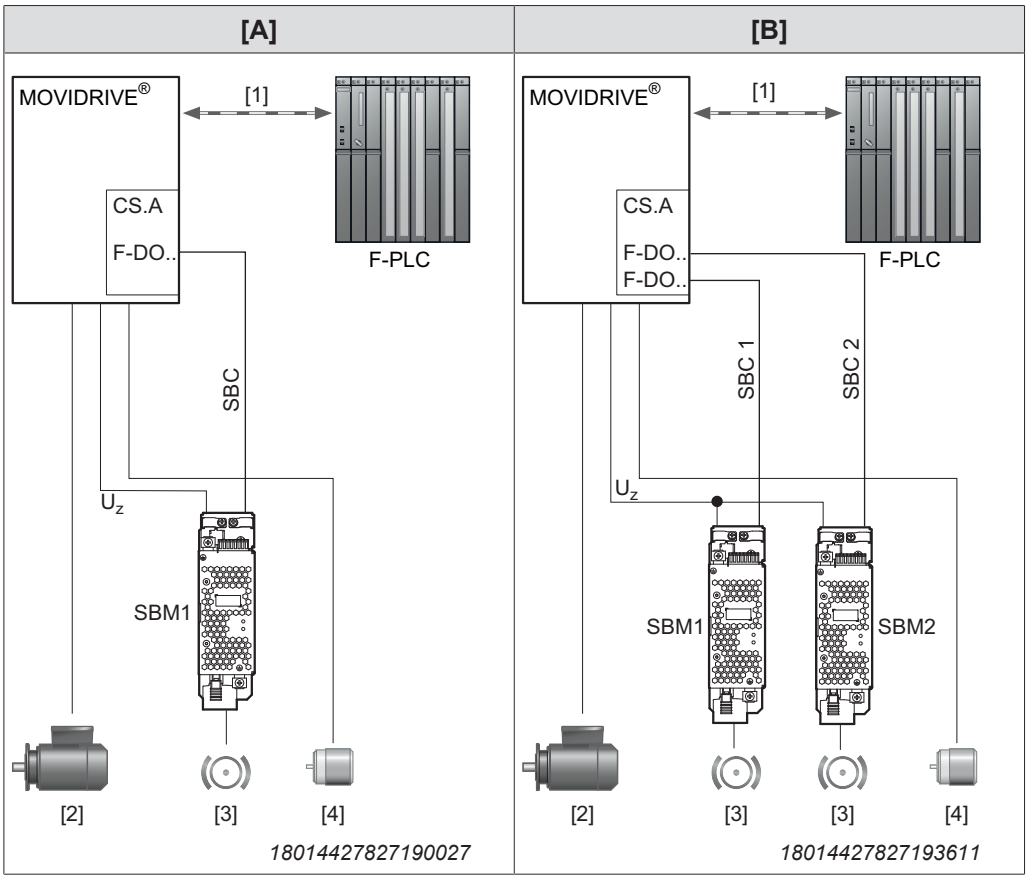
Use one of the following options to start the "Brake test" diagnostic function:

1. The brake test is called by a higher-level safe controller and, optionally, via the MOVI-C® CONTROLLER. The call must be ensured by the user.
2. The brake test is called up via a safe digital input F-DI.. and optionally via a digital input DI. The call must be ensured by the user.

31972098/EN – 8/2024

System overview

The following figure shows an extremely simplified system structure of a safe brake system with one brake [A] and two brakes [B] and an integrated brake test.



MOVIDRIVE®	MOVIDRIVE® modular/system/technology frequency inverter
F-PLC	Higher-level safety controller
CS.A	MOVISAFE® CS..A safety option
[1]	Safe communication
[2]	Motor
[3]	Brake(s)
[4]	Encoder mounted on the motor
SBM1/2	SBM safe brake module
U_Z	DC link voltage
SBC, SBC 1, 2	Control signal(s) for safe control of the brake(s) and for controlling the brake(s) during an active brake test
F-DO..	Safe digital output

Test rate in safe braking systems

The frequency of execution of a brake test is defined using the test rate. The brake test must be called by the user. SEW-EURODRIVE recommends calling up via a safe digital input or a safety controller.

The test rate must be defined by the user in a machine-specific way. Applicative and standards requirements must be taken into consideration when doing so.

31972098/EN – 8/2024

Regular call-up of the brake test

In IFA report 04/2018 "Safe drive controllers with frequency inverters", the Institute for Occupational Safety recommends regularly performing a brake test after approx. 8 hours or one shift. The same applies to system structures in category 2 and 3.

Special feature for machines with access regulation

In machines where access to the hazard zone is safely prevented, e.g. via security doors with an active guard locking device, the brake test can be performed immediately before accessing the hazard zone. Access to the hazard zone may be granted only after a positive diagnostics result.

One-off call-up of the brake test

In addition to regular call-ups, it is advisable to execute the brake test after the following events:

- Initial startup of a system
- After emergency stop braking
- After voltage failure
- After the system is switched on
- After inspection, maintenance or repair of the brake

Diagnostic coverage (DC)

The diagnostic coverage (DC) measures the effectiveness of the diagnostics in accordance with EN ISO 13849-1. The diagnostic coverage is specified as the ratio of the failure rate of discovered dangerous failures to the failure rate of overall dangerous failures. Diagnostics is required from a system architecture of category 2 and higher.

The functional and performance capability of a brake can be adversely affected by a multitude of potential faults. The potential faults are summarized in one of the following fault patterns, which are discovered by the brake test.

Fault pattern	Effect of fault	Discovery of fault
Brake remains applied	Safe state	Fault is discovered
Brake remains open	Dangerous state	Fault is discovered
Insufficient braking torque	Dangerous state	Fault is discovered

In order to determine the Performance Level (PL) that has been achieved in safe brake systems, a DC value of DC = 90% can be assumed for the brake test.

In systems which do not contain a motor-integrated safety brake from SEW-EURODRIVE, the user must rule out a possible break in the power transmission between the motor, the tested brake and the encoder that is used for the brake test diagnostics function.

INFORMATION

Depending on the type of encoder system, a break between an encoder and the brake (due to moving clear) can be detected by means of a clever arrangement of a multi-encoder system.

In systems in which the motor shaft and brake are not coupled in a backlash-free manner, the user must check whether the brake test still detects a defective brake. A configured backlash must not mask a defective brake.

6.7.2 Functional description of the static brake test



⚠ WARNING

Performing the brake test on a damaged brake or machine can lead to undesired movement of the machine.

Severe or fatal injuries.

- No person may be present in the hazard zone during an active brake test.
- The mechanics of a hoist must be designed for a possible fall using buffers, for example.
- The brake test must be performed with the machine in a suitable test position.

The Safe Brake Test (SBT) function is a static brake test for horizontal and vertical applications. The static brake test diagnoses whether the brake that is being tested can maintain a static test torque that is applied against the applied brake.

The brake test takes place in several stages. This makes it possible to clearly detect the numerous potential errors and minimize the effects of the system on the result of the brake test. To begin with, the drive carries out a parameterizable movement. The static brake test must be called up from a suitable test position that allows the machine to make this movement.

During startup, the settings must be made so that the applicative load torque and the proportional motor torque together give the required test torque. A static load torque acting upon the drive due to the own weight of the system, for example, must be taken into consideration. Before calling up the brake test and during the brake test, it must be ensured that the load conditions are steady during startup in accordance with the settings so that the brake is tested correctly.

The brake test records torques via the inverter and specifies torques to the inverter as setpoints. The torques are not evaluated from a safety technology point of view. The accuracy of the torque recording corresponds to the accuracy of the inverter.

When executing the brake test, movements are safely monitored for adherence to the limit values that have been set by the MOVISAFE® CS..A safety option.

In safe brake systems with more than one brake, the static brake test must be carried out separately for each brake. The brake test described here can test one or 2 brakes. With 2 brakes, the brakes can be tested separately with the same test parameters or with adapted test parameters. One brake is applied for testing, whereas the second brake remains released.

Direction of movement/test direction

The static brake test can be performed in the positive or negative direction of movement/test direction. The positive or negative specification relates to the counting direction of the encoder values, e.g. increasing encoder values (positive) or decreasing encoder values (negative) for a movement in the set direction of movement.

INFORMATION

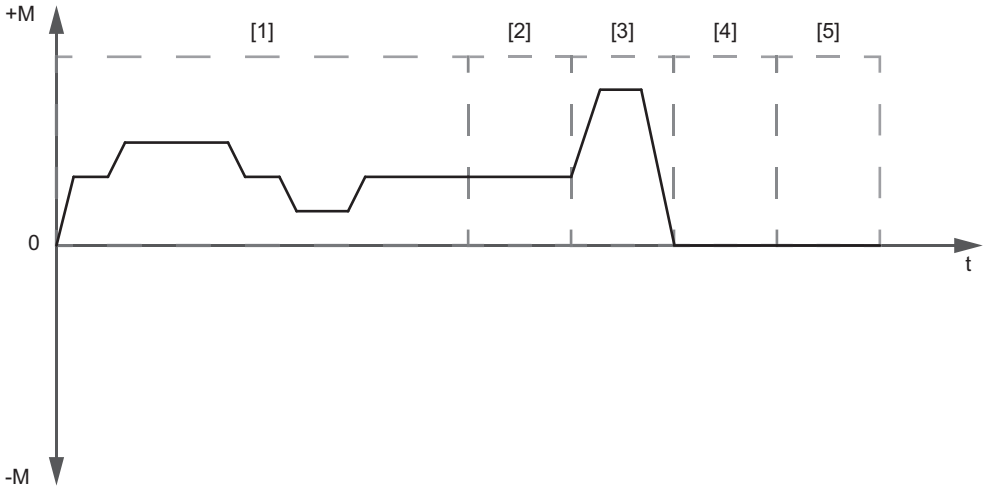
- The following figures are examples and can vary depending on the actual load situation and the respective setting.
- More information about the individual test steps can be found in chapter "Step-by-step brake test procedure".

31972098/EN – 8/2024

Load torque > 0 (5 test steps)

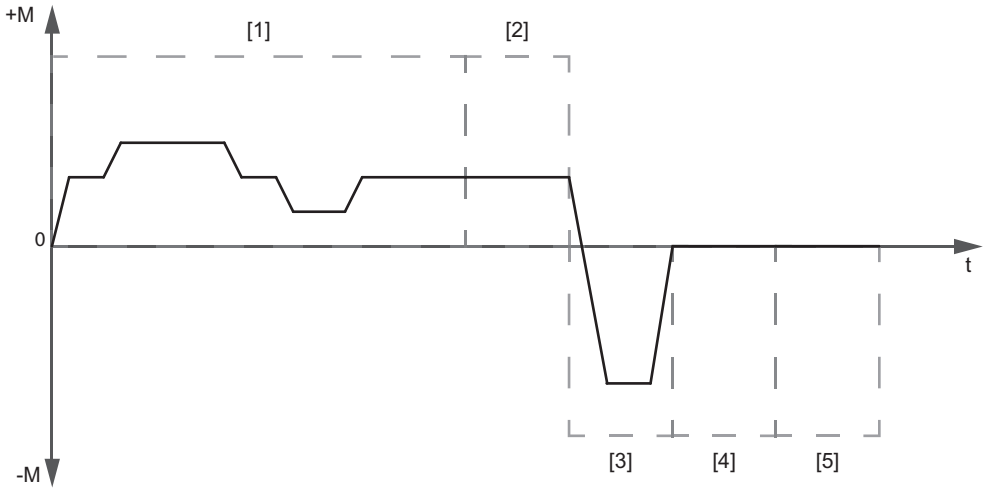
The following example figures apply to applications with a configured load torque of M > 0 (5 test steps), e.g. hoist.

- Positive direction of movement / positive test direction



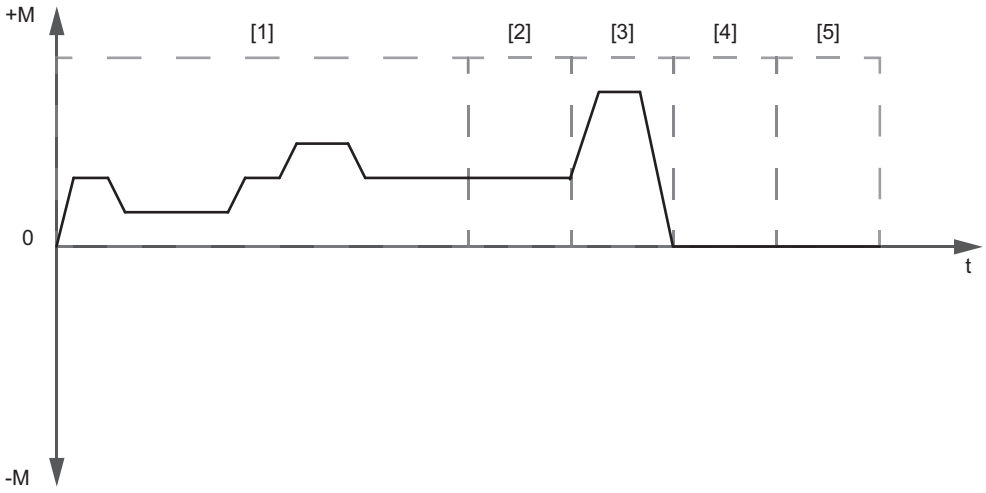
9007228411639179

- Positive direction of movement / negative test direction



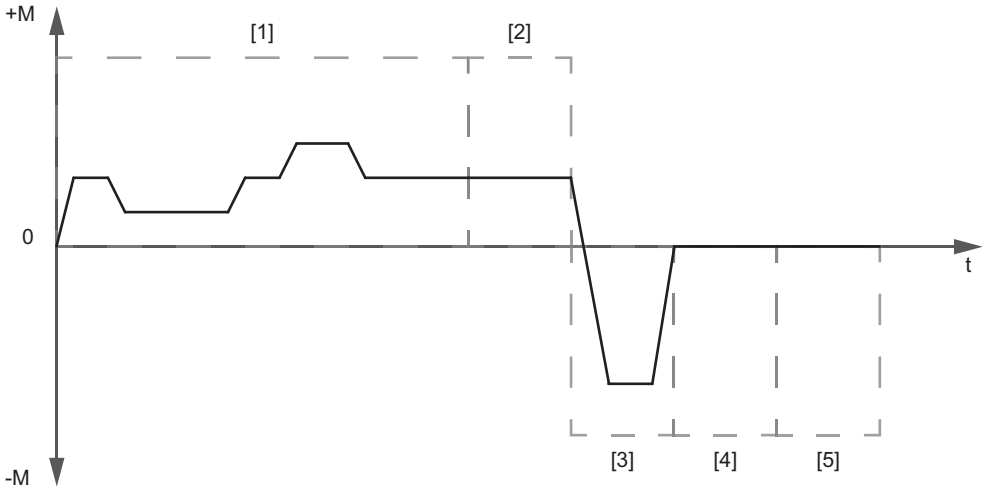
9007228411644683

- Negative direction of movement / positive test direction



9007228411648267

- Negative direction of movement / negative test direction



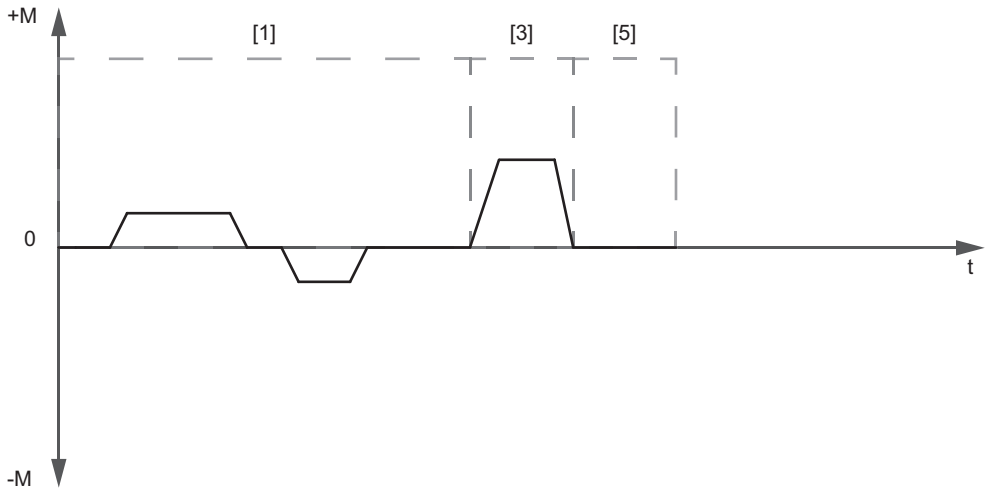
9007228416003851

31972098/EN – 8/2024

Load torque = 0 (3 test steps)

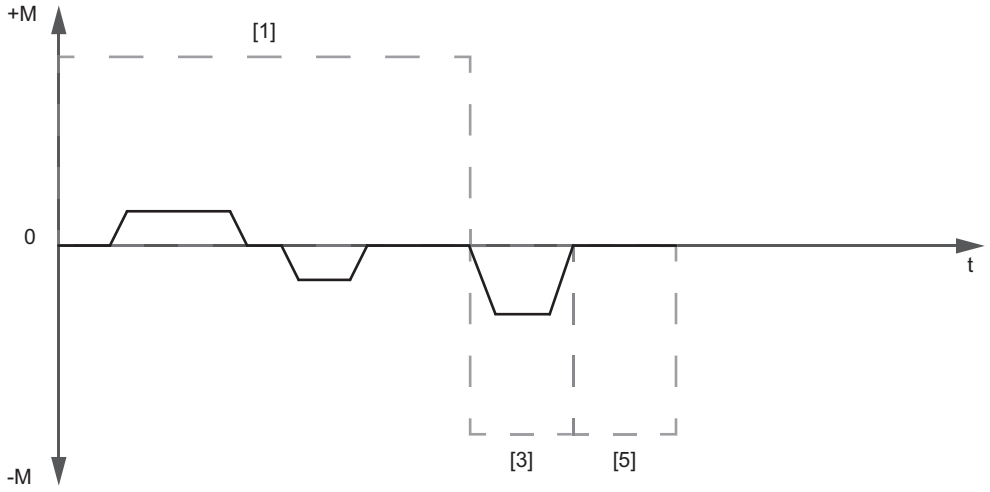
The following example figures apply to applications with a configured load torque of M = 0 (3 test steps), e.g. horizontal drive.

- Positive direction of movement / positive test direction



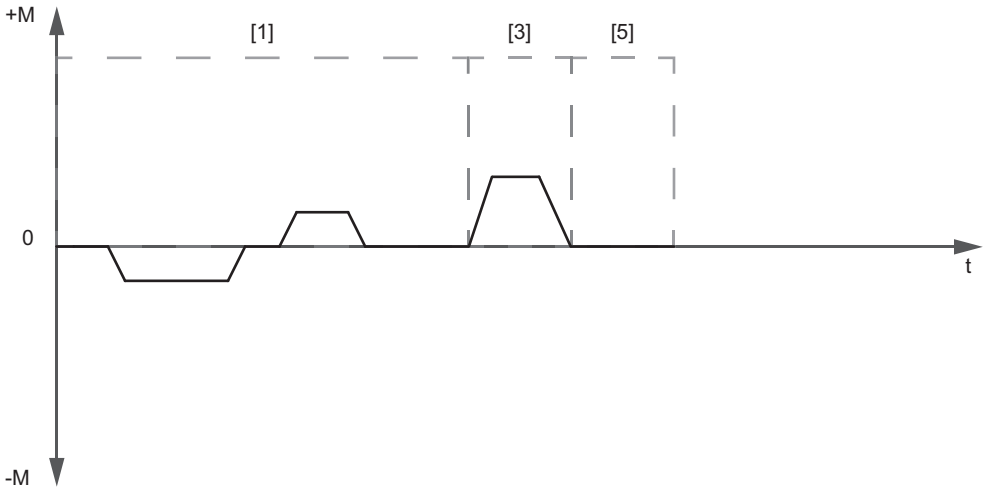
9007228416008587

- Positive direction of movement / negative test direction



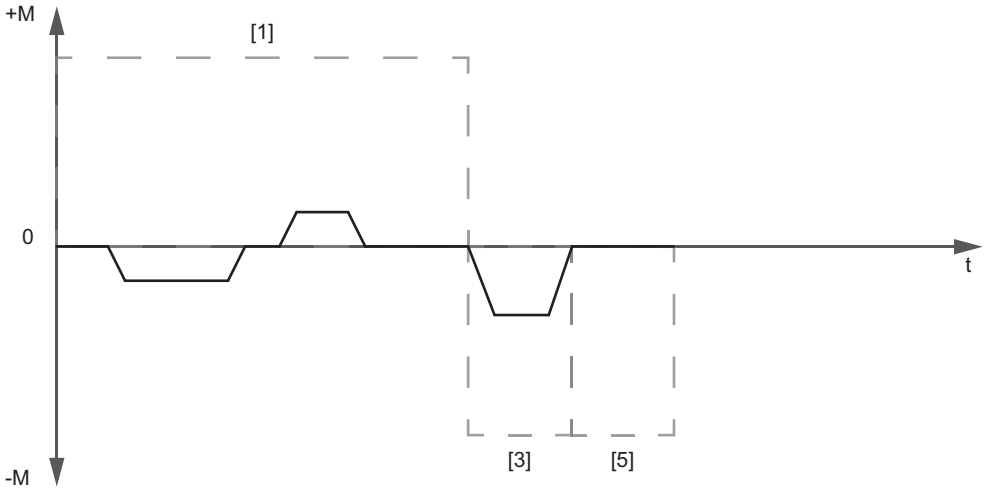
9007228416012171

- Negative direction of movement / positive test direction



9007228416041355

- Negative direction of movement / negative test direction



9007228416044939

Step-by-step brake test procedure

The static brake test goes through the following steps. Parameter names are shown in *italics*.

Step 1: Moving clear

In step 1, the system availability for a brake test and the correct starting conditions are checked, e.g., the load torque setting. Errors in the overall system can be detected, e.g., a blocked mechanism or a brake that fails to release. Applicative effects on the result of the brake test are reduced.

A jerk time set in the inverter is not taken into consideration when moving clear. Moving clear takes place without jerk limitation.

Moving clear takes place in the following sub-steps:

- The drive moves to the set target position. The movement takes place in the set direction of movement. The target position is specified via the *Track*.

31972098/EN – 8/2024

- The brake test calculates the expected duration of the movement and checks the actual movement, its direction and the duration required for it.
- After reaching the target position, the brake test waits for the duration of the set *Waiting time*. If position control is in operation, the drive remains in the target position. Then the next step is performed.
- The drive moves back in the opposite direction to 50% of the set target position. The movement takes place against the set direction of movement. The target position is specified via the *Track*.
- The brake test calculates the expected duration of the movement and checks the actual movement, its direction and the duration required for it.
- After reaching the target position, the brake test waits for the duration of the set *Waiting time*. If position control is in operation, the drive remains in the target position. Then the next step is performed.

During moving clear, all brakes are opened via the F-DO.. safe digital outputs configured with the SBC function.

Step 2: Load torque test (optional)

In step 2, a check is performed to verify if the static load torque determined in the current test situation is within the set limits.

This step is not necessary in machines without static load torque. In these cases, the load torque can be set to "0". The brake test then skips this step.

The load torque test takes place in the following sub-steps:

- The drive remains at the target position for the *Duration of individual test steps* if position control is active. This position is monitored using the *Permitted movement during idle state* parameter of brake 1.
- The actual torques are determined via the inverter via the *Duration of individual test steps* and the current load torque is calculated from this (arithmetic mean value).
- The set *Load torque* is checked against the calculated load torque. This must be within the range of the set *Load torque*, taking the *Load torque tolerance* into consideration.

During the load torque test, all brakes are released via the F-DO.. safe digital outputs configured with the SBC function.

Step 3: Active testing of the brake

In step 3, the brake is tested to verify whether it can hold the *Test torque*. The test torque is the sum of the applicative load torque during the brake test and the motor torque, which is set via the *Torque specification* parameter.

The brake is loaded with the *Test torque* for the set *Individual test steps duration*. The proportional motor torque builds up over the *Duration of torque buildup* and reduces again over the *Duration of torque reduction*. Possible movement of the machine is monitored during brake loading. A movement during active testing must be smaller than the sum of *Permitted movement during idle state* and *Mechanical backlash* of the respective brake.

The magnitude and direction of the actual torque supplied by the inverter is monitored. The recorded actual torque (arithmetic mean value) must be greater than the *Torque specification* minus the *Tolerance torque specification* of the respective brake.

31972098/EN – 8/2024

If two brakes are to be tested, this test step is first carried out with the brake on the safe digital output F-DO00, the second brake on the safe digital output F-DO01 remains released. This test step is then repeated for the second brake, and the first brake remains released.

INFORMATION

- Depending on the direction of the test and load torque, the torque acting on the brake can be increased or reduced. The *Load torque* configured in the brake test must be adhered to whenever the brake test is performed.
- All torques relate to the motor shaft.

Step 4: Passive brake testing (optional)

In step 4, the brake is tested to verify if it can maintain the present load torque.

This step is not necessary in machines without load torque. In these cases, the load torque can be set to the value "0". The brake test then skips this step.

The brake is exclusively loaded with the existing load torque of the machine without additional motor torque. In order to do so, the STO safety sub-function is activated at the inverter via the *Duration of individual test steps*. The drive cannot generate torque. Possible movement of the machine is monitored whilst the "STO" state is active. The movement must be within the range of the *Permitted movement at standstill* of the respective brake.

If two brakes are to be tested, this step is first carried out with the brake on the safe digital output F-DO00, and the second brake remains released. This step is then repeated for the second brake on the safe digital output F-DO01, and the first brake remains released.

Step 5: End of test

In order to complete the brake test, the existing brakes are applied and the STO safety sub-function is activated at the inverter. Afterwards, brake test control can be deactivated.

6.7.3 Project planning notes

Introduction

- The device must be started up using the CFC or VFC^{PLUS} control mode (with encoder).
- The brake test is exclusively compatible with the AS1 drive train.
- The required torque input for testing the brake must be taken into consideration during the configuration of the devices.
- The setting of the application limits *Torque* and *Apparent output current* in the inverter must allow the proportional motor torque (*Torque input*) to be built up in the *Test direction*.
- Select the parameter settings of the "FCB 01 output stage inhibit" drive function as follows:
  - 0: *Release brake/deactivate DynaStop® with FCB01 – enable*
  - 1: *Apply brake in event of STO*

  This corresponds to the default setting in the delivery state.

31972098/EN – 8/2024

Safety sub-functions

When the "Brake test" diagnostics function is being used, attention must be paid to compatibility with the safety sub-functions of the CS..A safety option.

- If one of the following safety sub-functions is activated during an active brake test, the brake test will be canceled:
  - STO/SBC
  - SSx
  - SOS
  - SSR
  - SDI
  - SLI
- The SLS, SSM, SLA and SLP safety sub-functions can be used at the same time as the brake test. A limit value violation at one of these safety sub-functions leads to the cancellation of the brake test. If exclusively the message via F process data (F-PI only) is set as the response to a limit value violation, then the brake test is not canceled in the event of a limit value violation. In this case, a suitable response is the task of the higher-level safety controller.

The functionality of a safety sub-function is always guaranteed and has a higher priority than the brake test.

Motors

The brake test is compatible with motors that can be operated on the device.

The existing requirements for the motors with regard to the CFC or VFC^{PLUS} control modes must be observed.

User units

The brake test uses the user units which are set in the inverter, e.g. min-1, mm/s.

If the user units in the inverter are changed at a later date, check that the safety option settings are correct. After changing the user units in the inverter, restart the "Assist CS.." parameterization tool. Check the settings and correct them, if necessary.

Encoder settings

The encoder settings of the CS..A safety option must match the encoder settings in the AS1 drive train of the basic unit.

INFORMATION

Detailed information about the CS..A safety option can be found in the chapter "Start-up of the MOVISAFE® CS..A safety option".

Encoder/safety encoder

The brake test requires a motor encoder as encoder feedback to the inverter. If the brake test is evaluated in a safety-related system, e.g. in accordance with the Performance Level (PL), the encoder must be designed as a safety encoder. You can select the following encoders from SEW-EURODRIVE in the "Assist CS..." parameterization tool:

- ES7S/EG7S/EK8S

31972098/EN – 8/2024

- AS7W/AG7W/AK8W
- AK0H/AK1H
- EK8Z/AK8Z

In addition to the incremental sin/cos signals, the A.7W, AK8W and AK.H encoders/ safety encoders also provide multi-turn absolute value signals (RS485 or HIPERFACE®). The CS..A safety option uses the sin/cos signals of the respective encoder for the brake test.

Systems with mechanical backlash

If a brake test is to be implemented in a system with mechanical backlash, then the "mechanical backlash" can be set for brake 1 and, if required, for brake 2.

The mechanical backlash extends the permissible movement during active testing of the brake in step 3. A limit value violation takes place if the detected movement is larger than the sum of *Permitted movement during idle state* and *Mechanical backlash* of the respective brake.

Brake control/safe brake control



⚠ WARNING

A faulty brake control connection and defective brake switching times can lead to undesired movement of the drive. An axis that is loaded with gravitational force (such as a hoist) may fall down.

Severe or fatal injuries.

- The brake output DB00 at the unit is not safety-related. Connect the safe brake control only to a safe digital output F-DO.., to which the SBC function is assigned.
- The brake release and application time that is set in the device or brake test must correspond to the respective brake.

The brake test requires control of the brake via a brake rectifier. During the startup of the device in the AS1 drive train with brake, select the *Brake control DB00* connection type. Other selection options, e.g. *Direct connection DB00 (DC24V)* or *MOVILINK® DDI* are not compatible with the brake test.

To start up the brake test, activate the SBC function in the "Assist CS..A" parameterization tool. When the SBC function is activated, the device also internally forwards the functional brake control (DB00) via the CS..A safety option to the F-DO.. safe digital output which is set using the SBC function.

Use a suitable safe brake control such as the SBM safe brake module in the safe brake system to interrupt the energy supply to the brake so that the brake is switched off in a safety-related way. For further information about this, refer to chapter "System description" (→ 🗎 213).

The available brake controls with a DC 24 V control input from SEW-EURODRIVE can be used in a brake system without safety technology relevance that has been extended with a brake test. Brake control then takes place exclusively via the assigned F-DO..

If other brakes or drives are present in a multi-axis system and are mechanically coupled to the drive to be tested, these brakes must be released and the drives must be torque-free or follow the drive under test synchronously.

31972098/EN – 8/2024

Number of testable brakes

A maximum of 2 brakes can be tested separately for each CS..A safety option. They are assigned via the functional assignment of the F-DO.. safe digital outputs.

F-DO..	F-DO function	Meaning for SBT
F-DO00	None	SBT not available
	STO	SBT not available
	SBC	SBT can be configured for a brake
F-DO01	None	SBT not available
	STO	SBT not available
	SBC	SBT can be configured for a brake

If F-DO00 and F-DO01 are set to "SBC", the brake test is carried out for 2 brakes. The brake test first tests brake 1 (F-DO00) and automatically repeats test steps 3 to 5 for brake 2 (F-DO01). With 2 brakes, brake 1 and brake 2 are tested with the same test parameters (default setting). You can also set individual test parameters for brake 2.

INFORMATION

In the "Brake test" menu, the settings of the test parameters for brake 2 are only displayed if both F-DO. digital outputs are set with the SBC function.

6.8 Data exchange with higher-level controller

6.8.1 Introduction

Devices with integrated safety option support parallel operation of standard and safe communication via a bus system or network. Safe communication is possible via PROFIsafe and via Safety over EtherCAT®.

The devices with an integrated safety option are connected to a MOVI-C® CONTROLLER, which is connected to a fail-safe controller (F-Host) via PROFINET IO.

Safe FSoE communication can be carried out via EtherCAT®. To that end, the device in the variant DSI with integrated safety option must be connected to a fail-safe controller (F-PLC) via EtherCAT®/SBus^{PLUS}.

To control safety sub-functions and to evaluate the responses from the safety option via PROFIsafe or Safety over EtherCAT®. the assignment of the individual bits in the F-process input/output data must be taken into consideration.

In the "System" profile variant, an additional 16 bit and a 32 bit process value are transferred. The safe speed, the safe position, and the SCA status can be transferred via the process values.

6.8.2 PROFIsafe safety protocol

Number of safety options on the MOVI-C® CONTROLLER

The safe PROFIsafe communication is routed via the MOVI-C® CONTROLLERs to the devices with an integrated safety option.

31972098/EN – 8/2024

MOVI-C® CONTROLLERs support a different number of devices.

MOVI-C® CONTROLLER	Number of safety options	Comment
UHX25-N FHX25-N	8	
UHX45-N FHX45-N	8	
UHX65-R	24	Maximum of 24 safety options or maximum of 432 bytes of safe process data (sum total of all safe process data of the safety options).
UHX85-R	8	• Firmware V2.0 release 201703xxxx (March 2017) and earlier. • Object in the hardware catalog of the TIA portal: UHX84-R/UHX85-R V2.0
UHX85-R	24	Maximum of 24 safety options or maximum of 432 bytes of safe process data (sum total of all safe process data of the safety options). • Firmware V2.x or V3.0 release 201707xxxx (July 2017) and later. • Object in the hardware catalog of the TIA portal: UHX84-R/UHX85-R V3.0 and later.
UHX86A-R	24	Maximum of 24 safety options or maximum of 432 bytes of safe process data (sum total of all safe process data of the safety options).

The following number of bytes must be taken into consideration when routing:

- CSB21A, CSB31A: 14 Bytes
- CSS21A, CSS31A, CSA31A in the "Technology" profile variant: 18 Bytes
- CSS21A, CSS31A, CSA31A in the "System" profile variant: 22 Bytes

F-periphery access of the safety option in the TIA Portal

PROFIsafe version 2.4

For safe communication, CSB..A safety options need a total of 8 bytes for input data and 7 bytes for output data for the PROFIsafe telegram part and occupy them in the process image. Of these, 4 bytes of input data and 3 bytes of output data are the actual safe I/O data (F-useful data). The module with the designation F-I/O module (4/3 byte) is required for data exchange via PROFIsafe with the CSB..A safety options.

31972098/EN – 8/2024

For safe communication in the "Technology" profile variant, CSS..A and CSA31A safety options need a total of 10 bytes for input data and 9 bytes for output data for the PROFIsafe telegram part and assign them in the process image. Of these, 6 bytes of input data and 5 bytes of output data are the actual safe I/O data (F-reference data). The module with the designation F-I/O module (6/5 bytes) is required for data exchange via PROFIsafe with the CSS21A, CSS31A and CSA31A safety options.

For safe communication in the "System" profile variant, CSS..A and CSA31A safety options need a total of 16 bytes for input data and 10 bytes for output data for the PROFIsafe telegram part and assign them in the process image. Of these, 12 bytes of input data and 5 bytes of output data are the actual safe I/O data (F-useful data). The module with the designation F-I/O module (12/5 bytes) is required for data exchange via PROFIsafe with the CSS21A, CSS31A and CSA31A safety options.

The remaining 4 bytes are required for the telegram backup according to the PROFIsafe communication.

PROFIsafe version 2.6

For safe communication, CSB..A safety options need a total of 9 bytes for input data and 8 bytes for output data for the PROFIsafe telegram part and occupy them in the process image. Of these, 4 bytes of input data and 3 bytes of output data are the actual safe I/O data (F-reference data). The module with the designation F-I/O-module (4/3 bytes) V2.6 is required for data exchange via PROFIsafe with the CSB..A safety options.

For safe communication in the "Technology" profile variant, CSS..A and CSA31A safety options need a total of 11 bytes for input data and 10 bytes for output data for the PROFIsafe telegram part and assign them in the process image. Of these, 6 bytes of input data and 5 bytes of output data are the actual safe I/O data (F-reference data). The module with the designation F-I/O module (6/5 bytes) V2.6 is required for data exchange via PROFIsafe with the CSS21A, CSS31A, and CSA31A safety options.

For safe communication in the "System" profile variant, CSS..A and CSA31A safety options need a total of 17 bytes for input data and 10 bytes for output data for the PROFIsafe telegram part and assign them in the process image. Of these, 12 bytes of input data and 5 bytes of output data are the actual safe I/O data (F-reference data). The module with the designation F-I/O module (12/5 bytes) V2.6 is required for data exchange via PROFIsafe with the CSS21A, CSS31A, and CSA31A safety options.

The remaining 5 bytes are required for the telegram backup according to the PROFIsafe communication.

PROFIsafe address type 1

Uniqueness of the PROFIsafe address is only ensured by the destination address.

- The destination address must be unique in the fieldbus network and the control network. This means the destination address ranges of all F-PLCs must not overlap.
- Destination and source address are included in the CRC value of the safety program of the F-PLC.

PROFIsafe address type 2

Uniqueness of the PROFIsafe address can be ensured by combining the source and destination addresses.

- The destination address must be unique in the control network and must differ from all destination addresses of PROFIsafe address type 1 in the same network.

31972098/EN – 8/2024

- The source address used for the F-periphery of an F-PLC must be unique in the network.
- Destination and source address are included in the CRC value of the safety program of the F-PLC.

F-periphery data component of the safety option

While compiling the configuration tool (HW Config), the system automatically generates an F-periphery data component (DB) for each safety option. The F-periphery DB offers users an interface in which they can evaluate or control variables in the safety program.

The symbolic name consists of the invariable prefix "F", the start address of the F-periphery, and the name entered in the object properties during configuration for the F-periphery (e.g.: F00008_198).

The following table shows the F-periphery DB of the safety option:

	Address	Symbolic name (Variable)	Data type	Function	Presetting
Variables that the user can control.	DBX0.0	"F00008_198" (PASS_ON)	BOOL	1: Activate passivation	0
	DBX0.1	"F00008_198" (ACK_NEC)	BOOL	1: Acknowledgment required for reintegration of the safety option	1
	DBX0.2	"F00008_198" (ACK_REI)	BOOL	1: Acknowledgment for reintegration	0
	DBX0.3	"F00008_198" (IPAR_EN)	BOOL	Variable for re-parameterization (not supported by the safety option)	0

31972098/EN – 8/2024

	Address	Symbolic name (Variable)	Data type	Function	Presetting
Variables that the user can read.	DBX2.0	"F00008_198" (PASS-OUT)	BOOL	Carry out passivation	1
	DBX2.1	"F00008_198" (QBAD)	BOOL	1: Substitute values are output	1
	DBX2.2	"F00008_198" (ACK_REQ)	BOOL	1: Acknowledgment requirement for reintegration	0
	DBX2.3	"F00008_198" (IPAR_OK)	BOOL	Variable for re-parameterization (not supported by the safety option)	0
	DBB3	"F00008_198" (DIAG)	BYTE	Service information	–

PASS_ON

With the *PASS_ON* variable, you can activate passivation of the safety option. Passivation of the F-periphery takes place for as long as *PASS_ON = 1*.

ACK_NEC

After resolving a fault, the safety option is reintegrated depending on the setting of the variable *ACK_NEC*.

- *ACK_NEC = 0:* Automatic reintegration takes place.
- *ACK_NEC = 1:* Automatic reintegration following acknowledgment by the user.

⚠ WARNING



Impermissible parameterization of the variable *ACK_NEC = 0*.

Death or severe injuries

- Parameterization of the *ACK_NEC = 0* variable is then only allowed if automatic reintegration of the relevant process is permissible from a technical safety point of view.
- Check if automatic reintegration is permitted for the respective process.

ACK_REI

In order to reintegrate the safety option after the fault has been corrected, user acknowledgment with positive edge at the variable *ACK_REI* is required. Acknowledgment is not possible until variable *ACK_REQ = 1*.

ACK_REQ

The F control system sets *ACK_REQ = 1* after all faults in the data exchange with the safety option have been corrected. After successful acknowledgment, *ACK_REQ* is set to 0 by the F-control system.

PASS_OUT

The variable *PASS_OUT* indicates whether there is a passivation of the safety option. Substitute values are output.

QBAD

Fault in the data exchange with the safety option. Indicates that passivation is present. Substitute values are output.

DIAG

Non-failsafe information about faults which have occurred in the F-control system is made available for service purposes via the *DIAG* variable. For further information, refer to the relevant F-control system manual.

31972098/EN – 8/2024

Acknowledgment of PROFIsafe data exchange

The PROFIsafe communication must be fault-free for safe data exchange of the safety option via PROFIsafe. As soon as there is an acknowledgment request of the safety option via the *ACK_REQ* bit in the F-periphery data component, the user must trigger an acknowledgment by a rising edge via the *ACK_REI* bit.

As soon as the safe data exchange of the safety option using PROFIsafe is fault-free, faults in the safety option can be acknowledged by a 0 → 1 edge with the "Acknowledgment" bit in the F-process data profile.

6.8.3 Safety over EtherCAT® safety protocol

Data exchange

- For data exchange via Safety over EtherCAT® between the CS..A safety option and a higher-level controller, the safety option in the "Technology" profile variant has the following process data assignment:
  - 6 bytes of input data
  - 1 byte of header data
  - 3 × 2 bytes of user data and 2 bytes of CRC, each in pairs
  - 2 bytes of connection ID
  - 6 bytes of output data
  - 1 byte of header data
  - 3 × 2 bytes of user data and 2 bytes of CRC, each in pairs
  - 2 bytes of connection ID
- For data exchange via Safety over EtherCAT® between the CSS21A, CSS31A, CSA31A safety option and a higher-level controller, the safety option has the following process data assignment in the "System" profile variant:
  - 12 bytes of input data
  - 1 byte of header data
  - 6 × 2 bytes of user data and 2 bytes of CRC, each in pairs
  - 2 bytes of connection ID
  - 12 bytes of output data
  - 1 byte of header data
  - 6 × 2 bytes of user data and 2 bytes of CRC, each in pairs
  - 2 bytes of connection ID

Profile data must be evaluated and made available in "Little Endian" representation in Safety over EtherCAT®.

Integrating safe communication

Each safety option must be created by the user in the safety program. For establishing the operation of the safety function, defined variables are available that can be named differently depending on the Safety over EtherCAT® main device.

31972098/EN – 8/2024

Example

The following example illustrates these variables on the basis of group ports from Beckhoff.

	Variable	Function
Group ports for controlling	RUN/STOP	Starts/stops the execution of the Safety over EtherCAT® program.
	Err Ack	Error reset/acknowledgment of safe communication.
	Module Fault	N.N.
Group ports for monitoring	FB Err	Error during execution of a function block.
	Com Err	Communication error.
	Out Err	Output error.
	Other Err	Other error.
	Com Startup	Safe communication is established.
	FB Inactive	N.N.
	FB Run	Execution of function blocks is running.
	In Run	Safety program is running.

The procedure for starting the safety function and for reintegrating a safety device depends on the Safety over EtherCAT® main device and is not shown here.

Safety over EtherCAT® has validity information for its safe process data. This is transferred from main device to sub-device for the process output data and from sub-device to main device for the process input data when the safety protocol is established. If "Invalid" is reported by the main device, all process output data on the sub-device side is zeroed. The sub-device always reports "valid" with the current process input data.

Requirements for the FSoE parameterization

Requirement for the FSoE address

The Safety over EtherCAT® user must ensure that the F-address is between 1 and 65535 and that it is unique in a communication domain. A communication domain is a logical network within which the safety-related messages are transported. The messages are not permitted to be transported beyond this network. The F addresses are set in the main device and in the sub-device.

Requirements for the connection ID

The Safety over EtherCAT® user must ensure that the connection ID is unique in a communications domain. A communication domain is a logical network within which the safety-related messages are transported. The messages are not permitted to be transported beyond this network. The connection ID is set in the main device.

FSoE watchdog time

The Safety over EtherCAT® connection monitoring time must be set in the main device. The range of values is from 24 ms to 60 000 ms.

6.8.4 F-process data profile

For safety sub-functions that are not used, the selection via the safe process output data must be set to "1" (not selected) and the reserve bits must be set to "0".

CSB21A profile variant "Technology"

Process output data

Byte	Bit	Name	Value	Description
0	0	STO	0	Activate STO.
			1	Deactivate STO.
	1	Reserve		
	2	Reserve		
	3	Reserve		
	4	Reserve		
	5	Reserve		
	6	Unlatch F-DI	0	No acknowledgment.
			1	Acknowledgment of latched F-DI (0 → 1 edge).
	7	Fault acknowledgment	0	No acknowledgment.
			1	Fault acknowledgment (0 → 1 edge).
1	0	Reserve		
	1	Reserve		
	2	Reserve		
	3	Reserve		
	4	Reserve		
	5	Reserve		
	6	Reserve		
	7	Reserve		
2	0	Reserve		
	1	Reserve		
	2	SSX1	0	Activate SSx1.
			1	Deactivate SSx1.
	3	SSX2	0	Activate SSx2.
			1	Deactivate SSx2.
	4	Reserve		
	5	Reserve		
	6	Reserve		
	7	Reserve		

31972098/EN – 8/2024

Process input data

Byte	Bit	Name	Value	Description
0	0	STO	0	STO is not active. Safe disconnection of the drive is not active.
			1	STO signals "STO active" status. All outputs parameterized to STO are disabled.
	1	Reserve		
	2	Reserve		
	3	Input data valid	0	At least one of the F-DI process values sends a substitute value.
			1	All process values of the F-DI contain actual values.
	4	Reserve		
	5	Reserve		
	6	Warning	0	The safety option is in fault-free operation.
			1	At least one warning in the safety option is active.
	7	Fault status	0	The safety option is in fault-free operation.
			1	At least one fault at the safety option.
1	0	F-DI00	0	F-DI00 process value: "low" or fault.
			1	F-DI00 process value: "high".
	1	F-DI01	0	F-DI01 process value: "low" or fault.
			1	F-DI01 process value: "high".
	2	F-DI02	0	F-DI02 process value: "low" or fault.
			1	F-DI02 process value: "high".
	3	F-DI03	0	F-DI03 process value: "low" or fault.
			1	F-DI03 process value: "high".
	4	Reserve		
	5	Reserve		
	6	Reserve		
	7	Not accepted	0	Device accepted
			1	Device not accepted.

31972098/EN – 8/2024

Byte	Bit	Name	Value	Description
2	0	Reserve		
	1	Reserve		
	2	SSX1	0	SSx1 not active or limit value violation/fault.
			1	SSx1 is active.
	3	SSX2	0	SSx2 not active or limit value violation/fault.
			1	SSx2 is active.
	4	Reserve		
	5	Reserve		
	6	Reserve		
	7	Reserve		
3	0	Reserve		
	1	Reserve		
	2	Reserve		
	3	Reserve		
	4	Reserve		
	5	Reserve		
	6	Reserve		
	7	Reserve		

CSB31A profile variant "Technology"

Process output data

Byte	Bit	Name	Value	Description
0	0	STO	0	Activate STO.
			1	Deactivate STO.
	1	Reserve		
	2	Reserve		
	3	Reserve		
	4	Reserve		
	5	Reserve		
	6	Enable F-DI	0	No acknowledgment.
			1	Acknowledgment of latched F-DI (0 → 1 edge).
	7	Fault ac-knowl-edgment	0	No acknowledgment.
			1	Fault acknowledgment (0 → 1 edge).

31972098/EN – 8/2024

Byte	Bit	Name	Value	Description
1	0	F-DO00	0	Disable F-DO00 output (open).
			1	Enable F-DO00 output (close).
	1	F-DO01	0	Disable F-DO01 output (open).
			1	Enable F-DO01 output (close).
	2	Reserve		
	3	Reserve		
	4	Reserve		
	5	Reserve		
	6	Reserve		
	7	Reserve		
2	0	Reserve		
	1	Reserve		
	2	SSx1	0	Activate SSx1.
			1	Deactivate SSx1.
	3	SSx2	0	Activate SSx2.
			1	Deactivate SSx2.
	4	Reserve		
	5	Reserve		
	6	Reserve		
	7	Reserve		

31972098/EN – 8/2024

Process input data

Byte	Bit	Name	Value	Description
0	0	STO	0	STO is not active. Safe disconnection of the drive is not active.
			1	STO signals "STO active" status. All outputs parameterized to STO are disabled.
	1	Reserve		
	2	Reserve		
	3	Input data valid	0	At least one of the F-DI process values sends a substitute value.
			1	All process values of the F-DI contain actual values.
	4	Reserve		
	5	Reserve		
	6	Warning	0	The safety option is in fault-free operation.
			1	At least one warning in the safety option is active.
	7	Fault status	0	The safety option is in fault-free operation.
			1	At least one fault in the safety option is active.
1	0	F-DI00	0	F-DI00 process value: "low" or fault.
			1	F-DI00 process value: "high".
	1	F-DI01	0	F-DI01 process value: "low" or fault.
			1	F-DI01 process value: "high".
	2	F-DI02	0	F-DI02 process value: "low" or fault.
			1	F-DI02 process value: "high".
	3	F-DI03	0	F-DI03 process value: "low" or fault.
			1	F-DI03 process value: "high".
	4	Reserve		
	5	Reserve		
	6	Reserve		
	7	Not accepted	0	Device accepted.
			1	Device not accepted.

31972098/EN – 8/2024

Byte	Bit	Name	Value	Description
2	0	Reserve		
	1	EDM	0	No fault detected.
			1	Fault detected on at least one of the outputs assigned to the EDM function.
	2	SSx1	0	SSx1 not active or limit value violation/fault.
			1	SSx1 is active.
	3	SSx2	0	SSx2 not active or limit value violation/fault.
			1	SSx2 is active.
	4	Reserve		
	5	Reserve		
	6	Reserve		
	7	Reserve		
3	0	Reserve		
	1	Reserve		
	2	Reserve		
	3	Reserve		
	4	Reserve		
	5	Reserve		
	6	Reserve		
	7	Reserve		

31972098/EN – 8/2024

CSS21A/CSS31A profile variant "Technology"

Process output data

Byte	Bit	Name	Value	Description
0	0	STO	0	Activate STO.
			1	Deactivate STO.
	1	SLI increment enable	0	Increment motion inhibited.
			1	Enable of an increment. In the case of edge 0 → 1, the current position value is saved as a reference value.
	2	SBT clearance[1)]	0	Brake test selection inhibited.
			1	Brake test selection possible.
	3	Reserve		
	4	Muting	0	Deactivate encoder fault muting.
			1	Activate encoder fault muting.
	5	Test mode active	0	Deactivate test mode.
			1	Activate test mode.
	6	Unlatch F-DI	0	No acknowledgment.
			1	Acknowledgment of latched F-DI (0 → 1 edge).
	7	Fault acknowledgment	0	No acknowledgment.
			1	Fault acknowledgment (0 → 1 edge).
1	0	F-DO00	0	Disable F-DO00 output (open).
			1	Enable F-DO00 output (close).
	1	F-DO01	0	Disable F-DO01 output (open).
			1	Enable F-DO01 output (close).
	2	Reserve		
	3	Reserve		
	4	Reserve		
	5	Reserve		
	6	Reserve		
	7	Reserve		

31972098/EN – 8/2024

Byte	Bit	Name	Value	Description
2	0	SOS	0	Activate SOS.
			1	Deactivate SOS.
	1	Reserve		
	2	SSx1	0	Activate SSx1.
			1	Deactivate SSx1.
	3	SSx2	0	Activate SSx2.
			1	Deactivate SSx2.
	4	SDI1	0	Activate SDI1.
			1	Deactivate SDI1.
	5	SDI2	0	Activate SDI2.
			1	Deactivate SDI2.
	6	SLI1	0	Activate SLI1.
			1	Deactivate SLI1.
	7	SLI2	0	Activate SLI2.
			1	Deactivate SLI2.
3	0	SLS1	0	Activate SLS1.
			1	Deactivate SLS1.
	1	SLS2	0	Activate SLS2.
			1	Deactivate SLS2.
	2	SLS3	0	Activate SLS3.
			1	Deactivate SLS3.
	3	SLS4	0	Activate SLS4.
			1	Deactivate SLS4.
	4	SSR1	0	Activate SSR1.
			1	Deactivate SSR1.
	5	SSR2	0	Activate SSR2.
			1	Deactivate SSR2.
	6	Reserve		
	7	Reserve		

31972098/EN – 8/2024

Byte	Bit	Name	Value	Description
4	0	SLA1	0	Activate SLA1.
			1	Deactivate SLA1.
	1	SLA2	0	Activate SLA2.
			1	Deactivate SLA2.
	2	Reserve		
	3	Reserve		
	4	Reserve		
	5	Reserve		
	6	Reserve		
	7	Reserve		

1) Permission level "internal" is required for the SBT function.

Process input data

Byte	Bit	Name	Value	Description
0	0	STO	0	STO is not active. Safe disconnection is not active.
			1	STO signals "STO active" status. All outputs parameterized to STO are disabled.
	1	Drive safety functions diagnostics	0	No safety sub-function has detected a limit value violation.
			1	At least one selected safety sub-function has detected a limit value violation or cannot execute limit value monitoring as a consequential error.
	2	SBT active	0	Brake test not active.
			1	Brake test is active.
	3	Input data valid	0	At least one of the F-DI process values sends a substitute value.
			1	All process values of the F-DI contain actual values.
	4	Muting	0	The encoder fault muting function is not active, or an error has occurred.
			1	The encoder fault muting function is active.
	5	Test mode active	0	Test mode of safety sub-functions is not active.
			1	Test mode of safety sub-functions is active.
	6	Warning	0	The safety option is in fault-free operation.
			1	At least one warning in the safety option is active.
	7	Fault status	0	The safety option is in fault-free operation.
			1	At least one fault in the safety option.

31972098/EN – 8/2024

Byte	Bit	Name	Value	Description
1	0	F-DI00	0	F-DI00 process value: "low" or fault.
			1	F-DI00 process value: "high".
	1	F-DI01	0	F-DI01 process value: "low" or fault.
			1	F-DI01 process value: "high".
	2	F-DI02	0	F-DI02 process value: "low" or fault.
			1	F-DI02 process value: "high".
	3	F-DI03	0	F-DI03 process value: "low" or fault.
			1	F-DI03 process value: "high".
	4	Reserve		
	5	Reserve		
	6	Reserve		
	7	Not accepted	0	Device accepted.
			1	Device not accepted.
2	0	SOS	0	SOS not active or limit value violation/fault.
			1	SOS is active.
	1	EDM	0	Fault detected on at least one of the outputs assigned to the EDM function.
			1	No fault detected.
	2	SSx1	0	SSx1 not active or limit value violation/fault.
			1	SSx1 is active.
	3	SSx2	0	SSx2 not active or limit value violation/fault.
			1	SSx2 is active.
	4	SDI1	0	SDI1 not active or limit value violation/fault.
			1	SDI1 is active.
	5	SDI2	0	SDI2 not active or limit value violation/fault.
			1	SDI2 is active.
	6	SLI1	0	SLI1 not active or limit value violation/fault.
			1	SLI1 is active.
	7	SLI2	0	SLI2 not active or limit value violation/fault.
			1	SLI2 is active.

31972098/EN – 8/2024

Byte	Bit	Name	Value	Description
3	0	SLS1	0	SLS1 not active or limit value violation/fault.
			1	SLS1 is active.
	1	SLS2	0	SLS2 not active or limit value violation/fault.
			1	SLS2 is active.
	2	SLS3	0	SLS3 not active or limit value violation/fault.
			1	SLS3 is active.
	3	SLS4	0	SLS4 not active or limit value violation/fault.
			1	SLS4 is active.
	4	SSR1	0	SSR1 not active or limit value violation/fault.
			1	SSR1 is active.
	5	SSR2	0	SSR2 not active or limit value violation/fault.
			1	SSR2 is active.
	6	Reserve		
	7	Reserve		
4	0	SLA1	0	SLA1 not active or limit value violation/fault.
			1	SLA1 is active.
	1	SLA2	0	SLA2 not active or limit value violation/fault.
			1	SLA2 is active.
	2	SSM1	0	SSM1 not active or limit value violation/fault.
			1	SSM1 is active.
	3	SSM2	0	SSM2 not active or limit value violation/fault.
			1	SSM2 is active.
	4	SSM3	0	SSM3 not active or limit value violation/fault.
			1	SSM3 is active.
	5	SSM4	0	SSM4 not active or limit value violation/fault.
			1	SSM4 is active.
	6	Reserve		
	7	Reserve		

31972098/EN – 8/2024

Byte	Bit	Name	Value	Description
5	0	Reserve		
	1	Reserve		
	2	Reserve		
	3	Reserve		
	4	Reserve		
	5	Reserve		
	6	Qualifier actual value process 1	0	Process value 1 is not valid or not in use
			1	Process value 1 is valid
	7	Qualifier actual value process 2	0	Process value 2 is not valid or not in use
			1	Process value 2 is valid

CSS21A/CSS31A profile variant "System"

With the "System" profile variant, a 16-bit value and a 32-bit value are transmitted in addition to the bits described in the "Technology" profile variant.

The following values can be selected for the process value 2 (32-bit):

- Speed
- Rotational speed

The speed, rotational speed, and position values are processed in the CSS21A and CSS31A safety options as 32-bit values.

The speed value also includes the parameterized decimal places. Example of a speed with 2 decimal places: v = 1234.56 mm/s. The internal numerical value is 123456. This means that there is a "1" in the high word and "57920" in the low word.

The validity for the set process values ("Process value 1" and "Process value 2") is signaled via the "Actual process value 1 qualifier" or "Actual process value 2 qualifier" bits.

The "Qualifier" bit is always "0" if an "Actual process value" is set to "Not used".

31972098/EN – 8/2024

CSA31A profile variant "Technology"

Process output data

Byte	Bit	Name	Value	Description
0	0	STO	0	Activate STO.
			1	Deactivate STO.
	1	SLI increment enable	0	Increment motion inhibited.
			1	Enable of an increment. In the case of edge 0 → 1, the current position value is saved as a reference value.
	2	SBT clearance	0	Brake test selection inhibited.
			1	Brake test selection possible.
	3	Reserve		
	4	Muting	0	Deactivate encoder fault muting.
			1	Activate encoder fault muting.
	5	Test mode active	0	Deactivate test mode.
			1	Activate test mode.
	6	Unlatch F-DI	0	No acknowledgment.
			1	Acknowledgment of latched F-DI (0 → 1 edge).
	7	Fault acknowledgment	0	No acknowledgment.
			1	Fault acknowledgment (0 → 1 edge).
1	0	F-DO00	0	Disable F-DO00 output (open).
			1	Enable F-DO00 output (close).
	1	F-DO01	0	Disable F-DO01 output (open).
			1	Enable F-DO01 output (close).
	2	Reserve		
	3	Reserve		
	4	Reserve		
	5	Reserve		
	6	Reserve		
	7	Reserve		

31972098/EN – 8/2024

Byte	Bit	Name	Value	Description
2	0	SOS1	0	Activate SOS.
			1	Deactivate SOS.
	1	Cam, slip adjust-ment	0	Cam actuated.
			1	Cam not actuated.
	2	SSX1	0	Activate SSx1.
			1	Deactivate SSx1.
	3	SSX2	0	Activate SSx2.
			1	Deactivate SSx2.
	4	SDI1	0	Activate SDI1.
			1	Deactivate SDI1.
	5	SDI2	0	Activate SDI2.
			1	Deactivate SDI2.
	6	SLI1	0	Activate SLI1.
			1	Deactivate SLI1.
	7	SLI2	0	Activate SLI2.
			1	Deactivate SLI2.
3	0	SLS1	0	Activate SLS1.
			1	Deactivate SLS1.
	1	SLS2	0	Activate SLS2.
			1	Deactivate SLS2.
	2	SLS3	0	Activate SLS3.
			1	Deactivate SLS3.
	3	SLS4	0	Activate SLS4.
			1	Deactivate SLS4.
	4	SSR1	0	Activate SSR1.
			1	Deactivate SSR1.
	5	SSR2	0	Activate SSR2.
			1	Deactivate SSR2.
	6	SLP1	0	Activate SLP1.
			1	Deactivate SLP1.
	7	SLP2	0	Activate SLP2.
			1	Deactivate SLP2.

31972098/EN – 8/2024

Byte	Bit	Name	Value	Description
4	0	SLA1	0	Activate SLA1.
			1	Deactivate SLA1.
	1	SLA2	0	Activate SLA2.
			1	Deactivate SLA2.
	2	Reserve		
	3	SCA	0	Activate SCA1 – 16.
			1	Deactivate SCA1 – 16.
	4	Direct referencing selection	0	Deactivate direct referencing.
			1	Activate direct referencing.
	5	Execute direct referencing	0	Direct referencing is not performed.
			1	Direct referencing is performed.
	6	Activation reference travel	0	Deactivate reference travel.
			1	Activate reference travel.
	7	Reference cam	0	Reference cam actuated.
			1	Reference cam not actuated.

31972098/EN – 8/2024

Process input data

Byte	Bit	Name	Value	Description
0	0	STO	0	STO is not active. Safe disconnection is not active.
			1	STO signals "STO active" status. All outputs parameterized to STO are disabled.
	1	Drive safety function diagnostics (ASF)	0	No safety sub-function has detected a limit value violation.
			1	At least one selected safety sub-function has detected a limit value violation or cannot execute limit value monitoring as a consequential error.
	2	SBT active	0	Brake test not active.
			1	Brake test is active.
	3	Input data valid	0	At least one of the F-DI process values sends a substitute value.
			1	All process values of the F-DI contain actual values.
	4	Muting	0	The encoder fault muting function is not active, or an error has occurred.
			1	The encoder fault muting function is active.
	5	Test mode active	0	Test mode of safety sub-functions is not active.
			1	Test mode of safety sub-functions is active.
	6	Warning	0	The safety option is in fault-free operation.
			1	At least one warning in the safety option is active.
	7	Fault acknowledgment	0	The safety option is in fault-free operation.
			1	At least one fault in the safety option.
1	0	F-DI00	0	F-DI00 process value: "low" or fault.
			1	F-DI00 process value: "high".
	1	F-DI01	0	F-DI01 process value: "low" or fault.
			1	F-DI01 process value: "high".
	2	F-DI02	0	F-DI02 process value: "low" or fault.
			1	F-DI02 process value: "high".
	3	F-DI03	0	F-DI03 process value: "low" or fault.
			1	F-DI03 process value: "high".
	4	Reserve		
	5	Reserve		
	6	Reserve		
	7	Not accepted	0	Device accepted.
			1	Device not accepted.

Byte	Bit	Name	Value	Description
2	0	SOS	0	SOS not active or limit value violation/fault.
			1	SOS is active.
	1	EDM	0	Fault detected on at least one of the outputs assigned to the EDM function.
			1	No fault detected.
	2	SSx1	0	SSx1 not active or limit value violation/fault.
			1	SSx1 is active.
	3	SSx2	0	SSx2 not active or limit value violation/fault.
			1	SSx2 is active.
	4	SDI1	0	SDI1 not active or limit value violation/fault.
			1	SDI1 is active.
	5	SDI2	0	SDI2 not active or limit value violation/fault.
			1	SDI2 is active.
	6	SLI1	0	SLI1 not active or limit value violation/fault.
			1	SLI1 is active.
	7	SLI2	0	SLI2 not active or limit value violation/fault.
			1	SLI2 is active.
3	0	SLS1	0	SLS1 not active or limit value violation/fault.
			1	SLS1 is active.
	1	SLS2	0	SLS2 not active or limit value violation/fault.
			1	SLS2 is active.
	2	SLS3	0	SLS3 not active or limit value violation/fault.
			1	SLS3 is active.
	3	SLS4	0	SLS4 not active or limit value violation/fault.
			1	SLS4 is active.
	4	SSR1	0	SSR1 not active or limit value violation/fault.
			1	SSR1 is active.
	5	SSR2	0	SSR2 not active or limit value violation/fault.
			1	SSR2 is active.
	6	SLP1	0	SLP1 is active.
			1	SLP1 not active or limit value violation/fault.
	7	SLP2	0	SLP2 is active.
			1	SLP2 not active or limit value violation/fault.

31972098/EN – 8/2024

Byte	Bit	Name	Value	Description
4	0	SLA1	0	SLA1 not active or limit value violation/fault.
			1	SLA1 is active.
	1	SLA2	0	SLA2 not active or limit value violation/fault.
			1	SLA2 is active.
	2	SSM1	0	SSM1 not active or limit value violation/fault.
			1	SSM1 is active.
	3	SSM2	0	SSM2 not active or limit value violation/fault.
			1	SSM2 is active.
	4	SSM3	0	SSM3 not active or limit value violation/fault.
			1	SSM3 is active.
	5	SSM4	0	SSM4 not active or limit value violation/fault.
			1	SSM4 is active.
	6	Reserve		
	7	Reserve		
5	0	SCA1	0	SCA1 not active or limit value violation/fault.
			1	SCA1 is active.
	1	SCA2	0	SCA2 not active or limit value violation/fault.
			1	SCA2 is active.
	2	SCA3	0	SCA3 not active or limit value violation/fault.
			1	SCA3 is active.
	3	SCA4	0	SCA4 not active or limit value violation/fault.
			1	SCA4 is active.
	4	Referencing active	0	Referencing is not active.
			1	Referencing is active.
	5	Referenced	0	Not all encoders for determining the "position" process value are referenced.
			1	All encoders for determining the "position" process value are referenced.
	6	Qualifier actual value process 1	0	Process value 1 is not valid or not in use.
			1	Process value 1 is valid.
	7	Qualifier actual value process 2	0	Process value 2 is not valid or not in use.
			1	Process value 2 is valid.

CSA31A profile variant "System"

With the "System" profile variant, a 16-bit value and a 32-bit value are transmitted in addition to the bits described in the "Technology" profile variant.

Process value 1 (16 bits)

- Speed in user unit (high word)

- Speed in user unit (low word)
- Speed in user unit (saturated)
- Speed in system unit (high word)
- Speed in system unit (low word)
- Rotational speed in system unit (saturated)
- SCA status

  Bit 0 = SCA1, Bit 1 = SCA2, ... Bit 15 = SCA16. For a description of the bit values, see table byte 5, bit 0 – 3.
- Position in user unit (high word)
- Position in user unit (low word)
- Position in user unit (saturated)
- Speed in user unit (scaled)
- Position in user unit (scaled)
- Rotational speed in system unit (scaled)

Process value 2 (32 bits)

- Position in user unit
- Speed in user unit
- Rotational speed in system unit
- Raw position value encoder 1
- Raw position value encoder 2
- Raw position value encoder 3

INFORMATION

The raw position values correspond to the position values sent by the encoders to the safety option for safety-related evaluation.

The speed, rotational speed, and position values are processed in the CSA31A safety option as 32-bit values.

The position and speed value also includes the parameterized decimal places. Example of a speed with 2 decimal places: v = 1234.56 mm/s. The internal numerical value is 123456. This means that there is a 1 in the high word and 57920 in the low word.

For the speed to be displayed in the low word, the speed with one decimal place must not exceed the value +/- 3276.7 in user units. If the number range of the low word has an overflow, the value freezes at 32767. This state is referred to as "saturated".

The motor speed value is indicated in system units. The numerical value is shown in 1E 4 min-1.

The validity for the set process values ("Process value 1" and "Process value 2") is signaled via the "Actual process value 1 qualifier" or "Actual process value 2 qualifier" bits.

The "Qualifier" bit is always "0" if an "Actual process value" is set to "Not used".

The "Actual process value x qualifier" bit is not set to "0" because referencing with the "Position in user unit" parameterization has not taken place. The status of the referencing is transferred to the "Referenced" bit.

31972098/EN – 8/2024

6.8.5 Process input data (F-PI) substitute values

For all process data (F-PI) outgoing from the safety option, the value "0" is written as the substitute value. One exception is *Fault state*. For *Fault state*, the value "1" is written as the substitute value in the case of a fault-free protocol. In the case of a faulty F-protocol, the value "0" is written for *Fault State*.

6.8.6 Edge evaluation of F-DI process data

Observe the following points for edge evaluation of F-DI process data in the higher-level controller for safety-relevant functions:

- Only the 0 → 1 edge may be used. The 1 → 0 edge must not be used as it can occur at any time during the transition to the safe state, e.g. in the event of a detected fault or a line interruption.
- The higher-level controller may only evaluate the edge if the process data bit changes from 0 to 1 and the "Qualifier process data" is set to "OK" (logical 1) for both the value "0" of the process data bit and the value "1" of the process data bit. If it is set to "Fault" (logical 0), the edge must be ignored.
- It is ensured that all edges evaluated in the higher-level controller were actually present at the F-DI input terminal.
- What cannot be ensured is that all edges occurring at the F-DI input terminal are detected by the higher-level controller. This must be particularly observed in the event of a defect in the safety option or the cabling.

6.8.7 Response when canceling safe communication

If the "Safe communication fault response" is not activated during a failure of the safe process data communication, all process data bits will be overwritten and processed with the substitute value "0". This means that all enabled safety sub-functions (including the STO safety sub-function) will be activated. This can lead to an abrupt stop of the system.

With activated "Safe communication fault response", the "SS1" fault response can be set and the corresponding SSx1 or SSx2 instance can be selected.

Before first establishment of the safe process data communication, all process data bits are set to the substitute value "0". After the safe process data communication is established and fails again, the process data bit of the set SSx instance will be set to "0". The additional process data bits of the STO, SOS, SDI, SLI, SLS, SSR, SLP, SLA, and SCA function retain the last value. All other process data bits are set to "0". After the SSx ramp has reached the final state of the STO function, all process data bits will be set to "0".

If "Safe communication fault response" is activated, in the event of a failure of the communication, the response time until the activation of the STO safety sub-function will be extended by the times of the parameterized SSx instance.

INFORMATION

If the F-DO function selection is set to "none", the outputs are disabled (logically "0").

If the F-DO function selection is set to "STO" or "SBC", the opening of the outputs is delayed by the activated function after the SSx ramp.

6.9 Response times

The response time plays a decisive role in the design and implementation of safety sub-functions for systems and machines. In order to match the response time to the requirements of a safety sub-function, the entire system from the sensor (or command device) to the actuator must always be taken into consideration. The following times are of particular importance in connection with the MOVISAFE® CS..A safety option:

- Response time of the connected sensors
- Safe communication cycle time
- Processing time (cycle time) in the safety controller
- Safe communication monitoring time
- Internal response times of the MOVISAFE® CS..A safety option
- Response time of the actuators (e.g. frequency inverters)

Establish the response sequence for each safety sub-function in your application and determine the maximum response time for each case, taking the relevant manufacturer data into consideration. It is particularly important to observe the information in the documentation of the used components.

Details of the maximum response time of the MOVISAFE® CS..A safety option can be found in chapter "Technical data". For detailed information regarding response time consideration for safe PROFIsafe communication, refer to the respective IEC 61784-3-3 standard.

6.9.1 Response times of the STO safety sub-function

The following response times are fixed:

	STO response times	
	Typical	Maximum
Duration from activation of the STO safety sub-function to the shutdown of the rotating field	1.5 ms	10 ms 2 ms[1)]
Duration from deactivation of the STO safety sub-function to the enabling of the rotating field	–	110 ms

1) Only when STO is being used and controlled via a MOVISAFE® CS..A safety option

6.9.2 Calculation of the response times of the CS..A safety options

Fixed response times

The following response times are fixed:

- $T_{_Sys}$ = 4 ms (cycle time of the system)
- $T_{_Task}$ = 0.5 ms (cycle time of a process)
- Maximum fault response time $T_{_FRZ}$ = 9 ms applies to the deactivation of the internal output F-DO_STO and the external safe digital outputs F-DO.. and to setting the fault status of the safe process input data (F-PI).
- The response times of the safety options in relation to the safe digital outputs (F-DO) apply for ohmic loads ≤30 kΩ.

31972098/EN – 8/2024

INFORMATION

Ensure that all the values are scaled to a consistent unit basis when setting the parameter values in the formulas.

31972098/EN – 8/2024

Encoder

All response times must be multiplied by the factor 1.002.

Encoder error response time (for all encoders)

Calculation factor (formula symbol)	Calculation specification response time
Deactivation F-DO_STO/F-DOx	8 ms
Setting fault status F-PI	12 ms

Sin/cos encoder

Calculation factor (formula symbol)	Calculation specification response time
Processing time encoder positioning ($T_{_ENC_POS}$)	$T_{_Sys} + T_{_Task}$
Processing time encoder speed ($T_{_ENC_VEL}$)	Filter time speed (8708.3) + $T_{_Task} + T_{_Sys}$
Processing time encoder acceleration ($T_{_ENC_ACC}$)	Filter time acceleration (8708.2) + 2 × $T_{_Task} + T_{_Sys}$

EI7C built-in encoder

Calculation factor (formula symbol)	Calculation specification response time
Processing time encoder positioning ($T_{_ENC_POS}$)	$T_{_Sys} + T_{_Task}$
Processing time encoder speed ($T_{_ENC_VEL}$)	3.5 × $1/n_{_Actual} + T_{_Task} + T_{_Sys}$ + Filter time speed (8708.4)

SSI encoder

Calculation factor (formula symbol)	Calculation specification response time
Processing time encoder positioning ($T_{_ENC_POS}$)	T_{ENC_POS} = SSI frame rate × (SSI fault tolerance - SSI encoder (8713.51) + 1) + 9 × $T_{_Task}$
Processing time encoder speed without update time ($T_{_ENC_VEL}$)	T_{ENC_VEL} = SSI frame rate × (SSI fault tolerance + 2) + filter time speed (8708.3) + 9 × $T_{_Task}$
Processing time encoder acceleration without update time ($T_{_ENC_ACC}$)	T_{ENC_ACC} = SSI frame rate × (SSI fault tolerance + 3) + filter time acceleration (8708.2) + 9 × $T_{_Task}$
Processing time encoder speed with update time > 0 ($T_{_ENC_VEL}$)	T_{ENC_VEL} = SSI frame rate × [round up (SSI refresh time + jitter / SSI frame rate) -1] + SSI frame rate × round up (filter time speed (8708.3) + SSI refresh time + jitter) / SSI frame rate + SSI frame rate × (SSI fault tolerance +1) + filter time speed (8708.3) + 9 × T_{Task}

31972098/EN – 8/2024

Calculation factor (formula symbol)	Calculation specification response time
Processing time encoder acceleration with update time > 0 ($T_{_ENC_ACC}$)	T_{ENC_ACC} = SSI frame rate × [round up (SSI refresh time + jitter / SSI frame rate) -1] + 2 × SSI frame rate × round up [(0.5 × filter time acceleration (8708.2) + SSI refresh time + jitter) / SSI frame rate) + SSI frame rate × (SSI fault tolerance +1) + filter time acceleration (8708.2) + 9 × T_{Task}
	Encoder 2: • SSI frame rate = frame rate (8713.52) • SSI fault tolerance = number of tolerated faults (8713.51) • SSI refresh time = update time (8382.29) Encoder 3: • SSI frame rate = 1 ms • SSI fault tolerance = number of tolerated faults (8714.51) • SSI refresh time = update time (8599.29) Jitter: 500 µs

Encoder with MOVILINK® DDI

Calculation factor (formula symbol)	Calculation specification response time
Processing time encoder positioning ($T_{_ENC_POS}$)	T_{ENC_POS} = 9 ms
Processing time encoder speed ($T_{_ENC_VEL}$)	T_{ENC_VEL} = 9 ms + speed filter time (8708.3)
Processing time encoder acceleration ($T_{_ENC_ACC}$)	T_{ENC_ACC} = 9 ms + acceleration filter time (8708.2)
Processing time of encoder system positioning ($T_{_ENC_POS_COMBINED}$)	• The following applies to a 1-encoder system: $T_{ENC_POS_COMBINED} = T_{ENC_POS}$ • For encoder systems in which the position value is calculated from the values of 2 encoders: $T_{ENC_POS_COMBINED}$ = MAX (T_{ENC_POS} (encoder A), T_{ENC_POS} (encoder B))
Processing time of encoder system speed ($T_{_ENC_VEL_COMBINED}$)	• The following applies to a 1-encoder system: $T_{ENC_VEL_COMBINED} = T_{ENC_VEL}$ • For encoder systems in which the speed value is calculated from the values of 2 encoders: $T_{ENC_VEL_COMBINED}$ = MAX (T_{ENC_VEL} (encoder A), T_{ENC_VEL} (encoder B))
Processing time of encoder system acceleration ($T_{_ENC_ACC_COMBINED}$)	• The following applies to a 1-encoder system: $T_{ENC_ACC_COMBINED} = T_{ENC_ACC}$ • For encoder systems in which the acceleration value is calculated from the values of 2 encoders: $T_{ENC_ACC_COMBINED}$ = MAX (T_{ENC_ACC} (encoder A), T_{ENC_ACC} (encoder B))

Safe digital input F-DI

All response times must be multiplied by the factor 1.002.

Calculation factor (formula symbol)	Calculation specification response time
Input processing time with F-DI selection ($T_{_InputProcessing_F\text{-}DI}$)	Input filter time (8704.2) + 2 ms + $T_{_Sys}$ + 350 µs
Input processing with F-DI deselection: ($T_{_InputProcessing_F\text{-}DI_Deselection}$)	
• Single-channel	Input filter time (8704.2) + 51 ms + $T_{_Sys}$ + 350 µs
• Dual-channel	Input filter time (8704.2) + 2 ms + $T_{_Sys}$ + 350 µs
Response time of line diagnostics	30 ms (the response times of the safety sub-functions are not taken into consideration)

Safe communication

The response times for the safe communication always relate to the safe protocol and not to the external interface of the safety option. All response times must be multiplied by the factor 1.002.

Calculation factor (formula symbol)	Calculation specification response time
Input processing time via safe process output data ($T_{_InputProcessing_F\text{-}PO}$)	2 × $T_{_Task}$ + $T_{_Sys}$
Response time selection (F-DIx after F-PI)	$T_{_InputProcessing_F\text{-}DIx}$ + T_{Sys}
Response time (F-PO after F-DOx)	$T_{_InputProcessing_F\text{-}PO}$ + T_{Sys}
Response time (safe position (SP) after F-PI)	$T_{_ENC_POS_COMBINED}$ + T_{Sys}
Response time (safe speed (SV) after F-PI)	$T_{_ENC_VEL_COMBINED}$ + T_{Sys}

Selection of a safety sub-function via safe digital input

All response times must be multiplied by the factor 1.002.

Calculation factor	Calculation specification response time
STO	$T_{_InputProcessing_F\text{-}DI}$ + $T_{_Sys}$
SOS	$T_{_InputProcessing_F\text{-}DI}$ + $T_{_Sys}$
SS1-r	$T_{_InputProcessing_F\text{-}DI}$ + $T_{_Sys}$ + SSx-r monitoring delay t_2 (8706.9) + brake application time[1] (8706.15) + actual_speed/SSx-r deceleration a (8706.10) + SSx-r jerk time[2] t_3 (8706.11)
SS2-r	$T_{_InputProcessing_F\text{-}DI}$ + $T_{_Sys}$ + SSx-r monitoring delay t_2 (8706.9) + actual_speed/SSx-r deceleration a (8706.10) + SSx-r jerk time t_3[2] (8706.11)
SS1-t	$T_{_InputProcessing_F\text{-}DI}$ + $T_{_Sys}$ + SSx-t deceleration t_1 (8706.8) + brake application time[3] (8706.15)
SS2-t	$T_{_InputProcessing_F\text{-}DI}$ + $T_{_Sys}$ + SSx-t delay t_1 (8706.8)

31972098/EN – 8/2024

Calculation factor	Calculation specification response time
SSx-r with SLI	$T_{_InputProcessing_F\text{-}DI}$ + $T_{_Sys}$ + SSx-r monitoring delay t_2 (8706.9) + actual_speed/SSx-r deceleration a (8706.10) + SSx-r jerk time t_3[2] (8706.11)
SSx-t with SLI	$T_{_InputProcessing_F\text{-}DI}$ + $T_{_Sys}$ + SSx-t delay t_1 (8706.8)
SLS	$T_{_InputProcessing_F\text{-}DI}$ + $T_{_Sys}$ + SSx-r monitoring delay t_2 (8706.23) + $v_{_Start}$/SSx-r delay a (8706.27) + SSx-r jerk time t_3[4] (8706.28) • SLS ramp start at actual speed = 0 $v_{_Start}$ = maximum speed (8707.1) - limit speed (8706.24) • SLS ramp start at actual speed = 1 and ramp monitoring = linear $v_{_Start}$ = actual speed - limit speed (8706.24) • SLS ramp start at actual speed = 1 and ramp monitoring = jerk-limited $v_{_Start}$ = actual speed + SLS speed offset v (8706.36) - limit speed (8706.24)
SLS via SCA	$T_{ENC_POS_COMBINED}$ + $T_{_Sys}$ + SSx-r monitoring delay t_2 (8706.23) + $v_{_Start}$/SSx-r deceleration a (8706.27) + SSx-r jerk time t_3[2] (8706.28) • SLS ramp start at actual speed = 0 $v_{_Start}$ = maximum speed (8707.1) - limit speed (8706.24) • SLS ramp start at actual speed = 1 and ramp monitoring = linear $v_{_Start}$ = actual speed - limit speed (8706.24) • SLS ramp start at actual speed = 1 and ramp monitoring = jerk-limited $v_{_Start}$ = actual speed + SLS speed offset v (8706.36) - limit speed (8706.24)
SSR	$T_{_InputProcessing_F\text{-}DI}$ + $T_{_Sys}$ + monitoring delay t_2 (8706.53)
SDI	$T_{_InputProcessing_F\text{-}DI}$ + $T_{_Sys}$
SLI	$T_{_InputProcessing_F\text{-}DI}$ + $T_{_Sys}$
SLA	$T_{_InputProcessing_F\text{-}DI}$ + $T_{_Sys}$ + monitoring delay t_2 (8706.76)
SLP	$T_{_InputProcessing_F\text{-}DI}$ + $T_{_Sys}$

1) If SBC enable (8706.14) = no, then the brake application time = 0
2) If ramp monitoring = linear, then jerk time = 0
3) If SBC enable (8706.14) = no, then brake application time = 0
4) If ramp monitoring = linear, then the jerk time = 0

The information that a safety sub-function was activated via a safe digital input is available on the safe process data 4 ms after activation.

Selection of a safety sub-function via safe communication

The response times for the safe communication always relate to the safe protocol and not to the external interface of the safety option. All response times must be multiplied by the factor 1.002.

Calculation factor	Calculation specification response time
STO	$T_{_InputProcessing_F\text{-}PO} + 2 \times T_{_Sys}$
SOS	$T_{_InputProcessing_F\text{-}PA} + T_{_Sys}$
SS1-r	$T_{_InputProcessing_F\text{-}PA} + 2 \times T_{_Sys}$ + SSx-r monitoring delay t_2 (8706.9) + brake application time[1] (8706.15) + actual_speed (8700.79)/ SSx-r deceleration a (8706.10) + SSx-r jerk time[2] t_3 (8706.11)
SS2-r	$T_{_InputProcessing_F\text{-}PA} + 2 \times T_{_Sys}$ + SSx-r monitoring delay t_2 (8706.9) + Brake application time[1] (8706.15) + Actual_speed (8700.79)/SSx-r deceleration a (8706.10) + SSx-r jerk time t_3[2] (8706.11)
SS1-t	$T_{_InputProcessing_F\text{-}PA} + 2 \times T_{_Sys}$ + SSx-t delay t_1 (8706.8) + brake application time [3] (8706.15)
SS2-t	$T_{_InputProcessing_F\text{-}PO} + T_{_Sys}$ + SSx-t delay t_1 (8706.8)
SSx-r with final state SLI	$T_{_InputProcessing_F\text{-}PA} + 2 \times T_{_Sys}$ + SSx-r monitoring delay t_2 (8706.9) + brake application time[1] (8706.15) + actual_speed (8700.79)/ SSx-r deceleration a (8706.10) + SSx-r jerk time t_3[2] (8706.11)
SSx-t with final state SLI	$T_{_InputProcessing_F\text{-}PA} + 2 \times T_{_Sys}$ + SSx-t delay t_1 (8706.8) + brake application time [3] (8706.15)
SLS	$T_{_InputProcessing_F\text{-}PA} + T_{_Sys}$ + SSx-r monitoring delay t_2 (8706.23) + $v_{_Start}$/SSx-r deceleration a (8706.27) + SSx-r jerk time t_3[2] (8706.28) • SLS ramp start at actual speed = 0 $v_{_Start}$ = maximum speed[4] - limit speed (8706.24) • SLS ramp start at actual speed = 1 and ramp monitoring = linear $v_{_Start}$ = actual speed - limit speed (8706.24) • SLS ramp start at actual speed = 1 and ramp monitoring = jerk-limited $v_{_Start}$ = actual speed + SLS speed offset v (8706.36) - limit speed (8706.24)
SLS via SCA	$T_{ENC_POS_COMBINED} + T_{_Sys}$ + SSx-r monitoring delay t_2 (8706.23) + $v_{_Start}$/deceleration a (8706.27) + SSx-r jerk time t_3[2] (8706.28) • SLS ramp start at actual speed = 0 $v_{_Start}$ = maximum speed[3]- limit speed (8706.24) • SLS ramp start at actual speed = 1 $v_{_Start}$ = actual speed - limit speed (8706.24)
SSM	$T_{_InputProcessing_F\text{-}PA} + T_{_Sys}$
SSR	$T_{_InputProcessing_F\text{-}PO} + T_{_Sys}$ + monitoring delay t_2 (8706.53)
SDI	$T_{_InputProcessing_F\text{-}PO} + T_{_Sys}$
SLI	$T_{_InputProcessing_F\text{-}PO} + 2 \times T_{_Sys}$
SLA	$T_{_InputProcessing_F\text{-}PO} + T_{_Sys}$ + monitoring delay (8706.76)

31972098/EN – 8/2024

Calculation factor	Calculation specification response time
SLP	$T_{_InputProcessing_F\text{-}PA} + T_{_Sys}$
SCA	$T_{_InputProcessing_F\text{-}PA} + T_{_Sys}$

1) If SBC enable (8706.14) = no, then the brake application time = 0
2) If ramp monitoring = linear, then jerk time = 0
3) If SBC enable (8706.14) = no, then brake application time = 0
4) Maximum speed (8707.1) or other SLS limit speed in the same effective direction

Response time for limit violation with active fault response

The response time describes the time from detection of the limit value violation to activation of the safe state (STO). All response times must be multiplied by the factor 1.002.

Calculation factor	Calculation specification response time
SOS	$T_{_ENC_POS_Combined} + T_{_Sys}$
SSx-r	$T_{_ENC_VEL_Combined} + T_{_Sys}$
SLS with parameterized fault response:	
• STO	$T_{_ENC_VEL_Combined} + T_{_Sys}$
• SS1-t	$T_{_ENC_VEL_Combined} + T_{_Sys}$ + SSx-t delay t_1 (8706.8) + Brake application time [1](8706.15)
• SS2-t	$T_{_ENC_VEL_Combined} + T_{_Sys}$ + SSx-t delay t_1 (8706.8)
• SS1-r	$T_{_ENC_VEL_Combined} + T_{_Sys}$ + SSx-r monitoring delay t_2 (8706.9) + Brake application time[2] (8706.15) + Actual_speed (8700.79)/ SSx-r deceleration a (8706.10) + SSx-r jerk time[3] t_3 (8706.11)
• SS2-r	$T_{_ENC_VEL} + T_{_Sys}$ + SSx-r delay t_2 (8706.9) + Actual_speed (8700.79)/SSx-r delay a (8706.10) + SSx-r jerk time t_3[4] (8706.11)
SSM	$T_{_ENC_VEL_Combined} + T_{_Sys}$
SSR with parameterized fault response:	
• STO	$T_{_ENC_VEL_Combined} + T_{_Sys}$
• SS1-t	$T_{_ENC_VEL_Combined} + T_{_Sys}$ + SSx-t delay t_1 (8706.8) + Brake application time [1] (8706.15)
• SS2-t	$T_{_ENC_VEL_Combined} + T_{_Sys}$ + SSx-t delay t_1 (8706.8)
• SS1-r	$T_{_ENC_VEL_Combined} + T_{_Sys}$ + SSx-r monitoring delay t_2 (8706.9) + Brake application time[2] (8706.15) + Actual_speed (8700.79)/ SSx-r deceleration a (8706.10) + SSx-r jerk time t_3[3](8706.11)
• SS2-r	$T_{_ENC_VEL_Combined} + T_{_Sys}$ + SSx-r delay t_2 (8706.9) + Actual_speed (8700.79)/SSx-r deceleration a (8706.10) + SSx-r jerk time t_3[3] (8706.11)
SDI	$T_{_ENC_POS_Combined} + T_{_Sys}$
SLI	$T_{_ENC_VEL_Combined} + T_{_Sys}$ For systems in which an encoder is responsible for the position and a 2nd encoder is responsible for the speed, the following applies: $T_{_ENC_VEL_Combined} + T_{ENC_POS_Combined} + T_{_Sys}$

Calculation factor	Calculation specification response time
SLA with parameterized fault response:	
• STO	$T_{_ENC_ACC_Combined} + T_{_Sys}$
• SS1-t	$T_{_ENC_ACC_Combined} + T_{_Sys}$ + SSx-t delay t_1 (8706.8) + Brake application time [1] (8706.15)
• SS2-t	$T_{_ENC_ACC_Combined} + T_{_Sys}$ + SSx-t delay t_1 (8706.8)
• SS1-r	$T_{_ENC_ACC_Combined} + T_{_Sys}$ + SSx-r monitoring delay t_2 (8706.9) + Brake application time[2] (8706.15) + Actual_speed (8700.79)/ SSx-r deceleration a (8706.10) + SSx-r jerk time t_3[3](8706.11)
• SS2-r	$T_{_ENC_ACC_Combined} + T_{_Sys}$ + SSx-r delay t_2 (8706.9) + Actual_speed (8700.79)/SSx-r deceleration a (8706.10) + SSx-r jerk time t_3[3] (8706.11)
SLP:	
• with ramp	$T_{_ENC_VEL_COMBINED} + T_{_ENC_POS_COMBINED} + T_{_Sys}$
• without ramp	$T_{_ENC_POS_COMBINED} + T_{_Sys}$

1) If SBC enable (8706.14) = no, then brake application time = 0
2) If SBC enable (8706.14) = no, then the brake application time = 0
3) If ramp monitoring = linear, then jerk time = 0
4) If ramp monitoring = linear, then the jerk time = 0

Response time when reporting the limit violation via safe communication

The response times for the safe communication always relate to the safe protocol and not to the external interface of the safety option. All response times must be multiplied by the factor 1.002.

Calculation factor	Calculation specification response time
SOS	$T_{_ENC_POS_Combined} + 2 \times T_{_Sys}$
SSx-r	$T_{_ENC_VEL_Combined} + 2 \times T_{_Sys}$
SLS with parameterized fault response:	
• STO	$T_{_ENC_VEL_Combined} + 2 \times T_{_Sys}$
• SS1-t	$T_{_ENC_VEL_Combined} + 2 \times T_{_Sys}$ + SSx-t delay t_1 (8706.8) + Brake application time[1](8706.15)
• SS2-t	$T_{_ENC_VEL_Combined} + T_{_Sys}$ + SSx-t delay t_1 (8706.8)
• SS1-r	$T_{_ENC_VEL_Combined} + 2 \times T_{_Sys}$ + SSx-r monitoring delay t_2 (8706.9) + Brake application time[2] (8706.15) + Actual_speed (8700.79)/SSx-r deceleration a (8706.10) + SSx-r jerk time t_3 [3] (8706.11)
• SS2-r	$T_{_ENC_VEL_Combined} + T_{_Sys}$ + SSx-r delay t_2 (8706.9) + Actual_speed (8700.79)/SSx-r deceleration a (8706.10) + SSx-r jerk time t_3[3] (8706.11)
SSM	$T_{_ENC_VEL_Combined} + T_{_Sys}$
SSR with parameterized fault response:	
• STO	$T_{_ENC_VEL_Combined} + 2 \times T_{_Sys}$
• SS1-t	$T_{_ENC_VEL_Combined} + 2 \times T_{_Sys}$ + SSx-t delay t_1 (8706.8) + Brake application time[1] (8706.15)

31972098/EN – 8/2024

Calculation factor	Calculation specification response time
• SS2-t	$T_{_ENC_VEL_Combined}$ + $T_{_Sys}$ + SSx-t delay t_1 (8706.8)
• SS1-r	$T_{_ENC_VEL_Combined}$ + 2 × $T_{_Sys}$ + SSx-r monitoring delay t_2 (8706.9) + Brake application time[2] (8706.15) + Actual_speed (8700.79)/SSx-r deceleration a (8706.10) + SSx-r jerk time t_3[3] (8706.11)
• SS2-r	$T_{_ENC_VEL_Combined}$ + $T_{_Sys}$ + SSx-r delay t_2 (8706.9) + Actual_speed (8700.79)/SSx-r deceleration a (8706.10) + SSx-r jerk time t_3[3] (8706.11)
• F-PI	$T_{_ENC_VEL_Combined}$ + $T_{_Sys}$
SDI	$T_{_ENC_POS_Combined}$ + 2 × $T_{_Sys}$
SLI	$T_{_ENC_VEL_Combined}$ + 2 × $T_{_Sys}$ For systems in which an encoder is responsible for the position and a 2nd encoder is responsible for the speed, the following applies: $T_{_ENC_VEL_Combined}$ + $T_{ENC_POS_Combined}$ + 2 × $T_{_Sys}$
SLA with parameterized fault response:	
• STO	$T_{_ENC_ACC_Combined}$ + 2 × $T_{_Sys}$
• SS1-t	$T_{_ENC_ACC_Combined}$ + 2 × $T_{_Sys}$ + SSx-t delay t_1 (8706.8) + Brake application time[1] (8706.15)
• SS2-t	$T_{_ENC_ACC_Combined}$ + $T_{_Sys}$ + SSx-t delay t_1 (8706.8)
• SS1-r	$T_{_ENC_ACC_Combined}$ + 2 × $T_{_Sys}$ + SSx-r monitoring delay t_2 (8706.9) + Brake application time[2] (8706.15) + Actual_speed (8700.79)/SSx-r delay a (8706.10) + SSx-r jerk time t_3[3] (8706.11)
• SS2-r	$T_{_ENC_ACC_Combined}$ + $T_{_Sys}$ + SSx-r delay t_2 (8706.9) + Actual_speed (8700.79)/SSx-r deceleration a (8706.10) + SSx-r jerk time t_3[3] (8706.11)
• F-PI	$T_{_ENC_ACC_Combined}$ + $T_{_Sys}$
SLP:	
• with ramp	$T_{_ENC_VEL_COMBINED}$ + $T_{_ENC_POS_COMBINED}$ + 2 × $T_{_Sys}$
• without ramp	$T_{_ENC_POS_COMBINED}$ + 2 × $T_{_Sys}$
SCA	$T_{_ENC_POS_COMBINED}$ + $T_{_Sys}$
F-ConnectionLoss response time:	
• SS1-t response	$T_{_Sys}$ + SSx-t delay t_1 (8706.8) + Brake application time [1] (8706.15)
• SS1-r response	$T_{_Sys}$ + SSx-r monitoring delay t_1 (8706.9) + Brake application time[2] (8706.15) + Actual_speed (8700.79)/SSx-r deceleration a (8706.10) + SSx-r jerk time t_3[3] (8706.11)

1) If SBC enable (8706.14) = no, then brake application time = 0
2) If SBC enable (8706.14) = no, then the brake application time = 0
3) If ramp monitoring = linear, then jerk time = 0

Deselection of a safety sub-function via safe communication

The response times for the safe communication always relate to the safe protocol and not to the external interface of the safety option. All response times must be multiplied by the factor 1.002.

Calculation factor (formula symbol)	Calculation specification response time
Response time ($T_{_InputProcessing_F\text{-}PO_Deselection}$)	$T_{_InputProcessing_F\text{-}PO}$ + 16 ms

EDM function response time

All response times must be multiplied by the factor 1.002.

Calculation factor	Calculation specification response time
Shut down affected F-DO	$T_{_InputProcessing_F\text{-}DI_Deselection}$ + Maximum (EDM pick-up delay (8705.32), EDM drop-out delay (8705.33)) + $T_{_Sys}$
Additional STO fault response	$T_{_InputProcessing_F\text{-}DI_Deselection}$ + Maximum (EDM pick-up delay (8705.32), EDM drop-out delay (8705.33)) + $T_{_Sys}$ + Brake application time[1] (8706.15)
Additional fault response STO and STO on F-PI	$T_{_InputProcessing_F\text{-}DI_Deselection}$ + Maximum (EDM pick-up delay (8705.32), EDM drop-out delay (8705.33)) + 2 × $T_{_Sys}$ + Brake application time[1] (8706.15)
Additional fault response SS1-t	$T_{_InputProcessing_F\text{-}DI_Deselection}$ + Maximum (EDM pick-up delay (8705.32), EDM drop-out delay (8705.33)) + $T_{_Sys}$ + SSx-t delay t1 (8706.8) + Brake application time[1] (8706.15)
Additional fault response SS1-t and STO bit on F-PI	$T_{_InputProcessing_F\text{-}DI_Deselection}$ + Maximum (EDM pick-up delay (8705.32), EDM drop-out delay (8705.33)) + 2 × $T_{_Sys}$ + SSx-t delay t1 (8706.8) + Brake application time[1] (8706.15)
Additional fault response SS1-r	$T_{_Inputprocessing_F\text{-}DI_Deselection}$ + Maximum (EDM pick-up delay (8705.32), EDM drop-out delay (8705.33)) + $T_{_Sys}$ + SSx-r monitoring delay t2 (8706.9) + Brake application time[1] (8706.15) + Actual_speed (8700.79)/SSx-r deceleration a (8706.10) + SSx-r jerk time[2] t3 (8706.11)
Additional fault response SS1-r and STO bit on F-PI	$T_{_InputProcessing_F\text{-}ID_Deselection}$ + Maximum (EDM pick-up delay (8705.32), EDM drop-out delay (8705.33)) +2 × $T_{_Sys}$ + SSx-r monitoring delay t2 (8706.9) + Brake application time[1] (8706.15) + Actual_speed (8700.79)/SSx-r deceleration a (8706.10) + SSx-r jerk time t_3[2] (8706.11)
Reporting the EDM fault via F-PI	$T_{_InputProcessing_F\text{-}DI_Deselection}$ + Maximum (EDM pick-up delay (8705.32), EDM drop-out delay (8705.33)) + $T_{_Sys}$

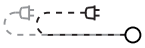
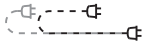
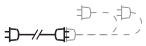
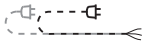
1) If SBC enable (8706.14) = no, then the brake application time = 0

2) If ramp monitoring = linear, then jerk time = 0

31972098/EN – 8/2024

7 Prefabricated cables

7.1 Meaning of the symbols

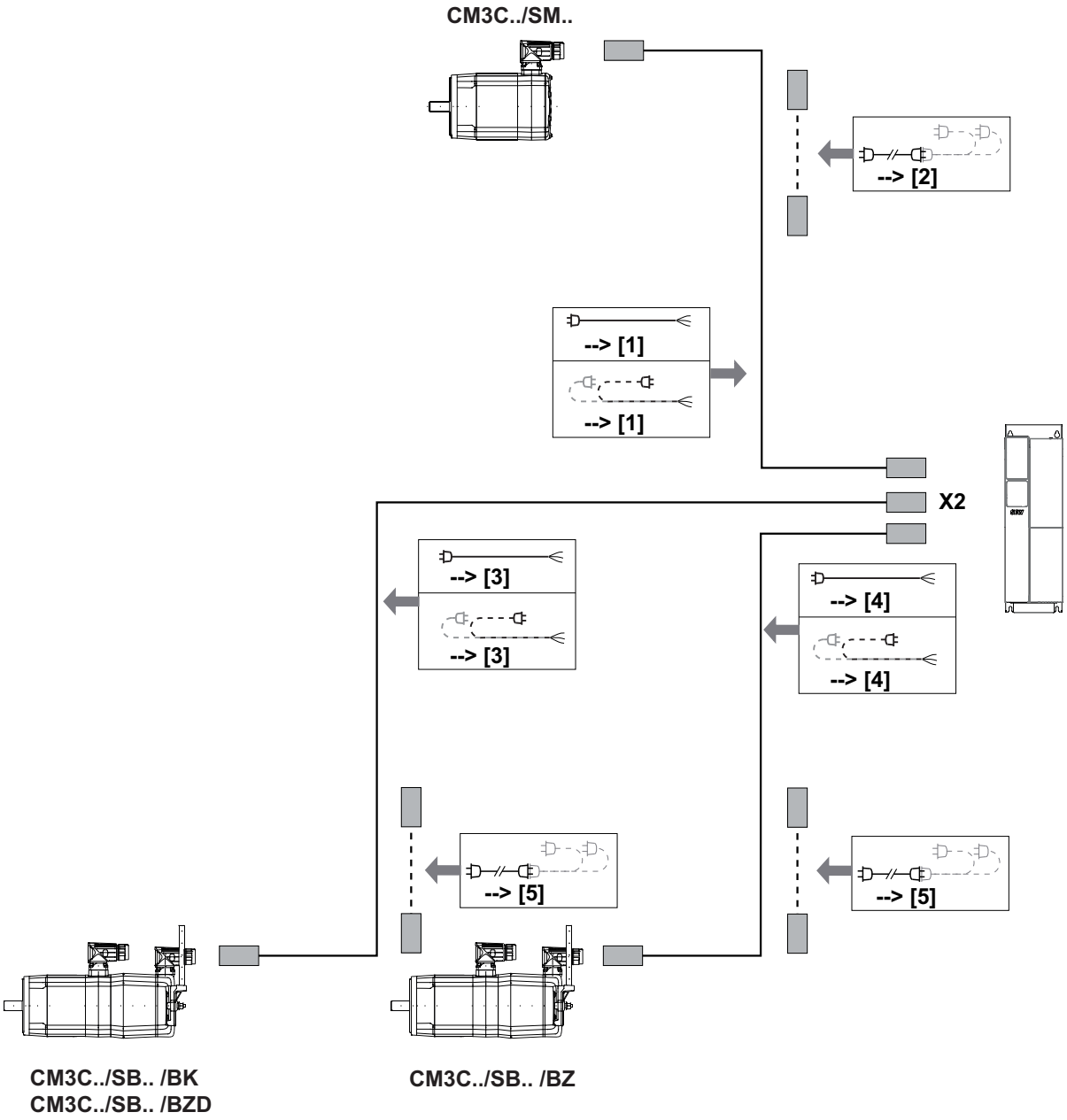
Symbol	Meaning
	Connection cable: Connector → connector for fixed installation
	Connection cable extension: Connector → connector for fixed installation
	Connection cable: Connector → encoder connection cover for fixed installation
	Connection cable: Connector → encoder connection cover for cable carrier installation
	Connection cable: Connector → connector for cable carrier installation
	Connection cable extension: Connector → connector for cable carrier installation
	Connection cable: Connector → open end for fixed installation
	Connection cable: Connector → open end for cable carrier installation

31972098/EN – 8/2024

7.2 Power cable

7.2.1 Power cables for CM3C.. motors

Overview

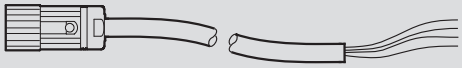


36028829899641867

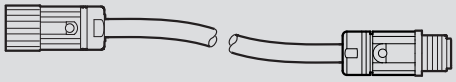
[1] "Motor cables ../SM.. " (→ 🗎 265)
[2] "Motor extension cable ../ SM.. " (→ 🗎 265)
[3] "Brakemotor cable ../SB.. for /BK and /BZD brakes " (→ 🗎 266)
[4] "Brakemotor cable ../SB.. for /BZ brakes " (→ 🗎 266)
[5] "Brakemotor extension cable ../SB.. for /BK, /BZD and /BZ brakes " (→ 🗎 267)

31972098/EN – 8/2024

Motor cables ../SM..

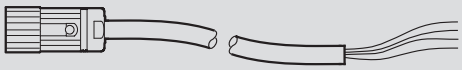
	Motor side / Inverter side				
				Fixed installation	Cable carrier installation
Cable type	**Connector type/ size**	**Cable cross section**	**Connector type/ size**	**Part number**	
Motor cable	SM1 / M23 SpeedTec	4 × 1.5 mm²	Open end	28125002	28125010
		4 × 2.5 mm²		28125029	28125037
		4 × 4 mm²		28125045	28125053
	SMB / M40 SpeedTec	4 × 6 mm²		28125061	28125088
		4 × 10 mm²		28125096	28125118
		4 × 16 mm²		28125126	28125134

Motor extension cables ../SM..

	Motor side / Inverter side				
				Fixed installation	Cable carrier installation
Cable type	**Connector type/ size**	**Cable cross section**	**Connector type/ size**	**Part number**	
Motor extension cable	SM1 / M23 SpeedTec	4 × 1.5 mm²	SM1 / M23 SpeedTec	–	28125142
		4 × 2.5 mm²		–	28125150
		4 × 4 mm²		–	28125169
	SMB / M40 SpeedTec	4 × 6 mm²	SMB / M40 SpeedTec	–	28125177
		4 × 10 mm²		–	28125185
		4 × 16 mm²		–	28125193

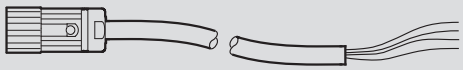
31972098/EN – 8/2024

Brakemotor cable ../SB.. for /BK and /BZD brakes

	Motor side		Inverter side		
				Fixed installation	Cable carrier installation
Cable type	**Connector type/ size**	**Cable cross section**	**Connector type/ size**	**Part number**	
Brakemotor cable[1] for BK.. and BZ..D brakes	SB1 / M23 SpeedTec	4 × 1.5 mm² + 3 × 1 mm²	Open end	28125207	28125215
		4 × 2.5 mm² + 3 × 1 mm²		28125223	28125231
		4 × 4 mm² + 3 × 1 mm²		28125258	28125266
	SBB / M40 SpeedTec	4 × 6 mm² + 3 × 1.5 mm²		28125274	28125282
		4 × 10 mm² + 3 × 1.5 mm²		28125290	28125304
		4 × 16 mm² + 3 × 1.5 mm²		28125312	28125320

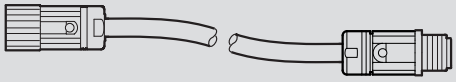
1) The cable contains 3 cores but only 2 cores are used.

Brakemotor cable ../SB.. for /BZ brakes

	Motor side		Inverter side		
				Fixed installation	Cable carrier installation
Cable type	**Connector type/ size**	**Cable cross section**	**Connector type/ size**	**Part number**	
Brakemotor cable for BZ.. brake	SB1 / M23 SpeedTec	4 × 1.5 mm² + 3 × 1 mm²	Open end	28125339	28125347
		4 × 2.5 mm² + 3 × 1 mm²		28125355	28125363
		4 × 4 mm² + 3 × 1 mm²		28125371	28125398
	SBB / M40 SpeedTec	4 × 6 mm² + 3 × 1.5 mm²		28125401	28125428
		4 × 10 mm² + 3 × 1.5 mm²		28125436	28125444
		4 × 16 mm² + 3 × 1.5 mm²		28125452	28125460

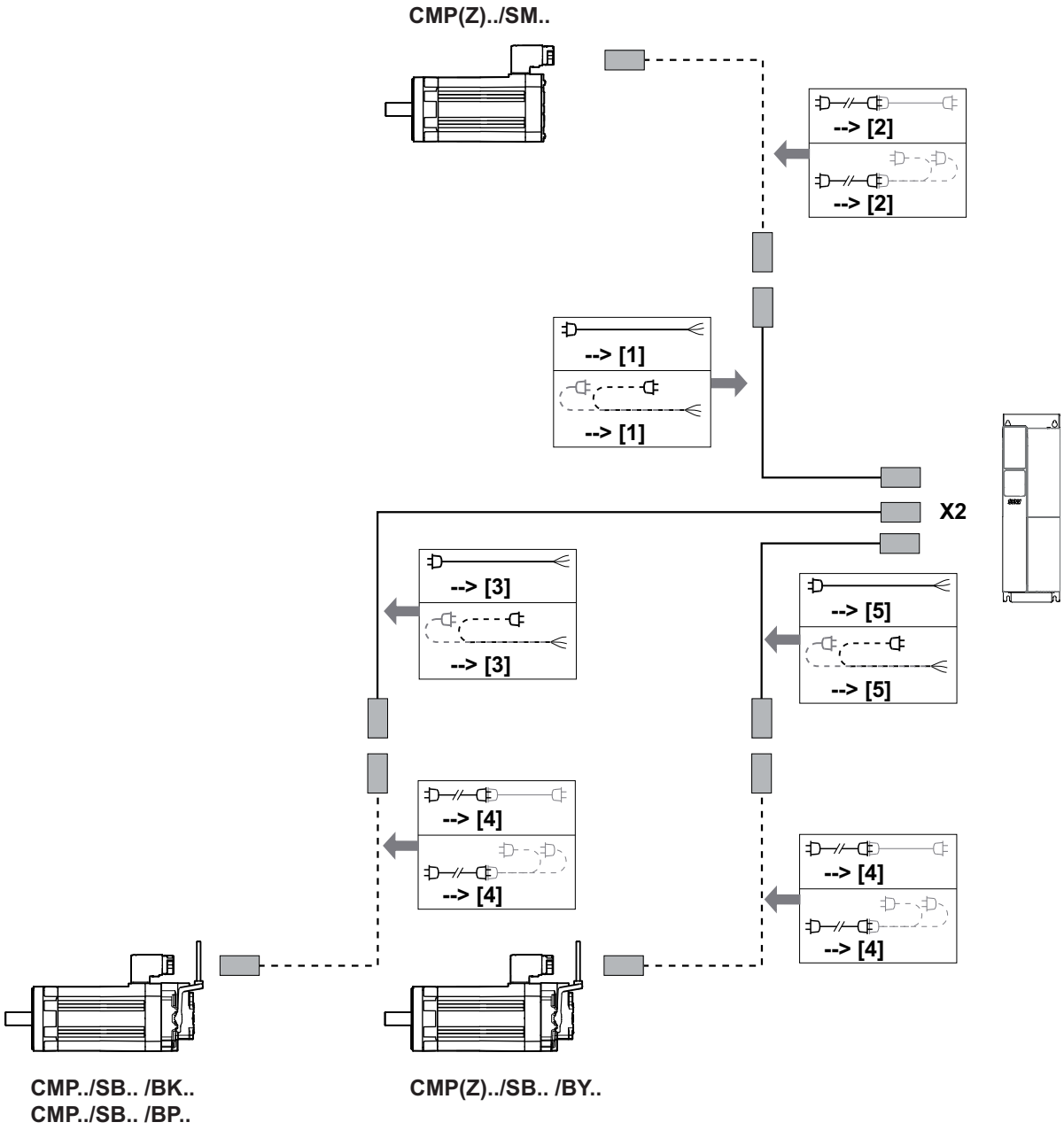
31972098/EN – 8/2024

Brakemotor extension cable ../SB.. for /BK, /BZD and /BZ brakes

	Motor side / Inverter side				
				Fixed installation	Cable carrier installation
Cable type	**Connector type/ size**	**Cable cross section**	**Connector type/ size**	**Part number**	
Brakemotor extension cable for BK../BZ..D/ BZ.. brakes	SB1 / M23 SpeedTec	4 × 1.5 mm^2 + 3 × 1 mm^2	SM1 / M23 SpeedTec	–	28125479
		4 × 2.5 mm^2 + 3 × 1 mm^2		–	28125487
		4 × 4 mm^2 + 3 × 1 mm^2		–	28125495
	SBB / M40 SpeedTec	4 × 6 mm^2 + 3 × 1.5 mm^2	SMB / M40 SpeedTec	–	28125509
		4 × 10 mm^2 + 3 × 1.5 mm^2		–	28125517
		4 × 16 mm^2 + 3 × 1.5 mm^2		–	28125525

7.2.2 Power cables for CMP motors

Overview

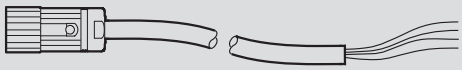


27021612519737611

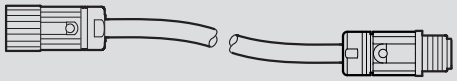
[1] "Motor cables ../SM.. " (→ 🗎 269)
[2] "Motor extension cables ../SM.. " (→ 🗎 269)
[3] "Brakemotor cables ../SB.. for /BK and /BP brakes " (→ 🗎 270)
[4] "Brakemotor extension cables ../SB.. for /BK, /BP, and /BY brakes " (→ 🗎 271)
[5] "Brakemotor cables ../SB.. for /BY brakes " (→ 🗎 272)

31972098/EN – 8/2024

Motor cables ../SM..

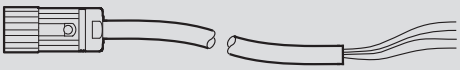
	Motor side		Inverter side		
				Fixed installation	Cable carrier installation
Cable type	**Connector type/ size**	**Cable cross section**	**Connector type/ size**	**Part number**	
Motor cable	SM1 / M23 SpeedTec-ready	4 × 1.5 mm²	Open end	05904544	05906245
		4 × 2.5 mm²		05904552	05906253
		4 × 4 mm²		05904560	05904803
	SMB / M40 SpeedTec-ready	4 × 6 mm²		13350269	13350293
		4 × 10 mm²		13350277	13350307
		4 × 16 mm²		13350285	13350315
	SMC / M58 SpeedTec-ready	4 × 16 mm²		18148476	18148484
		4 × 25 mm²		–	18148581
		4 × 35 mm²		–	18148697

Motor extension cables ../SM..

	Motor side		Inverter side		
				Fixed installation	Cable carrier installation
Cable type	**Connector type/ size**	**Cable cross section**	**Connector type/ size**	**Part number**	
Motor extension cable	SM1 / M23 SpeedTec-ready	4 × 1.5 mm²	SM1 / M23 SpeedTec-ready	–	13332457
		4 × 2.5 mm²		–	13332465
		4 × 4 mm²		–	13332473
	SMB / M40 SpeedTec-ready	4 × 6 mm²	SMB / M40 SpeedTec-ready	–	13350021
		4 × 10 mm²		–	13350048
		4 × 16 mm²		–	13350056
	SMC / M58 SpeedTec-ready	4 × 16 mm²	SMC / M58 SpeedTec-ready	–	18156819
		4 × 25 mm²		–	18156827
		4 × 35 mm²		–	18156835

31972098/EN – 8/2024

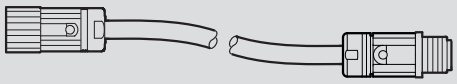
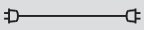
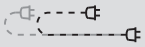
Brakemotor cables ../SB.. for /BK and /BP brakes

	Motor side		Inverter side		
				Fixed installation	Cable carrier installation
Cable type	**Connector type/ size**	**Cable cross section**	**Connector type/ size**	**Part number**	
Brakemotor cable[1] for BK.. and BP.. brakes	SB1 / M23 SpeedTec-ready	4 × 1.5 mm² + 3 × 1 mm²	Open end	13354345	13354388
		4 × 2.5 mm² + 3 × 1 mm²		13354353	13354396
		4 × 4 mm² + 3 × 1 mm²		13354361	13421603
	SBB / M40 SpeedTec-ready	4 × 6 mm² + 3 × 1.5 mm²		13350196	13350234
		4 × 10 mm² + 3 × 1.5 mm²		13350218	13350242
		4 × 16 mm² + 3 × 1.5 mm²		13350226	13350250

1) The cable contains 3 cores but only 2 cores are used.

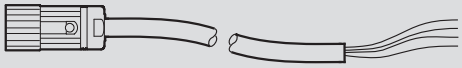
31972098/EN – 8/2024

Brakemotor extension cables ../SB.. for /BK, /BP, and /BY brakes

	Motor side / Inverter side				
				 Fixed installation	 Cable carrier installation
Cable type	**Connector type/ size**	**Cable cross section**	**Connector type/ size**	**Part number**	
Brakemotor extension cables ../SB.. for /BP, /BK, and /BY brakes	SB1 / M23 SpeedTec-ready	4 × 1.5 mm^2 + 3 × 1 mm^2	SM1 / M23 SpeedTec-ready	–	13354221
		4 × 2.5 mm^2 + 3 × 1 mm^2		–	13354248
		4 × 4 mm^2 + 3 × 1 mm^2		–	13354337
	SBB / M40 SpeedTec-ready	4 × 6 mm^2 + 3 × 1.5 mm^2	SMB / M40 SpeedTec-ready	–	13350099
		4 × 10 mm^2 + 3 × 1.5 mm^2		–	13350102
		4 × 16 mm^2 + 3 × 1.5 mm^2		–	13350110
	SBC / M58 SpeedTec-ready	4 × 16 mm^2 + 3 × 1.5 mm^2	SMC / M58 SpeedTec-ready	–	18156843

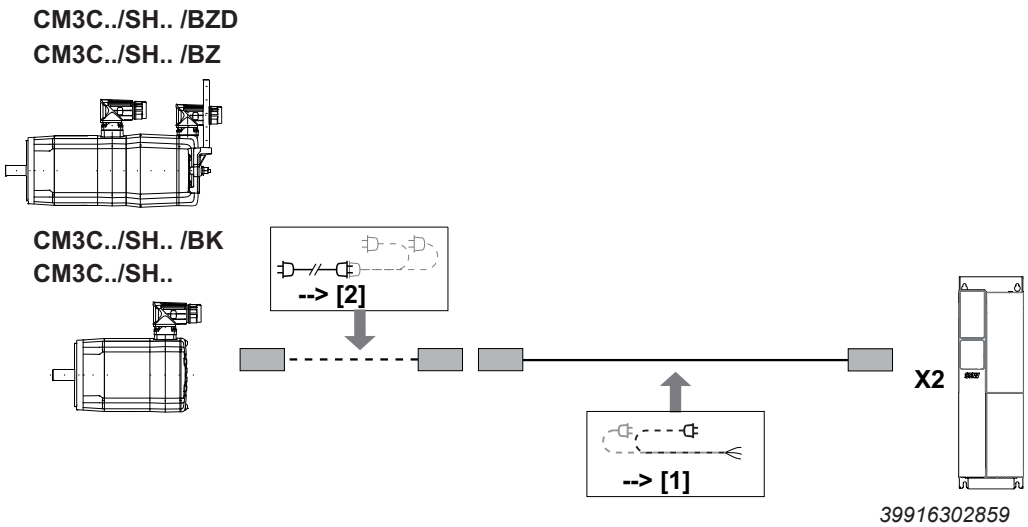
31972098/EN – 8/2024

Brakemotor cables ../SB.. for /BY brakes

	Motor side		Inverter side		
				Fixed installation	Cable carrier installation
Cable type	**Connector type/ size**	**Cable cross section**	**Connector type/ size**	**Part number**	
Brakemotor cables ../ SB.. for /BY brakes	SB1 / M23 SpeedTec-ready	4 × 1.5 mm² + 3 × 1 mm²	Open end	13354272	13354302
		4 × 2.5 mm² + 3 × 1 mm²		13354280	13354310
		4 × 4 mm² + 3 × 1 mm²		13354299	13354329
	SBB / M40 SpeedTec-ready	4 × 6 mm² + 3 × 1.5 mm²		13350129	13350153
		4 × 10 mm² + 3 × 1.5 mm²		13350137	13350161
		4 × 16 mm² + 3 × 1.5 mm²		13350145	13350188
	SBC / M58 SpeedTec-ready	4 × 16 mm² + 3 × 1.5 mm²		18148514	18148522

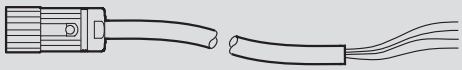
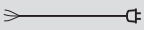
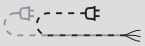
7.2.3 Motor hybrid cable for CMP..-/CM3C.. motors with/without brake, in encoder-less version

Overview



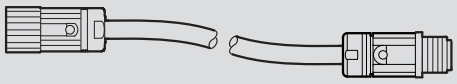
[1] "Motor/brakemotor cable ../SH.. " (→ 🗎 273)
[2] "Motor extension cables ../SH.. " (→ 🗎 274)

Motor/brakemotor cable ../SH..

	Motor side / Inverter side				
				 Fixed installation	 Cable carrier installation
Cable type	**Connector type/ size**	**Cable cross section**	**Connector type/ size**	**Part number**	
Motor cable/ brakemotor cable	SH1 / M23 SpeedTec	4 × 1.5 mm² + 3 × 1 mm² + 4 × 0.34 mm²	Open end	–	18191290
		4 × 2.5 mm² + 3 × 1 mm² + 4 × 0.34 mm²		–	18191304
		4 × 4 mm² + 3 × 1 mm² + 4 × 0.34 mm²		–	18191312
	SHB / M40 SpeedTec	4 × 6 mm² + 3 × 1.5 mm² + 4 × 0.34 mm²		–	18191320
		4 × 10 mm² + 3 × 1.5 mm² + 4 × 0.34 mm²		–	18191339

31972098/EN – 8/2024

Motor extension cables ../SH..

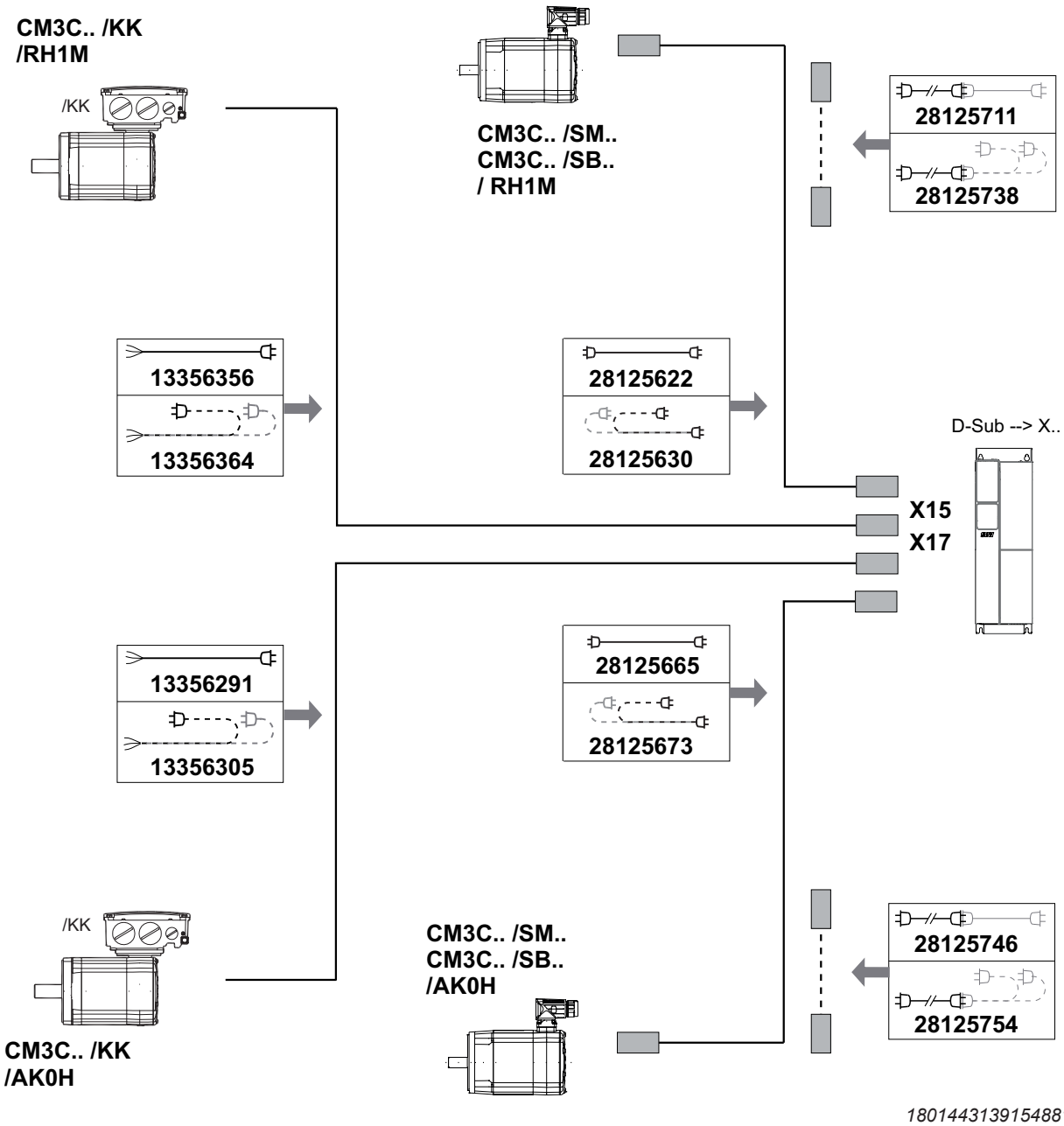
	Motor side		Inverter side		
				Fixed installation	Cable carrier installation
Cable type	**Connector type/ size**	**Cable cross section**	**Connector type/ size**	**Part number**	
Motor extension cable	SH1 / M23 SpeedTec	4 × 1.5 mm² + 3 × 1 mm² + 4 × 0.34 mm²	SH1 / M23 SpeedTec	–	18191347
		4 × 2.5 mm² + 3 × 1 mm² + 4 × 0.34 mm²		–	18191355
		4 × 4 mm² + 3 × 1 mm² + 4 × 0.34 mm²		–	18191363
	SHB / M40 SpeedTec	4 × 6 mm² + 3 × 1.5 mm² + 4 × 0.34 mm²	SHB / M40 SpeedTec	–	18191371
		4 × 10 mm² + 3 × 1.5 mm² + 4 × 0.34 mm²		–	18191398

31972098/EN – 8/2024

7.3 Encoder cable

7.3.1 Encoder cables for CM3C.. motors

Overview

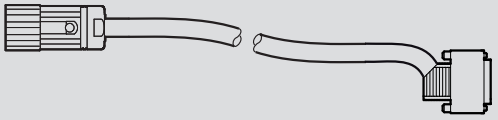


18014431391548811

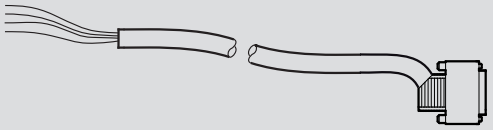
All prefabricated encoder cables with connectors on the motor side are designed in SpeedTec.

D-sub →
- X15 Encoder connection basic device (resolvers can only be connected to X15)
- X17 Encoder connection multi-encoder card

Encoder cable - plug connector connection variant

	Motor side		Inverter side		
				Fixed installation	Cable carrier installation
Encoder type	**Connector type**	**Cable cross section**	**Connector type**	**Part number**	
RH1M resolver	M23	5 × 2 × 0.25 mm²	D-sub 15	28125622	28125630
AK0H encoder		4 × 2 × 0.25 mm² + 2 × 0.5 mm²		28125665	28125673

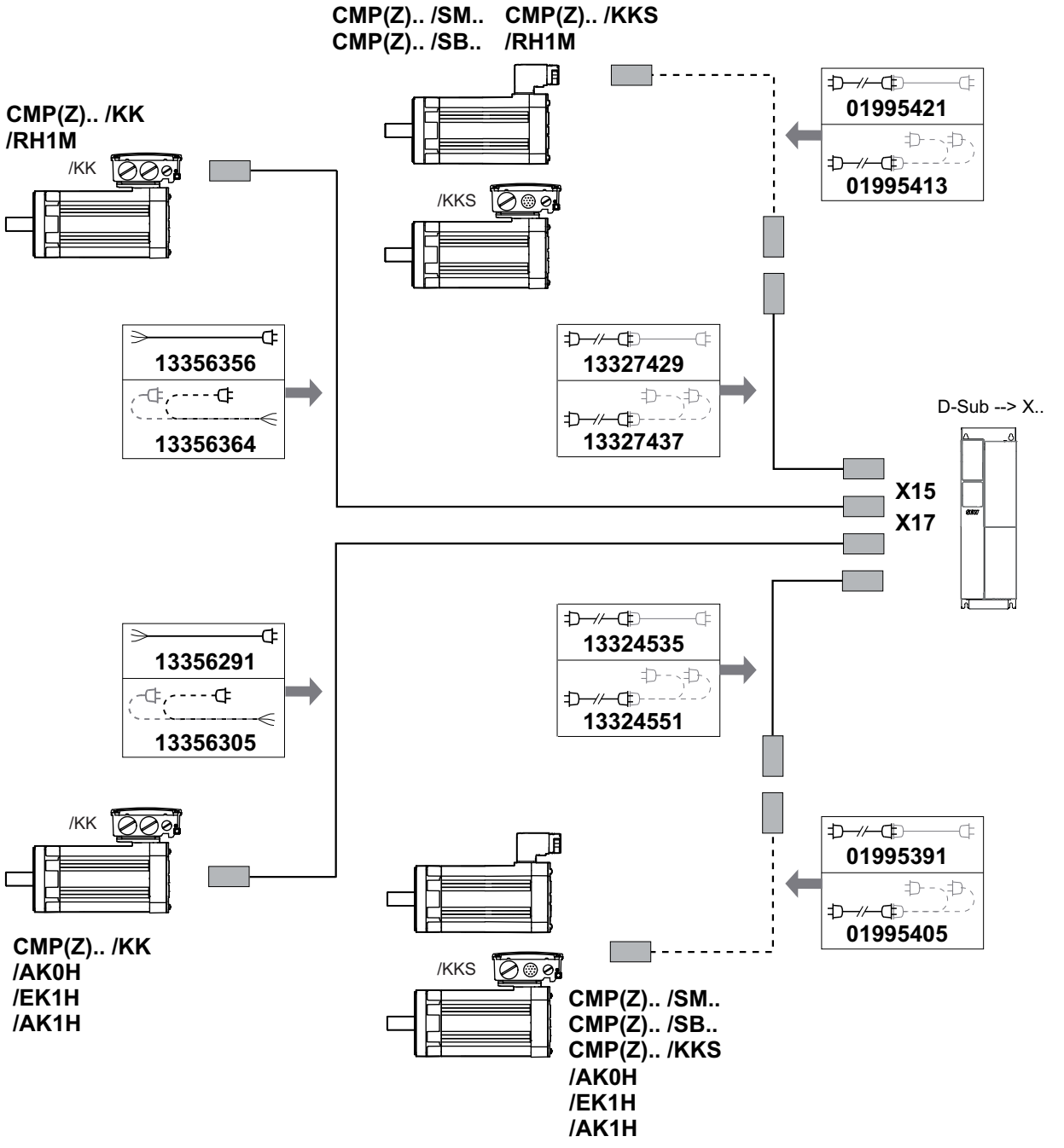
Encoder cable - /KK connection variant

	Motor side		Inverter side		
				Fixed installation	Cable carrier installation
Encoder type	**Connector type**	**Cable cross section**	**Connector type**	**Part number**	
RH1M resolver	Open end	5 × 2 × 0.25 mm²	D-sub 15	13356356	13356364
AK0H encoder		4 × 2 × 0.25 mm² + 2 × 0.5 mm²		13356291	13356305

31972098/EN – 8/2024

7.3.2 Encoder cables for CMP.. motors

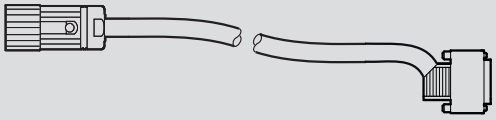
Overview



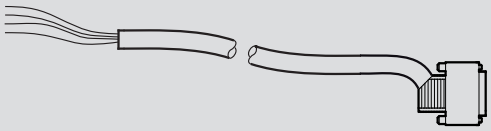
18014413270582027

D-sub →
- X15 Encoder connection basic device (resolvers can only be connected to X15)
- X17 Encoder connection multi-encoder card

Encoder cable - /KKS plug connector connection variant

	Motor side		Inverter side		
				Fixed installation	Cable carrier installation
Encoder type	**Connector type**	**Cable cross section**	**Connector type**	**Part number**	
RH1M resolver	M23	5 × 2 × 0.25 mm²	D-sub 15	13327429	13327437
AK0H, EK0H, AK1H, EK1H encoder		4 × 2 × 0.25 mm² + 2 × 0.5 mm²		13324535	13324551

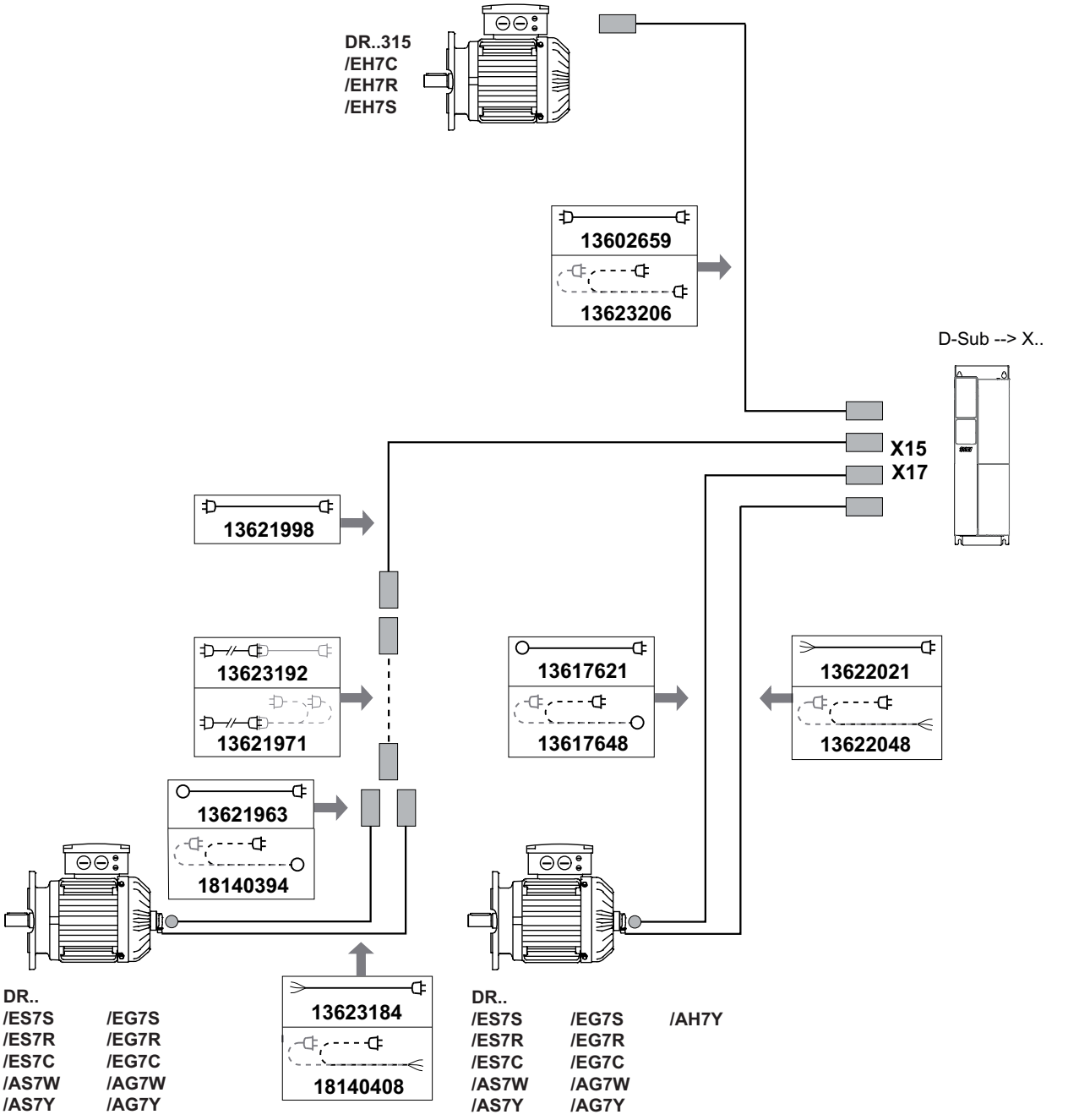
Encoder cable - /KK connection variant

	Motor side		Inverter side		
				Fixed installation	Cable carrier installation
Encoder type	**Connector type**	**Cable cross section**	**Connector type**	**Part number**	
RH1M resolver	Open end	5 × 2 × 0.25 mm²	D-sub 15	13356356	13356364
AK0H / AK1H / EK1H encoder		4 × 2 × 0.25 mm² + 2 × 0.5 mm²		13356291	13356305

31972098/EN – 8/2024

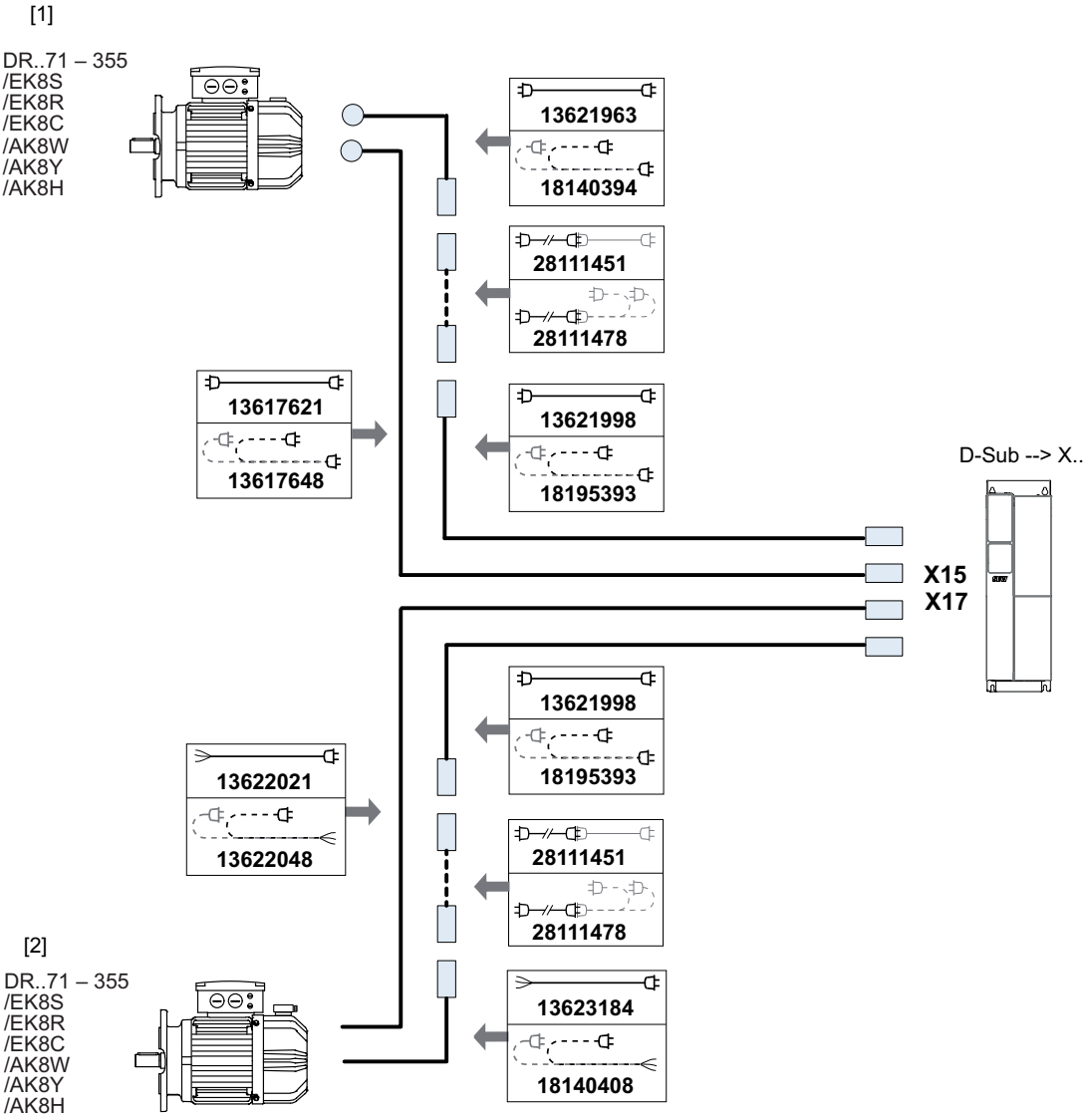
7.3.3 Encoder cables for DR.. motors

Overview



45036011090014603

D-sub →
- X15 Encoder connection basic unit (resolvers can only be connected to X15)
- X17 Encoder connection multi-encoder card (A..Y encoders can only be connected to X17)

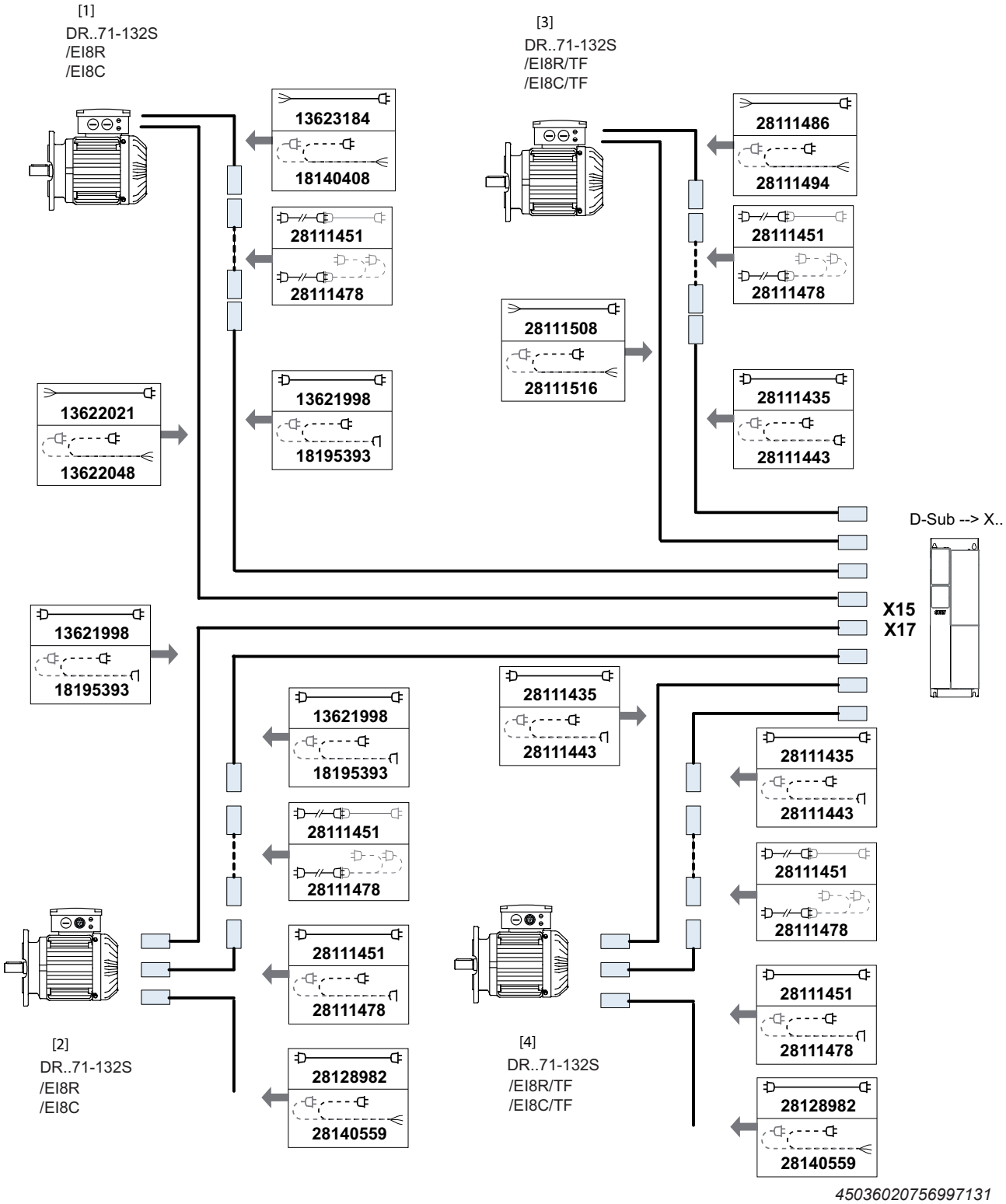


36028821502253707

D-sub →
- X15 Encoder connection basic unit (resolvers can only be connected to X15)
- X17 Encoder connection multi-encoder card (A..Y encoders can only be connected to X17)

[1] Motors with integrated plug connector for encoder signals **without** connection cover, connection type A2GA. The signals for thermal monitoring of the motor are not present in the encoder cable.

[2] Motors with integrated plug connector for encoder signals **with** connection cover, connection type A1GA. The signals for thermal monitoring of the motor are not present in the encoder cable.



45036020756997131

D-sub →

X15 Encoder connection basic unit (resolvers can only be connected to X15)

X17 Encoder connection multi-encoder card (A..Y encoders can only be connected to X17)

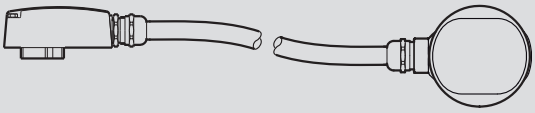
[1] Motors with terminal strip in the terminal box for encoder signals and thermal monitoring. The signals for thermal monitoring of the motor are **not** present in the encoder cable.

[2] Motors with M23 plug connector at the terminal box for encoder signals, connection type AIGA. The signals for thermal monitoring of the motor are **not** present in the encoder cable.

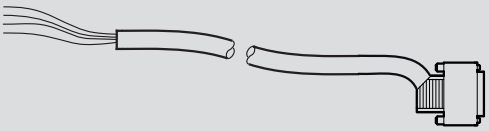
[3] Motors with terminal strip in the terminal box for encoder signals and thermal monitoring. The signals for thermal monitoring of the motor are present in the encoder cable.

[4] Motors with M23 plug connector at the terminal box for encoder signals and thermal monitoring, connection type AIGB. The signals for thermal monitoring of the motor are present in the encoder cable.

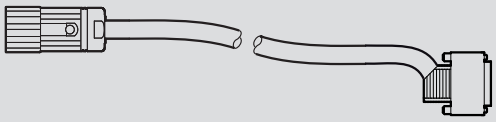
Encoder cable with connection cover and D-sub

Motor side		Inverter side		
			Fixed installation	Cable carrier installation
Connector type	**Cable cross section**	**Connector type**	**Part number**	
Connection cover	4 × 2 × 0.25 mm² + 2 × 0.5 mm²	D-sub 15	13617621	13617648

Encoder cable with open end and D-sub

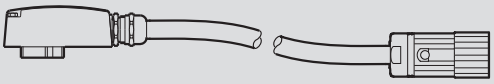
Motor side		Inverter side		
			Fixed installation	Cable carrier installation
Connector type	**Cable cross section**	**Connector type**	**Part number**	
Open end	4 × 2 × 0.25 mm² + 2 × 0.5 mm²	D-sub 15	13622021	13622048
	5 × 2 × 0.25 mm² + 2 × 0.5 mm²		28111508	28111516

Encoder cable with M23 and D-sub

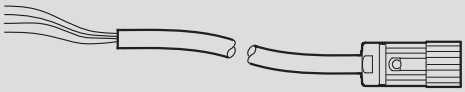
Motor side		Inverter side		
			Fixed installation	Cable carrier installation
Connector type	**Cable cross section**	**Connector type**	**Part number**	
M23	5 × 2 × 0.25 mm² + 2 × 0.5 mm²	D-sub 15	13602659	13623206
	5 × 2 × 0.25 mm² + 2 × 0.5 mm²		28111435	28111443
	4 × 2 × 0.25 mm² + 2 × 0.5 mm²		13621998	18195393

31972098/EN – 8/2024

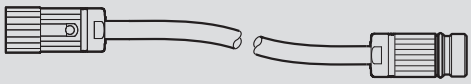
Encoder extension cable with connection cover and M23

Motor side		Inverter side		
			Fixed installation	Cable carrier installation
Connector type	**Cable cross section**	**Connector type**	**Part number**	
Connection cover	4 × 2 × 0.25 mm² + 2 × 0.5 mm²	M23	13621963	18140394

Encoder extension cable with open end and M23

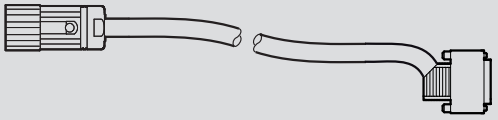
Motor side		Inverter side		
			Fixed installation	Cable carrier installation
Connector type	**Cable cross section**	**Connector type**	**Part number**	
Open end	4 × 2 × 0.25 mm² + 2 × 0.5 mm²	M23	13623184	18140408
	5 × 2 × 0.25 mm² + 2 × 0.5 mm²		28111486	28111494

Encoder extension cable with two M23

Motor side		Inverter side		
			Fixed installation	Cable carrier installation
Connector type	**Cable cross section**	**Connector type**	**Part number**	
M23	4 × 2 × 0.25 mm² + 2 × 0.5 mm²	M23	13623192	13621971
	5 × 2 × 0.25 mm² + 2 × 0.5 mm²		28111451	28111478

31972098/EN – 8/2024

Encoder extension cable with M23 and D-sub

	Motor side		Inverter side		
				Fixed installation	Cable carrier installation
Encoder type	**Connector type**	**Cable cross section**	**Connector type**	**Part number**	
RH1M resolver	M23	5 × 2 × 0.25 mm²	D-sub 15	28125622	28125630
AK0H, EK0H, AK1H, EK1H encoder		4 × 2 × 0.25 mm² + 2 × 0.5 mm²		28125665	28125673

7.4 Cables for MOVILINK® DDI

7.4.1 Overview

The MOVILINK® DDI interface requires a coaxial cable for data transmission between the motor and the inverter. Depending on the motor cable cross-section that is required, the coaxial cable is in the form of a hybrid cable (up to 10 mm²) or in separate cables (> 10 mm²).

The coaxial cable requires a FAKRA connector at the inverter and motor sides. SEW-EURODRIVE provides prefabricated cables with connectors already fitted. Rolls of bulk cable are also available, whereby the connectors must be fitted by the customer. The FAKRA connectors can be assembled using the "MOVILINK® DDI Tool Set 1".

More information can be found in the "MOVI-C® Modular Automation System – Digital Motor Integration" manual.

Single-cable technology up to 10 mm²

Prefabricated hybrid cables for motors with MOVILINK® DDI interface are structured as follows:

- 1 conductor for the PE connection
- 3 conductors for controlling the motor
- 4 conductors for controlling the brake
- 1 coaxial cable for MOVILINK® DDI

With this universal hybrid cable, all variants of the brake can be controlled.

Multi-cable technology larger than 10 mm²

For cross sections larger than 10 mm², the coaxial cable is routed separately in a cable. Individual coaxial cables are available as prefabricated cables.

Six plugging positions are available.

31972098/EN – 8/2024

The coaxial cable at the motor side is always connected using an M23 connector.

Number of plugging positions

The coaxial technology of MOVILINK® DDI allows for multiple plugging positions. Up to 4 plugging positions can be implemented, whereby merely plugging positions with an M23 or M40 plug connector are counted. The plugging positions of the FAKRA plug connector within the motor in the terminal box, on the encoder module, or on the inverter itself are not counted.

Examples for the numbering system of the plugging positions:

- Cable from MOVIDRIVE® to DRN.. motor with KD1 (M23 plug connector): 1 plugging position
- Cable from MOVIMOT® flexible to M23 for DRN.. motor with KD1 (M23 plug connector): 2 plugging positions
- Cable from MOVIDRIVE® to DRN.. motor with KD1 (M23 plug connector) connected to an extension cable M23 to M23: 2 plugging positions
- Cable from MOVIMOT® flexible with M23 to DRN.. motor with KD1 (M23 plug connector) connected to an extension cable M23 to M23: 3 plugging positions
- Cable from MOVIDRIVE® to DRN.. with KD (hybrid cable gland without connector): 0 plugging positions

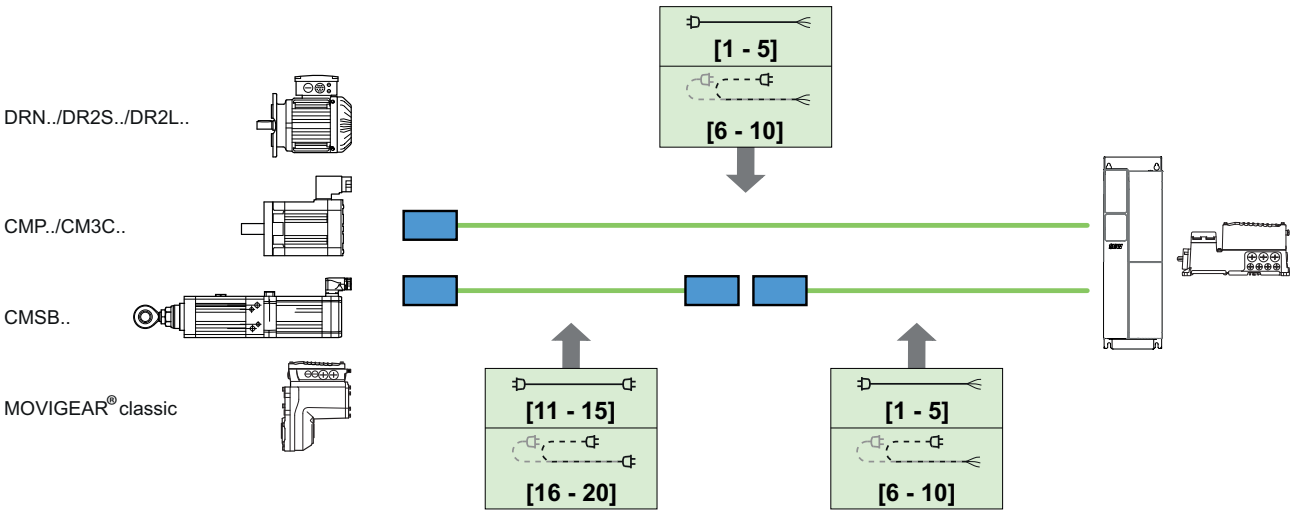
Interlocking of the plug connectors

MOVILINK® DDI cables with plug connectors are delivered with quick-lock SpeedTec plug connectors as standard. Note that this interlocking must be completely closed to achieve interference-free signal transmission via MOVILINK® DDI.

Hybrid cables with connector on the motor side, open end on the inverter side

The cable is used for the following inverters:

- MOVIDRIVE®
- MOVITRAC® advanced
- MOVIMOT® flexible

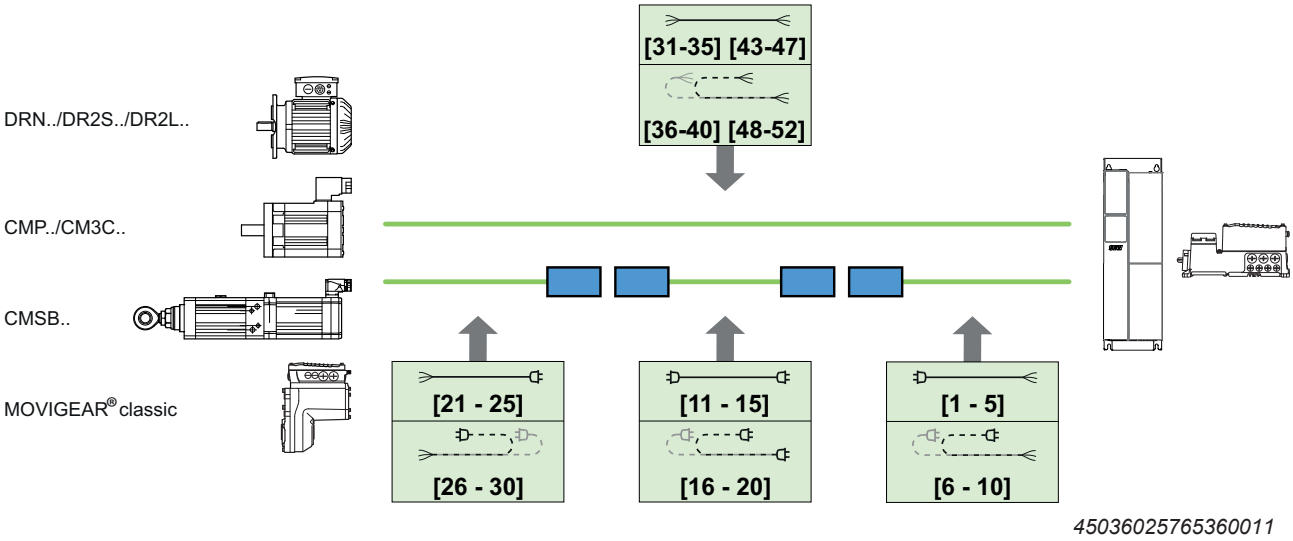


36028826510616587

Hybrid cables with open end on the motor side, open end on the inverter side

The cable is used for the following inverters:

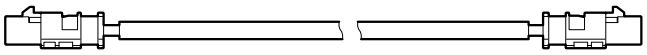
- MOVIDRIVE®
- MOVITRAC® advanced
- MOVIMOT® flexible



45036025765360011

FAKRA plug-in connector

Adapter cables are available for connecting the open FAKRA plug connector. This enables the connection of self-prefabricated cables with an open end and a FAKRA plug connector. The FAKRA plug connector is compatible with all prefabricated cables for MOVILINK® DDI with open end from SEW-EURODRIVE.



40957566603

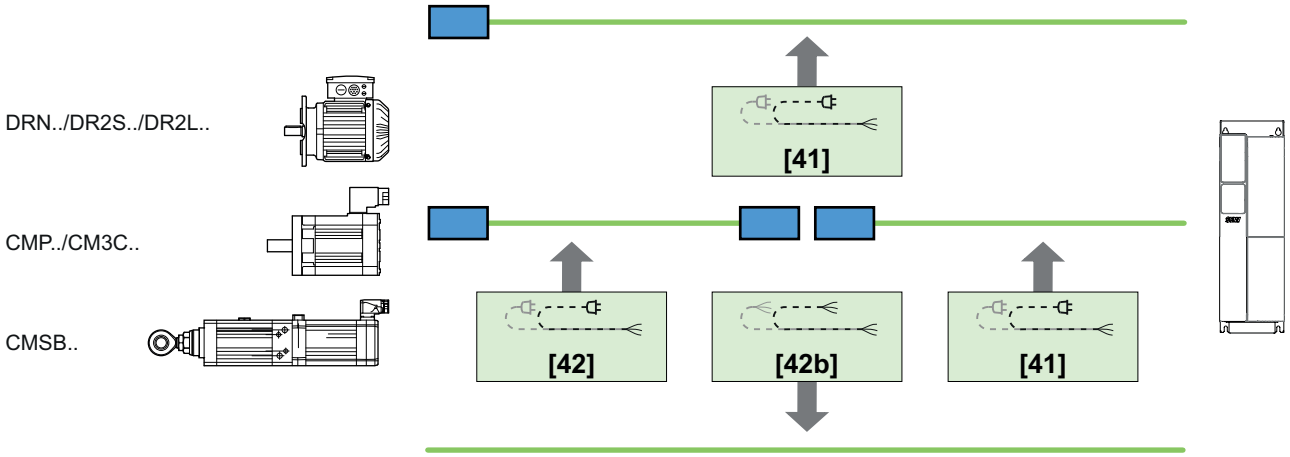
Part number	Installation type	Length	Connection	Motor side	Inverter side
28170792	Fixed	200 mm	FAKRA Coaxial	Male	Male

Coaxial signal cable with plug or open end on motor side, with open end on inverter side

The coaxial cable is required for a cross section greater than 10 mm² for the conductors for controlling the motor and contains the data line for the MOVILINK® DDI connection. The cable for connecting the motor and the brake must be laid separately.

The cable is used for the following inverters:

- MOVIDRIVE®
- MOVITRAC® advanced



27021630605266955

Cable tables

The prefabricated cables with open ends on the motor side and on the inverter side can also be supplied as cable reels in lengths of 30 m, 100 m and 200 m (lines 43 – 52). These cables are not prefabricated.

For more information on assembly, refer to the addendum to the "MOVILINK® DDI Tool Set 1" operating instructions.

Cables with M23, M40, with open end or with Fakra coaxial plug

The following table shows prefabricated cables for MOVILINK® DDI.

No.	Part number	Cross section in mm²	Installation type	Motor connection	Motor side	Inverter side
[1]	28123808	4 × 1.5 + 4 × 1 + coaxial cable	Fixed installation	SD1/KD1	M23	Open
[2]	28123816	4 × 2.5 + 4 × 1 + coaxial cable	Fixed installation	SD1/KD1	M23	Open
[3]	28123824	4 × 4 + 4 × 1 + coaxial cable	Fixed installation	SD1/KD1	M23	Open
[4]	28123832	4 × 6 + 4 × 1.5 + coaxial cable	Fixed installation	SDB/KDB	M40	Open
[5]	28123840	4 × 10 + 4 × 1.5 + coaxial cable	Fixed installation	SDB/KDB	M40	Open
[6]	28123743	4 × 1.5 + 4 × 1 + coaxial cable	Cable carrier installation	SD1/KD1	M23	Open
[7]	28123751	4 × 2.5 + 4 × 1 + coaxial cable	Cable carrier installation	SD1/KD1	M23	Open
[8]	28123778	4 × 4 + 4 × 1 + coaxial cable	Cable carrier installation	SD1/KD1	M23	Open
[9]	28123786	4 × 6 + 4 × 1.5 + coaxial cable	Cable carrier installation	SDB/KDB	M40	Open
[10]	28123794	4 × 10 + 4 × 1.5 + coaxial cable	Cable carrier installation	SDB/KDB	M40	Open
[11]	28123905	4 × 1.5 + 4 × 1 + coaxial cable	Fixed installation	SD1/KD1	M23	M23
[12]	28123913	4 × 2.5 + 4 × 1 + coaxial cable	Fixed installation	SD1/KD1	M23	M23
[13]	28123921	4 × 4 + 4 × 1 + coaxial cable	Fixed installation	SD1/KD1	M23	M23
[14]	28123948	4 × 6 + 4 × 1.5 + coaxial cable	Fixed installation	SDB/KDB	M40	M40
[15]	28123956	4 × 10 + 4 × 1.5 + coaxial cable	Fixed installation	SDB/KDB	M40	M40
[16]	28123859	4 × 1.5 + 4 × 1 + coaxial cable	Cable carrier installation	SD1/KD1	M23	M23
[17]	28123867	4 × 2.5 + 4 × 1 + coaxial cable	Cable carrier installation	SD1/KD1	M23	M23
[18]	28123875	4 × 4 + 4 × 1 + coaxial cable	Cable carrier installation	SD1/KD1	M23	M23
[19]	28123883	4 × 6 + 4 × 1.5 + coaxial cable	Cable carrier installation	SDB/KDB	M40	M40
[20]	28123891	4 × 10 + 4 × 1.5 + coaxial cable	Cable carrier installation	SDB/KDB	M40	M40
[21]	28124367	4 × 1.5 + 4 × 1 + coaxial cable	Fixed installation	KD	Open	M23
[22]	28124375	4 × 2.5 + 4 × 1 + coaxial cable	Fixed installation	KD	Open	M23
[23]	28124383	4 × 4 + 4 × 1 + coaxial cable	Fixed installation	KD	Open	M23
[24]	28143884	4 × 6 + 4 × 1.5 + coaxial cable	Fixed installation	KD	Open	M40
[25]	28143892	4 × 10 + 4 × 1.5 + coaxial cable	Fixed installation	KD	Open	M40
[26]	28124332	4 × 1.5 + 4 × 1 + coaxial cable	Cable carrier installation	KD	Open	M23

31972098/EN – 8/2024

No.	Part number	Cross section in mm²	Installation type	Motor connection	Motor side	Inverter side
[27]	28124340	4 × 2.5 + 4 × 1 + coaxial cable	Cable carrier installation	KD	Open	M23
[28]	28124359	4 × 4 + 4 × 1 + coaxial cable	Cable carrier installation	KD	Open	M23
[29]	28143868	4 × 6 + 4 × 1.5 + coaxial cable	Cable carrier installation	KD	Open	M40
[30]	28143876	4 × 10 + 4 × 1.5 + coaxial cable	Cable carrier installation	KD	Open	M40
[31]	28152395	4 × 1.5 + 4 × 1 + coaxial cable	Fixed installation	KD	Open	Open
[32]	28152409	4 × 2.5 + 4 × 1 + coaxial cable	Fixed installation	KD	Open	Open
[33]	28152417	4 × 4 + 4 × 1 + coaxial cable	Fixed installation	KD	Open	Open
[34]	28152425	4 × 6 + 4 × 1.5 + coaxial cable	Fixed installation	KD	Open	Open
[35]	28152433	4 × 10 + 4 × 1.5 + coaxial cable	Fixed installation	KD	Open	Open
[36]	28152441	4 × 1.5 + 4 × 1 + coaxial cable	Cable carrier installation	KD	Open	Open
[37]	28152468	4 × 2.5 + 4 × 1 + coaxial cable	Cable carrier installation	KD	Open	Open
[38]	28152476	4 × 4 + 4 × 1 + coaxial cable	Cable carrier installation	KD	Open	Open
[39]	28152484	4 × 6 + 4 × 1.5 + coaxial cable	Cable carrier installation	KD	Open	Open
[40]	28152492	4 × 10 + 4 × 1.5 + coaxial cable	Cable carrier installation	KD	Open	Open
[41]	28129431	Coaxial cable	Cable carrier installation	SMCD/SBCD/KDD	M23	Open
[42]	28138376	Coaxial cable	Cable carrier installation	SMCD/SBCD/KDD	M23	M23
[42b]	28183762	Coaxial cable	Cable carrier installation	KD	Open	Open

Cable for self-fabrication with open end and Fakra coaxial plug

No.	Part number	Cross section in mm²	Installation type	Motor connection	Motor side	Inverter side
[43]	28123395	4 × 1.5 + 4 × 1 + coaxial cable	Fixed installation	KD	cut off	cut off
[44]	28123409	4 × 2.5 + 4 × 1 + coaxial cable	Fixed installation	KD	cut off	cut off
[45]	28123417	4 × 4 + 4 × 1 + coaxial cable	Fixed installation	KD	cut off	cut off
[46]	28123425	4 × 6 + 4 × 1.5 + coaxial cable	Fixed installation	KD	cut off	cut off
[47]	28123433	4 × 10 + 4 × 1.5 + coaxial cable	Fixed installation	KD	cut off	cut off
[48]	28123336	4 × 1.5 + 4 × 1 + coaxial cable	Cable carrier installation	KD	cut off	cut off
[49]	28123344	4 × 2.5 + 4 × 1 + coaxial cable	Cable carrier installation	KD	cut off	cut off
[50]	28123352	4 × 4 + 4 × 1 + coaxial cable	Cable carrier installation	KD	cut off	cut off
[51]	28123360	4 × 6 + 4 × 1.5 + coaxial cable	Cable carrier installation	KD	cut off	cut off
[52]	28123379	4 × 10 + 4 × 1.5 + coaxial cable	Cable carrier installation	KD	cut off	cut off

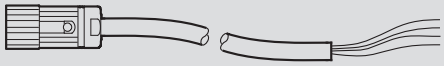
31972098/EN – 8/2024

7.4.2 Motor cables for motors without brake with MOVILINK® DDI interface

Connecting cables with connectors on the motor side for the following motors:

- DRN../DR2S../DR2L.. asynchronous motors
- CMP../CM3C.. synchronous motors
- MOVIGEAR® classic drive unit

The following table shows the conductor assignment of the cables:

Motor side  **Inverter side**

Contact		Signal	Conductor color	Conductor color IEC 60757	Identification	Assembly	Description
M23	M40						
U	U	U	Black	BK	U/L1	Not prefabricated	Motor connection phase U
V	V	V	Black	BK	V/L2	Not prefabricated	Motor connection phase V
W	W	W	Black	BK	W/L3	Not prefabricated	Motor connection phase W
A	1	Reserved	Yellow	YE	A	Not prefabricated	Do not connect
B	+	Reserved	Orange	OG	B	Not prefabricated	Do not connect
C	N	Reserved	Pink	PK	C	Not prefabricated	Do not connect
D	2	Reserved	Violet	VT	D	Not prefabricated	Do not connect
PE	PE	PE	Yellow/ green	YE/GN		Not prefabricated	Protective earth connection
DDI	DDI	DDI	Violet	VT		Coaxial connector	MOVILINK® DDI

Insulate each unconnected conductor end.

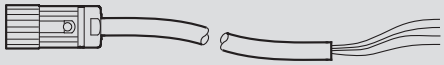
31972098/EN – 8/2024

7.4.3 Motor cables for motors with BE or BZ brake with MOVILINK® DDI interface

Connecting cables with connectors on the motor side for the following motors:

- DRN../DR2S../DR2L.. asynchronous motors
- CM3C.. synchronous motors

The following table shows the conductor assignment of the cables:

Motor side  **Inverter side**

Contact		Signal	Conductor color	Conductor color IEC 60757	Identification	Assembly	Description
M23	M40						
U	U	U	Black	BK	U/L1	Not prefabricated	Motor connection phase U
V	V	V	Black	BK	V/L2	Not prefabricated	Motor connection phase V
W	W	W	Black	BK	W/L3	Not prefabricated	Motor connection phase W
A	1	Reserved	Yellow	YE	A	Not prefabricated	Do not connect
B	+	15	Orange	OG	B	Not prefabricated	Brake connection 15
C	N	13	Pink	PK	C	Not prefabricated	Brake connection 13
D	2	14	Violet	VT	D	Not prefabricated	Brake connection 14
PE	PE	PE	Yellow/ green	YE/GN		Not prefabricated	Protective earth connection
DDI	DDI	DDI	Violet	VT		Coaxial connector	MOVILINK® DDI

Insulate each unconnected conductor end.

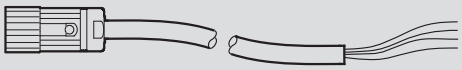
31972098/EN – 8/2024

7.4.4 Motor cables for motors with BK or BP brake with MOVILINK® DDI interface

Connecting cables with connectors on the motor side for the following motors:

- CMP../CM3C.. synchronous motors

The following table shows the conductor assignment of the cables:

Motor side  **Inverter side**

Contact M23	Contact M40	Signal	Conductor color	Conductor color IEC 60757	Marking	Assembly	Description
U	U	U	Black	BK	U/L1	Not prefabricated	Connection Motor phase U
V	V	V	Black	BK	V/L2	Not prefabricated	Connection Motor phase V
W	W	W	Black	BK	W/L3	Not prefabricated	Connection Motor phase W
A	1	Brake -	Yellow	YE	A	Not prefabricated	Connection Brake -
B	+	Re-served	Orange	OG	B	Not prefabricated	Do not connect
C	N	Re-served	Pink	PK	C	Not prefabricated	Do not connect
D	2	Brake +	Violet	VT	D	Not prefabricated	Connection Brake +
PE	PE	PE	Yellow/ green	YE/GN	–	Not prefabricated	Connection Protective earth
DDI	DDI	DDI	Violet	VT	–	Coaxial con-nector	MOVILINK® DDI

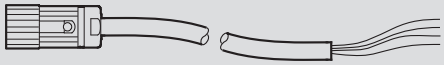
Insulate each unconnected conductor end.

7.4.5 Motor cables for motors with integrated BGZ brake control

Connecting cables with connectors on the motor side for the following motors:

- DRN../DR2S../DR2L.. asynchronous motors
- CMP../CM3C.. synchronous motors

The following table shows the conductor assignment of the cables:

Motor side  **Inverter side**

Contact M23	Contact M40	Signal	Conductor color	Conductor color IEC 60757	Identification	Assembly	Description
U	U	U	Black	BK	U/L1	Not prefabricated	Motor connection phase U
V	V	V	Black	BK	V/L2	Not prefabricated	Motor connection phase V
W	W	W	Black	BK	W/L3	Not prefabricated	Motor connection phase W
A	1	Reserved	Yellow	YE	A	Not prefabricated	Do not connect
B	+	N (L2)	Orange	OG	B	Not prefabricated	Brake connection, neutral conductor N (or phase L2)
C	N	Reserved	Pink	PK	C	Not prefabricated	Do not connect
D	2	L1	Violet	VT	D	Not prefabricated	Brake connection, phase L1
PE	PE	PE	Yellow/ green	YE/GN		Not prefabricated	Protective earth connection
DDI	DDI	DDI	Violet	VT		Coaxial connector	MOVILINK® DDI

Insulate each unconnected conductor end.

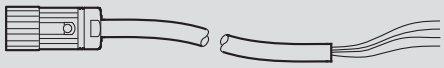
31972098/EN – 8/2024

7.4.6 Motor cables for motors with integrated BS.Z brake control

Connecting cables with connectors on the motor side for the following motors:

- CM3C.. synchronous motors

The following table shows the conductor assignment of the cables:

Motor side  **Inverter side**

Contact M23	Contact M40	Signal	Conductor color	Conductor color IEC 60757	Identification	Assembly	Description
U	U	U	Black	BK	U/L1	Not prefabricated	Motor connection phase U
V	V	V	Black	BK	V/L2	Not prefabricated	Motor connection phase V
W	W	W	Black	BK	W/L3	Not prefabricated	Motor connection phase W
A	1	GND	Yellow	YE	A	Not prefabricated	GND connection
B	+	DC 24 V	Orange	OG	B	Not prefabricated	DC 24 V connection
C	N	Reserved	Pink	PK	C	Not prefabricated	Do not connect
D	2	Reserved	Violet	VT	D	Not prefabricated	Do not connect
PE	PE	PE	Yellow/ green	YE/GN		Not prefabricated	Protective earth connection
DDI	DDI	DDI	Violet	VT		Coaxial connector	MOVILINK® DDI

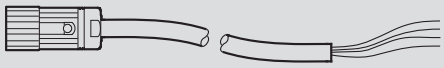
Insulate each unconnected conductor end.

7.4.7 Motor cables for motors with integrated braking resistor

Connecting cables with connectors on the motor side for the following motors:

- MOVIGEAR® classic drive unit

The following table shows the conductor assignment of the cables:

Motor side  **Inverter side**

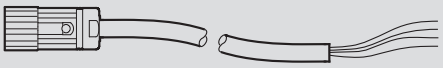
Contact M23	Contact M40	Signal	Conductor color	Conductor color IEC 60757	Identification	Assembly	Description
U	U	U	Black	BK	U/L1	Not prefabricated	Motor connection phase U
V	V	V	Black	BK	V/L2	Not prefabricated	Motor connection phase V
W	W	W	Black	BK	W/L3	Not prefabricated	Motor connection phase W
A	1	Reserved	Yellow	YE	A	Not prefabricated	Do not connect
B		Braking resistor	Orange	OG	B	Not prefabricated	Braking resistor connection
C		Braking resistor	Pink	PK	C	Not prefabricated	Braking resistor connection
D	2	Reserved	Violet	VT	D	Not prefabricated	Do not connect
PE	PE	PE	Yellow/ green	YE/GN		Not prefabricated	Protective earth connection
DDI	DDI	DDI	Violet	VT		Coaxial connector	MOVILINK® DDI

Insulate each unconnected conductor end.

31972098/EN – 8/2024

7.4.8 Coaxial cables with separate routing of power and signal cable

The power cable and signal cable can only be routed together up to a cable cross section of 10 mm^2. With larger cable cross sections, the power cable is routed separately from the signal cable.

Motor side 					Inverter side	
Contact M23	**Signal**	**Conductor color**	**Conductor color IEC 60757**	**Identification**	**Assembly**	**Description**
DDI	DDI	Violet	VT		Coaxial connector	MOVILINK® DDI

7.5 Module bus cable

The module bus cable is used to connect the devices via the module bus.

The RJ45 connectors and the socket contacts in the inverters have been checked for mechanical stability and contact reliability by SEW-EURODRIVE. SEW-EURODRIVE recommends using the cables listed below. If other cables and connectors are used, SEW-EURODRIVE makes no statement about the quality of the plug-in connection.

7.5.1 Overview



18027071371

[1] Connector, black [2] Connector, red

The module bus cable is used when two inverters are connected with one another in the DC link, see also the "DC link connection" manual.

31972098/EN – 8/2024

7.5.2 Cable assignment

The cable is available in the following lengths for fixed installation:

Cable length	Part number
0.2 m	18166970
0.23 m	18166989
0.26 m	18166997
0.29 m	18167004[1)]
0.35 m	18167012
0.44 m	18167020[2)]
0.59 m	28124251
0.75 m	28118618
1.6 m	18174205[3)]
2.6 m	28123549[3)]

1) Sizes 1 – 3 with devices directly next to each other
2) Sizes 4 – 6 with devices directly next to each other
3) With devices not directly next to each other

7.6 System bus cable

The system bus cable is used to connect the devices with the EtherCAT®/SBUS^{PLUS} interface.

The RJ45 connectors and the socket contacts in the inverters have been checked for mechanical stability and contact reliability by SEW-EURODRIVE. SEW-EURODRIVE recommends using the cables listed below. If other cables and connectors are used, SEW-EURODRIVE makes no statement about the quality of the plug-in connection.

NOTICE

Using the wrong cables.

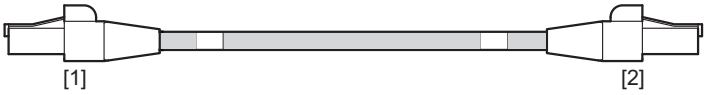
Inverter damage.

The system bus cables may only be designed with RJ45 connectors with 4-pin assignment. When using an RJ45 connector with 8-pin assignment at this point, malfunctions or defects may occur at the connected devices.

When RJ45 cables are being used, it must be ensured that the RJ45 connectors are equipped with all contacts.

31972098/EN – 8/2024

7.6.1 Overview



9007214291596811

[1] Connector, red [2] Connector, red

The 4-pin system bus cable [2] for EtherCAT® and SBus^{PLUS} is used between the automation components.

Some of these automation components are:

- MOVI-C® CONTROLLER
- Inverter
- PC with MOVISUITE® engineering software
- MOVI-PLC® I/O system
- additional EtherCAT® stations on the EtherCAT®/SBus^{PLUS}

7.6.2 Cable assignment

The cable is available in the following lengths for fixed installation:

Cable length	Part number
0.23 m	18179932
0.26 m	18179940
0.29 m	18179959[1)]
0.44 m	18179967[2)]
0.75 m	18167039[3)]
1.5 m	18179975[3)]
3 m	18167047[3)]
5 m	18179983[3)]
10 m	18179991[3)]

1) Sizes 1 – 3 with devices directly next to each other
2) Sizes 4 – 6 with devices directly next to each other
3) With devices not directly next to each other

If you use system bus cables from other manufacturers, it is necessary to comply with the relevant requirements of the "EtherCAT® Technology Group" (ETG). On this subject, note the "EtherCAT® Installation Guideline" from the ETG.

7.6.3 RJ45 connector

SEW-EURODRIVE recommends using the following plug connectors from Harting if the prefabricated cables from SEW-EURODRIVE are not used.

Harting order designation	Description	Core cross section
RJ45 CONNECTOR, PLUG, 4P4C, CAT5, 09451511100	RJ45 connector to IEC 60603-7, 4-pin	• Litz wires: 0.22 – 0.32 mm^2 • Wire: 0.26 – 0.32 mm^2 • Cable jacket: Ø 6.1 to 6.9 mm
RJ45 CONNECTOR, PLUG, 8P4C, CAT5, IDC09451511109		• Litz wires: 0.12 mm^2 • Cable jacket: Ø 6.1 to 6.9 mm

Plug connector characteristics:

- Can be preassembled in the field without tools
- Transmission category CAT 5
- Suitable for connecting litz wires and wires
- UL approval

7.6.4 Pin assignment

The prefabricated system bus cables are assigned according to EIA/TIA-568A. Also use this assignment for prefabrication in the field.

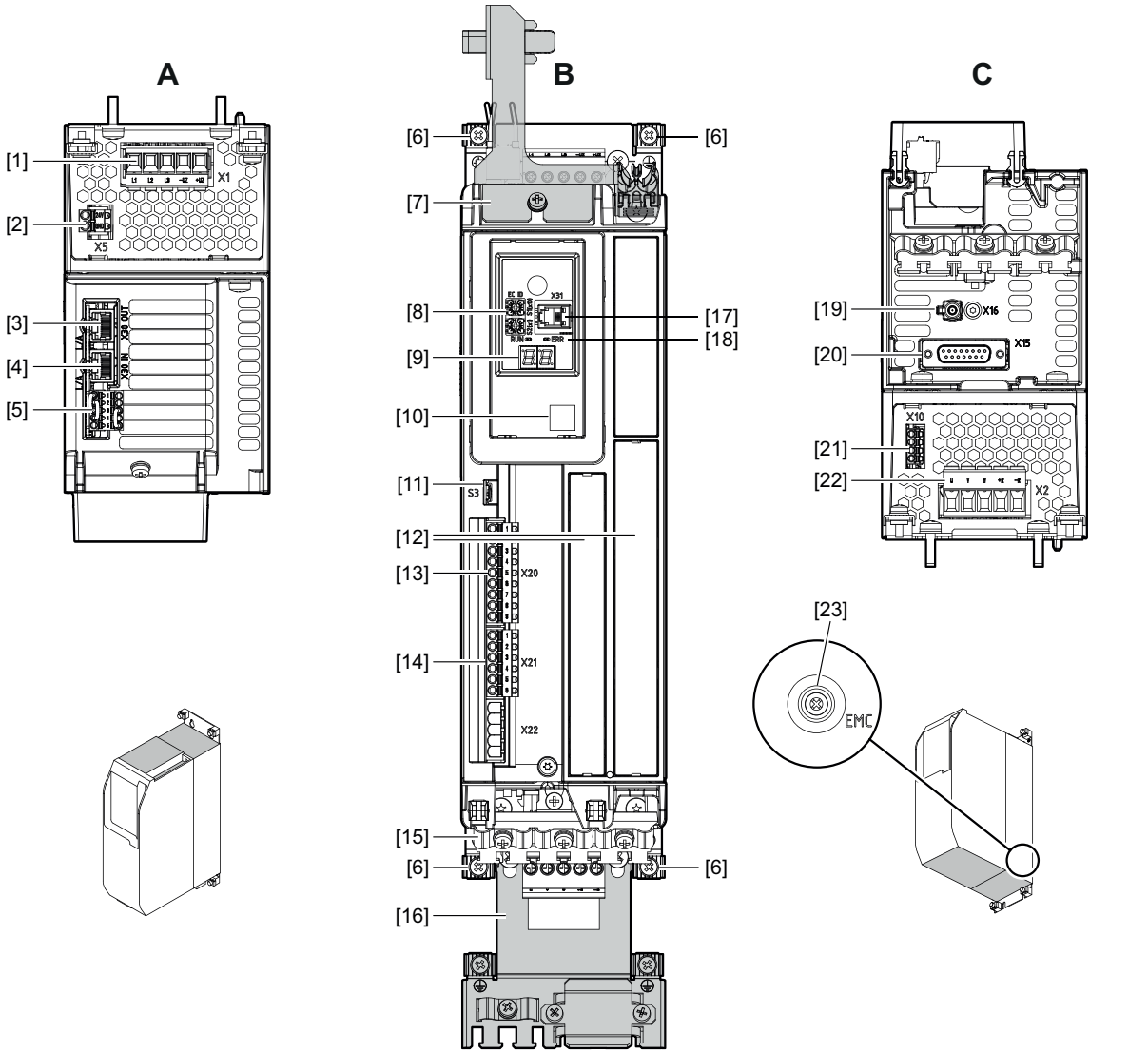
Contact	Conductor color	Function
1	White/green	RX+
2	Green	RX-
3	White/orange	TX+
4	Reserved	–
5	Reserved	–
6	Orange	TX-
7	Reserved	–
8	Reserved	–

31972098/EN – 8/2024

8 Device structure

8.1 Inverter

8.1.1 Size 1



54043209827806475

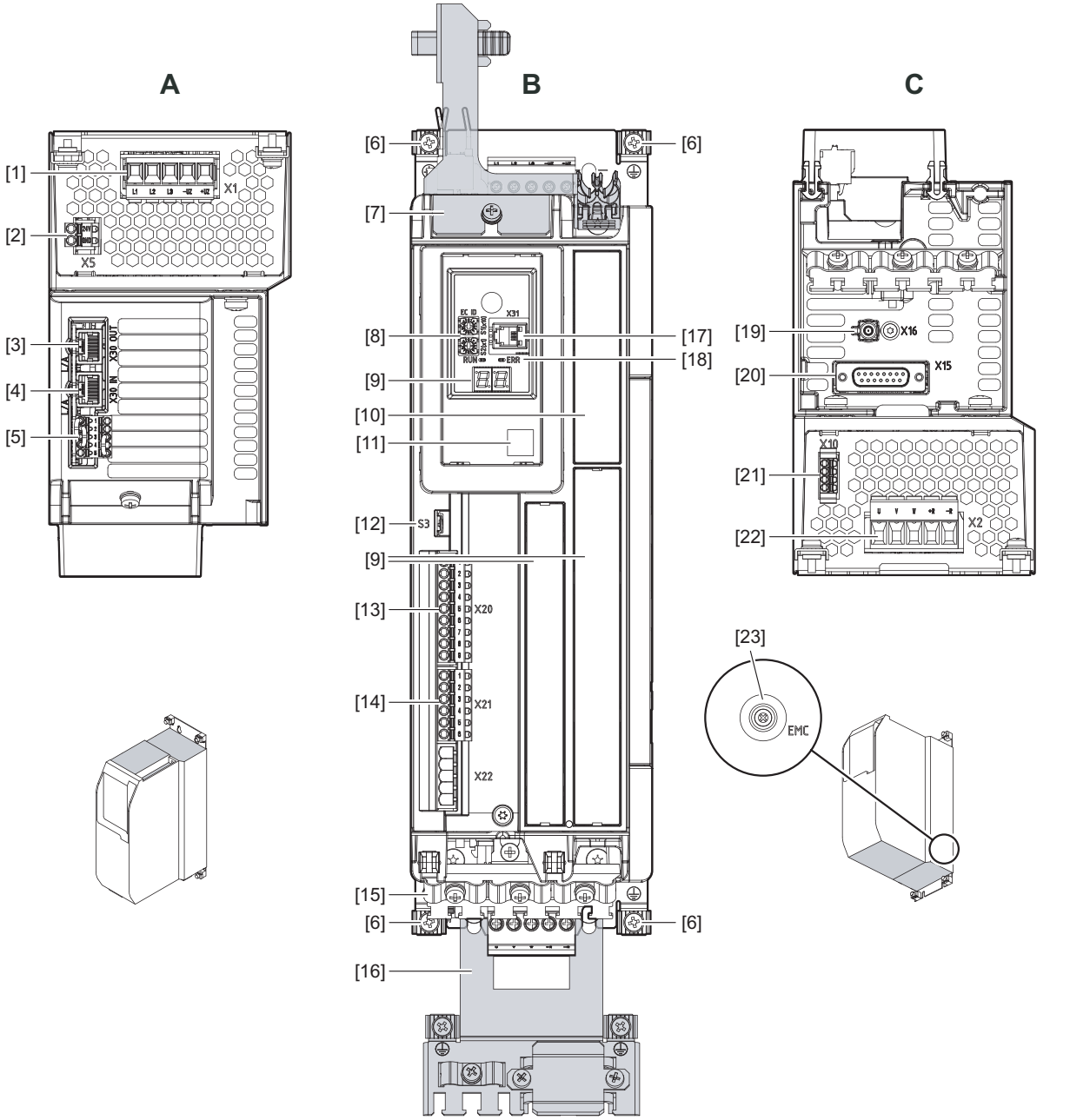
A View from top
[1] X1: Supply system and DC link connection
[2] X5: 24 V supply voltage
[3] X30 OUT: System bus
[4] X30 IN: System bus
[5] X6: Connection for Safe Torque Off (STO)

B View from front
[6] 4 × housing PE connection
[7] Shield plate
[8] EtherCAT® ID switch
[9] 7-segment display
[10] Product label with QR code
[11] S3: Switch for module bus operating mode
[12] Card slot
[13] X20: Digital inputs
[14] X21: Digital outputs
[15] Signal and control cable shield plate
[16] Signal and power cable shield plate
[17] X31: SEW-EURODRIVE service interface
[18] Status LEDs EtherCAT®/SBus^{PLUS} "RUN", "ERROR"

C View from below
[19] X16: MOVILINK® DDI connection
[20] X15: Motor encoder connection
[21] X10: Brake control and motor temperature monitoring
[22] X2: Motor and braking resistor connection
[23] EMC contact screw on the back of the inverter

31972098/EN – 8/2024

8.1.2 Size 2



54043209827816203

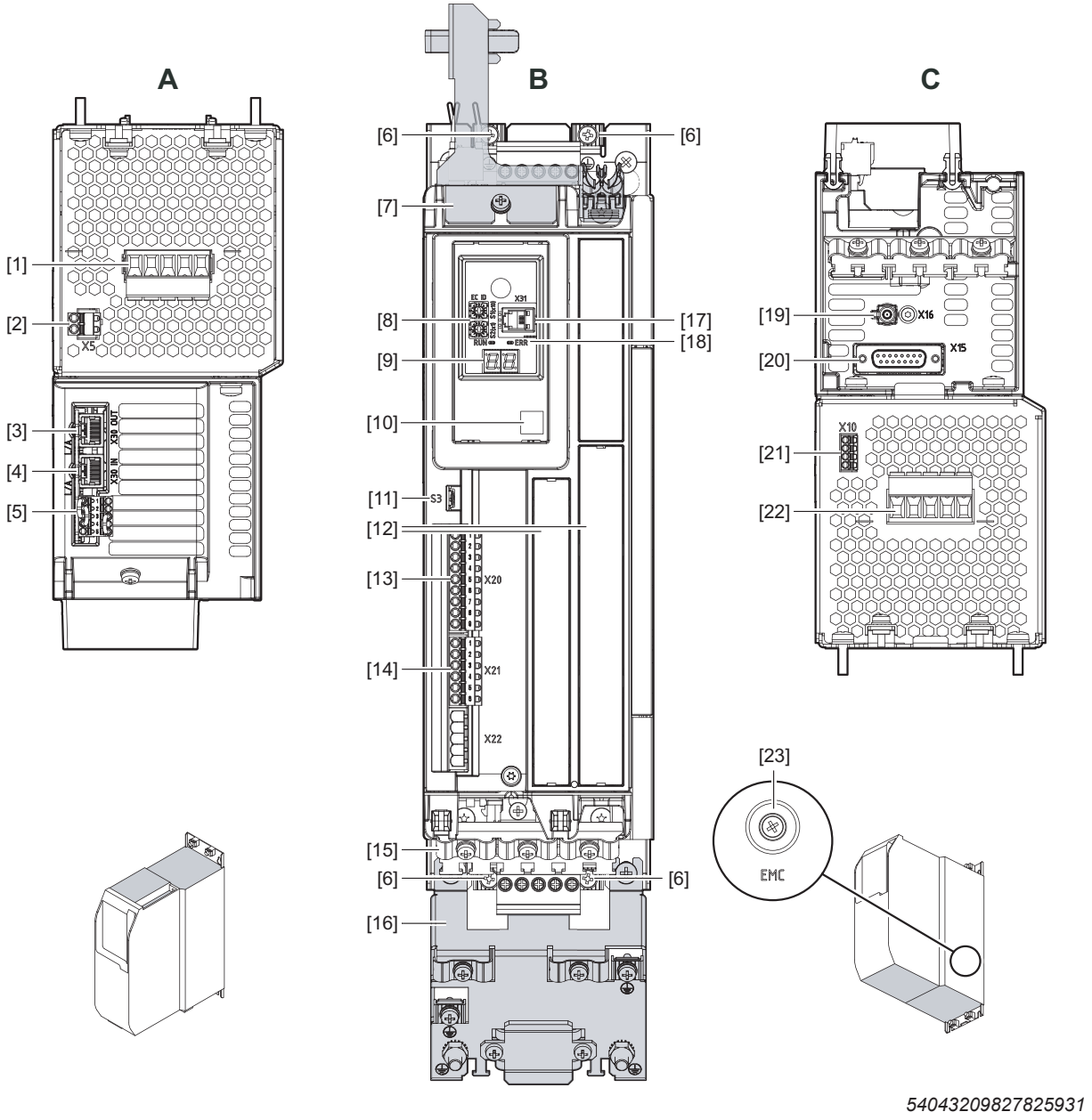
A View from top
[1] X1: Supply system and DC link connection
[2] X5: 24 V supply voltage
[3] X30 OUT: System bus
[4] X30 IN: System bus
[5] X6: Connection for Safe Torque Off (STO)

B View from front
[6] 4 × housing PE connection
[7] Shield plate
[8] EtherCAT® ID switch
[9] 7-segment display
[10] Product label with QR code
[11] S3: Switch for module bus operating mode
[12] Card slot
[13] X20: Digital inputs
[14] X21: Digital outputs
[15] Signal and control cable shield plate
[16] Signal and power cable shield plate
[17] X31: SEW-EURODRIVE service interface
[18] Status LEDs EtherCAT®/SBus^{PLUS} "RUN", "ERROR"

C View from below
[19] X16: MOVILINK® DDI connection
[20] X15: Motor encoder connection
[21] X10: Brake control and motor temperature monitoring
[22] X2: Motor and braking resistor connection
[23] EMC contact screw on the back of the inverter

31972098/EN – 8/2024

8.1.3 Size 3



54043209827825931

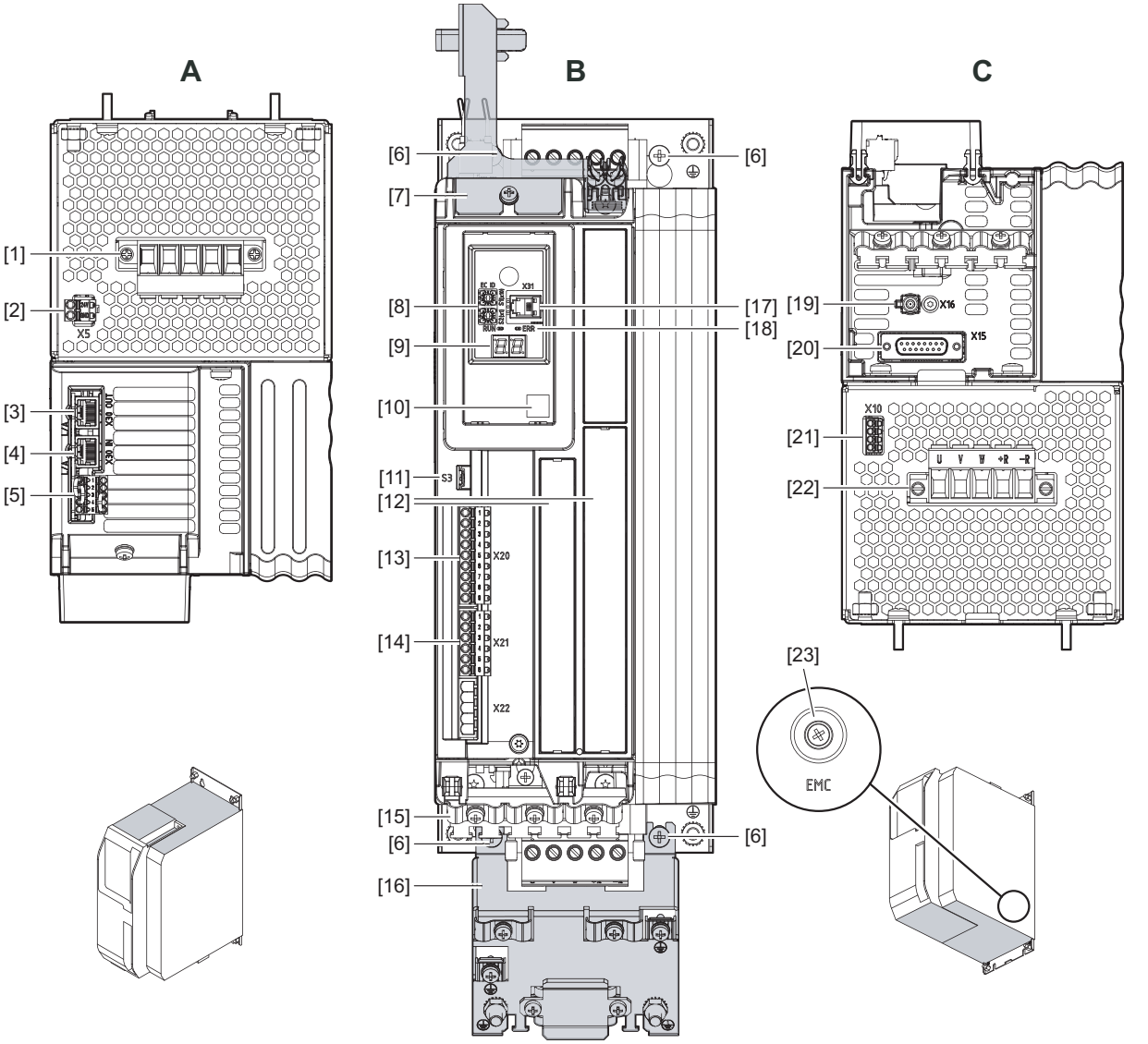
A View from top
[1] X1: Supply system and DC link connection
[2] X5: 24 V supply voltage
[3] X30 OUT: System bus
[4] X30 IN: System bus
[5] X6: Connection for Safe Torque Off (STO)

B View from front
[6] 4 × housing PE connection
[7] Shield plate
[8] EtherCAT® ID switch
[9] 7-segment display
[10] Product label with QR code
[11] S3: Switch for module bus operating mode
[12] Card slot
[13] X20: Digital inputs
[14] X21: Digital outputs
[15] Signal and control cable shield plate
[16] Signal and power cable shield plate
[17] X31: SEW-EURODRIVE service interface
[18] Status LEDs EtherCAT®/SBus^{PLUS} "RUN", "ERROR"

C View from below
[19] X16: MOVILINK® DDI connection
[20] X15: Motor encoder connection
[21] X10: Brake control and motor temperature monitoring
[22] X2: Motor and braking resistor connection
[23] EMC contact screw on the right side of the inverter

31972098/EN – 8/2024

8.1.4 Size 4



54043209827835659

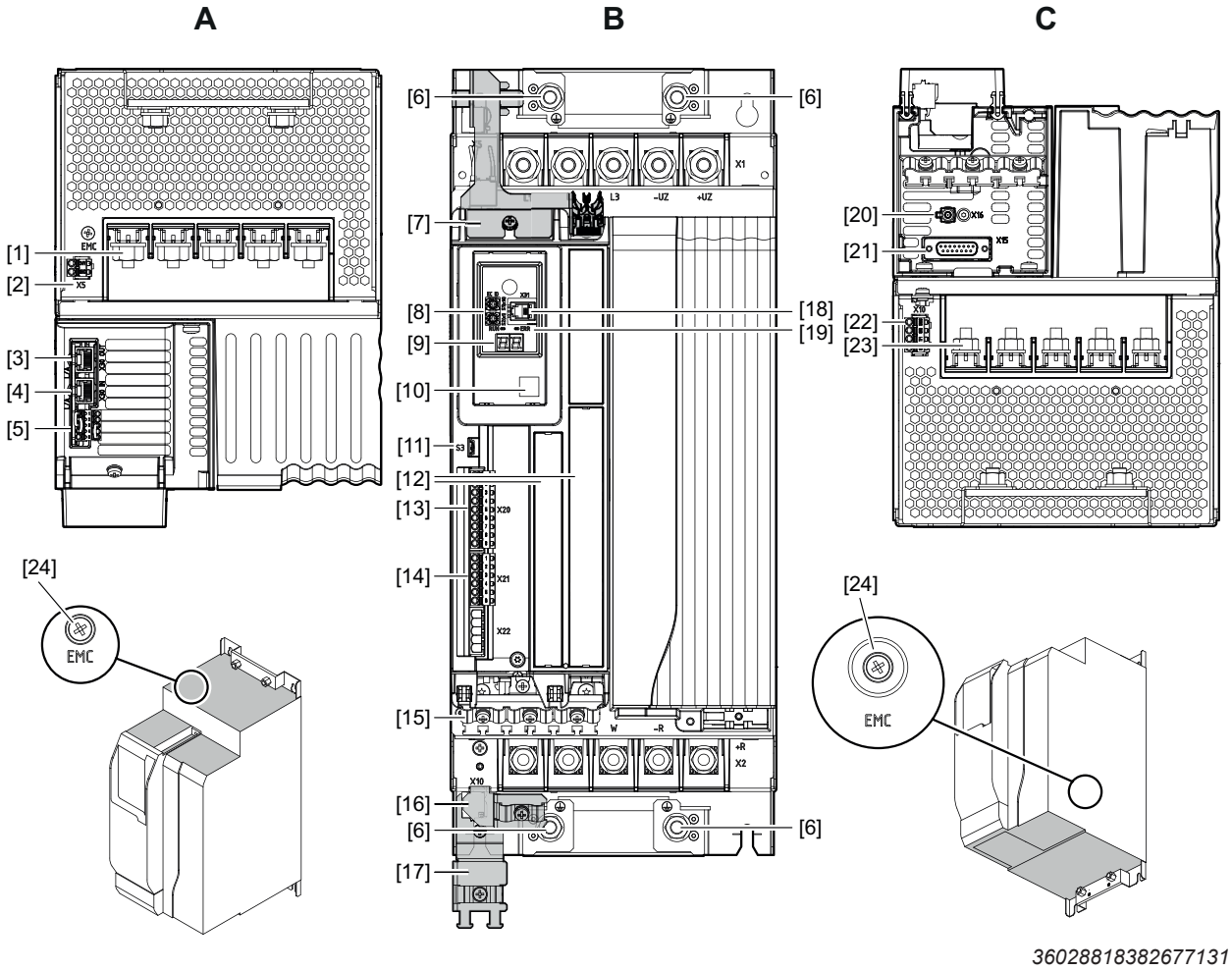
A View from top
[1] X1: Supply system and DC link connection
[2] X5: 24 V supply voltage
[3] X30 OUT: System bus
[4] X30 IN: System bus
[5] X6: Connection for Safe Torque Off (STO)

B View from front
[6] 4 × housing PE connection
[7] Shield plate
[8] EtherCAT® ID switch
[9] 7-segment display
[10] Product label with QR code
[11] S3: Switch for module bus operating mode
[12] Card slot
[13] X20: Digital inputs
[14] X21: Digital outputs
[15] Signal and control cable shield plate
[16] Signal and power cable shield plate
[17] X31: SEW-EURODRIVE service interface
[18] Status LEDs EtherCAT®/SBus^{PLUS} "RUN", "ERROR"

C View from below
[19] X16: MOVILINK® DDI connection
[20] X15: Motor encoder connection
[21] X10: Brake control and motor temperature monitoring
[22] X2: Motor and braking resistor connection
[23] EMC contact screw on the right side of the inverter

31972098/EN – 8/2024

8.1.5 Size 5



36028818382677131

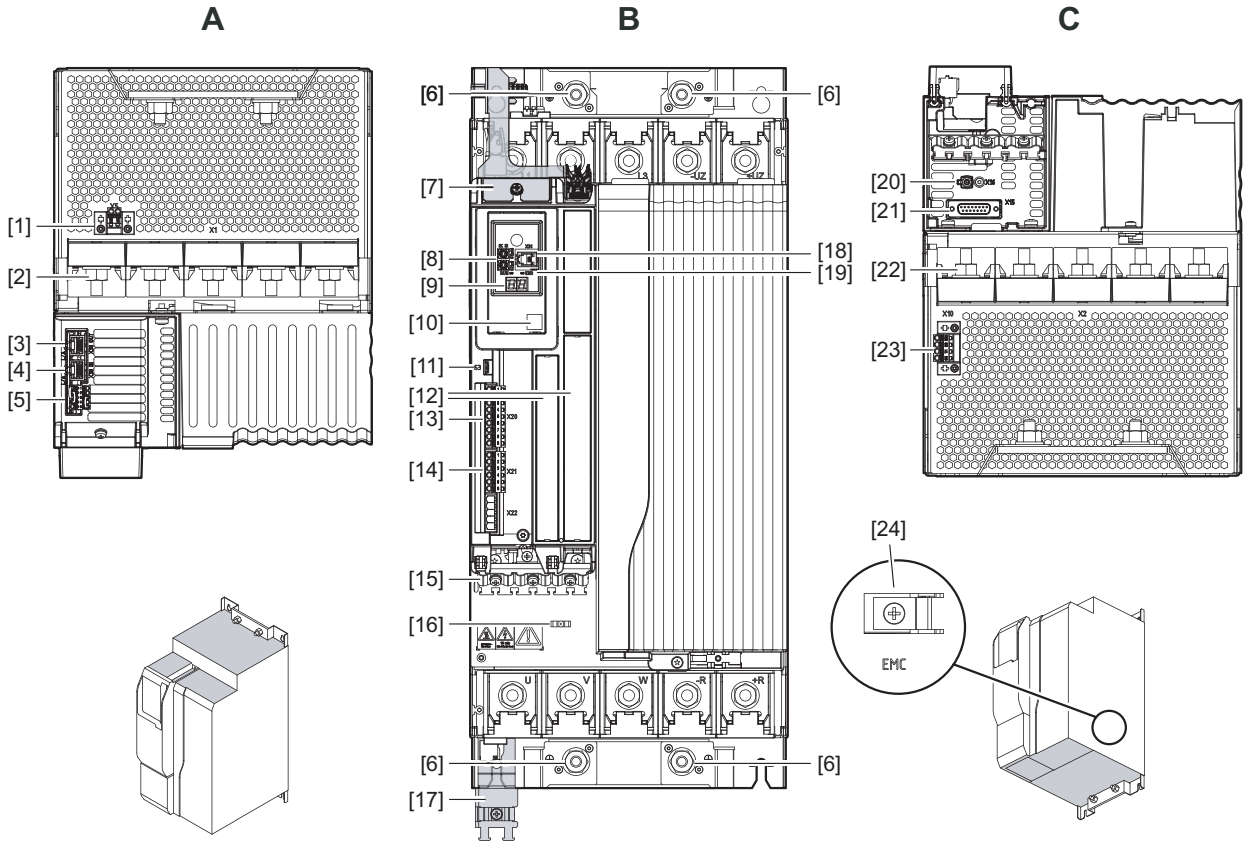
A View from top
[1] X1: Supply system and DC link connection
[2] X5: 24 V supply voltage
[3] X30 OUT: System bus
[4] X30 IN: System bus
[5] X6: Connection for Safe Torque Off (STO)

B View from front
[6] 4 × housing PE connection
[7] Shield plate
[8] EtherCAT® ID switch
[9] 7-segment display
[10] Product label with QR code
[11] S3: Switch for module bus operating mode
[12] Card slot
[13] X20: Digital inputs
[14] X21: Digital outputs
[15] Signal and control cable shield plate
[16] MOVILINK® DDI shield plate
[17] Encoder shield plate
[18] X31: SEW-EURODRIVE service interface
[19] Status LEDs EtherCAT®/SBus^{PLUS} "RUN", "ERROR"

C View from below
[20] X16: MOVILINK® DDI connection
[21] X15: Motor encoder connection
[22] X10: Brake control and motor temperature monitoring
[23] X2: Motor and braking resistor connection
[24] EMC contact screw on the top and another EMC contact screw on the right side of the inverter

31972098/EN – 8/2024

8.1.6 Size 6



36028820681712651

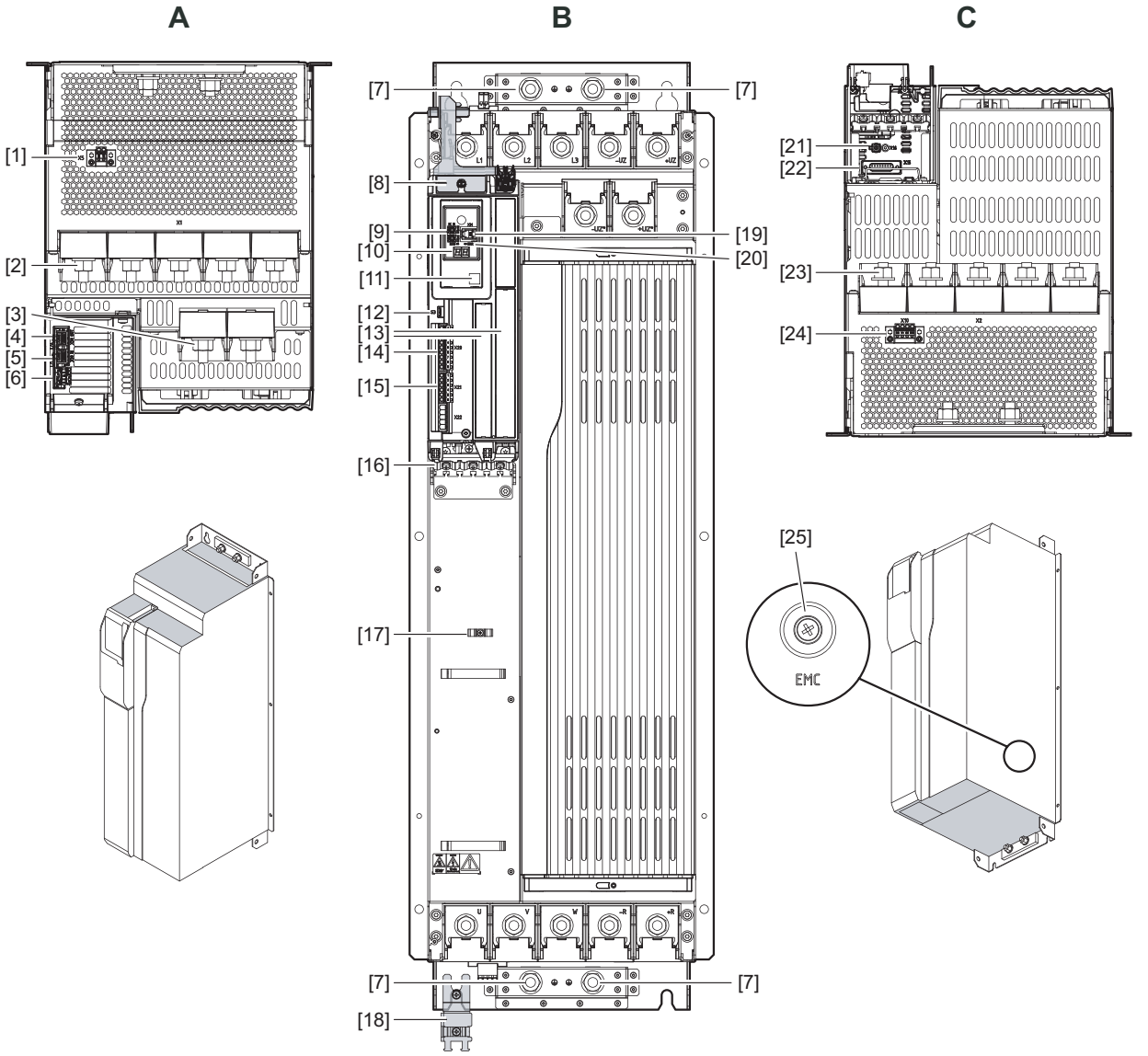
A View from top
[1] X5: 24 V supply voltage
[2] X1: Supply system and DC link connection
[3] X30 OUT: System bus
[4] X30 IN: System bus
[5] X6: Connection for Safe Torque Off (STO)

B View from front
[6] 4 × housing PE connection
[7] Shield plate
[8] EtherCAT® ID switch
[9] 7-segment display
[10] Product label with QR code
[11] S3: Switch for module bus operating mode
[12] Card slot
[13] X20: Digital inputs
[14] X21: Digital outputs
[15] Signal and control cable shield plate
[16] MOVILINK® DDI shield plate
[17] Encoder shield plate
[18] X31: SEW-EURODRIVE service interface
[19] Status LEDs EtherCAT®/SBus^{PLUS} "RUN", "ERROR"

C View from below
[20] X16: MOVILINK® DDI connection
[21] X15: Motor encoder connection
[22] X2: Motor and braking resistor connection
[23] X10: Brake control and motor temperature monitoring
[24] EMC contact screw on the right side of the inverter

31972098/EN – 8/2024

8.1.7 Size 7



18014434198373259

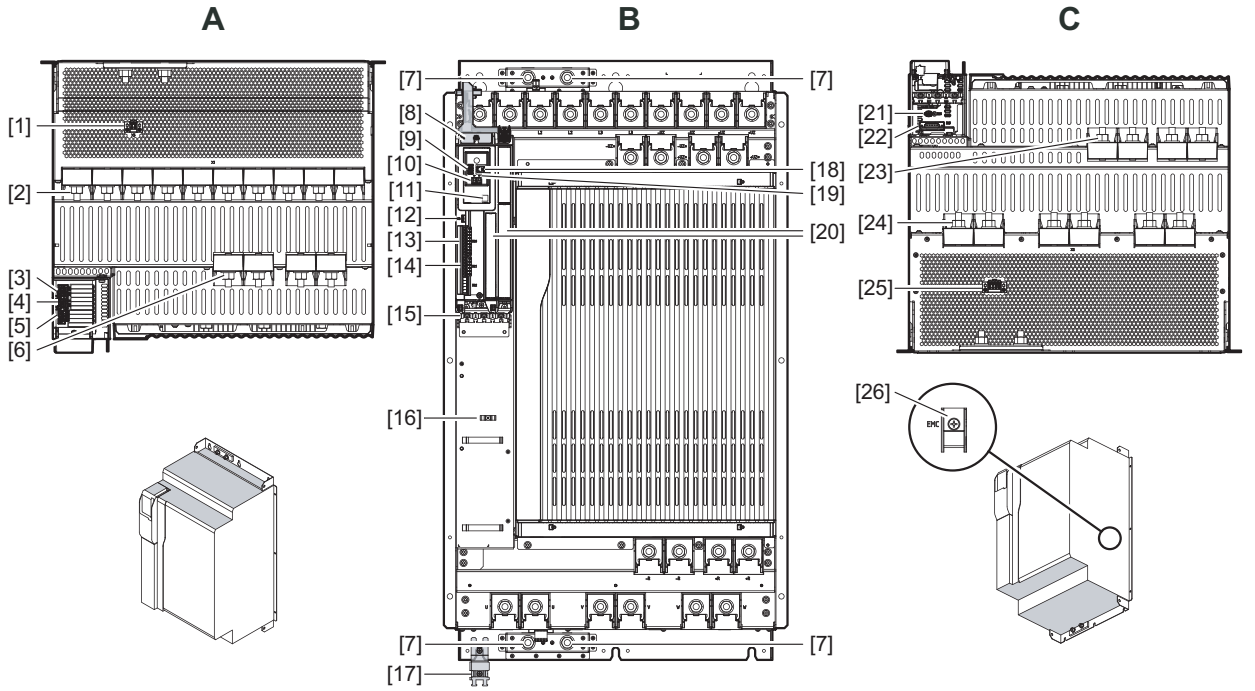
A View from top
[1] X5: 24 V supply voltage
[2] X1: Supply system connection and $+U_Z$, $-U_Z$: DC link connection before DC link choke
[3] $+U_Z$*, $-U_Z$* (V DC link): DC link connection after DC link choke
[4] X30 OUT: System bus
[5] X30 IN: System bus
[6] X6: Connection for Safe Torque Off (STO)

B View from front
[7] 4 × housing PE connection
[8] Shield plate
[9] EtherCAT® ID switch
[10] 7-segment display
[11] Product label with QR code
[12] S3: Switch for module bus operating mode
[13] Card slot
[14] X20: Digital inputs
[15] X21: Digital outputs
[16] Signal and control cable shield plate
[17] MOVILINK® DDI shield plate
[18] Encoder shield plate
[19] X31: SEW-EURODRIVE service interface
[20] Status LEDs EtherCAT®/SBus^{PLUS} "RUN", "ERROR"

C View from below
[21] X16: MOVILINK® DDI connection
[22] X15: Motor encoder connection
[23] X2: Motor and braking resistor connection
[24] X10: Brake control and motor temperature monitoring
[25] EMC contact screw on the right side of the inverter

31972098/EN – 8/2024

8.1.8 Size 8



9007241489312139

A View from top

[1] X5: 24 V supply voltage
[2] X1: Supply system connection and $+U_Z$, $-U_Z$: DC link connection before DC link choke
[3] X30 OUT: System bus
[4] X30 IN: System bus
[5] X6: Connection for Safe Torque Off (STO)
[6] $+U_Z$*, $-U_Z$* (V DC link): DC link connection after DC link choke

B View from front

[7] 4 × housing PE connection
[8] Shield plate
[9] EtherCAT® ID switch
[10] 7-segment display
[11] Product label with QR code
[12] S3: Switch for module bus operating mode
[13] X20: Digital inputs
[14] X21: Digital outputs
[15] Signal and control cable shield plate
[16] MOVILINK® DDI shield plate
[17] Encoder shield plate
[18] X31: SEW-EURODRIVE service interface
[19] Status LEDs EtherCAT®/SBus^{PLUS} "RUN", "ERROR"
[20] Card slot

C View from below

[21] X16: MOVILINK® DDI connection
[22] X15: Motor encoder connection
[23] Braking resistor connection
[24] X2: Motor connection
[25] X10: Brake control and motor temperature monitoring
[26] EMC contact screw on the right side of the inverter

8.2 MOVISAFE® CS..A device structure safety option

8.2.1 Type designation

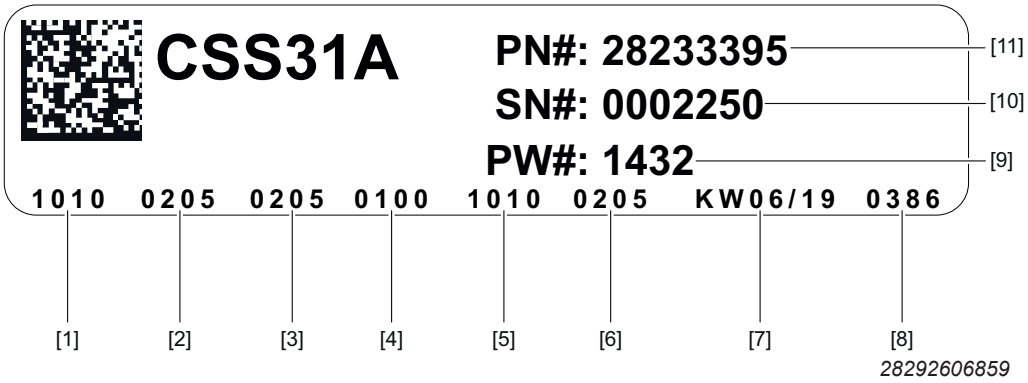
The type designation of MOVISAFE® CS..A contains the following data:

CSxx1A	MOVISAFE® CS..A safety option	
CS	Series:	
	C	MOVI-C® modular automation system option
	S	Safety
x	Function:	
	A	Advanced: Motion/positioning functions with safe encoder system
	B	Basic: Stop function without encoder
	L	Light: Movement functions with the EI7C FS encoder
	S	Standard: Motion functions with a safety encoder
x	Hardware design:	
	1	MOVITRAC®
	2	MOVIDRIVE® modular/system/technology without a 2nd encoder
	3	MOVIDRIVE® modular/system/technology with a 2nd encoder
	5	Electronics cover of the basic device (MOVI-C® decentralized electronics)
1	Design characteristic	
A	Technology version	

31972098/EN – 8/2024

8.2.2 Nameplate

In addition to the device nameplates on the basic device, a label is also attached to the rear of the CS..A safety option front cover. The following figure shows an example label:



[1] Safety option hardware ID

[2] Channel A firmware version (0205 = firmware version 2.05)

[3] Channel B firmware version (0205 = firmware version 2.05)

[4] EEPROM data set

[5] Safety key hardware ID

[6] Safety key data set

[7] Date of manufacture

[8] Internal inspection number

[9] Master password for changing the password

[10] Serial number

[11] Part number

8.2.3 Scope of delivery

- MOVISAFE® CS..A:
  - Safety option with plug-in spring-loaded terminals at X60.
  - Safety key

8.2.4 Compatibility

MOVISAFE® CS..A firmware version and MOVIDRIVE® device status

The use of the MOVISAFE® CS..A safety option depends on the following:

- the firmware version of the MOVISAFE® CS..A safety option.
- the device status of the MOVIDRIVE® modular/system/technology application inverter. The values for the status-related positions given in the following tables are minimum values.

  The device status can be found on the inverter's system nameplate.

MOVIDRIVE® system (MDX9.A..-S00) device status

If you have any questions about compatibility, please contact SEW-EURODRIVE Service with the serial number of your device.

For the CS..A safety option with firmware version 1.05, the MOVIDRIVE® firmware version 2.10 or later is required.

For the CS..A safety option with firmware version 2.05, the MOVIDRIVE® firmware version 4.00 or later is required.

For the CSA31A safety option with firmware version 3.02, the MOVIDRIVE® firmware version 7.00 or later is required.

MOVIDRIVE® system CiA402 (MDX9.A..-E00) device status

If you have any questions about compatibility, please contact SEW-EURODRIVE Service with the serial number of your device.

For the CS..A safety option with firmware version 2.05, the MOVIDRIVE® firmware version 4.00 or later is required.

For the CSA31A safety option with firmware version 3.02, the MOVIDRIVE® firmware version 7.00 or later is required.

MOVIDRIVE® device status for safety encoders with MOVLINK® DDI

The MOVISAFE® CS..A safety options as of firmware 5.01 support the use of safety encoders with MOVILINK® DDI. The CSS..A safety options must have at least the hardware version ".11". The safety encoders are supported by the MOVIDRIVE® modular/system/technology application inverters starting from firmware 11. A minimum value in the device status is also required.

If you have any questions about compatibility, please contact SEW-EURODRIVE Service with the serial number of your device.

MOVISAFE® CS..A firmware version and MOVISUITE® version

The use of the MOVISAFE® CS..A safety option depends on the following:

- the firmware version of the MOVISAFE® CS..A safety option.
- the version of the MOVISUITE® engineering software.

The table overview shows the following:

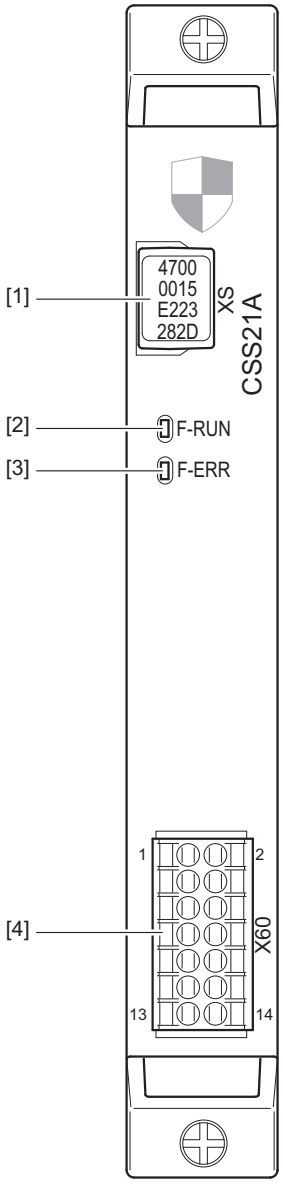
- The available CS..A safety options with the relevant part numbers depending on the firmware version.
- In case of service, you can order the MOVISAFE® CS..A safety options with firmware version 1.05 as a service kit by quoting the relevant part numbers. This means that no new acceptance of the safety sub-functions by changing the firmware is necessary when an option is replaced.

31972098/EN – 8/2024

CS..A safety option	CS..A firmware version	CS..A part number	MOVISUITE® version
CSB21A	1.05	28261976 (service kit)	1.2 and 2.0
CSS21A		28261984 (service kit)	
CSB31A		28261992 (service kit)	
CSS31A		28262018 (service kit)	
CSB21A	2.05 or higher	28233360	2.1 or higher
CSS21A		28233379	
CSB31A		28233387	
CSS31A		28233395	
CSA31A	3.02 or higher	28266412	2.20 or higher

31972098/EN – 8/2024

8.2.5 MOVISAFE® CSB21A/CSS21A

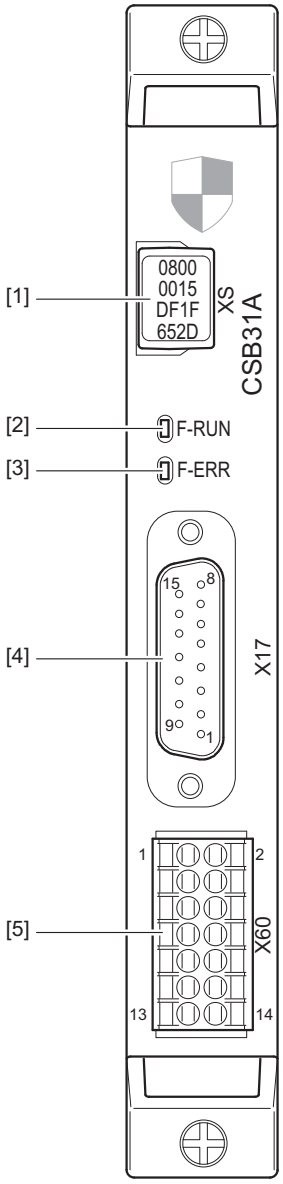


20367319307

[1] XS: Slot for the pluggable safety key
[2] "F-RUN" LED
[3] "F-ERR" LED
[4] X60: F-DIx and F-DOx connection

31972098/EN – 8/2024

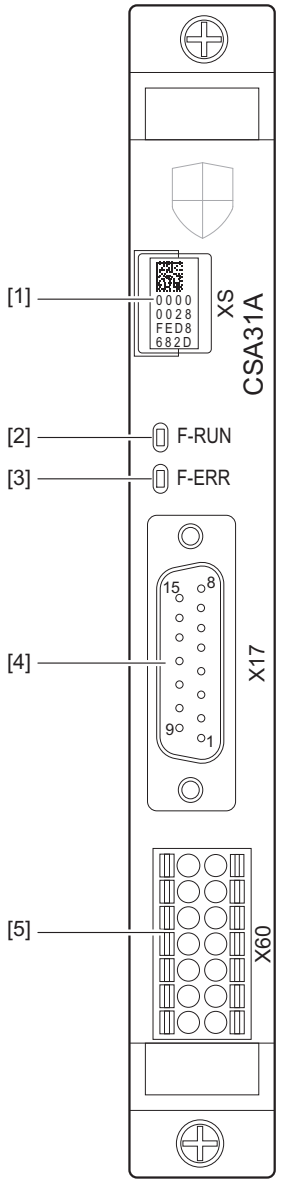
8.2.6 MOVISAFE® CSB31A/CSS31A



20370612875

[1] XS: Slot for the pluggable safety key
[2] "F-RUN" LED
[3] "F-ERR" LED
[4] X17: Connection of 2nd encoder (not used for functional safety)
[5] X60: F-DIx and F-DOx connection

8.2.7 MOVISAFE® CSA31A



32397079819

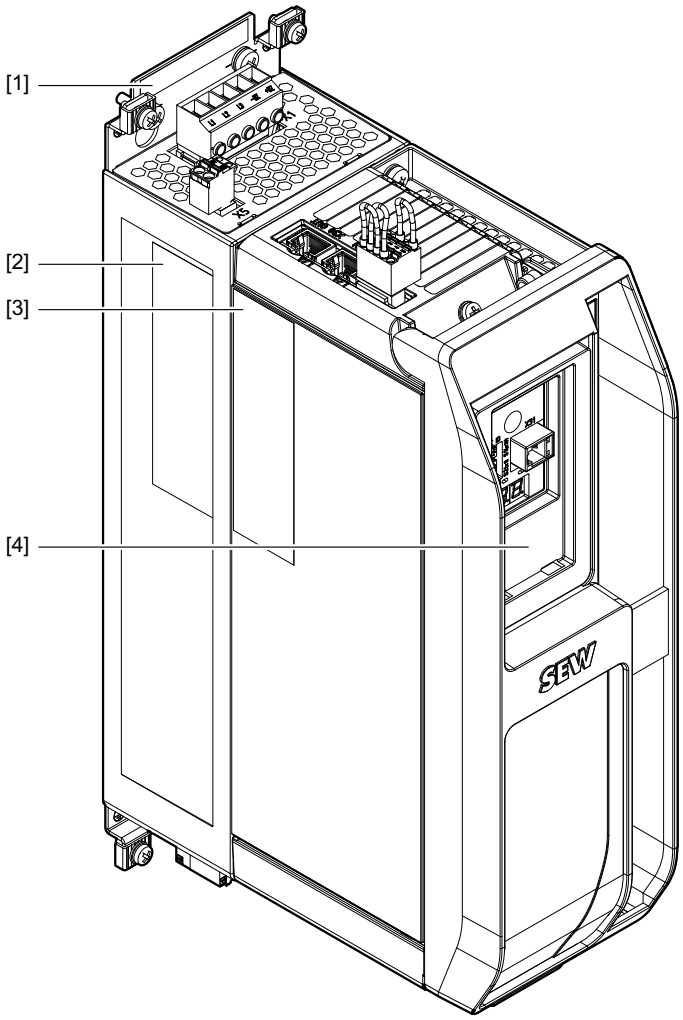
[1] XS: Slot for the pluggable safety key
[2] "F-RUN" LED
[3] "F-ERR" LED
[4] X17: Second encoder port (for use for functional safety)
[5] X60: F-DIx and F-DOx connection

31972098/EN – 8/2024

8.3 Nameplates

8.3.1 Nameplate positions

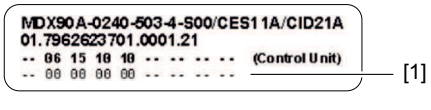
The following figure shows an example of the position of the nameplates and labels on the inverter:



50610950539

[1] Brief nameplate
[2] Performance data nameplate
[3] System nameplate
[4] Product label

8.3.2 Example of short nameplate

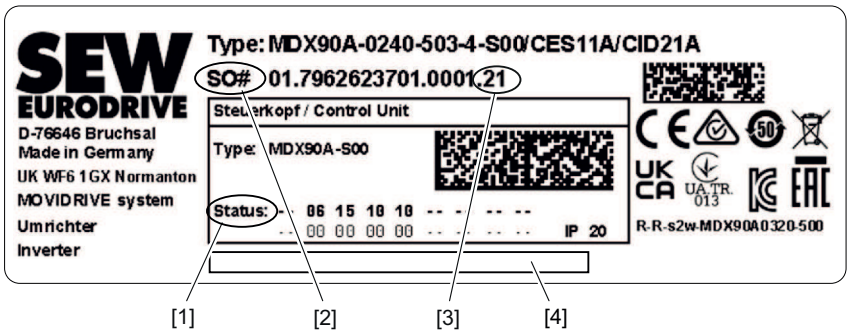


50623512843

[1] Device status

31972098/EN – 8/2024

8.3.3 Example of a system nameplate



45036011332165643

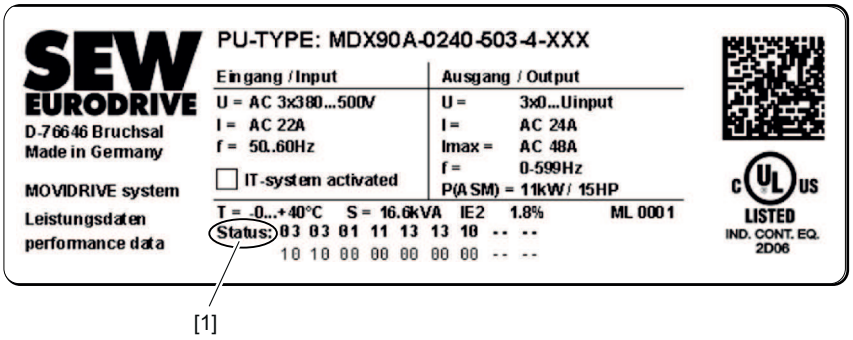
[1] Device status

[2] Serial number

[3] Year of manufacture as part of the serial number. Example: 21 → year of manufacture 2021

[4] Free text line, see product manual > chapter "Product description" > "Technologies" > "Free text on nameplate"

8.3.4 Example of a performance data nameplate



18014422417461003

[1] Device status

8.3.5 Product label

	Product label with QR code in accordance with IEC 61406. The QR code can be scanned. You will be redirected to the Digital Services of SEW-EURODRIVE. There, you have access to product-specific data, documents, and further services. **In the "Documentation" > "Data and documents" area, the product manual of the device with further information is available.**

31972098/EN – 8/2024

8.4 Type designation

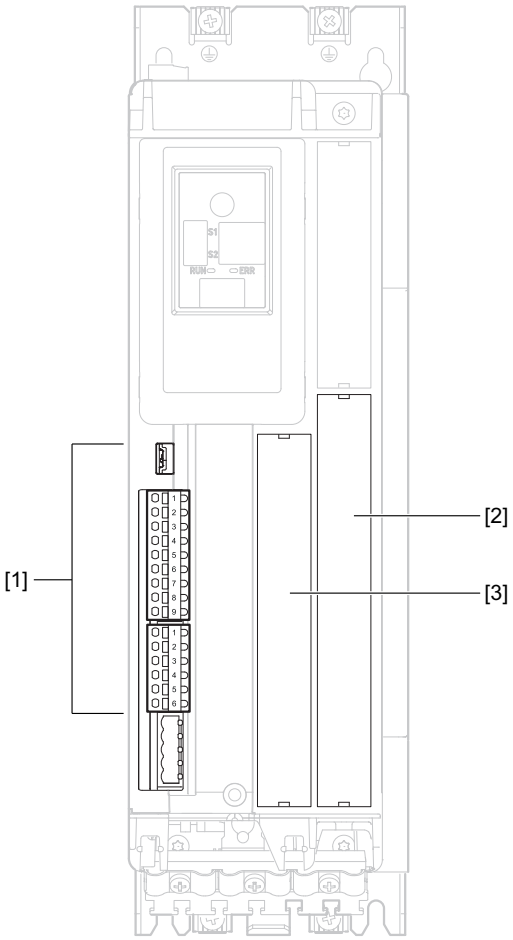
Example: MDX90A-0125-5E3-S00	
MD	**Product family** MOVIDRIVE®
X	**Device type** X = Single-axis inverter
90	**Series** 90 = Without DC 24 V switched-mode power supply 91 = With DC 24 V switched-mode power supply
A	**Version** A = Version status of the device series
0125	**Performance class** 0125 = Nominal output current, e.g. 0125 = 12.5 A
5	**Connection voltage** 2 = AC 200 – 240 V 5 = AC 380 – 500 V
E	**Power section variant EMC** 0 = Interference suppression integrated E = EMC filter limit value category C2 according to EN 61800-3
3	**Connection type** 3 = 3-phase connection type
S	**Device variant** 0 = Not relevant S = MOVIDRIVE® system: Control via MOVI-C® CONTROLLER E = Inverter with CiA402 device profile
0	**Technology level** 0 = Standard design
00	**Application level** 0 = Standard/MOVIKIT® Velocity Drive 1 = MOVIKIT® Positioning Drive 2 = Customized solution
	Options /L = Design with painted printed circuit boards /P = Parameters ex-works The following list is an example: /CES11A = Multi-encoder card /CES12A = multi-encoder card with incremental encoder simulation /CID21A, /CIO21A = Input/output cards /CS..A = MOVISAFE® CS..A safety option

31972098/EN – 8/2024

8.5 Card slots

The inverters can have up to 2 cards installed. The following section describes the assignment of the slots and possible combinations of cards.

Type designation	Description	Slot
CES11A	Multi-encoder card	[2]
CES12A	Multi-encoder card with incremental encoder simulation	[2]
CS..A	MOVISAFE® safety options	[2]
CID21A, CIO21A	Input/output cards	[3]



[1] Connector panel of basic unit

[2] Slot safety option/multi-encoder card

[3] Slot for input/output cards

31972098/EN – 8/2024

9 Mechanical installation

9.1 Installation notes

According to the degree of protection, the inverter is intended exclusively for installation in a control cabinet.

Observe the following information:

- Only install the device on a level, low-vibration, and torsionally rigid support structure.
- Observe the weight of the unit and the permissible tightening torques of the fasteners.
- Check the validity of the degree of protection using the information in the operating instructions and the data on the nameplate.
- Make sure that the cooling air supply is unobstructed; warm exhaust air from other units must not influence the cooling.

9.2 Installation requirements

Check that the following conditions have been met:

- The device is undamaged (no damage caused by transport or storage).
- The ambient temperature corresponds to the specification in the operating instructions and the nameplate.

Refer to the ambient conditions in the **Product manual** > chapter "Technical data" (→ 🗎 36).

9.3 Minimum clearance and mounting position

Observe the following information:

- To ensure unobstructed cooling, leave a minimum clearance of 100 mm above and below the inverter housings. Ensure that the air circulation in this clearance is not impaired by cables or other installation equipment.
- Make sure that the inverters are not exposed to the exhaust air from other units.
- Only install the inverters vertically. Do not install them horizontally, tilted or upside down.
- A lateral clearance of at least 100 mm is only required for size 8. All other devices may be placed directly next to each other.

INFORMATION

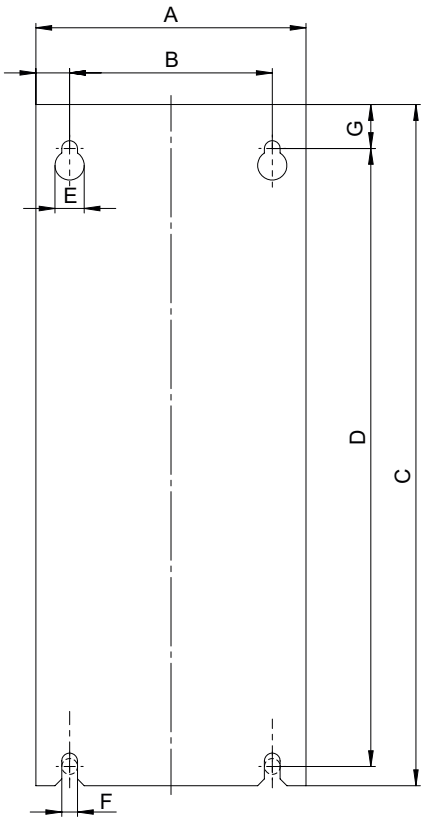
Special bending spaces are required according to EN 61800-5-1 for cables with a cross section of 10 mm^2 and larger. Increase the size of the spaces if necessary.

31972098/EN – 8/2024

9.4 Preparing the control cabinet back panel

Proceed as follows:

1. Drill the holes according to the following drilling diagram.
2. Cut the internal thread in the holes according to the screw size used.



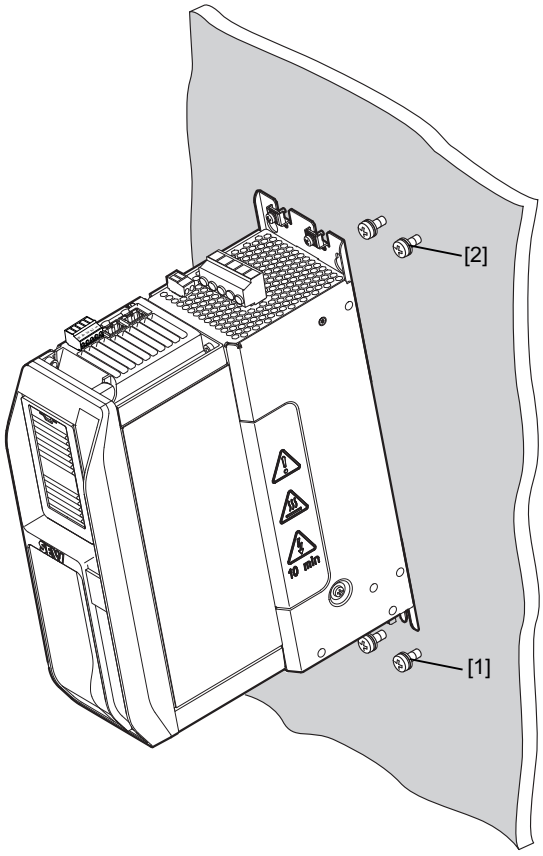
9007215129195275

Inverter	Dimensions of the device base plate in mm						
	A	B	C	D	E	F	G
Size 1	95	50	350	325	12	6	18
Size 2	105	50	350	325	12	6	18
Size 3	105	80	350	325	12	6	18
Size 4	135	80	350	325	12	6	18
Size 5	196	160	471	440	13	7	18
Size 6	240	200	544	510	13	7	18
Size 7	320	220	990	950	23	11	25
Size 8	518	450	990	950	23	11	25

31972098/EN – 8/2024

9.5 Installing inverter sizes 1 – 8

Proceed as follows:



18014413535715339

The retaining screws [1] and [2] are screwed into the prepared tapped holes in the mounting plate in the control cabinet but are not tightened.

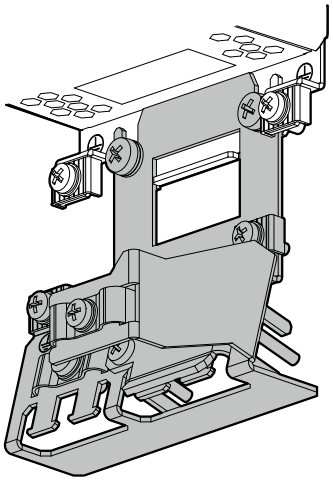
1. Place the inverter with the slotted holes in the device base plate onto the retaining screws [1] from the top.
2. Push the inverter backwards to insert the retaining screws [2] into the upper holes in the device base plate.
3. Lower the inverter.
4. Tighten the retaining screws [1] and [2].

31972098/EN – 8/2024

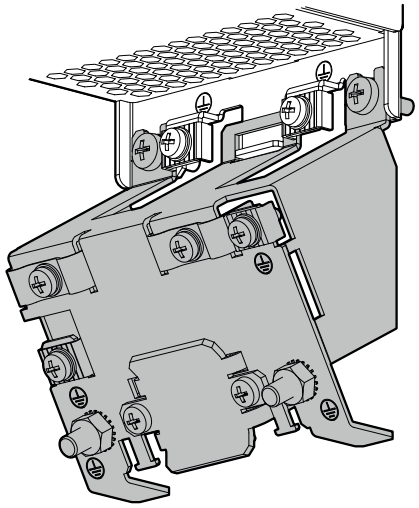
9.6 Installing the shield plate for the power section

A set of shield terminals is supplied as standard for the power section sizes 1 – 4. The shield terminals for the power section provide you with a way of installing the shield for the motor, brake and braking resistor cables. The shield terminals are not yet installed on the unit. Install the shield terminal on the power section together with the unit's retaining screws. Insert the shield terminal as follows:

- **Sizes 1 – 2**



- **Sizes 3 – 4**



41704495371

- **Sizes 5 – 8**

  No shield terminals for the power section are supplied with the sizes. Use commercially available shield terminals for installing the shielding of motor, brake and braking resistor cables. Apply the shielding as closely as possible to the inverter.

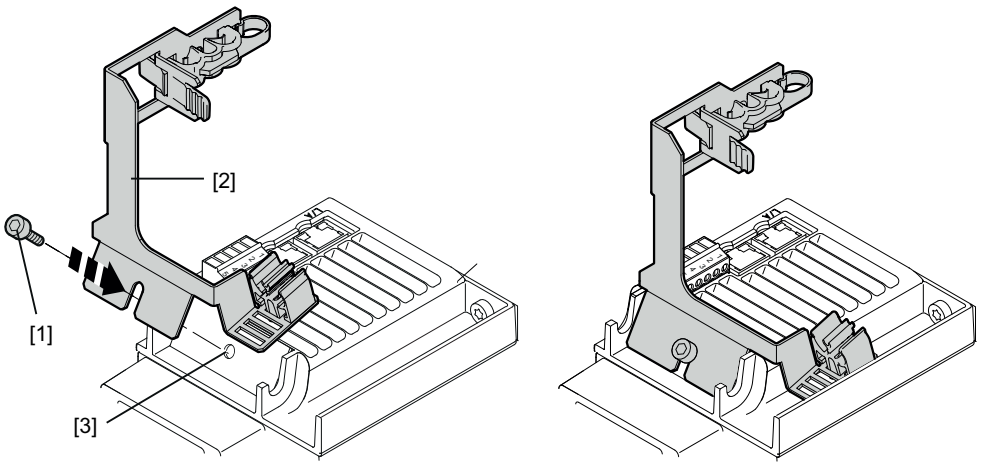
31972098/EN – 8/2024

9.7 Installing the shield plate for signal cables

9.7.1 Installing the top shield plate

Proceed as follows:

1. Insert the shield plate [2] so that you can fasten it to the device housing [3] with the screw [1].

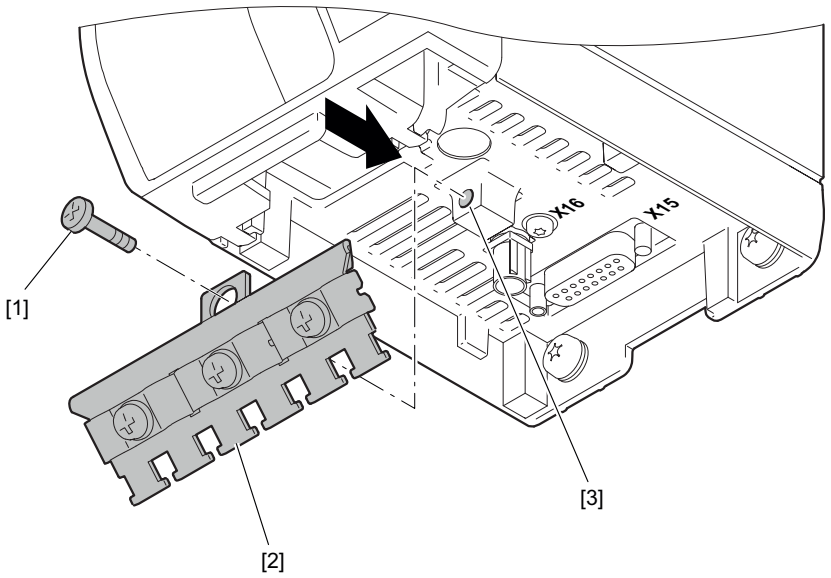


9007226776251659

9.7.2 Installing the bottom shield plate

Proceed as follows:

1. Insert the shield plate [2] so that you can fasten it with the screw [1] in the position [3] shown in the figure.



9007226776248075

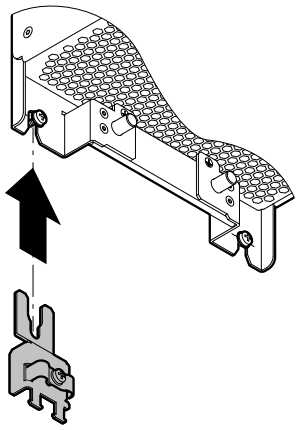
31972098/EN – 8/2024

9.7.3 Installing the shield plate for the encoder

Proceed as follows:

A shield terminal is supplied as standard for the encoder from size 5 and larger. The shield terminal is not yet installed on the unit.

1. Loosen one of the lower retaining screws securing the inverter to the control cabinet back panel, but do not unscrew it completely.
2. Install the shield plate as shown.



43024920971

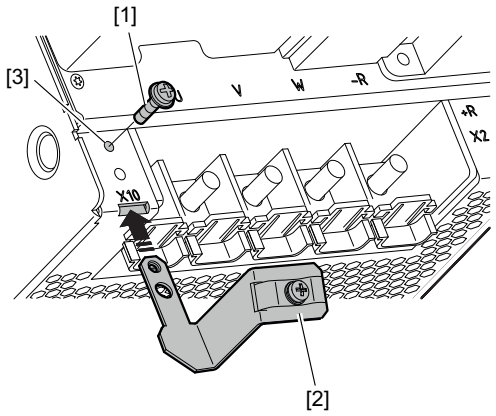
3. Retighten the retaining screws to secure the inverter to the control cabinet back panel.

9.7.4 Installing the shield plate for MOVILINK® DDI

Proceed as follows:

A shield plate is supplied as standard for MOVILINK® DDI from size 5 and larger. The shield plate is not yet installed on the unit.

1. Insert the shield plate [2] so that you can fasten it with the screw [1] in the position [3] shown.



18014432994211979

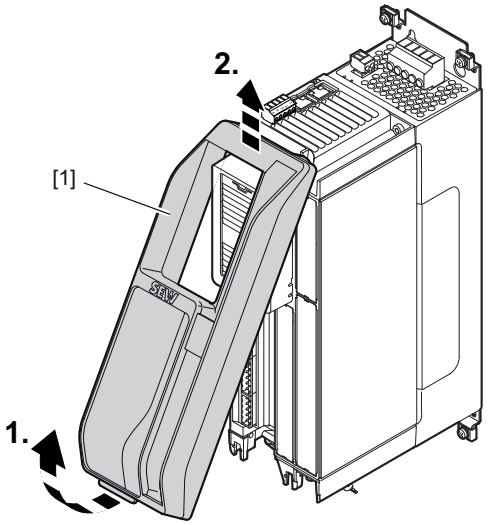
31972098/EN – 8/2024

9.8 Removing and attaching the safety cover

Proceed as follows:

The inverter is equipped with a safety cover [1].

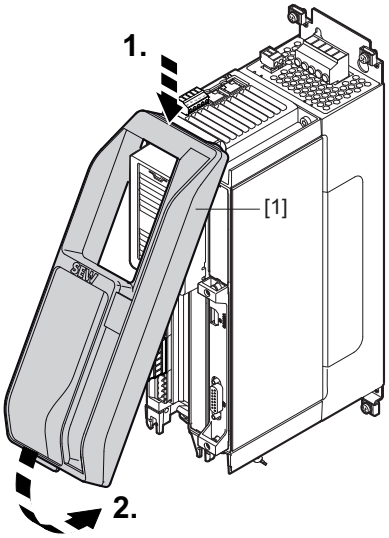
Removing the safety cover



18014412808876555

1. The safety cover [1] has a latching mechanism at the bottom. Pull the lower part of the safety cover away from the inverter to unlatch it.
2. Pivot the safety cover forward and lift it up and out of the mounting.

Installing the safety cover



18014413087937291

3. Place the safety cover [1] into the upper recess and move it towards the inverter until it clicks into place.
4. Always attach the safety cover [1] after having carried out installation work.

31972098/EN – 8/2024

9.9 Removing and reinstalling the touch guards

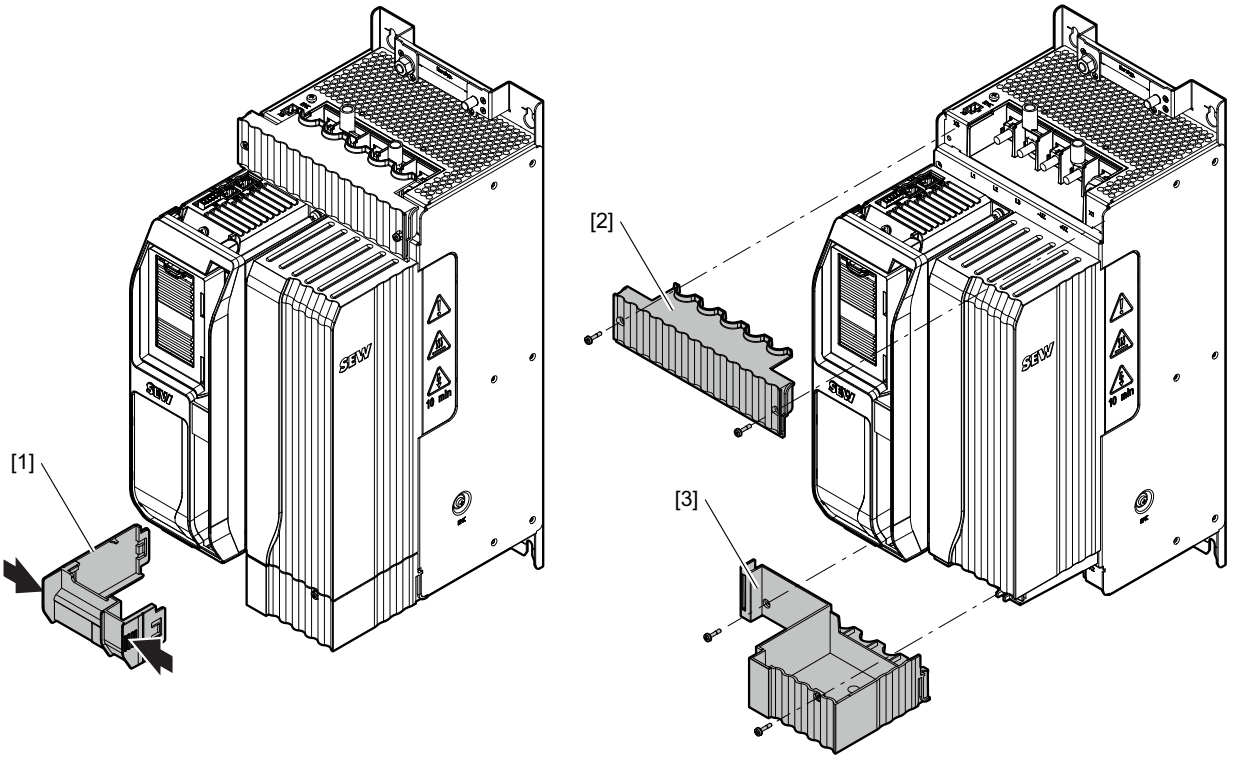
For inverters of size 5 and higher, touch guards must be removed for the line and DC link connection and the connection of the motor and braking resistor, and then reinstalled afterward.

When removing the touch guards, first remove the cover. When mounting the touch guards, attach the cover afterwards. Otherwise, the touch guards can be disassembled and assembled in any order.

Observe chapter "Permitted terminal tightening torques" (→ 🗎 351).

9.9.1 Size 5

The following figure shows an example of the touch guards of the inverter:



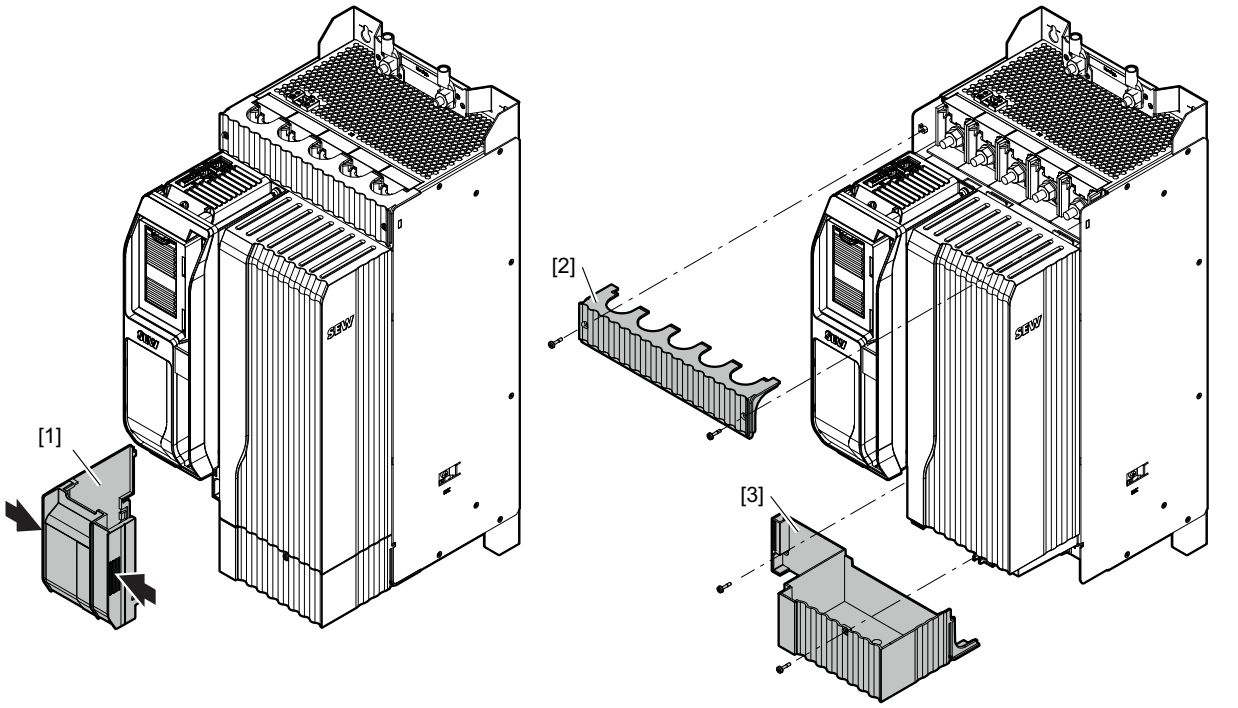
42739197451

[1] Cover
[2] Touch guard for connection of supply system and DC link
[3] Touch guard for connection of motor and braking resistor

31972098/EN – 8/2024

9.9.2 Size 6

The following figure shows an example of the touch guards of the inverter:



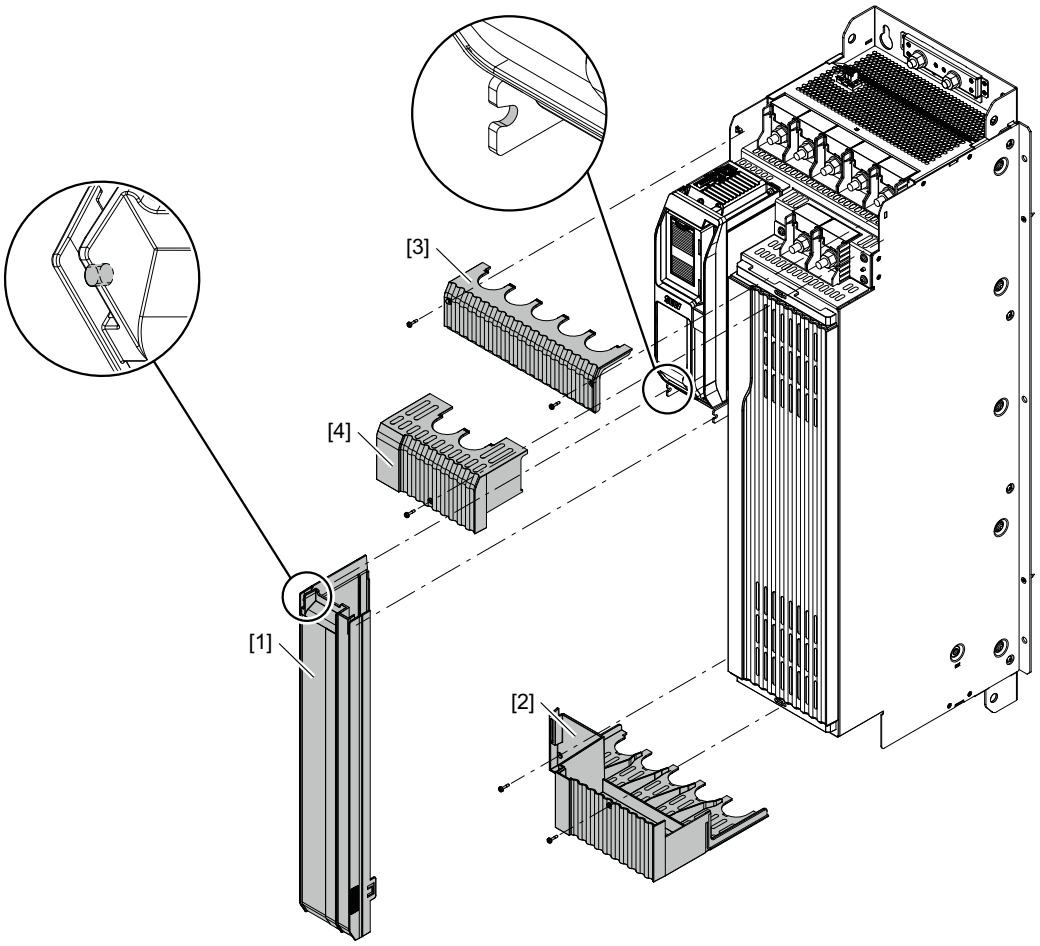
42739199883

[1] Cover
[2] Touch guard for connection of supply system and DC link
[3] Touch guard for connection of motor and braking resistor

31972098/EN – 8/2024

9.9.3 Size 7

The following figure shows an example of the touch guards of the inverter:



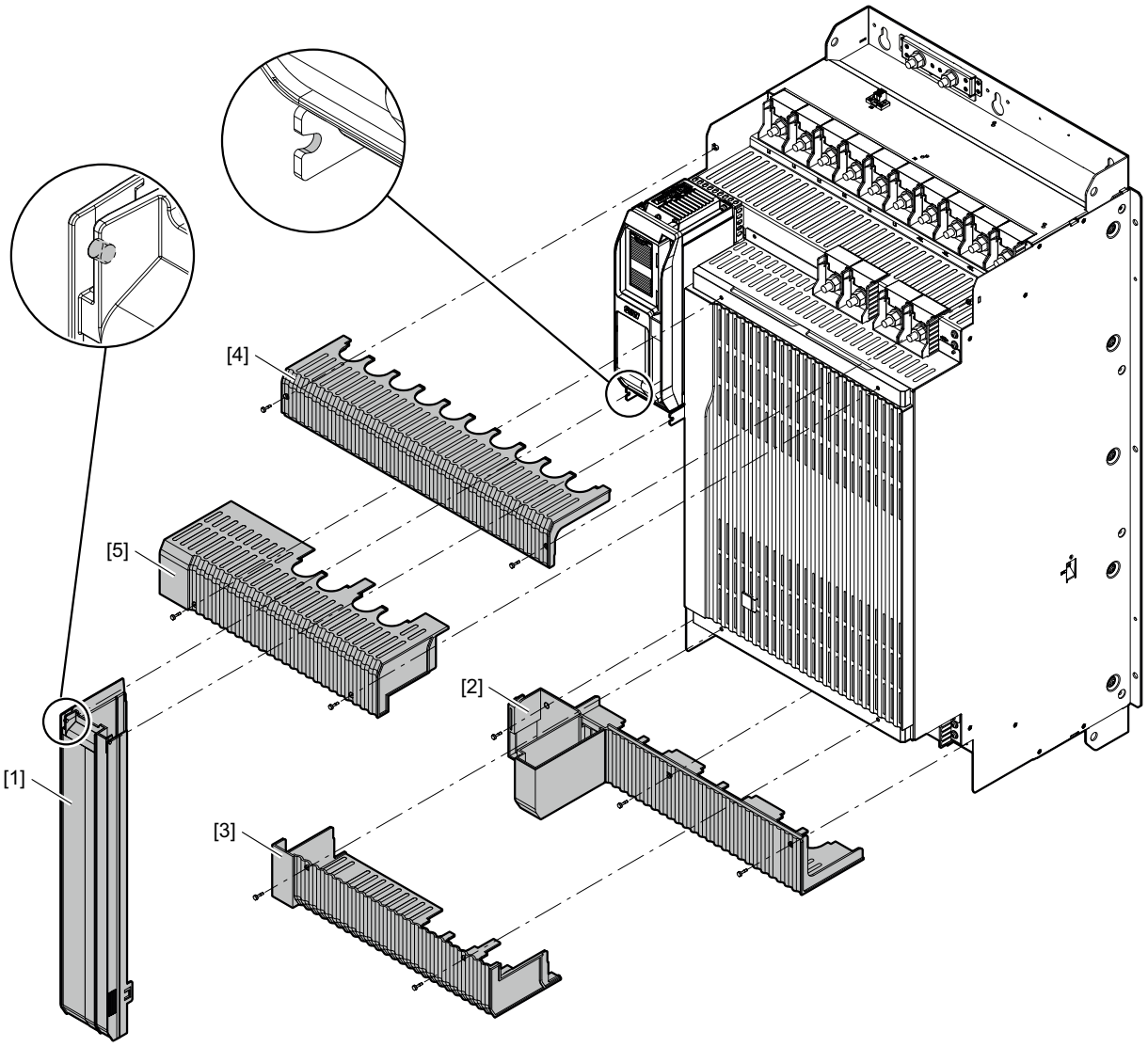
42739202315

[1] Cover
[2] Touch guard for connection of motor and braking resistor
[3] Touch guard for connection of supply system and DC link
[4] Touch guard for connection of DC link before DC link choke

31972098/EN – 8/2024

9.9.4 Size 8

The following figure shows an example of the touch guards of the inverter:



42739204747

[1] Cover
[2] Touch guard for connection of motor and braking resistor, part 1
[3] Touch guard for connection of motor and braking resistor, part 2
[4] Touch guard for connection of supply system and DC link
[5] Touch guard for connection of DC link before DC link choke

31972098/EN – 8/2024

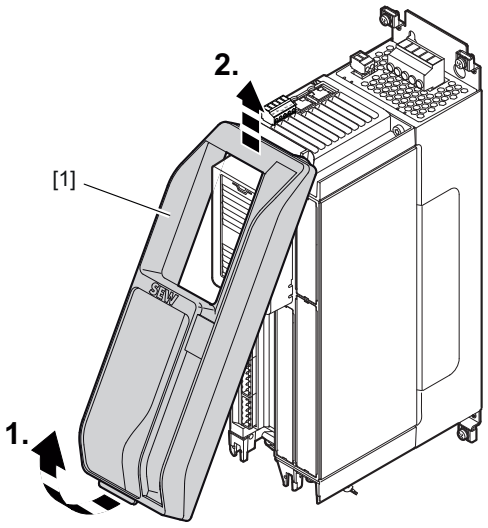
9.10 Installing a card

Observe the safety notes in chapter "Electrical installation" (→ 🗎 346).

For information on which option card can be installed in which slot, refer to chapter "Device structure" (→ 🗎 299) > "Card slots".

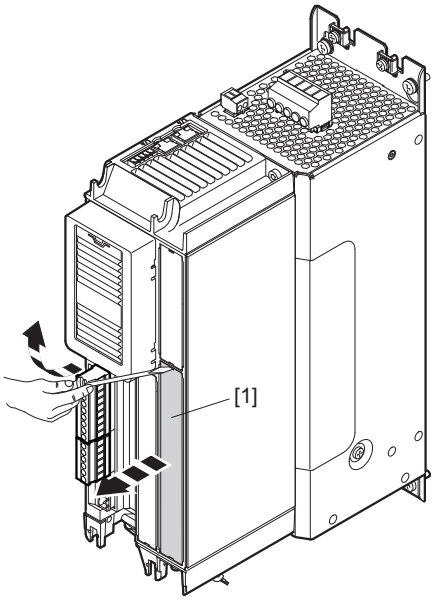
The procedure shows an example of the installation of a multi-encoder card CES11A.

1. Disconnect the inverter from the power. Switch off the external 24 V voltage supply for the electronics and the line voltage supply.
2. Before starting work, ensure electrostatic discharge with suitable measures. Suitable measures for equipotential bonding include, for example, using a discharge strap or wearing conductive shoes.
3. Remove the safety cover [1] from the front of the inverter. The slot in which the card is installed depends on the card used.



18014412808876555

4. Remove the plastic cover [1] of the card slot using a screwdriver.



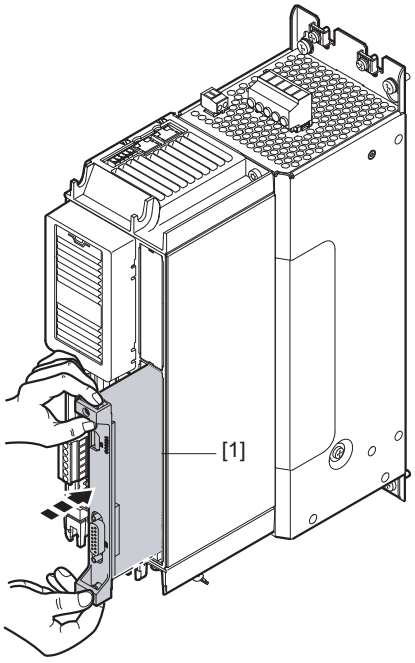
15160620811

31972098/EN – 8/2024

INFORMATION

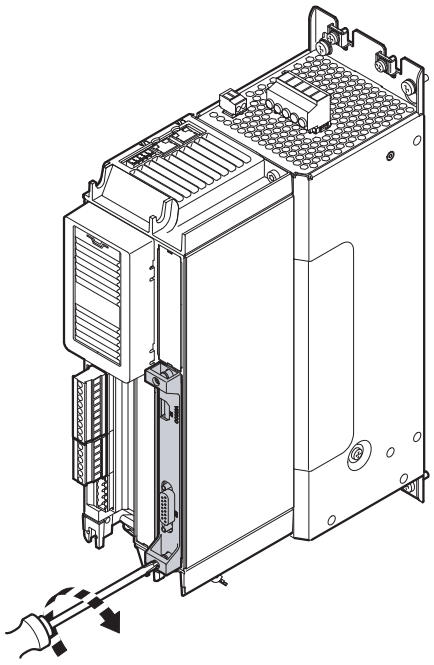
Hold the card by its edges only.

5. Take the card [1] and insert it into the slot with slight pressure.



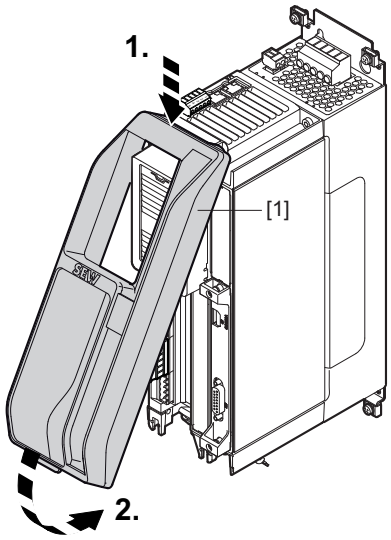
15160623243

6. Screw in the card with the specified "tightening torque" (→ 🗎 351).



15160625675

7. Attach the safety cover [1] to the front of the inverter again.



18014413087937291

9.11 Installing braking resistors

The surfaces of the braking resistors will reach temperatures of up to 250 °C when the braking resistors are loaded with the nominal power. The installation location of the braking resistor must be designed according to the high temperatures. For this reason, the braking resistors are usually mounted outside the control cabinet. Non-permissible installation might lead to heat build-up in the braking resistor due to reduced convection. A tripping temperature contact or an overheated braking resistor can lead to a system standstill.

9.11.1 Minimum clearances for convection cooling

The following minimum clearances must be observed for convection cooling depending on the continuous braking power and the mounting position.

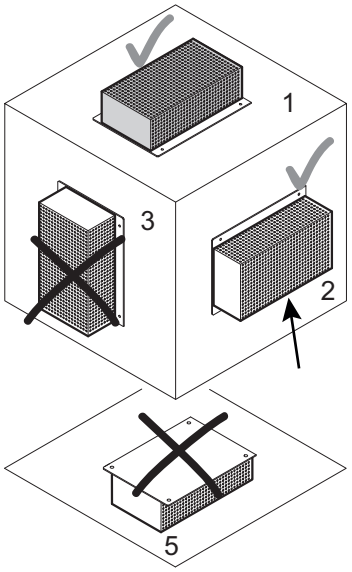
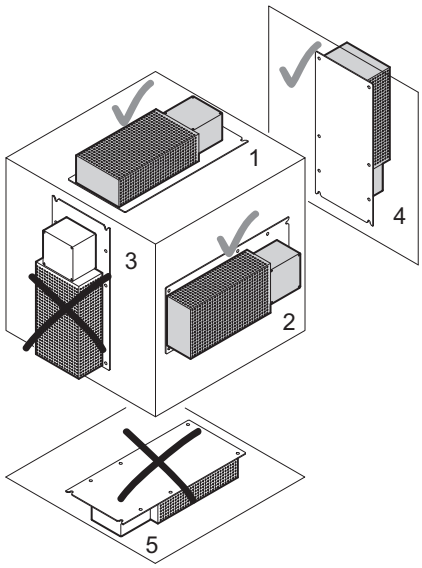
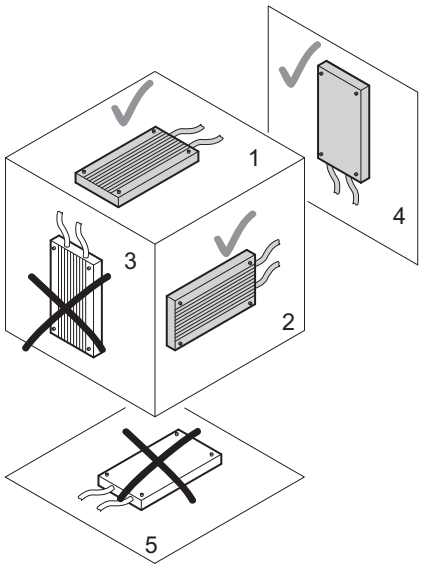
Continuous braking power at 100% cdf	Mounting position	Lateral distance in mm	Distance below in mm	Distance above in mm
up to 1 kW	horizontal[1)]	200	0	350
	vertical[2)]	150	250	300
up to 10 kW	horizontal[1)]	300	0	650
	vertical[2)]	250	350	600
up to 22 kW	horizontal[1)]	400	0	750
	vertical[2)]	350	400	700
up to 44 kW	horizontal[1)]	500	0	850
	vertical[2)]	Not permitted	Not permitted	Not permitted

1) Corresponds to mounting position 1, 2, 5, 6.
2) Corresponds to mounting position 3, 4.

31972098/EN – 8/2024

9.11.2 Permitted mounting positions

The following table shows the permitted mounting positions of the braking resistors:

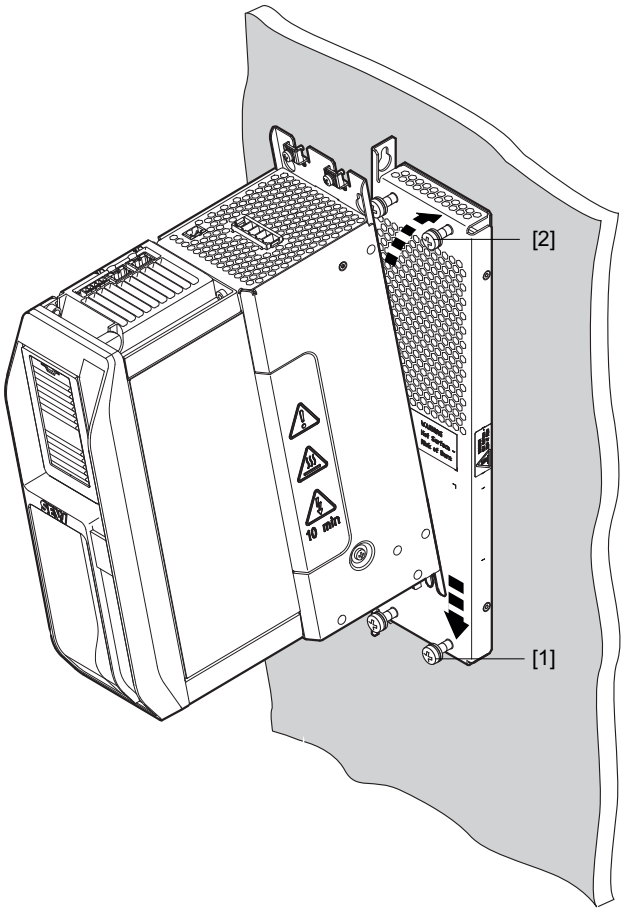
Grid resistor, frame resistor	Wire resistor	Flat type resistor
		
18512455307		*18512457739*

The BW003-420-T and BW1.0-170 braking resistors may only be used in position 1.

9.11.3 Installing submounting resistor BW120-001, BW100-002/M

Size 1 and 2 inverters can be installed in the control cabinet together with a braking resistor. The braking resistor is located on the rear panel of the inverter and therefore has the same mounting hole pattern as the inverter.

Note that the retaining screws [1] and [2] must be 20 millimeters longer for installation with a braking resistor.

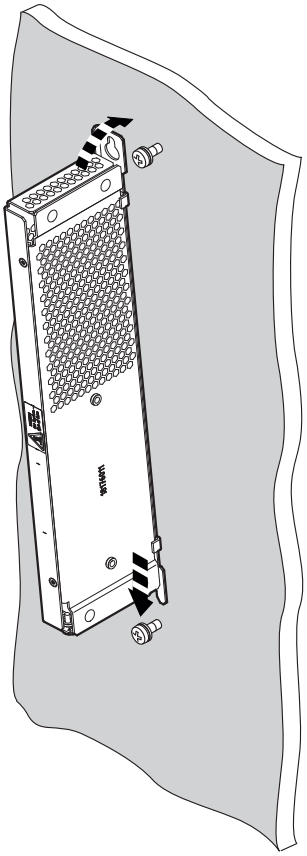


20363406219

1. Place the braking resistor at the desired position in the control cabinet as shown in the figure, and screw in the 4 retaining screws [1] and [2] without tightening them.
2. Place the inverter with the slotted holes in the device base plate onto the retaining screws [1] from the top.
3. Push the inverter backwards to insert the retaining screws [2] into the upper holes in the device base plate.
4. Lower the inverter.
5. Install the shield plate; see chapter "Mechanical installation" (→ 🗎 325).
6. Tighten the retaining screws [1] and [2].

31972098/EN – 8/2024

The submounting resistor can be installed next to an inverter, see the following figure. The hole distance of the submounting braking resistor must be larger than the hole distance of the inverter.



9007219618144779

9.11.4 Installing flatpack resistors without a support plate

Observe the following information:

- Use the spacer bolts included in the scope of delivery for installation.
- The spacer bolts must ensure a distance between the braking resistor and the mounting plate.

31972098/EN – 8/2024

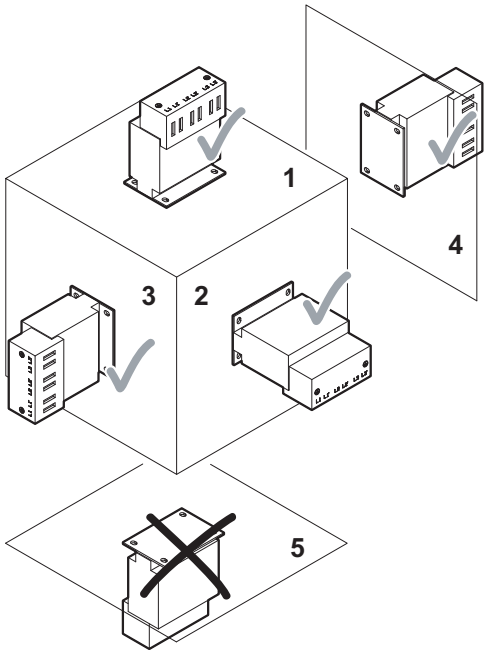
9.12 Installing the line choke

Observe the following information:

- Install the line choke close to the inverter but outside the minimum clearance for cooling. The line choke must not be heated by the exhaust air of the inverter.
- Install the line choke before the line filter.
- Observe the following minimum distances and mounting positions for convection cooling:

Permitted mounting position	Distance in mm		
	On the side	Downwards	Upwards
1, 2, 3, 4	0	100	100

- Observe the following permitted mounting positions during installation:



49906004235

31972098/EN – 8/2024

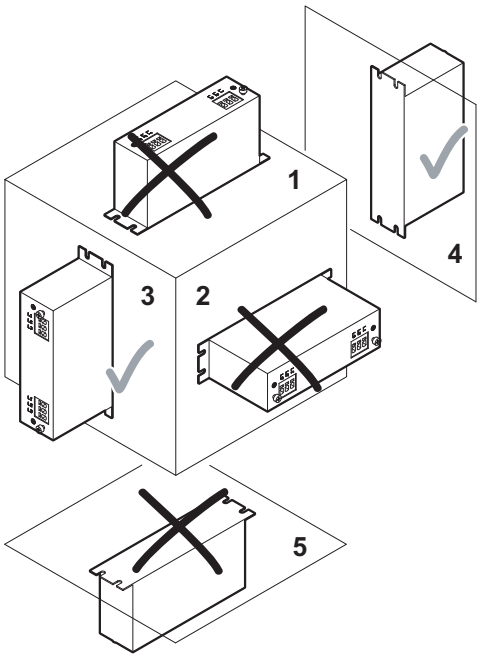
9.13 Installing the line filter

Observe the following information:

- Install the line filter close to the inverter but outside the minimum clearance for cooling. The line filter must not be heated by the exhaust air of the application inverter.
- Mount the line filter and inverter on a shared mounting plate. Make sure they are connected over as large an area as possible and with good conductivity.
- Observe the following minimum distances and mounting positions for convection cooling:

Permitted mounting position	Distance in mm		
	On the side	Downward	Upward
3 and 4	0	100	100

- Observe the following permitted mounting positions during installation:



49742030347

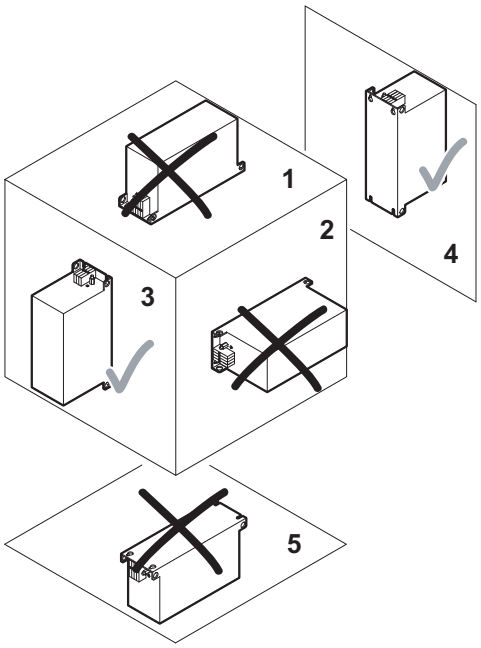
9.14 Mounting the output filter

Observe the following information:

- Install the output filter close to the inverter but outside the minimum clearance for cooling. The exhaust air from the output filter must not heat the supply air to the inverter.
- Mount the output filter and inverter on a shared mounting plate. Make sure they are connected over as large an area as possible and with good conductivity.
- Observe the following minimum distances and mounting positions for convection cooling:

Permitted mounting position	Distance in mm		
	On the side	Downward	Upward
3 and 4	0	100	100

- Observe the following permitted mounting positions during installation:



49906001291

31972098/EN – 8/2024

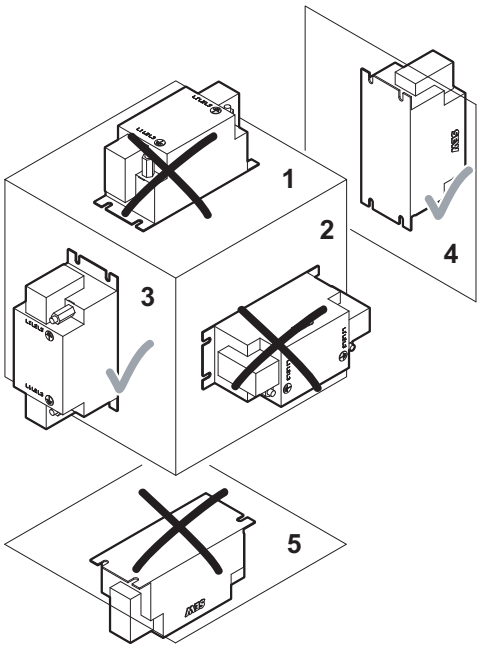
9.15 Mounting the output choke

Observe the following information:

- Install the output choke close to the inverter but outside the minimum clearance for cooling. The exhaust air of the output choke must not heat the supply air of the inverter.
- Mount the output choke and inverter on a shared mounting plate. Make sure they are connected over as large an area as possible and with good conductivity.
- Observe the following minimum distances and mounting positions for convection cooling:

Permitted mounting position	Distance in mm		
	On the side	Downward	Upward
3 and 4	0	100	100

- Observe the following permitted mounting positions during installation:



49905998347

10 Electrical installation

10.1 Installation planning considering EMC aspects

The information in this chapter will help you to optimize the system with regard to electromagnetic compatibility, or to eliminate any existing EMC interference.

The notes in this chapter are not legal regulations, but rather recommendations for improving the electromagnetic compatibility of your plant.

For further notes on EMC-compliant installation, refer to the publication Drive Engineering – Practical Implementation edition "EMC in Drive Engineering – Basic Theoretical Principles – EMC-Compliant Installation in Practice".

10.1.1 Compliance with the limit classes

Compliance with limit classes C1 and C2 has been tested in a CE-typical drive system. SEW-EURODRIVE can provide detailed information on request.

10.1.2 Arranging and routing installation components

You must always apply the **relevant standards**.

10.1.3 Control cabinet

Use control cabinets with electrically conductive (galvanized) mounting plates. If several mounting plates are used, connect them in such a way that they are conductive over a large area. EMC-compliant installation of the inverter is only possible with a mounting plate that is conductive over a large area.

10.1.4 Equipotential bonding

Regardless of the PE connection, it is essential that **low-impedance, HF-compatible equipotential bonding** is provided (see also EN 60204-1):

- Mount the line filter and inverter on a shared mounting plate. Make sure they are connected over as large an area as possible and with good conductivity.
- Make sure that there is a suitable equipotential bonding between the system, the control cabinet, the machine structure, the cable ducts, and the gearmotor:
  - Use the mounting plate as the star point with regard to the HF equipotential bonding.
  - Connect the PE busbar to the mounting plate in an HF-compatible manner.
  - Connect the sheet metal cable ducts to the control cabinet in an HF-compatible manner.
  - Connect the cable ducts to the mounting plate in the control cabinet using a high frequency litz wire.
  - Connect the parts of the sheet metal cable ducts together in an HF-compatible manner.
  - Connect the sheet metal cable ducts to the gearmotor in an HF-compatible manner.
- Ensure that shielded cables are connected in an HF-compatible manner, e.g. by using grounding clamps or EMC screw fittings, so that the braided shield has a large connection surface.
- Do not use the cable shield of signal cables for the equipotential bonding.

31972098/EN – 8/2024

10.1.5 Cable installation

Observe the following information:

- Route the power cables, such as the motor cable and the brake cable, separately from the supply system cable and the control cables.
- Route all cables as closely to the reference potential as possible, e.g. the mounting plate.
- Keep all cables as short as possible. Avoid spare loops.

10.1.6 Cable connection

Supply system cable

Observe the following information:

- The supply system cable can be connected to the line choke and/or line filter using single conductors or using unshielded cables. If necessary, shielded cables may improve EMC.
- Limit the length of the connection lead between the line filter and the inverter to the absolute minimum needed.
- Always route filtered and unfiltered cables separately from each other.
- Route incoming and outgoing line filter cables separately.

Braking resistor

Observe the following information:

- For connecting braking resistors, use 2 closely twisted cores or a shielded power cable.
- In the case of shielded cables, apply the braided shield over the entire circumference over a large area.
- For the shield connection, use the designated shield plates on the axis module, if provided. In all other cases, use commercially available shield terminals for installing the shielding of motor, brake, and braking resistor cables. Apply the shield as closely as possible to the unit.

Power connection of motor and brake

Observe the following information:

- SEW-EURODRIVE recommends using prefabricated motor and brake cables. When using unshielded motor leads, SEW-EURODRIVE recommends using output filters HF.. or output chokes HD.. .
- Apply the braided shield of all cables over the entire circumference over a large area at both ends.
- For the shield connection, use the designated shield plates on the inverter side (if provided). In all other cases, use commercially available shield terminals for installing the shielding of motor and brake cables. Apply the shield as closely as possible to the inverter.
- If the motor cable and brake cable are combined in a shared cable, the cable must have an inner shield separating the brake cables from the motor cores. The cables also possess an overall shield. If the brake cable is routed separately, SEW-EURODRIVE recommends using a shielded brake cable.

31972098/EN – 8/2024

- SEW-EURODRIVE recommends using prefabricated cables from SEW-EURODRIVE (self-assembled or also prefabricated).
- In the event of exceptionally high EMC requirements, an additional connection point for the shield is recommended. To limit the emitted interference, the motor shield can additionally be grounded to the control cabinet outlet using commercial installation materials (grounding clamps or EMC screw fittings).

Control cable

You may make the connection of the control cables (e.g. digital inputs and others) by unshielded single conductors. Shielded cables increase the EMC. Use the designated shield plates to connect the shield.

For routing outside of the control cabinet, you must use shielded cables.

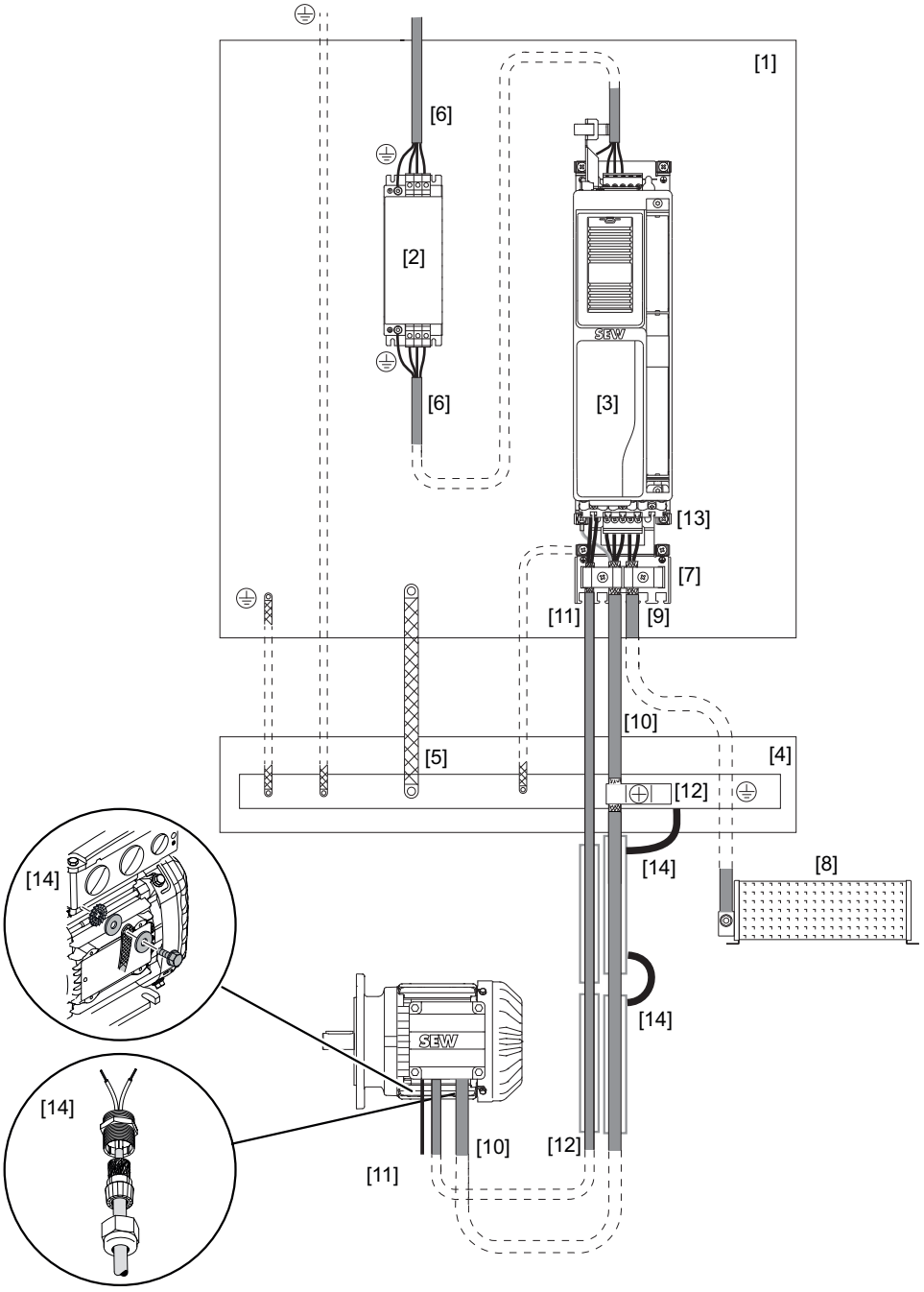
Encoder

SEW-EURODRIVE recommends using prefabricated encoder cables.

The shield of prefabricated cables from SEW-EURODRIVE is connected via the connector. SEW-EURODRIVE offers the option of additionally mounting the shield using a shield plate supplied.

31972098/EN – 8/2024

10.1.7 Installation example



18014418018001291

[1] Galvanized mounting plate
[2] Line filter
[3] Inverter
[4] PE busbar
[5] HF connection of PE busbar/mounting plate
[6] Supply system cable
[7] Power shield plate (depending on size)
[8] Braking resistor
[9] Braking resistor cable
[10] Motor line
[11] Brake cable
[12] Grounding clamp
[13] Electronics shield plate
[14] HF connection

10.2 Installation instructions

10.2.1 General information

Observe the following information:

- Provide for suitable measures to prevent the motor from starting up unintentionally. Take additional safety measures depending on the application to prevent possible injuries to people and damage to machinery.
- Only use closed cable lugs or conductor end sleeves for to prevent litz strands from emerging.
- To avoid mechanical vibrations, fasten connected cables by suitable means, e.g. by fixing them on the shield plate or a clamp on the mounting plate of the control cabinet.
- Disconnect the following electrical connections only in a de-energized state: Motor, supply system, braking resistor, brake, encoder, energy storage unit, discharge unit.

10.2.2 Permitted voltage systems

Voltage supply systems	Permissibility
TN and TT systems – voltage systems with directly grounded star point.	Use is possible without restrictions.
IT systems – voltage systems with non-grounded star point.	Use is only permitted with adherence to the following measures: 1. Unscrew all existing EMC contact screws on all devices. The positions of the EMC contact screws can be found in the product manual > chapter "Device structure" (→ 🗎 299). 2. Mark this on the nameplate in the "IT system activated" box provided for this purpose. **INFORMATION:** The EMC limit values for interference emission are not specified for voltage supply systems without grounded star point (IT systems). The efficiency of line filters is severely limited.
Voltage systems with grounded outer conductor.	Use only for nominal line voltages up to max. 240 V.

31972098/EN – 8/2024

10.2.3 Permitted terminal tightening torques

1. **NOTICE!** Failure to adhere to prescribed tightening torques. Damage to the device. Connect the power cables with the specified tightening torques.

		Tightening torques in Nm							
		Sizes							
		1	2	3	4	5	6	7	8
Line connection	X1	0.5 – 0.6			1.7 – 1.8	8.5 – 9.5	15 – 20	31	
Motor and braking resistor connection	X2	0.5 – 0.6			1.7 – 1.8	8.5 – 9.5	15 – 20	31	
Terminal screw for TN/IT systems	EMC	1 – 1.2							
PE connection	–	1.2 – 1.5		M4: 1.2 – 1.5 or M6: 2.5 – 3	2.5 – 3	6 – 10	15 – 20	31	
Fastening the cards	–	0.6 – 0.8							

10.2.4 Permitted terminal cable cross sections

Single conductor, without conductor end sleeve, rigid and flexible

Inverter	Terminal	Terminal type	Stripping length in mm	Cable cross section in mm²			
				Rigid		Flexible	
				Minimum	Maximum	Minimum	Maximum
Control unit							
All sizes	X20	Spring terminal	10	0.2	2.5	0.2	2.5
	X21		10	0.2	2.5	0.2	2.5
	X22		10	0.2	2.5	0.2	2.5
	X6		10	0.2	1.5	0.2	1.5
Power section							
All sizes	X5	Spring terminal	10	0.2	2.5	0.2	2.5
Sizes 1 – 4	X10		10	0.2	1.5	0.2	1.5
Sizes 5 – 8	X10		10	0.2	2.5	0.2	2.5
Sizes 1 – 3	X1/X2	Screw terminal[1)]	10	0.2	10	0.2	6
Size 4	X1/X2		12	0.75	16	0.75	16

1) SEW-EURODRIVE recommends using conductor end sleeves for installation with screw terminals and flexible cable.

31972098/EN – 8/2024

Single conductor, flexible, with conductor end sleeve, with or without plastic collar

Inverter	Terminal	Terminal type	Stripping length in mm	Cable cross section in mm²			
				Plastic collar			
				with		without	
				Minimum	Maximum	Minimum	Maximum
Control unit							
All sizes	X20	Spring terminal	10	0.25	2.5	0.25	2.5
	X21		10	0.25	2.5	0.25	2.5
	X22		10	0.25	2.5	0.25	2.5
	X6		10	0.25	0.75	0.25	1.5
Power section							
All sizes	X5	Spring terminal	10	0.25	2.5	0.25	2.5
Sizes 1 – 4	X10		10	0.25	0.75	0.25	1.5
Sizes 5 – 8	X10		10	0.25	2.5	0.25	2.5
Sizes 1 – 3	X1/X2	Screw terminal[1)]	10	0.25	4	0.25	6
Size 4	X1/X2		12	0.5	10	0.5	16

1) SEW-EURODRIVE recommends using conductor end sleeves for installation with screw terminals and flexible cable

Double conductor, flexible, with conductor end sleeve, with or without plastic collar

Inverter	Terminal	Terminal type	Stripping length in mm	Double conductor, same cross section in mm², twin conductor end sleeve			
				Plastic collar			
				with		without	
				Minimum	Maximum	Minimum	Maximum
Control unit							
All sizes	X20	Spring terminal	10	0.5	1.5	–	–
	X21		10	0.5	1.5	–	–
	X22		10	0.5	1.5	–	–
	X6		–	–	–	–	–
Power section							
All sizes	X5	Spring terminal	10	0.5	1.5	–	–
Sizes 1 – 4	X10		10	–	–	–	–
Sizes 5 – 8	X10		10	0.5	2.5	–	–
Sizes 1 – 3	X1/X2	Screw terminal[1)]	10	0.25	2.5	0.25	1.5
Size 4	X1/X2		12	0.5	6	0.5	4

"**–**" Not permitted

1) SEW-EURODRIVE recommends using conductor end sleeves for installation with screw terminals and flexible cable

31972098/EN – 8/2024

10.2.5 Selecting the residual current device

The inverter can cause a direct current in the PE conductor.

Proceed as follows to select the residual current device:

1. If using a residual current device is not mandatory according to the standards, SEW-EURODRIVE recommends not using a residual current device.
2. ⚠ **WARNING!** No protection against electric shock if an incorrect type of residual current device is used. Severe or fatal injuries.
   If a residual current device (residual current device RCD or residual current monitor RCM) is provided, use an all-current-sensitive RCD or RCM of type B.
3. If a residual current device is required, select the residual current device according to the requirements for protecting persons, fire protection or system protection. Observe the tripping characteristic, the deceleration and the rated tripping current of the residual current device during selection.
4. During project planning, note that leakage currents which are as low as possible occur in the system for operational reasons.
5. If the operational leakage currents are too high, you can distribute the current supply among several RCDs.

10.2.6 Using the line contactor

Proceed as follows:

1. Always place the line contactor before the line filter and line choke (if present).
2. Use at least one contactor of utilization category AC-3 (EN 60947-4-1) as a line contactor.
3. **NOTICE!** Failing to observe the minimum switch-off time of the line contactor can cause material damage. Irreparable damage to the inverter or unforeseen malfunctions.
   After switching off the voltage supply, keep it switched off for at least 10 s.
   ⇨ Do not switch the voltage supply on or off **more often than once per minute**.
4. Do not use the line contactor for jog mode, but only for switching on and off.

The following table provides an overview of when a line contactor is required. Observe the notes on the required protective measures for the braking resistor used in the product manual > chapter "Protecting the braking resistors from thermal overload" (→ 🗎 369).

Inverter	Braking resistor	Protective element/ preventive measure	Line contactor required?
Sizes 1 – 3	No BW..	–	No
	BW.. Flat design	–	No
	BW.. as PTC	–	No
	BW..	External overload relay	Yes
	BW..-T	External overload relay	Yes

31972098/EN – 8/2024

Inverter	Braking resistor	Protective element/ preventive measure	Line contactor required?
From size 4	No BW..	–	No
	BW.. Flat design	–	No
	BW.. as PTC	–	No
	BW..	External overload relay	No
	BW..-T	Temperature contact evaluation	No

If a braking resistor is connected to the inverter from size 4 without using a line contactor, an external DC 24 V voltage supply must be provided on the inverter.

10.2.7 Information regarding PE connection

A leakage current > 3.5 mA may be generated when operating the inverter. To avoid shock currents according to EN 61800-5-1, observe the following cable cross sections:

- Supply system cable < 10 mm^2:

  Route a second PE conductor with the cable cross section of the supply system cable in parallel to the protective earth via separate terminals or use a copper protective earth conductor with a cable cross section of 10 mm^2.
- Supply system cable 10 mm^2 to 16 mm^2:

  Route a copper protective earth conductor with the cable cross section of the supply system cable.
- Supply system cable 16 mm^2 to 35 mm^2:

  Route a copper PE conductor with a cable cross section of 16 mm^2.
- Supply system cable > 35 mm^2:

  Route a copper protective earth conductor with half the cross section of the supply system cable.
- If an earth leakage circuit breaker is used for protection against direct and indirect contact, it must be universal current sensitive (RCD type B).

31972098/EN – 8/2024

10.2.8 Installation with protective separation

The inverter meets all requirements for protective separation of power and electronics connections according to EN 61800-5-1. The connected signal circuits, including the DC 24 V voltage supply, have to meet the requirements according to SELV (Safety Extra Low Voltage) or PELV (Protective Extra Low Voltage) to ensure protective separation. The installation must meet the requirements for protective separation.

10.2.9 Protection devices

Observe the following information:

- The units come equipped with integrated protection devices against overload and short circuit.
- The power contactor of the supply system cable must be realized through external overload devices.
- The relevant standards must be observed concerning the cable cross section, the voltage drop, and the type of routing that is used.

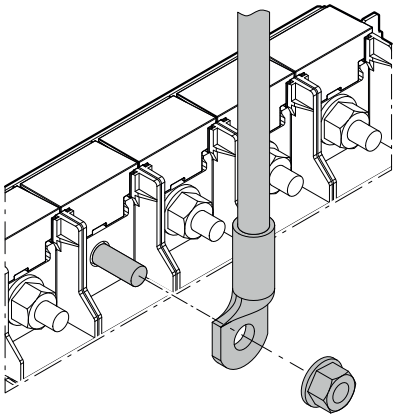
10.3 Connection to power terminals

Note that for inverters from size 5 upwards, degree of protection IP20 is only achieved if the terminal studs (for connecting the grid, motor, braking resistor, and DC link) are protected against contact with plastic covers. The plastic covers can be ordered optionally, see the **Product manual** > chapter "Fitting plastic covers for degree of protection IP20" (→ 🗎 357) and chapter "Standard accessories" (→ 🗎 103).

10.3.1 Designing the connection with 1 cable

Proceed as follows:

1. Attach the heat shrink tubing at the ring lug.
2. Connect the cables. If the device is connected using one cable, the plastic cover in the connection block must not be removed.

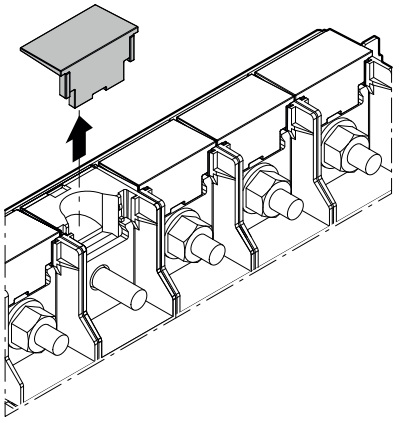


9007236401887627

10.3.2 Designing the connection with 2 cables

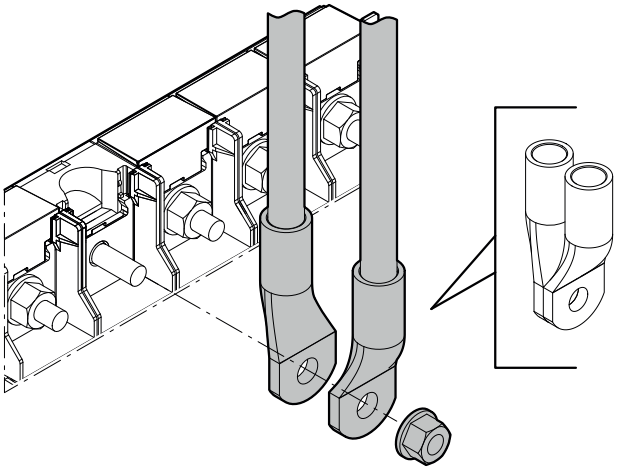
Proceed as follows:

1. Attach a heat shrink tubing at the ring lugs.
2. Remove the plastic covers in the connection block.



37147149067

3. Connect the two cables.



42922486923

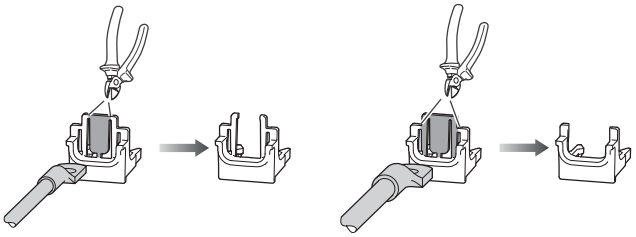
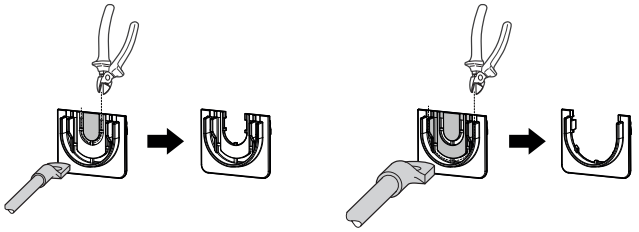
31972098/EN – 8/2024

10.3.3 Fitting plastic covers for degree of protection IP20

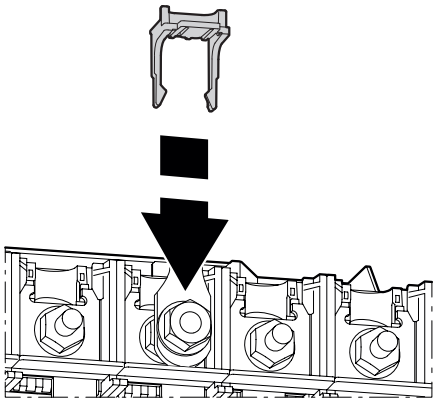
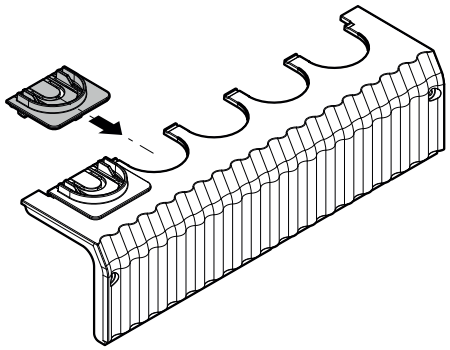
Proceed as follows:

- ✓ The plastic covers can be ordered as options.
- ✓ The ring lug is insulated with heat shrink tubing.

1. The plastic covers must be broken out in different ways depending on the cross section used.

Size 5	Sizes 6 – 8
	

2. Fit the plastic covers at the individual connections.

Size 5	Sizes 6 – 8
	

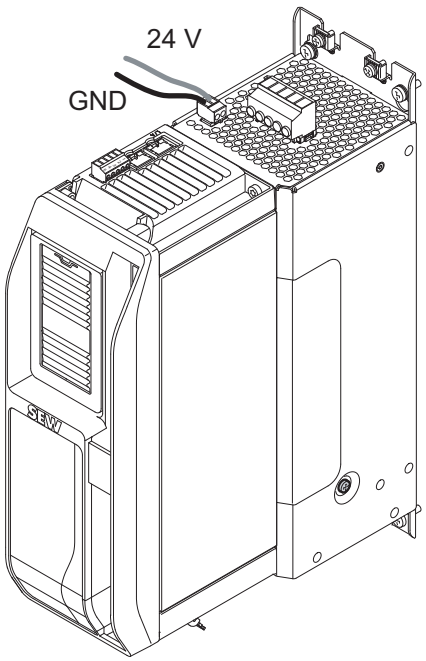
10.4 24 V supply voltage

The MDX90A.. inverter requires an external 24 V voltage supply for the electronics.

The MDX91A.. inverter has an internal 24 V voltage supply of 80 W that can also be supported externally.

The maximum cable cross section is 2.5 mm^2. The maximum permitted length of the 24 V supply cable is 30 m.

Whether an external 24 V supply is required for MDX91A-.. depends on the load, e.g. the encoder supply and the outputs.



15027024779

Select the cross section of the supply cable according to the power demand of the devices to be supplied.

31972098/EN – 8/2024

10.5 Line fuses

Motor circuit breakers, miniature circuit breakers and fuses are used for fusing the supply system cable. In case of a fault, these components additionally protect against short-circuits.

Observe the following information:

- Use the following components:

Input fuses	Prerequisite
Motor circuit breaker	Nominal voltage of the motor circuit breaker greater than nominal line voltage. Nominal current of the motor circuit breaker must be set 10% above the nominal line current.
Miniature circuit breaker with characteristics B, C, D	Nominal miniature circuit breaker voltage ≥ nominal line voltage
	Nominal current of the miniature circuit breaker must be 10% higher than the nominal line current.
Fuses in utilization categories gL, gG	Fusing voltage ≥ nominal line voltage

- Install safety devices at the beginning of the supply system cable for line protection. For further information, refer to chapter "Wiring diagrams" (→ 🗎 401).
- Dimension the safety equipment according to the cable cross section.
- The PE impedance must comply with the normative specifications.
- Adhere to country- and system-specific regulations regarding the fusing.

10.6 Brake chopper output

Observe the following information:

- Do not connect capacitive or inductive loads.
- Only connect ohmic loads (braking resistors).
- Connect the braking resistor to the connections +R and -R.
- Note that the maximum permissible cable length between the braking resistor and inverter is 100 m.
- Use a shielded cable or twisted single conductors.

31972098/EN – 8/2024

10.7 Temperature evaluation



⚠ WARNING

Dangerous voltages at the terminals of the inverter/power supply module when connecting an unsuitable temperature sensor.

Death or severe injuries due to electric shock.

- To avoid violating the requirements for protective separation, only connect temperature sensors with protective separation to the motor winding to the temperature evaluation.

The temperature sensor can be connected as follows:

- via the encoder cable, which contains the cables of the temperature sensor
- via connections TF1 and GND on terminal X10
- via MOVILINK® DDI to X16

Observe the following additional notes for group and multi-motor drives:

- Preferably use bimetallic temperature switches TH.
- The series connection of the TH contacts (normally closed) is not subject to any restriction if joint monitoring is provided.
- If the TF temperature sensors are available in motors, the temperature sensors of up to 3 motors can be connected in series.

10.8 Brake control output

Observe the following information:

- If the brake connection and the motor connection are combined in one power cable, the brake cable must be shielded separately. The shielding of the power cable and the brake cable must be connected to the motor and inverter over a large area.
- SEW-EURODRIVE recommends also using a shielded brake cable for separate brake cable routing.
- Note the different project planning criteria to determine the length of brake cable and motor cable.
- Connect the brakes and/or brake control units to terminal strip X10 (DB0/DB00 and GND).

10.9 Inputs/outputs

Observe the following information:

- The digital inputs and outputs are referenced to GND. GND is connected to PE. Incorrectly applied voltages can damage the digital inputs and digital outputs. Do not apply external voltage to the digital outputs.
- Cables outside the control cabinet must be shielded.
- When connecting the shielding, ensure equipotential bonding.
- The cable length must not exceed 30 m.
- Connect the digital inputs and outputs to the appropriate connections.

31972098/EN – 8/2024

10.10 System bus and module bus cabling

For connecting the EtherCAT®/SBus^{PLUS} system bus or module bus, SEW-EURODRIVE recommends using only prefabricated cables from SEW-EURODRIVE. The RJ45 connectors of the system bus and module bus cables and the sockets in the inverters have been checked for mechanical stability and contact reliability by SEW-EURODRIVE. If you use other cables and connectors, SEW-EURODRIVE makes no statement about the quality of the plug-in connection.

10.10.1 System bus cable

To establish the EtherCAT®/SBus^{PLUS} system bus communication between automation components, use the 4-pole system bus cable.

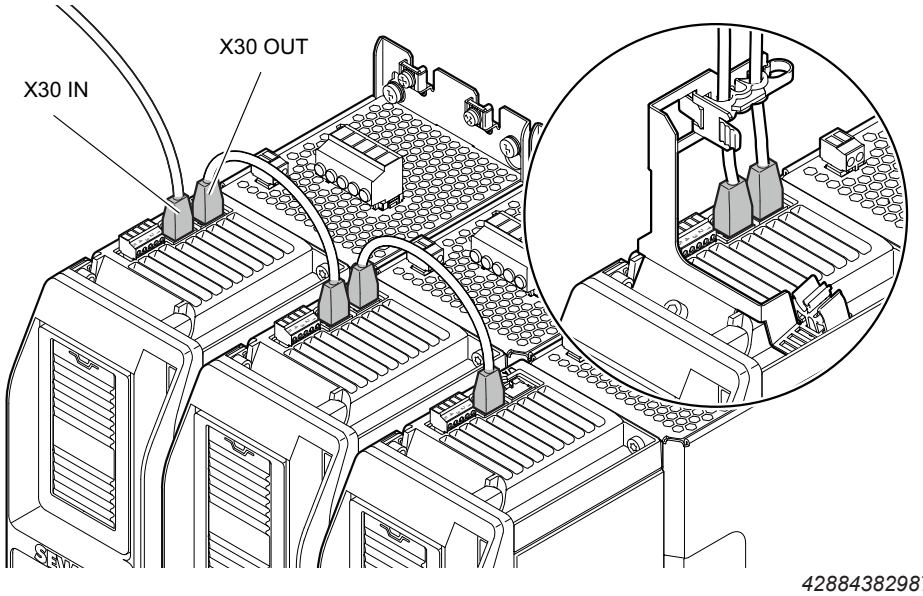
Some of the automation components are:

- MOVI-C® CONTROLLER
- Inverter
- PC with MOVISUITE® engineering software
- MOVI-PLC® I/O system
- Additional EtherCAT® stations on the EtherCAT®/SBus^{PLUS}

Connecting the system bus cable

Proceed as follows:

The connectors of the system bus cables are red.



42884382987

1. **NOTICE!** Use of the wrong cables. Damage to the inverter.
   If the 8-pin system bus cables are used, malfunctions or failures may occur at the connected devices. Only use the 4-pole system bus cables.
2. Connect the system bus cables between the individual automation components.
3. Connect the connectors to the bus input X30 IN.
4. Connect the connectors to the bus output X30 OUT.
5. Fix the system bus cables to the shield plate.

10.10.2 Module bus cable

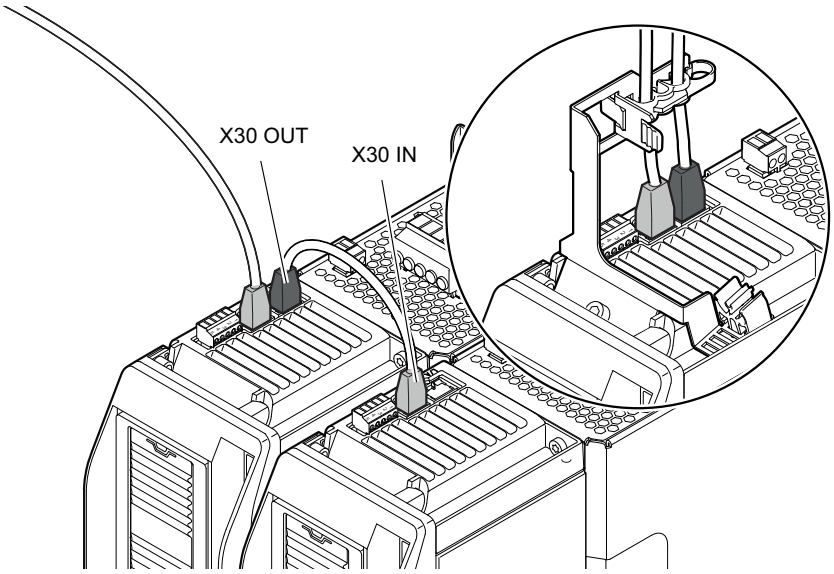
When connecting the DC links of two MOVIDRIVE® system or MOVIDRIVE® technology inverters in circuit type B, it is necessary to connect the two inverters via the module bus to exchange internal device information. The inverters are connected with a module bus cable. In addition, the system bus communication takes place via the module bus cable.

The module bus cable is not included in the scope of delivery of the inverter and must be ordered separately. For more information, refer to the manual "MOVIDRIVE® system/technology DC link connection".

Connecting the module bus cable

Proceed as follows:

The connectors of the module bus cables are red and black.



42884385419

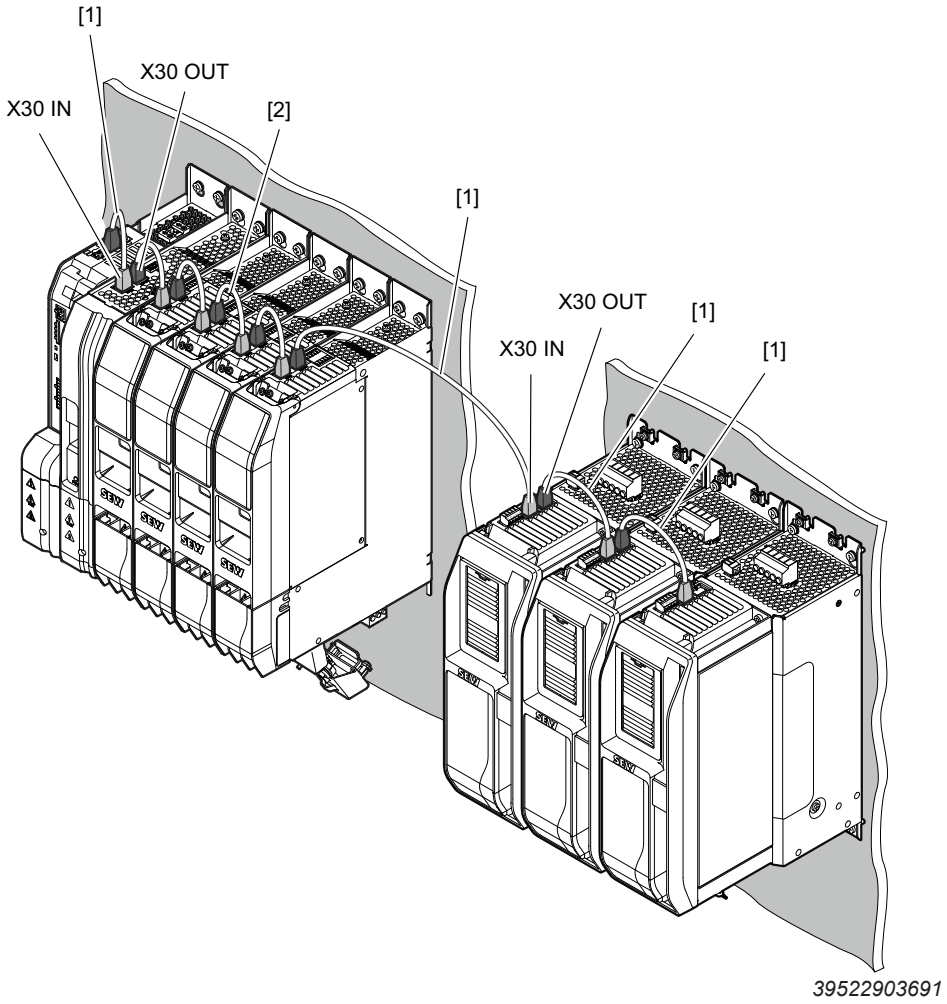
1. Connect the module bus cables between the inverters.
2. Connect the black connectors to the bus output X30 OUT.
3. Connect the red connectors to the bus input X30 IN.
4. Fix the module bus cables to the shield plate.

31972098/EN – 8/2024

10.10.3 Connection examples

MOVIDRIVE® modular with master module UHX45A/MDM90A and 3 MOVIDRIVE® system inverters

The following figure shows an example of system bus and module bus cabling with master module UHX45A/MDM90A and 3 MOVIDRIVE® system inverters.



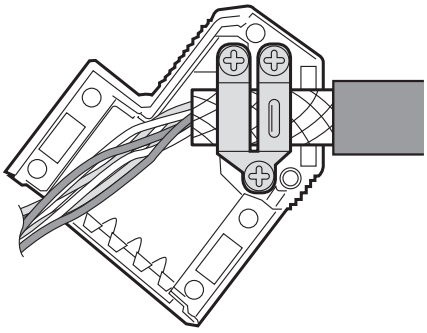
[1] System bus cable
[2] Module bus cable

10.11 Encoders

Observe the following notes before installation:

- SEW-EURODRIVE offers prefabricated cables for connecting encoders. SEW-EURODRIVE recommends to use these prefabricated cables.
- Make sure that self-assembled cables fulfilled the following requirements:
  - Cross section of voltage supply cable:
    - At least 0.25 mm^2 for cable lengths up to 50 m
    - At least 0.5 mm^2 for cable lengths from 50 m up to 100 m
  - Cross section of the signal wire:
    - At least 0.25 mm^2

  - Capacitance per unit length:
    - Maximum 70 pF/m – core/core
    - Maximum 120 pF/m – core/shield
  - The cable must be shielded.
  - Differential signals must be routed via twisted wires e.g., Data+ and Data-. Use shielded cables with twisted pair cores.
- Connect the shield over a wide area at both ends:
  - At the encoder in the cable gland or in the encoder plug
  - At the inverter in the housing of the D-sub plug



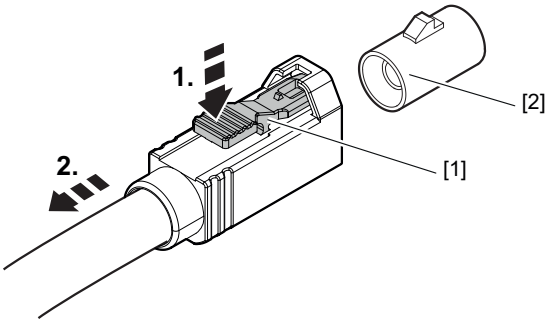
13887834891

- Route the encoder cable separately from the power cables.
- To ensure a flawless shield connection, you must use an EMC screw fitting for the cable entry of the signal cable.
- For drives with plug-in connection, connect the shield in the encoder connector.
- The maximum cable length might be reduced depending on the technical data of the respective encoder. Observe the specifications of the encoder manufacturer. Information on the maximum cable lengths can be found in the TD of the corresponding encoder interface.

10.12 MOVILINK® DDI

10.12.1 Disconnect MOVILINK® DDI connector

Proceed as follows:



9007238074952075

1. Before disconnecting the MOVILINK® DDI connector, make sure that the DC 24 V voltage supply is switched off or standby mode is activated.
2. Press the interlocking [1] on the connector and disconnect the MOVILINK® DDI connector from the connection for digital motor integration X16 [2].

31972098/EN – 8/2024

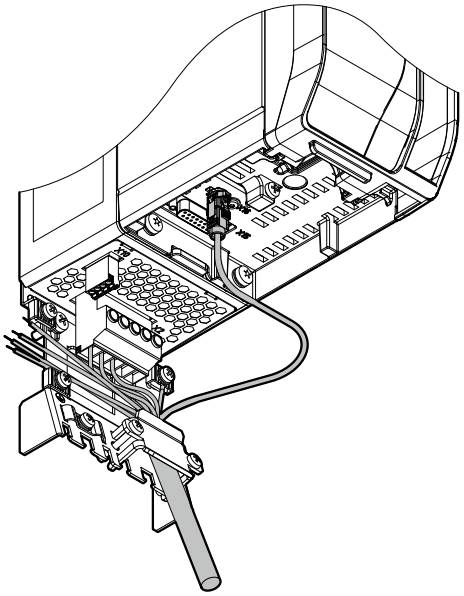
10.12.2 Connection when using a hybrid cable

Observe the following information:

- Use the shield plates provided for the shield support (if present).
- Apply the shielding of the hybrid cable over the entire circumference over a large area.
- Keep the distance or cable length between the shield connection and the connection for the cable conductors as short as possible.
- To avoid communication errors, the exposed length of the coaxial cable must not exceed 50 cm. For more information, refer to the addendum to the "Digital Motor Integration MOVILINK® DDI Toolset 1" operating instructions.

Connection example size 1 – 4 (using size 1 as an example)

The following figure shows an example of the connection when using a hybrid cable for the inverters of sizes 1 – 4:



9007238074947211

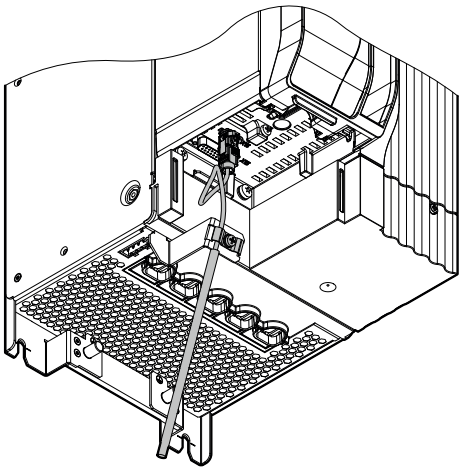
10.12.3 Connection when power and coaxial cables are routed separately

Observe the following information:

- Connect the shield of the outer cable jacket of the coaxial cable to the terminal provided for this purpose on the basic unit.
- To avoid communication errors, the exposed length of the coaxial cable must not exceed 50 cm. For more information, refer to the addendum to the "Digital Motor Integration MOVILINK® DDI Toolset 1" operating instructions.

Connection example size 5

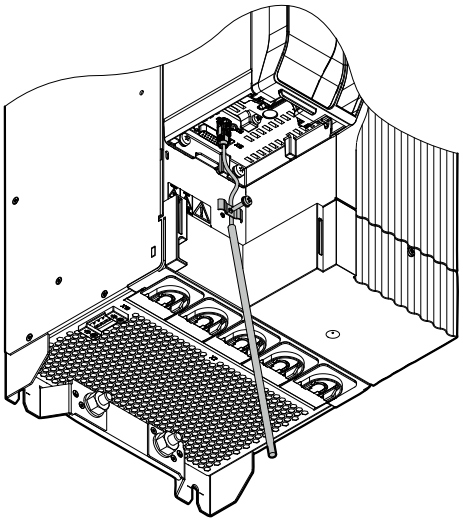
The following figure shows an example of the connection with separate routing of power and coaxial cables for the inverters of size 5:



9007238074949643

Connection example size 6

The following figure shows an example of the connection with separate routing of power and coaxial cables for the inverters of size 6:

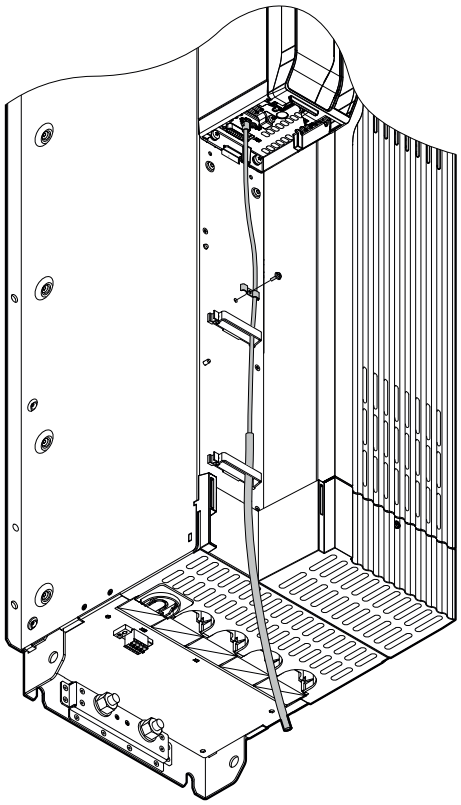


9007238074954507

31972098/EN – 8/2024

Connection example size 7 – 8 (using size 7 as an example)

The following figure shows an example of the connection with separate routing of power and coaxial cables for the inverters of sizes 7 – 8:



42879019787

Route the coaxial cable in such a way that it passes through the two tabs. Connect the shield of the coaxial cable to the terminal provided for this purpose.

10.12.4 Permitted number of connection or cable disconnection points

When using a hybrid cable or a solo coaxial cable on the MOVILINK® DDI interface, a maximum of 4 connection or cable disconnection points are permitted. The connection points that are implemented directly on the inverter or in the drive by means of FAKRA connectors are not included in the count. Communication errors can occur if there are more than 4 connection or cable disconnection points.

Examples

- Cable from inverter to motor with M23 connector KD1: 1 plugging position
- Cable from inverter to motor with M23 connector KD1 and 1 extension cable M23 at both sides: 2 plugging positions
- Cable from inverter to motor with M23 connector KD (hybrid cable gland without plug connector): 0 plugging positions

10.13 CIO21A and CID21A input/output card

10.13.1 Voltage supply

The I/O cards are supplied by the basic device via the 24 V voltage supply.

10.13.2 Short circuit behavior of digital outputs

The digital outputs are short-circuit-proof.

As soon as the short circuit is remedied, the target output voltage is output, meaning the output does not switch off.

10.13.3 Short circuit behavior of analog outputs

The analog outputs are short-circuit-proof.

In the event of a short circuit, the output current is limited to a maximum value of 30 mA. The short circuit current is not pulsating.

As soon as the short circuit is remedied, the target output voltage is output, meaning the output does not switch off.

10.13.4 Connecting inductive loads at digital outputs

The digital outputs can switch inductive loads up to an energy content of maximum 500 mJ 10 times per second at the maximum without any additional measures. For larger energy contents an external protective element (freewheeling diode) is required.

10.13.5 Connecting 2 digital outputs in parallel

Connecting digital outputs in parallel is possible. The possible output current is doubled. Ensure identical parameterization of the digital outputs.

10.13.6 Cable lengths and shielding

The maximum cable length of connections at the inputs and outputs is 30 m.

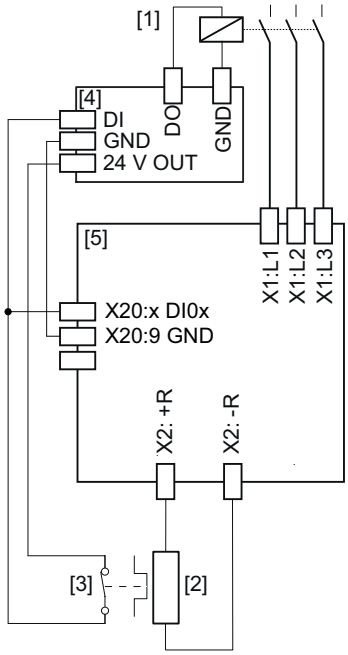
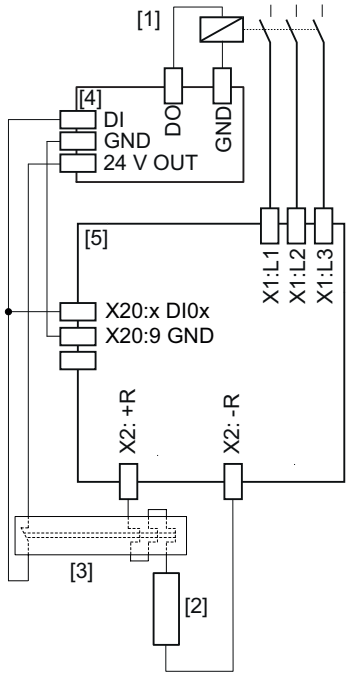
Cables outside the control cabinet must be shielded.

31972098/EN – 8/2024

10.14 BW.. braking resistors

10.14.1 Protecting the braking resistors from thermal overload

The braking resistors can be protected against overload and overtemperature with an integrated temperature switch for BW..-T braking resistors and with an external thermal overload relay for BW.. braking resistors.

Circuit 1 with integrated temperature switch	Circuit 1 with external overload relay
	
45036011595607947	*45036011595734667*

[1] Line contactor
[2] Braking resistor
[3] Internal temperature switch or overload relay
[4] PLC
[5] Inverter

For the sake of clarity, only the integrated temperature switch is visualized in the following graphics. Implementation with an external thermal overload relay is carried out in the same way.

INFORMATION

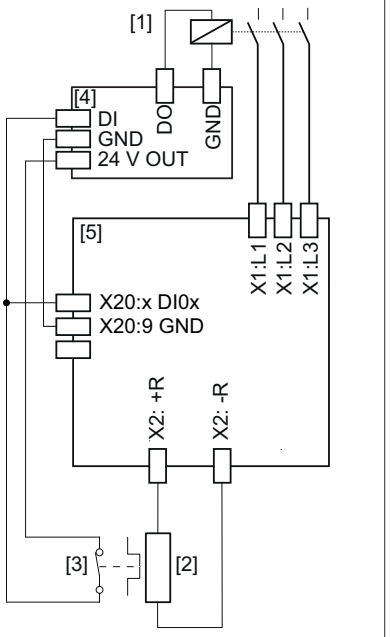
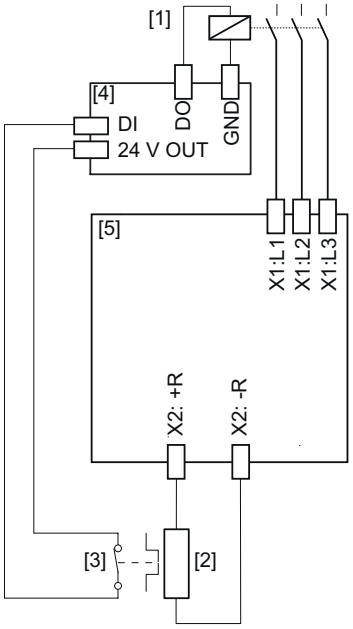
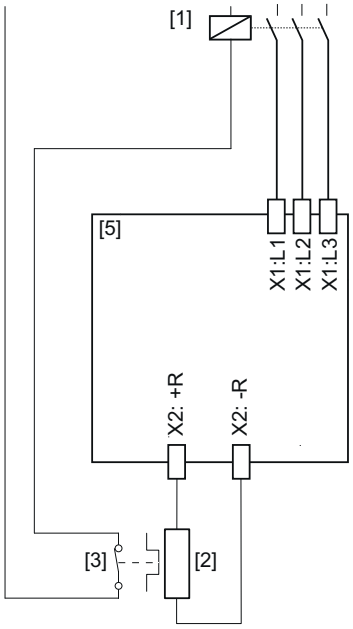
A PTC braking resistor becomes highly resistive in the event of an overload.

INFORMATION

Flatpack resistors have internal thermal protection (fuse cannot be replaced) that interrupts the current circuit in the event of overload. The configuration guidelines and the documented assignments of the drive inverter and braking resistor must be adhered to.

Inverters of size 1 – 3

The following 3 connections exist:

Connection 1	Connection 2	Connection 3
		

[1] Line contactor
[2] Braking resistor
[3] Internal temperature switch or overload relay
[4] PLC
[5] Inverter

Connection 1

INFORMATION

When connection 1 is used, the reference potential GND of the digital inputs on the PLC must be the same as the reference potential of the inverter.

The signal contact is evaluated in the inverter and in the PLC. The digital input of the inverter used for the evaluation must be parameterized to the "External braking resistor fault" function.

If the internal temperature switch responds, note the following:

- The PLC must disconnect the power supply.
- The inverter switches to "Output stage inhibit".

Connection 2

The signal contact is only evaluated in the PLC.

If the internal temperature switch responds, note the following:

- The PLC must disconnect the power supply.
- There is no direct response in the inverter.

31972098/EN – 8/2024

With connection 2, it is possible that the PLC finishes the current travel cycle although the thermal circuit breaker has tripped. Only then is the power supply disconnected. In this case, the residual braking energy $W_{Rest} = P_{BRnom} \times 20$ s must not be exceeded.

Connection 3

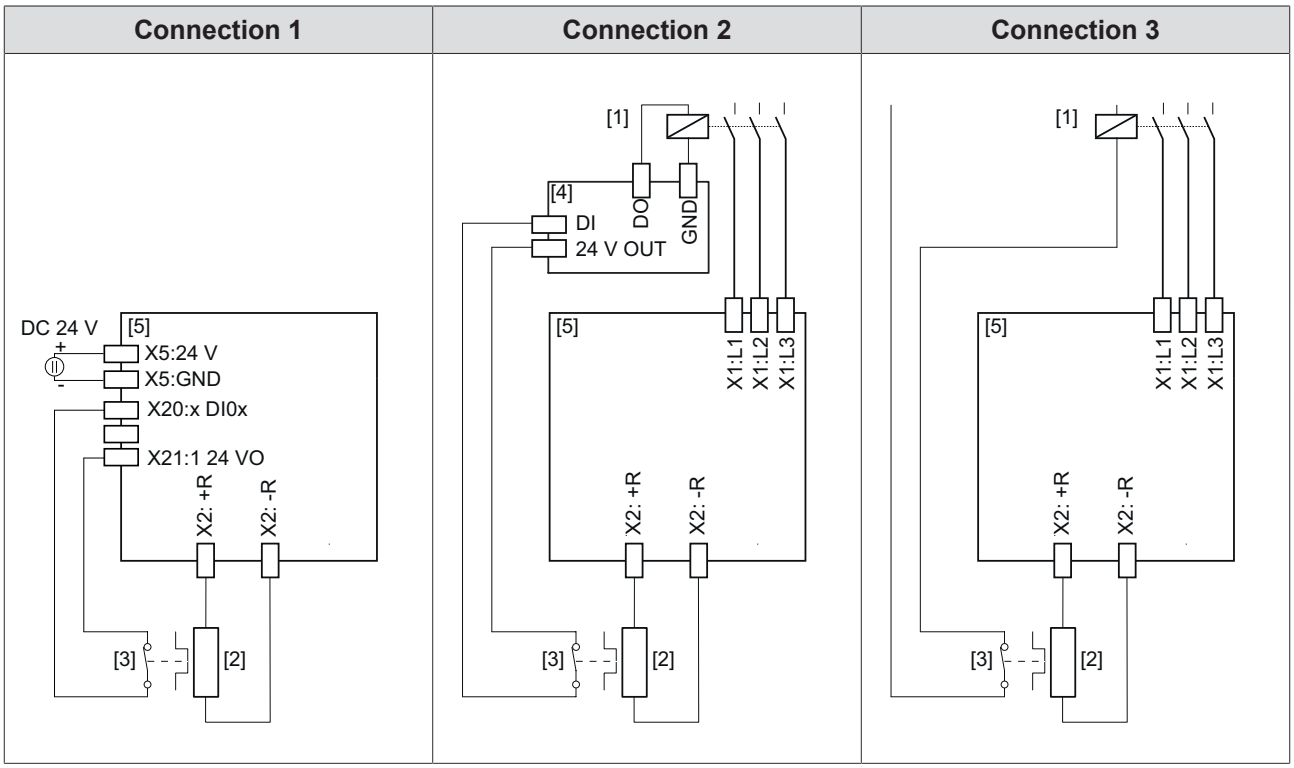
The signal contact directly affects the line contactor.

If the internal temperature switch responds, note the following:

- A response by the PLC is not required.
- There is no direct response in the inverter.

Inverters of size 4 and larger

The following 3 connections exist:



[1] Line contactor
[2] Braking resistor
[3] Internal temperature switch or overload relay
[4] PLC
[5] Inverter

Connection 1

INFORMATION

When using connection variant 1 (connection of braking resistor without line contactor), the inverter must be supplied with external DC 24 V.

INFORMATION

When circuit 1 is used, there is no galvanic isolation from the grid. The device is not de-energized. If it is necessary to de-energize the device, e.g., for electrical work, you have to switch it off with a main switch, for example. The switch-off design is always done system-specific depending on the specific application considering the applicable regulations.

The signal contact is evaluated in the inverter. The digital input of the inverter used for the evaluation must be parameterized to the "External braking resistor fault" function

- A response by the PLC is not required.
- It is not necessary to disconnect the line connection using an external switching device.
- If an internal short circuit in the brake chopper is detected by the inverter, the inverter interrupts the energy supply by inhibiting the rectifier.
- The inverter switches to "Output stage inhibit".

Connection 2

The signal contact is only evaluated in the PLC.

If the internal temperature switch responds, note the following:

- The PLC must disconnect the power supply.
- There is no direct response in the inverter.

With connection 2, it is possible that the PLC finishes the current travel cycle although the thermal circuit breaker has tripped. Only then is the power supply disconnected. In this case, the residual braking energy $W_{Rest} = P_{BRnom} \times 20$ s must not be exceeded.

Connection 3

The signal contact directly affects the line contactor.

If the internal temperature switch responds, note the following:

- A response by the PLC is not required.
- There is no direct response in the inverter.

10.14.2 Connecting braking resistors in parallel

It is permitted to connect several identical braking resistors in parallel. The following applies:

- Connect the power connections of the braking resistors to +R and -R in parallel.
- Each braking resistor requires separate protection against thermal overload.
- Connect the signal contacts (NC contacts) of the protection devices in series.
- Pay attention to the minimum permitted braking resistance value R_{BRmin} when connecting braking resistors in parallel.

10.14.3 Connecting braking resistors

Proceed as follows:

1. Connect the braking resistor to +R and -R.
2. For BW..-...-01 braking resistors, use connections 1 and 3. Connection 2 is reserved and may not be used.

31972098/EN – 8/2024

10.15 ND.. line choke

Observe the following information:

- The connection cable between line choke and line filter does not need to be shielded.
- Limit the length of the cable between the line choke and the line filter to the length that is absolutely necessary.

10.16 NF.. line filter

Observe the following information:

- No other consumers may be wired between the line filter and the inverter.
- No switching is allowed between the line filter and the inverter.
- The connection cable between the line filter and inverter does not have to be shielded.
- Limit the length of the cable between the line filter and the inverter to the required length.
- Always lay the cables upstream and downstream of the line filter separately.
- **Under no circumstances** are the cables before and after the line filter allowed to be laid along the motor lead or braking resistor cable.

10.17 Terminal assignment

INFORMATION

The device-internal reference potential is designated as GND. All reference potentials GND are internally connected to PE.

INFORMATION

The assignment "Reserved" means that no cable may be connected to this connection.

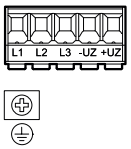
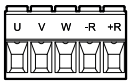
INFORMATION

The technical data for the power and control electronics connections is provided in the **Product manual** > chapter "Technical data" (→ 🗎 36).

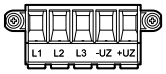
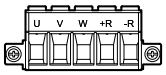
31972098/EN – 8/2024

10.17.1 Basic device

Sizes 1 – 3

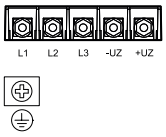
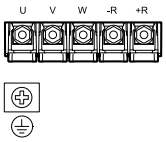
Terminal	Contact	Function	
	X1:L1	L1	Connection for supply system
	X1:L2	L2	
	X1:L3	L3	
	X1:-U_z	-V_z	DC link connection
	X1:+U_z	+U_z	
	⏚	PE	Protective earth connection
	X2:U	U	Motor connection
	X2:V	V	
	X2:W	W	
	X2:+R	+R	Braking resistor connection
	X2:-R	-R	
	⏚	PE	Protective earth connection

Size 4

Terminal	Contact	Function	
	X1:L1	L1	Connection for supply system
	X1:L2	L2	
	X1:L3	L3	
	X1:-U_z	-V_z	DC link connection
	X1:+U_z	+U_z	
	⏚	PE	Protective earth connection
	X2:U	U	Motor connection
	X2:V	V	
	X2:W	W	
	X2:+R	+R	Braking resistor connection
	X2:-R	-R	
	⏚	PE	Protective earth connection

31972098/EN – 8/2024

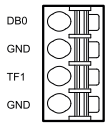
Sizes 5 – 8

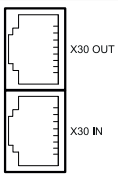
Terminal	Contact	Function	
	X1:L1	L1	Connection for supply system
	X1:L2	L2	
	X1:L3	L3	
	X1:-U_Z	-V_Z	DC link connection
	X1:+U_Z	+U_Z	
	⏚	PE	Protective earth connection
	X2:U	U	Motor connection
	X2:V	V	
	X2:W	W	
	X2:+R	+R	Braking resistor connection
	X2:-R	-R	
	⏚	PE	Protective earth connection

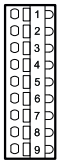
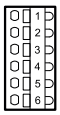
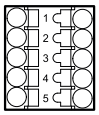
Sizes 7 – 8

Terminal	Contact	Function	
	-U_Z*	-V_Z	Connection in front of DC link choke
	+U_Z*	+U_Z	

Sizes 1 – 8

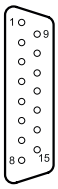
Terminal	Contact	Function	
	X5:24 V	V_i24 V	DC 24 V supply voltage
	X5:GND	GND	Reference potential
	X10:DB0 X10:DB00	DB00	Brake control
	X10:GND	GND	Reference potential
	X10:TF1	TF1	Sensor input for temperature evaluation of the motor
	X10:GND	GND	Reference potential

Terminal	Contact	Function
	X30 OUT	EtherCAT®/SBus^{PLUS} system bus
	X30 IN	
	X31	SEW-EURODRIVE Service interface

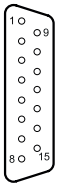
Terminal	Contact	Function	
	X20:1	DI00	Digital input 1, with fixed assignment "Output stage enable"
	X20:2	DI01	Digital input 2, fixed setpoints – positive direction of rotation
	X20:3	DI02	Digital input 3, fixed setpoints – negative direction of rotation
	X20:4	DI03	Digital input 4, fixed speed setpoint bit 0
	X20:5	DI04	Digital input 5, fixed speed setpoint bit 1
	X20:6	DI05	Digital input 6, fault reset
	X20:7	Reserved	–
	X20:8	Reserved	–
	X20:9	GND	Reference potential
	X21:1	VO24	DC 24 V voltage output
	X21:2	DO00	Digital output 1, operational
	X21:3	DO01	Digital output 2, output stage enable
	X21:4	DO02	Digital output 3, error
	X21:5	DO03	Digital output 4, STO active
	X21:6	GND	Reference potential
	X6:1	F_STO_P1	DC +24 V input F_STO_P1
	X6:2	F_STO_M	DC 0 V input F_STO_M
	X6:3	F_STO_P2	DC +24 V input F_STO_P2
	X6:4	GND	Reference potential
	X6:5	24 V STO_OUT	U_{out} = DC 24 V supply of F_STO_P1 and F_STO_P2

31972098/EN – 8/2024

X15: Resolver

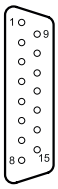
Terminal	Contact	Function	
	X15:1	sin+	Signal track sine+
	X15:2	cos+	Signal track cosine+
	X15:3	Reserved	–
	X15:4	Reserved	–
	X15:5	Reference+	Resolver excitation+
	X15:6	Temperature sensor-	Reference potential temperature sensor TF/TH/KTY-/PK
	X15:7	Reserved	–
	X15:8	Reserved	–
	X15:9	sin-	Signal track sine-
	X15:10	cos-	Signal track cosine-
	X15:11	Reserved	–
	X15:12	Reserved	–
	X15:13	Reference	Resolver excitation-
	X15:14	Temperature sensor+	Temperature sensor TF/TH/KTY+/PK
	X15:15	Reserved	–

X15: TTL, HTL and sin/cos encoder

Terminal	Contact	Function	
	X15:1	A / cos+	Signal track A / cosine+
	X15:2	B / sin+	Signal track B / sine+
	X15:3	C	Signal track C
	X15:4	DATA+[1]	Data cable for electronic nameplate
	X15:5	Reserved	–
	X15:6	Temperature sensor-	Reference potential temperature sensor TF/TH/KTY-/PK
	X15:7	Reserved	–
	X15:8	GND	Reference potential encoder supply
	X15:9	$\overline{A}$ / cos-	Signal track $\overline{A}$ / cosine-
	X15:10	$\overline{B}$ / sin-	Signal track $\overline{B}$ / sine-
	X15:11	$\overline{C}$	Signal track $\overline{C}$
	X15:12	DATA-[1]	Data cable for electronic nameplate
	X15:13	V_{S24VG}	Encoder supply 24 V
	X15:14	Temperature sensor+	Temperature sensor TF/TH/KTY+/PK
	X15:15	V_{S12VG}	Encoder supply 12 V

1) For encoders from SEW-EURODRIVE with electronic nameplate.

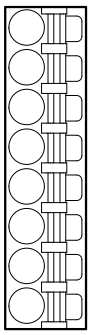
X15: HIPERFACE® encoder and SEW-EURODRIVE encoder with RS485 interface

Terminal	Contact	Function	
	X15:1	cos+	Cosine+
	X15:2	sin+	Sine+
	X15:3	Reserved	–
	X15:4	DATA+	Signal cable+
	X15:5	Reserved	–
	X15:6	Temperature sensor-	Reference potential temperature sensor TF/TH/KTY-/PK
	X15:7	Reserved	–
	X15:8	GND	Reference potential encoder supply
	X15:9	cos-	Cosine-
	X15:10	sin-	Sine-
	X15:11	Reserved	–
	X15:12	DATA-	Signal cable-
	X15:13	V_{S24VG}	24 V encoder supply
	X15:14	Temperature sensor+	Temperature sensor TF/TH/KTY+/PK
	X15:15	V_{S12VG}	12 V encoder supply

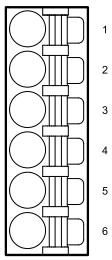
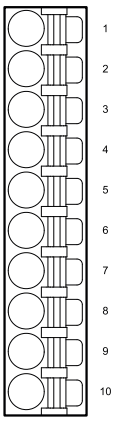
X16: MOVILINK® DDI interface

Terminal	Contact	Function	
	X16	Coaxial connection	MOVILINK® DDI

10.17.2 CIO21A input/output card

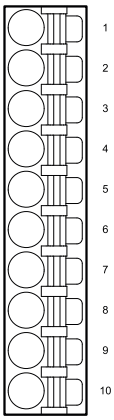
Terminal	Contact	Function	
			S50/1 on: Current input active for AI2x S50/2 on: Current input active for AI3x S50/1 off[1]: Voltage input active for AI2x S50/2 off[1]: Voltage input active for AI3x
	X50:1	REF1	+10 V DC reference voltage output
	X50:2	AI21	Analog current or voltage input
	X50:3	AI22	Analog current or voltage input, reference for AI21
	X50:4	GND	Reference potential
	X50:5	AI31	Analog current or voltage input
	X50:6	AI32	Analog current or voltage input, reference for AI31
	X50:7	GND	Reference potential
	X50:8	REF2	-10 V DC reference voltage output

31972098/EN – 8/2024

Terminal	Contact	Function	
	X51:1	AOV2	Analog voltage output, freely programmable
	X51:2	AOC2	Analog current output, freely programmable
	X51:3	GND	Reference potential for outputs AOV2 and AOC2
	X51:4	AOV3	Analog voltage output, freely programmable
	X51:5	AOC3	Analog current output, freely programmable
	X51:6	GND	Reference potential for outputsAOV3 and AOC3
	X52:1	DI10	Digital input 1, freely programmable
	X52:2	DI11	Digital input 2, freely programmable
	X52:3	DI12	Digital input 3, freely programmable
	X52:4	DI13	Digital input 4, freely programmable
	X52:5	GND	Reference potential for digital inputs DI10 – DI13
	X52:6	DO10	Digital output 1, freely programmable
	X52:7	DO11	Digital output 2, freely programmable
	X52:8	DO12	Digital output 3, freely programmable
	X52:9	DO13	Digital output 4, freely programmable
	X52:10	GND	Reference potential for digital outputs DO10 – DO13

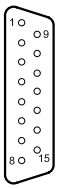
1) Delivery state.

10.17.3 Input/output card CID21A

Terminal	Contact	Function	
	X52:1	DI10	Digital input 1, freely programmable
	X52:2	DI11	Digital input 2, freely programmable
	X52:3	DI12	Digital input 3, freely programmable
	X52:4	DI13	Digital input 4, freely programmable
	X52:5	GND	Reference potential for digital inputs DI10 – DI13
	X52:6	DO10	Digital output 1, freely programmable
	X52:7	DO11	Digital output 2, freely programmable
	X52:8	DO12	Digital output 3, freely programmable
	X52:9	DO13	Digital output 4, freely programmable
	X52:10	GND	Reference potential for digital outputs DO10 – DO13

10.17.4 CES11A/CES12A multi-encoder card

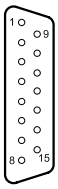
X17: TTL, HTL and sin/cos encoder

Terminal	Contact	Function	
	X17:1	A / cos+	Signal track A / cosine+
	X17:2	B / sin+	Signal track B / sine+
	X17:3	C	Signal track C
	X17:4	DATA+[1]	Data cable for electronic nameplate
	X17:5	Reserved	–
	X17:6	Temperature sensor-	Reference potential temperature sensor TF/TH/KTY-/PK
	X17:7	Reserved	–
	X17:8	GND	Reference potential encoder supply
	X17:9	$\overline{A}$ / cos-	Signal track $\overline{A}$ / cosine-
	X17:10	$\overline{B}$ / sin-	Signal track $\overline{B}$ / sine-
	X17:11	$\overline{C}$	Signal track $\overline{C}$
	X17:12	DATA-[1]	Data cable for electronic nameplate
	X17:13	V_{S24VG}	Encoder supply 24 V
	X17:14	Temperature sensor+	Temperature sensor TF/TH/KTY+/PK
	X17:15	V_{S12VG}	Encoder supply 12 V

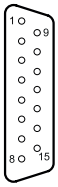
1) For encoders from SEW-EURODRIVE with electronic nameplate.

31972098/EN – 8/2024

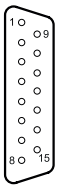
X17: HIPERFACE® encoder and SEW-EURODRIVE encoder with RS485 interface

Terminal	Contact	Function	
	X17:1	cos+	Cosine+
	X17:2	sin+	Sine+
	X17:3	Reserved	–
	X17:4	DATA+	Data line+
	X17:5	Reserved	–
	X17:6	Temperature sensor-	Reference potential temperature sensor TF/TH/KTY-/PK
	X17:7	Reserved	–
	X17:8	GND	Reference potential encoder supply
	X17:9	cos-	Cosine-
	X17:10	sin-	Sinusoidal
	X17:11	Reserved	–
	X17:12	DATA-	Data line-
	X17:13	V_{S24VG}	Encoder supply 24 V
	X17:14	Temperature sensor+	Temperature sensor TF/TH/KTY+/PK
	X17:15	V_{S12VG}	Encoder supply 12 V

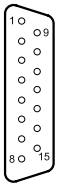
X17: EnDat 2.1 encoder

Terminal	Contact	Function	
	X17:1	cos+	Signal track cosine+
	X17:2	sin+	Signal track sine+
	X17:3	Pulse+	Clock signal+
	X17:4	DATA+	Data line+
	X17:5	Reserved	–
	X17:6	Temperature sensor-	Reference potential temperature sensor TF/TH/KTY-/PK
	X17:7	Reserved	–
	X17:8	GND	Reference potential encoder supply
	X17:9	cos-	Signal track cosine-
	X17:10	sin-	Signal track sine-
	X17:11	Pulse-	Clock signal-
	X17:12	DATA-	Data line-
	X17:13	V_{S24VG}	Encoder supply 24 V
	X17:14	Temperature sensor+	Temperature sensor TF/TH/KTY+/PK
	X17:15	V_{S12VG}	Encoder supply 12 V

X17: SSI encoder

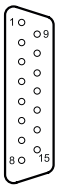
Terminal	Contact	Function	
	X17:1	Reserved	–
	X17:2	Reserved	–
	X17:3	PULSE+	Clock signal+
	X17:4	DATA+	Data line+
	X17:5	Reserved	–
	X17:6	Temperature sensor-	Reference potential temperature sensor TF/TH/KTY-/PK
	X17:7	Reserved	–
	X17:8	GND	Reference potential encoder supply
	X17:9	Reserved	–
	X17:10	Reserved	–
	X17:11	PULSE-	Clock signal-
	X17:12	DATA-	Data line-
	X17:13	V_{S24VG}	Encoder supply 24 V
	X17:14	Temperature sensor+	Temperature sensor TF/TH/KTY+/PK
	X17:15	V_{S12VG}	Encoder supply 12 V

X17: SSI and sin/cos combi encoder

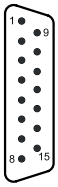
Terminal	Contact	Function	
	X17:1	cos+	Signal track cosine+
	X17:2	sin+	Signal track sine+
	X17:3	PULSE+	Clock signal+
	X17:4	DATA+	Data line+
	X17:5	Reserved	–
	X17:6	Temperature sensor-	Reference potential temperature sensor TF/TH/KTY-/PK
	X17:7	Reserved	–
	X17:8	GND	Reference potential encoder supply
	X17:9	cos-	Signal track cosine-
	X17:10	sin-	Signal track sine-
	X17:11	PULSE-	Clock signal-
	X17:12	DATA-	Data line-
	X17:13	V_{S24VG}	Encoder supply 24 V
	X17:14	Temperature sensor+	Temperature sensor TF/TH/KTY+/PK
	X17:15	V_{S12VG}	Encoder supply 12 V

31972098/EN – 8/2024

X17: CANopen encoder

Terminal	Contact	Function	
	X17:1	Reserved	–
	X17:2	Reserved	–
	X17:3	Reserved	–
	X17:4	CAN_H	CAN high data cable
	X17:5	Reserved	–
	X17:6	Temperature sensor-	Reference potential temperature sensor TF/TH/KTY-/PK
	X17:7	Reserved	–
	X17:8	GND	Reference potential encoder supply
	X17:9	Reserved	–
	X17:10	Reserved	–
	X17:11	Reserved	–
	X17:12	CAN_L	CAN low data cable
	X17:13	V_{S24VG}	Encoder supply 24 V
	X17:14	Temperature sensor+	Temperature sensor TF/TH/KTY+/PK
	X17:15	V_{S12VG}	Encoder supply 12 V

X19: Incremental encoder simulation (only for CES12A)

Terminal	Contact	Function	
	X19:1	A	Signal track A
	X19:2	B	Signal track B
	X19:3	C	Signal track C
	X19:4	Reserved	–
	X19:5	Reserved	–
	X19:6	Reserved	–
	X19:7	Reserved	–
	X19:8	GND	Reference potential
	X19:9	$\overline{A}$	Signal track $\overline{A}$
	X19:10	$\overline{B}$	Signal track $\overline{B}$
	X19:11	$\overline{C}$	Signal track $\overline{C}$
	X19:12	Reserved	–
	X19:13	Reserved	–
	X19:14	Reserved	–
	X19:15	Reserved	–

10.18 Electrical installation – functional safety

10.18.1 Important information



⚠ WARNING

The external jumper plug X6 is plugged into the unit or a voltage is connected although a MOVISAFE® CS..A safety option is installed in the unit.

Severe or fatal injuries.

- The jumper X6 must not be plugged in if a MOVISAFE® CS..A safety option is installed in the unit.
- No voltage may be connected.

10.18.2 Installation instructions



⚠ WARNING

Only the types of connection described in this documentation may be used.

Severe or fatal injuries.

- Non-compliant connection variants specified in other documentation are not permissible.

10.18.3 Terminal assignment of the MOVISAFE® CS..A safety option

Terminal	Contact	Function	
XS	XS		Slot for safety key.
X17	X17:1 to 15		• Assignment depending on connected encoder (see product manual, chapter "CES11A multi-encoder card"). • **CSS31A and CSB31A only:** Connection of 2nd encoder **Not used for functional safety.**
X17	X17:1 to 15		• **Only with CSA31A** • Assignment depending on connected encoder (see chapter "Technical data > X17 encoder interface for CSA31A" (→ 🗎 61)).

31972098/EN – 8/2024

Terminal	Contact	Function	
X60	X60:1	F-DI00	Safe digital input F-DI00.
	X60:2	F-DI01	Safe digital input F-DI01.
	X60:3	GND	Reference potential for safe inputs/outputs.
	X60:4	GND	Reference potential for safe inputs/outputs.
	X60:5	F-DI02	Safe digital input F-DI02.
	X60:6	F-DI03	Safe digital input F-DI03.
	X60:7	GND	Reference potential for safe inputs/outputs.
	X60:8	GND	Reference potential for safe inputs/outputs.
	X60:9	F-SS0	DC 24 V sensor voltage supply for safe digital inputs F-DI00 and F-DI02.
	X60:10	F-SS1	DC 24 V sensor voltage supply for safe digital inputs F-DI01 and F-DI03.
	X60:11	F-DO00_M	Safe digital output F-DO00_M (not with CSB21A).
	X60:12	F-DO00_P	Safe digital output F-DO00_P (not with CSB21A).
	X60:13	F-DO01_M	Safe digital output F-DO01_M (not with CSB21A)
	X60:14	F-DO01_P	Safe digital output F-DO01_P (not with CSB21A).

10.18.4 Safe disconnection

The jumper X6 must be removed from the inverter if a MOVISAFE® CS..A safety option is installed in the unit. No external voltage may be connected to connection X6 of the unit.

10.18.5 Connection examples for safe digital inputs (F-DI..)

Contact-equipped sensors (single-channel)

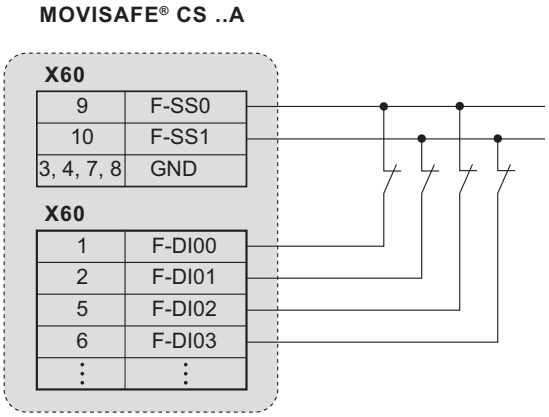
A one-channel sensor is connected via the sensor supply F-SS0 or F-SS1. The sensor cycle available there makes it possible for crossfaults in the wiring to be detected. Note the detailed assignment of F-DI.. to the sensor supply F-SS0 or F-SS1 in the chapter "Terminal assignment".

Settings in the "Assist CS.." parameterization tool:

- Choose the one-channel connection type.
- Depending on the requirement with respect to safety technology, activate or deactivate the "crossfault monitoring" and pulsed voltage supply of the sensor supply.

31972098/EN – 8/2024

The following figure shows the MOVISAFE® CS..A safety option with one-channel contact-equipped sensors.



9007207666482571

Operation with activated crossfault monitoring

The following faults are detected:

- Crossfault between every digital input line F-DI.. and a 24 V supply voltage.
- Crossfault between a digital input line F-DIx and another digital input line F-DIy, which is assigned to another sensor supply, if at least the associated switch contact of the other digital input F-DIy is closed.
- Crossfault between a digital input line F-DI.. and a sensor supply line not assigned to the input F-DI..
- Crossfault between a sensor supply line F-SS.. and a 24 V supply voltage if the digital input F-DI.. is assigned to the sensor supply and the switch contact belonging to F-DI.. is closed.
- Crossfault between the sensor supply lines F-SS.. themselves if the switch contact belonging to the digital input F-DI.. is closed.

⚠ WARNING

The MOVISAFE® CS..A safety option **cannot** detect a short circuit between a sensor supply F-SS.. and an associated safe input F-DI..

Severe or fatal injuries.

- Make sure that no short circuit between the sensor supply F-SS.. and an associated safe input F-DI.. is possible.

⚠ WARNING

If crossfault monitoring is deactivated, the MOVISAFE® CS..A safety option **cannot** detect crossfaults in the cabling. This configuration is **not** permitted for safe applications without further measures.

Severe or fatal injuries.

- A one-channel sensor with crossfault monitoring can achieve a category 2 structure according to EN ISO 13849-1.

Contact-equipped sensors (two-channel)

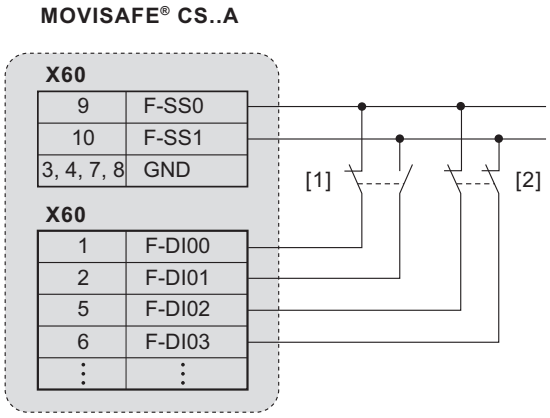
A two-channel sensor with contacts is connected via the sensor supply F-SS0 and F-SS1. Note the detailed assignment of the safe digital inputs (F-DI..) to the sensor supply F-SS0 and F-SS1 in chapter "Electrical installation" > "Terminal assignment".

31972098/EN – 8/2024

Settings in the "Assist CS.." parameterization tool:

- Choose the two-channel connection type.
- Activate or deactivate crossfault monitoring and pulsed sensor voltage supply, depending on the safety requirements.

The following figure shows the MOVISAFE® CS..A safety option with two-channel contact-equipped sensors in the connection variants "non-equivalent" and "equivalent".



18014406921227019

[1] Two-channel contact-equipped sensor in "non-equivalent" connection variant
[2] Two-channel contact-equipped sensor in "equivalent" connection variant

Operation with activated crossfault monitoring

The following faults are detected:

- Crossfault between every digital input line F-DI.. and a 24 V supply voltage
- Crossfault between a digital input line F-DIx and another digital input line F-DIy, which is assigned to another sensor supply, if at least the associated switch contact of the other digital input F-DIy is closed
- Crossfault between a digital input line F-DI.. and a sensor supply line not assigned to the input F-DI..
- Crossfault between a sensor supply line F-SS.. and a 24 V supply voltage if the digital input F-DI.. is assigned to the sensor supply and the switch contact belonging to F-DI.. is closed
- Crossfault between the sensor supply lines F-SS.. themselves if the switch contact belonging to the digital input F-DI.. is closed

Operation without crossfault monitoring

When using a two-channel, non-equivalent-switching sensor, the MOVISAFE® CS..A safety option can detect a crossfault between the two digital inputs of an input pair.

⚠ WARNING



The MOVISAFE® CS..A safety option **cannot** detect a short circuit between an F-SS.. sensor supply and an associated safe digital input F-DI.. (sensor jumpered).

Severe or fatal injuries.

- Make sure that a short circuit between the sensor supply F-SS.. and an associated safe digital input F-DI.. is not possible.



⚠ WARNING

If crossfault monitoring is deactivated and a two-channel, equivalent-switching sensor is used, the MOVISAFE® CS..A safety option **cannot** detect crossfaults in the cabling.

Severe or fatal injuries.

- Make sure that crossfaults are not possible at the safe digital inputs F-DI..



INFORMATION

Note that in the non-equivalent connection variant, the NC contact is connected to the sensor supply F-SS0.

Active sensors (two-channel)

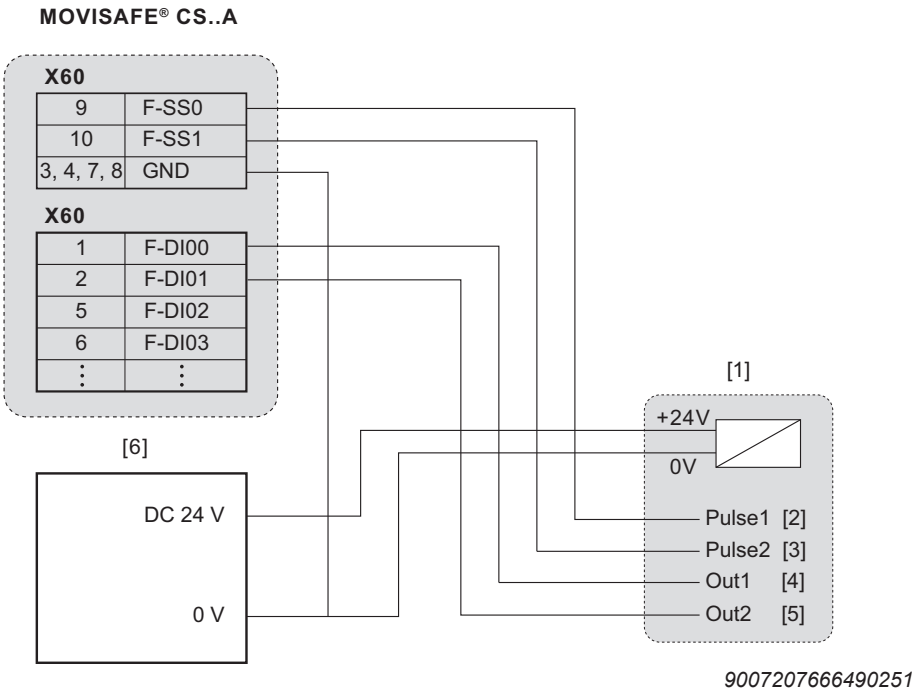
When connecting a two-channel sensor with additional voltage supply, the voltage is supplied via an external DC 24 V voltage supply. The voltage supplies for the sensor outputs are connected to the sensor supply F-SS0 and F-SS1. The safe outputs of the sensor are connected with two channels to the respective safe digital inputs (F-DI..) at terminal X60. Note the detailed assignment of the safe digital inputs (F-DI..) to the sensor supply F-SS0 and F-SS1 in chapter "Electrical installation" > "Terminal assignment".

Settings in the "Assist CS.." parameterization tool:

- Choose the two-channel connection type (equivalent/non-equivalent).
- Activate or deactivate the pulsed sensor voltage supply, depending on the safety requirements.
- Parameterize the permitted discrepancy time between the two input signals of the sensor you are using.

31972098/EN – 8/2024

The following figure shows the MOVISAFE® CS..A safety option with an active sensor (two-channel).



[1] Active two-channel sensor
[2] Supply of output 1 (Out1)
[3] Supply of output 2 (Out2)
[4] Safe digital output 1
[5] Safe digital output 2
[6] External DC 24 V voltage supply

Operation with activated crossfault monitoring

The following faults are detected:

- Crossfault between every digital input line F-DI.. and a 24 V supply voltage.
- Crossfault between a digital input line F-DIx and another digital input line F-DIy, which is assigned to another sensor supply, if at least the associated switch contact of the other digital input F-DIy is closed.
- Crossfault between a digital input line F-DI.. and a sensor supply line not assigned to the input F-DI..
- Crossfault between a sensor supply line F-SS.. and a 24 V supply voltage if the digital input F-DI.. is assigned to the sensor supply and the switch contact belonging to F-DI.. is closed.
- Crossfault between the sensor supply lines F-SS.. themselves if the switch contact belonging to the digital input F-DI.. is closed.

⚠ WARNING



The MOVISAFE® CS..A safety option **cannot** detect a short circuit between an F-SS.. sensor supply and an associated safe digital input F-.. (sensor jumpered).

Severe or fatal injuries.

- Make sure that a short circuit between the sensor supply F-SS.. and an associated safe digital input F-DI.. is not possible.

⚠ WARNING

If crossfault monitoring is deactivated, the MOVISAFE® CS..A safety option **cannot** detect crossfaults in the cabling.

Severe or fatal injuries.

- Make sure that crossfaults are not possible at the safe digital inputs F-DI.., or that they can be detected by the sensor.

Sensors with semiconductor outputs (OSSD, two-channel)

When connecting an OSSD sensor, make sure that pulsed voltage supply is deactivated.

INFORMATION

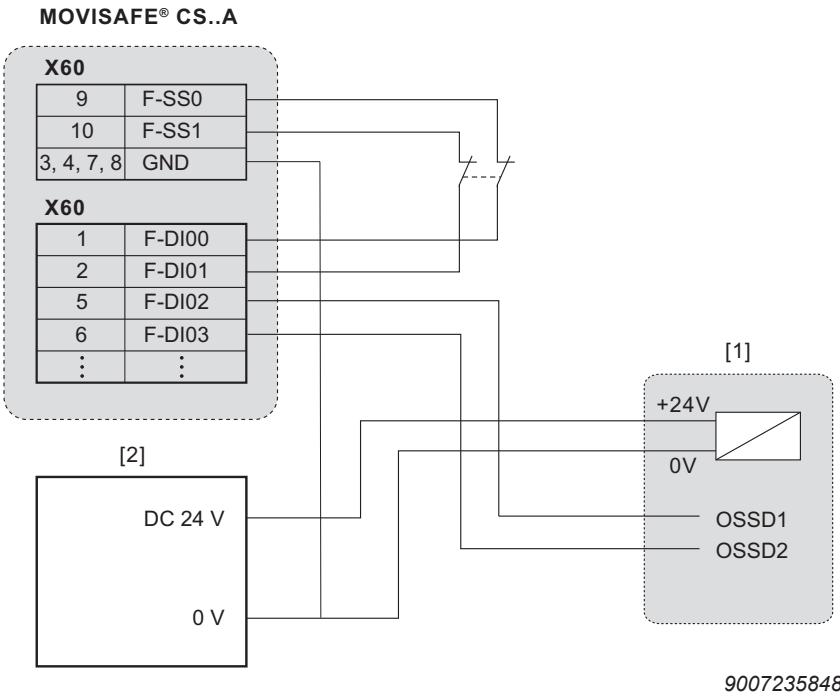
Deactivate crossfault monitoring at the respective safe inputs of the OSSD-capable sensor technology.

OSSD-capable sensor technology tests and diagnoses the OSSD outputs on its own. The faults detected in the cabling depend on the diagnostic function of the sensor in use.

For OSSD-capable sensors, the following two connection variants result (example):

Variant 1

If contact-equipped sensors are used in addition to sensors with OSSD-capable outputs and if the contact-equipped sensors require crossfault monitoring, the OSSD-capable sensor technology can be supplied via an external voltage supply.

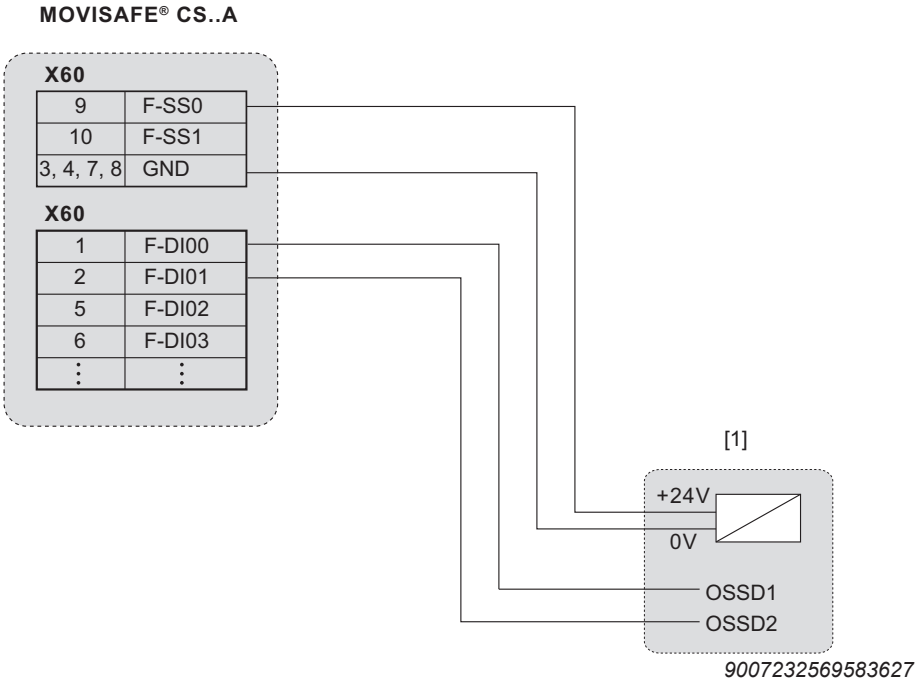


[1] OSSD-capable sensor (e.g. scanner or light grid)
[2] External DC 24 V voltage supply

31972098/EN – 8/2024

Variant 2

If only OSSD sensors are used, the voltage can also be supplied via terminals F-SS0 and F-SS1. In this case, deactivate the pulsed sensor voltage supply (F-SS0 and F-SS1) in the "Assist CS.." parameterization tool.



[1] OSSD-capable sensor (e.g. scanner or light grid)

INFORMATION

The performance level that can be achieved is mainly determined by the OSSD sensor technology used.

Use the external voltage supply for sensors that have a higher current consumption than the F-SS.. sensor supply lines can provide.

10.18.6 Connection examples for safe digital inputs

Actuator (two-channel, sourcing/sinking output)

The input of the actuator must be isolated and without any connection to a reference potential. Inside the MOVISAFE® CS..A safety option there is a switching element between F-DO._M and the reference potential. With a non-floating actuator, this switching element would be bridged. The redundancy of the sourcing and sinking output would no longer apply.

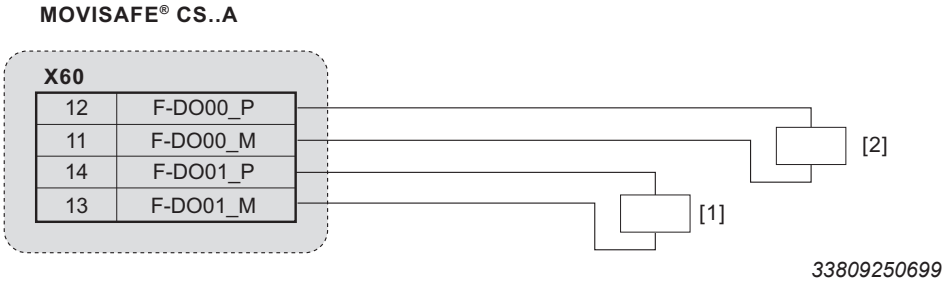
Fault detection using line diagnostics

The MOVISAFE® CS..A safety option detects the following faults in the external cabling when the output is disabled or enabled:

- Short circuit between sourcing output and a supply voltage that lies within the range of 15 to 30 V and has the same ground potential as the MOVISAFE® CS..A safety card.
- Short circuit between the sinking output and the reference potential or a voltage < 6 V.

The MOVISAFE® CS..A safety option can also detect the following faults when the output is enabled:

- Short circuit between different sourcing outputs
- Short circuit between different sinking outputs
- Short circuit between sourcing and sinking output
- Short circuit between sourcing output and GND
- Overload on each output
- Open circuit (with F-DO., if activated)



[1] Actuator 1
[2] Actuator 2

INFORMATION

In the event of short circuits, a high short-circuit current can occur for a short time. Depending on the DC 24 V supply voltage used, this can cause a voltage dip that limits the operation of MOVIDRIVE® modular or MOVIDRIVE® system and/or individual assemblies.

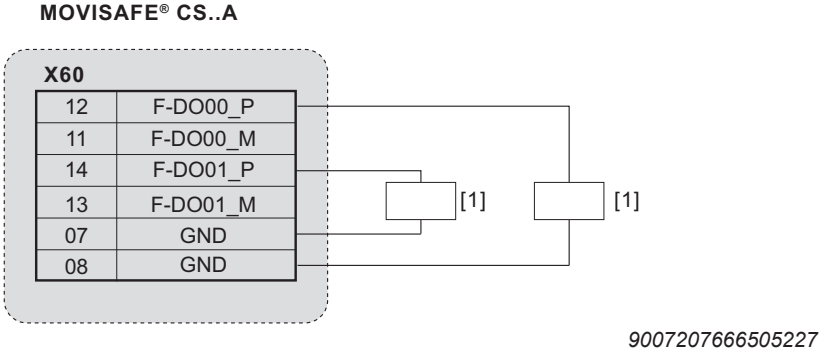
If the voltage supply is not stable enough, it can result in a reset and a restart of the MOVISAFE® CS..A safety option

- Make sure the voltage supply does not break down in the event of short circuits at the output.

The sourcing/sinking output connection variant is suitable for applications up to SIL 3 according to EN 61508 and Performance Level e according to EN ISO 13849-1.

Connect the actuator between F-DO.._P and F-DO.._M. The actuator can still be switched off in case of a crossfault in one of the connection leads, because the MOVISAFE® CS..A safety option disconnects the sourcing and the sinking output terminal.

Actuator (two-channel, sourcing output)



[1] Actuator

31972098/EN – 8/2024

Connect the actuator on two channels between F-DO00_P and GND as well as F-DO01_P and GND. The input of the actuator does not have to be zero potential. The two-channel, sourcing output connection variant is suitable for applications up to SIL 3 pursuant to EN 61508 and performance level e pursuant to EN ISO 13849-1.

This connection type cannot be adjusted directly via a parameter, but is instead achieved by the following parameterization and control of the two outputs involved:

- Both outputs are parameterized as single-channel sourcing outputs.
- Both outputs are switched simultaneously. This can be achieved via a safety sub-function (STO, SBC) assigned to both outputs or via the safe process output data F-PO (F-DO00 and F-DO01).

The MOVISAFE® CS..A safety option detects the following faults in the external cabling when the output is disabled or enabled:

- Short circuit between sourcing output and a supply voltage that lies within the range of 15 to 30 V and has the same ground potential as the other assembly.

The MOVISAFE® CS..A safety option can detect the following faults when the output is enabled:

- Short circuit between different sourcing outputs
- Short circuit between the sourcing output and the reference potential
- Overload on each output
- Wire break (if activated)

⚠ WARNING



In case of a short circuit between the sourcing output and a 24 V supply voltage, the MOVISAFE® CS..A safety option can no longer disable the actuator and thus cannot switch to a safe state.

Severe or fatal injuries.

- Route the cables in such a way that no short circuit can occur between the sourcing output and a +24 V supply voltage.

Actuator (one-channel, sourcing output)

The input of the actuator does not have to be zero potential.

The sourcing output connection variant is suitable for applications up to SIL 2 pursuant to EN 61508 and performance level d pursuant to EN ISO 13849-1.

The MOVISAFE® CS..A safety option detects the following faults in the external cabling when the output is disabled or enabled:

- Short circuit between sourcing output and a supply voltage that lies within the range of 15 to 30 V and has the same ground potential as the assembly.

The MOVISAFE® CS..A safety option can also detect the following faults when the output is enabled:

- Short circuit between different sourcing outputs
- Short circuit between sourcing output and reference potential 0 V
- Overload at each output
- Wire break F-DO (if activated)

⚠ WARNING

In the event of a short-circuit fault between the sourcing output and a 24 V supply voltage, the MOVISAFE® CS..A safety option can no longer disable the actuator and cannot change to the safe state.

The line diagnostics function can detect the fault. However, the MOVISAFE® CS..A safety option cannot enter a safe state as there is no redundant switch-off channel in this connection variant.

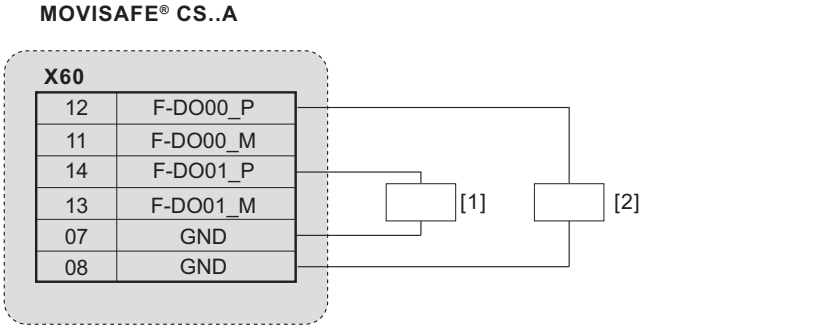
Severe or fatal injuries.

- Route the cables in such a way that no short circuit can occur between the sourcing output and a +24 V supply voltage.
- Make sure that an additional redundant switch-off channel exists for the actuator (e.g. by using a second sourcing output).

INFORMATION

If possible, SEW-EURODRIVE recommends a sourcing/sinking output connection or the use of 2 parallel, sourcing outputs.

For more information about safe outputs, see chapter "Technical data".



[1] Actuator 1
[2] Actuator 2

INFORMATION

In the event of short circuits, a high short-circuit current can occur for a short time. Depending on the DC 24 V supply voltage used, this can cause a voltage dip that affects the operation of MOVIDRIVE® modular or MOVIDRIVE® system and/or individual assemblies.

If the voltage supply is not stable enough, it can result in a reset and a restart of the MOVISAFE® CS..A safety option.

- Make sure the DC 24 V voltage supply does not break down in the event of short circuits at the output.

Connect the actuator between F-DO.._P and the GND reference potential.

10.18.7 EI7C FS built-in encoder

Properties

The EI7C FS built-in encoder is a safe incremental encoder with 24 signal periods per revolution.

31972098/EN – 8/2024

The EI7C FS built-in encoder may be used with MOVISAFE® CS..A.

MOVISAFE® CS..A can detect a minimum speed of 60 min^{-1} in connection with an EI7C FS built-in encoder.

MOVISAFE® CS..A evaluates the signal of the EI7C FS built-in encoder.

MOVISAFE® CS..A and the EI7C FS built-in encoder monitor the encoder signal. The MOVISAFE® CS..A safety option detects interruptions and crossfaults in the encoder line. If a fault occurs, MOVISAFE® CS..A activates the STO safety sub-function in the unit, and the torque is switched off safely.

Installation

Connect the built-in encoder EI7C FS to the encoder interface X15 of the unit using the encoder cable (part number 18191665).

⚠ WARNING



Incorrect wiring can disable the encoder function and monitoring features for the encoder.

Severe or fatal injuries.

- You may connect the EI7C FS built-in encoder only with the MOVISAFE® CS..A safety option.
- You may only connect the encoder signals to the designated encoder interface X15 of the unit. It is not permitted to connect other devices or assemblies.

INFORMATION



When connecting a built-in encoder EI7C FS to the unit, the encoder cable must not carry a TF signal.

10.18.8 Connection variants of the safety sub-function STO

General information

If the safety requirements from this documentation are met, then all connection variants listed in this documentation are generally permitted for safety-relevant applications. This means that you must ensure without fail that the DC 24 V safety inputs are activated by a safety controller or an external safety relay, so that an independent restart is not possible.

All the safety conditions stipulated in the chapters "Integrated safety technology", "Safety conditions", and "Connection variants" must be satisfied on a primary basis for the basic selection, installation, and application of the safety components such as safety relay, emergency stop switch, and the approved connection variants.

The wiring diagrams in chapter "Electrical installation" are block diagrams whose only purpose is to show the safety sub-function(s) with the relevant components. For reasons of clarity, circuit-related measures that always have to be implemented are not shown in the diagram. These measures are, e.g.:

- Ensuring the availability of touch guards.
- Handling overvoltages and undervoltages.
- Avoiding insulation faults.
- Detecting ground faults or short circuits in externally installed lines.
- Guaranteeing the required interference immunity against electromagnetic interference.

Requirements

Use of safety relays

The requirements of the manufacturers of safety relays (such as protecting the output contacts against welding) or of other safety components must be strictly observed. The basic requirements for cable routing apply as described in this documentation.

For connecting the device to the safety relays, observe the installation requirements according to chapter "Installation requirements" (→ 🗎 189).

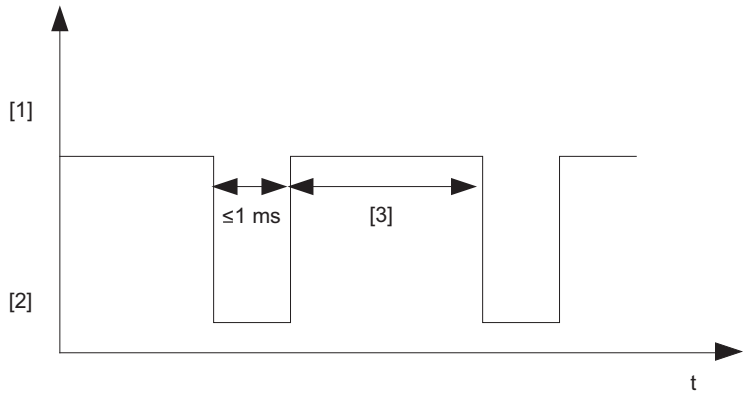
All information from the manufacturer about the use of safety relays for specific applications must also be observed.

INFORMATION

If F_STO_P1 and F_STO_P2 are connected to DC 24 V and if F_STO_M is connected to GND, STO is deactivated.

Use of safety controllers

The switch-off test pulse of the used safe digital outputs (F-DO) must be ≤ 1 ms and another switch-off test pulse must only occur 2 ms later at the earliest.



9007214469079819

[1] High
[2] Low

INFORMATION

- SEW-EURODRIVE recommends setting the dark tests (switch-off tests) to 0.8 ms due to tolerances in the safety controllers. Refer to the description of your safety controller for where and how to set this time.
- If the safety-related control voltage at the STO connection is switched off (STO activated), the specifications in chapter "External safety controller requirements" (→ 🗎 191) must be adhered to in regard to the test pulses.
- If F_STO_P1 and F_STO_P2 are connected to DC 24 V and if F_STO_M is connected to GND, STO is deactivated.

31972098/EN – 8/2024

STO signal for group disconnection

For group drives, the STO signal may be provided for several devices by a single safety relay. The following requirements must be met:

- The total cable length is limited to max. 100 m. Other instructions published by the manufacturer on the use of the safety device (for the respective application) must also be observed.
- The maximum output current and the maximum permitted contact load of the safety device must be observed (see chapter "Technical data" > "Electronic data – Safety sub-function").
- You must comply with the permitted signal levels at the STO input and all other technical data of the device. The routing of the STO control cables and the voltage drop must be considered.
- Other requirements of the safety manufacturer (such as protecting the output contacts against welding) must be strictly observed. The basic cable routing requirements apply.
- A calculation based on the technical data of the device must be performed separately for each case of group disconnection.
- A maximum of 20 devices may be used in a group disconnection.

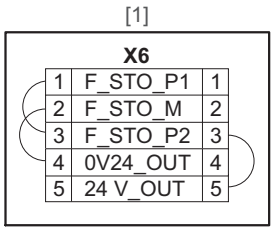
Wiring diagrams of the connection variants

STO connection at terminal X6

For detailed information on terminal X6, refer to chapter "Electrical installation" > "Terminal assignment" (→ 🗎 373).

Delivery state

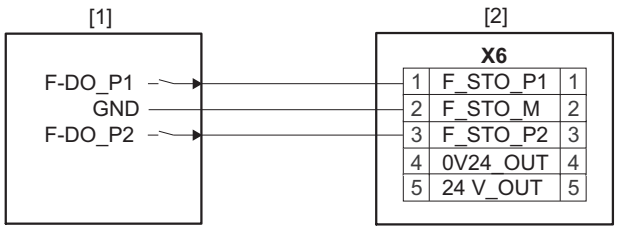
In the delivery state, the following terminals are bridged on STO connection X6:



27743538443

[1] STO terminal X6

Two-pole sourcing output

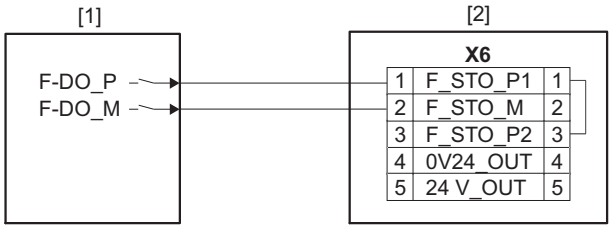


27743543947

[1] External safety device
[2] STO terminal X6

Two-pole sourcing/sinking output

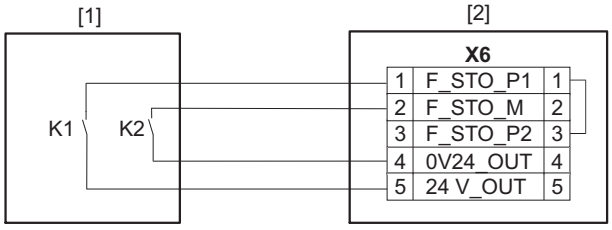
Example 1



27743625995

[1] External safety device
[2] STO terminal X6

Example 2



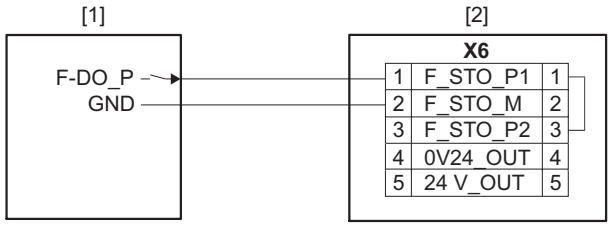
34101943179

[1] External safety device
[2] STO terminal X6

INFORMATION

The supply voltages 0V24_Out (X6:4) and 24V_Out (X6:5) must not be used to supply the external safety device.

Single-pole sourcing output

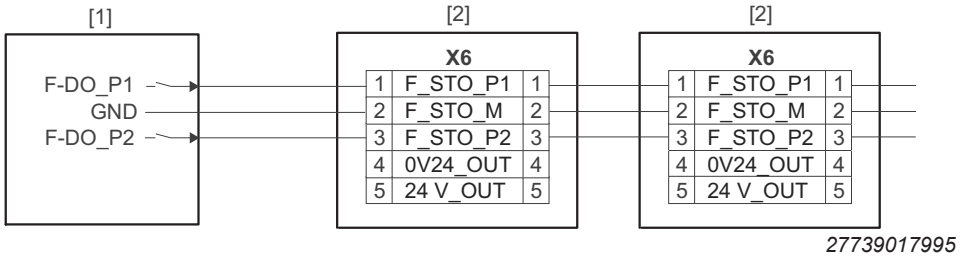


27743633163

[1] External safety device
[2] STO terminal X6

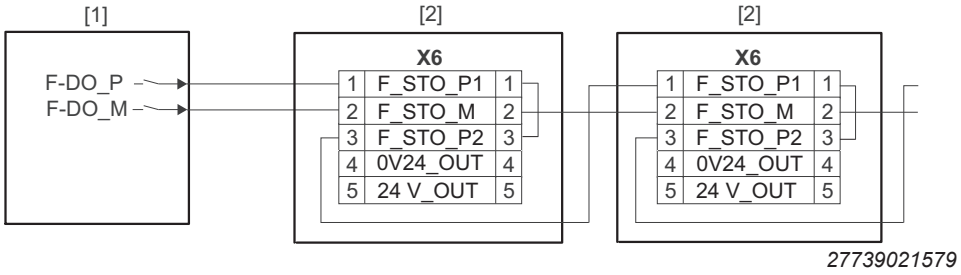
31972098/EN – 8/2024

STO group disconnection, two-pole, sourcing output



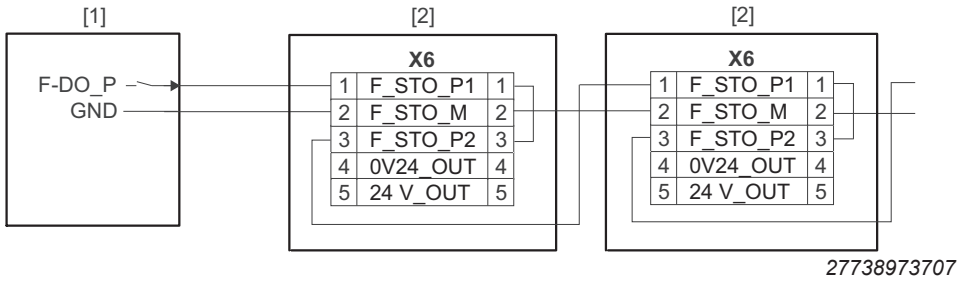
[1] External safety controller
[2] STO terminal X6

STO group disconnection, two-pole, sourcing/sinking output



[1] External safety controller
[2] STO terminal X6

STO group disconnection, one-pole, sourcing output



[1] External safety controller
[2] STO terminal X6

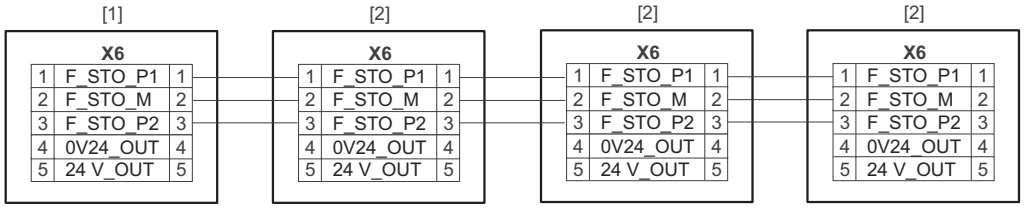
Group disconnection via CS..A

The safety option has an internal safe digital output for switching the inverter's internal STO function as well as 3 additional axes of the MOVIDRIVE® modular/system/technology inverter. No other components may be connected to the inverter's STO terminal X6.

The following conditions apply for shutting down the 3 additional axes:

- The cable length is limited to a maximum of 3 m up to the last axis.
- Cabling is permitted only within a control cabinet.
- The M-terminal of the individual axes must also be connected.
- No CS..A safety option is allowed to be installed in the additional axes.
- F-DO_STO's advanced diagnostics is available only for the device's internal STO circuit of the axis with a plugged CS..A safety option.

- For the additional axes, only short circuits of the cabling are detected.
- A connection according to the following figure is permissible:



[1] STO terminal X6 of a MOVI-C® MOVIDRIVE® with a CS..A safety option
[2] STO terminal X6 of a MOVI-C® MOVIDRIVE® without a CS..A safety option

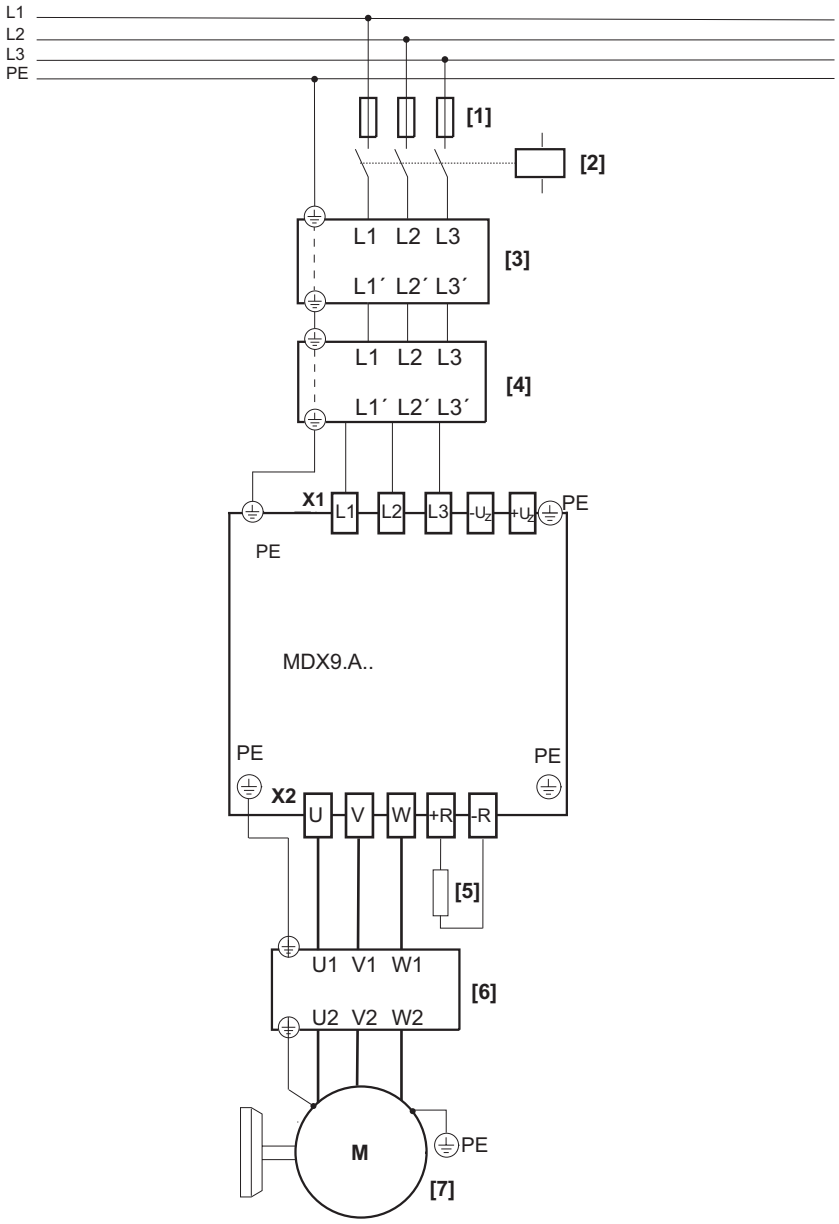
31972098/EN – 8/2024

10.19 Wiring diagrams

10.19.1 Power connection

Power connection with line contactor

The following figure shows an example of the wiring of the power connections with line contactor, line choke, line filter and output choke or output filter.



72057607916833419

[1] Fuses
[2] Line contactor
[3] Line choke (optional)
[4] Line filter (optional)
[5] Braking resistor (optional)
[6] Output choke or output filter (both optional)
[7] Motor

Power connection without line contactor

NOTICE

Operation without line contactor

If the required measures are not taken, operation of an inverter with connected braking resistor without line contactor may result in severe damage to property.

- Required measures as well as the inverters that can be operated without a line contactor can be found in the chapter "Using the line contactor" (→ 🗎 353).

INFORMATION



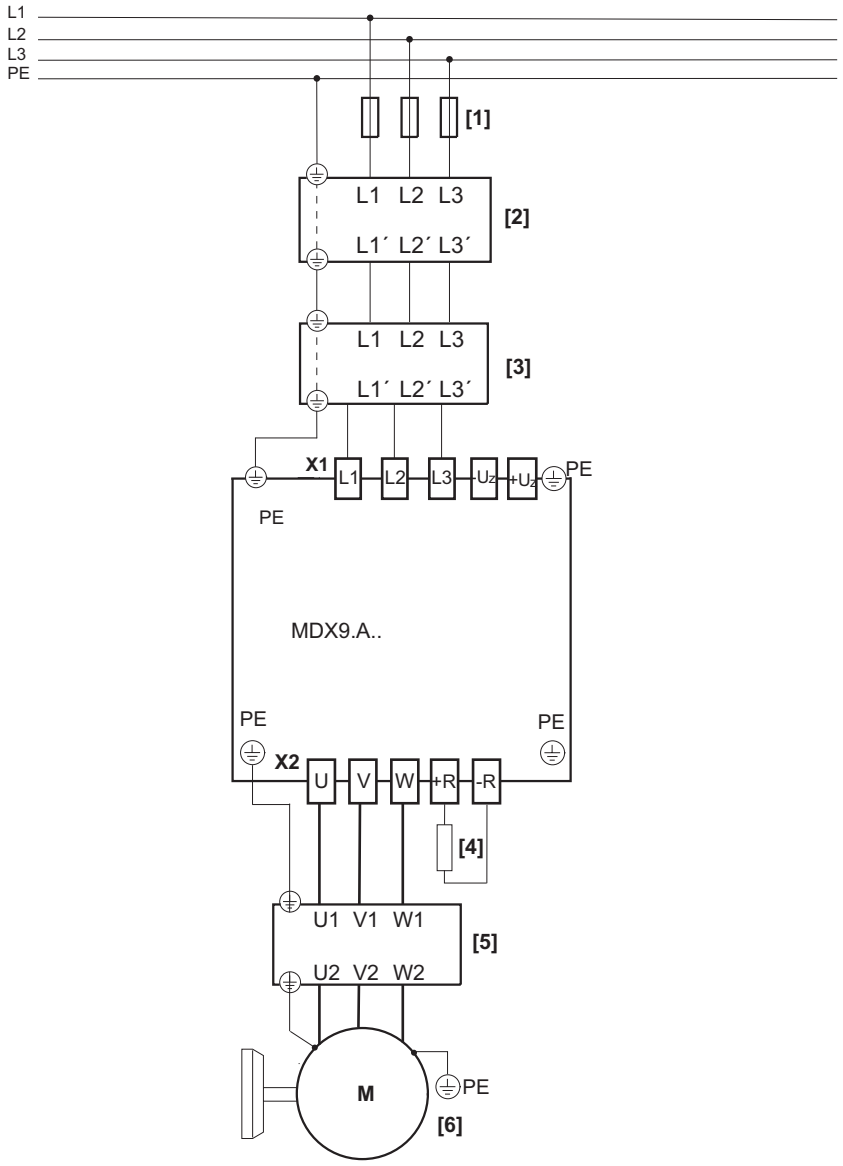
Line connection without line contactor

In the event of a line connection without line contactor, the temperature evaluation of the braking resistor must be ensured via a digital input on the inverter.

- Parameterize the connected digital input to monitor the braking resistor temperature evaluation.

31972098/EN – 8/2024

The following figure shows an example of the wiring of the power connections without line contactor, with line choke, line filter and output choke or output filter.

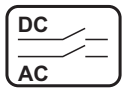


54043209407696267

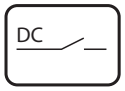
[1] Fuses
[2] Line choke (optional)
[3] Line filter (optional)
[4] Braking resistor (optional)
[5] Output choke or output filter (both optional)
[6] Motor

10.19.2 Brake control connection

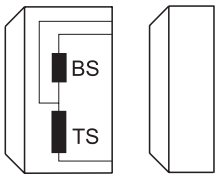
Key



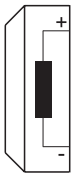
Switch-off in the DC and AC circuit
(rapid application of the brake)



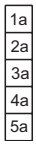
Switch-off in the DC circuit



Brake
BS = Accelerator coil
TS = Coil section



DC brake with one brake coil



Auxiliary terminal strip in terminal box



Control cabinet limit

WH	White
RD	Red
BU	Blue
M	Motor

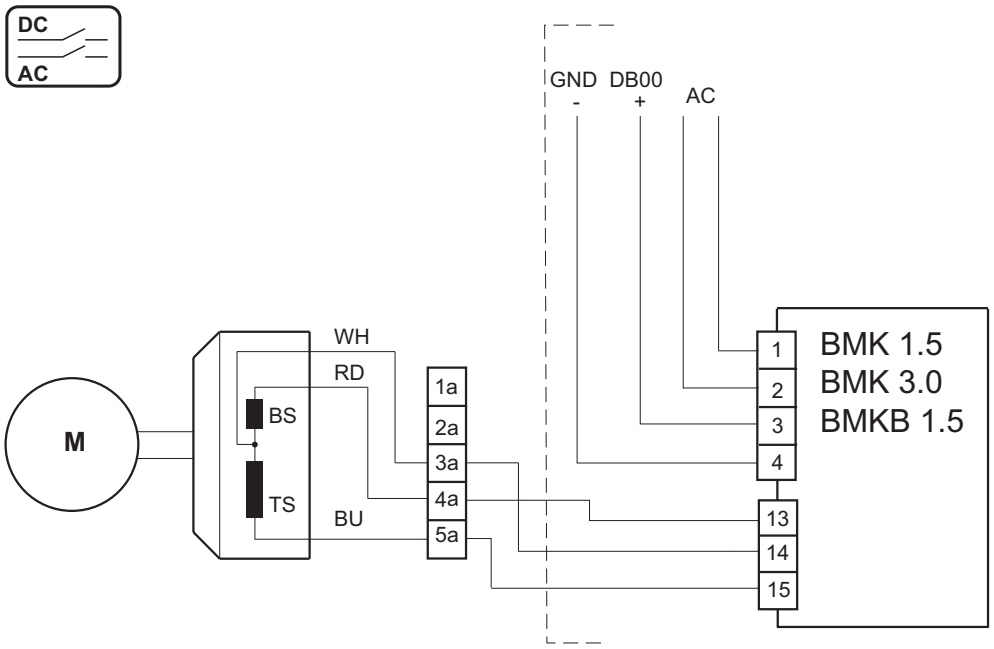
INFORMATION

The selection of the brake control and the shown connection diagrams only represent one of the many possibilities. For further information, refer to the catalogs and the operating instructions of the motors.

31972098/EN – 8/2024

BMK. brake control

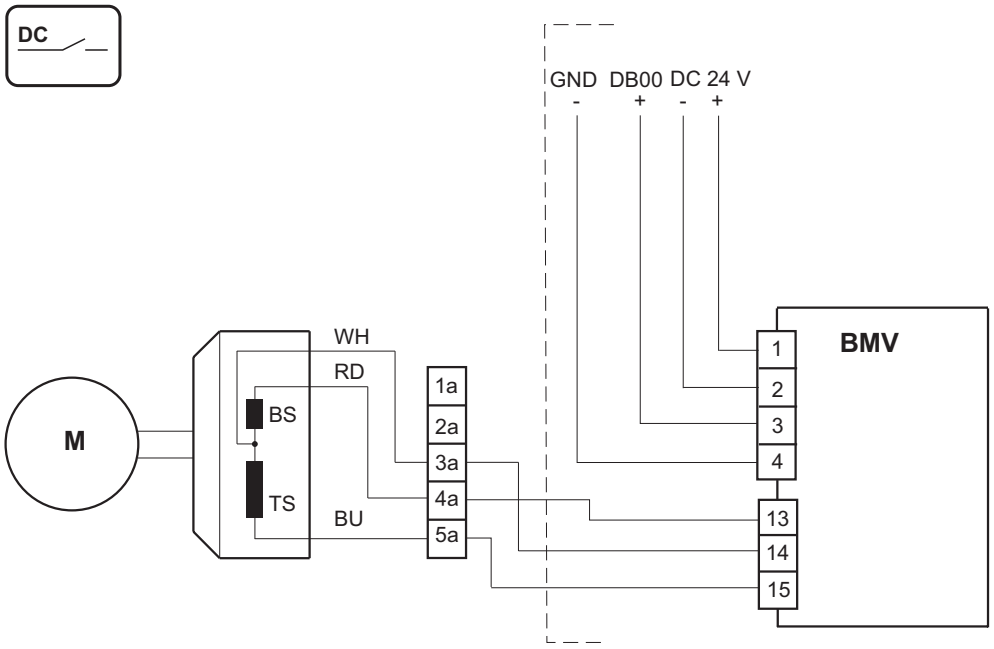
The meaning of the symbols can be found in chapter "Key" (→ 🗎 404).



9007213579236747

BMV brake control – 2 coils

The meaning of the symbols can be found in chapter "Key" (→ 🗎 404).

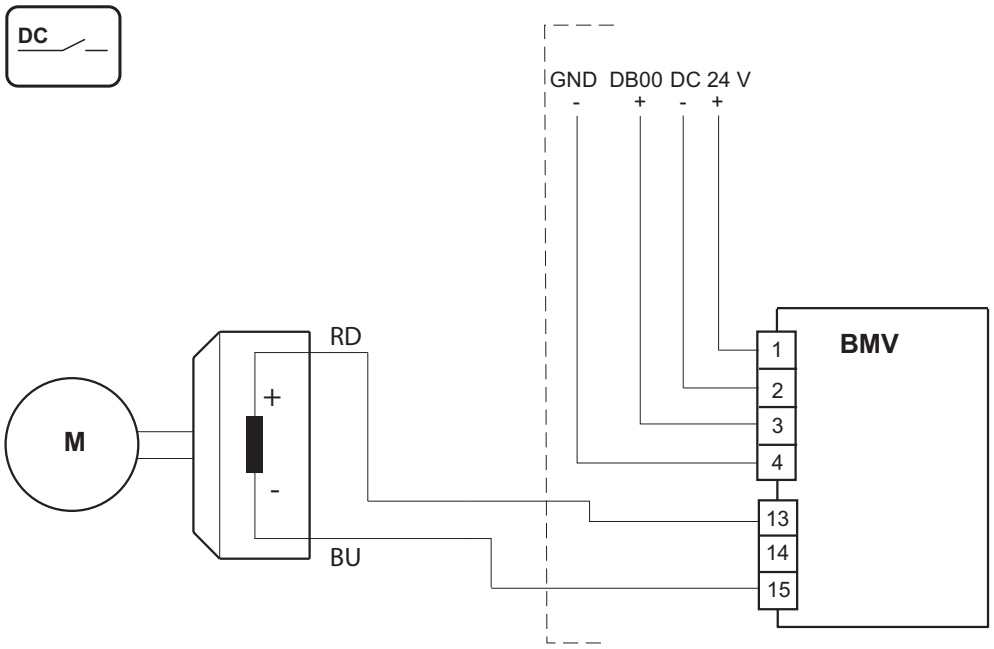


14373482507

31972098/EN – 8/2024

BMV brake control – 1 coil

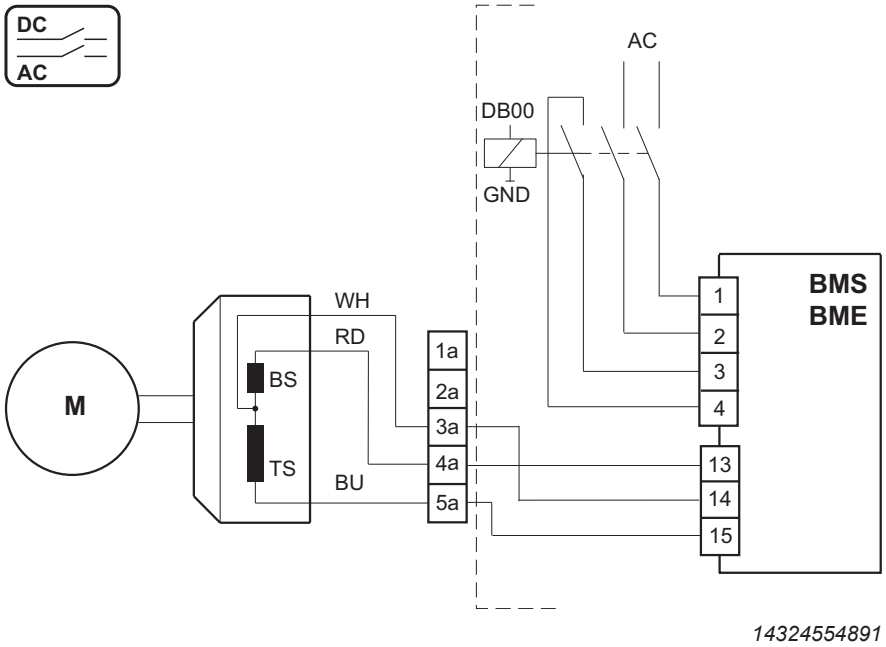
The meaning of the symbols can be found in chapter "Key" (→ 🗎 404).



9007213628235915

BMS, BME brake control

The meaning of the symbols can be found in chapter "Key" (→ 🗎 404).

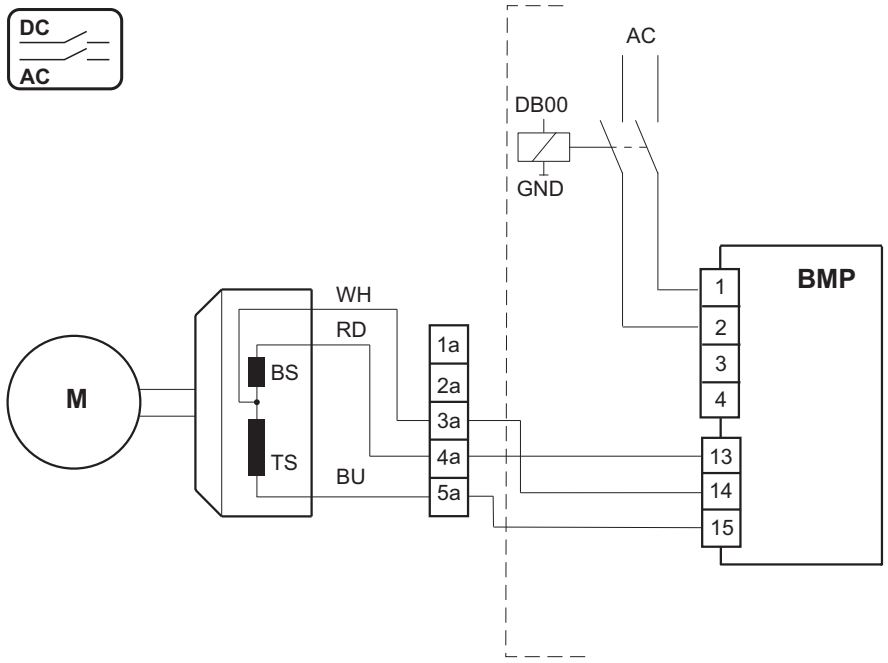


14324554891

31972098/EN – 8/2024

BMP brake control

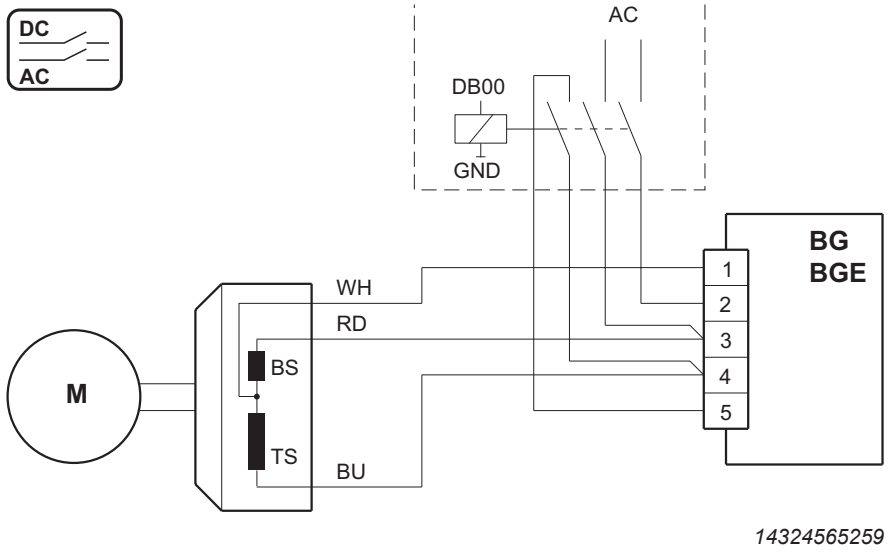
The meaning of the symbols can be found in chapter "Key" (→ 🗎 404).



14324544523

BG, BGE brake control

The meaning of the symbols can be found in chapter "Key" (→ 🗎 404).

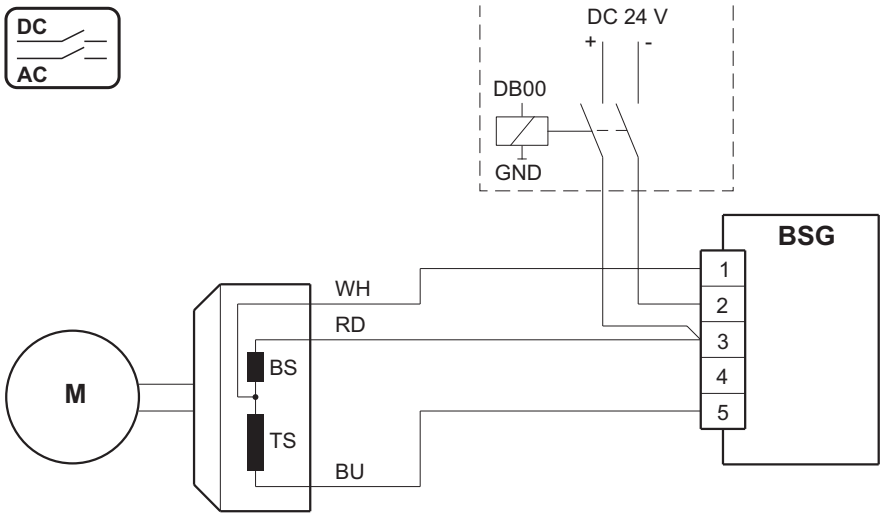


14324565259

31972098/EN – 8/2024

BSG brake control

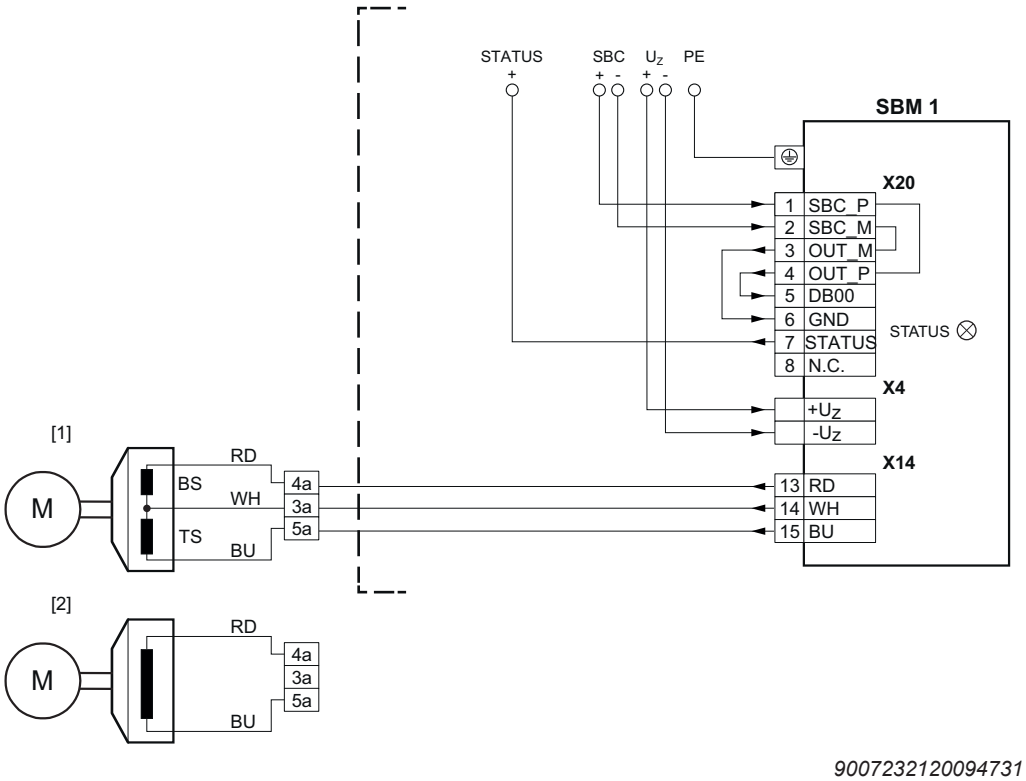
The meaning of the symbols can be found in chapter "Key" (→ 🗎 404).



14324597131

SBM brake control with 1 control cable

The meaning of the symbols can be found in chapter "Key" (→ 🗎 404).



9007232120094731

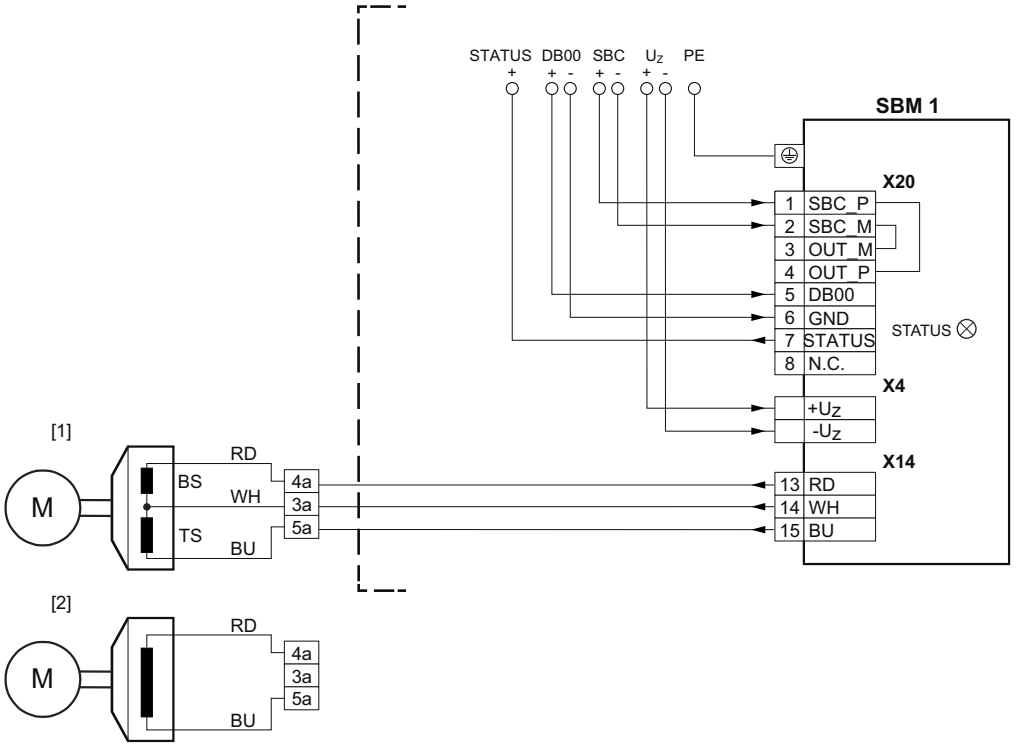
[1] Connection of the brake with 3-wire technology (standard)

[2] Connection of the brake with 2-wire technology (optional). In this case, there is no connection from terminal X14:14 of the brake module to terminal 3a of the auxiliary terminal strip.

31972098/EN – 8/2024

SBM brake control with 2 control cables

The meaning of the symbols can be found in chapter "Key" (→ 🗎 404).



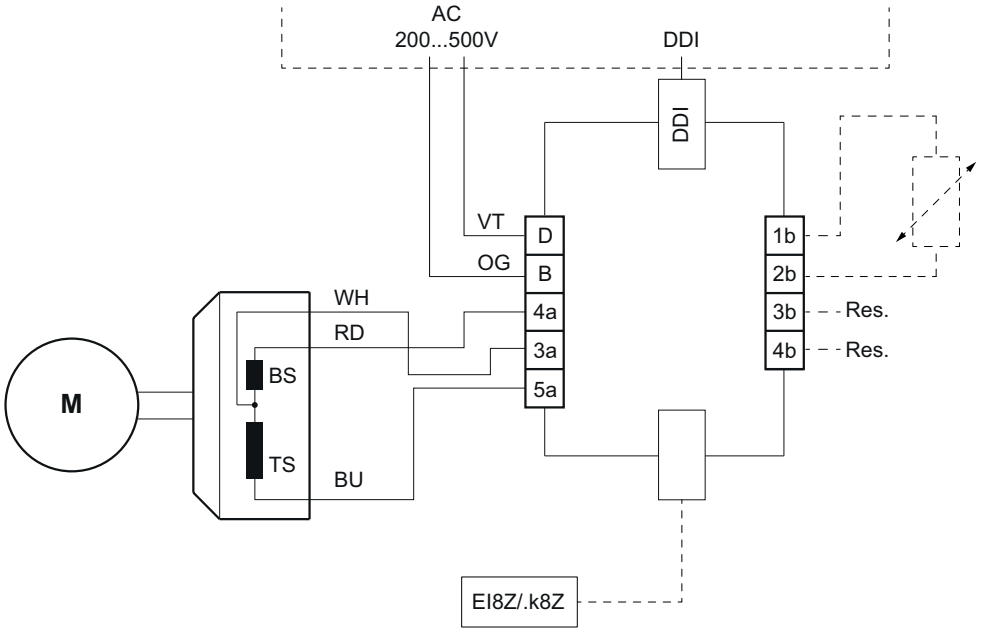
9007232118783115

[1] Connection of the brake with 3-wire technology (standard)

[2] Connection of the brake with 2-wire technology (optional). In this case, there is no connection from terminal X14:14 of the brake module to terminal 3a of the auxiliary terminal strip.

BG1Z brake control

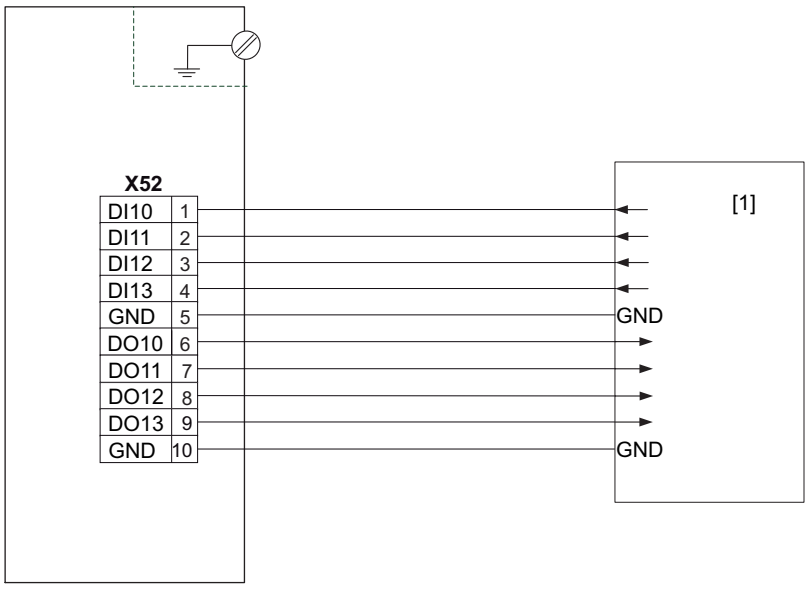
The meaning of the symbols can be found in chapter "Key" (→ 🗎 404).



42869783691

10.19.3 Connection of CIO21A and CID21A input/output cards

Digital inputs and outputs

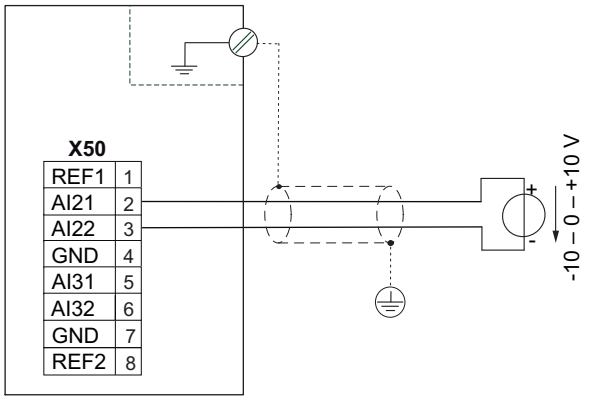


18014412829087243

[1] Higher-level controller

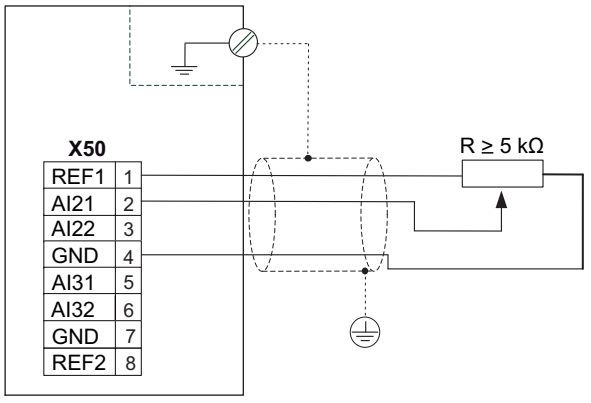
31972098/EN – 8/2024

Voltage input



9007213575393675

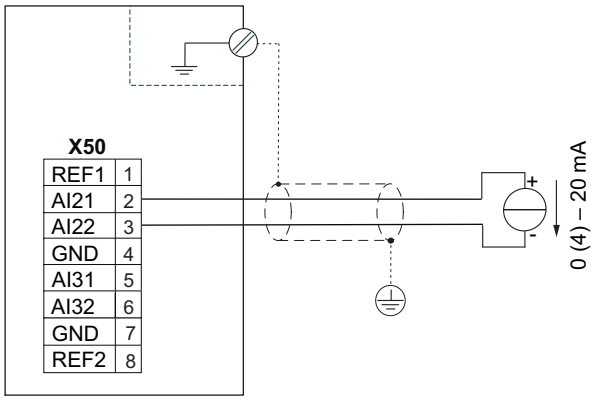
Connection to the terminals AI31 and AI32 is carried out analogously to the connection to the terminals AI21 and AI22 shown in the wiring diagrams.



18014412830137099

Connection to the terminals REF2 and AI31 is carried out analogously to the connection to the terminals REF1 and AI21 shown in the wiring diagrams.

Current input

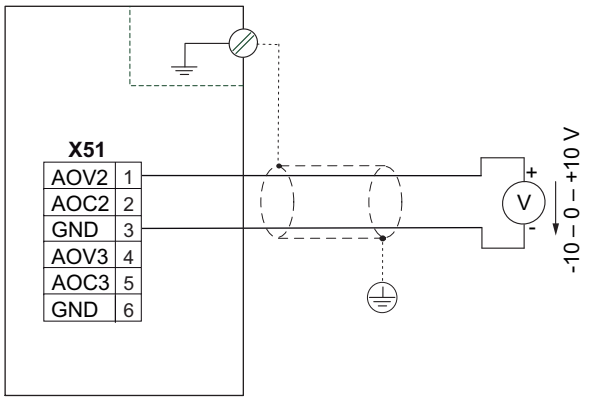


9007213575398539

Connection to the terminals AI31 and AI32 is carried out analogously to the connection to the terminals AI21 and AI22 shown in the wiring diagrams.

Observe the switch position of "DIP switch S50" (→ 🗎 378) when activating the current input.

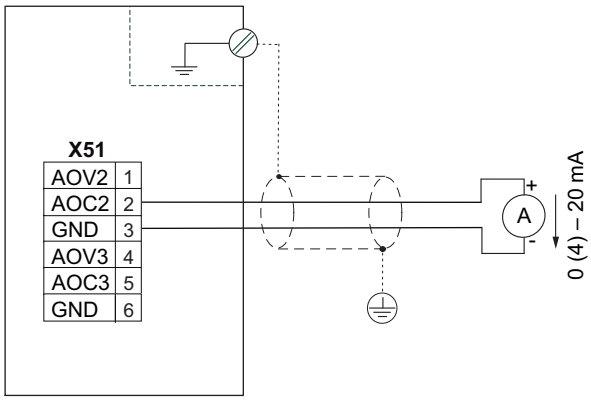
Voltage output



18014412830141963

Connection to the terminals AOV3 and GND is carried out analogously to the connection to the terminals AOV2 and GND shown in the wiring diagram.

Current output



18014412830272395

Connection to the terminals AOC3 and GND is carried out analogously to the connection to the terminals AOC2 and GND shown in the wiring diagram.

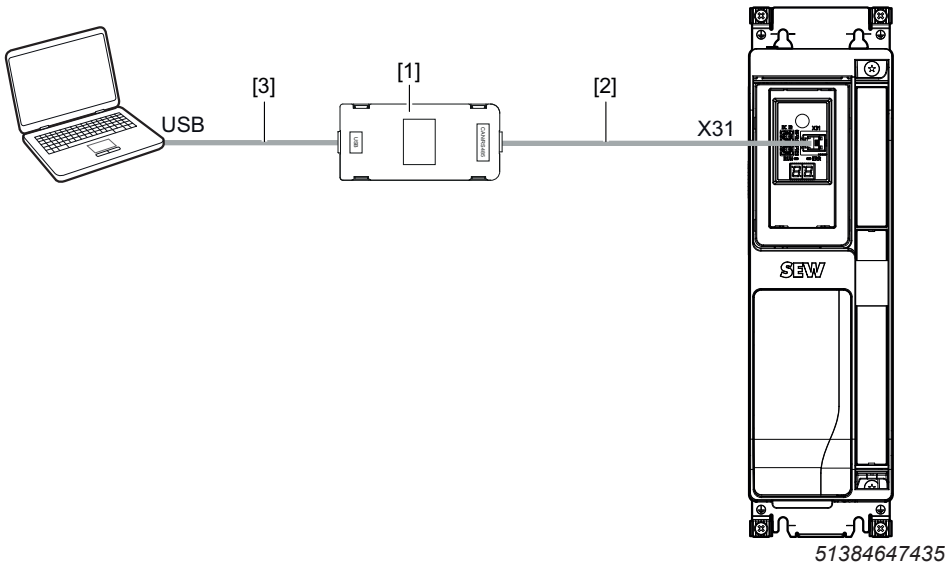
31972098/EN – 8/2024

10.20 PC connection

Observe the information in the product manual > chapter "Electrical installation" > "PC connection" including the sub-chapters.

10.20.1 Connection via USM21A

The following figure shows the connection of inverters to the MOVISUITE® engineering software using the USM21A interface adapter:

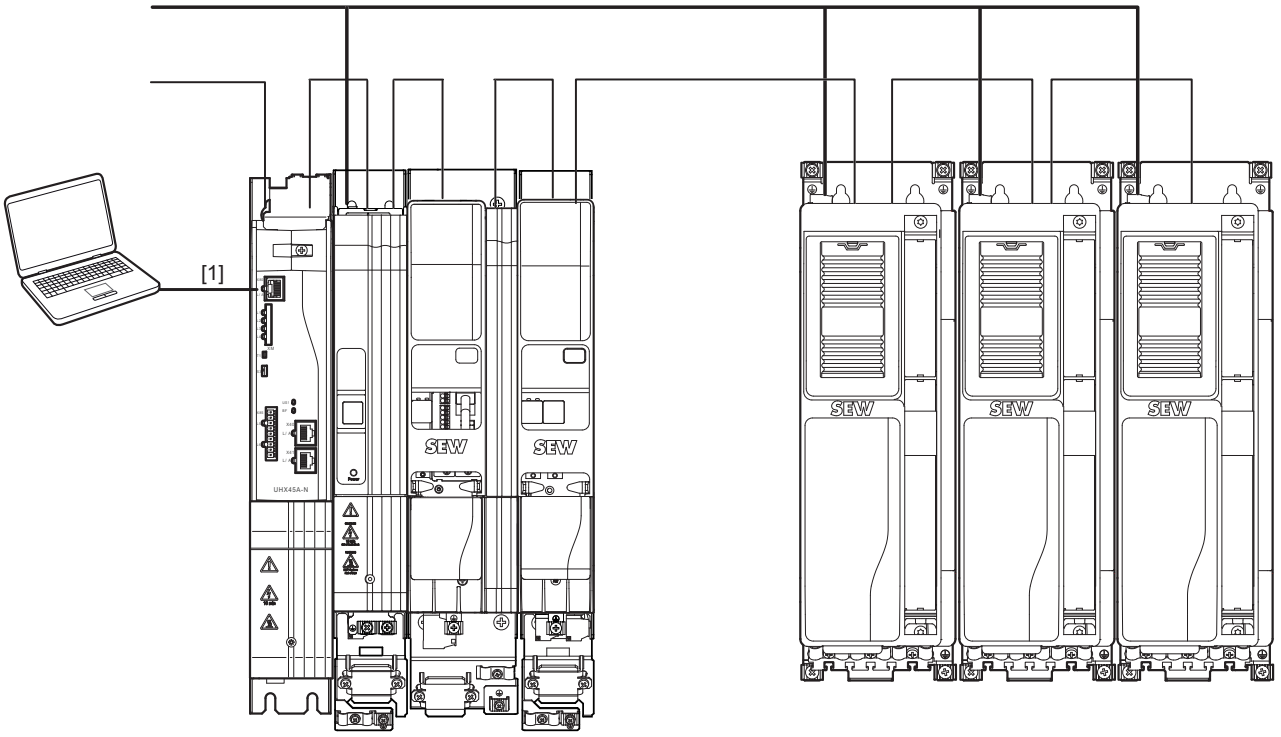


51384647435

[1] Interface adapter USM21A, part number 28231449
[2] Serial interface cable with 2 × RJ10 plugs
The cable is included in the scope of delivery of the interface adapter.
[3] USB connection cable, type USB A-B
The cable is included in the scope of delivery of the interface adapter.

10.20.2 Connection via MOVI-C® CONTROLLER

The following figure shows the connection of inverters to the MOVISUITE® engineering software using a PC:



[1] Ethernet

31972098/EN – 8/2024

11 Startup

11.1 Startup information

Perform the following steps before startup:

1. ⚠ **WARNING!** Electric shock caused by dangerous voltages. Severe or fatal injuries.
   De-energize the device. Observe the 5 safety rules in chapter "Performing electrical work safely". Then wait at least 10 minutes.
2. ⚠ **WARNING!** Risk of burns due to hot surfaces. Severe injury.
   Let the device and its accessories cool down before touching it.
3. **NOTICE!** Failing to observe the minimum switch-off time of the line contactor can cause material damage. Irreparable damage to the inverter or unforeseen malfunctions.
   After switching off the voltage supply, keep it switched off for at least 10 s.
   ⇨ Do not switch the voltage supply on or off at the line contactor more than once per minute.
4. Install the protective covers of the system according to the instructions. This will avoid injuries.
   ⇨ Never start the device if the protective covers are not installed.
5. ⚠ **WARNING!** Danger if the motor starts up unintentionally. Severe or fatal injuries.
   If the control signals are present, the motor can unintentionally automatically start up.

11.1.1 Lifting applications

Perform the following additional steps before starting up the lifting applications:

1. ⚠ **WARNING!** Danger from falling hoist. Severe or fatal injuries.
   Observe the following information.
   ⇨ Do not use the device alone as a safety device for the lifting application.
   ⇨ Use additional monitoring systems or mechanical protection devices as a safety device.
2. ⚠ **WARNING!** Danger from falling hoist. Severe or fatal injuries.
   Do not use the "Release brake/deactivateDynaStop® with FCB01" function in lifting devices or applications with loads that may potentially fall down. Disable the function as follows:
   ⇨ Disable the function via parameter *Functions* > *Drive functions* > *FCB01 Output stage inhibit* > *Release brake/deactivate DynaStop® for FCB01 – enable* = **"0"** (no).
3. In the MOVISUITE® engineering software, configure the parameters according to the lifting application requirements and its safety assessment.
   ⇨ Set the parameter *Functions* > *Drive functions* > *FCB01 Output stage inhibit* > *Apply brake with STO* = "1" (Yes).
4. Check the setting of the parameter *Drive train* > *ASx drive train* > *Controller* > *Motor behavior* > *Hoist preload* in the MOVISUITE® engineering software. Set the parameter in accordance with the lifting application requirements.

31972098/EN – 8/2024

Lifting application without encoder

ELSM®

Use of the drive unit in lifting applications with **ELSM®** control mode is not permitted.

V/f

SEW-EURODRIVE recommends that you do not use the drive unit in hoist applications with V/f control mode.

VFC^{PLUS}

SEW-EURODRIVE recommends the following settings and control behavior for using the drive unit in lifting applications with the **VFC^{PLUS}** control mode (without encoder):

Parameter settings:

- For vertical drives, use the setpoint/stop function (FCB05 - speed control). *Functions* > *Drive functions* > *FCB 05 Speed control* > *Stop by setpoint function* > *Activation* = **"1"** (Yes).
  - Set the parameter *Functions* > *Drive functions* > *FCB 05 Speed control* > *Stop by setpoint function* > *Stop setpoint* so that the resulting motor speed is ≥ 1.5 × nominal slip of the motor.
  - As an alternative, set the parameter *Functions* > *Drive functions* > *FCB 05 Speed control* > *Minimum speed* so that the resulting motor speed is ≥ 1.5 × nominal slip of the motor.
- Set the parameter *Drive train* > *Drive train ASx* > *Controller* > *Control behavior* > *Flying restart* = **"0"** (off).
- Set the parameter *Drive train* > *Drive train ASx* > *Controller* > *Control behavior* > *Flow optimization* = **"0"** (off).
- Set the parameter *Drive train* > *Optimization ASx* > *VFCplus* > *Boost*=**10%**.

Control behavior:

- Design the control in such a way that a direction of rotation reversal is only possible in an idle state (with the brake applied).
- If you want to change the direction of rotation without a standstill, use a drive with encoder.
- Control the drive at a setpoint speed that corresponds to a speed ≥ 1.5 × nominal slip of the motor.

31972098/EN – 8/2024

11.2 Startup requirements

The following prerequisites are required for startup:

- You have installed the inverter correctly both mechanically and electrically.
- You have configured the inverter and connected drives correctly.
- You have taken suitable measures to ensure that the drives do not start up unintentionally.
- Safety precautions rule out hazards to people and machinery.

You can perform startup using the MOVISUITE® engineering software.

11.2.1 Required hardware

- USM21A interface adapter

  or

- EtherCAT® cable and access via the MOVI-C® CONTROLLER or directly via the integrated EtherCAT® interface of the inverter

Part number	Scope of delivery
28231449	• USM21A interface adapter • Serial interface cable with 2 RJ10 connectors • USB cable (A-B)

31972098/EN – 8/2024

11.3 Setting the EtherCAT® ID

It is not strictly necessary to set one of the EtherCAT® IDs. The slaves are automatically addressed by the master by default. The EtherCAT® ID must only be set on the inverter if the use of EtherCAT® IDs has been preset in the hardware configuration of the master.

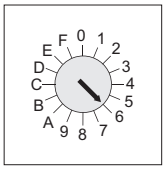
An EtherCAT® ID can be permanently assigned to the inverter with the EtherCAT® interface using hexadecimal switches S1 and S2. With these switches, you can set a decimal EtherCAT® ID between 1 and 255 in hexadecimal notation.

This ID serves as a unique identification tag of the respective EtherCAT® slave for the EtherCAT® master. The EtherCAT® ID is not an EtherCAT® address. The EtherCAT® ID is always assigned by the EtherCAT® master.

In the delivery state of the inverter, the ID is set to 0 by default (S1 = 0 and S2 = 0).

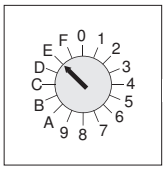
Required ID, decimal	ID, hexadecimal	Setting S1 (× 16)	Setting S2 (× 1)
3	03	0	3
18	12	1	2
25	19	1	9
100	64	6	4
110	6E	6	E
255	FF	F	F

S1-EtherCAT® ID (× 16)



6

S2-EtherCAT® ID (× 1)



E

The EtherCAT® ID "110" is set as an example in the illustration above.

11.4 Startup with "ex works parameters"

SEW-EURODRIVE offers the ordering of products with customer-specific parameter settings in the delivery state. This option is known as "ex works parameters". Startup procedures and processes can be optimized in the best possible way using this option. Products with a customer-specific parameter set are marked with .../P... in the type designation.

11.5 Startup of third-party motors

Asynchronous motors

The nameplate data of the motor must be entered during startup:

- Nominal motor speed
- Rated motor frequency

31972098/EN – 8/2024

- Nominal motor voltage
- Nominal motor current
- Power factor cos φ
- Nominal motor power

The parameters required for startup are calculated based on the nameplate data and the motor is taken into operation. A prerequisite is that the inverter is connected with the MOVISUITE® engineering software.

SEW-EURODRIVE also recommends carrying out a parameter measurement with FCB25 for better control characteristics. This determines the equivalent wiring diagram data of the motor. The duration of the measurement depends on the motor parameters. In the case of asynchronous motors, the measurement is carried out in an idle state. If a brake is present, it remains closed.

Permanent-field synchronous motors

The nameplate data of the motor must be entered during the startup of synchronous motors:

- Nominal motor speed
- Nominal motor current
- Nominal motor voltage
- Nominal motor torque
- Rated motor frequency or number of poles
- Maximum torque at motor shaft
- Max. motor current
- Optional:
  - Phase inductance
  - Back EMF voltage

In the case of permanent-field synchronous motors without an encoder, a parameter measurement must then be carried out with FCB 25. In the case of synchronous motors with an encoder, SEW-EURODRIVE recommends carrying out the parameter measurement. The brake is released (if present) during the measurement to align the rotor electrically. Make sure that the rotor can turn freely. For this reason, the motor must be separated from the gear unit or system.

In the case of synchronous motors with an encoder, the encoder offset must also be set after the above-mentioned startup procedure. This commutation takes place using the "Rotor position identification" function (FCB 18). The rotor turns during the rotor position identification. Make sure that the rotor can turn freely. For this reason, the motor must be separated from the gear unit or system.

Synchronous reluctance motors

During startup of synchronous reluctance motors[1)] the nameplate data of the motor must be entered:

- Nominal motor voltage
- Nominal motor torque
- Nominal motor speed
- Nominal motor frequency
- Optional:
  - Number of poles
  - Mechanical power
  - Power factor

After the nameplate startup, SEW-EURODRIVE recommends carrying out a parameter parameterization with FCB25.

1) Guided startup in preparation.

11.6 Startup with MOVISUITE® engineering software

The inverters are started up using the MOVISUITE® engineering software from SEW-EURODRIVE.



The motor is started up in drive train 1 or drive train 2.

When using a motor from SEW-EURODRIVE, select the motor type from the catalog or enter the nameplate. You can perform the startup for motors and encoders from SEW-EURODRIVE with an electronic nameplate based on the data contained there.

When using a third-party motor, enter the corresponding nominal motor data. SEW-EURODRIVE recommends performing a motor parameter measurement using the FCB 25 for third-party motors.

The engineering software can be operated intuitively and is not described further in this document.

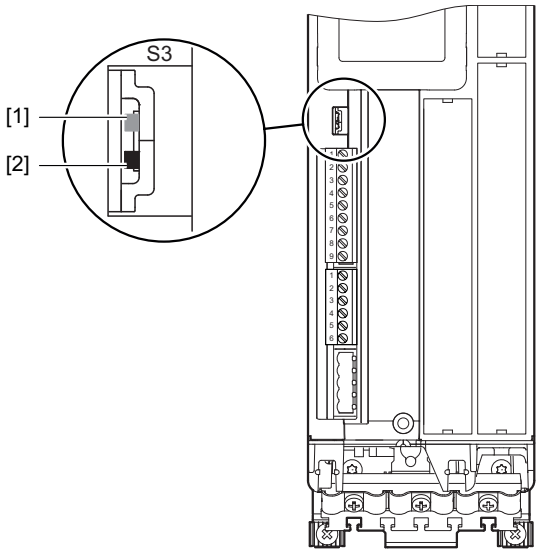
11.7 Setting the "module bus" operating mode

If 2 inverters are connected via a DC link connection, they require the information whether they are "module bus master" or "module bus slave" in the network.

This is set using switch S3 "Module bus operating mode". For further information, refer to the "DC link connection" manual.

If the inverters are not connected to each other via a DC link connection, always set switch "S3" to switch position "Master".

31972098/EN – 8/2024



9007214942710923

[1] "Master" switch setting

[2] "Slave" switch setting

11.8 Startup of motors with the MOVILINK® DDI interface

If an inverter has the MOVILINK® DDI interface and is connected to a motor that also has this interface, the motor is started up automatically via its electronic nameplate. The process is started by switching on the inverter. This function is only supported if the inverter is in the delivery state.

The status of the inverter is "AC" (Auto Configuration) during the data transfer from the electronic nameplate. You can obtain more information from the SEW-EURODRIVE hotline.

11.9 Control options

The following description requires the use of the MOVISUITE® engineering software.

Depending on the design, the inverter is controlled via the digital or analog inputs or via fieldbus.

In principle, the user is free to configure the respective interface individually or use the standard interface of SEW-EURODRIVE. Various MOVIKIT® software modules are available for this purpose.

MOVIKIT® software modules have the following advantages:

- Application-specific functionalities
- Standard interface of SEW-EURODRIVE
- Automated parameterization of the interface
- MOVIKIT®-specific diagnostics and manual operation

11.9.1 Control via terminals

Analog setpoints and fixed setpoints can be used for control via terminals. If no MOVIKIT® has been loaded ex-works, the source is set to "No source" under "Setpoints/basic setting" and the inverter can be controlled via terminals. The following default setting/factory setting applies here:

- **Digital inputs**
  - DI00: Output stage enable
  - DI01: FCB05 – Fixed setpoint, positive direction of rotation
  - DI02: FCB05 – Fixed setpoint, negative direction of rotation
  - DI03: Fixed speed setpoint bit 0
  - DI04: Fixed speed setpoint bit 1
  - DI05: Error reset
  - DI06: no function
- **Digital outputs**
  - DB00: Brake output (fixed function)
  - D00: Ready
  - D01: Output stage enabled
  - D02: Error
  - D03: STO active

11.9.2 Control via fieldbus

For control via fieldbus, the source must be set to "Standard fieldbus system" under "Setpoints/basic setting".

- Process output data (controller → device)

  Setpoint and profile value interconnections can be individually linked to the corresponding process output data.

  In addition, the control words used must be documented and the link to the process output data must be established.
- Process input data (device → controller)

  The data sources for the process input data can be linked under "Actual values/PI data".

  In addition, the status words used must be documented and the link to the process input data must be established.

11.9.3 Control via MOVIKIT® software module

The MOVIKIT® software modules have fixed defined interfaces.

When using the MOVISUITE® engineering software, the MOVIKIT® software modules can be selected and added via the software catalog.

For further information on using and operating the MOVIKIT® software modules, refer to the corresponding documentation.

31972098/EN – 8/2024

11.10 Application-related startup

The applications are started up with specific settings using the MOVISUITE® engineering software.

Pay attention to the information in the **Product manual** > chapter "Startup" > "Application-related startup", including the sub-chapters.

11.10.1 Hoist

Set the following parameters:

- Preload hoist (index 8404.9): This parameter determines the behavior of the integrator when re-entering control. Example: When the output stage is inhibited (e.g. with FCB 02, FCB 01, FCB 13, FCB 14), the I component (which corresponds to the preload in the case of the hoist) is deleted. The following selections are available to prevent this:
  - "Off" (= default): The integrator always starts with the value "0". Adjustment is made to an existing load torque. The speed controller can usually compensate for sagging of the hoist without additional settings.
  - "Save": The value that was present at the time of opening the speed control loop is retained. If the load torque has not changed, no adjustment is necessary when closing the speed control loop.
  - "Initialization value": If the load torque is known, this can be specified on the speed controller as an initial value via the parameter "Torque bias" in the range -1000% to 1000% of the nominal motor torque. This can be done during startup or optimization of the drive with the MOVISUITE® engineering software or you can use a local setpoint or a channel of the process data buffer. If the direction of rotation is positive in the stroke direction, enter a positive value and vice versa.
- Activate speed monitoring (index 8550.1). You must set the monitoring time (index 8550.2) for the specific application.
- For hoists without encoder, activate the stop by setpoint function (index 8570.1) or set the minimum speed accordingly.

11.10.2 3-wire control

3-wire control is a control method for operation with pushbuttons. The enable is edge-controlled via the direction of rotation selection. If you activate the positive and negative direction of rotation at the same time or if you remove the enable stop signal, FCB 13 (application stop) stops. The speed setpoint source can be selected as required.

Parameterization example

In the following parameterization example, the analog input is used as setpoint source.

Description	Index	Function	Comment
Basic settings/ Setpoint source	8366.4	No source	
Setpoints/speed	8376.11	Fixed speed setpoints	
Fixed setpoints/operating mode	8354.20	Unipolar/fixed setpoint	

31972098/EN – 8/2024

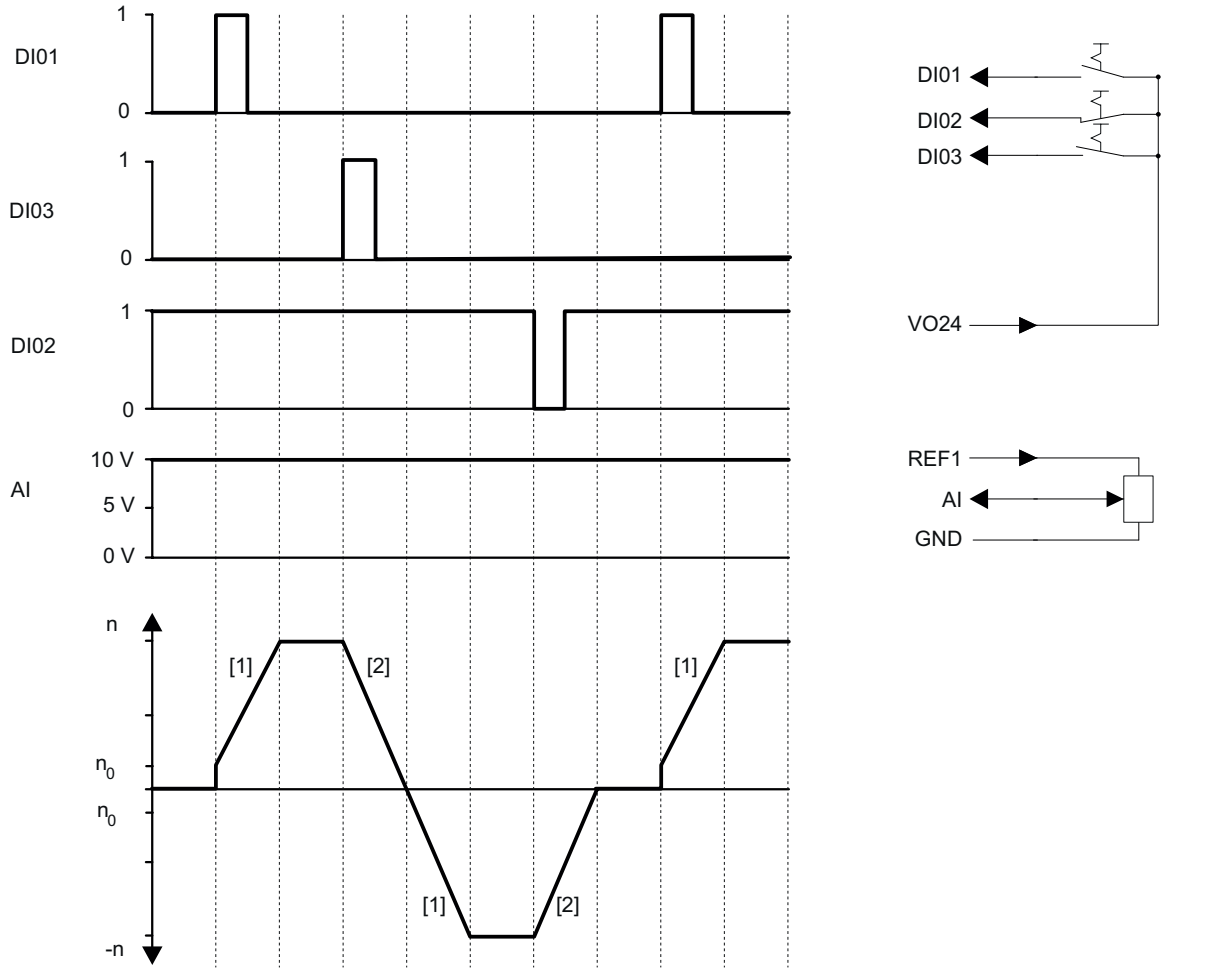
Description	Index	Function	Comment
Fixed setpoints/analog setpoint source	8354.25	Analog input 1	Observe scaling
Acceleration	8377.1	Selection of the source	Default setting: Application limit
Deceleration (FCB13)	8357.13	Entry in user units	
Stop by setpoint function (FCB 05)	8570.1		This parameter should be activated for encoderless systems
Stop setpoint	8570.2	Entry in user units	
Start offset	8570.3	Entry in user units	

Setting the digital inputs

Description	Index	Function	Comment
Digital input 1	8334.11	3-wire control – positive direction of rotation	Pushbutton, NO contact
Digital input 2	8334.12	3-wire control – enable/stop (FCB13)	Pushbutton, NC contact
Digital input 3	8334.13	3-wire control – negative direction of rotation	Pushbutton, NO contact
Digital input 4	8334.14	Reset	Pushbutton, NO contact

31972098/EN – 8/2024

Cycle diagram



50796502155

[1] Acceleration according to the source
[2] Application limit deceleration (FCB 13)
DI01 3-wire control – positive direction of rotation
DI02 3-wire control – enable/stop
DI03 3-wire control – negative direction of rotation
AI Analog input setpoint
n Motor speed
n_0 Start/stop speed

11.10.3 "Motor potentiometer" function

The motor potentiometer function lets the inverter respond to signal levels.

If the digital inputs "motor potentiometer up/down" are activated, the speed changes with the profile value "max. acceleration" (index 8377.21) or "max. deceleration" (index 8377.31).

The last motor potentiometer setpoint is retained even when the supply system is switched off if the "save setpoint" function is activated via index 8369.2.

If the digital inputs "motor potentiometer up/down" are activated simultaneously, there are two options:

- Save setpoint (index 8369.2): OFF:
  - The inverter stops along the "max. deceleration" (index 8377.31)
- Save setpoint (index 8369.2): ON:
  - The current speed is maintained.

If none of the two inputs are activated, the current speed and direction of rotation are maintained.

Parameter setting example for DT1

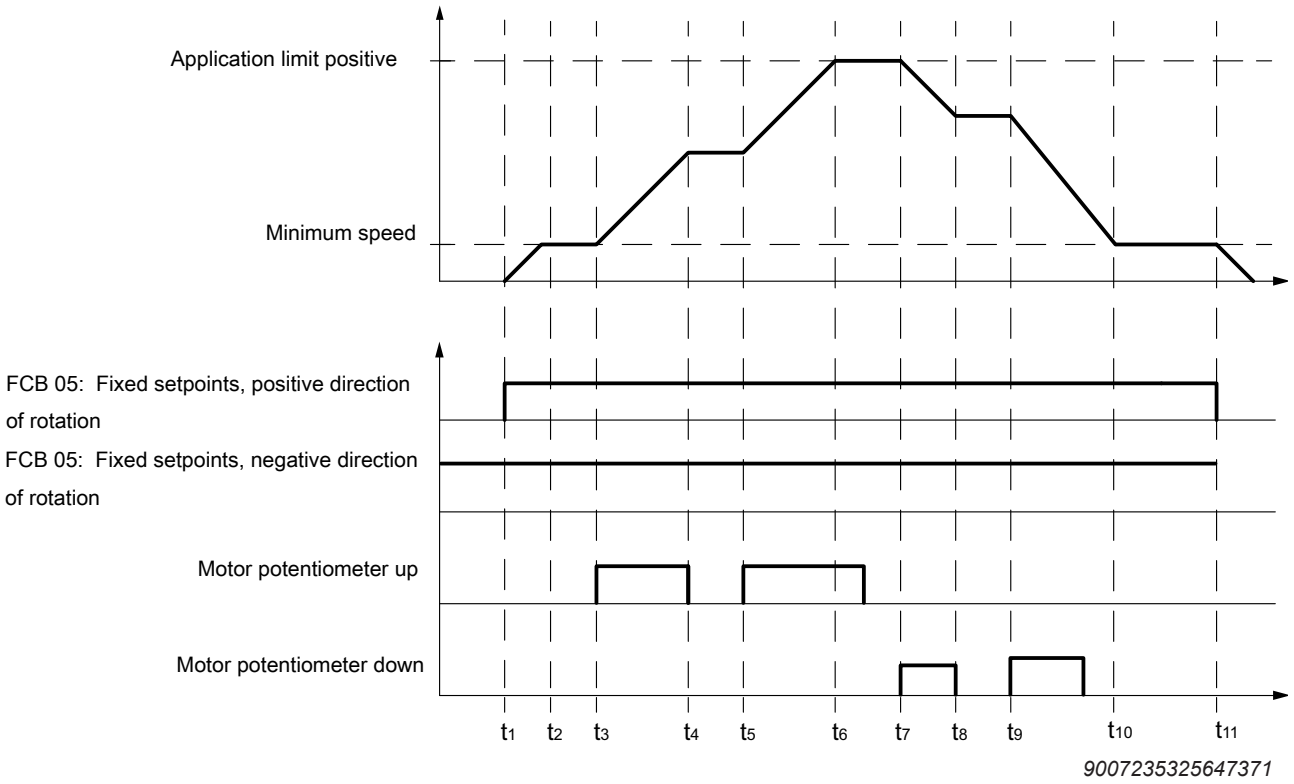
Description	Index	Function	Comment
Basic settings/ setpoint source	8366.4	No source	–
Setpoints/speed	8376.11	Fixed setpoints – speed	–
Fixed setpoints/operating mode	8354.20	Motor potentiometer/fixed setpoint	–
Fixed setpoints/analog setpoint source	8354.25	No source	–
Setpoints/ maximum acceleration	8377.21	Selection of the source	Default setting: Application limit
Setpoints/ maximum deceleration	8377.31	Selection of the source	Default setting: Application limit
Minimum speed	8357.18	Limitation of minimum speed	–
Save setpoint	8369.2	Off	Behavior after "power off"

Setting the digital inputs

Description	Index	Function	Comment
Digital input 1	8334.11	FCB05 – Fixed setpoints, positive direction of rotation	Switch, NO contact
Digital input 2	8334.12	FCB05 – Fixed setpoints, negative direction of rotation	Switch, NO contact
Digital input 3	8334.13	Motor potentiometer up	Pushbutton, NO contact
Digital input 4	8334.14	Motor potentiometer down	Pushbutton, NO contact
Digital input 5	8334.14	Reset	Pushbutton, NO contact

31972098/EN – 8/2024

Cycle diagram



t_1	Output stage enable via "FCB05 – fixed setpoints for positive direction of rotation"
t_1 - t_2	Motor runs up to the set minimum speed.
t_2 - t_3	Motor keeps minimum speed.
t_3	"Motor potentiometer up" is activated.
t_3 - t_4	As long as the signal "Motor potentiometer up" is present, the motor speed is increased along the acceleration ramp (index 8377.21).
t_4 - t_5	If no signal is present any longer at "Motor potentiometer up", the actual speed is maintained.
t_5	"Motor potentiometer up" is activated again.
t_5 - t_6	As long as the signal "Motor potentiometer up" is present, the motor speed is increased further along the acceleration ramp until it reaches the application limit (8357.10/11).
t_6 - t_7	The maximum speed is maintained, even if the signal at "Motor potentiometer up" is no longer present.
t_7	"Motor potentiometer down" is activated.
t_7 - t_8	As long as the signal at "Motor potentiometer down" is present, the motor speed is decreased along the deceleration ramp (index 8377.31).
t_8 - t_9	If no signal is present any longer at "Motor potentiometer down", the actual speed is maintained.
t_9 - t_{10}	As long as the signal at "Motor potentiometer down" is present, the motor speed is decreased along the deceleration ramp (index 8377.31) until it reaches the minimum speed.
t_{10} - t_{11}	The minimum speed is maintained.
t_{11}	Revoking of the output stage inhibit via "FCB 05 – fixed setpoints, positive direction of rotation"

31972098/EN – 8/2024

11.10.4 Prioritized terminal control

Description

The prioritized terminal control is a control function that allows you to control a drive with priority via digital inputs. After activating the "prioritized terminal control" function, a drive can be operated independently of the parameterized control signal source (e.g., Fieldbus) via digital inputs.

You can implement the following functions with the prioritized terminal control:

- Setpoint changeover: Automatic/manual control
- Setpoint changeover: Bus connection/terminal control
- Setpoint changeover: Basic device function/prioritized terminal control

INFORMATION

For drives with safe fieldbus communication, the STO function remains active when the prioritized terminal control is activated.

- For drives with safe fieldbus communication, SEW-EURODRIVE does not recommend using the prioritized terminal control.
- For further Information, refer to chapter "Restrictions in connection with safe communication" (→ 🗎 428).

The STO safety sub-function can be used by connecting the STO signal to the terminals specified for this purpose.

The prioritized terminal control and manual mode are mutually exclusive.

- If the prioritized terminal control is active, you cannot open the manual mode on the CBG.. keypad or in the MOVISUITE® engineering software. The message "Manual mode cannot be activated" appears in the MOVISUITE® engineering software.
- If manual mode is open in the MOVISUITE® engineering software or on the CBG.. keypad, you cannot activate the prioritized terminal control.

Restrictions in connection with safe communication

INFORMATION

The prioritized terminal control is not a safety-related function and therefore cannot take over a safety function of the safety options.

After a safety option error, you cannot start the drive without additional configuration and controls.

When activating the prioritized terminal control, stop the fieldbus. This means that the STO function is permanently active when using safe communication. Therefore, you must not use the prioritized terminal control in conjunction with the MOVISAFE® safety option.

You can use the prioritized terminal control in conjunction with the MOVISAFE® safety option under the following conditions:

- If the STO function is active, you must deactivate the STO function by activating the muting function. This is only possible if fieldbus communication is interrupted or disrupted.

  To use the muting function, you must configure it as follows using the "Assist CS" of the MOVISUITE® engineering software:

31972098/EN – 8/2024

  - Configure a safe digital input using the "muting" function.
  - In the basic settings of the safety option, set the "Selection muting" parameter to "Encoder error and F-PA".
  - Set the maximum muting time according to your application's requirements.

  ⚠ **WARNING!** Danger due to unexpected startup. The active "Muting F-PA" function deactivates the encoder-dependent safety sub-functions (except STO). This can cause the system to start up immediately. Severe or fatal injuries.
  Before activating the "Muting F-PO" function, the user must take organizational measures for the protection of personnel and the system.
- By activating the prioritized terminal control, you trigger an error reset that resets pending device errors.
  - **NOTICE!** Device faults that are caused by a hardware defect, for example, may not be reset. This causes the drive to stop in the fault state.
    Take this behavior into account during the risk assessment.
- If a **device fault** occurs during the active prioritized terminal control, you must acknowledge the fault by performing a fault reset.
  - **NOTICE!** Device faults that are caused by a hardware defect, for example, may not be reset. This causes the drive to stop in the fault state.
    Take this behavior into account in the risk assessment of the system.
- If an **error of the safety option** occurs during the active prioritized terminal control, you must safely acknowledge the error by assigning a safe digital input with the parameter "acknowledge error" and activating it.
  - **NOTICE!** You cannot reset all errors of the safety option (e.g., hardware error, critical error). This causes the drive to stop in the fault state.
    Take this behavior into account in the risk assessment of the system.

Functions

The following table describes the functions of the prioritized terminal control:

Signal at digital input	Description
Prioritized terminal control – **activation**	This signal activates the prioritized terminal control. During activation, the inverter performs a fault reset once. The drive only starts in combination with a selected direction of rotation (signal "positive direction of rotation" or "negative direction of rotation").

Signal at digital input	Description
Prioritized terminal control – **positive direction of rotation**	• **Signal level**[1)] If you set the "positive direction of rotation" signal when the prioritized terminal control is activated, the drive starts at speed 1 in positive direction of rotation. If the "positive direction of rotation" and "negative direction of rotation" signals are set at the same time, the drive decelerates to an idle state. • **Positive signal edge (edge-controlled)** The "activation" signal must be set before the direction of rotation is selected. A positive edge of the "positive direction of rotation" signal starts the drive in positive direction of rotation at speed 1. – After a power off or STO, the drive only starts when the device is ready for operation, the "activation" signal is set and a positive signal edge of the "positive direction of rotation" signal (0 → 1) is generated. – If the "positive direction of rotation" and "negative direction of rotation" signals are set at the same time, the earlier edge defines the direction of rotation.
Prioritized terminal control – **negative direction of rotation**	• **Signal level** If you set the "negative direction of rotation" signal when the prioritized terminal control is activated, the drive starts in negative direction of rotation at speed 1. If the "positive direction of rotation" and "negative direction of rotation" signals are set at the same time, the drive decelerates to an idle state. • **Positive signal edge (edge-controlled)** The "activation" signal must be set before the direction of rotation is selected. A positive edge of the "negative direction of rotation" signal starts the drive in negative direction of rotation at speed 1. – After a power off or STO, the drive only starts when the device is ready for operation, the "activation" signal is set and a positive signal edge of the "negative direction of rotation" signal (0 → 1) is generated. – If the "positive direction of rotation" and "negative direction of rotation" signals are set at the same time, the earlier edge defines the direction of rotation.
Prioritized terminal control – **speed 2** (optional)	If the signals for "activation" and "direction of rotation .." are set, the "speed 2" signal activates speed 2 of the drive.
Fault reset (optional)	You can reset faults with the "fault reset" signal. **NOTICE!** Device faults that are caused by a hardware defect, for example, may not be reset. This causes the drive to stop in the fault state. Take this behavior into account in the risk assessment of the system.

1) Select the edge detection "signal level" or "positive signal edge" in the basic settings.

Observe the following information:

- You control the functions of the prioritized terminal control via the signals at the digital inputs.
- When the prioritized terminal control is activated, the inverter resets the present fault once (fault reset).
- Further digital inputs (e.g. from limit switches or external faults) are still evaluated.

31972098/EN – 8/2024

- If several digital inputs are assigned the same function (e.g. "Positive direction of rotation"), the signals are linked with OR.
- Unused functions are assigned level 0 and are therefore not active.

Check whether the inverter has enough free digital inputs for the functions of the prioritized terminal control.

At least 2 digital inputs are required for the prioritized terminal control:

- "Prioritized terminal control – activation" (= "Activation")

  and the

- "Prioritized terminal control – positive direction of rotation" (= "Positive direction of rotation")

  or

- "Prioritized terminal control – negative direction of rotation" (= "Negative direction of rotation")

You can optionally use an additional digital input for the fault reset and/or speed 2.

Parameters, setpoints

The following parameters and setpoints for the prioritized terminal control can be found in the MOVISUITE® engineering software > "Functions" > "Setpoints" > "Prioritized terminal control".

Basic settings

- "Edge detection after STO and power ON"

  The control signals at the digital inputs must always be present.

  Selection:

  – "Signal level"

    The function starts whenever the input signals are set or are already present.

  – "Positive signal edge (edge-controlled)"

    The function only starts

    - after resetting STO or

    - after switching on the line voltage (power on) or

    - after switching from 24 V backup mode to line operation (power on)

    - when a positive edge of the "positive direction of rotation" or "negative direction of rotation" signal (0 → 1) occurs.

Status

- "Prioritized terminal control – activation"
- "Prioritized terminal control – positive direction of rotation"
- "Prioritized terminal control – negative direction of rotation"
- "Prioritized terminal control – speed 2"

Velocity

- "Speed 1 DT1"
- "Speed 2 DT1"
- "Speed 1 DT2"
- "Speed 2 DT2"

31972098/EN – 8/2024

Acceleration/deceleration

- "Acceleration/deceleration DT1"
- "Acceleration/deceleration DT2"

Operating principle

For prioritized terminal control, the controller uses FCB 04 function block (= manual mode). This function block can only be overwritten by a higher-level FCB (e.g., FCB 01, FCB 14, FCB 13, ..).

Activation

If you set the "Activation" signal, the prioritized terminal control is activated.

- The previous setpoint inputs (e.g. from MOVIKIT®, fieldbus control, basic device functions, …) are deactivated.
- The inverter resets present faults once (e.g. fieldbus fault, etc.).
- The drive is not enabled.
- The output stage is inhibited.
- Display: **FCB 01**

Starting the drive

If you set the "positive direction of rotation" or "negative direction of rotation" signal, the drive is started.

- The drive is enabled in the selected direction of rotation.
- The drive accelerates up to speed 1 of the selected drive train (DT). The "Acceleration DT1" or "Acceleration DT2" parameter specifies the acceleration.
- Display: **FCB 04**

Speed 2

If you set the "Speed 2" signal, speed 2 is activated.

- The drive accelerates up to speed 2 of the selected drive train (DT). The "Acceleration DT1" or "Acceleration DT2" parameter specifies the acceleration.
- Display: **FCB 04**

Status display

The status of the prioritized terminal control (e.g., message "Prioritized terminal control active" or group message "Manual mode/prioritized terminal control active") can be output as follows:

- Via a binary output
- Via a relay
- Via a status word bit
- Via a message bit
- Via the visual 7-segment display
- Via the "DRIVE" LED

  For devices without a 7-segment display, the "DRIVE" LED flashes green with a frequency of 1 Hz (= manual mode/prioritized terminal control).

31972098/EN – 8/2024

Stopping the drive

If **none of the signals** "Positive direction of rotation" and "Negative direction of rotation" is set, the drive is stopped.

- The drive decelerates until standstill.
- The output stage of the inverter is inhibited.
- Display: **FCB 01**

INFORMATION

If **none of the signals** "Positive direction of rotation" and "Negative direction of rotation" is set, the drive is stopped and remains energized.

- The drive decelerates until standstill.
- The drive remains energized.
- The output stage of the inverter is not inhibited.
- Display: **FCB 04**

Deactivation

⚠ WARNING



Danger due to unexpected startup. If you deactivate the prioritized terminal control, the drive is immediately controlled by the original control source. Depending on the settings of the original control source, the drive may restart unexpectedly.

Severe or fatal injuries.

- Check the parameters and signals of the original control source before deactivating.
- Make sure that the settings of the parameters and signals of the original control source do not pose any risks.

If you reset the "Activation" signal, the prioritized terminal control is deactivated.

- The inverter no longer responds to the signals at the digital inputs of the prioritized terminal control.
- The inverter only responds to the parameters and signals of the original control source (e.g. fieldbus signals, other inverter functions, etc.).

11.10.5 Scaling of analog inputs

The analog inputs can be scaled using the MOVISUITE® engineering software. A detailed description of the scaling function can be found in the online help of MOVISUITE®.

11.11 Startup of the MOVISAFE® CS..A safety option

11.11.1 Important information

⚠ WARNING



Unexpected and unwanted movement of the drive during parameterization of the safety option.

Severe or fatal injuries.

- Before parameterization, make sure the system is in idle state.

INFORMATION



No safety sub-function is enabled in the delivery state of the safety option. The safety option permanently activates STO.

31972098/EN – 8/2024

11.11.2 General information about startup

- Before starting up the MOVISAFE® CS..A safety option, observe the firmware dependencies in chapter "Compatibility".
- If a brake is connected to the device, the *FCB 01 Output stage inhibit* function block must be selected in the MOVISUITE® parameter tree under [Functions] > [Drive functions]. In *FCB 01 Output stage inhibit*, the *Apply brake in event of STO* parameter must be set to "On".
- The following chapters describe the additional startup procedure for the MOVISAFE® CS..A safety option and the safety sub-functions.
- Note the prerequisites for installation and operation of MOVISUITE®.
- MOVISAFE® CSB..A and CSS..A safety options are supported by MOVISUITE® version 1.2 and later.
- The MOVISAFE® CSA..A safety option is supported by MOVISUITE® version 2.20 and later.
- The EDM safety sub-function is supported by the safety option as of firmware version 4.01, the basic unit firmware as of version 9.0 and MOVISUITE® as of version 2.30.
- The safety encoders with MOVILINK® DDI are supported by the safety option as of firmware version 5.0x, by the basic unit firmware as of version 11.0, and by MOVISUITE® as of version 2.50.
- Make sure that the MOVISAFE® F-Protocol Editor and the Assist CS.. parameterization tool are not used simultaneously in the system. The parameterization tool used must be open only once.
- A safe encoder or a safe encoder system is required for the SS1-r, SS2-r, SS2-t, SOS, SDI, SLI, SLS, SSM, SSR, SLA, SCA, SLP safety sub-functions and the SBT diagnostics function.
- When starting up several similar devices with identical parameterization, the devices can be parameterized using the "Import/Export" function. Note that you must accept every single device to accomplish this.
- If the SBC safety sub-function is active, the brake is controlled safely only via the selected F-DO. The safe digital output F-DO.. additionally performs the function of the brake control DB00. The DB00 connection on the basic device does not have to be used additionally. A SBM safe brake module from SEW-EURODRIVE can be used as a safe actuator for controlling the brake. If both F-DOs are parameterized on the SBC safety sub-function, the user is only allowed to use them for brakes on the same drive train because the safe brake test (SBT) does not work on the 2nd brake.
- All adjustable parameter values are limited to their minimum and maximum values. Hover the mouse over the respective parameter to view the limit values in MOVISUITE®.

31972098/EN – 8/2024

11.11.3 Startup options

Requirements

For a successful startup, you need the "Assist CS.." parameterization tool. You can call up the "Assist CS.." parameterization tool directly in MOVISUITE® (download from www.sew-eurodrive.com).

Parameterization procedure

This chapter describes the parameterization of the safety sub-functions step-by-step.

1. Start **MOVISUITE®.**
2. **Scan the network.**

   Scan the network that contains your engineering interface to the device (USB, Ethernet, etc.).
3. **Start the "Assist CS.." parameterization tool.**

   Start the "Assist CS.." parameterization tool from the MOVISUITE® interface.

   A window opens with a prompt to enter the ID of the safety key and the password.
4. **Enter the safety key ID number of the device and establish a connection.**

   Enter the safety key ID of the safety option to be parameterized and the corresponding password, and confirm the entry with [OK].

   The safety key ID is printed on the safety key. During the first connection, you can set a password by entering it twice.

   The querying of the safety key ID ensures that the "Assist CS.." parameterization tool connects to the correct device.

   As an alternative, you can read the safety key ID via the "Assist CS.." parameterization tool. Proceed as follows:

   - Click the [Read safety key ID] button.
   - Check whether the addressed device signals a read safety key ID operation via the "F-RUN" LED (see chapter ""F-RUN" LED" (→ 🗎 516)). This process should take a maximum of one minute. After one minute, the device LED will stop flashing and confirmation of the flashing code will no longer be accepted. In this case, restart the flashing code query.
   - The read safety key ID is applied in the "Safety key ID" field.
5. **Upload the current parameterization of the device.**

   Once the safety key ID has been entered, the current parameterization of the CS..A safety option is compared to the current parameterization in the "Assist CS.." parameterization tool. If both data sets are identical, the "Assist CS.." parameterization tool starts. In case of deviation, a dialog opens in which the user can choose whether the data set of the safety option or the data set of the "Assist CS.." is used.

31972098/EN – 8/2024

6. **Parameterization**

   Set the parameterization according to the safety-related requirements of your application.

   To parameterize the MOVISAFE® CS..A safety option, call up the individual areas in the parameter tree and enter the required input values. The higher-level parameters, such as IO fault effects, fieldbus connection, encoder activation, and limit speeds of the motor are set in the "General parameters" area. The parameters of the sensors and actuators are set in the "F-DI" and "F-DO" areas. The parameters of the safety sub-functions are then set and assigned to the parameterized inputs/outputs in the "Function assignment" area.

   The "Assist CS.." parameterization tool creates a parameter set from all of the parameters.

7. **Transferring the parameter set to the device**

   Clicking the [Download] button transfers the parameter set to the MOVISAFE® CS..A safety option.

   After the download, the transferred parameter set is checked for consistency and plausibility. Possible inconsistencies or plausibility errors are displayed and can then be corrected.

When the parameter set has been transferred to the MOVISAFE® CS..A safety option without any problems, you can start up the standard functions and, if required, connect it to the higher-level safety controller (F-PLC).

Variant 1: Startup with default parameterization

After a safety protocol (e.g. PROFIsafe) has been activated, the MOVISAFE® CS..A safety option can be started up with the default parameterization of the safety sub-functions.

Take the following marginal conditions into consideration with this operating mode:

- The safety protocol on the MOVISAFE® CS..A safety option is activated via the "Assist CS.." parameterization tool.

For startup, perform the following steps:

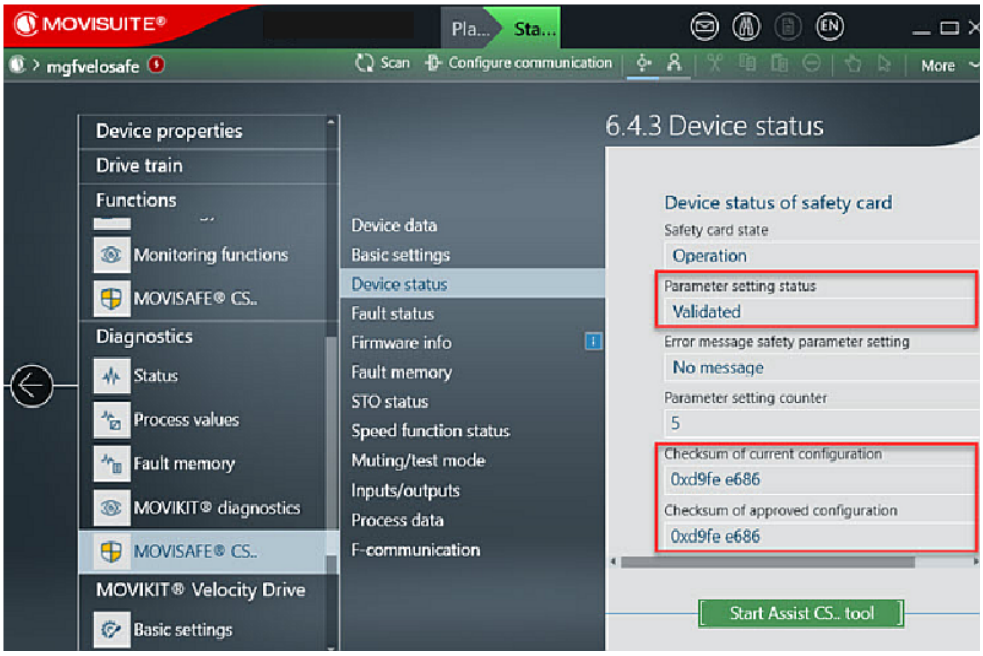
1. Activation of the safety protocol on the MOVISAFE® CS..A safety option in the "Assist CS.." parameterization tool.
2. Startup of the safe fieldbus and the higher-level F-PLC.

   Make sure that the default parameterization of the MOVISAFE® CS..A safety option is active. To do so, check the following parameters (see following figure).

   - The parameter setting status of the safety option is "Validated".

31972098/EN – 8/2024

- The preset iPar_CRC for the default parameterization in the GSDML file corresponds to the checksums of the current and accepted configuration.



28643836683

3. The acceptance of the STO function can be performed as part of the acceptance of the complete system or the acceptance of the F-PLC.

Variant 2: With connection to safe communication (safety protocol)

The MOVISAFE® CS..A safety option can be parameterized and operated (fieldbus connection) with connection to safe communication (e.g. PROFIsafe safety protocol).

Take the following marginal conditions into consideration with this operating mode:

- The parameters of the MOVISAFE® CS..A safety option are set using the "Assist CS.." parameterization tool.
- The validation of the system is supported by an acceptance report generated in the "Assist CS.." parameterization tool.

For startup, perform the following steps:

1. Parameterization of the safety sub-functions in the "Assist CS.." parameterization tool.
2. Startup of the fieldbus and the higher-level F-PLC.
3. Startup of the standard functions.

   For further information, refer to chapter "Startup".
4. The acceptance is supported by the "Assist CS.." parameterization tool. When the acceptance report is created, the *ParCRCBus* parameter is updated and must be adjusted in the safety controller.

Variant 3: Independent operation (without connection to safe communication)

The MOVISAFE® CS..A safety option can be parameterized and operated without a safe communication connection (independent operation).

31972098/EN – 8/2024

Take the following boundary conditions into consideration with this operating mode:

- The parameters of the MOVISAFE® CS..A safety option are set using the "Assist CS.." parameterization tool.
- The safety-relevant acceptance of the system is supported by an acceptance report generated in the "Assist CS.." parameterization tool.

For startup, perform the following steps:

1. Parameterization of the safety sub-functions in the "Assist CS.." parameterization tool.
2. Startup of the standard functions.

   For further information, refer to chapter "Startup".
3. The acceptance is supported by the "Assist CS.." parameterization tool.

11.11.4 Adjusting the maximum test duration for load with unknown capacitance

In order to determine the "Maximum test duration" parameter (Index 8705.2) for a load with unknown capacitance at a safe digital output (F-DO..), proceed as follows:

1. Select one of the two safe digital outputs, F-DO00 or F-DO01. Connect the load according to the selected connection type and set the "Connection type".
2. Set the "Maximum test duration" parameter (Index 8705.2) to the maximum value of 5000 µs.
3. Interconnect the selected output for at least 10 seconds.
4. Form the maximum value from the following values for the selected output:
   - Value of display parameter "Maximum duration test pulse A" (Index 8703.37)
   - Value of display parameter "Maximum duration test pulse B" (Index 8703.8)
5. Block the selected output for at least 10 seconds.
6. Form the maximum value from the following values for the selected output:
   - Formed maximum value from step 4
   - Value of display parameter "Maximum duration test pulse A" (Index 8703.37)
   - Value of display parameter "Maximum duration test pulse B" (Index 8702.8)
7. In order to specify the "Maximum test duration" value (Index 8705.2), add a reserve of 500 µs to the maximum value determined in step 6.

11.11.5 Starting up encoder systems

Encoder evaluation of the CSS..A safety option

The CSS..A safety option supports 1-encoder concepts with a safe encoder. The encoder used is deemed a safe encoder if the following conditions are met:

- The encoder must comply with the necessary safety requirements according to EN ISO 13849-1 and EN 62061.
- The encoder must be approved for the use of speed/position-dependent safety sub-functions.

The safe encoder can be connected in the following ways:

- as a motor encoder without MOVILINK® DDI to X15 on the device
- as a motor encoder with MOVILINK® DDI to X16 on the device

The encoder that is used is selected in the Assist CS.. tool in the "Encoder" dialog via the "Encoder type" drop-down list. All of the required encoder configurations are taken over. The parameter is marked with an "i" if the encoder selection deviates from the configured motor encoder in the drive train.

Encoder evaluation of the CSA31A safety option

The CSA31A safety option supports 1- and 2-encoder concepts that can be parameterized independently for position and speed/acceleration.

In a 1-encoder concept, the encoder must comply with the necessary safety requirements according to EN ISO 13849-1 and EN 62061 and be approved for the use of speed/position-dependent safety sub-functions.

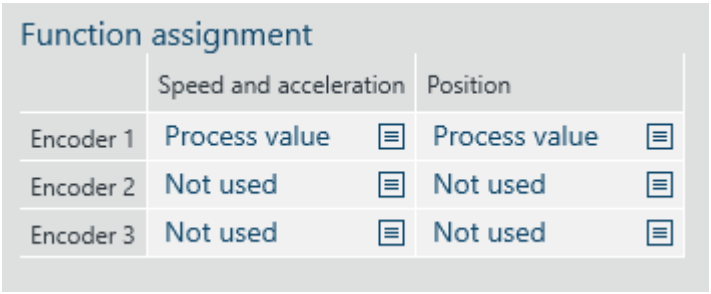
The following applies to encoder assignment:

Encoder 1 can be connected in the following ways:

- as a motor encoder without MOVILINK® DDI to X15 on the device
- as a motor encoder with MOVILINK® DDI to X16 on the device
- Encoder 2 is the SSI encoder that is used for position control. Alternatively, a sin/cos encoder can also be used.
- Encoder 3 is an SSI encoder that is evaluated exclusively by the CSA31A safety option.

The encoder function is assigned in the Assist CS.. tool in the "Encoder function" dialog. For a 1-encoder concept, set the function assignment for this encoder to "Process value".

The figure below shows the setting for a safe motor encoder.



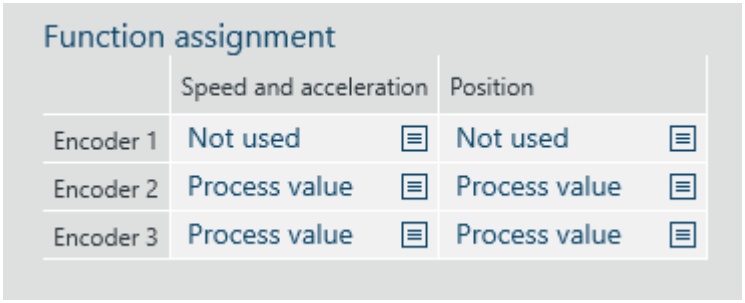
33566360587

In the case of a 1-encoder concept, the encoder must be referenced again after power on if the safe position is used.

In the case of a 2-encoder concept, a safe encoder system is formed from 2 encoders. The user is responsible for the selection of components and compliance with the requirements of the relevant standard, e.g. EN ISO 13849. Alternatively, a safe double SSI encoder that meets the required safety requirements according to EN ISO 13849-1 and EN 62061 and that is approved for the use of speed/position-dependent safety sub-functions can be used.

31972098/EN – 8/2024

The following figure shows the configuration of the encoders. In this case, encoder 2 and encoder 3 must be configured to "Process value".



33566364171

If both encoders are parameterized to "Process value", the system first checks whether both encoder values are within the configured tolerance for position and speed. The mean value is then formed from both encoder values and used in the safety sub-functions for monitoring.

If one of the encoders is parameterized to "Process value" and the 2nd encoder is parameterized to "Comparison value", the difference in both encoder values must be within the tolerance for position and speed. The process value is used for monitoring in the safety sub-functions.

For the response time in the combination of process value and comparison value, take into account the respective tolerance values for position and speed. For averaging, take into account half of the tolerance values in each case.

2-encoder system

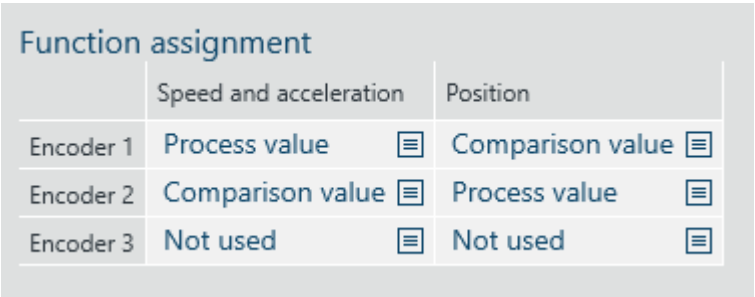
When using encoder 1 and encoder 2, the process values "position", "speed," and "acceleration" are formed from these two encoders in terms of safety.

The function assignment "Process value" should be assigned to the encoder that has the higher resolution for this value.

This is why the selected process value for speed and acceleration is typically assigned to encoder 1, which is the motor encoder, and the selected comparison value is assigned to the second encoder, which is typically an SSI distance encoder.

The selection is typically reversed for the "position" process value because the distance encoder provides better position information.

If both encoders have comparable resolutions, both encoders can be set to "Process value".



33565595275

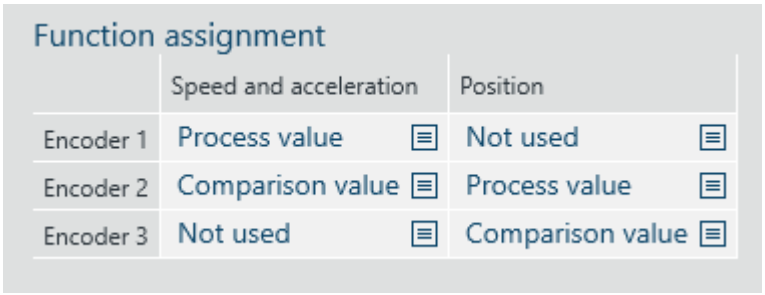
In applications with slip (e.g. storage/retrieval system) or in movements where the applied position is not linear to the motor position (e.g. scissor lift table) and the absolute position is to be monitored, 2 distance encoders can be used in addition to the motor encoder.

This results in the following setting options:

- All 3 encoders are used, but only 2 encoders are considered per process value.
- The motor encoder (encoder 1) and a distance encoder (encoder 2 or encoder 3) are usually used to generate the "speed" and "acceleration" process values. Both distance encoders (encoder 2 and encoder 3) are used to obtain the "position" process value.

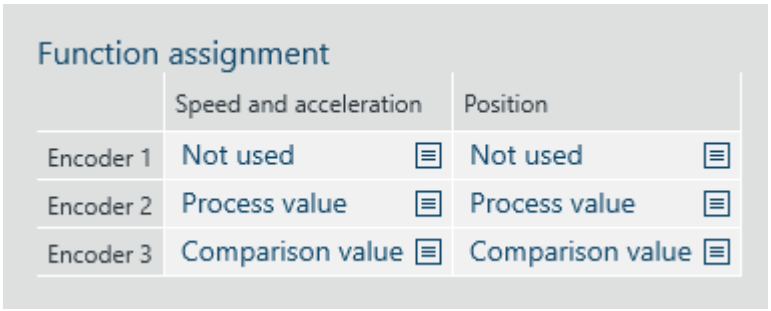
INFORMATION

The combination of HTL (encoder 1) and sin/cos (encoder 2) is not permitted.



33566150667

- To generate the "speed" process values in this constellation, it is possible to calculate speed and acceleration from the two distance encoders (encoder 2 and encoder 3) in addition to the position. In this case, the motor encoder is not necessary. If an SBT brake test is not used, an encoder type that is not supported by the safety option can also be used. The SBT brake test uses solely encoder 1 and requires a safe motor encoder.



33566154251

Startup of safety encoders with MOVILINK® DDI

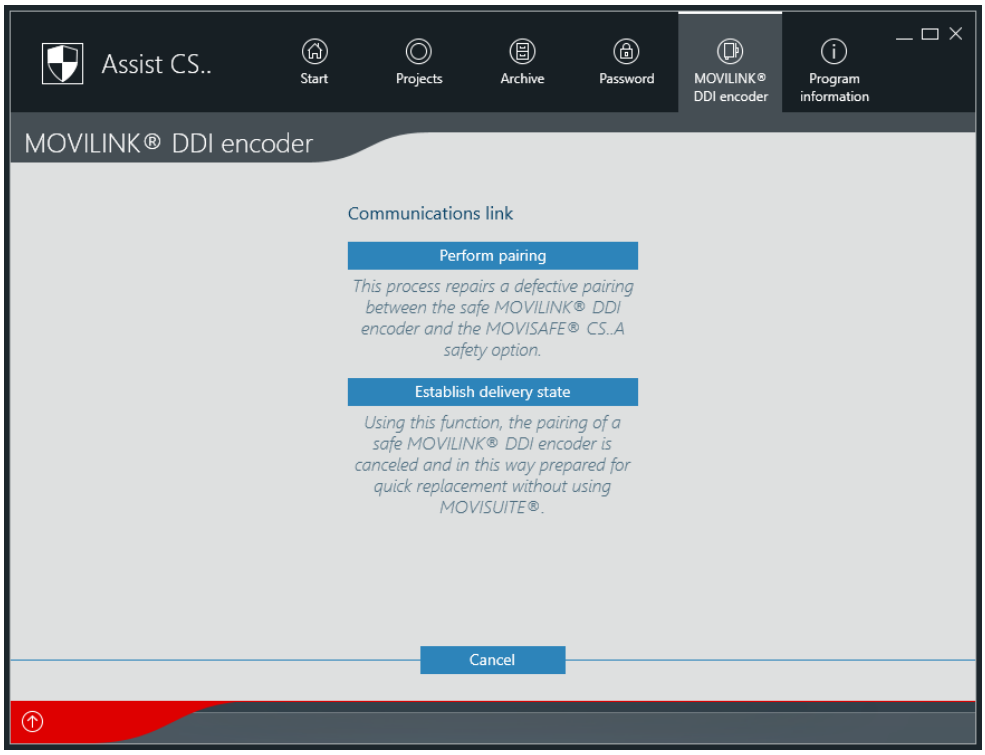
Select the safety encoder with MOVILINK® DDI (EK8Z or AK8Z) in the Assist CS.. parameterization tool. After the configuration is transferred to the CS..A safety option, the encoder and the safety option automatically connect. This process is called pairing.

If the pairing process does not work, you have the option of starting the process manually via the Assist CS.. parameterization tool.

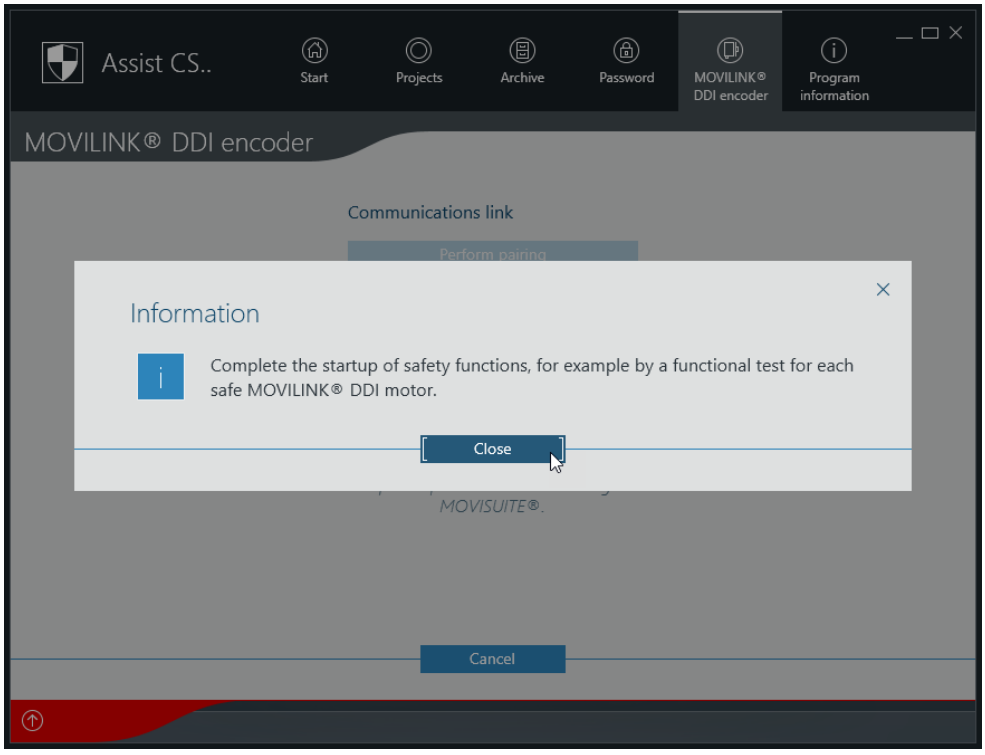
1. Select the menu item "MOVILINK® DDI encoder".

31972098/EN – 8/2024

2. Then select the menu item "Perform pairing".



3. After successful pairing, you can conclude your startup phase.



48371223947

Method for determining the position with the CSA31A safety option

Application

For the application, 3 different ways for determining the position are available.

1. Absolute position with limited travel distance
2. Relative position
3. Modulo applications

Absolute position with limited travel distance

The travel distance is physically limited on both sides. The absolute position in user units is unique on the travel path. If a stored reference offset is available without errors after a voltage failure in the safety option, the encoder is referenced immediately. The absolute position is recalculated from the reference offset and the current raw encoder value. If there is no reference offset, only a relative position is calculated until the next referencing.

Relative position

The position has no fixed reference to the system position. This means that no safety sub-functions based on an absolute position (such as SLP, SCA) can be used in this application.

Modulo applications

The travel path is not physically limited, the drives can travel as far as required. This means that after moving around the modulo range once or several times, the system is back in the same position.

Encoders

For the encoders, 3 different ways for determining the position are available.

1. Absolute position without overflow counter
2. Single-turn absolute position
3. Incremental evaluation

Absolute position without overflow counter

- Operating principle:

  The scaling (configuration) and the offset determined during referencing are used for conversion into user units between the encoder and absolute position reference systems.

- Use:

  All rotary or linear absolute encoders, no incremental encoders.

- Limitation:

  The measuring range of the encoder must clearly cover the travel path. A plausibility check is performed automatically during startup. When using motor encoders, the gear ratio to the track must be taken into account.

- Behavior when switching on:

  If referencing was performed before switch-off, the encoder is immediately referenced when switched on.

31972098/EN – 8/2024

- Replacement of the CSA31A safety option:

  Referencing is retained.
- Replacement of the encoder:
  - With linear encoder:

    Referencing is retained
  - With rotary encoder:

    New referencing is required

Single-turn absolute position

- Operating principle:

  The unique position value over one revolution (single turn) is mapped to a modulo range (scaling determined by configuration) and to an offset determined by referencing.
- Use:

  All rotary absolute encoders (single-turn absolute).
- Limitation:

  The encoder must be installed in the application in such a way that its single-turn range maps a logical revolution (e.g. of a rotary table). The single-turn measuring range of the encoder must correspond exactly to the modulo range in user units after rescaling to user units. There must not be a division remainder during the conversion. Under this condition, each single-turn raw position value is uniquely mapped to an absolute position in user units within the configured modulo range.
- Behavior when switching on:

  If referencing was performed before switch-off, the encoder is immediately referenced when switched on.
- Replacement of the CSA31A safety option:

  If referencing was performed before switch-off, the encoder is immediately referenced when switched on.
- Replacement of the encoder:

  New referencing is required.

Incremental evaluation

- Operating principle:

  The position value is continuously updated in increments. This also applies to HIPERFACE® encoders and SSI absolute encoders. A HIPERFACE® encoder connected as encoder 2 must be evaluated in increments.
- Use:

  All encoders.
- Limitation:

  Referencing is required after each activation.
- Behavior when switching on:

  The encoder must be referenced. No safety sub-function based on an absolute position can be used during this time.

- Replacement of the CSA31A safety option:

  New referencing is required.
- Replacement of the encoder:

  New referencing is required.

Combination options

The various methods for determining the position for applications and encoders can be combined as follows:

Encoder	Application		
	Absolute position with limited travel distance	**Modulo applications**	**Relative position**
Absolute position without overflow counter	✓	–	–
Incremental evaluation	✓	✓	✓
Single-turn absolute position	–	✓	–

11.11.6 Parameterizing the safety sub-functions

Requirements

To use the safety sub-functions, certain process values must be available.

- The "speed" and "acceleration" process values must be calculated for the SS1-r, SS2-r, SLS, SSM, SSR, SLI, SLP safety sub-functions and for the SBT brake test diagnostic function.
- The "Position" process value is used for the SOS, SDI, SLI, SLP and SCA safety sub-functions.
- The SLP and SCA safety sub-functions can only be used after the encoders involved have been referenced.
- All the limit speeds of the safety sub-functions must lie between the minimum speed and the maximum speed.

If a safety sub-function is selected without an appropriately configured process value (or other requirements), the MOVISAFE® CSA31A safety option reports a fault. With the CSS..A safety option, the required process values are created by selecting the encoder.

For further information on parameterization of process value generation, refer to chapter "Encoder evaluation of the CSA31A safety option".

Proceed in the following order:

1. Configure the drive train in the inverter with all the encoders involved and the user units.
2. Open the "Assist CS.." parameterization tool and log in. The user units configured in the drive train are added to the "Assist CS.." parameterization tool.
3. Apply the encoder parameters to the safe configuration.

   Also follow steps 4 – 7 for the CSA31A safety option.
4. If necessary, further configure the individual encoder type and encoder parameters.
5. Configure the application type and the function assignment.

31972098/EN – 8/2024

6. Configure the involved encoders (encoder operating modes).
7. Configure safe referencing, if required.
8. Configure the required safety sub-functions.
9. The safety sub-functions can be activated via parameterization, safe digital inputs F-DI, or safe process data. Activation via safe digital inputs F-DI and safe process data is performed with logic "0".

STO safety sub-function with MOVISAFE® CS..A

When the STO safety sub-function is activated, the internal safe digital output F-DO_STO and the safe digital outputs F-DO assigned to the STO function are disabled immediately. In the basic device, the function block *FCB01 Output stage inhibit* is activated and the status STO is set.

If the parameter *SBC enable* is set to "yes", all safe digital outputs F-DO assigned to the SBC function will be disabled immediately when the STO function is activated. Once the time defined in the parameter *Brake application time* has elapsed, the internal safe digital output F-DO_STO and all safe digital outputs F-DO assigned to the STO function are disabled with a delay.

If the STO function is activated due to a limit value violation of a safety sub-function, the internal safe digital output F-DO_STO and all safe digital outputs F-DO assigned to the STO/SBC function are disabled immediately.

If the STO function is activated due to a limit value violation of a safety sub-function, the internal safe digital output F-DO_STO is disabled immediately.

If a limit value violation of a safety sub-function, a system error, or an output error occurs during the brake application delay, the brake application time is immediately stopped and the internal safe digital output F-DO_STO and all safe digital outputs F-DO assigned to the STO function are disabled. The safe digital outputs F-DO assigned to the SBC function are already disabled.

If the STO function is deactivated, the internal safe digital output F-DO_STO and all safe digital outputs F-DO assigned to the STO/SBC function are activated immediately.

Activation

Number of instances: 1

The STO safety sub-function can be activated via the following sources:

- F-DI (function assignment)
- Safe process output data (STO 1)
- SSx 1/2 final state
- Fault response
- Limit value violation

Status

The status of the STO safety sub-function is displayed in the following areas:

- Diagnostics > MOVISAFE® CS..A, STO status
- Safe process input data (STO 1)

31972098/EN – 8/2024

SS1-t safety sub-function with MOVISAFE® CS..A

The SS1-t safety sub-function monitors the parameterized time delay and triggers the STO safety sub-function once the time delay has elapsed. To implement the SS1-t safety sub-function, the ramp monitoring must be set to "none" and the final state to "STO" in the SSx instance.

If the *Inverter control* parameter is set to "Active", activating the SS1-t safety sub-function results in the activation of the *FCB13 Application stop* drive function in the inverter.

If the *Inverter control* parameter is set to "Not active", the inverter is not controlled.

Activation

Number of instances: 2 (SSx1, SSx2)

The safety sub-function can be activated via the following sources:

- F-DI (function assignment)
- Safe process output data (SSx1, SSx2)
- Fault response
- Limit value violation

Status

The status of the safety sub-function is displayed in the following areas:

- Diagnostics > MOVISAFE® CS..A, speed function status
- Safe process input data (SSx1, SSx2)

Fault response during limit value violation

No fault response with limit value violation.

SS1-r safety sub-function with MOVISAFE® CS..A

Introduction

The SS1-r safety sub-function monitors the amount of motor deceleration within specified limits. The STO safety sub-function is activated if the motor speed drops below a specified limit value. When the limit speed is exceeded, the STO safety sub-function is activated without brake application delay.

If the SS1-r safety sub-function is activated, first the parameterized *Monitoring delay* (8706.9) applies. During the monitoring delay, the parameterized *Maximum speed* (8707.1) is monitored. Then the monitoring of the parameterized speed ramp starts.

If the *Ramp monitoring* parameter is set to "linear", monitoring of the linear speed ramp starts at the currently detected actual speed when the SS1-r safety sub-function is activated. The end speed of the speed ramp is the parameterized minimum speed.

If the *Ramp monitoring* parameter is set to "jerk-limited", monitoring of the jerk-limited speed ramp starts at the sum of the currently detected actual speed plus the parameterized offset speed after the SS1-r safety sub-function is activated. The end speed of the speed ramp is either the parameterized minimum speed or, if larger, the parameterized offset speed.

If the limit speed of the speed ramp reaches the end speed, the parameterized final state (STO, SOS, or SLI safety sub-function) is activated.

If the *Inverter control* parameter is set to "active", activating the safety sub-function results in the activation of the *FCB13 Application stop* drive function in the inverter.

31972098/EN – 8/2024

If the *Inverter control* parameter is set to "Not active", the inverter is not controlled.

If the *Inverter control* parameter is set to "Active with limiting", the stop ramp of the inverter is limited to the following values:

- Minimum value of the SSx deceleration
- Maximum value of the parameterized jerk time

Activation

Number of instances: 2 (SSx1, SSx2)

The safety sub-function can be activated by the following sources:

- F-DI (function assignment)
- Safe process output data (SSx1, SSx2)

Status

The status of the safety sub-function is displayed in the following areas:

- Diagnostics > MOVISAFE® CS..A, speed function status
- Safe process input data (SSx1, SSx2)

Fault response during limit value violation

Due to the limit value violation, the STO safety sub-function is activated without brake application delay.

The limit value violation must be acknowledged. By deactivating the SSx function, the limit value violation is not acknowledged. The SSx function cannot be reactivated with an existing limit value violation. It can only be acknowledged if the SSx function is deactivated. After acknowledgment, the final state of the SSx function is active immediately.

Fault response during encoder fault

If an encoder fault occurs, the STO safety sub-function is activated immediately without brake application delay. The status of the SSx function becomes inactive. The encoder fault must be acknowledged. The encoder fault cannot be acknowledged by deactivating the SSx function.

INFORMATION

If an SSx instance is assigned to another safety sub-function as a fault response, the SLI function cannot be parameterized as the final state.

INFORMATION

An SLI instance must be enabled for the SLI final state.

SS2-t safety sub-function with MOVISAFE® CS..A

INFORMATION

The SS2-t safety sub-function must not be used in conjunction with the EI7C FS built-in encoder.

31972098/EN – 8/2024

The SS2-t safety sub-function monitors the parameterized time delay and triggers the SOS safety sub-function once the time delay has elapsed. To do this, the SOS safety sub-function must be enabled.

If the *Inverter control* parameter is set to "Active", activating the SS2-t safety sub-function results in the activation of the *FCB19 Position hold control* drive function in the inverter.

If the *Inverter control* parameter is set to "Not active", no changeover of the *FCB19 Position hold control* drive function is carried out in the inverter. Stopping of the drive must be ensured by the user. The standstill behavior (changeover to the *FCB19 Position hold control* drive function) is dependent on the parameterization of the SOS safety sub-function.

Activation

Number of instances: 2 (SSx1, SSx2)

The safety sub-function can be activated by the following sources:

- F-DI (function assignment)
- Safe process output data (SSx1, SSx2)

Status

The status of the safety sub-function is displayed in the following areas:

- Diagnostics > MOVISAFE® CS..A, speed function status
- Safe process input data (SSx1, SSx2)

Fault response during limit value violation

No fault response with limit value violation.

Fault response during encoder fault

If an encoder fault occurs, the STO safety sub-function is activated immediately without brake application delay. The status of the SSx function becomes inactive. The encoder fault must be acknowledged. The encoder fault cannot be acknowledged by deactivating the SSx function.

INFORMATION

If an SSx instance is assigned to another safety sub-function as a fault response, the SLI function cannot be parameterized as the final state.

INFORMATION

An SLI instance must be enabled for the SLI final state.

SS2-r safety sub-function with MOVISAFE® CS..A

INFORMATION

The SS2-r safety sub-function must not be used in conjunction with the EI7C FS built-in encoder.

31972098/EN – 8/2024

The SS2-r safety sub-function monitors the amount of motor deceleration within specified limits.

If the motor speed falls below a defined limit value, the SS2-r safety sub-function triggers the SOS function. To do this, the SOS safety sub-function must be enabled. The STO safety sub-function is triggered if the motor speed exceeds a specified limit value

If the SS2-r safety sub-function is activated, first the parameterized *Monitoring delay* (8706.9) applies. During the monitoring delay, the parameterized *Maximum speed* (8707.1) is monitored. Then the monitoring of the parameterized speed ramp starts.

If the *Ramp monitoring* parameter is set to "linear", monitoring of the linear speed ramp starts at the currently detected actual speed when the SS2-r safety sub-function is activated. The end speed of the speed ramp is the parameterized minimum speed.

If the *Ramp monitoring* parameter is set to "jerk-limited", monitoring of the jerk-limited speed ramp starts at the sum of the currently detected actual speed plus the parameterized offset speed after the SS2-r safety sub-function is activated. The end speed of the speed ramp is either the parameterized minimum speed or, if larger, the parameterized offset speed.

If the limit speed of the speed ramp reaches the end speed, the parameterized final state (STO, SOS, or SLI safety sub-function) is activated.

If the *Inverter control* parameter is set to "Active", activating the safety sub-function results in the activation of the *FCB19 Position hold control* drive function in the inverter.

If the *Inverter control* parameter is set to "Not active", no changeover of the *FCB19 Position hold control* drive function is carried out in the inverter. Stopping of the drive must be ensured by the user. The standstill behavior (changeover to the *FCB19 Position hold control* drive function) is dependent on the parameterization of the SOS safety sub-function.

If the *Inverter control* parameter is set to "Active with limiting", the stop ramp of the inverter is limited to the following values:

- Minimum value of the SSx deceleration
- Maximum value of the parameterized jerk time

Activation

Number of instances: 2 (SSx1, SSx2)

The safety sub-function can be activated by the following sources:

- F-DI (function assignment)
- Safe process output data (SSx1, SSx2)

Status

The status of the safety sub-function is displayed in the following areas:

- Diagnostics > MOVISAFE® CS..A, speed function status
- Safe process input data (SSx1, SSx2)

Fault response during limit value violation

Due to the limit value violation, the STO safety sub-function is activated without brake application delay.

31972098/EN – 8/2024

The limit value violation must be acknowledged. By deactivating the SSx function, the limit value violation is not acknowledged. The SSx function cannot be reactivated with an existing limit value violation. It can only be acknowledged if the SSx function is deactivated. After acknowledgment, the final state of the SSx function is active immediately.

Fault response during encoder fault

If an encoder fault occurs, the STO safety sub-function is activated immediately without brake application delay. The status of the SSx function becomes inactive. The encoder fault must be acknowledged. The encoder fault cannot be acknowledged by deactivating the SSx function.

INFORMATION

If an SSx instance is assigned to another safety sub-function as a fault response, the SLI function cannot be parameterized as the final state.

INFORMATION

An SLI instance must be enabled for the SLI final state.

SOS safety sub-function with MOVISAFE® CS..A

INFORMATION

The SOS safety sub-function must not be used in conjunction with the EI7C FS built-in encoder.

The SOS safety sub-function monitors the drive position with the parameterized positional tolerance.

If the *Inverter control* parameter is set to "Active", activating the SOS safety sub-function results in the activation of the *FCB19 Position hold control* drive function in the inverter.

If the *Inverter control* parameter is set to "Not active", activating the SOS safety sub-function does not result in the activation of the *FCB19 Position hold control* drive function in the inverter. The user must use the correct controller to ensure that the drive remains in an idle state. The positive and negative limit position is determined based on the actual position and the parameterized positional tolerance detected upon activation of the SOS safety sub-function.

If the positive or negative limit position is exceeded, the fault response (STO) is triggered. After a limit value violation, acknowledgment leads to the limit positions being recalculated based on the current actual position.

Activation

Number of instances: 1

The SOS safety sub-function can be activated via the following sources:

- F-DI (function assignment)
- Safe process output data (SOS1)
- Final state of SS2 or SLI

31972098/EN – 8/2024

Status

If the SOS safety sub-function is activated and the determined limit positions are not exceeded, the status of the SOS safety sub-function is active. The status is displayed in the following areas:

- Diagnostics > MOVISAFE® CS, position function status
- Safe process input data (SOS1)

Fault response during limit value violation

When one of the limit positions is exceeded, the STO safety sub-function is activated without brake application delay as fault response.

SLA safety sub-function with MOVISAFE® CS..A

The SLA function monitors the acceleration within the parameterized limit values. If the SLA safety sub-function is activated, first the parameterized *Monitoring delay (8706.9)* applies. During the monitoring delay, the parameterized *Maximum speed (8707.1)* is monitored. Then the monitoring of the parameterized speed ramp starts.

The actual acceleration is monitored based on the following conditions:

- The speed is greater than the parameterized *Minimum speed for acceleration functions (8707.6)*.
- The speed is increased.

If the speed is decreased, monitoring is not active.

A *Fault response (8706.32)* is triggered if the parameterized *Limit acceleration (8706.73)* is exceeded.

If the *Inverter control* parameter is set to "Active with limiting", the inverter acceleration is limited to the limit values of the SLA function minus the value set in the *Acceleration offset* parameter.

An exceeded limit acceleration must be acknowledged. With the "Only F-PI" fault response, the status of the SLA function is reset automatically if the limit acceleration is held again. A safe protocol must be selected for this purpose.

Limitation

INFORMATION

The SLA safety sub-function cannot be used in combination with the EI7C FS built-in encoder.

The SLA safety sub-function cannot be used if the MOVISAFE® CSA31A safety option evaluates 3 encoders and the Safety over EtherCAT® safety protocol has been selected.

Activation

Number of instances: 2

The SLA safety sub-function can be activated via the following sources:

- F-DI (function assignment)
- Safe process output data (SLA1, SLA2)
- Permanently activated

31972098/EN – 8/2024

Status

If the SLA safety sub-function is activated and the limit values are not exceeded, the status of the SLA function is active. The status is displayed in the following areas:

- Diagnostics > MOVISAFE® CS..A, acceleration function status
- Safe process input data (SLA1, SLA2)

Fault response during limit value violation

If one of the monitoring limits is exceeded, one of the following parameterized error responses can be activated:

- STO
- SSx1, SSx2

  The "SSx1" or "SSx2" error response can be selected only if the corresponding SSx instance is enabled.
- F-PI

  The fault response "F-PI" can only be selected if a safety protocol has been selected.

SLS safety sub-function with MOVISAFE® CS..A

The SLS safety sub-function monitors the actual speed for exceeding the parameterized limit speed. When the limit speed is exceeded, the parameterized fault response is triggered.

The speed filter allows the limit speed to be exceeded "briefly" without triggering the fault response (see parameter *Speed filter*, index 8706.25).

Monitoring of the SLS limit speed or start of the transition ramp can be delayed using the *Monitoring delay t2* parameter. The actual speed is monitored for exceeding the parameterized maximum speed during the monitoring delay.

The *Ramp start at actual speed* parameter defines whether the monitoring ramp begins at the maximum speed or the actual speed.

If the *Ramp start at actual speed* parameter (8706.18) is set to "Yes" and the *Ramp monitoring* parameter is set to "linear", the monitoring of the linear speed ramp begins at the currently detected actual speed after the SLS safety sub-function is activated. The end speed of the speed ramp is the parameterized limit speed.

If the *Ramp start at actual speed* (8706.18) parameter is set to "Yes" and the *Ramp monitoring* parameter is set to "jerk-limited", monitoring of the jerk-limited speed ramp starts at the sum of the currently detected actual speed plus the parameterized offset speed after the SLS safety sub-function is activated. The end speed of the speed ramp is the parameterized limit speed.

If the *Ramp start at actual speed* (8706.18) parameter is set to "No", the transition ramp begins at the lowest, previously monitored limit speed.

If no other SLS safety sub-function is activated, the parameterized maximum speed is used as the lowest, previously monitored limit speed.

The lowest, previously monitored limit speed is the lowest parameterized limit speed of all activated SLS instances that meet all the following conditions:

- The transition ramp is completed.
- Both effective directions are monitored or the monitored effective direction is identical to the current speed.
- The limit speed or the speed filter have not been exceeded.

31972098/EN – 8/2024

If the lowest monitored limit speed is lower than the parameterized limit speed of the last activated SLS, no transition ramp is calculated, but rather the limit speed is immediately monitored.

Use the *Effective direction* parameter to define the direction of rotation in which the SLS function is effective:

- Only in positive direction of rotation
- Only in negative direction of rotation
- In both directions of rotation
- The maximum speed must not be exceeded during movement against the effective direction.

If the *Inverter control* parameter is set to "Not active", the inverter is not controlled. If the *Inverter control* parameter is set to "Active with limiting", the following inverter values are limited to these values:

- Minimum value of the deceleration
- Maximum value of the parameterized jerk time
- Speed:

  Maximum limit speed – SLS distance to the limit speed

This limit does not affect interpolating FCBs (e.g. FCB10).

Limitation

INFORMATION

If the MOVISAFE® CSA31A safety option evaluates 3 encoders and the Safety over EtherCAT® safety protocol has been selected, a total of 4 instances of the SLS and SSM safety sub-function are available.

Activation

Number of instances: 4

The SLS safety sub-function can be activated via the following sources:

- F-DI (function assignment)
- Safe process output data (SLS 1, SLS 2, SLS 3, SLS 4)
- Permanently activated

Status

If the SLS function is activated and the transition ramp is completed, the status of the SLS function is active. If the limit speed is exceeded, the status is deactivated.

The status is displayed in the following areas:

- Diagnostics > MOVISAFE® CS..A, speed function status
- Safe process input data (SLS1, SLS2, SLS3, SLS4)

31972098/EN – 8/2024

Fault response during limit value violation

One of the following parameterized fault responses can be activated:

- STO
- SSx1, SSx2

  The "SSx1" or "SSx2" fault response can be selected only if the corresponding SSx instance is enabled.

SSR safety sub-function with MOVISAFE® CS..A

The SSR function monitors the motor speed within the parameterized speed limits. The parameterized fault response is triggered if the limit values are exceeded. The drive is stopped with the STO or SS1 safety sub-functions, or the information that the limit values were exceeded is transmitted to a safety controller via the safe process data.

When limit values are exceeded and the fault response is STO or SSx, then the fault response must be acknowledged. No acknowledgment is required if the information that limit values were exceeded is reported to a safe controller. When the speed drops below the limit value, the status of the safety sub-functions is set again, taking the parameterized *Speed hysteresis v1 (8706.57)* into consideration.

Once the safety sub-functions have been activated, the actual speed is monitored for exceeding the maximum speed for the duration of the monitoring delay. After this time, the actual speed is monitored for leaving the range of upper and lower limit speed. Both the upper and the lower limit speed can be positive and negative.

A speed filter can be set for the SSR function. If a speed filter is set, it will be calculated separately for the upper and lower limit speed.

The distance between the upper and lower SSR limit speed must be greater than twice the value of the parameterized *Speed hysteresis v1 (8706.57)*.

Activation

Number of instances: 2

The SSR safety sub-functions can be activated via the following sources:

- F-DI (function assignment)
- Safe process output data (SSR1, SSR2)
- Permanently activated

Status

The status of the SSR safety sub-function is active if the SSR function is activated and the current speed is within the speed limits. If the speed limit is exceeded, the status of the SSR function is deactivated. If the actual speed is within the limit values taking into account the speed hysteresis, the status of the SSR safety sub-function changes back to "1". A parameterized speed filter delays the status change. An acknowledgment in an idle state or below the limit speed resets the speed filter and the status immediately changes to "1".

The status is displayed in the following areas:

- Diagnostics > MOVISAFE® CS..A, speed function status
- Safe process input data (SSR1, SSR2)

31972098/EN – 8/2024

Fault response during limit value violation

If one of the speed limits is exceeded, one of the following parameterized fault responses can be activated:

- STO
- SSx1, SSx2

  The "SSx1" or "SSx2" error response can be selected only if the corresponding SSx instance is enabled.
- Only F-PI

  The fault response "F-PI" can only be selected if a safe protocol has been selected.

SSM safety sub-function with MOVISAFE® CS..A

The SSM function provides a safe output signal on the safe process data to indicate whether the speed is below a specified limit value.

A speed filter can be activated for each instance of the SSM function. The speed filter integrates the speeds exceeding the speed limit along the track. If the track is longer than the parameterized track, feedback is provided by the corresponding status message.

Use the *Effective direction* parameter to determine in which direction the SSM function should be effective (positive, negative, or both directions) for each SSM function.

Do not exceed the maximum speed while moving against the effective direction.

If the SSM function is activated, the speed hysteresis must be lower than the limit speed.

Limitation

INFORMATION



If the MOVISAFE® CSA31A safety option evaluates 3 encoders and the Safety over EtherCAT® safety protocol has been selected, a total of 4 instances of the SLS and SSM safety sub-function are available.

Activation

Number of instances: 4

The SSM function is active if the limit value is not "0".

Status

If the limit values are exceeded, the status of the SSM safety sub-function switches to "0". Taking the speed hysteresis into consideration, if the actual speed is below the limit value, the status of the SSM safety sub-function changes back to "1". A parameterized speed filter delays the status change. An acknowledgment in an idle state or below the limit speed resets the speed filter and the status immediately changes to "1".

The status is displayed in the following areas:

- Diagnostics > MOVISAFE® CS..A, speed function status
- Safe process input data (SSM1, SSM2, SSM3, SSM4)

31972098/EN – 8/2024

Fault response during limit value violation

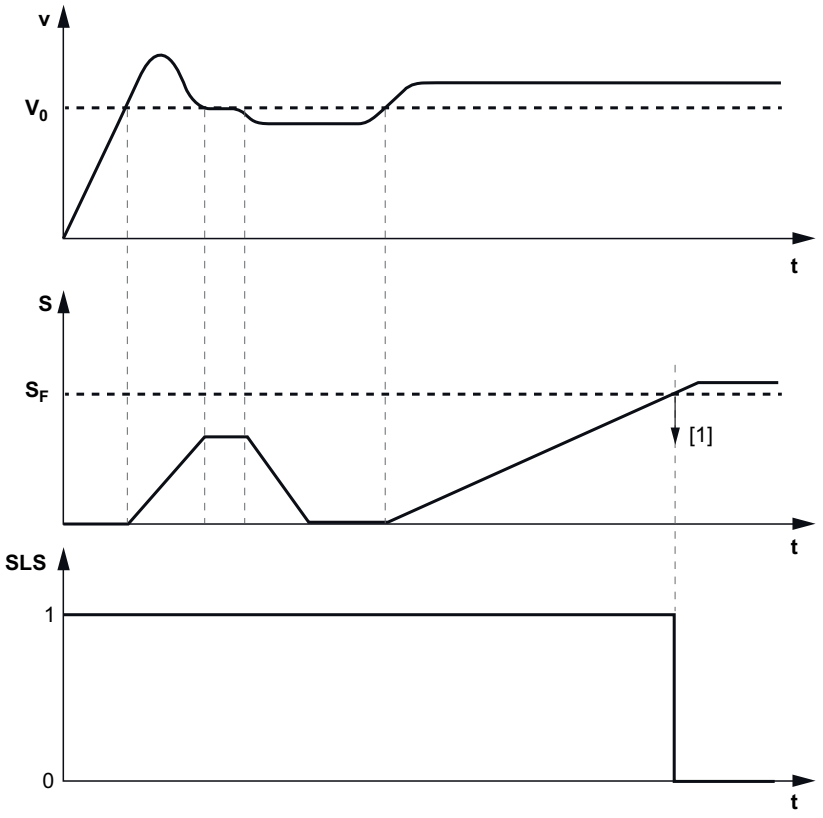
No fault response with limit value violation.

Speed filter

The speed filter can be parameterized with the SLS, SSM and SSR function. The speed filter makes it possible to exceed the speed limit "briefly" without triggering the fault response. The speed filter is activated if the filter is > "0".

This additional functionality allows you to filter speed peaks in the event of an unbalanced operation (speed peaks in the signal). Starting from the difference between the current speed and the parameterized speed monitoring value, the distance integral is calculated and compared with the entered value. If the entered value is exceeded, the safety sub-function is triggered and the status of the safety sub-function changes from "1" to "0".

The following figure shows an example of the speed filter:



43176130443

[1] Response

A drive exceeds the threshold "v_0" parameterized in the SLS safety sub-function. When the threshold "v_0" is exceeded, the speed above the threshold is integrated (S). If the current speed changes again to a value that is below the parameterized threshold "v_0", the integral also decreases again to "0". The speed then rises again and remains above the parameterized threshold "v_0". As a result, the integral increases again and, when the filter value (S_F) is exceeded, triggers the corresponding response [1] (here: SLS safety sub-function). The status changes from "1" to "0". You can record the trend of the fault value in the scope.

- SLS speed filter 8706.25 (offset 0 – 3)

31972098/EN – 8/2024

- SSM speed filter 8706.31 (offset 0 – 1)
- SSR speed filter 8706.56 (offset 0 – 1)

For the initial startup of the speed filter, it is sensible to record the speed curve using the scope. In the first approximation, this maximum value can be used as the filter value for the speed filter, taking possible tolerances into consideration.

SDI safety sub-function with MOVISAFE® CS..A

The SDI function monitors the movement in the blocked direction of rotation. The STO safety sub-function is activated when the configured tolerance is violated.

The function can be activated by means of a safe digital input F-DI via safe process data (SDI 1, SDI 2), or the function can be activated permanently via the parameterization.

When the SDI safety sub-function is activated, the limit position is calculated based on the actual position detected by the encoder system at this point in time and the *Tolerance* and *Permitted direction of movement* parameters. The limit position is corrected for movements in the permitted direction of movement, which means the limit position is recalculated cyclically from the current actual position and the tolerance. This means the maximum distance to the actual position is the configured tolerance. The maximum speed may not be exceeded during the movement. In case of movement in the inhibited direction of movement or if a limit position is exceeded, a fault response is issued. The limit position is calculated again during acknowledgment after violation of a limit value, or after an encoder fault. The position on which the recalculation is based is the actual position detected at the time of acknowledgment. The SDI function does not monitor the speed.

Activation

Number of instances: 2

The SDI safety sub-function can be activated via the following sources:

- F-DI (function assignment)
- Safe process output data (SDI1, SDI2)
- Permanently activated

Status

If the SDI safety sub-function is activated and no movement is detected in the monitored direction of rotation, the status of the SDI function is active. The status of the SDI function is deactivated if movement in the monitored direction of rotation over the parameterized tolerance is detected.

The status of the SDI safety sub-function is displayed in the following areas:

- Diagnostics > MOVISAFE® CS..A, position function status
- Safe process input data (SDI1, SDI2)

Fault response during limit value violation

If the limit position is exceeded, the STO safety sub-function is activated without a brake application delay as a fault response.

31972098/EN – 8/2024

SLI safety sub-function with MOVISAFE® CS..A

The SLI safety sub-function can be used to implement safe, relative position functions. The SLI function monitors whether the set limits are exceeded. The defined limits are calculated based on the settings of the following parameters:

- *Increment*
- *Deceleration a*
- *Effective direction*
- *Maximum speed*

INFORMATION

The SLI function and SLI increment enable must not be activated at the same time. With simultaneous control, the parameterized stop state is not canceled.

When the SLI function is activated, first the parameterized stop state is activated. The "STO stop state" or "SOS stop state" setting can then be used to deactivate the stop state by a 0 → 1 edge of SLI increment enable, and the SLI function can monitor the parameterized limits. The "SOS stop state" can only be used if the SOS safety sub-function has been parameterized and the *Control inverter* parameter is set to "Active".

If the stop state is parameterized to "No stop state", the parameterized limits are monitored without prior increment enable.

The limits are calculated based on the current position upon activation of monitoring. The monitoring curve in the effective direction comprises the set increment and delay.

The SLI increment enable deactivates the stop state and calculates the limit position:

- Positive limit position: Actual position plus increment
- Negative limit position: Actual position minus increment

The stop state is activated immediately when SLI increment enable is revoked. With the next increment enable, the limits are recalculated based on the actual position. After a limit value violation, the SLI increment enable or the SLI function must be deactivated before acknowledgment, otherwise the limit value violation will be reported again after acknowledgment.

Limitation

INFORMATION

If the MOVISAFE® CSA31A safety option evaluates 3 encoders and the Safety over EtherCAT® safety protocol has been selected, a total of 3 instances of the SLP and SLI safety sub-function are available.

Activation

Number of instances: 2

The SLI safety sub-function can be activated via the following sources:

- F-DI (function assignment)
- Safe process output data (SLI1, SLI2)
- SSx1, SSx2 final state

SLI increment enable

Number of instances: 1

31972098/EN – 8/2024

The SLI increment enable is not time limited and is activated by a 0 → 1 edge on one of the following sources:

- F-DI (function assignment)
- Safe process output data (SLI increment enable)

Status

The status of the SLI safety sub-function is displayed in the following areas:

- Diagnostics > MOVISAFE® CS..A, acceleration function status
- Safe process output data (SLI1, SLI2)

The status of the SLI safety sub-function is active as soon as the safety sub-function has been activated and no limit value has been exceeded. In the stop state, the status bits of the STO and SOS safety sub-functions behave as described in the safety sub-functions.

Fault response during limit value violation

The STO safety sub-function without brake application delay is activated as fault response in one of the following cases:

- If a limit position is exceeded.
- If the braking distance in direction of movement in the parameterized effective direction is larger than the distance to the limit position.

Encoder fault muting



⚠ WARNING

The active "Encoder fault muting" function deactivates the encoder-dependent safety sub-functions (except STO). This can cause the system to start up immediately.

Severe or fatal injuries.

- Before activating the "Encoder fault muting" function, the user must take organizational measures for the protection of personnel and machinery.

The "Encoder fault muting" function can be activated by a safe digital input F-DI, by the safe process output data (F-PO) or by starting emergency mode with the keypad. The activated "Encoder fault muting" function is signaled on the LED F-ERR by rapid yellow flashing. The "Encoder fault muting" function has the following effects:

- Opening of the internal safe digital output F-DO_STO is suppressed due to the encoder fault response.
- The fault responses of all safety sub-functions are suppressed.
- The *Muting* bit is set in the safe process input data.
- The *Fault status* bit is set in the safe process input data.
- The safe process data bit *F-PI-ErrorState* remains set.
- The fault code continues to be displayed.
- Activation of the STO safety sub-function is still possible without restriction. All other safety sub-functions have no effect.

The "Encoder fault muting" function is automatically terminated in the following cases:

- Another fault (e.g. input fault) is present or has been detected.
- A fault is acknowledged.

- 1 to 60 minutes after activation via F-DI or F-PO. This time period is adjusted via the *Maximum muting time* parameter.
- 5 minutes after activation via emergency mode.

If the "Encoder fault muting" function has been automatically deactivated, all sources must first cancel activation before another activation.

Each ending of the "Encoder fault muting" function activates the start inhibit.

Muting safe process output data (muting F-PO)



⚠ WARNING

The active "Muting F-PO" function deactivates the safety sub-functions. This can cause the system to start up immediately.

Severe or fatal injuries.

- Before activating the "Muting F-PO" function, the user must take organizational measures for the protection of personnel and machinery.

The "Muting safe process output data" function is activated by a 0 → 1 edge at a safe digital input F-DI or by starting the emergency mode using the keypad. The activated "Muting F-PO" function is signaled on the LED F-ERR by rapid yellow flashing. The "Muting F-PO" function has the following effects:

- Opening the internal safe digital output F-DO_STO is suppressed due to the substitute values of the F-PO data.
- The fault responses of all safety sub-functions are suppressed.
- Activating the STO safety sub-function is still possible without any restrictions using a safe digital input F-DI.

The "Muting F-PO" function is automatically terminated in the following cases:

- Another fault (e.g. input fault) is present or has been detected.
- A fault is acknowledged.
- 1 to 60 minutes after activation via F-DI or the keypad. This time period is adjusted via the *Maximum muting time* parameter.
- 5 minutes after activation via emergency mode.
- Connection to the keypad is interrupted if the "Muting F-PO" function was activated using the keypad.

After automatic deactivation of the "Muting F-PO" function, all sources must revoke their activation prior to a new activation of the function.

Every time the "Muting F-PO" function finishes, the start inhibit is activated.

EDM muting

The "EDM muting" function is activated by starting the emergency mode with the keypad. The activated "EDM muting" function is signaled on the LED F-ERR by rapid yellow flashing. The "EDM muting" function has the following effects:

- The activation of the EDM fault response is suppressed. This means that opening the internal safe digital output F-DO_STO is suppressed.
- The fault responses of all safety sub-functions are suppressed.

The "EDM muting" function is automatically terminated in the following cases:

- Another fault is present or has been detected.
- A fault is acknowledged.

31972098/EN – 8/2024

- 1 to 60 minutes after activation via the keypad. This time period is adjusted via the *Maximum muting time* parameter.
- 5 minutes after activation via emergency mode.
- Connection to the keypad is interrupted if the "EDM muting" function was activated using the keypad.

After automatic deactivation of the "EDM muting" function, all sources must revoke their activation prior to a new activation of the function.

Every time the "EDM muting" function finishes, the start inhibit is activated.

Test mode

The limit value violation of the safety sub-functions SS1, SS2, and SOS can be tested when test mode is active.

The test mode suppresses the basic device control (FCB selection).

The test mode is activated by a rising edge (0 → 1) at a safe digital input or via the safe process output data (F-PO).

The status of the test mode is signaled by the safe process data (process data bit: Test mode active), in the "Assist CS.." parameterization tool and via the LED display.

The test mode is automatically exited in the following cases:

- During parameterization of the safety option.
- By opening the internal safe digital output F-DO_STO (e.g. fault response, limit violation, activation of STO safety sub-function).
- 5 minutes after activation.

Once it automatically finishes, the test mode can be activated again with a rising edge.

SCA safety sub-function with MOVISAFE® CSA31A

The SCA safety sub-function provides a safe output signal on the safe process data to indicate whether the position is within the specified position range.

To activate automatic SLS monitoring within the position range, one of the 4 SLS instances can be assigned to each instance of the SCA function. The SLS instance used must be parameterized for this purpose. The *Position hysteresis* parameter prevents unintentional switching of the SCA status bits should the drive stop at the start or end position of a positioning range. The MOVISAFE® CSA31A safety option does not change the SCA status bit until after the position hysteresis. The position hysteresis takes effect when entering the position range and the status of the SCA function is shifted by the position hysteresis. The position hysteresis takes effect when leaving the position range only after a direction reversal. The distance between the upper and lower cam positions must be greater than twice the value of the *Position hysteresis (8707.20)* parameter.

The threshold positions must be within the limits of the position mode.

Activation

Number of instances: 16

If no safety protocol has been selected for safe communication, the SCA function is active permanently.

If a safety protocol is selected (e.g. PROFIsafe), all SCA instances can be enabled with the bit "SCA = 0".

Status

The status of the SCA safety sub-function is displayed in the following areas:

- Diagnostics > MOVISAFE® CS..A, position function status
- Safe process input data (SCA1, SCA2, SCA3, SCA4) in the "Technology" and "System" profile variants.
- Safe process input data process value 1 (SCA status) in the "System" profile variant.

The status of the safety sub-function has the value "1" in the following cases:

- The safety sub-function has been activated
- The encoder system is referenced and error-free
- The absolute position is within the parameterized range

In all other cases, the status has the value "0".

SLP safety sub-function with MOVISAFE® CSA31A

The SLP safety sub-function can be used to implement safe, absolute position functions. The SLP function monitors whether the defined limit positions are exceeded. The defined limit positions are monitored based on the settings of the following parameters:

- Lower limit position s_1
- Upper limit position s_2
- Deceleration a
- Ramp monitoring

The threshold positions must be within the limits of the position mode. The calculation of the stopping distance is made only above the minimum speed.

Limitation

INFORMATION

If the MOVISAFE® CSA31A safety option evaluates 3 encoders and the Safety over EtherCAT® safety protocol has been selected, a total of 3 instances of the SLP and SLI safety sub-function are available.

Activation

Number of instances: 2

The SLP safety sub-function can be activated via the following sources:

- F-DI (function assignment)
- Safe process output data (SLP1, SLP2)

Status

The status of the SLP function is active if the SLP safety sub-function is activated and the encoder system is referenced and fault-free. If a movement beyond one of the two parameterized limit positions is detected, the status of the SLP safety sub-function is deactivated.

31972098/EN – 8/2024

The status of the SLP safety sub-function is displayed in the following areas:

- Diagnostics > MOVISAFE® CS..A, position function status
- Safe process input data (SLP1, SLP2)

Fault response during limit value violation

- If the SLP limit position including the stopping distance is exceeded, the STO safety sub-function is activated without a brake application time as a fault response.
- If an SLP limit position is exceeded, the STO safety sub-function is selected, which means that the drive can no longer deliver torque. A gravity-loaded axis will crash without further action.
- When an SLP limit position is exceeded, all safe outputs parameterized to SBC are additionally disabled. Brakes connected to these outputs will be applied. A gravity-loaded axis can sag during the brake application time.
- Without ramp monitoring, the SLP function does not select the STO safety sub-function until the position limit is exceeded. Since the braking system still requires brake application time before deceleration starts, a sufficiently large safety area must still be provided beyond the position limits.
- With ramp monitoring, the SLP function selects the STO safety sub-function before the position limit is exceeded. For the system to come to a stop before the position limit, the braking system must result in a higher deceleration than with monitored deceleration. The resulting brake application time must be taken into account.
- In the event of a fault (all faults of the system, inputs, sensors), the STO safety sub-function is activated. If a gravity-loaded axis is at an SLP limit position without the brake applied, the gravity-loaded axis will sag for the brake application time and exceed the SLP limit position.

EDM safety sub-function with MOVISAFE® CS..A

The EDM (External Device Monitoring) safety sub-function diagnoses the connection of the external, safe digital outputs F-DO.. The EDM function uses one or several safe digital inputs F-DI.. to monitor external switching elements connected to a safe digital output. To that end, the auxiliary contacts of the external switching element are connected to the safe digital inputs F-DI.. of the CS..A safety option.

The EDM function permanently compares the logical output signal of the safe digital output F-DO.. with the logical input signals of the assigned safe digital inputs F-DI.

If the expected logical signals are not detected once the monitoring time has lapsed, the configured fault response is triggered and the affected safe digital output F-DO.. is disabled. If the F-DO.. has the "closed" switching state and there is voltage present, the *Operating time T_1 (8705.32)* is used as the monitoring time. If the F-DO.. has the "open" switching state and there is no voltage present on the F-DO.., the *Fall time T_2 (8705.33)* is used as the monitoring time. The *Operating time T_1 (8705.32)* and *Fall time T_2 (8705.33)* monitoring times must be greater than the input filter time. Furthermore, the discrepancy time in the monitoring time must be taken into account for a 2-channel safe digital input. The *Operating time T_1 (8705.32)* and *Fall time T_2 (8705.33)* monitoring times should be configured to the same value. If there is an applicative need for different values, the signal can change again upon expiry of a longer period of time.

31972098/EN – 8/2024

The monitoring time begins again every time that the logical F-DO signal is switched. If the auxiliary contact's signal bounces, the bouncing must be filtered out via the *Input filter time (8704.2)* of the F-DI.. If the F-DO.. is consistently controlled and after the monitoring time has lapsed, a level change in the input signal must trigger the execution of the error response.

One EDM instance can be enabled for each safe digital output F-DO..:

- EDM 1 on F-DO00
- EDM 2 on F-DO01

Each EDM instance can be assigned 1 or 2 F-DI.. The F-DI.. must not be parameterized interlocking. The auxiliary contacts of the external switching element can be designed as an NO contact or typically as an NC contact. The user is responsible for ensuring its safety-related suitability.

The following tables show all the error-free combinations of the input and output signals.

- 1 auxiliary contact of type NO contact

F-DO..	F-DI..
0	0
1	1

- 1 auxiliary contact of type NC contact

F-DO..	F-DI..
0	1
1	0

- 2 auxiliary contacts of type NO contact

F-DO..	F-DI0	F-DI1
0	0	0
1	1	1

- 2 auxiliary contacts of type NC contact

F-DO..	F-DI0	F-DI1
0	1	1
1	0	0

Activation

Number of instances: 2

The EDM instance is permanently activated with the enable.

Status

The status of the EDM safety sub-function is "1" if the function is enabled and the fault response is not executed. The status of all EDM instances is transferred to the safe process output data. The EDM status bit has the value "1" if the status of all enabled EDM functions is "1".

The status of the EDM safety sub-function is "0" if the EDM instance is not enabled or a fault response is executed.

31972098/EN – 8/2024

Fault response

If the expected logical signals are not detected once the monitoring time has lapsed, the configured fault response is carried out:

- STO
- SSx1
- SSx2
- Only F-PI

  The fault response "F-PI" can only be carried out if a safe protocol has been selected.

In addition to the configured fault response, the EDM output is switched off.

The fault response is also carried out if a fault is detected on one of the inputs assigned to the EDM function.

The fault response is carried out until an acknowledgment is made.

Safe referencing

Introduction



⚠ WARNING

If the reference position or the position of the reference cam is incorrectly configured and in case of direct referencing, the safety sub-functions that use the absolute position can fail.

Severe or fatal injuries.

- Ensure that the absolute position matches the system position after the referencing.

By referencing an encoder, the zero point of the user absolute position can be defined in a way that it can be linked with machine zero.

Once all of the encoders that are involved in the process value calculation have been safely referenced, the "absolute position" process value, which affects the SLP, SCA, and safe position (SP) safety sub-functions, can be created.

The referencing data set is on the safety key. It is used to create the location reference for the referencing via the safety key. As a safeguard, the referencing data set is also in the non-volatile memory of the safety option.

In the following cases, the referencing of encoders is reset with purely incremental evaluation:

- In case of a system error
- When restoring or downloading the parameterization



INFORMATION

If the encoder system has been reconfigured and one of the encoders involved in the position formation has been changed, then this encoder must be referenced again. This is also the case if the safety option continues to report "referenced".

For safe referencing, 3 referencing types are available for encoders:

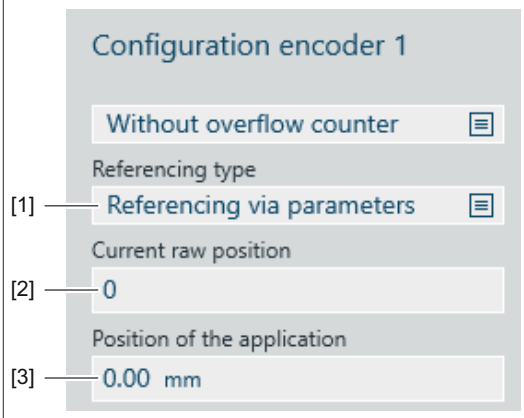
- Referencing via parameters
- Direct referencing
- Reference travel to cams

The position must be within the position limits after referencing.

Referencing via parameters

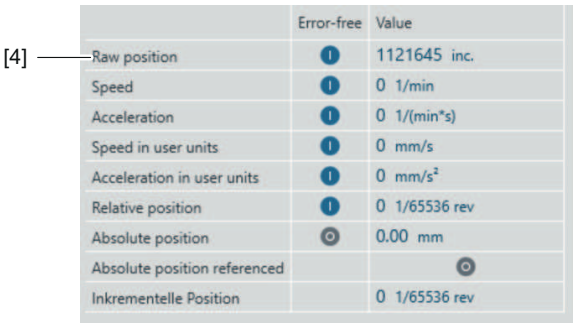
When referencing via parameters, the current raw position [2] and the reference position (current position of the application) [3] are entered. The safety option calculates the offset from these values. In MOVISUITE®, you can read out the current raw position [4] under [Diagnostics] > [MOVISAFE® CS..] > [Encoder evaluation] and enter it in the "Assist CS.." parameterization tool [2]. The current raw position can be read only after the safety option is aware of the encoders that are being used. To do so, the parameterization (encoder evaluation) must be loaded into the safety option.

Assist CS..



32401327883

MOVISUITE®



32401332747

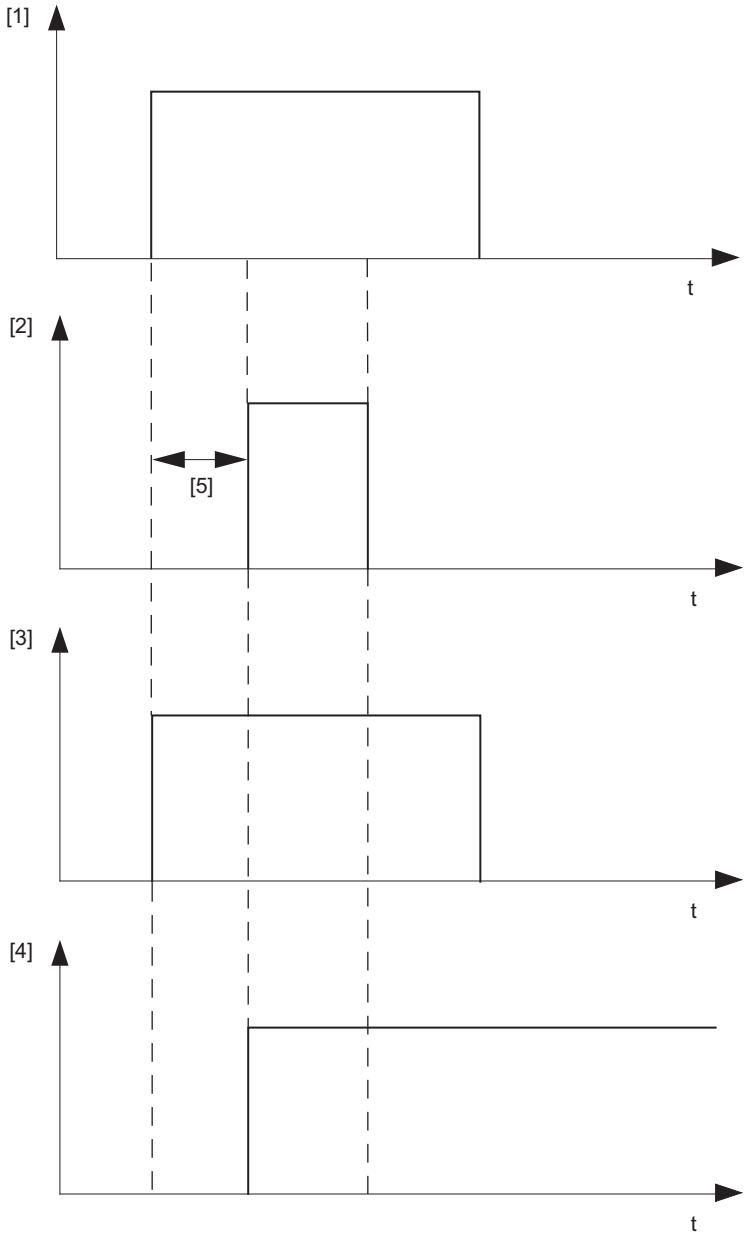
[1]	*Referencing type* parameter: "Referencing via parameters" setting
[2]	Input value of the current raw position of the encoder
[3]	Current position of the application (= reference position)
[4]	MOVISUITE® diagnostic value of the current raw position

INFORMATION

If the reference position is changed or after a rotary absolute encoder has been replaced, the checksum changes and a new validation is required.

The *ParCRCBus* also changes. This requires a change in the safety control system.

Direct referencing



47841287691

[1] Selection and activation via the "Direct referencing" bit
[2] Execution of the "Direct referencing" bit
[3] "Referencing active" bit
[4] "Referenced" bit is active
[5] Min. 10 ms; max. 60 s

With direct referencing, the reference position is entered in the "Assist CS.." parameterization tool. The offset is calculated when activating (0 → 1 edge) direct referencing.

During referencing, the drive must be in an idle state and the position must not move by more than the parameterized positional tolerance (basic settings) for 500 ms.

31972098/EN – 8/2024

The direct referencing function can be activated by the following sources:

- F-DI (function assignment)
- Safe process output data (referencing)

Direct referencing via the safe process data is selected on the "Activate direct referencing" bit via high level. In case of an error-free selection, the status (Index 8700.103 Bit 10) and the "Referencing active" bit have a high level in the safe process input data. With a rising edge, direct referencing is executed on the "Direct referencing execution" bit of the safe process output data. After the selection of direct referencing, 60 seconds remain for execution. Afterwards, a warning message appears and a direct referencing must be selected again.

If a safe digital input (F-DI) has been assigned, the bits of the safe process output data (F-PO) are not evaluated.

No referencing data is saved on the safety option if direct referencing is interrupted. All the encoders that are to be referenced via direct referencing are subsequently not referenced. The "Referenced" bit is logically "0" afterwards.

Reference travel to cams

When referencing to cams, the offset is reset when a reference switch is passed. The cam can be connected via safe digital inputs or provided as a bit in the process output data of the CSA31A.

Reference travel must be enabled via a safe digital input or via the safe process output data. The use of a safe digital input has priority over the bit via the process output data, i.e. if the "Reference travel" function is assigned to at least one safe digital input, no referencing to the bit of the process output data takes place. Activation is performed using a logical "1" on the F-DI or on the set bit in the safe process data. If 2 cams or a redundant reference switch are used, 2 safe digital inputs must be parameterized as single-channel and the "Reference cam" function must be assigned to both. Using non-equivalent switching reference switches is not permitted. The reference switches are to be designed as NC contacts.

In the case of redundantly designed reference switches, two separate switches must be used. A two-channel switch cannot be used as 2 reference cams. Furthermore, it must be ensured that there is no crossfault in the cabling of the two F-DIs, or both switches must be connected to different F-SSx sensor supply lines.

The following parameters are relevant for reference travel:

- Reference offset
- Maximum speed
- Cam source
- Maximum tolerance with 2 cams
- Direction of movement

Safe reference travel is to be started from the non-safe area. At the start or during movement, reference travel must be activated via the "Reference travel" bit or via the safe digital input with "Reference travel" function assignment.

During reference travel, the reference cam must be intentionally passed with the parameterized direction of movement. The parameterized maximum speed must not be exceeded. When leaving the reference cam in the parameterized direction of movement, a rising edge is detected, which performs the referencing and sets the bit "Referenced".

31972098/EN – 8/2024

If the reference cam is passed over against the parameterized direction of movement, the reference travel is terminated with an error. Especially with 2 reference cams, it must be ensured that leaving the reference cam changes the direction of movement after both cams provide a low signal.

For encoder 1, encoder 2 or encoder 3, the position is set to the reference offset for which the reference travel type "decoupled reference travel" is parameterized.

No referencing data is saved if the reference travel is interrupted. All the encoders that are to be referenced via reference travel are not referenced afterwards. The "F-PI_Referenced" signal is afterwards logically "0".

Accuracy

- When using reference cams at safe digital inputs, the accuracy of the position is limited to the following value:

  Input filter time (8704.2) + 6.35 ms × *maximum reference travel speed (8707.56)* + specific encoder accuracy
- When using F-PO cams, the accuracy of the position is limited to the following value:

  3 ms × *maximum reference travel speed (8707.56)* + specific encoder accuracy

Minimum cam length

- If a mechanical cam is passed, the length of a cam must be greater than the following minimum value:

  Input filter time processing (8704.02) + 6.35 ms × maximum reference travel speed (8707.56) + specific encoder accuracy + 2 × *position hysteresis (8707.20)*
- If a direction of rotation reversal takes place on the cam, the cam must be traveled at least the following distance:

  Minimum value consisting of: (0.5 × *input filter time (8704.2) + 6.35 ms × maximum reference travel speed (8707.56)* + specific encoder accuracy) + *position hysteresis (8707.20)*
- When using the "F-PO_Reference cam" signal, the signal must be active in at least one F-PO telegram.

"Slip adjustment" function

The "Slip adjustment" function is integrated only in MOVISAFE® CSA31A. The "Slip adjustment" function is used for the automatic adjustment of an incremental position measuring system that is prone to slip. This system is part of a safety-related setup with a second absolute position measuring system. A guided rail vehicle, driven by wheel-rail coupling (friction contact, prone to slip) and positioned using a slip-free position measuring system, is used as an example.

Position measuring will inevitably diverge because the position measurement system mounted on the driving motor (incremental) and the second absolute position measuring system that is slip-free are evaluated at the same time. The "Slip adjustment" function corrects this slip by setting the incremental value to the actual physical position at certain positions. One cam (e.g. switch lug) is required per defined adjustment position for this purpose. The hardware position switch (NC contact) is read-in at the safe digital input F-DI of the CSA31A safety card and the "Slip adjustment – cam" function is assigned to the safe digital input F-DI in the function assignment. Only single-channel sensors are permitted.

31972098/EN – 8/2024

By passing over the cam, the "Slip adjustment" function evaluates the current position value at the falling edge in conjunction with the corresponding entry in a position table. If the current position value is within the specified tolerance range to a corresponding cam position and the current speed is less than the parameterized maximum speed, the encoder system with slip is adjusted with the rising edge. For this purpose, the current position value is overwritten with the second position value.

To use the "Slip adjustment" function, the cam positions must be parameterized in the "Assist CS..." parameterization tool. You have to enter 2 position values for each switch position to be adjusted.

The encoder system must be referenced. If an edge is identified on a position that is outside of the parameterized tolerance, the slip adjustment function triggers the "Slip adjustment" fault response. If the "Slip adjustment" fault response is triggered, the "Referenced" bit is set to "0" and the encoder system must be referenced again.

Notes

- For process value calculation, the slip-affected encoder 1 must be set to "Comparison value" and the slip-free encoder 2 to "Process value".
- Slip is only adjusted when the parameterized position is approached below the configured maximum speed. If the position is approached at a speed above the speed threshold, no slip adjustment takes place.
- For each switch position to be adjusted, 2 positions (left and right position) must be parameterized. The values must be checked by an appropriate method in relation to the actual values of the real system.
- At least one cam (e.g. switch lug) is necessary for active encoder adjustment. If the cam is passed over in one direction of movement, no direction of rotation reversal must take place on the cam. The slip is adjusted at the falling edge. The distance since the last slip adjustment must not be longer than the maximum distance after the last slip adjustment.
- The distance between 2 cams must be ten times greater than the maximum encoder tolerance position.
- The distance between 2 cams must be ten times greater than the cam length. The lower cam position must be smaller than the upper cam position.
- To generate the "Cam slip adjustment" state of the safe process data bit in the safety controller, physically existing cams must be used. It is not permitted to calculate the status of the "Cam slip adjustment" process data bit from the process values of the CSA31A safety option alone, e.g. the safe position. If a F-DI is set to "Slip adjustment cam", the process data bit is not used.
- The upper and lower cam positions that have been stored in the configuration must be checked to ensure they are at a proper position on the machine during the acceptance procedure.

Minimum cam length

The minimum cam length results from the signal processing duration t_{Sig} and the maximum speed at which the cam is passed.

The signal processing time is calculated as follows:

$$t_{Sig} = \text{Filter F_DI} + 6\ \text{ms}$$

t_{Sig}	=	Signal processing duration	$[t_{Sig}] = s$
Filter F_DI	=	Input filter time parameter (8704.2)	[Filter F_DI] = s

31972098/EN – 8/2024

The minimum cam length is calculated as follows:

$$l_{N_min} = 2 \times t_{Sig} \times v_{N_max}$$

l_{N_min}	=	Minimum cam length	$[l_{N_min}]$ = mm
t_{Sig}	=	Signal processing duration	$[t_{Sig}]$ = s
v_{N_max}	=	Maximum speed at which the cam is passed	$[v_{N_max}]$ = mm s^{-1}

This results in a minimum cam length of 62 mm with the default value of the input filter time (8704.2) of 25 ms and a maximum speed of 1000 mm s^{-1}.

INFORMATION

If the position accuracy is greater than half the minimum cam length, the minimum cam length must be increased by twice the position accuracy.

The positional tolerance must be parameterized greater than the position accuracy of encoder 2.

Parameters for the "Slip adjustment" function

- Number of cams: 1 to 10
- Fault response: STO/SSx1/SSx2

  The "SSx1" or "SSx2" error response can be selected only if the corresponding SSx instance is enabled.
- Maximum speed

  Maximum speed at which a slip is still adjusted.
- Positional tolerance

  The positional tolerance indicates the tolerated deviation between the position value of encoder 2 and the set cam position. The positional tolerance must be greater than the position error of encoder 2.
- Left position of cams 1 to 10 (in user units position)
- Right position of cams 1 to 10 (in user units position)
- Maximum distance since last slip adjustment

11.11.7 "Brake test" diagnostics function

INFORMATION

- The brake test cannot be used in combination with the EI7C FS built-in encoder.
- The brake test uses only encoder 1.

Configuring the brake test

Pre-selection for control

The brake test can optionally be called up via a safe signal or in combination with a standard signal and a safe signal.

The desired control is selected in the "Assist CS..." parameterization tool. To do so, call up the *Activation by SBT clearance* parameter in the "Brake test" menu.

You have the following configuration options:

1. *Activation by SBT clearance* = 1

   The brake test starts when the *SBT clearance* safe signal is present. This can optionally be sent via a safe digital input (F-DI..) at the safety option or via a bit in the safe process output data (F-PO) of the F process data.

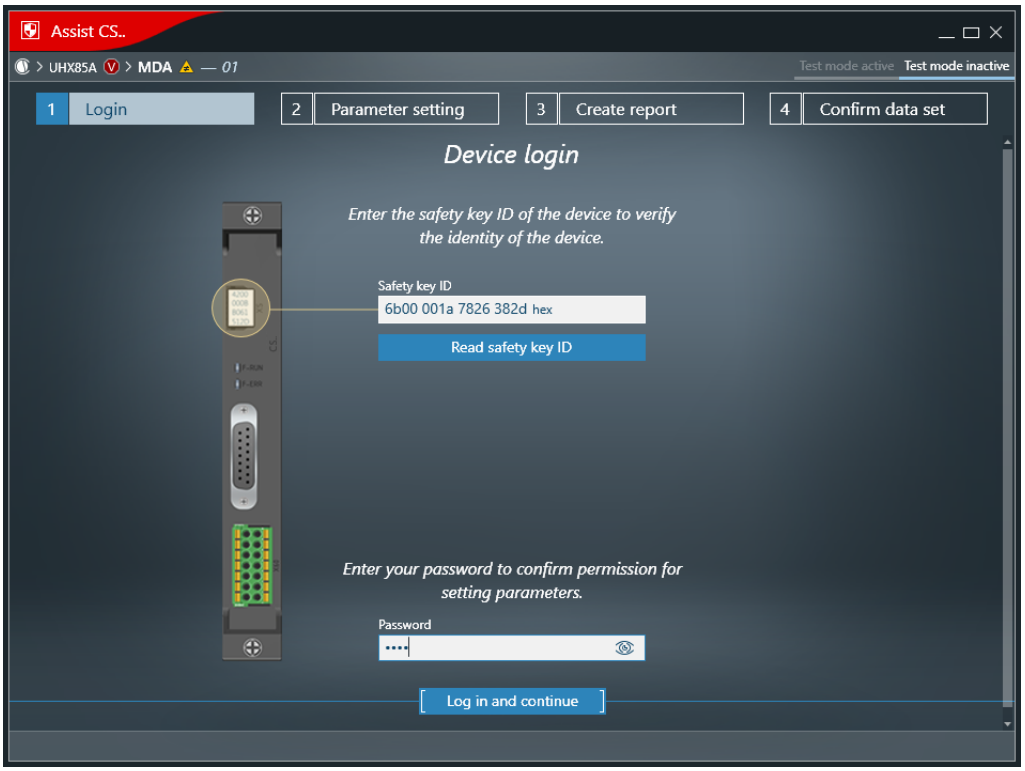
   No additional signal is required to start the brake test.

2. *Activation by SBT clearance* = 0

   The brake test starts when both signals "SBT clearance" and "Activate SBT" are present. The "SBT clearance" signal can optionally be sent via a safe digital input (F-DI..) at the safety option or via a bit in the safe process output data (F-PO) of the F process data.

   The "Activate SBT" signal is also required at the start of the brake test. The "Activate SBT" signal can optionally be emitted via a digital input (DI) at the inverter or via a bit in the process output data (PO) of the communication.

Starting the "Assist CS.." parameterization tool



29144769163

1. Start the "Assist CS.." parameterization tool and log in with your password. Ensure that you are connected to the desired device by entering or reading the safety key ID.
2. Confirm your entries with the [Log in and continue] button. The "Parameter setting" window opens. The processing of the individual menu items is described in the following chapters.

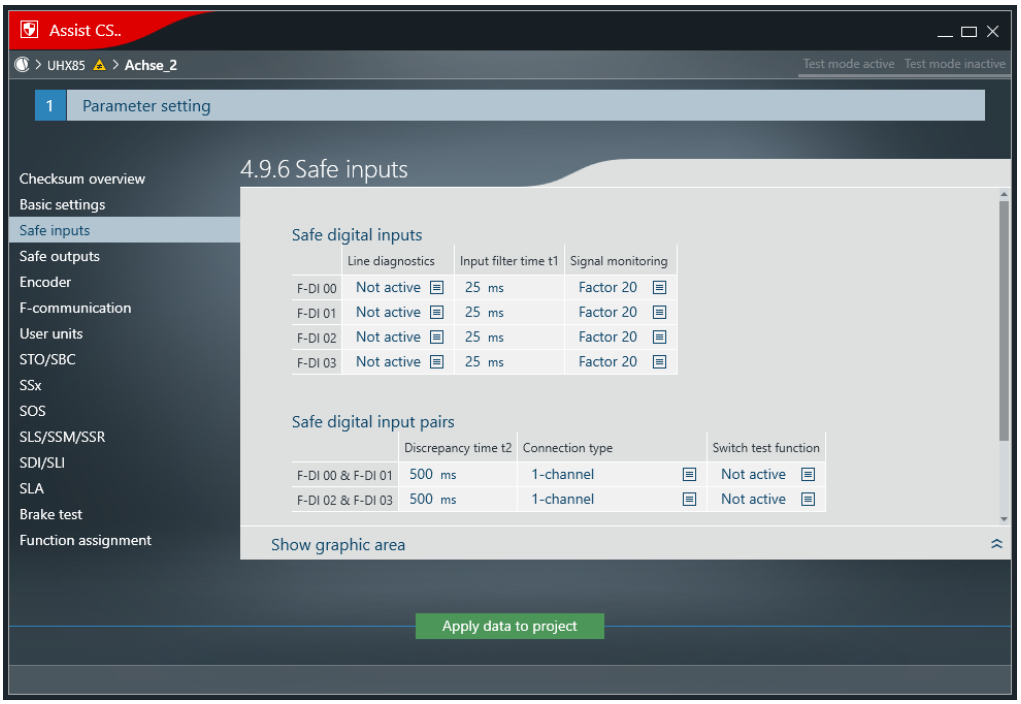
"Checksum overview" menu

The checksums are needed after completing the configuration for accepting the respective functions.

"Basic settings" menu

The menu is not needed to configure the brake test. The system limit settings are not relevant for the brake test.

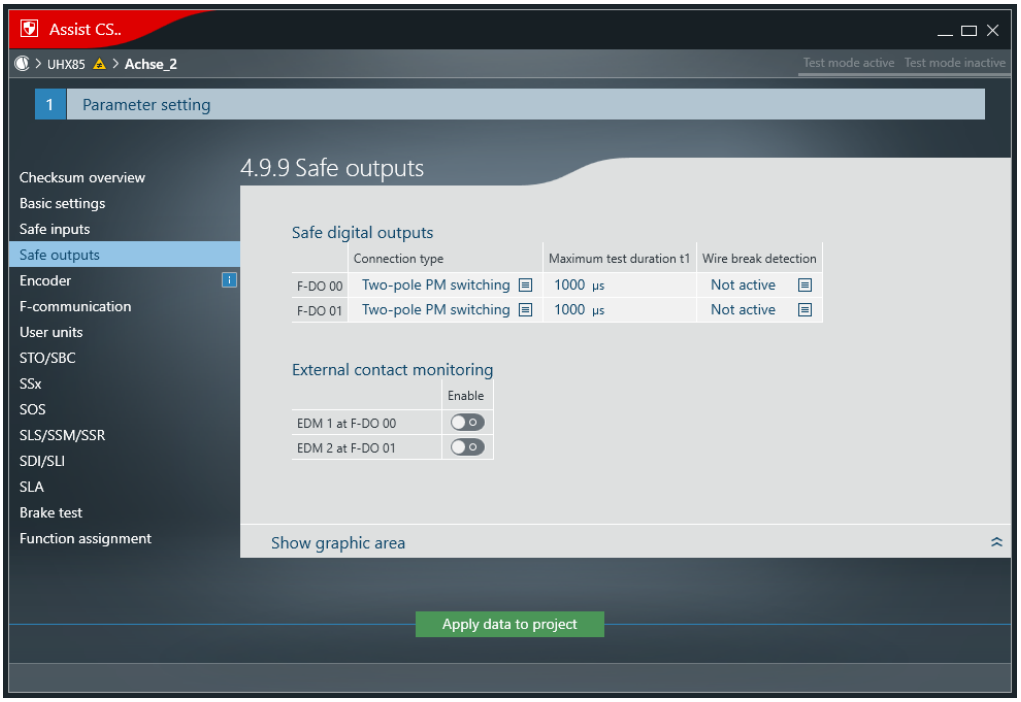
"Safe inputs" menu



9007228399570059

If the brake test is to be started via a safe digital input (F-DI..), select the relevant F-DI.. in accordance with its connection (single/dual channel, etc.).

"Safe outputs" menu



9007228399576843

In order to actuate the brake, assign the "SBC" function to the desired safe digital output (F-DO) during function assignment. Select the connection type for the relevant safe digital output (F-DO) in accordance with its connection (single/dual channel, etc.).

"Encoder" menu (only for CSS..A)

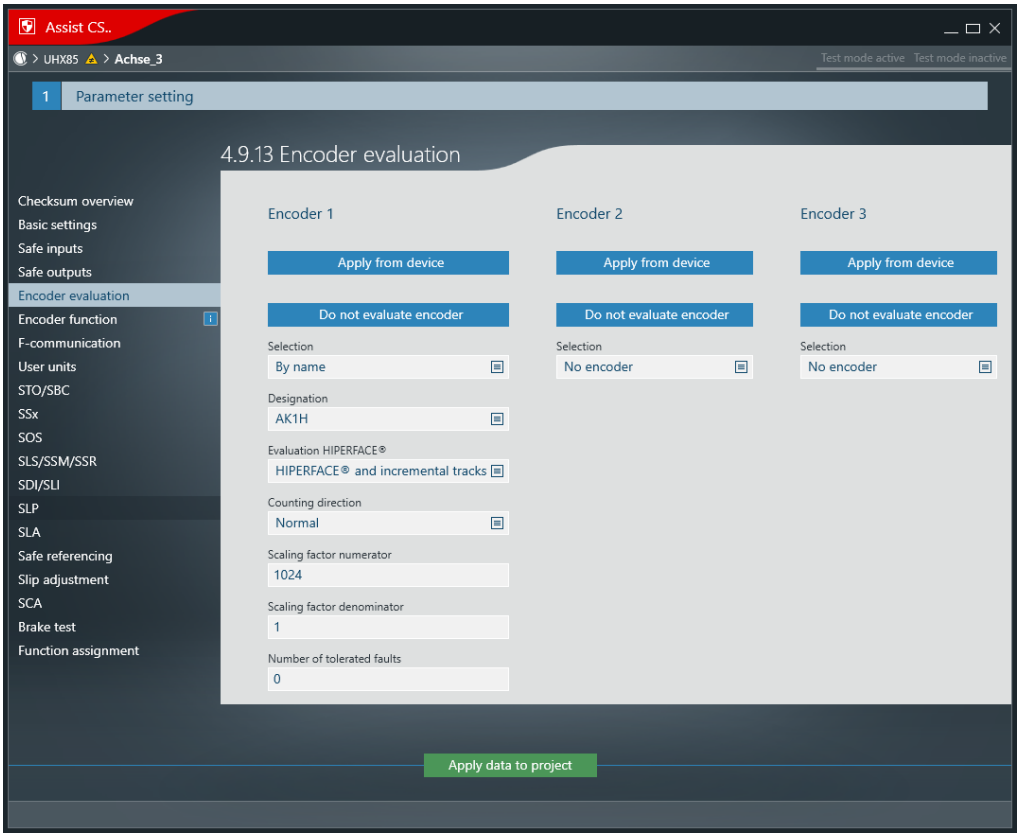


9007228400018827

Select the safety encoder that is used from the "Encoder type" list. Set the counting direction to match the encoder settings in the AS1 drive train.

31972098/EN – 8/2024

"Encoder evaluation" menu (only for CSA31A)

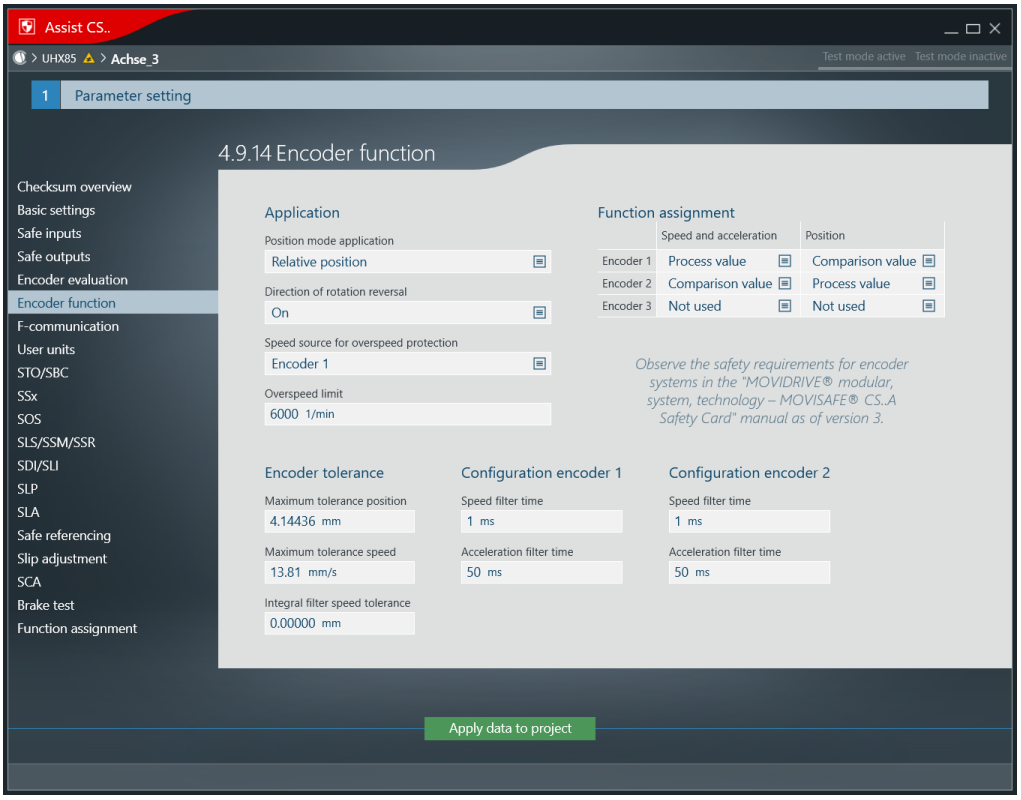


39306075787

The CSA31A uses only encoder 1 for the brake test. Accept the encoder of the basic device with the [Apply from device] button or select the safety encoder used from the "Designation" list. Adjust the other encoder settings (e.g. counting direction).

Encoder 2 and encoder 3 are not compatible with the brake test and are only available for other functions of the safety option.

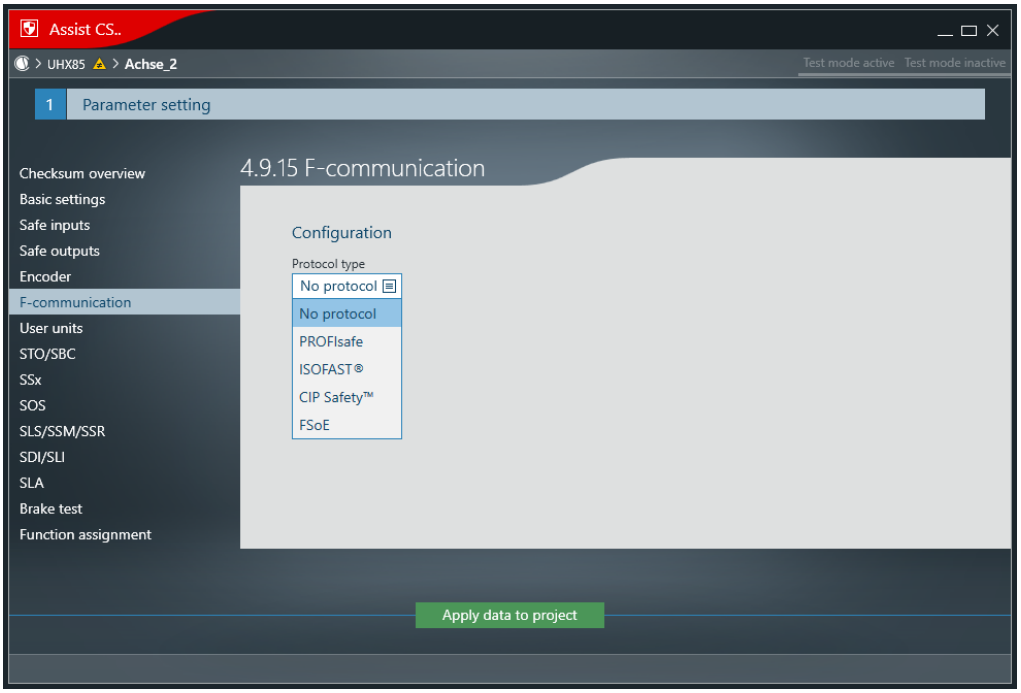
"Encoder function" menu (only for CSA31A)



39306115083

Adjust the other encoder settings (e.g. direction of rotation reversal). The function assignment is only relevant for further safety sub-functions such as SLS and SLP.

"F communication" menu



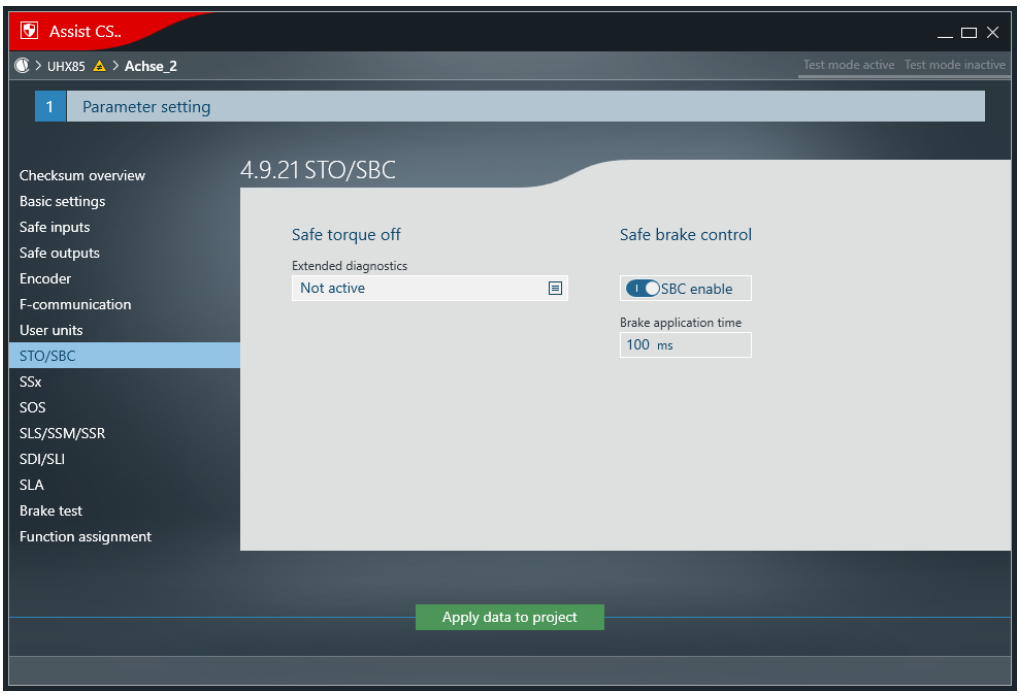
9007228400025611

For operation with safe communication, select the safety protocol being used (e.g. PROFIsafe) from the "Protocol type" list in the "F-communication" menu. For operation without safe communication, select "No protocol".

"User units" menu

The brake test uses the user units that are set in the inverter. For further information, refer to chapter "Project planning for functional safety" > "Brake test diagnostics function".

"STO/SBC" menu



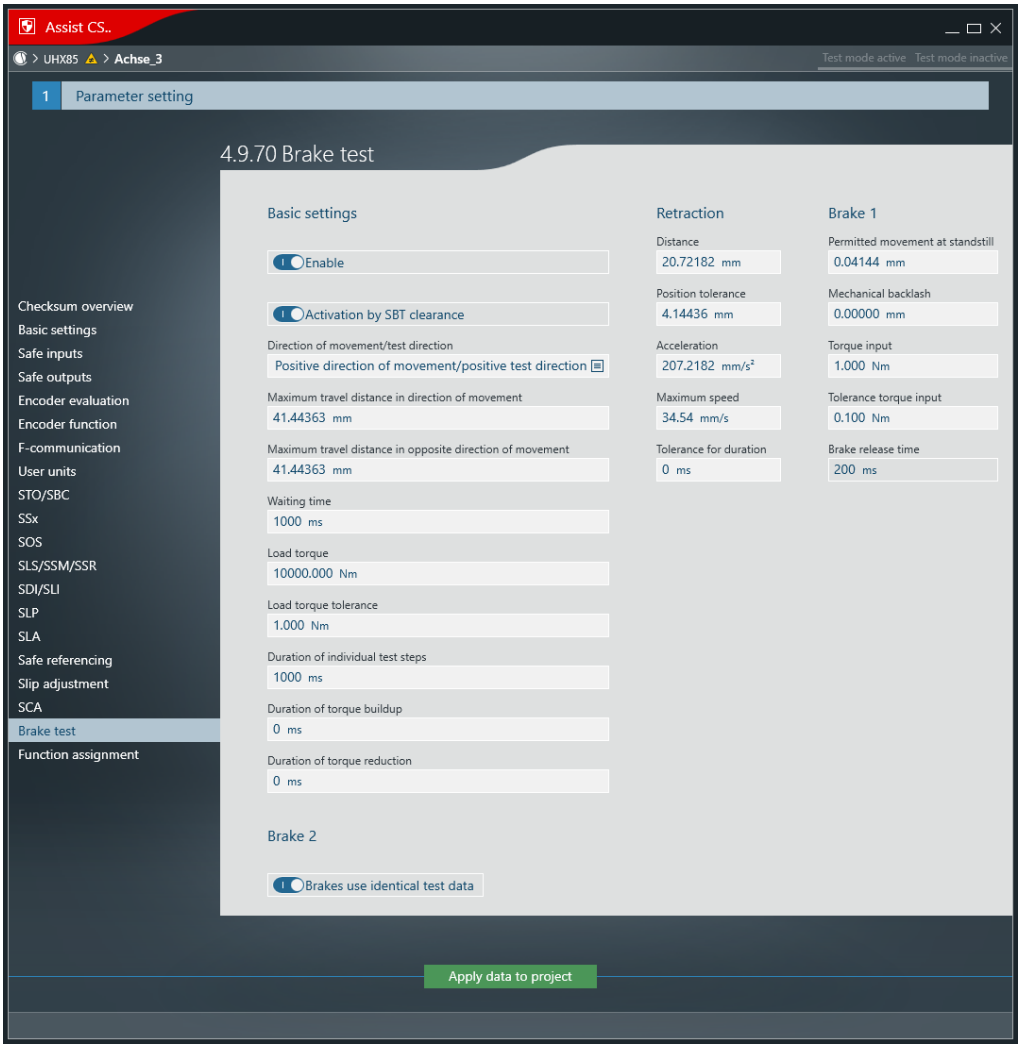
9007228401517963

Safe brake control must be activated to configure the brake test. Set "SBC enable" to "1" for this purpose.

Menus "SSx" to "SCA"

Menus "SSx" to "SCA" are not required to configure the brake test.

"Brake test" menu



9007228401525131

Basic settings

Menu item	Description
Enable	"1": The brake test is enabled on the safety option and can be used.
Activation by SBT clearance	• "1" The brake test starts solely with the "SBT clearance" signal (F-DI.. or F-PO). • "0" Starting the safe brake test requires that both signals be set, "SBT clearance" (F-DI.. or F-PO) and "SBT enable" (DI or PO).

Menu item	Description
Direction of movement / test direction	• Positive direction of movement / positive test direction: – Moving clear in the positive direction of movement takes place in step 1. – The build-up of the motor torque in the positive direction of movement takes place in step 3. • Positive direction of movement / negative test direction: – Moving clear in the positive direction of movement takes place in step 1. – The build-up of the motor torque in the negative direction of movement takes place in step 3. • Negative direction of movement / positive test direction – Moving clear in the negative direction of movement takes place in step 1. – The build-up of the motor torque in the positive direction of movement takes place in step 3. • Negative direction of movement / negative test direction – Moving clear in the negative direction of movement takes place in step 1. – The build-up of the motor torque in the negative direction of movement takes place in step 3.
Maximum travel distance in direction of movement	• The set value defines a limit value for the maximum travel distance. Up to this limit value, movement is permitted during moving clear. • The set value must be greater than the set *Distance*.
Maximum travel distance in opposite direction of movement	• The set value defines a limit value for the maximum travel distance against the set direction of movement. Up to this limit value, movement is permitted during moving clear. • The set value must be greater than the set *Distance*.
Waiting time	Time for which the drive stops (waits) after a movement or possible movement before the next sub-step starts. The waiting time allows possible vibration/fluctuation in the machine to die away.
Load torque	• Entry of load torque that is present at the drive at the test position. • For machines without load torque, enter a value of "0".
Load torque tolerance	• The set load torque is tested during the test procedure. This parameter defines the permitted deviation of the determined load torque from the parameterized load torque. • Possible load torque fluctuations over the planned service life of the machine such as friction, wear, etc. must be taken into consideration. • The tolerance must not be used to compensate for variable load torques.
Duration of individual test steps	• Duration of individual test steps until next test step, e.g. stopping the proportional motor torque in step 3. • The duration must make it possible to determine the actual torques. SEW-EURODRIVE recommends durations greater than 0.5 s. With a high level of device utilization, the minimum duration can also be greater.

31972098/EN – 8/2024

Menu item	Description
Duration of torque buildup	Time used by the inverter to build up the motor torque according to *Torque input*.
Duration of torque reduction	Time used by the inverter to reduce the motor torque according to *Torque input*.

Moving clear

Menu item	Description
Distance	• In step 1, the machine moves in the required direction of movement with the set section length. Then the machine moves against the required direction of movement with half the section length. • The value must be smaller than the value set for *Maximum travel distance in direction of movement*. • The value must be greater than 20 times the value of *Permitted movement at standstill*. When testing two brakes, the parameter for brake 1 and 2 can be set separately. In this case, the larger value applies. • The *Distance* must be selected in such a way that moving clear takes at least as long as the *Duration of individual test steps*. **Information:** After moving the machine clear in step 1, the position differs from the start position. If the identical start/end position is required in a machine-specific manner, positioning to the desired position must be carried out by the machine control after the brake test is complete.
Position tolerance	Maximum permitted difference between the actual moving clear distance and the setpoint entered for *Distance*.
Acceleration	• Setpoint for accelerating the machine to the set *Maximum speed* while moving clear. • In the case of machines with *Load torque* = *0*, the acceleration of the inverter must be set.
Maximum speed	Maximum permitted speed of machine during moving clear. The actual speed during moving clear varies together with the *Distance*. With long travel sections, the machine moves at the set maximum speed. With short moving clear distances, the actual speed will be less in order to move to the target position correctly.
Tolerance for duration	Maximum permitted deviation of actual moving clear duration in comparison to the calculated duration. The duration that is expected is calculated from the following parameter settings: • *Distance* • *Maximum speed* • *Acceleration* • *Filter times encoder 1*

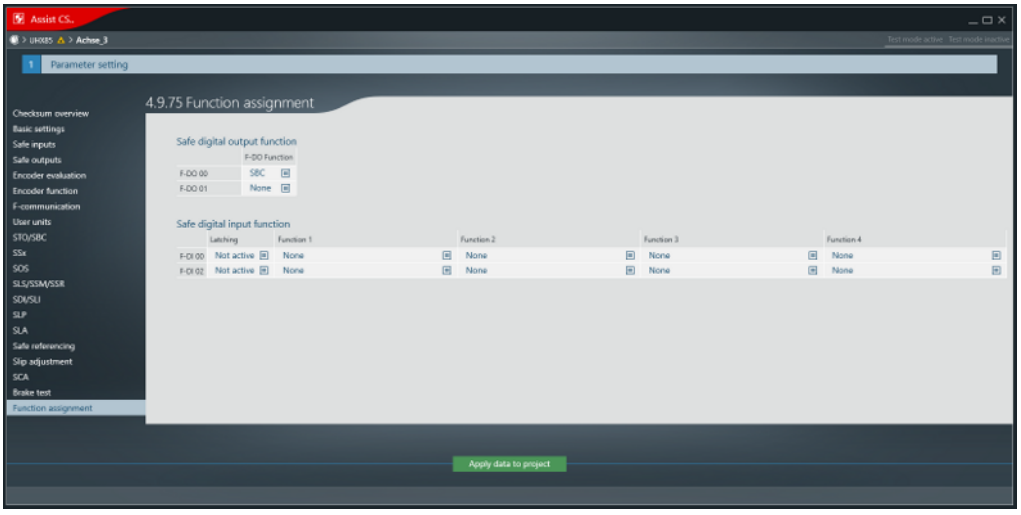
31972098/EN – 8/2024

Brake 1/2

Menu item	Description
Permitted movement at standstill	During the brake test, the position is monitored several times during idle state. The setting value tolerates the maximum movement during idle state. The setting value must not be used to compensate for a mechanical backlash.
Mechanical backlash	Mechanical backlash until the encoder detects movement. Example: Brake 2 is mounted behind the gear unit. A defined movement of the motor is required until the output shaft of the gear unit stops moving and a torque is built up against the applied brake.
Torque input	Setting value for the proportional motor torque which forms the required test torque together with the load torque. The level and direction of an existing load torque must be taken into consideration in the setting value. Examples: • Vertical drive: Base load "pushes" in the direction of movement. – Required test torque: 100 Nm, load torque: +30 Nm – Setting value: 70 Nm • Vertical drive: Base load "pulls" in the direction of movement. – Required test torque: 100 Nm, load torque: -30 Nm – Setting value: 130 Nm • Horizontal drive: No base load present – Required test torque: 100 Nm, load torque: 0 Nm – Setting value: 100 Nm
Tolerance torque input	The set value tolerates a deviation of the actual motor torque in relation to the *Torque input*.
Brake release time	• Brake 1: Duration until brake is released. The value is taken from the AS1 drive train of the inverter and displayed here for information (not adjustable). • Brake 2: Duration until brake is released. The value can be parameterized.
Brake application time (with brake 2)	Brake 2: The value is taken from the AS1 drive train of the inverter and displayed here for information. The value can be parameterized. Changing the value only affects the brake test and has no effect on the settings in the AS1 drive train.
Brakes use identical test data	• "1": The values for the menu items described in the table are used for both brakes. • "0": For brake 2, the values for the menu items described in the table can be entered separately.

31972098/EN – 8/2024

"Function assignment" menu



9007228402824715

The required function is assigned to the safe digital inputs F-DI and the safe digital outputs F-DO in the "Function assignment" menu.

Function assignment of safe digital outputs F-DO..

If a brake is to be tested in the safe brake system, you must select an F-DO.. with the SBC safety sub-function. You can select any F-DO.. you like. Afterwards, the function of the F-DO.. is as follows:

- With functional control, the F-DO.. controls the brake within the device via the inverter (DB00).
- With safe control using the SBC safety sub-function via the MOVISAFE® CS..A safety option, the brake is safely switched off.

If two brakes are to be tested in the safe brake system, both F-DOs must be selected with the "SBC" function. Afterwards, both F-DOs function as follows:

- With functional control, the F-DOs control both brakes simultaneously within the device via the inverter (DB00).
- With safe control using the SBC function via the MOVISAFE® CS..A safety option, both brakes are safely switched off at the same time.
- When the brake test is carried out, both brakes are controlled separately. First, the brake test is carried out with the brake controlled at F-DO00, then the brake test is automatically repeated with the brake controlled at F-DO01.

Menu item	Description
F-DO00	• "None" The output has no function. • "STO" The output switches with activation/deactivation of the STO status. • "SBC" The output takes over the function of the SBC safe brake control and the functional control DB00 from the inverter. The SBT brake test tests the brake that is controlled with this output.

31972098/EN – 8/2024

Menu item	Description
F-DO01	• "None" The output has no function. • "STO" The output switches with activation/deactivation of the STO status. • "SBC" The output takes over the function of the SBC safe brake control and the functional control DB00 from the inverter. The SBT brake test tests the brake that is controlled with this output.

Function assignment of safe digital inputs F-DI..

Menu item	Description
F-DI00 to F-DI03	• "None" The input has no function. • "SBT clearance" Depending on the setting of menu item "Activation by SBT clearance", the signal triggers the enable for carrying out the brake test or for starting the brake test. • Other settable functionality has no bearing on the brake test.

Controlling the brake test

Starting conditions

Pay attention to the following starting conditions **before activating the brake test**.

- The machine must be in a suitable test position that makes a movement possible during the active brake test. The performance of the brake test must not put persons at risk.
- Activate a suitable drive function (e.g. FCB 02) at the inverter, which allows the brake test to be performed.

  The brake test is canceled if a drive function with a priority higher than FCB 23 is activated. You will find the current drive functions in the inverter in chapter "FCB concept". More information about the FCB concept is described in the inverter product manual.
- Pay attention to compatibility with the safety sub-functions. Refer to chapter "Safety sub-functions" for more information.

Starting the brake test

- Start the brake test via safe signal "SBT clearance". In accordance with the parameterization, the brake test starts immediately or must be additionally started using the "SBT enable" signal.

  Drive function FCB 23 is active in the inverter while the safe brake test is being carried out. FCB 23 is exclusively used in combination with the safe brake test. Bit "SBT active" is set to a logical status of "1" in the process data (PI and F-PI).
- If a safe digital output F-DO is parameterized to the SBC safe brake control function, the brake that is controlled by this F-DO is tested. If both F-DOs of the safety option are parameterized to SBC, the brake test is performed twice. The brake at F-DO 00 is tested first. If this test is error-free, the test of the second brake is automatically tested at F-DO 01. Steps 3 – 5 are repeated to test the second brake.

Test result and ending the test

The brake test can be ended with or without an error message.

1. The brake test ends **without an error message**.

   The brake has successfully passed the brake test. Completion of the brake test is indicated by bit "SBT active" being set to logical "0". At the same time, the inverter is set to status "STO". The "STO" bit is set to logical "1". The 7-segment display at the inverter flashes in status "C2".

   Brake test control can be deactivated (signals "SBT clearance" and, if necessary, "SBT enable"). The inverter switches to FCB 02.
2. The brake test ends **with an error message**.

   The brake has not passed the brake test. Completion of the brake test is indicated by bit "SBT active" being set to logical "0". At the same time, the inverter is set to status "STO". The "STO", "Diagnostics ASF" and "Drive safety function diagnostics" bits are set to logical "1". The 7-segment display at the inverter flashes with error message *E-46.50 (Safety option error)*. The safety option signals an error detected by SBT *E-70.xx (Safe brake system)*. The error numbers of positions "xx" provide detailed information about the error that has been detected. A list of error numbers can be found in chapter "Service" > "Fault description for CS..A safety option".

   To acknowledge an error, first deactivate the safe brake test control (signals "SBT clearance" and, if necessary, "SBT enable"). You can then reset the pending error by acknowledging the error at the safety option. After successful acknowledgment, the inverter switches to FCB 02.

11.11.8 Startup of the safety option at the safety protocol

Requirements for safe communication

The user must ensure the IT safety of the safety protocol network according to EN 61508.

INFORMATION

Before making changes to the set safety protocol at the CS..A safety option, you must physically disconnect the connection to the safe control (F-host).

31972098/EN – 8/2024

PROFIsafe safety protocol

INFORMATION

To control failsafe functions and to evaluate the responses from the CS..A safety option via PROFIsafe, the assignment of the individual bits within the safety protocol must be taken into account.

Requirements

- The CS..A safety option supports PROFIsafe versions 2.4 and 2.6.
- The higher-level F-PLC must support the iPar CRC mechanism.
- For a successful startup, you need the "Assist CS.." parameterization tool.
- Additional requirements when using MOVISAFE® CS..A with PROFIsafe via PROFINET fieldbus connection:
  - TIA portal with STEP7 Safety option (for Siemens controllers)
  - Device description file of the MOVI-C® CONTROLLER that is used.

    Download at www.sew-eurodrive.com. Always use the latest device description file (iPar_CRC for default parameterization: D9FEE686).
- It must be ensured that the current version of the device description file is installed so that the safety option can be configured correctly in the device configuration. The safety option must be configured in the device configuration via drag and drop from the hardware catalog into the slot of the SEW-EURODRIVE drive system enabled for it. The following settings must be checked so that fault-free PROFIsafe communication with the safety option can be established:
  - F-Source address (F_Source_Add)
  - F-Destination address (F_Dest_Add)
  - F-Monitoring time (F_WD_Time)
  - F-iParameter CRC (F_iPar_CRC)

INFORMATION

The PROFIsafe addresses must be unique in the existing network structure. Depending on the network structure, the safety option can be configured via the *Address type* parameter to ensure the required uniqueness.

Safety option settings

As well as parameterization of the safety sub-functions, the corresponding safety protocol and the destination addresses must be set during startup.

Setting the safety protocol

The CS..A safety option supports several safety protocols. Select "PROFIsafe" under [F-communication] > [Configuration] in the "Assist CS.." parameterization tool.

Setting the destination address

The destination address must be identical with the address set for the device in the PROFIsafe host. Enter the correct destination address under [F-communication] > [Configuration] > [PROFIsafe]. The destination addresses used must be unique in the fieldbus network.

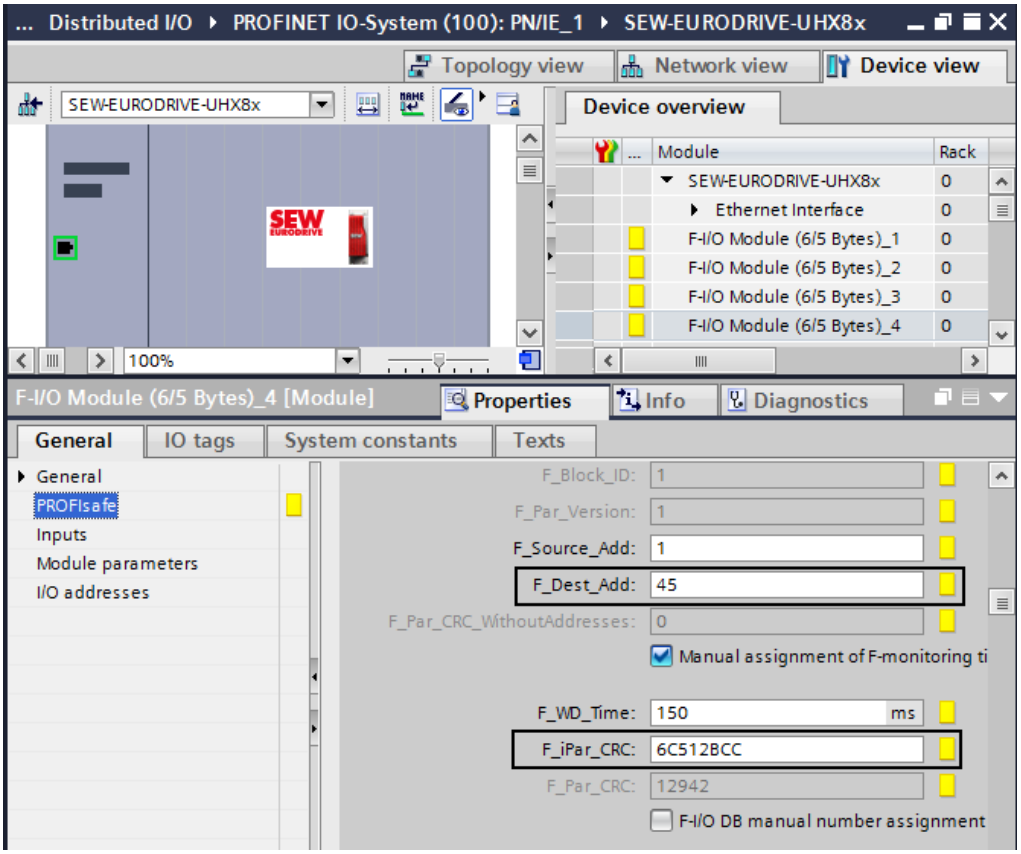
31972098/EN – 8/2024

Setting the address type

Selecting address type 1 or 2 defines whether the PROFIsafe station is assigned exclusively via the destination address or whether the source address is also used.

PROFIsafe host settings

The settings that must be made at the PROFIsafe host are shown in an example for an S71500F in the TIA portal. Transfer the F_iPar_CRC of the report to the PROFIsafe host after successful startup of the CS..A safety option.



28300490891

To enable the safety option in the higher-level controller to issue a diagnostic alarm, the diagnostic alarm must be enabled for the module in the device configuration.

Safety over EtherCAT® safety protocol

Requirements

- For communication via the Safety over EtherCAT® safety protocol, the CS..A safety option must be connected to a safety controller with Safety over EtherCAT® main device functionality.
- Firmware version 2.05 or later is required for the CS..A safety option.
- MOVISUITE® engineering software version 2.10 or later (download from www.sew-eurodrive.com).
- Additional requirements when using MOVISAFE® CS..A with Safety over EtherCAT® fieldbus connection:

31972098/EN – 8/2024

– ESI device description file (EtherCAT® XML/ESI files for MOVI-C® MOVIDRIVE® modular/system/technology, XML/ESI files for MOVI-C® MOVIDRIVE® modular/system CiA402). Download at www.sew-eurodrive.com. Always use the latest device description file.

Safety option settings

As well as parameterization of the safety sub-functions, the corresponding safety protocol and the F-address must be set during startup.

Setting the safety protocol

The CS..A safety option supports several safety protocols. To do so, select "FSoE" under [F-communication] > [Configuration].

Setting the F-address

The F-address must be identical to the address set for the station in the Safety over EtherCAT® main device. Enter the correct F-address under the [F-communication] > [Configuration] > [FSoE] menu item. The used F-addresses must be unique within the Safety over EtherCAT® network.

Setting the ParCRC bus

Transfer the ParCRC bus from the acceptance report of the safety option into the safety controller.

3. F-communication

Line	Property	Value
186	Version	2
187	F-protocol type	FSoE
188	FSoE slave - F-address	45
189	ParCrcBus	0x6c5128cc

28300484491

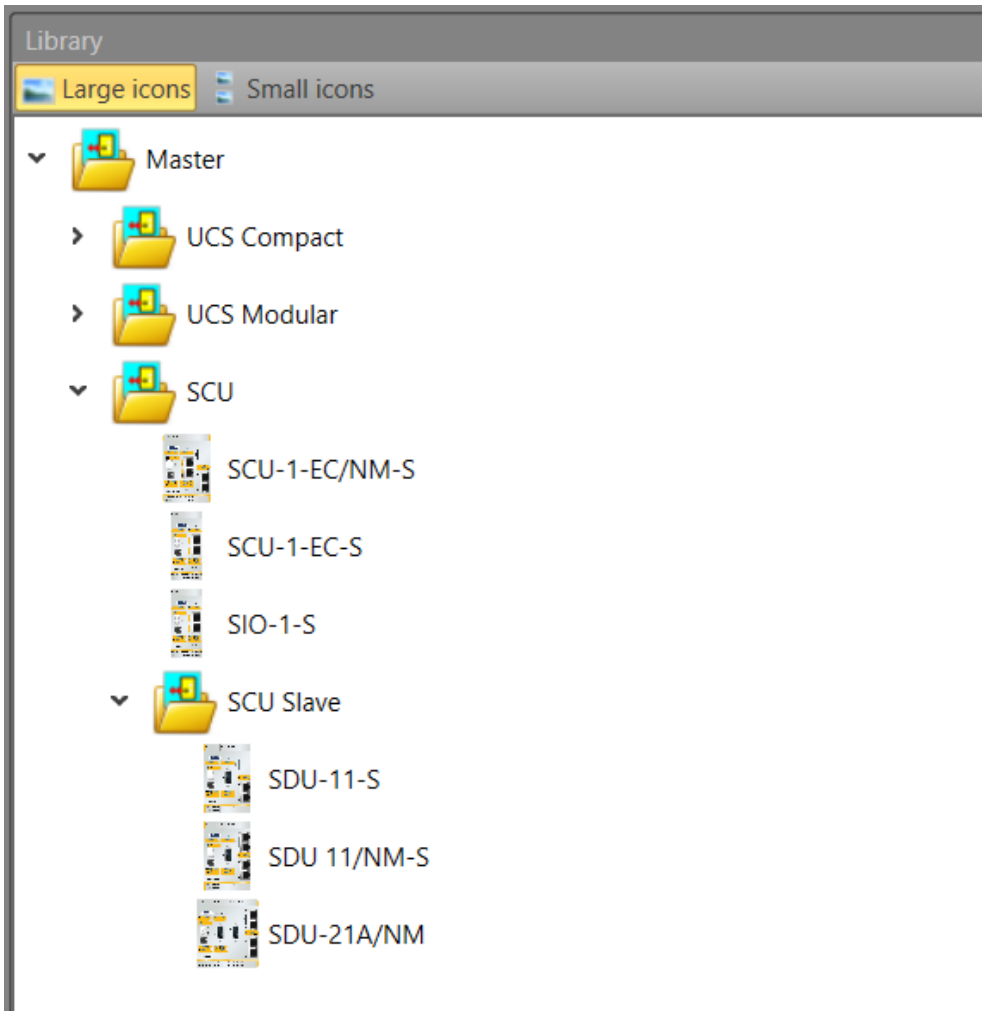
Setting Safety over EtherCAT® main device SCU-1/EC in the SafePLC2 configuration tool

The devices with the MOVISAFE ® CS..A safety options are implemented and available as of version SafePLC2 1.7.1.8081.

Proceed as follows:

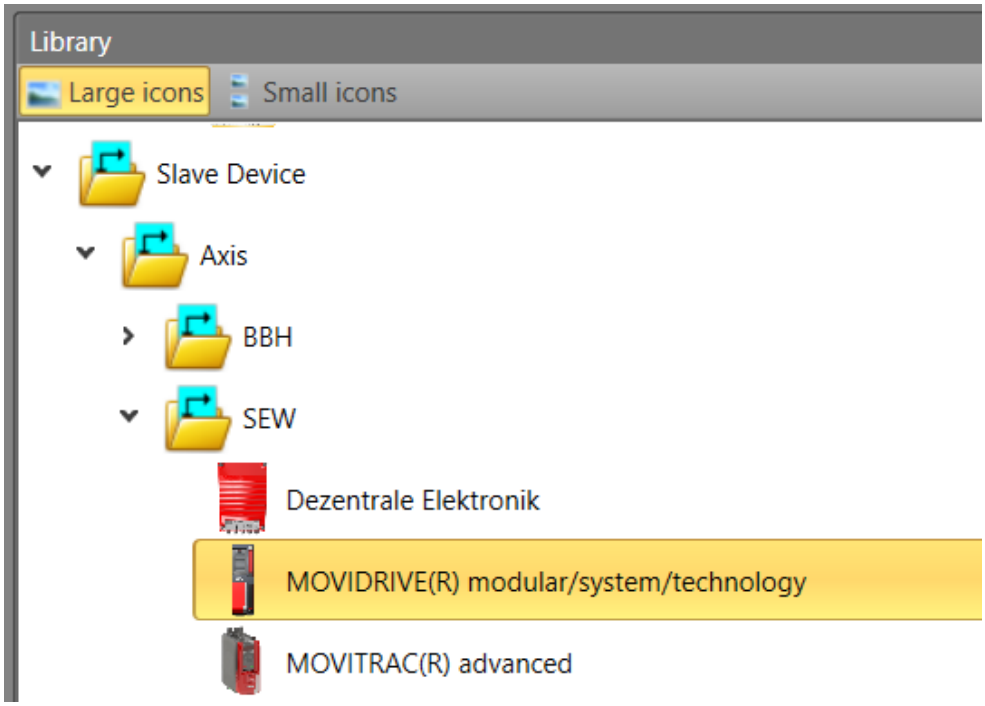
1. Start the SafePLC2 configuration tool.

2. Integrate a corresponding Safety over EtherCAT® main device into the project.

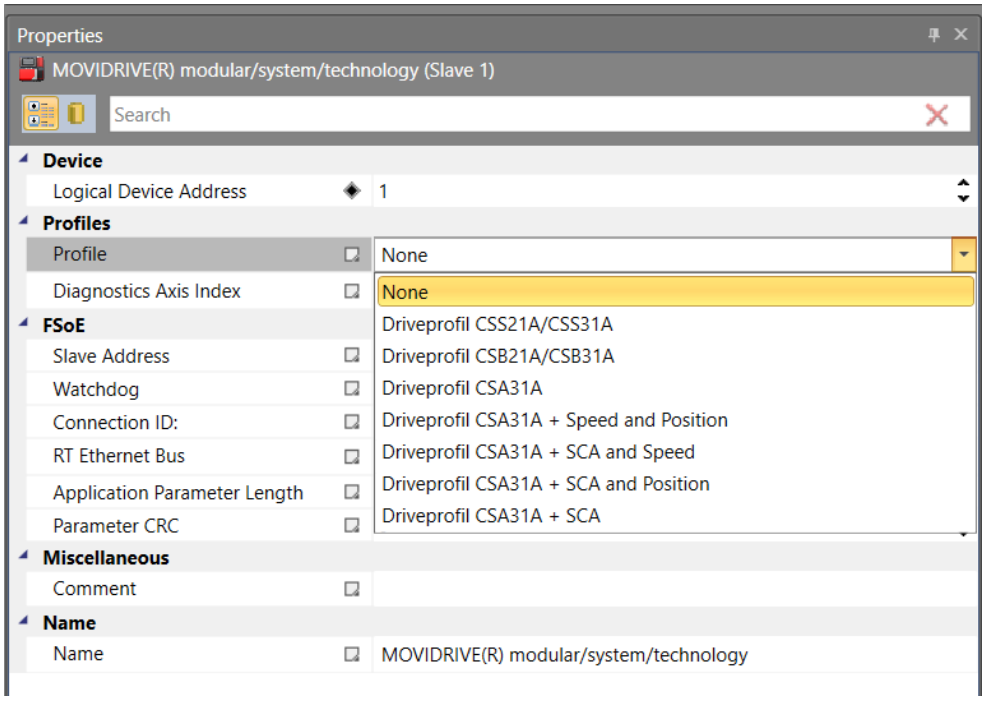


31972098/EN – 8/2024

3. The devices are available in the library under [Slaves] > [Axis]. Add a device into the project according to the wiring diagram.

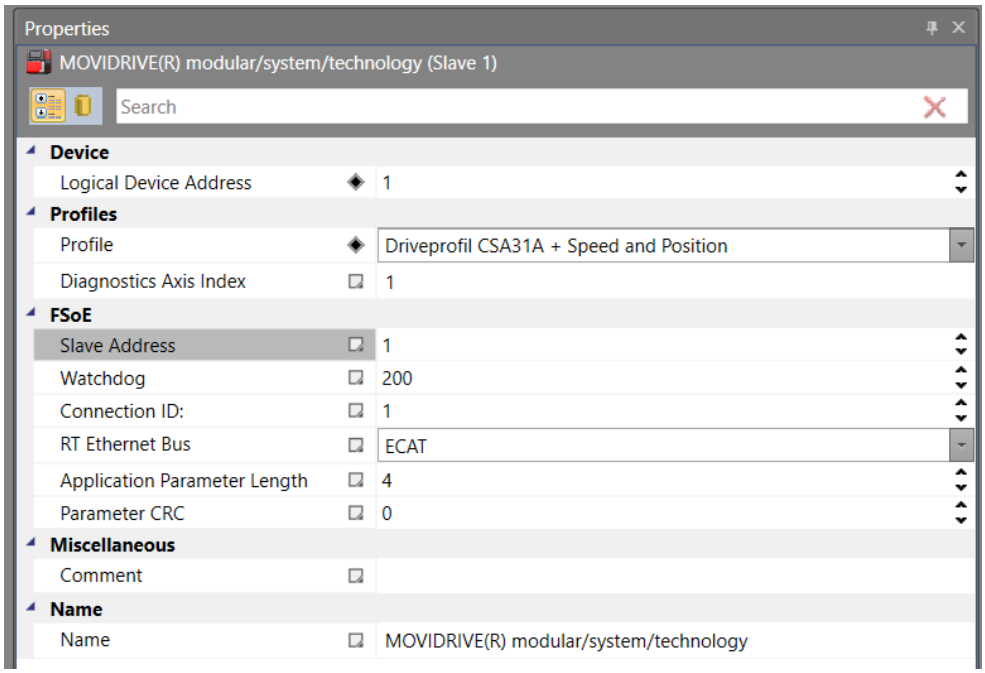


4. Select the profile matching the safety option used.



33765168651

5. Make the required settings.



33765375371

- "Slave address" choice box

  Here you select the Safety over EtherCAT® address specified in the "Assist CS.." parameterization tool in MOVISUITE®.

- "Watchdog time" choice box

  Transmission is monitored via timers (watchdog) that are checked in each Safety over EtherCAT® station in the network. In this way, an interruption in the transmission can be reliably detected. Default: 200 ms. Recommended: 250 ms.

- "Connection ID" choice box

  Set this value to "1".

- "RT Ethernet Bus" drop-down list

  The clock-synchronous EtherCAT® is connected to the SCU at "ECAT in" and "ECAT out". Choose "ECAT".

- "Application Parameter Length" choice box

  Set this value to "4".

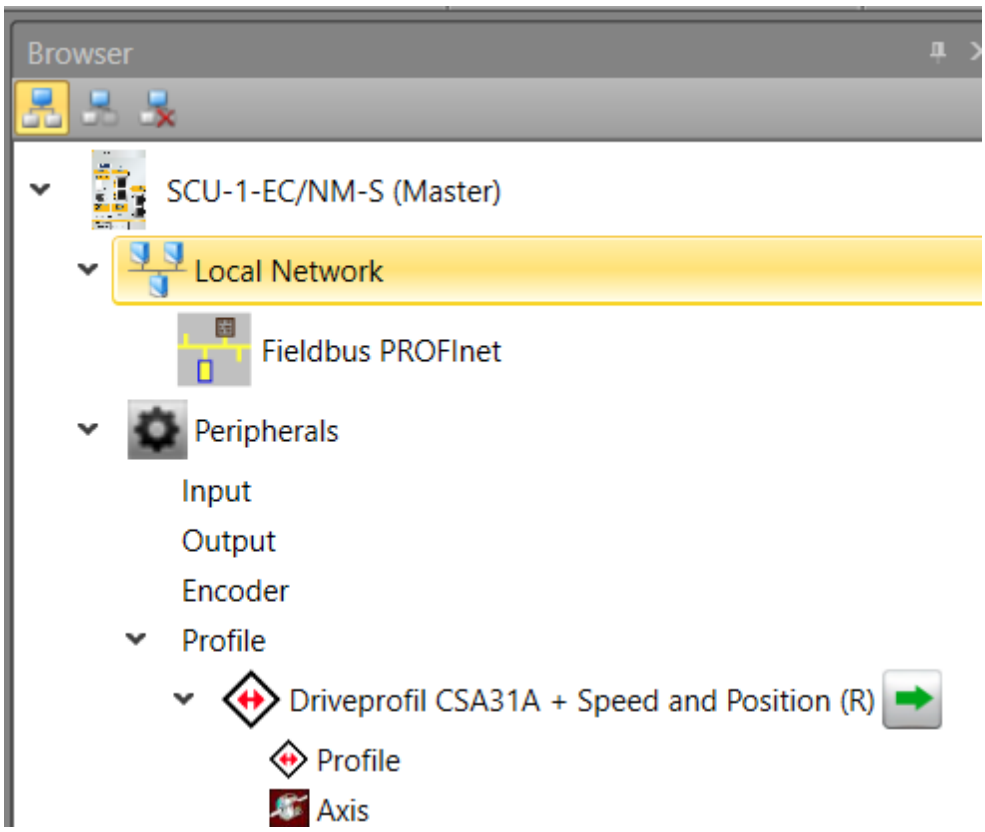
- "Parameter CRC" choice box

  For this value, refer to MOVISUITE® once you have successfully parameterized the CS..A safety option using the "Assist CS.." parameterization tool.

6. Call up the function block diagram.

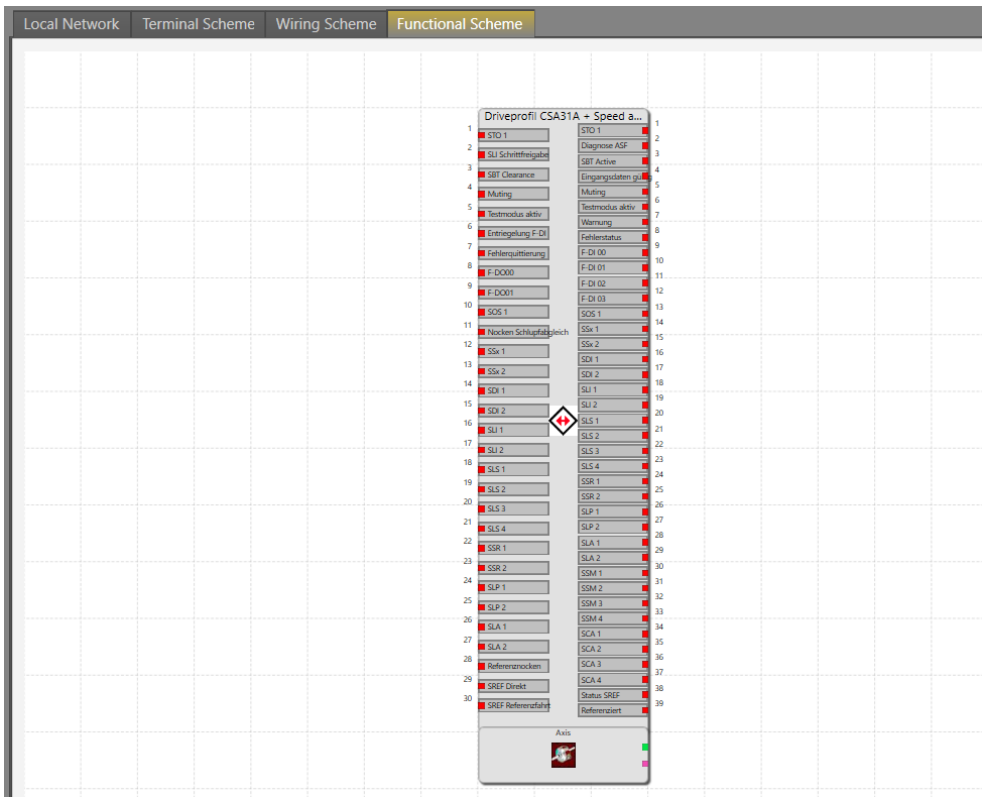
31972098/EN – 8/2024

7. After creating the appropriate profile, transfer this profile to the function block diagram of the SafePLC2 configuration tool using the corresponding green arrow.



33764895755

8. In the function block diagram of the SafePLC2 configuration tool, you now have access to all available safety sub-functions of the safety option.



33764891275

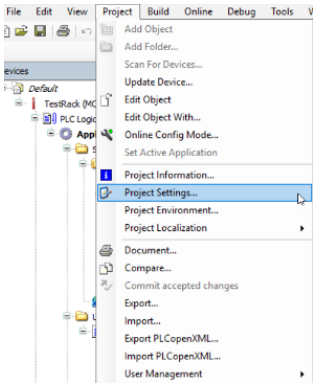
9. Load the configuration into the Safety over EtherCAT® main device module SCU.

Requirements in the IEC Editor

In order to use Safety over EtherCAT® communication between the Safety over EtherCAT® main device module SCU and the safety options in the inverter, it is necessary to activate this in the project settings in the IEC Editor.

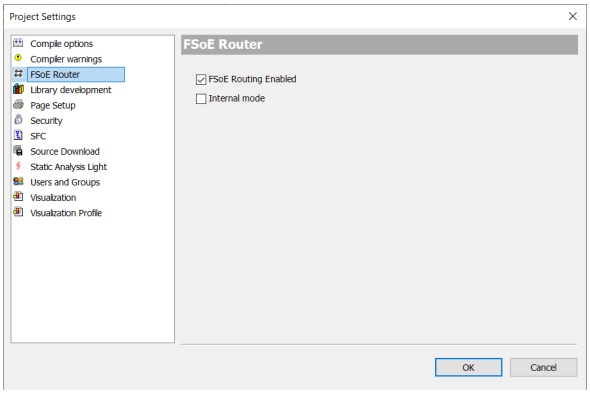
Proceed as follows:

1. Create or open a corresponding IEC project or MOVISUITE® project.
2. Click the [Project] > [Project Settings] menu item in the IEC Editor.



33037484171

3. Under "Project Settings", select the "FSoE Router" entry. In the "FSoE Router" window, activate the "FSoE Routing Enabled" check box and confirm your setting with [OK].

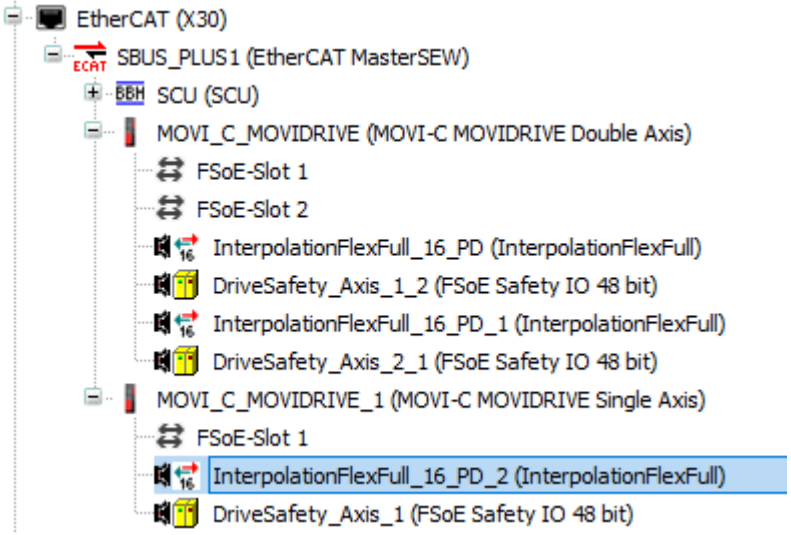


33037456139

Startup in the IEC Editor

Requirements

- FSoE routing is activated.
- The safety program with the safety options used has been loaded onto the safety controller.
- The safety controller is physically integrated in the EtherCAT® string.
- The safety controller is scanned in the EtherCAT® string by software and the corresponding defined profiles are visible in the IEC Editor.



33764887307

Proceed in the following order:

1. Double-click an FSoE slot of the safety option used. The allocation window opens.

Dev_Achse_1_Achse_2 FSoE-Slot 1

Index	1
Out PDO	FSoE Safety Outputs 48 bit
In PDO	FSoE Safety Inputs 48 bit
Bitsize Out	120
Bitsize In	120
Mapped Slot	none
Status	not mapped

Assign	FSoE Device	Index	Out PDO	In PDO	Bitsize Out	Bitsize In	Mapped Slot
⇄	SCU	1	FSoE SafetySlaveMessage 48 bit	FSoE SafetyMasterMessage 48 bit	120	120	none
⇄	SCU	2	FSoE SafetySlaveMessage 48 bit	FSoE SafetyMasterMessage 48 bit	120	120	none

33764883723

2. Assign a free FSoE slot to the safety controller.
3. Repeat these steps for all FSoE slots.
4. Log on the project on the safety controller.
5. Upload the configuration to the SEW-EURODRIVE controller.
6. Create a boot project.
7. Restart the system.

11.11.9 Safety-relevant acceptance



⚠ DANGER

Proper functioning of the safety sub-functions is not guaranteed without a safety-related acceptance.

Severe or fatal injuries.

- Check each individual safety sub-function.
- An individual acceptance report may be created only when the system is in idle state.

To ensure that the safety sub-functions have been parameterized properly, you must perform validation and documentation of the parameters once startup and parameterization have been completed. This is supported by the "Assist CS.." parameterization tool, which is integrated in MOVISUITE® in the form of an acceptance report. The acceptance report can only be created with valid parameterization. If the parameterization is invalid, the creation of the acceptance report is rejected.

The safety concept relies on the following basic assumptions. Parameters stored in the flash memory of the safety option cannot change automatically. Online tests and appropriate signatures safeguard this during the course of basic measures on the assembly. However, the configuration cannot be evaluated by the assembly. This affects the parameterization of the safe inputs and outputs and the limit values of the safety sub-functions. Verification is performed by means of the acceptance report.

For safety sub-functions that are not used, it is sufficient to verify whether the enable is parameterized to "No".

A device that is not accepted will issue a warning after switching on and after a period of 8 hours (main fault 46.50, subcomponent fault 66.85) indicating that the device has not been accepted. There is no response by the device. The warning can be acknowledged and reappears again after 8 hours.

31972098/EN – 8/2024

Sequence

After a successful startup, you must confirm that the data of the acceptance report matches the parameters on the safety option and the requirements. You must prove and protocol the values parameterized for the user units, sensors, and monitoring functions individually. This can be carried out with the aid of function tests. All limit values of the safety option must be verified by exceeding each limit value and then triggering the defined state (safe state = STO + brake de-energized). You must take this into account in the machine or system control system.

Performing a simple acceptance

- ✓ The unit used is an SI unit (e.g. m, mm)

1. Generate the acceptance report. Enter the value of the *ParCRCBus* parameter in the engineering tool of the F-host.
2. Check the limit values in the report for input or transmission errors.
3. Check the correct calculation of position values. This is also required if only speed and acceleration functions are used.
4. Check the correct calculation of speed and acceleration values.
5. Check the wiring of inputs and outputs.
6. Select all parameterized safety sub-functions once via the digital inputs and/or via the safety bus. Use the status of the CS..A to check whether the corresponding safety sub-function is selected. In addition, check the LED and the 7-segment display on the inverter for the STO function, as well as the application of the brake.

INFORMATION

In the case of MOVISAFE® CS..A, a fault injection test is not required for acceptance of the safety options. This means that it is not necessary to explicitly test whether, for example, an SLS function triggers when the parameterized limit value is exceeded.

Procedure for acceptance of the position values

It is always necessary to check the position values as they are the basis for the speed and acceleration values. Proceed as follows to accept the correct encoder resolution and conversion into user units:

1. Set a starting point for a movement, e.g. a reference point.
2. Mark the starting point.
3. In MOVISUITE®, read the positions of the utilized encoders in the [Diagnostics] > [MOVISAFE CS..A] > [Encoder Evaluation] dialog and log them.
4. Travel a defined distance (e.g. 5 m).
5. Mark the target point.
6. Measure the traveled distance using a suitable measuring instrument (e.g. magnetic tape).
7. In MOVISUITE® in the dialog [Diagnostics] > [MOVISAFE® CS..] > [Encoder Evaluation], read the position values of the utilized encoders again and log them.
8. Calculate the traveled distance from the difference of read-out values and compare the result with the measured distance.
9. If both values are identical, the following is accepted:
   - Position values in user units

31972098/EN – 8/2024

- Encoder resolution
- Gear unit ratio and other ratios
- All other mechanical elements that have an influence on the position values, such as diameter of the drive wheel.

Procedure for acceptance of speed and acceleration

1. Calculations for speed and acceleration are printed on the acceptance report in chapter "Creating an acceptance report".
2. If both values have been calculated correctly, the following is accepted:
   - User unit speed

4.1. Speed across a distance

With speed v the distance s is covered in 1 second.

Line	Property	Value	Unit
260	s = v * 1sec	1000	mm
261	v	1000	mm/s

   - User unit acceleration

4.2. Acceleration across a distance

From standstill, the distance s is covered in 1 second with acceleration a.

Line	Property	Value	Unit
262	s = (a / 2) * 1sec * 1sec	5000	mm
263	a	10000	mm/s²

INFORMATION

The calculations from the acceptance report are used to verify internal normalizations and are not related to real values. The procedure can only be used with SI units.

Creating an acceptance report

With the Assist CS.. tool integrated in MOVISUITE®, you can generate an individual acceptance report and save it as a PDF. Before creating the report, enter the system-specific data in the Assist CS.. form. The system-specific data is transferred to the PDF file.

Structure of the acceptance report

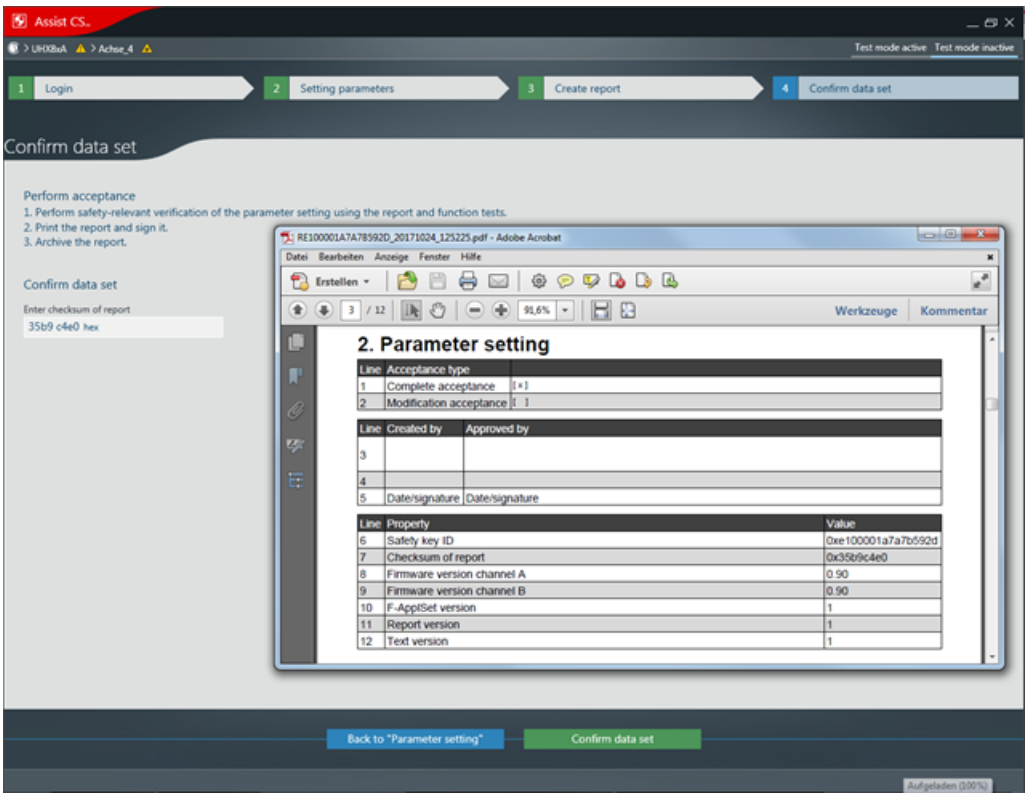
The acceptance report that is generated as a PDF file contains the following information:

- System information
- Parameters of the safety option
- Overview of checksums
- Communication data

31972098/EN – 8/2024

Publishing acceptance

The acceptance of the safety option can be published after completion of the safety check. To publish the data set, enter the checksum of the report in Assist CS.. (line 7 in the following figure).



21877787147

This information is not safety-related and does not contain any information about the acceptance of the system in combination with external sensors and actuators.

11.11.10 Restoring the delivery state



⚠ WARNING

Unexpected and unwanted movement of the drive after having restored the delivery state of the safety option.

Severe or fatal injuries.

- Make sure that organizational measures are taken for the protection of personnel and machinery.

Requirements

Before restoring the delivery state, ensure that the system is in idle state and no dangerous movements can be performed.

You have the password for logging in to the "Assist CS.." parameterization tool. The password is not reset when you reset the device to the delivery state.

No safety sub-function is enabled in the delivery state of the safety option. The safety option permanently activates STO.

The parameterization of safe communication is not reset automatically. To do so, set the protocol to "No protocol" in the "Assist CS.." parameterization tool.

The connection (pairing) between a safety encoder with MOVILINK® DDI and a safety option is disconnected. After switching on again, the pairing process is carried out automatically.

Procedure

1. In MOVISUITE®, select "MOVISAFE® CS.. diagnostics" in the "Diagnostics" menu. Select the menu item "General". Click the [Restore delivery state] button.
2. Open the "Assist CS.." parameterization tool and log in.
3. Transfer the data to the device. In the context menu of the axis, select the menu item "Device → PC" to update the data in MOVISUITE®. The data set is then valid and behaves as it did after delivery. "Accepted" is not set.

INFORMATION

The parameters of the F-communication are not reset.

11.11.11 Resetting the password

INFORMATION

When you install or remove the safety option, pay attention to the information in chapter "Mechanical installation".

Proceed as follows:

1. Switch off the system.
2. Remove the safety option. To reset the password, you require the master password of the safety option.
3. You can find the card-specific master password on the label of the safety option (see chapter "Nameplate" (→ 🗎 315)).
4. Reinsert the safety option.
5. Switch on the system again.
6. Open the "Assist CS.." parameterization tool. To open the main menu, click the red "Assist CS.." tile in the left upper corner.
7. Select the menu item "Change password". In the "Old password" edit box, enter the master password.
8. In the edit boxes "New password" and "Enter new password again", enter the new password and confirm your entries.

   You can now parameterize the safety option in the "Assist CS.." parameterization tool.

11.11.12 Changing the password

1. Open the "Assist CS.." parameterization tool. To open the main menu, click the red "Assist CS.." tile in the left upper corner.
2. Select the menu item "Change password". In the "Old password" edit box, enter the old password.
3. In the edit boxes "New password" and "Enter new password again", enter the new password and confirm your entries.

31972098/EN – 8/2024

12 Operation

12.1 Operation - Functional safety

12.1.1 Hazard caused by coasting of the drive

⚠ WARNING



Hazard caused by coasting of the drive. Without a mechanical brake or if the brake is faulty, a danger exists of the drive coasting to a halt.

Severe or fatal injuries.

- If the coasting of the drive causes any application-specific dangers, you must provide for additional preventive measures (e.g. guard with guard locking device). The additional preventive measures must cover the danger zone until no further danger to personnel exists. As an alternative, you must equip the drive with a safety brake.
- The additional protective covers must be designed and integrated so that they meet the requirements determined in the risk assessment for the machine.
- After activating the stop command, access to the machine must remain blocked until the drive has reached standstill depending on the hazard involved. As an alternative, you must determine the access or intervention time and then calculate and observe the resulting safety clearance.

12.1.2 Start inhibit

The start inhibit activates the STO function and prevents the automatic startup of the safety option.

The start inhibit is activated in the following cases:

- Switching on of the device with integrated safety option
- End of a muting function
- Parameterization in the event of a limit value violation
- Parameterization with pending input, output or encoder fault
- Parameterization during active brake test
- Parameterization with active errors in the EDM safety sub-function
- Restoration of the parameter set, e.g. after device replacement
- Restoration of the delivery state

The start inhibit can be deactivated as follows:

- Through a fault acknowledgment with a safe digital input F-DI or via the *Fault acknowledgment* bit on the safe process data
- For all causes (except for the start inhibit after powering on the device) by switching the device off and on again

Using the *Fault status after startup* parameter (8703.240), you can set whether the start inhibit is activated after the device is powered on.

12.1.3 Operating states of the MOVISAFE® CS..A safety option

The MOVISAFE® CS..A safety option distinguishes between the following operating states:

- Operation

31972098/EN – 8/2024

- Parameterization
- Safe state after critical fault

Operating state "Operation"

In the "Operation" operating state, the selected safety sub-functions are executed according to the parameterization. For further information, refer to chapter "Parameterizing the safety sub-functions" (→ 🖹 446). The safety sub-functions are selected either via the safe digital inputs or the F-process data. The external, safe digital outputs can be controlled directly via the F-process data if no function has been assigned to the safe digital outputs in the function assignment.

Operating state "Parameterization"

In the "Parameterization" operating state, the MOVISAFE® CS..A safety option is in a safe state. The MOVISAFE® CS..A can be parameterized in this state. If a fault occurs during the parameterization, e.g. a violation of a plausibility rule, the MOVISAFE® CS..A remains in the "Parameterization" operating state.

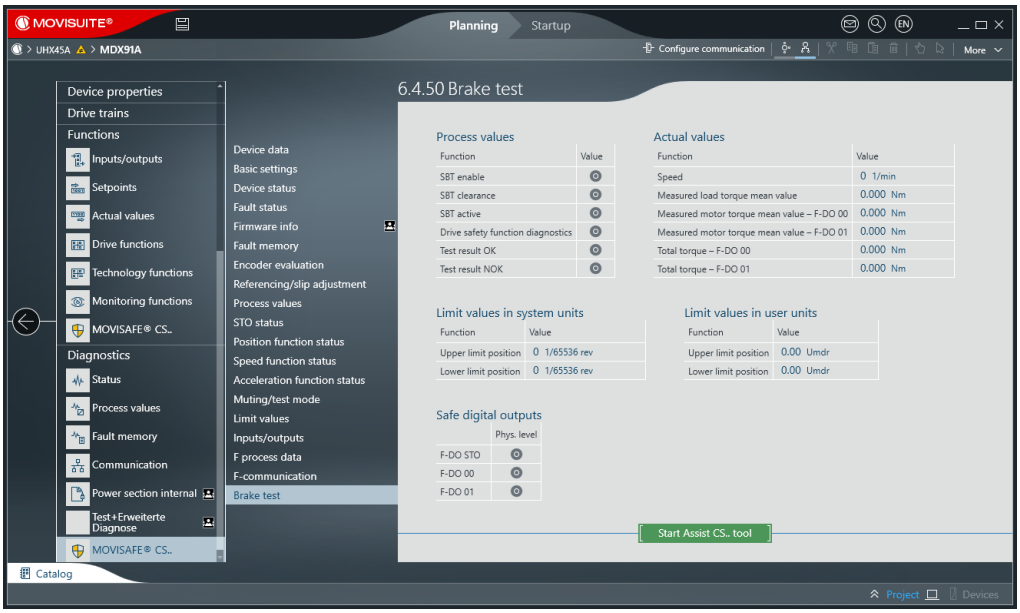
Operating state "Safe state" after critical fault

No F-process data communication occurs in the "Safe state" operating state. All safe digital inputs and outputs are disconnected. The "Safe state" operating state can be resolved only by deactivation and reactivation.

12.1.4 Operation of the brake test diagnostics function

Process and actual values

In MOVISUITE® diagnostics, the process and actual values for the brake test are displayed under [MOVISAFE® CS..A] > [Brake test].



9007228404100107

Process values

Parameter	Description
SBT enable	"1": "SBT enable" signal is present. Only relevant if the *Activation by SBT clearance* parameter is set to "0".
SBT clearance	"1": "SBT clearance" safe signal is present.
SBT active	"1": Brake test is active.
Drive safety function diagnostics	"1": At least one selected safety sub-function has detected a limit value violation or cannot execute limit value monitoring as a consequential error.
Test result OK	• "0": Brake test is inactive or there is another brake test result, e.g. test result NOK. • "1": Brake test is completed without limit value violation.
Test result NOK	• "0": Brake test is inactive or there is another brake test result, e.g. test result OK. • "1": Brake test has detected a limit value violation.



INFORMATION

The following applies if 2 brakes are tested with the brake test:

- The "OK" test result applies to both brakes tested.
- The "NOK" test result applies to the brake at which a fault occurs. This can be brake 1 or brake 2.

Actual values

Parameter	Description
Speed	Actual speed in system units.
Measured load torque mean value	Load torque applied by the motor to test the brake at FDO00. The motor torque is determined by the brake test in step 3.
Measured motor torque mean value – F-DO00	Proportion of the motor torque applied by the motor to test the brake at F-DO00. The motor torque is determined by the brake test in step 3.
Measured motor torque mean value – F-DO01	Proportion of the motor torque applied by the motor to test the brake at F-DO01. The motor torque is determined by the brake test in step 3.
Total torque – F-DO00	Total torque with which the brake was tested at F-DO00. The total torque is the sum of the *Measured load torque mean value* and the *Measured motor torque mean value – F-DO00*.
Total torque – F-DO01	Total torque with which the brake was tested at F-DO01. The total torque is the sum of the *Measured load torque mean value* and the *Measured motor torque mean value – F-DO01*.

Limit values in system units

Parameter	Description
Upper limit position	Maximum position when moving clear in the direction of movement. The limit position is the sum of the actual position at the start of the brake test and the set value at *Maximum travel distance in direction of movement*.

31972098/EN – 8/2024

Parameter	Description
Lower limit position	Maximum position when moving clear opposite the direction of movement. The limit position is the sum of the actual position at the start of the brake test and the set value at *Maximum travel distance in opposite direction of movement*.

Limit values in user units

Parameter	Description
Upper limit position	Maximum position when moving clear in the direction of movement. The limit position is the sum of the actual position at the start of the brake test and the set value at *Maximum travel distance in direction of movement*.
Lower limit position	Maximum position when moving clear opposite the direction of movement. The limit position is the sum of the actual position at the start of the brake test and the set value at *Maximum travel distance in opposite direction of movement*.

Safe digital outputs

Parameter	Description
F-DO STO	"1": STO safety sub-function is active.
F-DO00	"1": Safe digital output F-DO00 is active.
F-DO01	"1": Safe digital output F-DO01 is active.

Brake test status in F process data

The status of the brake test is transmitted in the F process data (process input data) in the "SBT active" bit.

- SBT active = 0: Brake test is inactive
- SBT active = 1: Brake test is active

The SBT active status is inactive if the brake test shows the following states:

- Brake test has not been activated
- Brake test has ended
- Brake test was canceled. The "Diagnosis ASF" bit is also set to logical "1" as an error message.

The status is transferred to the inverter internally. It can continue to be used in the inverter, e.g. as a digital output or for transferring to the process data (PI).

Aborting the brake test

If an active brake test is canceled, the STO safety sub-function is activated on the inverter. The inverter cannot build up any more torque. At the same time, the F-DOs that are assigned with SBCs are switched off. The brakes are applied. The drive can still move for the duration of the brake application time.

An active brake test is canceled if the following events occur:

- In step 1, a section is detected that is bigger than the section set under *Maximum travel distance in direction of movement* or *Maximum travel distance in opposite direction of movement*.

31972098/EN – 8/2024

- In step 1, the target position is not reached on time when moving clear is performed. In this case, the brake test calculates the anticipated position duration from the settings of the following parameters:
  - *Distance*
  - *Maximum speed*
  - *Maximum acceleration*
  - *Filter times encoder 1*

  After the calculated position duration, including the set tolerance, the drive must have undershot the *Minimum speed of the speed functions*.
- In step 1, an actual position is detected during moving clear, which differs more than the value permitted under *Distance*, taking into consideration the *Position tolerance*.
- In step 1, a movement is detected during the wait time, which is greater than the value set for brake 1 under *Permitted movement at standstill*.
- In step 2 (load torque test), it is detected that the difference between the determined load torque and the *Load torque* settings when considering the *Load torque tolerance* is unacceptably high.
- In step 3 (active testing of the brake), the determined motor torque is too low.
- In step 3, a movement is detected during "active" brake testing that is greater than the value set for the respective brake under *Permitted movement at standstill*.
- In step 3 during "active" brake testing, it is detected that the difference between the determined motor torque and the *Torque input* settings when considering the *Tolerance torque input* is unacceptably high.
- In step 3 during "active" brake testing, it is detected that the inverter is generating the required test torque in the wrong direction of movement.
- In step 4, a movement is detected during "passive" brake testing that is greater than the value set under *Permitted movement at standstill* for the respective brake.
- Activation of one of the following safety sub-functions: STO/SBC, SSx, SOS, SSR, SDI, SLI.
- Limit value violation at one of the SLS, SSM, SLA, or SLP safety sub-functions. If only the message via F-process data (F-PI only) is set as the response to a limit value violation, then the brake test is not canceled in the event of a limit value violation. In this case, a suitable response is the task of the higher-level safety controller.
- Activation of a drive function (FCB) with a higher priority than FCB 23 in the inverter.
- Control of the "SBT enable" or "SBT clearance" signals is deactivated (logical "0").
- The brake is applied by the inverter.
- Fault status at CS..A safety option.
- The CS..A safety option is parameterized, the report is generated or the parameterization is confirmed.
- Fault status at inverter.

Error messages

Error messages for the brake test function are displayed or signaled as follows:

- Displayed on the device with:
  - E-46.50 safety option: Warning (for errors with response "FS – Warning")

31972098/EN – 8/2024

– E-46.52 safety option: System error/critical error (for errors with response "FS – System error" or "FS – Critical error")

For more information, refer to chapter "Service" > "Fault description for basic device".

- Signaled in the CS..A safety option with E-70.xx safe brake system

  Positions "xx" are placeholders for a detailed error number.

  For more information, refer to chapter "Service" > "Fault description for CS..A safety option".
- Signaled in the process data to the higher-level controller
- With PROFINET, signaled via the diagnostic alarm

Acknowledging the error messages

Observe the information in chapter "Startup of the MOVISAFE® CS..A safety option" > "Brake test diagnostics function" > "Test result and ending the test".

12.2 IT security

12.2.1 Hardening measures



Perform the following hardening measures:

- Regularly check if updates are available for your products.
- Report incidents concerning IT security by e-mail to cert@sew-eurodrive.com.
- Regularly check which Security Advisories are available in the Online Support of SEW-EURODRIVE.
- Evaluate the fault memories and diagnostics information of your products regularly and check whether there are entries that affect IT security.

12.2.2 Guidelines for secure operation



The engineering protocol from SEW-EURODRIVE allows authorized personnel to activate various service accesses on the device. Authentication is implemented by using static access data. This data is not used to defend against attacks on IT security but to protect against unintentional modification. This is the reason why it cannot be changed.

To prevent misuse of these service accesses, network access must be restricted according to the state of the art. For more information, refer to section "IT security of the environment" (→ 🗎 12).

12.2.3 Guidelines for user account management



The device has no user accounts.

31972098/EN – 8/2024

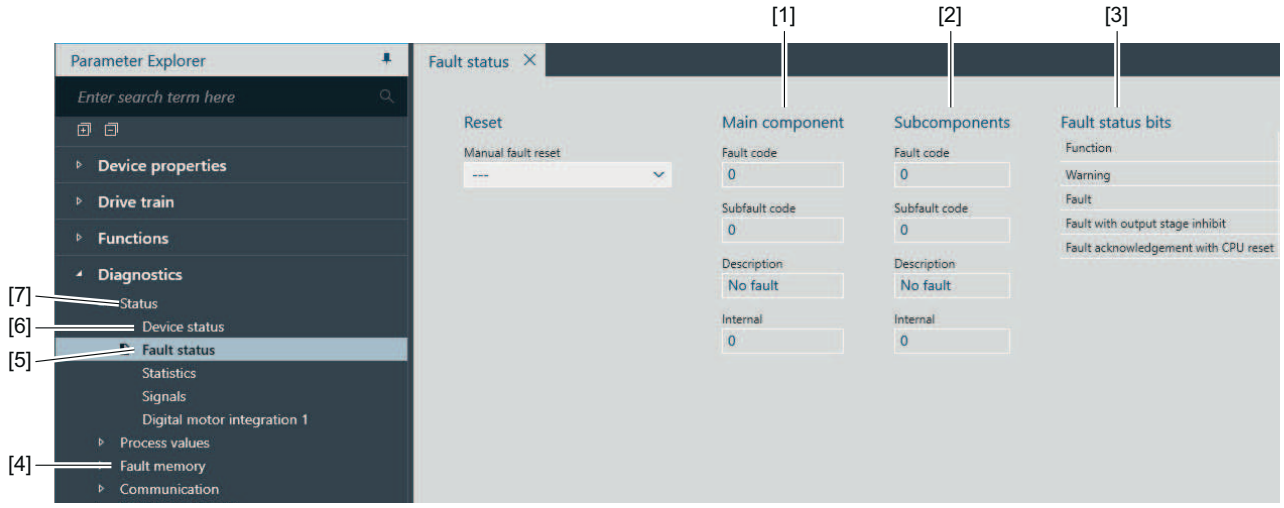
13 Service

13.1 Evaluating fault messages

13.1.1 MOVISUITE®

The following section shows a sample evaluation of a fault message in MOVISUITE®:

1. Open the parameter tree in MOVISUITE®.
2. In the parameter tree, select the "Status" node [7].
   - ⇨ The **current fault messages** can be found in the "Fault status" group [5].
   - ⇨ **Additional information** on the causes for the "Not ready" status can be found in the "Device status" group [6].
   - ⇨ Information on the **history of the fault messages** can be found in the "Fault memory" node [4].



36028818994022283

[1] Fault status of the main component
[2] Fault status of the subcomponent
[3] Display of the status bits
[4] Fault memory
[5] Fault status
[6] Device status
[7] Status

31972098/EN – 8/2024

13.2 Resetting fault messages



⚠ WARNING

Removing the source of the malfunction or performing a reset can result in an automatic restart of the connected drives.

Severe or fatal injuries.

- Prevent the system from performing an unintentional startup.

Acknowledge the fault message by:

- Switching the device off and on again.
- Send "Reset command" via the controller or PLC.

13.3 Fault responses

The following table describes the following fault responses:

Error response	Description
No response	The inverter ignores the event
Warning with self reset	The inverter issues a warning message with self-reset. The fault is automatically reset after the cause of fault is eliminated.
Warning	The inverter issues a warning message.
Application stop (with output stage inhibit)	The inverter stops with the deceleration set for the application limit. Parameter set 1 Index 8375.0-13 Parameter set 2 Index 8375.8-13 If n = 0: Brake "applied" and output stage "off".
Application stop (with output stage inhibit) with self-reset	
Emergency stop (with output stage inhibit)	The inverter stops with the set emergency stop deceleration. Parameter set 1 Index 8375.0-20 Parameter set 2 Index 8375.8-20
Emergency stop (with output stage inhibit) with self-reset	
Inhibit output stage with self-reset	The output stage is deactivated and the brake is applied.
Inhibit output stage	

Self-reset means: Eliminating the cause of the fault results in acknowledgment of the fault. The inverter automatically resumes the operation before the fault occurred. The drive can restart automatically.

31972098/EN – 8/2024

13.4 Fault messages with parameterizable response

Parameterizable faults	Description	Index no.	Possible fault response
Manual mode – timeout response	This parameter is used to set the response to a bus timeout during manual mode.	8504.3	• Application stop (with output stage inhibit) • Emergency stop (with output stage inhibit) • Inhibit output stage
Heat sink overtemperature – prewarning	Here you can set the device response when the prewarning threshold for heat sink utilization is exceeded (index 8336.1).	8622.2	• No response • Warning
Positioning lag error	Here you can set the device response to a lag error (lag error window exceeded, index 8509.4).	8622.3	• No response • Warning • Application stop (with output stage inhibit) • Emergency stop (with output stage inhibit) • Inhibit output stage.
Line phase failure	Here you can set the device response to a line phase failure (values below threshold defined by the user, index 8351.5).	8622.4	• No response • Warning • Application stop (with output stage inhibit) • Emergency stop (with output stage inhibit) • Inhibit output stage.
External fault	Here you can set the device response to an external fault (e.g., triggered by terminal or control word).	8622.5	• No response • Warning • Application stop (with output stage inhibit) • Emergency stop (with output stage inhibit) • Inhibit output stage.

31972098/EN – 8/2024

Parameterizable faults	Description	Index no.	Possible fault response
Fieldbus – timeout	Here you can set the device response to a timeout on the EtherCAT®/SBus^{PLUS} (timeout period, index 8455.3).	8622.6	• Warning • Application stop (with output stage inhibit) • Emergency stop (with output stage inhibit) • Inhibit output stage. • Warning with self reset • Application stop (with output stage inhibit) with self-reset • Emergency stop (with output stage inhibit) with self-reset • Inhibit output stage with self-reset
External synchronization	Here you can set the device response to loss of external synchronization.	8622.7	• No response • Warning • Application stop (with output stage inhibit) • Emergency stop (with output stage inhibit) • Inhibit output stage. • Warning with self reset • Application stop (with output stage inhibit) with self-reset • Emergency stop (with output stage inhibit) with self-reset • Inhibit output stage with self-reset
Motor temperature prewarning – current parameter set	Motor temperature current parameter set – prewarning.	8622.8	• No response • Warning • Application stop (with output stage inhibit) • Emergency stop (with output stage inhibit) • Inhibit output stage.
Electromechanical capacity utilization – prewarning	Here you can set the device response to an exceeded prewarning threshold for electromechanical capacity utilization (index 8336.2).	8622.10	• No response • Warning • Application stop (with output stage inhibit) • Emergency stop (with output stage inhibit) • Inhibit output stage.

31972098/EN – 8/2024

Parameterizable faults	Description	Index no.	Possible fault response
HW limit switches – current parameter set		8622.11	• No response • Emergency stop (with output stage inhibit) • Emergency stop (with output stage inhibit) with self-reset
SW limit switches – current parameter set		8622.12	• No response • Emergency stop (with output stage inhibit) • Emergency stop (with output stage inhibit) with self-reset
Encoder – warning	Here you can set the device response to an encoder warning.	8622.13	• Warning • Application stop (with output stage inhibit) • Emergency stop (with output stage inhibit) • Inhibit output stage.
Encoder – fault	Here you can set the device response to an encoder fault.	8622.14	• Application stop (with output stage inhibit) • Emergency stop (with output stage inhibit) • Inhibit output stage
Additional encoder	This parameter is used to set the device response to a fault of an encoder that is not used for control (speed or positioning control).	8622.15	• Warning • Application stop (with output stage inhibit) • Emergency stop (with output stage inhibit) • Inhibit output stage.
Encoder 1 – latest fault		8622.16	• No response
Encoder 2 – latest fault		8622.17	• No response
Encoder 1 – latest critical fault		8622.18	• No response • Inhibit output stage.
Encoder 2 – latest critical fault		8622.19	• No response • Inhibit output stage.
Response to external braking resistor fault	External braking resistor fault	8622.20	• No response • Warning • Application stop (with output stage inhibit) • Emergency stop (with output stage inhibit) • Inhibit output stage.

31972098/EN – 8/2024

Parameterizable faults	Description	Index no.	Possible fault response
Application heartbeat timeout	Here you can set the device response to a timeout of the application heartbeat.	8622.21	• Warning • Application stop (with output stage inhibit) • Emergency stop (with output stage inhibit) • Inhibit output stage.

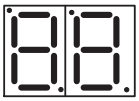
13.5 Responses to fault acknowledgement

13.5.1 Fault acknowledgement

When acknowledging an error, the error end state determines which reset type (system restart or warm start) is executed.

13.6 Status and operating displays of the 7-segment display

13.6.1 Description



- The two 7-segment displays indicate the operating state of the inverter.

13.6.2 Operating displays of the 7-segment display

Display	Description	State	Remark/action
b0 b1 b2 b3 br	Device passes through several states when loading the firmware (boot) in order to become ready for operation.	• Status: Not ready • Output stage is inhibited. • Communication is not possible.	• Wait until the boot procedure is complete. • Device stays in this state: Device defective
.	Energy-saving mode	–	Energy-saving mode active
00	DC link voltage missing.	• Status: Not ready • Output stage is inhibited. • Communication is possible.	Check the supply system.
C0 flashing	Module bus is not ready.	–	Check the module bus connection.
C1 flashing	Startup state	–	Startup state is active.

31972098/EN – 8/2024

Display	Description	State	Remark/action
C2 flashing	Safe Torque Off active	• Status: Not ready • Output stage is inhibited. • Communication is possible.	The Safe Torque Off function is active.
C3 flashing	Synchronization with the bus is not OK. Process data processing is not ready.		• Check the bus connection. • Check the synchronization setting at the device and controller. • Check the process data settings at the device and controller.
C4 flashing	Encoder evaluation is not ready.		• Encoders are being initialized. • Device stays in this state: - No encoder selected. - "Source actual speed" or "Actual position" parameter shows an encoder that does not exist.
C5 flashing	Motor management is not ready.	–	–
C6 flashing	Internal device supply is incomplete.	–	–
C7 flashing	Power section is not ready.	–	–
C8 flashing	External device is not ready.	–	–
C9 flashing	Data flexibilization layer is not ready.	–	–
Cd flashing	Parameter download is running.	–	–
CA	MOVILINK® DDI is not ready.	–	Determination of the cause via the MOVISUITE® engineering software under Status or Digital motor integration.
bo	Start of the firmware download	• Status: Not ready • Output stage is inhibited.	The device passes through various states during a firmware update.
u	Waiting for update		
u.	Deleting firmware		
u[1)]	Data is being transmitted.		
br	Conclusion of the firmware download and reboot		
d0 flashing	Basic initialization	• Status: Not ready • Output stage is inhibited. • Communication is possible.	Waiting for initialization to finish.
d1 flashing	Initialization at delivery state		
01	Output stage inhibit	Output stage is inhibited.	The drive is not controlled by the output stage. The brake is applied; without the brake, the motor coasts to a halt. FCB 01 can be selected from various sources.

Display	Description	State	Remark/action
AC	Auto Configuration	Data is transferred to the inverter via the MOVILINK® DDI interface.	Motor is started up via the MOVILINK® DDI interface.
02	Default stop	For further information, refer to the description of the FCBs.	Drive function (FCB) "Default stop" active if no other FCB is selected and the system is ready.
04	Manual mode		Manual mode active
05	Speed control		Speed control with internal ramp generator
06	Interpolated speed control		Speed control with setpoints cyclically via bus. The ramp generator is located externally; for example, in a higher-level controller.
07	Torque control		Torque control
08	Interpolated torque control		Torque control with setpoints cyclically via bus
09	Positioning control		Positioning mode with internal ramp generator
10	Interpolated positioning control		Positioning mode with setpoints cyclically via bus. The ramp generator is located externally; for example, in a higher-level controller.
12	Reference travel		The drive performs a reference travel.
13	Stop at application limits		Deceleration at the application limit. FCB 13 is also active if no FCB is selected other than the default FCB 02.
14	Emergency stop	For further information, refer to the description of the FCBs.	Deceleration at the emergency stop limit
18	Rotor position identification		Encoder commutation for synchronous motors
19	Position hold control		Position control on current position
20	Jog		Jog mode active
21	Brake test		Brake is tested by applying a torque while the brake is closed.
25	Motor parameter measurement		Motor parameter measurement active
26	Stop at user limits		Serves to stop at user limits.

1) Outer segment parts are switched off and on in clockwise order.

13.6.3 Fault displays of the 7-segment display

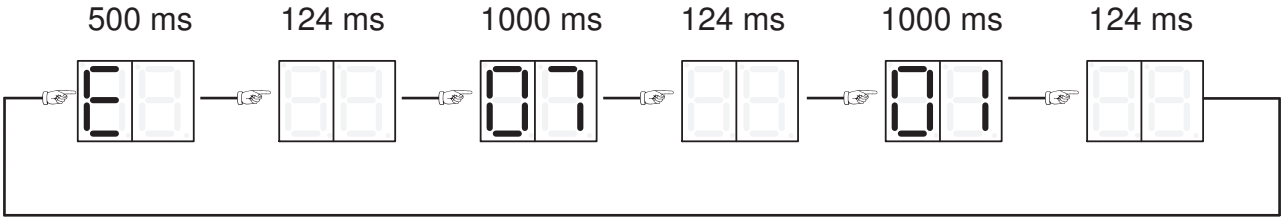
The inverter detects any faults that occur and displays them as a fault code. Each fault is clearly defined by its fault code and the associated attributes:

- Fault response

31972098/EN – 8/2024

- The final status after executing the fault response
- Type of reset response

The fault codes are displayed as flashing numerical values in the inverter display. The fault code appears in the following display sequence:



9007211336799115

In the example shown, a two-digit fault code with subfault is displayed (fault 07.01).

13.7 Status and operating displays of the LEDs

The positions of the LEDs can be found in the **Product manual** > chapter "Device structure" (→ 🗎 299).

13.7.1 General LEDs

"F-ERR" LED

INFORMATION

The "flashing sequence" state means that both LEDs of the assembly alternately flash in yellow or green. The LED color is alternately assigned to the LEDs, e.g. the "F-RUN" LED flashes green, the "F-ERR" LED flashes yellow, and vice versa.

The following table describes the display functions of the "F-ERR" LED:

LED	Meaning
Flashing sequence	Device identification for safety key ID query
Red **Illuminated**	Critical fault, cannot be acknowledged
Red **Flashing (0.5 Hz)**	• Fault can be acknowledged • Fault outside the device, cabling system fault, internal memory data fault • Response to limit value overshoot active
Yellow **Flashing (2 Hz)**	• Fault suppression (muting) active • Emergency mode active
Yellow **Illuminated**	Warning: Fault connection basic device

31972098/EN – 8/2024

LED	Meaning
Green **Flashing (0.5 Hz)**	Fault in the operating state "Parameterization": • Fault in parameterization • No parameterization exists • Current parameter set not consistent with the safety key • Inconsistent parameterization
Green **Illuminated**	Fault-free operation
Off	Device off

"F-RUN" LED

INFORMATION

The "flashing sequence" state means that both LEDs of the assembly alternately flash in yellow or green. The LED color is alternately assigned to the LEDs, e.g. the "F-RUN" LED flashes green, the "F-ERR" LED flashes yellow, and vice versa.

The following table describes the display functions of the "F-RUN" LED:

LED	Meaning
Flashing sequence	Device identification for safety key ID query
Red **Flashing (0.5 Hz)**	Device identification for parameterization
Red **Flashing (2 Hz)**	Firmware update, do not switch the device off
Red **Illuminated**	Critical fault (cannot be acknowledged)
Yellow **Illuminated**	STO safety sub-function is active.
Yellow **Flashing (0.5 Hz)**	Device in operating state with one or more of the following constraints: • The assembly controls inverters • Test mode • Referencing active
Green **Flashing (0.5 Hz)**	Acceptance of the assembly has not yet taken place
Green **Flashing (2 Hz)**	• Device booting up or initializing • Device in parameterization state
Green **Illuminated**	Device in operating state and parameter set approved
Off	Device off

31972098/EN – 8/2024

"RUN" LED

LED	Meaning
Off	"INIT" state The interface is in the "INIT" state.
Green **Flashing**	"PRE_OPERATIONAL" state Mailbox communication is possible. Process data communication is not possible.
Green **Flashing (1 Hz)**	"SAFE_OPERATIONAL" state Mailbox and process data communication is possible. Safety-related output signals are not output.
Green **Illuminated**	"OPERATIONAL Mode" state Mailbox and process data communication is possible.

"ERR" LED

LED	Meaning
Off	No error The interface is in operating state.
Red **Flickering**	Boot error A BOOT error has occurred. "INIT" state has been reached. However the "Change" parameter is set to "0x01:change/error".
Red **Flashing**	Invalid configuration A general configuration fault has occurred.
Red **Flashing once**	Unrequested state change The slave application has changed the state automatically. The "Change" parameter is set to "0x01:change/error".
Red **Flashing twice**	Application watchdog timeout A watchdog timeout error has occurred in the application.
Red **Illuminated**	PDI[1] Watchdog Timeout A PDI watchdog timeout error has occurred.

1) PDI = Process Data Interface

"LNK/ACT" LED

LED	Meaning
Off	No link available. No physical connection to a neighboring device was detected.

LED	Meaning
Green **Illuminated**	Link available, no bus activity. A physical connection to a neighboring device was detected. No data is being exchanged via the Ethernet port.
Green **Flickering**	Link available, bus activity. A physical connection to a neighboring device was detected. Data is being exchanged via the Ethernet port.

13.8 Fault description on basic device

13.8.1 Fault 1 Output stage monitoring

Error: 1.1 (0101hex | 257dec) **Description: Overcurrent at motor output terminals**	
Response: Output stage inhibit	
Cause	Measure
Short circuit at the motor output.	– Check the motor cable for a short circuit. – Rectify the short circuit.
Power output stage defective.	Contact SEW-EURODRIVE Service.
Motor current too high.	Connect a smaller motor.

Error: 1.2 (0102hex | 258dec) **Description: Overcurrent in output stage**	
Response: Output stage inhibit	
Cause	Measure
Motor current too high.	Connect a smaller motor.
Current controller of intelligent power supply module set incorrectly.	Contact SEW-EURODRIVE Service.
Ramp time too short.	Increase the ramp time.
One of the following components is faulty: – Internal current supply – Current measurement – Phase module	Contact SEW-EURODRIVE Service.
The external DC 24 V supply voltage is unstable.	Check the DC 24 V supply voltage.
The voltage fluctuations are too strong. The current controller of the intelligent power supply module cannot compensate for them.	– Stabilize the voltage. – Check the supply. – Check the project planning.

31972098/EN – 8/2024

13.8.2 Fault 3 Ground fault

Error: 3.1 (0301hex | 769dec) Description: Ground fault		
	Response: Output stage inhibit	
	Cause	Measure
	Ground fault detected in the motor cable.	Eliminate the ground fault.
	Ground fault in the inverter.	Contact SEW-EURODRIVE Service.
	Ground fault in the motor.	Eliminate the ground fault.
	Ground fault detected in the line components.	Eliminate the ground fault.
	Ground fault detected in the storage line.	Eliminate the ground fault.
	Ground fault in the storage unit.	Contact the service department of the respective storage unit manufacturer.

13.8.3 Fault 4 Brake chopper

Error: 4.1 (0401hex | 1025dec) Description: Overcurrent in brake chopper		
	Response: Output stage inhibit	
	Cause	Measure
	Excessive regenerative power.	Decrease deceleration.
	Short circuit in braking resistor circuit.	Check the supply cable to the braking resistor.
	The braking resistor impedance is too low.	Check the minimum permitted resistance value of the braking resistor and connect a suitable braking resistor.

Error: 4.2 (0402hex | 1026dec) Description: Brake chopper defective		
	Response: Output stage inhibit	
	Cause	Measure
	Brake chopper defective.	Contact SEW-EURODRIVE Service.

13.8.4 Fault 6 Line fault

Error: 6.1 (0601hex | 1537dec) Description: Line phase failure		
	Response: Line phase failure	
	Cause	Measure
	Line phase missing.	Check the supply system cable.
	Poor line voltage quality.	Check the supply (fuses, contactor, line components).
	DC link voltage periodically too low.	Check line voltage.

31972098/EN – 8/2024

13.8.5 Fault 7 DC link

Error: 7.1 (0701hex | 1793dec) Description: Overvoltage in the DC link		
	Response: Output stage inhibit	
	Cause	Measure
	Maximum permitted DC link voltage exceeded.	– Check the connection of the braking resistor. – Decrease deceleration. – Check the configuration of the braking resistor (resistance value).

Error: 7.2 (0702hex | 1794dec) Description: DC link discharge failed		
	Response: Warning	
	Cause	Measure
	DC link voltage level has not dropped below the discharge threshold within the discharge time.	Contact SEW-EURODRIVE Service.

13.8.6 Fault 8 Speed monitoring

Error: 8.1 (0801hex | 2049dec) Description: Speed monitoring – motor mode		
	Response: Output stage inhibit	
	Cause	Measure
	Speed controller operates at setting limit (mechanical overload or phase failure in supply system or motor).	– Increase delay time of speed monitoring. – Reduce the load. – Increase current limiting/torque limiting. – Reduce the acceleration. – Check the motor cable, motor, and line phases.
	The encoder is not connected correctly.	Check the encoder connection.
	The encoder has the incorrect direction of rotation.	Check the direction of rotation.

31972098/EN – 8/2024

Error: 8.2 (0802hex | 2050dec) Description: Speed monitoring – generator mode		
	Response: Output stage inhibit	
	Cause	Measure
	Speed controller operates at setting limit (mechanical overload or phase failure in supply system or motor).	– Increase delay time of speed monitoring. – Reduce the load. – Increase current limiting/torque limiting. – Decrease deceleration. – Check the motor cable, motor, and line phases.
	The encoder is not connected correctly.	Check the encoder connection.
	The encoder has the incorrect direction of rotation.	Check the direction of rotation.

Error: 8.3 (0803hex | 2051dec) Description: Maximum speed at motor shaft exceeded		
	Response: Output stage inhibit	
	Cause	Measure
	The actual speed has exceeded the "Maximum speed at motor shaft" limit value. This limit value is set at startup matching the motor and gear unit.	Reduce the maximum speed.
	The setpoint is too high.	Reduce the setpoint.
	The motor is driven by the load.	Check the project planning of the drive.

13.8.7 Fault 9 Control mode

Error: 9.1 (0901hex | 2305dec) Description: Magnetization of motor not possible		
	Response: Output stage inhibit	
	Cause	Measure
	The user-defined current limit or the output stage monitoring has reduced the possible maximum current to such an extent that the required magnetizing current cannot be set.	– Reduce output stage utilization by reducing the PWM frequency or the load. – Increase user-defined current limit. – Connect a smaller motor.

Error: 9.2 (0902hex | 2306dec) Description: Operating mode not possible with active control mode		
	Response: Output stage inhibit	
	Cause	Measure
	The active control mode does not support the operating mode selected in the current FCB. EXAMPLE: The U/f control mode does not support the "position control" or "torque control" FCB.	– Use a control mode that supports the required operating mode. If necessary, connect an encoder. or – Select an operating mode that is supported by the current control mode.

Error: 9.3 (0903hex | 2307dec) Description: Absolute rotor position not available		
	Response: Output stage inhibit	
	Cause	Measure
	The active control mode requires an absolute rotor position. The encoder set as the source of the actual speed does not provide an absolute rotor position.	– Use an absolute encoder. or – Identify the rotor position using FCB 18.

Error: 9.4 (0904hex | 2308dec) Description: Correct current supply of motor not possible		
	Response: Output stage inhibit	
	Cause	Measure
	With active current monitoring during premagnetization, the required current could not be impressed into the motor.	– Check motor cable. – Check motor windings. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service. NOTE to SEW-EURODRIVE Service: Check output stage.

Error: 9.5 (0905hex | 2309dec) Description: Maximum output frequency exceeded		
	Response: Output stage inhibit	
	Cause	Measure
	The maximum output frequency has been exceeded.	– Reduce maximum rotation speed/maximum speed. – Reduce setpoint.

31972098/EN – 8/2024

Error: 9.6 (0906hex | 2310dec) Description: Maximum model speed exceeded		
	Response: Output stage inhibit	
	Cause	Measure
	The speed calculated in ELSM® control mode is too high for the motor control.	– Reduce the sampling cycle ("Speed/position controller sampling cycle" parameter). – Reduce the speed.

Error: 9.8 (0908hex | 2312dec) Description: Motor protection function – demagnetization	
Response: Output stage inhibit	
Cause	Measure
The motor is blocked.	Check the motor for blockage.
Motor has already been operated at a speed below the transition speed for too long.	Check the drive selection.
Motor has not been started up properly.	Perform motor startup again and run the drive function "FCB 25 Motor parameter measurement".

Error: 9.9 (0909hex | 2313dec) Description: Parameter measurement not possible with active motor type	
Response: Output stage inhibit	
Cause	Measure
Only the parameters of an asynchronous motor or synchronous motor can be measured.	Omit parameter measurement.

Error: 9.10 (090Ahex | 2314dec) Description: Rotor stall monitoring	
Response: Output stage inhibit	
Cause	Measure
The current control cannot hold the load torque.	Reduce the load.

Error: 9.11 (090Bhex | 2315dec) Description: Standstill current function not possible	
Response: Output stage inhibit	
Cause	Measure
In ELSM® control mode, the standstill current function can only be used if the rotor position can be measured.	Activate rotor position measurement and perform the drive function "FCB 25 Motor parameter measurement".

Error: 9.13 (090Dhex | 2317dec) Description: Torque control not within valid speed range		
	Response: Output stage inhibit	
	Cause	Measure
	The speed is too low.	– Perform motor startup again and run the drive function "FCB 25 Motor parameter measurement". – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.
	The flying start function is deactivated.	Activate the flying start function.
	The motor is blocked.	Check the motor for blockage.

Error: 9.14 (090Ehex | 2318dec) Description: Transition from open-loop speed control to closed-loop speed control failed		
	Response: Output stage inhibit	
	Cause	Measure
	The motor is blocked.	Check the motor for blockage.
	The motor accelerates too slowly.	Check the setting of the "Load moment of inertia" speed controller parameter.
	Ohmic resistance was measured incorrectly.	If the ohmic resistance of the motor cable is smaller than 10% of the ohmic resistance of the motor winding, deactivate the "Measure stator resistance" parameter.
	Motor has not been started up properly.	Perform motor startup again and run the drive function "FCB 25 Motor parameter measurement".
	The drive is overloaded by mechanical stiffness.	– Reduce the load. – Check the mechanical components. – Check the drive selection.

13.8.8 Fault 10 Data flexibility

Error: 10.1 (0A01hex | 2561dec) Description: Initialization error		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	Fault detected in the init task. The return code is not equal to 0.	Check the program. Contact SEW-EURODRIVE Service.

31972098/EN – 8/2024

Error: 10.2 (0A02hex | 2562dec) Description: Illegal operation command		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	Unknown program command (illegal opcode) detected in Data Flexibility program.	Check the program. Contact SEW-EURODRIVE Service.
	The version of the MOVIKIT® software module in use does not run with the current firmware version of the device.	– Adjust the firmware version of the device according to the version overview in the installation notes. or – Adjust the version of the MOVIKIT® software module according to the version overview in the installation notes. In the context menu of the device, execute the [Adjust version and device] menu command.

Error: 10.3 (0A03hex | 2563dec) Description: Access to memory defective		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	Memory area violated while accessing array. For example, an address that does not exist or is not permitted was addressed.	Check the program. Contact SEW-EURODRIVE Service.

Error: 10.4 (0A04hex | 2564dec) Description: Stack overflow		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	Overflow of Data Flexibility stack detected.	Check the program. Contact SEW-EURODRIVE Service.

Error: 10.5 (0A05hex | 2565dec) Description: Division by 0		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	Division by 0 was performed in the program.	Check the program. Contact SEW-EURODRIVE Service.

31972098/EN – 8/2024

Error: 10.6 (0A06hex | 2566dec) Description: Runtime error		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	Watchdog has detected a fault. The program runtime exceeds the permitted time.	Check the program. Contact SEW-EURODRIVE Service.
	Execution time of PDI task or PDO task exceeds permitted time.	– Use slicing mode. – Check the program. Contact SEW-EURODRIVE Service.

Error: 10.7 (0A07hex | 2567dec) Description: Calculation result too large		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	Calculation result of multiplication/division command exceeds 32 bits.	Check the program. Contact SEW-EURODRIVE Service.
	Failed to write calculation result of multiplication/ division command into result variable.	Check the program. Contact SEW-EURODRIVE Service.

Error: 10.8 (0A08hex | 2568dec) Description: Illegal connection		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	The parameter index to be linked with the connect command in the init task does not exist or is not permitted for access via process data (see parameter list).	Check the program. Contact SEW-EURODRIVE Service.

Error: 10.9 (0A09hex | 2569dec) Description: CRC fault		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	The checksum (CRC) is incorrect. This can be due to the following reasons: – The program memory is corrupt. – Unauthorized write access was executed on the program memory.	Adjust the program and load it again.

Error: 10.10 (0A0Ahex | 2570dec) Description: Setpoint cycle time not supported		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	The set setpoint cycle time is not supported.	Set the setpoint cycle time to the default value of 1 ms.

31972098/EN – 8/2024

Error: 10.11 (0A0Bhex | 2571dec) Description: No application program loaded		
	Response: Output stage inhibit	
	Cause	Measure
	No Data Flexibility application program loaded.	– Load program. or – Deactivate Data Flexibility.

Error: 10.12 (0A0Chex | 2572dec) Description: Runtime warning		
	Response: Warning	
	Cause	Measure
	The program requires more runtime than has been configured.	Check the program. Contact SEW-EURODRIVE Service.

Error: 10.20 (0A14hex | 2580dec) Description: Application error – warning		
	Response: Warning	
	Cause	Measure
	Error detected in the application program.	Check the program. Contact SEW-EURODRIVE Service.

Error: 10.21 (0A15hex | 2581dec) Description: Application error – application stop + output stage inhibit		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	Error detected in the application program.	Check the program. Contact SEW-EURODRIVE Service.

Error: 10.22 (0A16hex | 2582dec) Description: Application error – emergency stop + output stage inhibit		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	Error detected in the application program.	Check the program. Contact SEW-EURODRIVE Service.

Error: 10.23 (0A17hex | 2583dec) Description: Application error – output stage inhibit		
	Response: Output stage inhibit	
	Cause	Measure
	Error detected in the application program.	Check the program. Contact SEW-EURODRIVE Service.

31972098/EN – 8/2024

Error: 10.24 (0A18hex | 2584dec) Description: Application error – warning with self-reset		
	Response: Warning with self reset	
	Cause	Measure
	Error detected in the application program.	Check the program. Contact SEW-EURODRIVE Service.

Error: 10.25 (0A19hex | 2585dec) Description: Application error – application stop + output stage with self-reset		
	Response: Application stop + output stage inhibit with self reset	
	Cause	Measure
	Error detected in the application program.	Check the program. Contact SEW-EURODRIVE Service.

Error: 10.26 (0A1Ahex | 2586dec) Description: Application error – emergency stop + output stage inhibit with self-reset		
	Response: Emergency stop + output stage inhibit with self reset	
	Cause	Measure
	Error detected in the application program.	Check the program. Contact SEW-EURODRIVE Service.

Error: 10.27 (0A1Bhex | 2587dec) Description: Application error – output stage inhibit with self-reset		
	Response: Output stage inhibit with self reset	
	Cause	Measure
	Error detected in the application program.	Check the program. Contact SEW-EURODRIVE Service.

Error: 10.99 (0A63hex | 2659dec) Description: Unknown error		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	Unknown Data Flexibility error.	Contact SEW-EURODRIVE Service.

31972098/EN – 8/2024

13.8.9 Fault 11 Temperature monitoring

Error: 11.1 (0B01hex | 2817dec) Description: Heat sink overtemperature		
	Response: Output stage inhibit	
	Cause	Measure
	The capacity utilization is too high. Maximum permitted heat sink temperature exceeded.	– Reduce the load. – Reduce the PWM frequency. – Reduce the ambient temperature.
	Air circulation disrupted. Maximum permitted heat sink temperature exceeded.	– Check air circulation. – Ensure sufficient cooling.
	The fan is defective. Maximum permitted heat sink temperature exceeded.	Contact SEW-EURODRIVE Service.
	The temperature sensor is defective. Maximum permitted heat sink temperature exceeded.	Contact SEW-EURODRIVE Service.

Error: 11.2 (0B02hex | 2818dec) Description: Heat sink utilization – prewarning		
	Response: Heat sink utilization – prewarning	
	Cause	Measure
	High thermal load on heat sink of device. Prewarning threshold reached.	– Reduce the load. – Reduce the PWM frequency. – Reduce the ambient temperature.
	Air circulation disrupted. Prewarning threshold reached.	– Check air circulation. – Ensure sufficient cooling.
	The fan is defective. Prewarning threshold reached.	Contact SEW-EURODRIVE Service.
	The temperature sensor is defective. Prewarning threshold reached.	Contact SEW-EURODRIVE Service.
	Air convection is unfavorable.	Check air convection.

31972098/EN – 8/2024

Error: 11.3 (0B03hex | 2819dec) Description: Device utilization		
	Response: Output stage inhibit	
	Cause	Measure
	The mean output current is too high. The device utilization has reached or exceeded the switch-off threshold.	– Reduce the load. – Check motor/inverter combination.
	The PWM frequency is too high. The device utilization has reached or exceeded the switch-off threshold.	Reduce the PWM frequency.
	The ambient temperature is too high. The device utilization has reached or exceeded the switch-off threshold.	Reduce the ambient temperature.
	Air circulation disrupted. The device utilization has reached or exceeded the switch-off threshold.	– Check air circulation. – Ensure sufficient cooling.
	The fan is defective. The device utilization has reached or exceeded the switch-off threshold.	Contact SEW-EURODRIVE Service.

Error: 11.5 (0B05hex | 2821dec) Description: Electromechanical capacity utilization		
	Response: Output stage inhibit	
	Cause	Measure
	Electromechanical components of device overloaded by excessive continuous current.	Reduce the load.

Error: 11.6 (0B06hex | 2822dec) Description: Electromechanical capacity utilization – prewarning		
	Response: Electromechanical capacity utilization – prewarning	
	Cause	Measure
	High load on electromechanical components of device due to high continuous current. Prewarning threshold reached.	Reduce the load.

Error: 11.7 (0B07hex | 2823dec) Description: Wire break at temperature sensor of heat sink		
	Response: Output stage inhibit	
	Cause	Measure
	Wire break at temperature sensor of heat sink.	Contact SEW-EURODRIVE Service.

31972098/EN – 8/2024

Error: 11.8 (0B08hex | 2824dec) Description: Short circuit at temperature sensor of heat sink		
	Response: Output stage inhibit	
	Cause	Measure
	There is a short circuit at the temperature sensor of the heat sink.	Contact SEW-EURODRIVE Service.

13.8.10 Fault 12 Brake

Error: 12.20 (0C14hex | 3092dec) Description: Digital motor integration – critical fault		
	Response: Output stage inhibit with self-reset	
	Cause	Measure
	The intelligent brake rectifier of digital motor integration has detected a critical fault.	Observe the fault message of the subslave. Identify the exact cause of this fault message and take the appropriate measures to eliminate the fault.

Error: 12.21 (0C15hex | 3093dec) Description: Digital motor integration – fault		
	Response: Emergency stop + output stage inhibit with self-reset	
	Cause	Measure
	The intelligent brake rectifier of digital motor integration has detected a fault.	Observe the fault message of the subslave. Identify the exact cause of this fault message and take the appropriate measures to eliminate the fault.

Error: 12.22 (0C16hex | 3094dec) Description: Digital motor integration – warning		
	Response: Warning with self-reset	
	Cause	Measure
	The intelligent brake rectifier of digital motor integration signaled a warning.	Observe the warning of the subslave. Identify the exact cause of this warning and take the appropriate measures for elimination.

Error: 12.23 (0C17hex | 3095dec) Description: Digital motor integration – timeout		
	Response: Output stage inhibit	
	Cause	Measure
	Communication with intelligent brake rectifier disrupted.	Check the connection.

Error: 12.24 (0C18hex | 3096dec) Description: Digital motor integration – initialization error		
	Response: Output stage inhibit	
	Cause	Measure
	Initialization of intelligent brake rectifier failed.	– Acknowledge the fault. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

13.8.11 Fault 13 Encoder 1

Error: 13.1 (0D01hex | 3329dec) Description: Error during position comparison check		
	Response: Encoder 1 – latest critical fault	
	Cause	Measure
	Fault detected when comparing raw position and track counter of absolute encoder.	– Check the wiring of the track signals. – Check for EMC-compliant installation. – Replace the encoder. – Replace the encoder card. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

Error: 13.2 (0D02hex | 3330dec) Description: Unknown encoder type		
	Response: Encoder 1 – latest critical fault	
	Cause	Measure
	Encoder type not known and not supported by device.	– Check the encoder type. – Contact SEW-EURODRIVE Service. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

31972098/EN – 8/2024

Error: 13.3 (0D03hex | 3331dec) Description: Invalid data		
	Response: Encoder 1 – latest critical fault	
	Cause	Measure
	Invalid encoder nameplate data (measuring steps/pulses per revolution/multi-turn).	Use a different encoder type. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.
	The ratio of motor encoder resolution and distance encoder resolution is too large.	– Check the startup. – Check the project planning. – Check whether a suitable encoder is being used. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

Error: 13.4 (0D04hex | 3332dec) Description: Track measurement error		
	Response: Encoder 1 – latest critical fault	
	Cause	Measure
	Error during track measurement.	– Switch the device off and on again. – Check the wiring. – Check for EMC-compliant installation. – Check the encoder. Replace if necessary. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

Error: 13.5 (0D05hex | 3333dec) Description: Internal warning		
	Response: Encoder – warning	
	Cause	Measure
	The encoder has signaled a warning.	– Check the wiring. – Check interference sources (light beam interrupted, reflector, signal cables, etc.). – Clean the sensor.

Error: 13.6 (0D06hex | 3334dec) Description: Signal level too low		
	Response: Encoder 1 – latest critical fault	
	Cause	Measure
	The value established from the level of the two track signals A and B is below the permitted limit.	– Check the wiring. – Check for EMC-compliant installation. – Check the encoder. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

Error: 13.7 (0D07hex | 3335dec) Description: Signal level too high		
	Response: Encoder 1 – latest critical fault	
	Cause	Measure
	The value of one or both of the track signals A and B exceeds the permitted limit.	Check the gear ratio of the resolver that is being used.

Error: 13.8 (0D08hex | 3336dec) Description: Error during level monitoring		
	Response: Encoder 1 – latest critical fault	
	Cause	Measure
	The value established from the level of the two track signals A and B exceeds the permitted limit.	Check the resolver mounting position.

Error: 13.9 (0D09hex | 3337dec) Description: Error during quadrant check		
	Response: Encoder 1 – latest critical fault	
	Cause	Measure
	Error checking quadrants (sine tracks/cosine tracks).	– Switch the device off and on again. – Check the wiring. – Check for EMC-compliant installation. – Check the encoder. Replace if necessary. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

31972098/EN – 8/2024

Error: 13.10 (0D0Ahex | 3338dec) Description: Positional tolerance range exceeded		
	Response: Encoder 1 – latest critical fault	
	Cause	Measure
	Jump in position impermissibly large.	– Check the startup parameters. – Check the wiring. – Check interference sources (light beam interrupted, reflector, signal cables, etc.). – Replace the encoder. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

Error: 13.11 (0D0Bhex | 3339dec) Description: Encoder data timeout		
	Response: Encoder 1 – latest critical fault	
	Cause	Measure
	Internal fault detected in resolver evaluation.	Check for EMC-compliant installation.
	Communication to the encoder has failed.	Contact SEW-EURODRIVE Service.

Error: 13.12 (0D0Chex | 3340dec) Description: Emergency		
	Response: Encoder 1 – latest critical fault	
	Cause	Measure
	The CANopen encoder signals an emergency.	For measures to correct the fault, refer to the documentation of the respective encoder. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

Error: 13.13 (0D0Dhex | 3341dec) Description: Initialization error		
	Response: Encoder 1 – latest fault	
	Cause	Measure
	Communication error during initialization.	– Check the wiring. – Check the startup parameters. – Check the encoder settings. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

Error: 13.14 (0D0Ehex | 3342dec) Description: Communication error		
	Response: Encoder 1 – latest fault	
	Cause	Measure
	Faulty communication with encoder.	– Check the voltage supply. – Check for EMC-compliant installation. – Check the wiring. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

Error: 13.15 (0D0Fhex | 3343dec) Description: System error		
	Response: Encoder 1 – latest critical fault	
	Cause	Measure
	System error while evaluating encoder.	– Check the setting of the encoder numerator/denominator factors. – Check whether the frame length matches the set transmission rate. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

Error: 13.16 (0D10hex | 3344dec) Description: High level in signal cable – critical fault		
	Response: Encoder 1 – latest critical fault	
	Cause	Measure
	Permanent high level of data signal detected.	– Check the wiring. – Check the encoder. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

31972098/EN – 8/2024

Error: 13.17 (0D11hex | 3345dec) Description: High level in signal cable – fault		
	Response: Encoder 1 – latest fault	
	Cause	Measure
	Permanent high level of data signal detected.	– Check the wiring. – Check the encoder. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

Error: 13.18 (0D12hex | 3346dec) Description: Low level in signal cable – critical fault		
	Response: Encoder 1 – latest critical fault	
	Cause	Measure
	Permanent low level of data signal detected.	– Check the wiring. – Check the encoder. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

Error: 13.19 (0D13hex | 3347dec) Description: Low level in signal cable – fault		
	Response: Encoder 1 – latest fault	
	Cause	Measure
	Permanent low level of data signal detected.	– Check the wiring. – Check the encoder. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

Error: 13.20 (0D14hex | 3348dec) Description: SSI encoder – critical fault		
	Response: Encoder 1 – latest critical fault	
	Cause	Measure
	The SSI encoder has detected a critical fault.	– Check the startup parameters. – Check the settings on the SSI encoder. – Check the wiring. – Check interference sources (light beam interrupted, reflector, signal cables, etc.). – Replace the encoder. INFORMATION In "Emergency mode" manual mode, you can move the drive even with a faulty external position encoder.

Error: 13.21 (0D15hex | 3349dec) Description: SSI encoder – fault		
	Response: Encoder 1 – latest fault	
	Cause	Measure
	The SSI encoder has detected a fault.	– Check the startup parameters. – Check the settings on the SSI encoder. – Check the wiring. – Check interference sources (light beam interrupted, reflector, signal cables, etc.). – Replace the encoder. INFORMATION In "Emergency mode" manual mode, you can move the drive even with a faulty external position encoder.

Error: 13.22 (0D16hex | 3350dec) Description: Critical internal fault		
	Response: Encoder 1 – latest critical fault	
	Cause	Measure
	The encoder has detected an internal fault.	– Check the wiring. – Check interference sources (light beam interrupted, reflector, signal cables, etc.). – Replace the encoder. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

31972098/EN – 8/2024

Error: 13.23 (0D17hex | 3351dec) Description: Internal fault		
	Response: Encoder 1 – latest fault	
	Cause	Measure
	The encoder has detected an internal fault. INFORMATION The encoder fault code is displayed in MOVISUITE® in the [Diagnostics] > [Fault memory T.] parameter group in the "Internal" parameter.	– Check the wiring. – Check interference sources (light beam interrupted, reflector, signal cables, etc.). – Replace the encoder. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

Error: 13.24 (0D18hex | 3352dec) Description: Travel range exceeded		
	Response: Encoder 1 – latest fault	
	Cause	Measure
	Current position mode does not allow for larger travel range.	– Ensure that the multi-turn encoder remains within the configured track range. – Check the limits. – Check the "Position mode" parameter. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

Error: 13.25 (0D19hex | 3353dec) Description: Error during encoder startup		
	Response: Output stage inhibit	
	Cause	Measure
	Error during encoder start-up.	Switch the device off, check the connection of the encoder, and switch the device on again.

Error: 13.26 (0D1Ahex | 3354dec) Description: Digital motor integration – critical fault		
	Response: Encoder 1 – latest critical fault	
	Cause	Measure
	The encoder of the digital motor integration has detected a fault. The exact cause of the fault is displayed in the fault status of the subslave.	– Check for EMC-compliant installation. – Replace the encoder.

Error: 13.27 (0D1Bhex | 3355dec) Description: Digital motor integration – fault		
	Response: Encoder 1 – latest fault	
	Cause	Measure
	The encoder of the digital motor integration has detected a fault. The exact cause of the fault is displayed in the fault status of the subslave.	– Check for EMC-compliant installation. – Replace the encoder.

Error: 13.28 (0D1Chex | 3356dec) Description: Digital motor integration – warning		
	Response: Encoder – warning	
	Cause	Measure
	The encoder of the digital motor integration has signaled a warning. The exact cause of the fault is displayed in the fault status of the subslave.	Check for EMC-compliant installation.

Error: 13.29 (0D1Dhex | 3357dec) Description: Absolute position invalid		
	Response: Encoder 1 – latest fault	
	Cause	Measure
	Diagnostics error detected while evaluating absolute encoder position. The referencing has been canceled.	– Reference the drive again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

13.8.12 Fault 14 Encoder 2

Error: 14.1 (0E01hex | 3585dec) Description: Error during position comparison check		
	Response: Encoder 2 – latest critical fault	
	Cause	Measure
	Fault detected when comparing raw position and track counter of absolute encoder.	– Check the wiring of the track signals. – Check for EMC-compliant installation. – Replace the encoder. – Replace the encoder card. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

31972098/EN – 8/2024

Error: 14.2 (0E02hex | 3586dec) Description: Unknown encoder type		
	Response: Encoder 2 – latest critical fault	
	Cause	Measure
	Encoder type not known and not supported by the device.	– Check the encoder type. – Contact SEW-EURODRIVE Service. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

Error: 14.3 (0E03hex | 3587dec) Description: Invalid data		
	Response: Encoder 2 – latest critical fault	
	Cause	Measure
	Invalid encoder nameplate data (measuring steps/pulses per revolution/multi-turn).	Use a different encoder type. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.
	The ratio of motor encoder resolution and distance encoder resolution is too large.	– Check the startup. – Check the project planning. – Check whether a suitable encoder is being used. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

Error: 14.4 (0E04hex | 3588dec) Description: Track measurement error		
	Response: Encoder 2 – latest critical fault	
	Cause	Measure
	Error during track measurement.	– Switch the device off and on again. – Check the wiring. – Check for EMC-compliant installation. – Check the encoder. Replace if necessary. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

31972098/EN – 8/2024

Error: 14.5 (0E05hex | 3589dec) Description: Internal warning		
	Response: Encoder – warning	
	Cause	Measure
	Encoder has signaled a warning.	– Check the wiring. – Check interference sources (light beam interrupted, reflector, signal cables, etc.). – Clean the sensor.

Error: 14.6 (0E06hex | 3590dec) Description: Signal level too low		
	Response: Encoder 2 – latest critical fault	
	Cause	Measure
	The amount of both or one of the track signals A and B is below the permitted limit.	– Check the wiring. – Check for EMC-compliant installation. – Check the encoder. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

Error: 14.7 (0E07hex | 3591dec) Description: Signal level too high		
	Response: Encoder 2 – latest critical fault	
	Cause	Measure
	The amount resulting from both or one of the two track signals A and B exceeds the permitted limit.	Check the transmission ratio of the resolver in use.

Error: 14.8 (0E08hex | 3592dec) Description: Error during level monitoring		
	Response: Encoder 2 – latest critical fault	
	Cause	Measure
	The amount resulting from the level of the two track signals A and B exceeds the permitted limit.	Check the mounting position of the resolver.

31972098/EN – 8/2024

Error: 14.9 (0E09hex | 3593dec) Description: Error during quadrant check		
	Response: Encoder 2 – latest critical fault	
	Cause	Measure
	Error checking quadrants (sine tracks/cosine tracks).	– Switch the device off and on again. – Check the wiring. – Check for EMC-compliant installation. – Check the encoder. Replace if necessary. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

Error: 14.10 (0E0Ahex | 3594dec) Description: Positional tolerance range exceeded		
	Response: Encoder 2 – latest critical fault	
	Cause	Measure
	Jump in position impermissibly large.	– Check the startup parameters. – Check the wiring. – Check interference sources (light beam interrupted, reflector, signal cables, etc.). – Replace the encoder. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

Error: 14.11 (0E0Bhex | 3595dec) Description: Encoder data timeout		
	Response: Encoder 2 – latest critical fault	
	Cause	Measure
	Communication to the encoder has failed.	Contact SEW-EURODRIVE Service.
	Internal fault detected in resolver evaluation.	Check for EMC-compliant installation.

31972098/EN – 8/2024

Error: 14.12 (0E0Chex | 3596dec) Description: Emergency		
	Response: Encoder 2 – latest critical fault	
	Cause	Measure
	CANopen encoder signals emergency.	For measures to correct the fault, refer to the documentation of the respective encoder. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

Error: 14.13 (0E0Dhex | 3597dec) Description: Initialization error		
	Response: Encoder 2 – latest fault	
	Cause	Measure
	Communication error during initialization.	– Check the wiring. – Check the startup parameters. – Check the encoder settings. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

Error: 14.14 (0E0Ehex | 3598dec) Description: Communication error		
	Response: Encoder 2 – latest fault	
	Cause	Measure
	Faulty encoder communication.	– Check the voltage supply. – Check for EMC-compliant installation. – Check the wiring. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

31972098/EN – 8/2024

Error: 14.15 (0E0Fhex | 3599dec) Description: System error		
	Response: Encoder 2 – latest critical fault	
	Cause	Measure
	System error while evaluating encoder.	– Check the setting of the encoder numerator/denominator factors. – Check whether the frame length matches the set transmission rate. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

Error: 14.16 (0E10hex | 3600dec) Description: High level in signal cable – critical fault		
	Response: Encoder 2 – latest critical fault	
	Cause	Measure
	Permanent high level of data signal.	– Check the wiring. – Check the encoder. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

Error: 14.17 (0E11hex | 3601dec) Description: High level in signal cable – fault		
	Response: Encoder 2 – latest fault	
	Cause	Measure
	Permanent high level of data signal.	– Check the wiring. – Check the encoder. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

Error: 14.18 (0E12hex | 3602dec) Description: Low level in signal cable – critical fault		
	Response: Encoder 2 – latest critical fault	
	Cause	Measure
	Permanent low level of data signal.	– Check the wiring. – Check the encoder. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

Error: 14.19 (0E13hex | 3603dec) Description: Low level in signal cable – fault		
	Response: Encoder 2 – latest fault	
	Cause	Measure
	Permanent low level of data signal.	– Check the wiring. – Check the encoder. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

Error: 14.20 (0E14hex | 3604dec) Description: SSI encoder – critical fault		
	Response: Encoder 2 – latest critical fault	
	Cause	Measure
	SSI encoder has signaled a critical fault.	– Check the startup parameters. – Check the settings on the SSI encoder. – Check the wiring. – Check interference sources (light beam interrupted, reflector, signal cables, etc.). – Replace the encoder. INFORMATION In "Emergency mode" manual mode, you can move the drive even with a faulty external position encoder.

31972098/EN – 8/2024

Error: 14.21 (0E15hex | 3605dec) Description: SSI encoder – fault		
	Response: Encoder 2 – latest fault	
	Cause	Measure
	SSI encoder has detected a fault.	– Check the startup parameters. – Check the settings on the SSI encoder. – Check the wiring. – Check interference sources (light beam interrupted, reflector, signal cables, etc.). – Replace the encoder. INFORMATION In "Emergency mode" manual mode, you can move the drive even with a faulty external position encoder.

Error: 14.22 (0E16hex | 3606dec) Description: Critical internal fault		
	Response: Encoder 2 – latest critical fault	
	Cause	Measure
	Encoder has detected an internal fault.	– Check the wiring. – Check interference sources (light beam interrupted, reflector, signal cables, etc.). – Replace the encoder. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

Error: 14.23 (0E17hex | 3607dec) Description: Internal fault		
	Response: Encoder 2 – latest fault	
	Cause	Measure
	Encoder has detected an internal fault. INFORMATION The encoder fault code is displayed in MOVISUITE® in the [Diagnostics] > [Fault memory T.] parameter group in the "Internal" parameter.	– Check the wiring. – Check interference sources (light beam interrupted, reflector, signal cables, etc.). – Replace the encoder. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

Error: 14.24 (0E18hex | 3608dec) Description: Travel range exceeded		
	Response: Encoder 2 – latest fault	
	Cause	Measure
	Current position mode does not allow for larger travel range.	– Ensure that the multi-turn encoder remains within the configured track range. – Check the limits. – Check the "Position mode" parameter. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

Error: 14.25 (0E19hex | 3609dec) Description: Error during encoder startup		
	Response: Output stage inhibit	
	Cause	Measure
	Error during encoder start-up.	Switch the device off, check the connection of the encoder, and switch the device on again.

Error: 14.29 (0E1Dhex | 3613dec) Description: Absolute position invalid		
	Response: Encoder 2 – latest fault	
	Cause	Measure
	Diagnostics error detected while evaluating absolute encoder position. The referencing has been canceled.	– Reference the drive again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

13.8.13 Fault 16 Startup

Error: 16.1 (1001hex | 4097dec) Description: Incomplete motor startup		
	Response: Output stage inhibit	
	Cause	Measure
	The motor has not been started up or not started up completely.	Perform complete motor startup.

31972098/EN – 8/2024

Error: 16.2 (1002hex | 4098dec) Description: Cannot calculate controller parameters		
	Response: Output stage inhibit	
	Cause	Measure
	The long delay of the encoder that is used is preventing the calculation of the required filter coefficients.	Use an encoder with a shorter delay.

Error: 16.3 (1003hex | 4099dec) Description: Thermal motor model not possible		
	Response: Output stage inhibit	
	Cause	Measure
	Startup of the thermal model not yet completed or its parameterization is invalid.	Perform startup again.

Error: 16.5 (1005hex | 4101dec) Description: Current limit smaller than magnetizing current of the motor		
	Response: Output stage inhibit	
	Cause	Measure
	Current limit smaller than magnetizing current of motor calculated by active control mode.	Increase the current limit.

Error: 16.6 (1006hex | 4102dec) Description: Control mode not possible		
	Response: Output stage inhibit	
	Cause	Measure
	Wrong control mode selected for the motor.	Choose a suitable control mode.
	When starting up a synchronous third-party motor, some control modes and drive functions are only permitted after motor parameter measurement.	Perform a motor parameter measurement using the FCB 25 drive function.

31972098/EN – 8/2024

Error: 16.7 (1007hex | 4103dec) Description: PWM frequency not possible		
	Response: Output stage inhibit	
	Cause	Measure
	The set speed controller sampling cycle of 1 ms is not possible with the set PWM frequency.	– Set a PWM frequency of 4, 8, or 16 kHz. or – Adjust the sampling cycle.
	The motor requires a higher PWM frequency than the inverter can provide.	Use an inverter with suitable PWM frequency.
	The ELSM® control mode can only be used with an inverter that supports PWM frequencies of 2.5, 4 or 8 kHz.	Use an inverter with suitable PWM frequency.
	The FCB 25 drive function can only be used with an inverter that supports PWM frequencies of 2.5, 4 or 8 kHz.	Use an inverter with suitable PWM frequency.
	The FCB 18 drive function can only be used with an inverter that supports PWM frequencies of 2.5, 4 or 8 kHz.	Use an inverter with suitable PWM frequency option.

Error: 16.8 (1008hex | 4104dec) Description: Temperature sensor motor 1 – startup error		
	Response: Output stage inhibit	
	Cause	Measure
	Fault detected in the startup of the temperature sensor of motor 1.	Check the startup parameters.

Error: 16.9 (1009hex | 4105dec) Description: Temperature sensor motor 2 – startup error		
	Response: Output stage inhibit	
	Cause	Measure
	Fault detected in the startup of the temperature sensor of motor 2.	Check the startup parameters.

Error: 16.10 (100Ahex | 4106dec) Description: Actual position source not assigned		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	In the selected drive function, an encoder is required for position control that is used as the source for calculating the actual position.	– Assign an encoder for the position control in the drive train configuration. – If an encoder is present, only use FCBs without positioning control.

31972098/EN – 8/2024

Error: 16.11 (100Bhex | 4107dec) Description: Error calculating motor data		
	Response: Output stage inhibit	
	Cause	Measure
	Motor startup cannot be performed because of inconsistent motor data or wrong device configuration data.	– Check the startup. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

Error: 16.12 (100Chex | 4108dec) Description: Motor data write sequence not adhered to	
Response: Output stage inhibit	
Cause	Measure
Write sequence not adhered to before writing electrical startup parameters.	Perform startup again.

Error: 16.13 (100Dhex | 4109dec) Description: Several motor protection models active	
Response: Output stage inhibit	
Cause	Measure
Several motor protection models are active in one of the thermal motor monitorings.	– Perform startup again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

Error: 16.20 (1014hex | 4116dec) Description: Nominal speed too high or nominal frequency too low	
Response: Output stage inhibit	
Cause	Measure
No plausible value could be determined when calculating the number of pole pairs from the nominal speed and nominal frequency.	– Check the settings for nominal speed and nominal frequency. – Perform startup again.

Error: 16.21 (1015hex | 4117dec) Description: Negative nominal slip determined	
Response: Output stage inhibit	
Cause	Measure
Negative slip determined at startup.	– Check the settings for nominal speed and nominal frequency. – Perform startup again.

Error: 16.22 (1016hex | 4118dec) Description: Number of pole pairs cannot be determined		
	Response: Output stage inhibit	
	Cause	Measure
	It is not possible to calculate the number of pole pairs accurately from the nominal frequency and the nominal speed.	Enter the number of pole pairs.

Error: 16.23 (1017hex | 4119dec) Description: Plausibility check failed		
	Response: Output stage inhibit	
	Cause	Measure
	The estimated nominal power does not match the nominal power entered at startup.	– Check the entered data. – Perform startup again.

Error: 16.24 (1018hex | 4120dec) Description: Speed controller sampling cycle not possible with PWM frequency or control mode		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	The set speed controller sampling cycle of not equal to 2 ms is not possible with the set PWM frequency.	– Set PWM frequency that is suitable for the sampling cycle. or – Set sampling cycle to 2 ms (suitable for PWM frequency).
	For ELSM® control mode, the only permitted speed controller sampling cycles are 1 ms and 2 ms.	Set the sampling cycle to 1 ms or 2 ms.

Error: 16.25 (1019hex | 4121dec) Description: User-defined current limit too low for standstill current		
	Response: Output stage inhibit	
	Cause	Measure
	User-defined current limit value too low for configured standstill current.	– Increase user-defined current limit. or – Reduce standstill current.

31972098/EN – 8/2024

Error: 16.26 (101Ahex | 4122dec)

Description: Nominal values incomplete or not plausible

Response: Output stage inhibit

Cause	Measure
One or all of the following parameters are not set or are not plausible: – Nominal voltage – Nominal current – Nominal speed – Nominal torque	– Check the entered data. – Perform startup again.

Error: 16.27 (101Bhex | 4123dec)

Description: Maximum current or maximum torque not plausible

Response: Output stage inhibit

Cause	Measure
The following parameters are not set or are not plausible: – Maximum current – Maximum torque	– Check the entered data. – Perform startup again.

Error: 16.30 (101Ehex | 4126dec)

Description: Faulty EtherCAT® EEPROM configuration status

Response: Warning

Cause	Measure
The EtherCAT®/SBusPLUS EEPROM is incorrectly configured.	Contact SEW-EURODRIVE Service.

Error: 16.55 (1037hex | 4151dec)

Description: PID controller – source of actual value not defined

Response: Output stage inhibit

Cause	Measure
The PID controller has been activated but the source of the actual value has not been defined yet.	Define the source of the actual value.

Error: 16.60 (103Chex | 4156dec)

Description: Parameter setting for 3-wire control not valid

Response: Warning

Cause	Measure
No 3-wire control stop terminal parameterized.	Set stop terminal parameters.

31972098/EN – 8/2024

13.8.14 Fault 17 Internal processor error

Error: 17.7 (1107hex | 4359dec) Description: Exception error		
	Response: Output stage inhibit	
	Cause	Measure
	Internal computing error (trap) in CPU.	– Switch the device off and on again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

Error: 17.8 (1108hex | 4360dec) Description: Non-volatile data not loaded		
	Response: Output stage inhibit System state: Fault acknowledgment with CPU reset	
	Cause	Measure
	The CPU has been restarted several times without firmware being fully initialized. The non-volatile data is not loaded, the default values remain active.	– Acknowledge the fault. – Check the voltage supply. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

13.8.15 Fault 18 Software error

Error: 18.1 (1201hex | 4609dec) Description: Error in motor management interface		
	Response: Output stage inhibit System state: Fault acknowledgment with CPU reset	
	Cause	Measure
	Error at motor management interface.	– Switch the device off and on again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

Error: 18.3 (1203hex | 4611dec) Description: Task system – warning		
	Response: Warning	
	Cause	Measure
	A fault was detected while processing the internal task system.	– Acknowledge the warning. – If the warning occurs repeatedly, contact SEW-EURODRIVE Service.

31972098/EN – 8/2024

Error: 18.4 (1204hex | 4612dec) Description: Task system – error		
	Response: Output stage inhibit System state: Fault acknowledgment with CPU reset	
	Cause	Measure
	A fault was detected while processing the internal task system.	– Switch the device off and on again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

Error: 18.7 (1207hex | 4615dec) Description: Fatal software error		
	Response: Output stage inhibit System state: Fault acknowledgment with CPU reset	
	Cause	Measure
	Fatal software error.	– Switch the device off and on again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

Error: 18.8 (1208hex | 4616dec) Description: Invalid fault code		
	Response: Output stage inhibit	
	Cause	Measure
	Invalid fault code requested.	– Switch the device off and on again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

Error: 18.9 (1209hex | 4617dec) Description: Internal software error		
	Response: Output stage inhibit System state: Fault acknowledgment with CPU reset	
	Cause	Measure
	The software signaled an unexpected event.	– Switch the device off and on again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

Error: 18.10 (120Ahex | 4618dec) Description: Watchdog error		
	Response: Output stage inhibit	
	Cause	Measure
	Watchdog has detected an error. The software is not operating within the intended cycle time.	– Switch the device off and on again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

31972098/EN – 8/2024

Error: 18.12 (120Chex | 4620dec) Description: Configuration data faulty		
	Response: Output stage inhibit System state: Fault acknowledgment with CPU reset	
	Cause	Measure
	Configuration data not plausible or cannot be interpreted by active firmware version.	– Perform a firmware update. – Contact SEW-EURODRIVE Service.

Error: 18.13 (120Dhex | 4621dec) Description: Calibration data not plausible		
	Response: Output stage inhibit System state: Fault acknowledgment with CPU reset	
	Cause	Measure
	Calibration data not plausible.	Contact SEW-EURODRIVE Service.

Error: 18.14 (120Ehex | 4622dec) Description: Energy management error		
	Response: Output stage inhibit System state: Fault acknowledgment with CPU reset	
	Cause	Measure
	An application that switches supply voltages (e.g. standby mode) off or on could not be stopped or started.	– Switch the device off and on again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

13.8.16 Fault 19 Process data

Error: 19.1 (1301hex | 4865dec) Description: Torque profile value violation		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	The set torque profile values are not plausible. The torque limit may only be specified as an absolute value.	Correct the profile values.

Error: 19.2 (1302hex | 4866dec) Description: Position setpoint violation		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	Position setpoint outside software limit switches.	Check the position setpoint.
	Position setpoint outside modulo positioning range.	Check the position setpoint.
	Position in user unit generates number overflow in the system unit.	Check the position in the user unit.

31972098/EN – 8/2024

Error: 19.3 (1303hex | 4867dec) Description: Speed setpoint violation		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	The speed setpoints in the profile value connection are not plausible. The speed limit is only permitted to be specified as an absolute value.	Correct the setpoints.

Error: 19.4 (1304hex | 4868dec) Description: Acceleration setpoint violation		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	The acceleration setpoint in the profile value connection is not plausible. The acceleration limit is only permitted to be specified as an absolute value.	Correct the setpoint.

Error: 19.5 (1305hex | 4869dec) Description: Drive function not available		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	Non-existent drive function (FCB) selected.	Enter the available FCB number.

Error: 19.6 (1306hex | 4870dec) Description: Mass moment of inertia setpoint violation		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	The mass moment of inertia setpoint is not plausible. The mass moment of inertia is only permitted to be specified as an absolute value.	Correct the setpoint.

Error: 19.7 (1307hex | 4871dec) Description: Referencing missing		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	The activated function can only be performed with a referenced drive.	Reference the drive.

Error: 19.8 (1308hex | 4872dec) Description: Drive train changeover not allowed		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	Drive train changeover requested while output stage is enabled.	Inhibit the output stage before changing to another drive train.

Error: 19.9 (1309hex | 4873dec) Description: Jerk setpoint violation		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	The jerk time is not plausible. The jerk time is only permitted to be specified as an absolute value	Adjust the jerk time.

13.8.17 Fault 20 Device monitoring

Error: 20.1 (1401hex | 5121dec) Description: Supply voltage fault		
	Response: Output stage inhibit System state: Fault acknowledgment with CPU reset	
	Cause	Measure
	Internal electronics supply voltage or externally connected DC 24 V supply voltage not within permitted voltage range.	– Check the voltage level of the external DC 24 V supply voltage and check for correct connection. – Acknowledge the fault. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.
	24 V power supply unit overloaded.	Check the project planning for the power demand.

Error: 20.2 (1402hex | 5122dec) Description: Supply voltage overloaded		
	Response: Output stage inhibit	
	Cause	Measure
	The current load on the current paths of the DC 24 V supply voltage inside the device is too high. The signal outputs of the device were therefore de-energized.	– Remove all external consumers: – at the digital outputs of the basic device – at any options that may be present – at all encoder connections – at other consumers at the DC 24 V output voltage terminals – Acknowledge the fault. – Reconnect the consumers with the device, one after the other, until the fault message appears once again. – Connect a consumer with a lower current consumption or eliminate the short circuit.

31972098/EN – 8/2024

Error: 20.7 (1407hex | 5127dec) Description: Internal hardware fault		
	Response: Output stage inhibit System state: Fault acknowledgment with CPU reset	
	Cause	Measure
	Fault in the device hardware.	– Acknowledge the fault. – If the fault occurs repeatedly, replace the device.

Error: 20.8 (1408hex | 5128dec) Description: Fan – warning	
	Response: Warning with self-reset
Cause	Measure
Fan function impaired.	– Check fan for dirt. – If the warning occurs repeatedly, contact SEW-EURODRIVE Service.

Error: 20.9 (1409hex | 5129dec) Description: Fan – fault	
	Response: Application stop + output stage inhibit
Cause	Measure
The fan is defective.	Contact SEW-EURODRIVE Service.

Error: 20.10 (140Ahex | 5130dec) Description: Fan – supply voltage fault	
	Response: Emergency stop + output stage inhibit
Cause	Measure
Supply voltage of fan missing.	Contact SEW-EURODRIVE Service.

Error: 20.11 (140Bhex | 5131dec) Description: STO – switching delay	
	Response: Output stage inhibit
Cause	Measure
Switching delay between STO signals F-STO_P1 and F-STO_P2.	– Check the STO wiring. – Make sure that both STO signals are switched to low level. – Acknowledge the fault.

31972098/EN – 8/2024

Error: 20.23 (1417hex | 5143dec) Description: Temperature detection in power section faulty		
	Response: Output stage inhibit	
	Cause	Measure
	Fault in the device hardware. Power section does not provide temperature data.	– Acknowledge the fault. – Contact SEW-EURODRIVE Service.

13.8.18 Fault 21 Digital motor integration 1

Error: 21.1 (1501hex | 5377dec) Description: Communication error		
	Response: Output stage inhibit	
	Cause	Measure
	Communication error at interface of digital motor integration.	Check the cabling.

Error: 21.2 (1502hex | 5378dec) Description: Slave required		
	Response: Digital motor integration	
	Cause	Measure
	Device started up with a drive with digital motor integration but no drive with digital motor integration is connected.	– Check the connection of the digital motor integration. – Perform startup again.

Error: 21.3 (1503hex | 5379dec) Description: Incompatible drive		
	Response: Output stage inhibit	
	Cause	Measure
	The connected drive does not match the drive that was started up.	– Connect an appropriate drive. – Perform startup again.

Error: 21.4 (1504hex | 5380dec) Description: Invalid label		
	Response: Output stage inhibit	
	Cause	Measure
	The connected drive contains invalid data.	Replace the drive.

Error: 21.5 (1505hex | 5381dec) Description: Incompatible slave		
	Response: Output stage inhibit	
	Cause	Measure
	The firmware versions of the slaves used are not compatible with one another.	Update the inverter and/or the slave.

31972098/EN – 8/2024

Error: 21.6 (1506hex | 5382dec) Description: Overload/short circuit on the interface		
	Response: Output stage inhibit	
	Cause	Measure
	Short circuit in the cabling of a slave of digital motor integration.	Check the cabling of the slave.
	The voltage of the digital motor integration slave is too low.	Check the permitted cable length.

Error: 21.7 (1507hex | 5383dec) Description: High current demand of slave	
Response: Output stage inhibit	
Cause	Measure
The current consumption of the slave is too high.	Use a slave with lower current consumption.

Error: 21.8 (1508hex | 5384dec) Description: Parameter error	
Response: Output stage inhibit	
Cause	Measure
Error while processing data from digital motor integration slave.	Repeat the process in configuration state.
The connected drive contains invalid data.	Replace the drive.

Error: 21.9 (1509hex | 5385dec) Description: Illegal hot plug	
Response: Emergency stop + output stage inhibit	
Cause	Measure
A slave of digital motor integration was connected while the drive was enabled.	– Activate the configuration state of the inverter, e.g. by inhibiting the output stage. – Switch the inverter off and on again. – Connect the slave when it is de-energized.
A slave of digital motor integration was connected while the inverter was in standby mode without switching off the encoder supply.	– Switch off encoder supply in standby mode. – Connect the slave when it is de-energized.

Error: 21.10 (150Ahex | 5386dec) Description: Connection type not configured correctly	
Response: Output stage inhibit	
Cause	Measure
The connection type of the connected drive cannot be determined.	Set the connection type on the drive correctly.

31972098/EN – 8/2024

Error: 21.11 (150Bhex | 5387dec) Description: Illegal subslave		
	Response: Output stage inhibit	
	Cause	Measure
	The device cannot be operated with a subslave connected via digital motor integration.	Connect another subslave.

Error: 21.12 (150Chex | 5388dec) Description: Slave/subslave not accessible – fault		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	A slave/subslave of digital motor integration is in the Device Update Manager.	– Update the firmware of the slave/subslave. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

Error: 21.13 (150Dhex | 5389dec) Description: Slave/subslave not accessible – warning		
	Response: Warning	
	Cause	Measure
	A slave/subslave of digital motor integration is in the Device Update Manager.	– Update the firmware of the slave/subslave. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

Error: 21.14 (150Ehex | 5390dec) Description: Missing startup of brake control		
	Response: Output stage inhibit	
	Cause	Measure
	Brake control not started up.	Start up brake control or connect another drive.

Error: 21.20 (1514hex | 5396dec) Description: Slave – critical fault		
	Response: Output stage inhibit	
	Cause	Measure
	A slave of digital motor integration has detected a critical fault.	Observe the fault message of the subslave. Identify the exact cause of this fault message and take the appropriate measures to eliminate the fault.

31972098/EN – 8/2024

Error: 21.21 (1515hex | 5397dec) Description: Slave – fault		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	A slave of digital motor integration has detected a fault.	Observe the fault message of the subslave. Identify the exact cause of this fault message and take the appropriate measures to eliminate the fault.

Error: 21.22 (1516hex | 5398dec) Description: Slave – warning		
	Response: Warning	
	Cause	Measure
	A slave of digital motor integration has signaled a warning.	Observe the warning of the subslave. Identify the exact cause of this warning and take the appropriate measures for elimination.

13.8.19 Fault 23 Power section

Error: 23.1 (1701hex | 5889dec) Description: Warning		
	Response: Warning with self-reset	
	Cause	Measure
	The power section has signaled a warning.	Observe the warning of the power section subcomponent. Identify the exact cause of this warning and take the appropriate measures to eliminate the fault.

Error: 23.2 (1702hex | 5890dec) Description: Error		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	The power section has detected a fault.	Observe the fault message of the power section subcomponent. Identify the exact cause of this fault message and take the appropriate measures to eliminate the fault.

Error: 23.3 (1703hex | 5891dec) Description: Critical fault		
	Response: Output stage inhibit	
	Cause	Measure
	The power section has detected a critical fault.	Observe the fault message of the power section subcomponent. Identify the exact cause of this fault message and take the appropriate measures to eliminate the fault.

Error: 23.4 (1704hex | 5892dec) Description: Hardware fault		
	Response: Output stage inhibit	
	Cause	Measure
	Fault detected in a hardware component of the power section.	– Check for short circuit / ground fault at the output of the inverter. – Reduce the line capacity at the output of the inverter. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.
	Fault detected on switched-mode power supply.	Check the DC 24 V supply voltage.
	Fault detected at the gate driver of a power semiconductor.	Contact SEW-EURODRIVE Service.

Error: 23.5 (1705hex | 5893dec) Description: Invalid process data configuration		
	Response: Output stage inhibit	
	Cause	Measure
	Invalid process data configuration.	– Switch the devices off and on again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

Error: 23.6 (1706hex | 5894dec) Description: Process data transfer timeout		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	Timeout of process data transfer at the communication interface of the power section.	– Switch the device off and on again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

Error: 23.7 (1707hex | 5895dec) Description: Parameter communication timeout		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	Timeout in parameter communication at the communication interface of the power section.	– Switch the device off and on again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

31972098/EN – 8/2024

Error: 23.8 (1708hex | 5896dec) Description: Parameter communication error		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	Parameter communication error detected at the communication interface of the power section.	– Switch the device off and on again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

Error: 23.9 (1709hex | 5897dec) Description: Firmware of power section corrupt		
	Response: Output stage inhibit	
	Cause	Measure
	Failed to update firmware on power section.	– Update the firmware again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

13.8.20 Fault 24 Cam switch

Error: 24.1 (1801hex | 6145dec) Description: Cam window limits interchanged	
	Response: Warning
Cause	Measure
Left cam window limit larger than right limit.	Check cam window limits and adjust.

Error: 24.2 (1802hex | 6146dec) Description: Cam window limit outside modulo positioning range	
	Response: Warning
Cause	Measure
Cam window limits outside modulo positioning range.	Check cam window limits and adjust.

Error: 24.3 (1803hex | 6147dec) Description: Overlapping cam windows in track	
	Response: Warning
Cause	Measure
Cam window limits of a track overlap.	Adjust the cam window limits in such a way that they are flush.

31972098/EN – 8/2024

Error: 24.4 (1804hex | 6148dec) Description: Modulo – minimum interpretation and modulo – maximum interpretation not plausible		
	Response: Warning	
	Cause	Measure
	The value of the "Modulo – minimum interpretation" parameter is greater than the "Modulo – maximum interpretation" parameter.	Correct the parameter values.

13.8.21 Fault 25 Parameter memory monitoring

Error: 25.1 (1901hex | 6401dec) Description: Timeout warning	
Response: Warning with self-reset	
Cause	Measure
Access to memory (read/write) takes longer than expected.	No measure required. The fault will be reset automatically after completed memory access.

Error: 25.2 (1902hex | 6402dec) Description: Non-volatile memory system – runtime error	
Response: Output stage inhibit System state: Fault acknowledgment with CPU reset	
Cause	Measure
Runtime error in non-volatile memory system.	– Switch the device off and on again. – Restore delivery state. Note that doing so will reset all data in the non-volatile memory to the values at delivery. – If the fault occurs repeatedly, replace the device/memory module. Contact SEW-EURODRIVE Service. – Perform basic initialization. Contact SEW-EURODRIVE Service for this.

31972098/EN – 8/2024

Error: 25.6 (1906hex | 6406dec) Description: Incompatible device configuration		
	Response: Output stage inhibit	
	Cause	Measure
	The data set of another device was copied in the device, which differs in device family, power, or voltage from the current device.	– Acknowledge the fault through a manual fault reset. To do so, under [Diagnostics] > [Status] > [Fault status] in the "Manual fault reset" parameter, select the "With parameter set acceptance" setting. – Restore delivery state. Note that doing so will reset all data in the non-volatile memory to the values at delivery.
	The replaceable memory module of another device has been inserted in the device, which differs from the current device in device family, power, voltage or design, for example.	– Insert the correct memory module. – Acknowledge the fault through a manual fault reset. To do so, under [Diagnostics] > [Status] > [Fault status] in the "Manual fault reset" parameter, select the "With parameter set acceptance" setting. – Restore delivery state. Note that doing so will reset all data in the non-volatile memory to the values at delivery. – Perform basic initialization. Contact SEW-EURODRIVE Service for this.
	The power section has been replaced and differs in its power rating or voltage from the original power section.	– Insert the correct power section. – Acknowledge the fault through a manual fault reset. To do so, under [Diagnostics] > [Status] > [Fault status] in the "Manual fault reset" parameter, select the "With parameter set acceptance" setting. – Restore delivery state. Note that doing so will reset all data in the non-volatile memory to the values at delivery.
	The subcomponent is defective.	Contact SEW-EURODRIVE Service.

Error: 25.7 (1907hex | 6407dec) Description: Non-volatile memory system – initialization error		
	Response: Output stage inhibit	
	Cause	Measure
	Initialization of the non-volatile memory system has failed.	– Switch the device off and on again. – Restore delivery state. Note that doing so will reset all data in the non-volatile memory to the values at delivery. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service. – Perform basic initialization. Contact SEW-EURODRIVE Service for this.

Error: 25.10 (190Ahex | 6410dec) Description: Power section configuration data – version conflict		
	Response: Output stage inhibit	
	Cause	Measure
	Wrong version of configuration data of power section.	Contact SEW-EURODRIVE Service.

Error: 25.12 (190Chex | 6412dec) Description: Power section configuration data – CRC error		
	Response: Output stage inhibit	
	Cause	Measure
	Faulty configuration data of power section.	Contact SEW-EURODRIVE Service.

Error: 25.13 (190Dhex | 6413dec) Description: Control electronics configuration data – CRC error		
	Response: Output stage inhibit	
	Cause	Measure
	Faulty configuration data of control electronics.	Contact SEW-EURODRIVE Service.

Error: 25.14 (190Ehex | 6414dec) Description: Calibration data of power section – version conflict		
	Response: Output stage inhibit	
	Cause	Measure
	Wrong version of calibration data of power section.	Contact SEW-EURODRIVE Service.

Error: 25.15 (190Fhex | 6415dec) Description: Calibration data of control electronics – version conflict		
	Response: Output stage inhibit	
	Cause	Measure
	Wrong version of calibration data of control electronics.	Contact SEW-EURODRIVE Service.

Error: 25.16 (1910hex | 6416dec) Description: Power section calibration data – CRC error		
	Response: Output stage inhibit	
	Cause	Measure
	Faulty calibration data of power section.	Contact SEW-EURODRIVE Service.

31972098/EN – 8/2024

Error: 25.17 (1911hex | 6417dec) Description: Control electronics calibration data – CRC error		
	Response: Output stage inhibit	
	Cause	Measure
	Faulty calibration data of control electronics.	Contact SEW-EURODRIVE Service.

Error: 25.18 (1912hex | 6418dec) Description: Power section QA data – CRC error		
	Response: Warning	
	Cause	Measure
	Faulty quality assurance data of power section.	Contact SEW-EURODRIVE Service.

Error: 25.19 (1913hex | 6419dec) Description: Control electronics QA data – CRC error		
	Response: Warning	
	Cause	Measure
	Faulty quality assurance data of control electronics.	Contact SEW-EURODRIVE Service.

Error: 25.20 (1914hex | 6420dec) Description: Basic device memory – initialization error		
	Response: Output stage inhibit	
	Cause	Measure
	Initialization of basic device memory failed.	Contact SEW-EURODRIVE Service.

Error: 25.21 (1915hex | 6421dec) Description: Basic device memory – runtime error		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	Runtime error detected in memory of basic device.	Contact SEW-EURODRIVE Service.

Error: 25.30 (191Ehex | 6430dec) Description: Replaceable memory module – initialization error		
	Response: Output stage inhibit	
	Cause	Measure
	The formatting of the replaceable memory module does not match.	– Switch the device off and on again. – Restore delivery state. Note that doing so will reset all data in the replaceable memory module to the values at delivery.
	Initialization of replaceable memory module failed after restoring delivery state.	– Contact SEW-EURODRIVE Service. – Perform basic initialization. Contact SEW-EURODRIVE Service for this.

31972098/EN – 8/2024

Error: 25.31 (191Fhex | 6431dec) Description: Replaceable memory module – runtime error		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	Runtime error detected in replaceable memory module.	– Insert new memory module and perform startup again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

Error: 25.32 (1920hex | 6432dec) Description: Incompatible replaceable memory module	
	Response: Output stage inhibit System state: Fault acknowledgment with CPU reset
Cause	Measure
The replaceable memory module is not compatible with the device.	Replace the memory module.

Error: 25.33 (1921hex | 6433dec) Description: Replaceable memory module – incompatible equipment category	
	Response: Output stage inhibit
Cause	Measure
The replaceable memory module is formatted and contains data from a device of a different equipment category. The data is not compatible and cannot be used.	– Replace the memory module. – Restore delivery state. Note that doing so will reset all data in the replaceable memory module to the values at delivery.

Error: 25.50 (1932hex | 6450dec) Description: Replaceable memory module of safety option – runtime error	
	Response: Output stage inhibit System state: Fault acknowledgment with CPU reset
Cause	Measure
Runtime error detected in the replaceable memory module of the safety option.	Contact SEW-EURODRIVE Service.

Error: 25.51 (1933hex | 6451dec) Description: Replaceable memory module of safety option – initialization error	
	Response: Warning
Cause	Measure
Initialization of the replaceable memory module of the safety option failed.	Contact SEW-EURODRIVE Service.

31972098/EN – 8/2024

Error: 25.61 (193Dhex | 6461dec) Description: Restore point – failure		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	Failed to create restore point.	Create the restore point again.

Error: 25.70 (1946hex | 6470dec) Description: Incompatible card configuration		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	The current configuration of the cards does not match the configuration state saved during start-up. For example, a card was removed that was still present during startup.	– Restore the original configuration of the cards. – Acknowledge the fault through a manual fault reset. To do so, under [Diagnostics] > [Status] > [Fault status] in the "Manual fault reset" parameter, select the "With parameter set acceptance" setting.

13.8.22 Fault 26 External fault

Error: 26.1 (1A01hex | 6657dec) Description: External fault via digital input/control bit		
	Response: External fault	
	Cause	Measure
	An error was triggered via a digital input or a bit of a control word.	– Eliminate the external fault. or – Change the response to an external fault under [Functions] > [Setpoints] > [Basic settings].

Error: 26.2 (1A02hex | 6658dec) Description: Emergency shutdown		
	Response: Output stage inhibit	
	Cause	Measure
	A module bus station requested external emergency shutdown.	Identify the fault of the module bus station and eliminate it.

Error: 26.3 (1A03hex | 6659dec) Description: Power section emergency shutdown		
	Response: Output stage inhibit	
	Cause	Measure
	The power section has detected a critical fault and requested external emergency shutdown.	Contact SEW-EURODRIVE Service.

Error: 26.4 (1A04hex | 6660dec) Description: Error while monitoring temperature of external braking resistor		
	Response: Response to external braking resistor fault	
	Cause	Measure
	The connected temperature switch of the external braking resistor has tripped.	– Check the mounting position of the braking resistor. – Clean the braking resistor. – Check the configuration of the braking resistor. – Install a larger braking resistor. – Check the external trip switch settings. – Optimize the travel cycle so that less regenerative operation energy is created. – Check the settings of the storage discharge function in the MOVIKIT® software module concerned.

13.8.23 Fault 28 FCB drive functions

Error: 28.1 (1C01hex | 7169dec) Description: FCB 11/12 – Searching zero pulse timeout		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	Failed to find zero pulse of encoder's C track within specified search time during reference travel.	Check the encoder wiring.

Error: 28.2 (1C02hex | 7170dec) Description: FCB 11/12 – Hardware limit switch before reference cam		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	The hardware limit switch was reached during reference travel. The reference cam was not detected.	Make sure that the reference cam is not installed downstream of the hardware limit switch.

Error: 28.3 (1C03hex | 7171dec) Description: FCB 11/12 – Hardware limit switch and reference cam not flush		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	Hardware limit switch and reference cam not mounted flush.	Make sure that the reference cam and the hardware limit switch are mounted flush.

31972098/EN – 8/2024

Error: 28.4 (1C04hex | 7172dec) Description: FCB 11/12 – Faulty reference offset		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	Error determining reference offset.	– Make sure that the reference offset is smaller than the "Modulo maximum" limit value. – When using a single-turn absolute encoder, make sure that the reference offset is larger than one encoder revolution. – Make sure that an encoder has been inserted when assigning the encoder as the source of the actual position.

Error: 28.5 (1C05hex | 7173dec) Description: FCB 11/12 – Referencing not possible		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	In the active drive train during encoder assignment, no encoder was specified as the source of the actual position.	– Set an encoder as the source of the actual position. –"Reference all encoders of the drive train" = "Yes"
	The reference travel type "Absolute encoder position" is only permitted for absolute encoders in the position mode "Linear mode" or "Single-turn absolute position".	– Adjust the positioning mode of the encoder. – Use a different reference travel type
	Either no encoders are assigned in the active drive train, or there is no referenceable position present.	Assign encoder.

Error: 28.6 (1C06hex | 7174dec) Description: FCB 11/12 – Limit switch/reference cam not flush/overlapping with fixed stop		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	Hardware limit switch and reference cam hit at the same time during reference travel to fixed stop.	Check whether the positions of the hardware limit switch and reference cam for reference travel are correctly set.
	During reference travel to fixed stop and active speed changeover at hardware limit switch or reference cam, the fixed stop has been reached without the hardware limit switch or reference cam being hit.	Check whether the positions of the hardware limit switch and reference cam for reference travel are correctly set.

31972098/EN – 8/2024

Error: 28.7 (1C07hex | 7175dec) Description: FCB 21 – Required total torque too high		
	Response: Output stage inhibit	
	Cause	Measure
	The required total torque is greater than the permitted maximum torque at the motor shaft. The total torque is calculated from the torque specification and the determined/specified load torque.	– Reduce the torque specification. – Change the direction of rotation. – Increase the power of the drive.

Error: 28.8 (1C08hex | 7176dec) Description: FCB 21 – Total torque not reached		
	Response: Output stage inhibit	
	Cause	Measure
	The required total torque (at least 90%) was not reached. The total torque is calculated from the torque specification and the determined/specified load torque.	– Reduce the torque specification. – Check the limit values of the inverter. – Check the motor connection.

Error: 28.9 (1C09hex | 7177dec) Description: FCB 18 – Rotor position identification not possible		
	Response: Output stage inhibit	
	Cause	Measure
	Rotor position identification with an incremental encoder was aborted.	– Restart the rotor position identification. – Check whether the encoder is properly connected. – Check whether the encoder is defective.
	Result of rotor position identification (measured encoder offset) cannot be stored in encoder.	Store the measured encoder offset in the inverter
	In the "Automatic" operating mode, the result of rotor position identification (measured encoder offset) cannot be stored in the encoder. In this operating mode, the measured value can only be stored in the inverter	– Set the operating mode to "Manual". or – Store the measured encoder offset in the inverter.

Error: 28.10 (1C0Ahex | 7178dec) Description: FCB 25 – Unbalanced motor phases		
	Response: Output stage inhibit	
	Cause	Measure
	Significantly different values determined in the 3 phases while measuring stator resistances.	– Check whether the motor is properly connected. – Check all contact points on the motor and inverter. – Check the motor and motor cable for damage.

31972098/EN – 8/2024

Error: 28.11 (1C0Bhex | 7179dec) Description: FCB 25 – High impedance motor phase		
	Response: Output stage inhibit	
	Cause	Measure
	At least one motor phase could not be measured during motor parameter measurement.	– Check whether the motor is properly connected. – Check all contact points on the motor and inverter. – Check the motor and motor cable for damage.

Error: 28.12 (1C0Chex | 7180dec) Description: FCB 25 – Stator resistance measurement timeout		
	Response: Output stage inhibit	
	Cause	Measure
	Motor parameter measurement activated while motor is turning.	– Stop motor. – Start motor parameter measurement when the motor is at standstill.

Error: 28.13 (1C0Dhex | 7181dec) Description: FCB 25 – Characteristic curve identification not possible		
	Response: Output stage inhibit	
	Cause	Measure
	The characteristic curve cannot be clearly identified by the motor parameter measurement.	Contact SEW-EURODRIVE Service.

Error: 28.14 (1C0Ehex | 7182dec) Description: Modulo minimum and modulo maximum not plausible		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	The value of the "Modulo minimum" parameter is greater than the value of the "Modulo maximum" parameter.	Correct the parameter values.

Error: 28.15 (1C0Fhex | 7183dec) Description: FCB 25 – Timeout		
	Response: Output stage inhibit	
	Cause	Measure
	Measuring of rotor resistance, leakage inductance, and stator inductance not completed.	Contact SEW-EURODRIVE Service.

31972098/EN – 8/2024

Error: 28.17 (1C11hex | 7185dec) Description: FCB only possible for drive train 1		
	Response: Output stage inhibit	
	Cause	Measure
	The active FCB can only be operated if drive train 1 is set as the active drive train.	Select drive train 1 as the active drive train.

Error: 28.18 (1C12hex | 7186dec) Description: FCB 21 – Brake missing	
Response: Application stop + output stage inhibit	
Cause	Measure
No brake has been parameterized in the inverter. However, a brake is required to perform the brake test.	– Parameterize the brake in drive train 1. – Start FCB 21 again.

Error: 28.19 (1C13hex | 7187dec) Description: FCB 21 – Encoder missing	
Response: Application stop + output stage inhibit	
Cause	Measure
No encoder has been parameterized in the inverter. However, an encoder is required to detect a movement of the drive.	– Parameterize the encoder in drive train 1. – Use an encoder for speed control or position control. – Start FCB 21 again.

Error: 28.20 (1C14hex | 7188dec) Description: FCB 21 – Load torque not within tolerance range	
Response: Application stop + output stage inhibit	
Cause	Measure
The measured load torque is outside of the permitted range. The permitted range is defined by the "Load torque" and "Permitted load torque tolerance" parameters as follows: Load torque ± permitted load torque tolerance	– Check the load torque of the system. – Check the "Load torque" parameter value. – Check the "Permitted load torque tolerance" parameter value.

Error: 28.21 (1C15hex | 7189dec) Description: FCB 09 – Position overshoot through changes to the active travel order	
Response: Application stop + output stage inhibit	
Cause	Measure
Due to changing of the target position or profile values during an active travel order, the drive must travel beyond the target and then reverse to adhere to the profile. Reversing is forbidden in the current operating mode, so when the target position is overrun, the drive triggers an error and stops in the permitted direction.	Change the target position/profile values in such a way that it is still possible to stop at the target position.

31972098/EN – 8/2024

Error: 28.22 (1C16hex | 7190dec) Description: FCB 09 – Wrong touchprobe data source		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	For the "Remaining travel from touchprobe 1" operating mode, the data source of the touchprobe used must be set to "Actual position in user unit".	Change the data source of the touchprobe.

Error: 28.23 (1C17hex | 7191dec) Description: Minimum speed too high	
Response: Output stage inhibit	
Cause	Measure
Minimum speed greater than application limit of the speed.	– Reduce the minimum speed. or – Increase the application limit.

Error: 28.24 (1C18hex | 7192dec) Description: FCB 05 – Limits of skip range outside setpoint limits	
Response: Output stage inhibit	
Cause	Measure
The speed range of the active speed resonance skip function is larger than the permitted setpoint value range. Both the minimum speed as well as the application limit lie within the skip range. As such, each setpoint falls within the skip range.	– Adjust the speed resonance range skip function. – Adjust the minimum speed. – Adjust the application limit.

Error: 28.25 (1C19hex | 7193dec) Description: FCB 11/12 – Faulty reference offset of encoder 1	
Response: Emergency stop + output stage inhibit	
Cause	Measure
Error determining reference offset for encoder 1.	– Make sure that the reference offset is smaller than the "Modulo maximum" limit value. – When using a single-turn absolute encoder, make sure that the reference offset is not larger than one encoder revolution.

Error: 28.26 (1C1Ahex | 7194dec) Description: FCB 11/12 – Faulty reference offset of encoder 2	
Response: Emergency stop + output stage inhibit	
Cause	Measure
Error determining reference offset for encoder 2.	– Make sure that the reference offset is smaller than the "Modulo maximum" limit value. – When using a single-turn absolute encoder, make sure that the reference offset is not larger than one encoder revolution.

Error: 28.27 (1C1Bhex | 7195dec) Description: FCB 11/12 – Reference cam and hardware limit switch active		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	During reference travel, the hardware limit switch was hit when the reference cam was active.	– Check the position of the reference cam to the hardware limit switch. – Check the signal of the reference cam.

13.8.24 Fault 29 HW limit switch

Error: 29.1 (1D01hex | 7425dec) Description: Positive limit switch hit		
	Response: HW limit switch – current drive train	
	Cause	Measure
	Positive hardware limit switch hit.	– Check the wiring of the hardware limit switch. – Check the target position. – Leave the hardware limit switch in the opposite direction.

Error: 29.2 (1D02hex | 7426dec) Description: Negative limit switch hit		
	Response: HW limit switch – current drive train	
	Cause	Measure
	Negative hardware limit switch hit.	– Check the wiring of the hardware limit switch. – Check the target position. – Leave the hardware limit switch in the opposite direction.

Error: 29.3 (1D03hex | 7427dec) Description: Limit switch missing		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	Positive and negative hardware limit switches hit at the same time.	– Check the wiring of the hardware limit switches. – Check the parameter setting of the digital inputs. – Check the parameter setting of the process output data.

31972098/EN – 8/2024

Error: 29.4 (1D04hex | 7428dec) Description: Limit switches swapped		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	The fault can be caused as follows: – The positive hardware limit switch was hit with a negative direction of rotation or – The negative hardware limit switch was hit with a positive direction of rotation.	Check whether the hardware limit switch connections are swapped.

13.8.25 Fault 30 Software limit switch

Error: 30.1 (1E01hex | 7681dec) Description: Positive limit switch hit		
	Response: SW limit switch – current drive train	
	Cause	Measure
	Positive software limit switch hit.	– Check the position of the software limit switch. – Check the target position. – Leave the software limit switch in the opposite direction.

Error: 30.2 (1E02hex | 7682dec) Description: Negative limit switch hit		
	Response: SW limit switch – current drive train	
	Cause	Measure
	Negative software limit switch hit.	– Check the position of the software limit switch. – Check the target position. – Leave the software limit switch in the opposite direction.

Error: 30.3 (1E03hex | 7683dec) Description: Limit switches swapped		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	Position of negative software limit switch greater than position of positive software limit switch.	Check the positions of the software limit switches.

31972098/EN – 8/2024

Error: 30.4 (1E04hex | 7684dec) Description: Distance of software limit switches too small/noise suppression window too large		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	The range limited by the positive and negative software limit switches is smaller than the range set in the "SW limit switch noise suppression window" parameter.	– Check the positions of the software limit switches. or – Adjust the width of the noise suppression window.

13.8.26 Fault 31 Thermal motor protection

Error: 31.1 (1F01hex | 7937dec) Description: Temperature sensor motor 1 – wire break	
Response: Application stop + output stage inhibit	
Cause	Measure
Wire break detected at the temperature sensor of the motor.	Check the wiring of the temperature sensor.

Error: 31.2 (1F02hex | 7938dec) Description: Temperature sensor motor 1 – short circuit	
Response: Application stop + output stage inhibit	
Cause	Measure
Short circuit at temperature sensor of motor.	Check the wiring of the temperature sensor.

Error: 31.3 (1F03hex | 7939dec) Description: Temperature sensor motor 1 – overtemperature	
Response: Output stage inhibit	
Cause	Measure
The motor temperature determined via the temperature sensor exceeds the maximum permitted motor temperature.	– Let the motor cool down. – Check for motor overload. – Check whether the correct temperature sensor has been configured.

Error: 31.4 (1F04hex | 7940dec) Description: Temperature model motor 1 – overtemperature	
Response: Output stage inhibit	
Cause	Measure
The motor temperature determined via the temperature model exceeds the maximum permitted motor temperature.	– Let the motor cool down. – Check for motor overload. – Check whether the correct temperature sensor has been configured.

31972098/EN – 8/2024

Error: 31.5 (1F05hex | 7941dec) Description: Temperature sensor motor 1 – prewarning		
	Response: Thermal motor protection 1 – prewarning threshold	
	Cause	Measure
	Motor temperature determined via the temperature sensor has exceeded the prewarning threshold.	Check for motor overload.

Error: 31.6 (1F06hex | 7942dec) Description: Temperature model motor 1 – prewarning		
	Response: Thermal motor protection 1 – prewarning threshold	
	Cause	Measure
	Motor temperature determined via the motor model has exceeded the prewarning threshold.	Check for motor overload.

Error: 31.7 (1F07hex | 7943dec) Description: UL temperature model – overtemperature		
	Response: Output stage inhibit	
	Cause	Measure
	The temperature of the active motor determined via the UL temperature model exceeds the maximum permitted motor temperature.	Check for motor overload.

Error: 31.8 (1F08hex | 7944dec) Description: Temperature sensor motor 1 – communication timeout		
	Response: Output stage inhibit	
	Cause	Measure
	Communication with temperature sensor is disrupted (e.g. via MOVILINK® DDI).	Check the wiring of the temperature sensor.

Error: 31.9 (1F09hex | 7945dec) Description: Temperature sensor motor 1 – temperature too low		
	Response: Output stage inhibit	
	Cause	Measure
	The temperature detected via the temperature sensor has fallen below -50 °C.	– Check whether the correct temperature sensor has been configured. – Heat the motor.
	Short circuit in the long connection to the temperature sensor of the motor.	Check the wiring of the temperature sensor.

Error: 31.11 (1F0Bhex | 7947dec) Description: Temperature sensor motor 2 – wire break		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	Wire break detected at the temperature sensor of the motor.	Check the wiring of the temperature sensor.

Error: 31.12 (1F0Chex | 7948dec) Description: Temperature sensor motor 2 – short circuit		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	Short circuit at temperature sensor of motor.	Check the wiring of the temperature sensor.

Error: 31.13 (1F0Dhex | 7949dec) Description: Temperature sensor motor 2 – overtemperature		
	Response: Output stage inhibit	
	Cause	Measure
	The motor temperature determined via the temperature sensor exceeds the maximum permitted motor temperature.	– Let the motor cool down. – Check for motor overload. – Check whether the correct temperature sensor has been configured.

Error: 31.14 (1F0Ehex | 7950dec) Description: Temperature model motor 2 – overtemperature		
	Response: Output stage inhibit	
	Cause	Measure
	The motor temperature determined via the temperature model exceeds the maximum permitted motor temperature.	– Let the motor cool down. – Check for motor overload. – Check whether the correct temperature sensor has been configured.

Error: 31.15 (1F0Fhex | 7951dec) Description: Temperature sensor motor 2 – prewarning		
	Response: Thermal motor protection 2 – prewarning threshold	
	Cause	Measure
	Motor temperature determined via the temperature sensor has exceeded the prewarning threshold.	Check for motor overload.

31972098/EN – 8/2024

Error: 31.16 (1F10hex | 7952dec) Description: Temperature model motor 2 – prewarning		
	Response: Thermal motor protection 2 – prewarning threshold	
	Cause	Measure
	Motor temperature determined via the motor model has exceeded the prewarning threshold.	Check for motor overload.

Error: 31.19 (1F13hex | 7955dec) Description: Temperature sensor motor 2 – temperature too low		
	Response: Output stage inhibit	
	Cause	Measure
	The temperature detected via the temperature sensor has fallen below -50 °C.	– Check whether the correct temperature sensor has been configured. – Heat the motor.
	Short circuit in the long connection to the temperature sensor of the motor.	Check the wiring of the temperature sensor.

Error: 31.50 (1F32hex | 7986dec) Description: Fault at temperature sensor 1		
	Response: Output stage inhibit	
	Cause	Measure
	Fault detected at temperature sensor 1 of the motor.	Observe the fault code of the main component. Identify the exact cause of this fault message and take the appropriate measures to eliminate the fault.

Error: 31.51 (1F33hex | 7987dec) Description: Fault at temperature sensor 2		
	Response: Output stage inhibit	
	Cause	Measure
	Fault detected at temperature sensor 2 of the motor.	Observe the fault code of the main component. Identify the exact cause of this fault message and take the appropriate measures to eliminate the fault.

Error: 31.52 (1F34hex | 7988dec) Description: Fault at temperature sensor 3		
	Response: Output stage inhibit	
	Cause	Measure
	Fault detected at temperature sensor 3 of the motor.	Observe the fault code of the main component. Identify the exact cause of this fault message and take the appropriate measures to eliminate the fault.

13.8.27 Fault 32 Communication

Error: 32.2 (2002hex | 8194dec) Description: EtherCAT®/SBusPLUS communication timeout		
	Response: Fieldbus – timeout response	
	Cause	Measure
	Timeout in process data transfer during EtherCAT®/SBusPLUS communication.	– Check the wiring of system bus and module bus. – Make sure that the EtherCAT®/SBusPLUS configuration in the controller is set correctly. – Check the set timeout time of the EtherCAT®/SBusPLUS interface.

Error: 32.3 (2003hex | 8195dec) Description: Faulty synchronization signal		
	Response: External synchronization	
	Cause	Measure
	Synchronization signal period is not correct.	Make sure that the EtherCAT®/SBusPLUS configuration in the controller is set correctly.

Error: 32.4 (2004hex | 8196dec) Description: Missing synchronization signal		
	Response: External synchronization	
	Cause	Measure
	No synchronization signal present.	Make sure that the EtherCAT®/SBusPLUS configuration in the controller is set correctly.

Error: 32.5 (2005hex | 8197dec) Description: Synchronization timeout		
	Response: External synchronization	
	Cause	Measure
	Timeout while synchronizing to synchronization signal.	Make sure that the EtherCAT®/SBusPLUS configuration in the controller is set correctly.

Error: 32.6 (2006hex | 8198dec) Description: Error while transferring parameter set		
	Response: Output stage inhibit	
	Cause	Measure
	Error while downloading parameter set to device.	– Check the wiring of system bus and module bus. – Start the download again.

31972098/EN – 8/2024

Error: 32.7 (2007hex | 8199dec) Description: Application heartbeat timeout		
	Response: Application heartbeat – timeout response	
	Cause	Measure
	Communication between application program (e.g. IEC program or MOVIKIT® of the Drive module group) and device interrupted.	– Check the status of the application program. – Restart the application program.

Error: 32.8 (2008hex | 8200dec) Description: Timeout user timeout		
	Response: User timeout – timeout response	
	Cause	Measure
	The timeout time of the user timeout function has expired.	– Check communication. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

Error: 32.12 (200Chex | 8204dec) Description: Manual mode timeout		
	Response: Manual mode – timeout response	
	Cause	Measure
	Communication connection to inverter interrupted in manual mode.	– Check whether too many programs are open on the engineering PC. – Increase the timeout time in manual mode.
	New Scope project created.	– Acknowledge the fault. – Restart manual mode.
	Scope measurement transferred from inverter to project.	– Acknowledge the fault. – Restart manual mode.

13.8.28 Fault 33 System initialization

Error: 33.1 (2101hex | 8449dec) Description: Error during offset determination of current measurement	
Response: Output stage inhibit System state: Fault acknowledgment with CPU reset	
Cause	Measure
Error detected during current measurement.	Contact SEW-EURODRIVE Service.

Error: 33.2 (2102hex | 8450dec) Description: Firmware – checksum error	
Response: Output stage inhibit System state: Fault acknowledgment with CPU reset	
Cause	Measure
Error calculating firmware checksum.	Contact SEW-EURODRIVE Service.

31972098/EN – 8/2024

Error: 33.6 (2106hex | 8454dec) Description: Faulty FPGA configuration		
	Response: Output stage inhibit	
	Cause	Measure
	Error in FPGA configuration.	Contact SEW-EURODRIVE Service.

Error: 33.7 (2107hex | 8455dec) Description: Function block compatibility error		
	Response: Output stage inhibit	
	Cause	Measure
	Error checking compatibility of function block.	Contact SEW-EURODRIVE Service.

Error: 33.8 (2108hex | 8456dec) Description: Software function block not configured correctly		
	Response: Output stage inhibit	
	Cause	Measure
	Error detected in the configuration of the software function block.	Contact SEW-EURODRIVE Service.

Error: 33.10 (210Ahex | 8458dec) Description: Boot timeout		
	Response: Output stage inhibit System state: Fault acknowledgment with CPU reset	
	Cause	Measure
	Timeout during system boot.	Contact SEW-EURODRIVE Service.

Error: 33.11 (210Bhex | 8459dec) Description: Hardware compatibility error		
	Response: Output stage inhibit	
	Cause	Measure
	Firmware not compatible with device.	Contact SEW-EURODRIVE Service.

Error: 33.12 (210Chex | 8460dec) Description: Memory module plugged in		
	Response: Output stage inhibit System state: Fault acknowledgment with CPU reset	
	Cause	Measure
	A plugged-in memory module was detected during device start. However, the internal memory was set as the storage location.	Switch off the device. Remove the memory module and restart the device.

31972098/EN – 8/2024

Error: 33.13 (210Dhex | 8461dec) Description: Memory module removed		
	Response: Output stage inhibit System state: Fault acknowledgment with CPU reset	
	Cause	Measure
	Memory module removed from device parameterized for operation with replaceable memory module.	Switch off the device, insert the memory module, and switch on the device again.
	Replaceable memory module removed during ongoing operation.	Switch off the device, insert the memory module, and switch on the device again.
	Memory module missing for a device that can only be operated with replaceable memory module.	Switch off the device, insert the memory module, and switch on the device again.

Error: 33.14 (210Ehex | 8462dec) Description: EtherCAT® slave controller cannot be accessed		
	Response: Output stage inhibit System state: Fault acknowledgment with CPU reset	
	Cause	Measure
	EtherCAT® slave controller cannot be accessed.	Contact SEW-EURODRIVE Service.

Error: 33.15 (210Fhex | 8463dec) Description: Firmware configuration conflict in the Device Update Manager		
	Response: Output stage inhibit System state: Fault acknowledgment with CPU reset	
	Cause	Measure
	The firmware does not correspond with the expected configuration in the Device Update Manager.	– Acknowledge the fault. Doing so will update the configuration data of the Device Update Manager. – If the fault occurs again after a reset, contact SEW-EURODRIVE Service

Error: 33.18 (2112hex | 8466dec) Description: Incompatible fieldbus configuration		
	Response: Output stage inhibit System state: Fault acknowledgment with CPU reset	
	Cause	Measure
	The fieldbus used is not compatible with the basic unit.	– For devices with pluggable fieldbus card, replace the card. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

13.8.29 Fault 34 Process data configuration

Error: 34.1 (2201hex | 8705dec) Description: Changed process data configuration		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	Process data configuration changed during active process data operation.	Perform a reset. Doing so will stop the process data, apply the changes, and restart the process data.

13.8.30 Fault 35 Function activation

Error: 35.1 (2301hex | 8961dec) Description: Application level – invalid activation key		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	Activation key not entered properly.	Enter the activation key again.
	The activation key was not created for this device.	Check the activation key.
	When using a double axis, the activation key for the wrong instance was entered in the device.	Enter the activation key for the assigned instance.
	The activation key has been entered for a technology level in the "Application level – activation key" parameter.	Enter the activation key in the correct parameter.

Error: 35.2 (2302hex | 8962dec) Description: Application level too low		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	The activated software module requires a higher application level.	Determine the required application level ("Application level – required level" parameter) and enter its activation key.

Error: 35.3 (2303hex | 8963dec) Description: Technology level too low		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	An activated technology function requires a higher technology level.	Determine the required technology level ("Technology level – required level" parameter) and enter its activation key.

31972098/EN – 8/2024

Error: 35.4 (2304hex | 8964dec) Description: Technology level – invalid activation key		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	Activation key not entered properly.	Enter the activation key again.
	Activation key not created for this device.	Check the activation key.
	When using a double axis, the activation key for the wrong instance was entered in the device.	Enter the activation key for the assigned instance.
	The activation key has been entered for an application level in the "Technology level – activation key" parameter.	Enter the activation key in the correct parameter.

13.8.31 Fault 37 Brake control

Fault: 37.1 (2501hex | 9473dec) Description: Brake control 1 – switching state not consistent		
	Response: Brake control 1 – status	
	Cause	Measure
	The switching state of the input signal "Brake control 1 – status" differs from the switching state of the brake control (DB 00/SBC).	– Check the connection and function of brake control 1. – Check whether the selected connection is compatible with the monitoring of brake control. – Check the connection and configuration of the input signal "Brake control 1 – status".

Fault: 37.2 (2502hex | 9474dec) Description: Brake control 1 – switching frequency exceeded		
	Response: Brake control 1 – switching frequency	
	Cause	Measure
	Permitted switching frequency of brake control 1 exceeded.	– Check the application. – Check the permitted switching frequency of brake control and the limit value of monitoring.

Fault: 37.3 (2503hex | 9475dec) Description: Brake control 2 – switching state not consistent		
	Response: Brake control 2 – status	
	Cause	Measure
	The switching state of the input signal "Brake control 2 – status" differs from the switching state of the brake control (DB 00/SBC).	– Check the connection and function of brake control 2. – Check whether the selected connection is compatible with the monitoring of brake control. – Check the connection and configuration of the input signal "Brake control 2 – status".

Fault: 37.4 (2504hex | 9476dec) Description: Brake control 2 – switching frequency exceeded		
	Response: Brake control 2 – switching frequency	
	Cause	Measure
	Permitted switching frequency of brake control 2 exceeded.	– Check the application. – Check the permitted switching frequency of brake control and the limit value of monitoring.

13.8.32 Fault 42 Lag error

Error: 42.1 (2A01hex | 10753dec) Description: Positioning lag error		
	Response: Positioning lag error	
	Cause	Measure
	Encoder not connected correctly.	Check the encoder wiring.
	Position encoder inverted or not installed correctly on the track.	Check the installation and connection of the position encoder.
	Motor phases not connected properly.	Check the wiring of the motor.
	Acceleration too high.	– Check the profile values. – Increase the torque limit and/or current limit. – Check the project planning.
	P component of position controller too small.	Increase the P component of the position controller.
	The speed controller is parameterized incorrectly.	Check the controller parameters.
	Lag error window too small.	Increase the lag error window.
	There is a mechanical stiffness or blockage.	– Check the mechanical components for stiffness. – Check the mechanical components for blockage.
	Supply voltage too low or line phase missing.	Check the supply voltage.

31972098/EN – 8/2024

Error: 42.2 (2A02hex | 10754dec) Description: Jog mode lag error		
	Response: Output stage inhibit	
	Cause	Measure
	Encoder not connected correctly.	Check the encoder wiring.
	Position encoder inverted or not installed correctly on the track.	Check the installation and connection of the position encoder.
	Motor phases not connected properly.	Check the wiring of the motor.
	Acceleration too high.	– Check the profile values. – Increase the torque limit and/or current limit. – Check the project planning.
	P component of position controller too small.	Increase the P component of the position controller.
	The speed controller is parameterized incorrectly.	Check the controller parameters.
	Lag error window too small.	Increase the lag error window.
	There is a mechanical stiffness or blockage.	– Check the mechanical components for stiffness. – Check the mechanical components for blockage.
	Supply voltage too low or line phase missing.	Check the supply voltage.

Error: 42.3 (2A03hex | 10755dec) Description: Standard lag error		
	Response: Output stage inhibit	
	Cause	Measure
	Encoder not connected correctly.	Check the encoder wiring.
	Position encoder inverted or not installed correctly on the track.	Check the installation and connection of the position encoder.
	Motor phases not connected properly.	Check the wiring of the motor.
	Acceleration too high.	– Check the profile values. – Increase the torque limit and/or current limit. – Check the project planning.
	P component of position controller too small.	Increase the P component of the position controller.
	The speed controller is parameterized incorrectly.	Check the controller parameters.
	Lag error window too small.	Increase the lag error window.
	Supply voltage too low or line phase missing.	Check the supply voltage.

31972098/EN – 8/2024

13.8.33 Fault 45 Fieldbus interface

Error: 45.1 (2D01hex | 11521dec) Description: No response from fieldbus interface	
Response: Emergency stop + output stage inhibit	
Cause	Measure
The fieldbus interface does not start properly and is therefore not functional.	– Switch the device off and on again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

Error: 45.2 (2D02hex | 11522dec) Description: Fieldbus interface – fault	
Response: Fieldbus – timeout response	
Cause	Measure
Fault detected on the device-internal connection to the fieldbus interface.	– Switch the device off and on again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

Error: 45.3 (2D03hex | 11523dec) Description: Process output data timeout	
Response: Fieldbus – timeout response	
Cause	Measure
Timeout in process data transfer during fieldbus communication.	– Check the communication connection between the fieldbus master and the fieldbus interface for interruption. – Check the configuration of the fieldbus master. – Adjust the timeout monitoring of the fieldbus interface.

Error: 45.5 (2D05hex | 11525dec) Description: Fault in engineering	
Response: Warning	
Cause	Measure
Engineering via fieldbus interface no longer works, or only works to a limited extent.	– Switch the device off and on again. – Check the network load in the communications network. – Close unneeded engineering connections that are open in parallel (e.g. parameter access via managing EDGE devices, asset management tools, network scanners, etc.). – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

31972098/EN – 8/2024

Error: 45.7 (2D07hex | 11527dec) Description: Invalid process output data		
	Response: Fieldbus – timeout response	
	Cause	Measure
	– The fieldbus master sends invalid process output data. – The fieldbus interface has detected an internal failure of the process data exchange and marks the process output data as invalid.	– Check whether the PLC is in "Stop" state. – Restart the PLC. – Check the configuration of the fieldbus master. – In the event of a failure of the internal process data exchange, switch the device off and then on again.

Error: 45.9 (2D09hex | 11529dec) Description: Warning		
	Response: Warning	
	Cause	Measure
	The inverter has detected a non-critical fault on the device-internal connection to the fieldbus interface.	– Switch the device off and on again. – If the warning occurs repeatedly, contact SEW-EURODRIVE Service.

Error: 45.50 (2D32hex | 11570dec) Description: Warning		
	Response: Warning with self-reset	
	Cause	Measure
	The fieldbus interface has signaled a warning.	Observe the warning of the fieldbus interface subcomponent. Identify the exact cause of this warning and take the appropriate measures for elimination.

Error: 45.51 (2D33hex | 11571dec) Description: Error		
	Response: Fieldbus – timeout response	
	Cause	Measure
	The fieldbus interface has detected a fault.	Observe the fault code of the fieldbus interface subcomponent. Identify the exact cause of this fault message and take the appropriate measures to eliminate the fault.

Error: 45.52 (2D34hex | 11572dec) Description: Critical fault		
	Response: Fieldbus – timeout response	
	Cause	Measure
	The fieldbus interface has detected a critical fault.	Observe the fault code of the fieldbus interface subcomponent. Identify the exact cause of this fault message and take the appropriate measures to eliminate the fault.

13.8.34 Fault 46 Safety option

Error: 46.1 (2E01hex | 11777dec) Description: MOVISAFE® CS.. safety option no longer responding		
	Response: Output stage inhibit	
	Cause	Measure
	No synchronization could be performed with the safety option.	– When using a pluggable safety card, check the device assignment of the basic device and the safety card. – When using a pluggable safety card, check the slot and installation of the safety card. – Switch the device off and on again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

Error: 46.2 (2E02hex | 11778dec) Description: Invalid variant		
	Response: Output stage inhibit	
	Cause	Measure
	Safety option variant does not match inverter type.	Use the correct safety option variant.
	In the double axis of a MOVIDRIVE® modular application inverter, only safety cards without encoder interface may be used.	Use the correct safety card variant.

Error: 46.3 (2E03hex | 11779dec) Description: MOVISAFE® CS.. safety option no longer responding		
	Response: Output stage inhibit	
	Cause	Measure
	Communication between inverter and safety option interrupted.	– When using a pluggable safety card, check the installation. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.
	The safety option has signaled a warning.	– When using a pluggable safety card, check the installation. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

Error: 46.50 (2E32hex | 11826dec) Description: Warning		
	Response: Warning with self-reset	
	Cause	Measure
	The safety option has signaled a warning	Observe the warning of the safety option subcomponent. Identify the exact cause of this warning and take the appropriate measures for elimination.

31972098/EN – 8/2024

Error: 46.51 (2E33hex | 11827dec) Description: Error		
	Response: Emergency stop + output stage inhibit with self-reset	
	Cause	Measure
	The safety option has detected an error.	Observe the fault code of the safety option subcomponent. Identify the exact cause of this fault message and take the appropriate measures to eliminate the fault.

Error: 46.52 (2E34hex | 11828dec) Description: System error / data error / critical error		
	Response: Output stage inhibit with self-reset	
	Cause	Measure
	The MOVISAFE® CS.. safety option has detected an error.	Open the error status of the safety option in section Diagnostics -> MOVISAFE® CS... Determine the cause of the error from the error with the highest priority and perform the suggested troubleshooting measures.

13.8.35 Fault 47 Supply unit

Error: 47.1 (2F01hex | 12033dec) Description: Warning		
	Response: Warning with self-reset	
	Cause	Measure
	The power supply unit has signaled a warning.	Observe the warning of the power supply unit subcomponent. Identify the exact cause of this warning and take the appropriate measures for elimination.

Error: 47.2 (2F02hex | 12034dec) Description: Error		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	The power supply unit has detected a fault.	Observe the fault code of the power supply unit subcomponent. Identify the exact cause of this fault message and take the appropriate measures to eliminate the fault. The fault response is executed in the inverter.

Error: 47.3 (2F03hex | 12035dec) Description: Critical fault		
	Response: Output stage inhibit	
	Cause	Measure
	The power supply unit has detected a critical fault.	Observe the fault code of the power supply unit subcomponent. Identify the exact cause of this fault message and take the appropriate measures to eliminate the fault. The fault response is executed in the inverter.

13.8.36 Fault 48 Module bus

Error: 48.1 (3001hex | 12289dec) Description: Incompatible device combination	
Response: Output stage inhibit	
Cause	Measure
Module bus stations are not compatible with one another.	Contact SEW-EURODRIVE Service.

Error: 48.2 (3002hex | 12290dec) Description: Communication timeout	
Response: Emergency stop + output stage inhibit	
Cause	Measure
Communication timeout on the module bus.	– Check the cable connections and voltage supply of the module bus stations. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

Error: 48.3 (3003hex | 12291dec) Description: Too many module bus stations	
Response: Output stage inhibit	
Cause	Measure
Too many module stations are connected.	Reduce the number of module bus stations.

Error: 48.4 (3004hex | 12292dec) Description: CRC error	
Response: Emergency stop + output stage inhibit	
Cause	Measure
Checksum error detected during module bus communication.	– Switch the device off and on again. – Reset the fault. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

31972098/EN – 8/2024

13.8.37 Fault 50 I/O card

Error: 50.1 (3201hex | 12801dec) Description: Boot synchronization timeout		
	Response: Output stage inhibit	
	Cause	Measure
	The I/O card is inserted but cannot be addressed.	– When using a pluggable safety card, check the device assignment of the basic device and the I/O card. – When using an I/O card, check the installation. – Switch the device off and on again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

Error: 50.2 (3202hex | 12802dec) Description: FPGA driver – CRC error		
	Response: Output stage inhibit	
	Cause	Measure
	Communication between FPGA and I/O card does not work or is disrupted.	– When using an I/O card, check the installation. – Check for EMC-compliant installation. – Switch the device off and on again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

Error: 50.3 (3203hex | 12803dec) Description: CRC error		
	Response: Output stage inhibit	
	Cause	Measure
	Checksum error on communication interface between I/O card and basic unit (SPI bus).	– When using an I/O card, check the installation. – Check for EMC-compliant installation. – Switch the device off and on again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

Error: 50.4 (3204hex | 12804dec) Description: SPI bus timeout		
	Response: Output stage inhibit	
	Cause	Measure
	Timeout on communication interface between I/O card and basic unit (SPI bus).	– When using an I/O card, check the installation. – Check for EMC-compliant installation. – Switch the device off and on again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

Error: 50.5 (3205hex | 12805dec) Description: Watchdog error		
	Response: Output stage inhibit	
	Cause	Measure
	Watchdog of the I/O card processor has detected an error.	– When using an I/O card, check the installation. – Check for EMC-compliant installation. – Switch the device off and on again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

Error: 50.6 (3206hex | 12806dec) Description: Ready signal timeout		
	Response: Output stage inhibit	
	Cause	Measure
	I/O card booted but cyclic communication is not possible.	– When using an I/O card, check the installation. – Check for EMC-compliant installation. – Switch the device off and on again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

Error: 50.7 (3207hex | 12807dec) Description: Telegram error		
	Response: Output stage inhibit	
	Cause	Measure
	Communication error between I/O card and basic unit.	– Replace the pluggable I/O card. – Replace the basic device. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

13.8.38 Fault 51 Analog processing

Error: 51.1 (3301hex | 13057dec) Description: Current at analog current input too small		
	Response: Analog input – 4 mA limit undershot	
	Cause	Measure
	Input current at analog input below 4 mA.	– Check the wiring. – Check the parameterization of the analog input.

31972098/EN – 8/2024

13.8.39 Fault 52 Ex protection function category 2

Error: 52.1 (3401hex | 13313dec) Description: Startup error		
	Response: Output stage inhibit	
	Cause	Measure
	One or several parameters of the explosion protection function have been changed.	Before activating the function, start up the explosion protection function.

Error: 52.2 (3402hex | 13314dec) Description: Invalid function activated		
	Response: Output stage inhibit	
	Cause	Measure
	The explosion protection function and the "standstill current" function may not be active at the same time.	Disable the "standstill current" function.

Error: 52.3 (3403hex | 13315dec) Description: Nominal inverter current too large		
	Response: Output stage inhibit	
	Cause	Measure
	Ratio of nominal inverter current and nominal motor current too large.	Check assignment of motor and inverter.

Error: 52.4 (3404hex | 13316dec) Description: Parameterization of current limit characteristic faulty		
	Response: Output stage inhibit	
	Cause	Measure
	Error while setting parameters for current limit characteristic.	– Perform startup again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

Error: 52.5 (3405hex | 13317dec) Description: Time duration exceeded for f < 5 Hz		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	The rotating field frequency must not be below 5 Hz for longer than 60 s. This time period has been exceeded.	– Check the project planning. – Make sure that work is not performed below 5 Hz for a longer period of time. – Check behavior in idle state. For instance, activate the "FCB 01 output stage inhibit" drive function for position hold control on the device.

13.9 Power section fault description

13.9.1 Fault 7 DC link

Error: 7.1 (0701hex | 1793dec) Description: Overvoltage in the DC link		
	Response: Remote – critical fault	
	Cause	Measure
	Maximum permitted DC link voltage exceeded.	– Check the connection of the braking resistor. – Decrease deceleration. – Check the configuration of the braking resistor (resistance value).

13.9.2 Fault 11 Temperature monitoring

Error: 11.7 (0B07hex | 2823dec) Description: Wire break at temperature sensor of heat sink	
Response: Remote – warning with self-reset	
Cause	Measure
Wire break at temperature sensor of heat sink.	Contact SEW-EURODRIVE Service.

Error: 11.8 (0B08hex | 2824dec) Description: Short circuit at temperature sensor of heat sink	
Response: Remote – warning with self-reset	
Cause	Measure
There is a short circuit at the temperature sensor of the heat sink.	Contact SEW-EURODRIVE Service.

13.9.3 Fault 17 Internal processor error

Error: 17.6 (1106hex | 4358dec) Description: Watchdog error	
Response: Block rectifier	
Cause	Measure
CPU watchdog has detected a fault.	– Switch the devices off and on again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

31972098/EN – 8/2024

Error: 17.7 (1107hex | 4359dec) Description: Exception error		
	Response: Block rectifier	
	Cause	Measure
	Internal computing error (trap) in CPU.	– Switch the device off and on again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

13.9.4 Fault 18 Software error

Error: 18.7 (1207hex | 4615dec) Description: Fatal software error		
	Response: Block rectifier	
	Cause	Measure
	Fatal software error.	– Switch the device off and on again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

Error: 18.8 (1208hex | 4616dec) Description: Invalid fault code		
	Response: Remote – standard fault	
	Cause	Measure
	Invalid fault code requested.	– Switch the device off and on again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

13.9.5 Fault 20 Device monitoring

Error: 20.1 (1401hex | 5121dec) Description: Supply voltage fault		
	Response: Remote – critical fault	
	Cause	Measure
	Internal electronics supply voltage or externally connected DC 24 V supply voltage not within permitted voltage range.	– Check the voltage level of the external DC 24 V supply voltage and check for correct connection. – Acknowledge the fault. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.
	24 V power supply unit overloaded.	Check the project planning for the power demand.

Error: 20.8 (1408hex | 5128dec) Description: Fan – warning		
	Response: Remote – warning with self-reset	
	Cause	Measure
	Fan function impaired.	– Check fan for dirt. – If the warning occurs repeatedly, contact SEW-EURODRIVE Service.

Error: 20.9 (1409hex | 5129dec) Description: Fan – fault		
	Response: Remote – standard fault	
	Cause	Measure
	The fan is defective.	Contact SEW-EURODRIVE Service.

13.9.6 Fault 25 Parameter memory monitoring

Error: 25.1 (1901hex | 6401dec) Description: Timeout warning		
	Response: Remote – warning with self-reset	
	Cause	Measure
	Access to memory (read/write) takes longer than expected.	No measure required. The fault will be reset automatically after completed memory access.

Error: 25.2 (1902hex | 6402dec) Description: Non-volatile memory system – runtime error		
	Response: Remote – standard fault	
	Cause	Measure
	Runtime error in non-volatile memory system.	– Switch the device off and on again. – Restore delivery state. Note that doing so will reset all data in the non-volatile memory to the values at delivery. – If the fault occurs repeatedly, replace the device/memory module. Contact SEW-EURODRIVE Service. – Perform basic initialization. Contact SEW-EURODRIVE Service for this.

31972098/EN – 8/2024

Error: 25.3 (1903hex | 6403dec) Description: Non-volatile memory system – data import error		
	Response: Remote – standard fault	
	Cause	Measure
	Error while importing data from non-volatile memory system.	– Switch the device off and on again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service. – Restore delivery state. Note that doing so will reset all data in the non-volatile memory to the values at delivery. – Perform basic initialization. Contact SEW-EURODRIVE Service for this.

Error: 25.4 (1904hex | 6404dec) Description: Non-volatile memory system – setup error		
	Response: Remote – standard fault	
	Cause	Measure
	Error while restoring delivery state or during basic initialization of the parameters.	– Switch the device off and on again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

Error: 25.5 (1905hex | 6405dec) Description: Non-volatile memory system – faulty data		
	Response: Remote – standard fault	
	Cause	Measure
	Faulty data detected in non-volatile memory system.	– Check whether the data on the non-volatile memory is formatted for another device. – Reformat the memory system (perform basic initialization).

31972098/EN – 8/2024

Error: 25.6 (1906hex | 6406dec) Description: Incompatible device configuration		
	Response: Remote – standard fault	
	Cause	Measure
	The data set of another device was copied in the device, which differs in device family, power, or voltage from the current device.	– Acknowledge the fault through a manual fault reset. To do so, under [Diagnostics] > [Status] > [Fault status] in the "Manual fault reset" parameter, select the "With parameter set acceptance" setting. – Restore delivery state. Note that doing so will reset all data in the non-volatile memory to the values at delivery.
	The replaceable memory module of another device has been inserted in the device, which differs from the current device in device family, power, voltage or design, for example.	– Insert the correct memory module. – Acknowledge the fault through a manual fault reset. To do so, under [Diagnostics] > [Status] > [Fault status] in the "Manual fault reset" parameter, select the "With parameter set acceptance" setting. – Restore delivery state. Note that doing so will reset all data in the non-volatile memory to the values at delivery. – Perform basic initialization. Contact SEW-EURODRIVE Service for this.
	The power section has been replaced and differs in its power rating or voltage from the original power section.	– Insert the correct power section. – Acknowledge the fault through a manual fault reset. To do so, under [Diagnostics] > [Status] > [Fault status] in the "Manual fault reset" parameter, select the "With parameter set acceptance" setting. – Restore delivery state. Note that doing so will reset all data in the non-volatile memory to the values at delivery.
	The subcomponent is defective.	Contact SEW-EURODRIVE Service.

Error: 25.7 (1907hex | 6407dec) Description: Non-volatile memory system – initialization error		
	Response: Remote – standard fault	
	Cause	Measure
	Initialization of the non-volatile memory system has failed.	– Switch the device off and on again. – Restore delivery state. Note that doing so will reset all data in the non-volatile memory to the values at delivery. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service. – Perform basic initialization. Contact SEW-EURODRIVE Service for this.

31972098/EN – 8/2024

Error: 25.9 (1909hex | 6409dec) Description: Non-volatile memory system – hardware error		
	Response: Remote – standard fault	
	Cause	Measure
	Error while accessing hardware of non-volatile memory system.	– Switch the device off and on again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

Error: 25.10 (190Ahex | 6410dec) Description: Power section configuration data – version conflict		
	Response: Remote – standard fault	
	Cause	Measure
	Wrong version of configuration data of power section.	Contact SEW-EURODRIVE Service.

Error: 25.12 (190Chex | 6412dec) Description: Power section configuration data – CRC error		
	Response: Remote – standard fault	
	Cause	Measure
	Faulty configuration data of power section.	Contact SEW-EURODRIVE Service.

13.9.7 Fault 32 Communication

Error: 32.6 (2006hex | 8198dec) Description: Error while transferring parameter set		
	Response: Remote – standard fault	
	Cause	Measure
	Error while downloading parameter set to device.	– Check the wiring of system bus and module bus. – Start the download again.

Error: 32.13 (200Dhex | 8205dec) Description: Process data timeout		
	Response: Remote – warning with self-reset	
	Cause	Measure
	A timeout has occurred in process data transfer.	– Switch devices off and back on again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

31972098/EN – 8/2024

13.9.8 Fault 33 System initialization

Error: 33.2 (2102hex | 8450dec) Description: Firmware – checksum error		
	Response: Block rectifier	
	Cause	Measure
	Error calculating firmware checksum.	Contact SEW-EURODRIVE Service.

Error: 33.8 (2108hex | 8456dec) Description: Software function block not configured correctly		
	Response: Remote – standard fault	
	Cause	Measure
	Error detected in the configuration of the software function block.	Contact SEW-EURODRIVE Service.

Error: 33.9 (2109hex | 8457dec) Description: Hardware compatibility error of the power section		
	Response: Remote – critical fault	
	Cause	Measure
	Firmware not compatible with hardware of power section.	Contact SEW-EURODRIVE Service.

13.9.9 Fault 44 Power section subcomponent

Error: 44.1 (2C01hex | 11265dec) Description: Error at switched-mode power supply		
	Response: Remote – critical fault	
	Cause	Measure
	Switched-mode power supply in power section is faulty.	Contact SEW-EURODRIVE Service.

Error: 44.2 (2C02hex | 11266dec) Description: Overcurrent phase U		
	Response: Remote – critical fault	
	Cause	Measure
	The connected motor is too large.	Connect a smaller motor.
	Acceleration too high.	Reduce the acceleration.
	A short circuit has occurred.	– Remove the short circuit on the motor connection. – Check the motor phases.
	There is a problem with the output filter.	– Activate the output filter during startup of the drive train. – Check assignment of output filter and inverter.
	Output stage defective.	Contact SEW-EURODRIVE Service.

31972098/EN – 8/2024

Error: 44.3 (2C03hex | 11267dec) Description: Overcurrent phase V		
	Response: Remote – critical fault	
	Cause	Measure
	The connected motor is too large.	Connect a smaller motor.
	Acceleration too high.	Reduce the acceleration.
	A short circuit has occurred.	– Remove the short circuit on the motor connection. – Check the motor phases.
	There is a problem with the output filter.	– Activate the output filter during startup of the drive train. – Check assignment of output filter and inverter.
	Output stage defective.	Contact SEW-EURODRIVE Service.

Error: 44.4 (2C04hex | 11268dec) Description: Overcurrent phase W		
	Response: Remote – critical fault	
	Cause	Measure
	The connected motor is too large.	Connect a smaller motor.
	Acceleration too high.	Reduce the acceleration.
	A short circuit has occurred.	– Remove the short circuit on the motor connection. – Check the motor phases.
	There is a problem with the output filter.	– Activate the output filter during startup of the drive train. – Check assignment of output filter and inverter.
	Output stage defective.	Contact SEW-EURODRIVE Service.

Error: 44.5 (2C05hex | 11269dec) Description: Supply voltage fault at gate driver		
	Response: Remote – critical fault	
	Cause	Measure
	Faulty supply voltage for gate drivers for phases U, V, W.	– Switch device off and back on again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.
	Phase module not ready for operation.	– Switch device off and back on again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

31972098/EN – 8/2024

Error: 44.6 (2C06hex | 11270dec) Description: Fault in supply voltage at gate driver for brake chopper		
	Response: Remote – critical fault	
	Cause	Measure
	Faulty supply voltage of gate driver for brake chopper.	– Switch device off and back on again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.
	Brake chopper not ready for operation.	– Switch device off and back on again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

Error: 44.7 (2C07hex | 11271dec) Description: Hardware fault		
	Response: Remote – critical fault	
	Cause	Measure
	The hardware of the power section has detected a fault. It is not possible to pinpoint the fault.	– Switch device off and back on again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

13.9.10 Fault 84 Rectifier

Fault: 84.1 (5401hex | 21505dec) Description: Warning		
	Response: Remote – warning with self reset	
	Cause	Measure
	The rectifier has signaled a warning.	– Switch the device off and on again. – If the error fault repeatedly, contact SEW-EURODRIVE Service.

Fault: 84.2 (5402hex | 21506dec) Description: Fault		
	Response: Remote – standard fault with self reset	
	Cause	Measure
	The rectifier has detected a fault.	– Switch the device off and on again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

31972098/EN – 8/2024

Fault: 84.3 (5403hex | 21507dec) Description: Critial fault		
	Response: Remote – critical fault with self reset	
	Cause	Measure
	The rectifier has detected a critical fault.	– Switch the device off and on again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

13.10 Device replacement

Device replacement is only possible when using an identical replacement device. Deviating device configurations lead to fault E25.06 and can be acknowledged with parameter acceptance. The device can then be used without further startup. If a device needs to be replaced, the following procedures apply.

13.10.1 Using a MOVI-C® CONTROLLER

The "Update configuration" function can be started using the MOVISUITE® engineering software at any time, usually after completed startup of the devices and the controller.

Using this function, all parameter and configuration settings of the devices and the controller are saved on the memory card of the controller and are provided with a checksum.

When the controller is switched on, the data on the memory card and the data on the connected device are compared in a test to see if they match. In case a defective device has been replaced previously, the controller recognizes that the data on the memory card does not match the data of the new device. In this case, the controller loads the data of the memory card to the device.

In addition, changes in the device that have not been saved using the "Update configuration" function are overwritten. The process is performed automatically.

MOVI-C® CONTROLLER without CMM.. memory module in the inverter

If the data management (axis data set recovery) of the MOVI-C® CONTROLLER is used, the parameter and configuration settings of the controller are always transferred to the inverter.

13.11 Service – functional safety

13.11.1 Modification/changes to the device

- Hardware changes

  Any changes to the CS..A safety option can be performed only by SEW-EURODRIVE.
- Firmware modifications

  Only SEW-EURODRIVE is authorized to make modifications to the firmware.

- Repair

  Only SEW-EURODRIVE is authorized to repair the CS..A safety option.
- Warranty

INFORMATION

The safety certification and any right to claim under limited warranty of SEW-EURODRIVE become void if the user modifies the device internally (e.g. exchange of components, welding parts).

13.11.2 Status LEDs

The description of the "F-ERR" and "F-RUN" LEDs can be found in chapter "General LEDs" (→ 🗎 515).

13.11.3 Fault states of the MOVISAFE® CS..A safety option

⚠ DANGER

The MOVISAFE® CS..A safety option has a fault and automatically restarts in the following cases:

- The DC 24 V supply voltage was switched off and back on.
- The safety option was in standby state.
- Several inverter faults were acknowledged.

Death or severe injuries

- To prevent automatic restart in the aforementioned cases, the parameter *Fault status after startup* (8703.240) must be parameterized to "Start inhibit". The "Start inhibit" state must be acknowledged.

Fault responses

The occurring faults of the safety option are divided into 6 fault classes. Depending on the fault class, the fault response described in the following table is carried out:

Fault class	Fault response
FS message	Entry in fault memory, no further response
FS warning	Entry in fault memory, no further response
FS output fault, FS input fault, FS encoder fault	Entry in fault memory and safe state of digital inputs and outputs as applicable
FS system fault	Entry in fault memory and safe state of digital inputs and outputs
FS critical fault	Entry in fault memory and safe state of digital inputs and outputs, no safe communication
FS data fault of internal memory	The data fault is triggered by faulty data in the RAM and results in a processor restart.

FS message

No fault response is carried out in the case of an FS message. An entry is made in the fault memory. In addition, the corresponding fault code is transferred.

31972098/EN – 8/2024

FS warning

No fault response is carried out in the case of an FS warning. An entry is made in the fault memory. In addition, the corresponding fault code is transferred.

An FS warning is information, e.g. about a fault in the encoder system, which has no effect with regard to safety technology at the time of occurrence, but which can represent a fault at a later time.

FS – output fault, FS – input fault, FS – encoder fault

FS – output fault

If the safety option detects an error at a safe digital output, all safe digital outputs are switched to the safe state. In addition, the STO safety sub-function is activated and the safety option is set to the safe state. In the FS protocol, the bits of the outputs F-DO00 and F-DO01 are set to "0" and the bits for the STO safety sub-function and the fault are set to "1".

In addition, the corresponding error code is transferred for the FS output error that occurred.

FS – input fault

If the safety option detects a fault at a safe digital input, the affected safe digital input is switched to the safe state. If the affected safe digital input is parameterized as dual-channel, both inputs are switched to the safe state. In the FS-protocol, the bits of the affected safe digital inputs are set to "0" and the fault bit is set to "1".

In addition, the corresponding fault code is transferred for the FS input fault that occurred.

INFORMATION

If a safe digital input is assigned to a safety sub-function via function assignment, then this safety sub-function is selected in the event of an FS input fault.

At a safe digital input with detected fault, the fault must first be resolved and the safe state established before acknowledging the FS input fault. In this way, a safety sub-function is not erroneously selected after acknowledgment of an FS input fault.

FS – encoder fault

If the safety option detects a fault in the encoder system, this results in a warning if no safety sub-function is activated. The safety option continues to remain operational. If at least one safety sub-function is active, this leads to an FS encoder fault. The safety sub-functions switch to the relevant fault state. The corresponding fault code for the FS encoder fault that occurred is transferred.

In the case of faults in the encoder system that are assigned to the fault class "FS Encoder fault" or "FS System fault", the corresponding fault response is initiated as soon as the fault or error is detected.

Acknowledging the FS encoder fault with activated safety sub-function leads to a restart of the safety sub-function.

INFORMATION

Acknowledgment of a limit violation leads to a different behavior of the activated safety sub-function than the acknowledgment of an FS encoder fault.

The response to an FS encoder fault can be suppressed using the "Encoder fault muting" function or emergency mode. The "Encoder fault muting" function can be activated at a safe digital input or via the safe process data. Further information can be found in the chapter "Startup of the safety option MOVISAFE® CS..A > "Parameterization of the safety sub-functions > Muting encoder error".

31972098/EN – 8/2024

FS – system fault

In the case of an FS system fault, all safe digital inputs and all safe digital outputs are switched to the safe state. In addition, the STO safety sub-function is executed without delay and the safe digital outputs F-DO00 and F-DO01 are disabled. The safety option is set to the safe state.

In the FS protocol, the bits of the safe digital outputs F-DO00 and F-DO01 and the safe digital inputs F-DI00, F-DI01, F-DI02 and F-DI03 are set to "0". The bits for the STO safety sub-function and the fault are set to "1".

In addition, the corresponding error code is transferred for the FS system fault that occurred.

INFORMATION

If the safe digital output is assigned to a safety sub-function via the function assignment, this safety sub-function is selected in the case of an FS system error.

FS – critical fault

In the case of a critical fault, the safety option is set to the safe state. Parameterization of the safety option is not possible. All safe digital inputs and all safe digital outputs are switched to safe state. In addition, the STO safety sub-function is executed without a delay. The sensor supply for the safe digital inputs is also switched to de-energized state. Active safe communication is suspended.

In addition, the corresponding fault code is transferred for the critical fault that occurred.

If the critical error was caused by the parameterization, you must start the safety option without safety key and then restore the safety option to its delivery state. You can then restart the safety option with safety key.

INFORMATION

Please note that the safety key may only be inserted or removed when the device is switched off.

Error messages

If there is a fault in the safety option, the inverter indicates that the safety option is reporting a fault.

Measures for fault elimination and more information on causes can be found using the fault status of the safety option.

FS data fault of internal memory

The data fault is triggered by faulty data in the RAM and results in a restart of the safety option.

In the case of a data fault, all safe digital inputs and all safe digital outputs are switched to the safe state. In addition, the STO safety sub-function is executed without a delay. The safe state of the safety option is activated and a corresponding fault code is set.

The data fault can be acknowledged via a safe digital input or safe communication.

31972098/EN – 8/2024

Starting behavior of the safety option



⚠ DANGER

After a fault, the safety option automatically restarts if the supply voltage is switched on, if the standby mode is completed, or if certain inverter faults are acknowledged.

Severe or fatal injuries.

- The *Fault status after startup* parameter must be parameterized to "start inhibit". This way, the automatic restart of the safety option is prevented in the cases mentioned above.

In the "Basic settings" of the "Assist CS.." parameterization tool, the starting behavior of the safety option can be defined using the *Fault status after startup* parameter. The following parameter settings are possible:

- "Start inhibit" parameter setting

  The safety option always starts with start inhibit after the supply voltage is switched on. This parameterization is provided for independent operation.

- "No start inhibit" parameter setting

  The safety option starts immediately. Note that faults must be acknowledged by switching the supply voltage off and on again or by quitting standby mode. This means that a fault pending prior to switching off the supply voltage or during standby mode is acknowledged and the safety option starts up. This parameterization is designated for fieldbus operation where the higher-level controller, if necessary, takes over interlocking in case of a fault.

The STO safety sub-function is active for as long as start inhibit is active. Outputs assigned to the STO or SBC function are activated depending on the safety sub-function. If outputs are configured to "F-PO data", they will still be controlled by the higher-level safety controller. The outputs are not set to safe state

Start inhibit is deactivated if one of the following conditions is met:

- An acknowledgment has taken place
- Muting is activated

13.11.4 Fault diagnostics

The "Current initial fault" fault status shows the fault that occurred first in the safety option with the corresponding fault code, subfault code and fault description. For internal purposes, additional fault codes are displayed.

The current initial fault is the fault that occurs after a restart or since the last acknowledgment as the first fault with the highest priority.

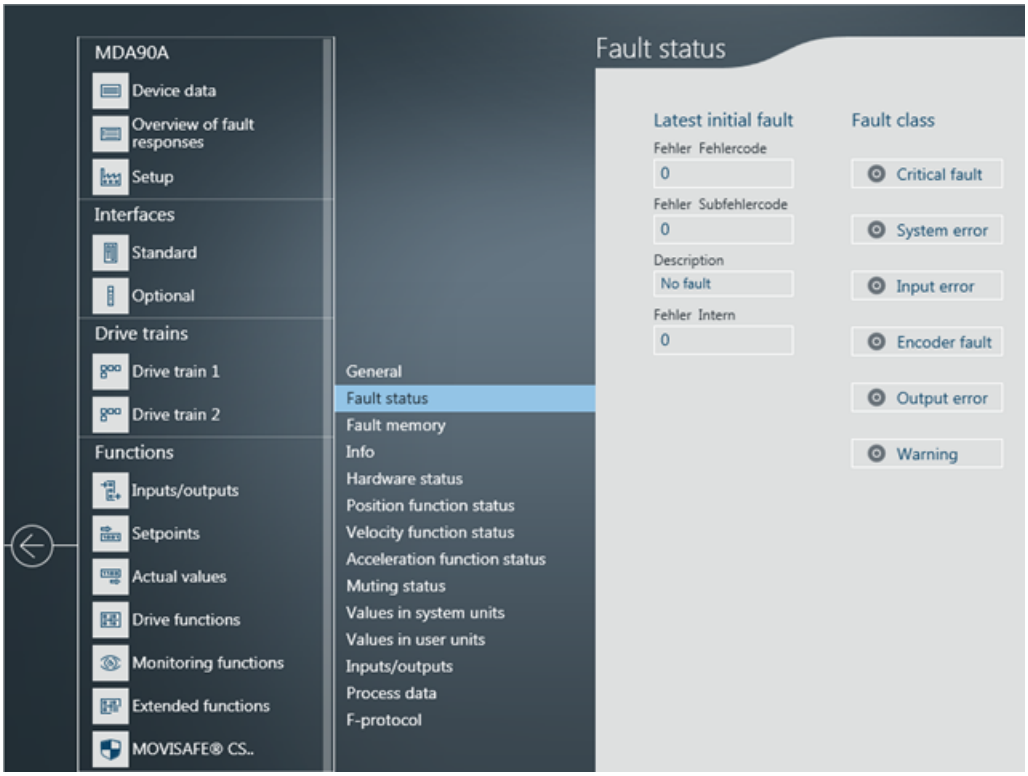
Fault messages

If there is a fault in the safety option, this fault is indicated by the inverter. Further information can be found in chapter "Service" > "Fault description for CS..A safety option".

31972098/EN – 8/2024

Diagnostics with MOVISUITE® Assist CS..

In the "Diagnostics" segment, in menu command [MOVISAFE® CS..] > [Fault status], the current fault of the safety option is displayed with the corresponding fault description.



21877778571

Diagnostics with PROFIsafe connection

The CS..A safety option with PROFIsafe connection triggers a diagnostic alarm on the F-PLC in the data exchange between the F-PLC (fieldbus host) and the safety option (fieldbus device) in case of a fault. Simultaneously, the associated fault code is transferred via the communication connection.

The F-PLC responds to the issued diagnostic alarm if the *Diagnostic alarm* assembly parameter is enabled for the safety option in the F-PLC per configuration. Depending on the fieldbus used (PROFINET), the fault code of the safety option can be evaluated in the F-PLC. A diagnostic alarm does not trigger a fault response in the F-PLC (default setting of the safety option in the F-PLC).

The safety option has PROFIsafe and assembly-specific fault codes. All fault codes of the CS..A safety option are listed in a fault table.

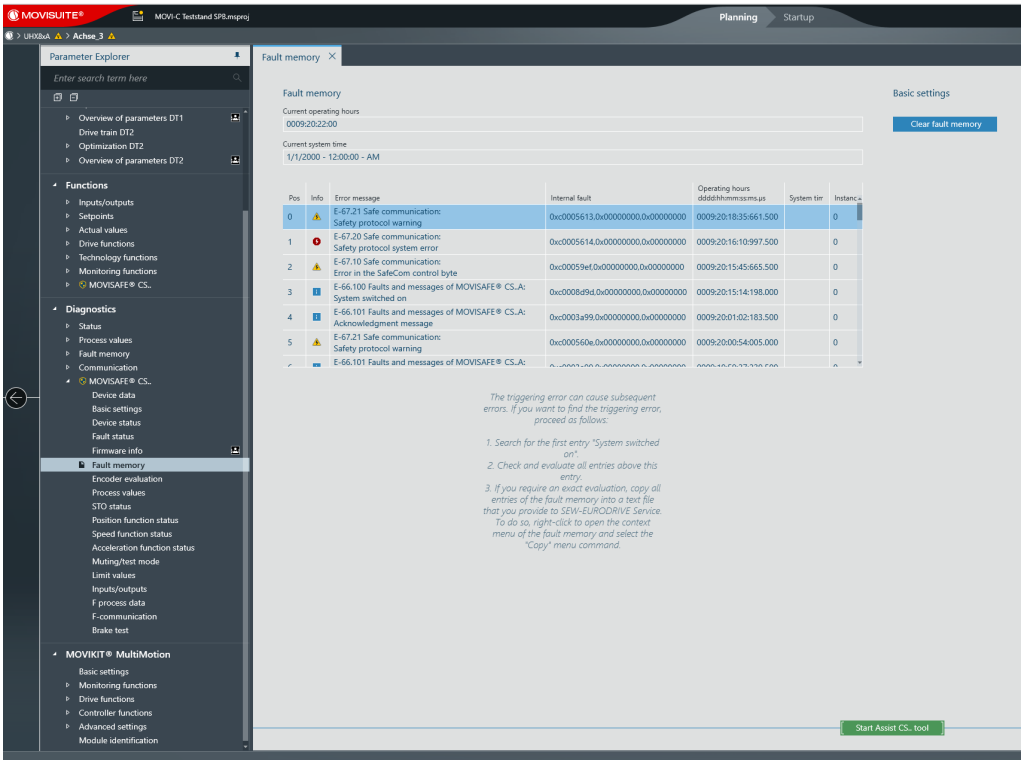
INFORMATION

You can find the structure and the evaluation of a diagnostic data set in the F-PLC in the respective manual of the fieldbus host. In addition, ensure that the current device description file of the SEW-EURODRIVE drive system is always installed in the engineering tool of the F-PLC during configuration.

31972098/EN – 8/2024

Fault memory

The current initial fault and all other subsequent faults are residually saved in the fault memory with associated timestamp.



18014420387287947

Additional messages for the faults are entered in the fault memory in the columns "Primary fault" and "Sub-fault". These are messages that do not directly trigger a fault response of the CS..A safety option. Essentially, these are the message "Power On" (primary fault 66 and sub-fault 100) and the message "Acknowledgment message" (primary fault 66 and sub-fault 101).

In the "Pos" column, the position of the fault is displayed. In the "Info" column, a symbol indicates the category of the fault. In the "Fault message" column, the fault number, the main fault text and the subfault text is displayed. The timestamp is entered twice in the list. Once as an operating hours counter and once as system time. The system time is a time synchronized by the controller and is based on the Universal Time Coordinated (UTC). The user can set the time from UTC to local time in the controller. The system time is recorded in the fault memory after synchronization; no time is displayed in the column beforehand. The "Internal fault" column is used for internal purposes. The fault memory is organized as a ring memory. The most recently occurring fault is shown in line 0 of the list. If there are more than 50 entries, the oldest fault is overwritten.

13.11.5 Acknowledgment

Introduction

The acknowledgment of a warning, the start inhibit, a fault and a limit violation can be realized via a safe digital input F-DI or via the "Fault acknowledgment" bit of the safe process data.

To acknowledge a fault or a limit value violation via a safe digital input, an input must be set to "Acknowledge faults" or "Unlatch latched F-DI and acknowledge faults".

Acknowledgment is performed by a 0 → 1 edge. In the following cases, a warning will be indicated after 20 s:

- A permanent high signal is present on the safe digital input to which the acknowledgment has been assigned.
- One of the fault acknowledgment bits in the process data is permanently "1".

To acknowledge faults via PROFIsafe or Safety over EtherCAT®, the exchange of safe data of the safety option must be fault-free. Faults in the safety option can then be acknowledged by a rising edge via the "Fault acknowledgment" bit in the safe process output data.

A critical fault can only be acknowledged by switching the supply voltage off and on.

⚠ DANGER



Depending on the connection, MOVISAFE® CS..A can deactivate the STO safety sub-function after the acknowledgment. This can cause an immediate restart of the system.

Severe or fatal injuries.

- Make sure that no person is in the hazardous area of the system during the acknowledgment.
- Make sure that the STO safety sub-function is active via F-DI or safe communication during the acknowledgment.

Existing limit violations of the safety sub-functions are deleted by parameterizing, creating the acceptance report, and publishing the acceptance. Start inhibit is set to prevent the system from switching to operation afterwards.

For details on the cause of the STO, refer to MOVISUITE® in the menu "Diagnostics" > "MOVISAFE® CS.." in the menu item "STO status" in the parameters *Cause for start inhibit* (8700.124) and *Cause for STO* (8700.85).

Acknowledging a system error

If safe digital inputs with active interlocking are used for acknowledging a system error, adhere to the following sequence:

1. If possible, eliminate the cause of the error.
2. Make sure of the following:
   - No person is in the hazardous area of the system.
   - The STO safety sub-function is activated via F-DI or via safe communication and the SDI and SOS safety sub-functions are deselected and the SLI increment enable has been canceled.
3. Acknowledge the system fault.
4. If necessary, re-select the deselected SDI and SOS safety sub-functions and set the SLI increment enable again.

Acknowledging a limit value violation of a safety sub-function

After a limit violation of a safety sub-function has been identified, the status of this function will become inactive. In addition, a fault of the "FS Warning" class will be set.

A limit violation must always be acknowledged.

31972098/EN – 8/2024

A limit violation cannot be acknowledged through deactivation of the safety sub-function. With the exception of this, the parameterization of the fault response is at "F-PI only". With the SSM, SSR, and SLA safety sub-functions, the error is acknowledged by deactivating the safety sub-function.

The acknowledgment always affects all safety sub-functions. The safety sub-function can still be activated during acknowledgment.

Parameterized speed filters of the safety sub-functions that have triggered a limit violation are reset.

Note the following behavior of the safety sub-functions during an acknowledgment:

- SOS, SDI:

  The limit positions are recalculated.
- SLI:

  An existing limit value violation is signaled again via the acknowledgment.
- SLS:

  The delay time and the transition ramp will **not** be recalculated; there will be an immediate monitoring of the limit speed.
- SS1/2:

  The delay time and the transition ramp are not recalculated; the final state becomes immediately active (STO, SOS, SLI activation).
- SSR:

  The limit speeds are monitored once the delay time has lapsed.

Acknowledging an input fault

An input fault can occur if one of the following functions is assigned to a two-channel safe digital input F-DI in the function assignment:

- SBT clearance
- SLI increment enable
- Unlatch F-DI
- Unlatch F-DI and acknowledge fault
- Muting
- Activate test mode.

Before acknowledging an input fault, ensure the following:

- No person is in the hazardous area of the system.
- No DC 24 V signal is present at the corresponding inputs.

13.11.6 Device replacement

INFORMATION

- Observe the information in chapter "Compatibility" (→ 🗎 316).
- A faulty CS..A safety option must be taken out of operation within 100 hours.

31972098/EN – 8/2024



⚠ WARNING

Incorrect parameterization of the safety option is enabled by an incorrectly plugged safety key.

Severe or fatal injuries.

- Make sure that the safety key matching the application is plugged into the correct system position.



⚠ WARNING

The safety option does not detect that the encoder was replaced and still shows the replaced encoder as referenced.

Severe or fatal injuries.

- Ensure that the safety option delivers the same raw value at the same system position after replacing the encoder or perform a new referencing.
- Carry out a functional test.

The "Device marked as removed" feature does not become invalid in the following cases:

- The inverter with safety option has been replaced
- The safety option has been replaced
- A sensor or actuator connected to the safety option has been replaced

The safety option is not capable of recognizing these cases. Both the "RUN" LED and the standard process data continue to signal the "Assembly accepted" status. In these cases, it is the user's responsibility to check to what extent a new acceptance is required.

Replace the MOVISAFE® CSA31A safety option

When replacing the CSA31A, incrementally evaluated encoders must be referenced again.

When replacing the previous CSA31A with a new CSA31A without saved referencing data, the referencing is preserved on encoders that are not incrementally evaluated if the safety key from the previously used safety option continues to be used.

If a CSA31A replacement safety option that already has referencing data saved is used, the referencing data from the safety key is not automatically accepted. The referencing can be taken from the safety key during the next system start via MOVISUITE® using the [Accept referencing] button. Once the button is actuated, the safety option must be restarted. As an alternative, a new referencing can be performed.

Device replacement with MOVI-C® CONTROLLER

The following steps must be performed for the actual device replacement:

The system offers the option to save the application data set for the inverter and the data set for the safety option on the controller. This step must be carried out in advance by the user.

1. Switch off the device to be replaced.
2. Remove the pluggable safety key from the safety option.
3. Replace the device (including the MOVISAFE® CS..A safety option) or only the MOVISAFE® CS..A safety option.

31972098/EN – 8/2024

4. Re-insert the safety key removed in step 2.
5. Carry out a functional test. The checking of all parameters is omitted.

The controller detects the device replacement automatically and loads the application data set to the MOVISAFE® CS..A safety option. The localized key data set on the pluggable safety key ensures that the correct application data set has been loaded. The MOVISAFE® CS..A safety option is then in the same state that it was in before the device replacement. This means that if the MOVISAFE® CS..A safety option was in the "Accepted" state before the device replacement, it will be in the "Accepted" state again after device replacement. In order to ensure correct connection of the sensors and actuators, a function test of the safety option is still required even with automatic device replacement function.

INFORMATION

Check the referencing of the safety option after having replaced the safety option.

Device replacement with MOVISUITE®

For device replacement with MOVISUITE®, proceed as follows:

1. Back up the device data set of the device to be replaced using the menu item [Device] > [PC].
2. Switch off the device to be replaced.
3. Remove the pluggable safety key from the safety option.
4. Replace the device (including the MOVISAFE® CS..A safety option) or only the MOVISAFE® CS..A safety option.
5. Insert the safety key removed in step 3 back into the replaced safety option.
6. Switch only the DC 24 V control voltage back on.
7. Load the device data set saved in step 1 back onto the new device using the menu item [PC] > [Device].
8. Switch the main power supply (AC 400 V) back on and perform a functional test of the system.

INFORMATION

Check the referencing of the CSA31A after having replaced a MOVISAFE® CSA31A safety option.

Replacing the safety key

A defective safety key of a safety option can be replaced by a new safety key.

Replace the safety key as follows:

1. Have the original acceptance report available or document the current checksums.
2. Switch off the device.
3. Replace the defective safety key.
4. Switch on the device again.
5. In MOVISUITE®, open the "Assist CS.." parameterization tool.
6. Load the parameters into the safety option.
7. Generate a report.

8. Compare the previous checksums with the current checksums. No checksum must have changed. If the checksums differ, check the corresponding functions again.
9. Publish the successful acceptance.

INFORMATION

After replacing the safety key of the MOVISAFE® CSA31A safety option, you must perform the referencing of the CSA31A again.

13.12 SEW-EURODRIVE Service

13.12.1 Sending in a device for repair

If a fault cannot be repaired, contact SEW-EURODRIVE Service, see chapter "Contacting SEW-EURODRIVE" (→ 🗎 626).

Always specify the digits of the status label when contacting the SEW-EURODRIVE electronics service team. This will enable our Service personnel to assist you more effectively.

Provide the following information when sending the device in for repair:

- Serial number (see nameplate)
- Type designation
- Unit design
- Short description of the application (application, control type, etc.)
- Type of fault
- Accompanying circumstances
- Your own presumptions
- Unusual events preceding the problems, etc.

13.13 Shutdown

⚠ WARNING



Electric shock due to incompletely discharged capacitors.

Severe or fatal injuries.

- Observe a minimum switch-off time of 10 minutes after disconnecting the power supply.

To shut down the device, de-energize the device using appropriate measures.

⚠ WARNING



Risk of burns due to hot surfaces.

Severe injuries.

- Let the devices cool down before touching them.

31972098/EN – 8/2024

13.14 Extended storage

No additional measures are required for extended storage of inverters.

13.15 IT security guidelines for secure disposal

13.15.1 Removing the product from its intended environment



If the data stored on the product is considered relevant for IT security, remove it as described in the section "Secure removal of data stored in the product." (→ 🗎 621)

13.15.2 Removing reference and configuration data in the environment



Reference files, configuration files, log files, and other data belonging to the product can be stored in the environment on other devices, such as a higher-level controller or a local OPC-UA client. If the stored data is considered relevant for IT security, remove it from the corresponding devices.

13.15.3 Secure removal of data stored in the product



You can reset the data saved in the product to the factory settings using the MOVISUITE® engineering software.

This encompasses the following data, if present on the device variant:

- Configuration of the device
- Scope recording of the device
- Fault memory
  - Fault number
  - Timestamp
  - Fault code, subfault code, descriptive text
  - Process data
  - States of the digital inputs/outputs
  - Control word and status word
- Device name
- IP address
- Safety-relevant data

The following data is not reset with this procedure and can be changed individually, if present on the device variant:

- Enabled functions
- AS-Interface address
- Data set of the safety option
- EtherCAT® device designation
- PROFINET name
- Last detected options

31972098/EN – 8/2024

13.15.4 Removing a customer data backup

You can delete a customer data backup using the MOVISUITE® engineering software. To do so, in the parameter configuration of the corresponding device under [Basic setting] > [Data backup] > [Backup of customer-specific device parameters] click the [Delete] button.

Some of the data of the product is stored on removable storage media. If the data on the removable storage medium is classified as sensitive data from the operator's point of view and is not intended for later use, reset the device to the factory settings before disposing of the data. This also deletes the storage medium content.

13.16 Waste disposal

Dispose of the product and all parts separately in accordance with their material structure and the national regulations. Put the product through a recycling process or contact a specialist waste disposal company. If possible, divide the product into the following categories:

- Iron, steel or cast iron
- Stainless steel
- Magnets
- Aluminum
- Copper
- Electronic parts
- Plastics

The following materials are hazardous to health and the environment. These materials must be collected and disposed of separately:

- Oil and grease

  Collect used oil and grease separately according to type. Ensure that the used oil is not mixed with solvent. Dispose of used oil and grease correctly.
- Screens
- Capacitors

Waste disposal according to WEEE Directive 2012/19/EU



This product and its accessories may fall within the scope of the country-specific application of the WEEE Directive. Dispose of the product and its accessories according to the national regulations of your country.

For further information, contact the responsible SEW-EURODRIVE branch or an authorized partner of SEW-EURODRIVE.

31972098/EN – 8/2024

14 Inspection and maintenance

The device is maintenance-free. SEW-EURODRIVE does not stipulate any regular inspection work. However, it is recommended that you check the following components regularly:

- **Connection cables:**

  If cables become damaged or fatigued, replace them immediately.
- **Cooling fins:**

  Remove any deposits to ensure sufficient cooling.

INFORMATION



Only SEW-EURODRIVE may repair the inverters.

31972098/EN – 8/2024

15 Appendix

15.1 Abbreviation key

The following table lists the abbreviations that are used in the documentation together with their unit and meaning.

Abbreviation	Unit	Meaning
ASM	–	Asynchronous motor
BG..	–	Inverter size
C	µF	Capacitance
f_{max}	Hz	Maximum output frequency
f_{max}	Hz	Maximum input frequency (encoder input)
f_{line}	Hz	Line frequency
f_{PWM}	kHz	Frequency of the pulse width modulation
h	m	Installation altitude
HF	–	High frequency
I_F	A	Tripping current (braking resistor)
I_{max}	A	Maximum DC link current (specification on the nameplate)
I_{max}	A	Maximum output current (encoder interface)
I_{peak}	A	Output peak current (encoder interface)
I_{A_max}	A	Maximum output current
I_{Appl}	A	Total current of the application
I_{Cont}	A	Continuous output current
I_N	A	Nominal output current/nominal current (filter, choke)
I_{line}	A	Nominal line current
I_{DCL_nom}	A	DC link current
L_N	mH	Inductance
LSPM	–	Line Start Permanent Magnet
asl	m	Above sea level, reference for altitudes above sea level
P_{rms}	kW	Effective power (braking resistor)
P_{max}	kW	Maximum power (braking resistor)
P_{Mot}	kW	Motor power of the asynchronous motor
P_N	kW	Nominal motor power (rated power)
P_V	W	Power loss
PWM	–	Pulse width modulation
R_{BR}	Ω	Value of the braking resistance
R_{BR_min}	Ω	Minimum value of the braking resistance
R_i	Ω	Input resistance
S_N	kVA	Apparent output power

31972098/EN – 8/2024

Abbreviation	Unit	Meaning
SM	–	Synchronous motor
V_A	V	Inverter output voltage
U_{BR}	V	Brake supply voltage
U_{Drop}	V	Voltage drop
V_N	V	Nominal line voltage (filter, choke)
U_{line}	V	Connection voltage
U_{DCL_nom}	V	Nominal DC link voltage
V_{DCL}	V	DC link voltage
U_{out}	V	DC 24 V to supply STO_P1 and STO_P2
V_S	V	Supply voltage of encoders
V_{S12VG}	V	DC 12 V supply voltage of encoders
V_{S24VG}	V	DC 24 V supply voltage of encoders
V_{I24}	V	Voltage supply for electronics and brake
ϑ_A	°C	Ambient temperature
+ES	–	... with output stage inhibit

31972098/EN – 8/2024

16 Contacting SEW-EURODRIVE

You can find the worldwide contact data and locations on the **SEW-EURODRIVE website** via the following link or the QR code shown below.

https://www.sew-eurodrive.de/contacts-worldwide



31972098/EN – 8/2024

Index

Numerical

24 V supply voltage 358
7-segment display 514
  Fault table 512
  Operating displays 512

A

Abbreviation key 624
Accessories
  Standard accessories 103
Acknowledgment of the CS..A safety option
  Acknowledgment of PROFIsafe data exchange 230
Ambient temperature 59, 77
  Safety option 59
Assist CS..
  Safety concept 187

B

Bore patterns
  Control cabinet rear panel 326
Brake
  Control 126
Brake chopper 359
Brake control 404
  Permitted load 127
Brake output 360
Brake test
  Direction of movement/test direction 216
  Functional description 216
  Step-by-step procedure 220
Brake test system description 213
  Diagnostic coverage (DC) 215
  Test rate in safe braking systems 214
Brake test, step by step procedure
  End of test 222
  Step 3: Active testing of the brake 221
  Step 1: Moving clear 220
  Step 2: Load torque test (optional) 221
  Step 4: Passive brake testing (optional) 222
Braking resistor
  Thermal overload 143
Braking resistor selection 138
Braking resistors 369
  Installation 338
  Parallel connection 372
  Protection against thermal overload 369
Braking resistors BW..
  Description 78
  Parallel connection of braking resistors 78
BS.. touch guard 91
  Dimension sheet 91
  Dimensions 91
  Mounting rail fastening 91
  Part number 91
Built-in encoder EI7C FS installation 395
Built-in encoder EI7C FS properties 394
BW.. braking resistors 78, 79
  Assignment to an inverter 79
  Dimension sheets 88
  Part number 79
  Technical data 79

C

Cable installation 347
Calculation of response times
  Deselection of a safety sub-function via safe communication 262
  EDM function response time 262
  Encoder 254
  Fixed response times 252
  Response time in case of limit value violation with active fault response 259
  Response time in case of limit value violation with safe communication 260
  Safe communication 256
  Safe digital input F-DI 256
  when selecting a safety sub-function via a safe digital input 256
  when selecting a safety sub-function via safe communication 258
Card installation 336
Card slots 324
Cards, combination options 324
CES11A multi-encoder card
  Terminal assignment 380
CFC control mode 34, 116
  Asynchronous servomotors 131
  Standard asynchronous motors 131

31972098/EN – 8/24

Synchronous servomotors 132
Characteristic safety values
MOVISAFE® CSB..A and CSS..A, safety sub-functions with encoder evaluation 75
MOVISAFE® CSB..A and CSS..A, safety sub-functions without encoder evaluation 74
MOVISAFE® CSA31A 75
CiA402 profile 31
CIO21A and CID21A input/output card
Cable lengths and shielding 368
Circuit breaker 149, 353
Compatibility
CS..A firmware version and MOVI-C® MOVIDRIVE® device status 316
MOVISAFE® CS..A firmware version and MOVISUITE® version 316
Configuration example 154
Configuring the brake test
"Basic settings" menu 475
"Brake test" menu 480
"Checksum overview" menu 474
"Encoder" menu 476
"F-communication" menu 479
"Function assignment" menu 484
"Safe inputs" menu 475
"Safe outputs" menu 476
"STO/SBC" menu 479
"User units" menu 479
Encoder evaluation 477
Encoder function 478
Menus "SSx" to "SCA" 479
Pre-selection for control 473
Starting the "Assist CS.." parameterization tool 474
Connecting the system bus cable 361
Connection
Brake 347
Braking resistor 347
Control cable 348
Encoder 348
Installation instructions 350
Motor 347
Supply system cable 347
Connection diagram of digital inputs and outputs 410
Connection to the engineering software 413
Connection variants 395
Control cabinet rear panel 326
Control mode 33, 115
CFC 34, 116
ELSM® 34, 117
Output frequency 119
Position control 116
Properties 118
Speed control 115, 116, 117
Torque control 116, 117
U/f 34
V/f 115
VFC^{PLUS} 34, 115
Control options 421
Control topologies 32
Controlling the brake test
Starting conditions 485
Starting the brake test 486
Test result and ending the test 486
Copyright notice 9
Covers
Safety covers 331
CS..A
Nameplate 315
Type designation 314
CS..A type designation 314
CSA31A profile variant "Technology"
Process input data 247
Process output data 244
CSB21A profile variant "Technology"
Process input data 233
Process output data 232
CSB31A profile variant "Technology"
Process input data 236
Process output data 234
CSS21A/CSS31A profile variant "Technology"
Process input data 240
Process output data 238
Current profiles 135

D

Data exchange with higher-level controller
Acknowledgment of the safety option 230
F-periphery access of the safety option in the TIA Portal 226
Introduction 225
Safety over EtherCAT® safety protocol 230

31972098/EN – 8/24

DC link choke ZD..
Assignment to inverter ... 100
Decimal separator ... 9
Degree of protection ... 77
Derating
Installation altitude ... 136
Line voltage and temperature ... 137
Description
Input/output card CID21A ... 52
Input/output card CIO21A ... 52
Description of the FCBs ... 156
Designated use ... 12
Device replacement ... 609
Replacing the safety key ... 619
Using a MOVI-C® CONTROLLER ... 609
With MOVI-C® CONTROLLER ... 618
With MOVISUITE® ... 619
Device status ... 322
Device structure
Card slots ... 324
Compatibility ... 316
CS..A type designation ... 314
MOVISAFE® CSA31A ... 320
MOVISAFE® CSB21A/CSS21A ... 318
MOVISAFE® CSB31A/CSS31A ... 319
Diagnostic coverage (DC) ... 215
Diagnostics
Evaluating fault messages ... 507
MOVISUITE® ... 507
Digital inputs ... 360
Digital outputs ... 360
Dimension sheets
BW.. braking resistors ... 88
HD.. output choke ... 99
HF.. output filter ... 97
NF.. line filter ... 93
ZD.. DC link choke ... 101, 102
Dimensions ... 77
HD.. output choke ... 99
HF.. output filter ... 97
ND.. line choke ... 95
NF.. line filter ... 93
ZD.. DC link choke ... 101
Direction of movement/test direction
Load torque = 0 (3 test steps) ... 219
Load torque > 0 (5 test steps) ... 217
Disconnection of a single device
Requirements ... 396
Drive selection ... 121

E

EDM muting ... 462
Electrical installation ... 19
24 V supply voltage ... 358
Brake chopper ... 359
Brake output ... 360
Digital inputs ... 360
Digital inputs and outputs ... 410
Digital outputs ... 360
EI7C FS built-in encoder ... 394
Encoder ... 363
General information ... 350
Input fuses ... 148, 359
Line contactor ... 353
Miniature circuit breaker ... 148
Permitted voltage supply systems ... 350
Safe digital inputs (F-DI.) ... 206
Safe disconnection ... 385
Safety notes ... 19
Temperature sensor ... 360
Terminal assignment ... 374
Electronics data ... 50
ELSM® control mode ... 34, 117
Embedded safety notes ... 8
EMC-compliant installation
Installation example ... 349
Encoder ... 34
Electronic nameplate ... 126
Encoder cable requirements
SIN/COS encoder cable ... 205
Encoder concepts
1-encoder concept – FS distance encoder (with MOVISAFE® CSA31A only) ... 204
1-encoder concept – FS motor encoder ... 201
2-encoder concept – 2 distance encoders (with MOVISAFE® CSA31A only) ... 204
2-encoder concept (with MOVISAFE® CSA31A only) ... 202
Permitted encoder combinations ... 76, 200
Encoder connection ... 363
Encoder fault muting ... 461

Encoder requirements
Barcode encoder ... 199
Counting direction ... 196
Encoder concepts ... 76, 200
General requirements ... 193
Permitted encoders for MOVISAFE® CSA31A ... 197
Preventing the mechanical limit speed from being exceeded ... 197
Quantization error ... 195
Safe absolute encoder ... 200
Safety encoders approved by SEW-EURODRIVE ... 194
SSI encoder ... 198
Energy saving functions
Partial magnetization ... 155
Standby mode ... 155
Energy-saving function ... 34
Energy-saving functions ... 155
Environmental conditions ... 40
Equipotential bonding ... 346
Error
Evaluating fault messages ... 507
Shut-off responses ... 508
Error messages
Acknowledgment ... 506
Display ... 505
Explosion-protected AC motors ... 125
Extended storage ... 621
External safety controller ... 191

F

Fault
Fault messages ... 509
Reset ... 508
Fault classes
Error messages ... 612
FS message ... 610
FS warning ... 611
FS – critical fault ... 612
FS – encoder fault ... 611
FS – input fault ... 611
FS – output fault ... 611
FS – system fault ... 612
Fault description ... 518
Fault diagnostics
Error messages ... 613
Fault memory ... 615
With MOVISUITE® Assist CS ... 614
With PROFIsafe connection ... 614
Fault display
7-segment display ... 514
Fault messages
With parameterizable response ... 509
Fault states of the CS..A safety option
Fault responses ... 610
Important information ... 610
Fault table
7-segment display ... 512
FCB concept ... 156
Description of the FCBs ... 156
FCB description ... 156
FEA31A SSI combi-box
Dimension drawing ... 72
Flux optimization ... 155
F-periphery access of the safety option in the TIA Portal
F-periphery data component of the safety option ... 228
PROFIsafe address type 1 ... 227
PROFIsafe address type 2 ... 227
PROFIsafe version 2.4 ... 226
PROFIsafe version 2.6 ... 227
F-process data profile ... 232
CSA31A profile variant "System" ... 249
CSA31A profile variant "Technology" ... 244
CSB21A profile variant "Technology" ... 232
CSB31A profile variant "Technology" ... 234
CSS21A/CSA31A profile variant "System" ... 243
CSS21A/CSS31A profile variant "Technology" ... 238
Free text ... 322
FS standards ... 170
FS validity ... 170
Function control block ... 156
Functional description of the brake test ... 216
Functional safety
Safe state STO, safety option CS..A ... 172

G

Group drive and multi-motor drive ... 124

31972098/EN – 8/24

Group drives 35

H

Hazard symbols
Meaning 8
HD.. output choke 98
Assignment to inverter 98
Description 98
Dimension sheets 99
Dimensions 99
Part number 98
Technical data 98
HF.. output filter 96
Assignment to inverter 96
Description 96
Dimension sheets 97
Dimensions 97
Part number 96
Technical data 96

I

Information
Designation in the documentation 7
Installation 325
Transport 14, 15, 16
Input fuses 148, 359
Input/output card CID21A
Description 52
Technical data 53
Terminal assignment 379
Input/output card CIO21A
Terminal assignment 378
Input/output cards CIO21A
Description 52
Technical data 53
Inspection 623
Installation
Braking resistors 338
Line choke 342, 373
Output choke 345
Output filter 344
Requirements 325
Safety notes 19
Tightening torques 351
Installation (electrical)
Equipotential bonding 346
Installation instructions 350
Line protection 149, 353
Protection devices 355
Residual current device 149, 353
Installation instructions 350
Installation notes
Encoder connection 363
Installation of options and accessories
CIO21A, CID21A input/output card 367
Installing a card 336
Integrated safety technology
Overview of firmware versions 171
Interfaces 77
Interference immunity 77

L

Leakage current 354
LED
RUN 517
Lifting applications 13, 415
Line components
Line contactor 148
Line contactor 353
Line filter NF..
Description 92
Line protection 149, 353

M

Maintenance 623
Mass 77
Mechanical installation
Installation notes 325
Requirements 325
Miniature circuit breaker 148
Minimum clearance 325
Modification/handling with changes to the device 609
Module bus cable 362
Motor
Electronic nameplate 126
Motor control 33
Motor protection 34
Motor protection without temperature sensor 123
Motors that can be connected 121
Mounting position 325
MOVIKIT® Drive 30

31972098/EN – 8/24

MOVILINK® DDI ... 378
Disconnect connector ... 364
MOVISAFE® CS..A
Terminal assignment ... 384
MOVISUITE®
Evaluating error messages ... 507
Multi-motor drive and group drive ... 124
Muting safe process output data (F-PO) ... 462

N

Nameplate CS..A ... 315
Nameplates ... 321
System nameplate ... 322
ND.. line choke ... 94
Assignment to inverter ... 94
Description ... 94
Dimension sheets ... 95
Dimensions ... 95
Part number ... 94
Technical data ... 94
NF.. line filter
Assignment to inverter ... 92
connect ... 373
Description ... 92
Dimension sheets ... 93
Dimensions ... 93
Installation ... 343
Part number ... 92
Technical data ... 92
Notes
Meaning of the hazard symbols ... 8

O

Online Support ... 29
Operable motors ... 33
Operating states of the CS..A safety card ... 501
Operating state "Safe state" after critical fault ... 502
Operating states of the CS..A safety option
"Operation" operating state ... 502
"Parameterization" operating state ... 502
Operation ... 501
7-segment display ... 512
Brake test status in F process data ... 504
Cancellation of the brake test ... 504
Error messages ... 505
Fault description ... 518
in noise-sensitive environments ... 127
Process and actual values ... 502
Responses to fault reset ... 512
Safety notes ... 20
Overload capacity ... 135
Overload relay ... 78

P

Parameterizing the safety sub-functions
EDM muting ... 462
Encoder fault muting ... 461
Muting safe process output data (F-PO) ... 462
Prerequisites ... 436
Process ... 436
Test mode ... 463
Part number
BS.. touch guard ... 91
Carrying aid ... 103
Connectors ... 104
HD.. output choke ... 98
HF.. output filter ... 96
Interface adapter ... 77
ND.. line choke ... 94
NF.. line filter ... 92
Plastic cover ... 103
Safety options ... 59
Shield plate ... 103
ZD.. DC link choke ... 100
Partial magnetization ... 155
PE connection ... 354
Permitted devices ... 188
Permitted encoders for MOVISAFE® CSA31A
Safe distance encoders ... 198
Sin/cos encoder ... 197
Permitted voltage supply systems ... 350
Position control
VFC^{PLUS} mode ... 116
Power cable
Overview ... 264
Power consumption
Cards ... 153
Safety cards ... 154
Prefabricated cables
System bus cable ... 296

31972098/EN – 8/24

Process input data
Substitute values ... 251
Product description
Control mode ... 33
Energy-saving functions ... 155
FCB concept ... 156
Product names ... 9
PROFIsafe safety protocol
Number of safety options on the MOVI-C® CONTROLLER ... 225
Project planning ... 113
Control mode ... 115
Drive selection ... 121
Explosion-protected AC motors ... 125
Group drive and multi-motor drive ... 124
Motors that can be connected ... 121
Requirements for brake control ... 126
Schematic illustration of the project planning procedure ... 113
Selection of the braking resistor ... 138
SEW-Workbench ... 113
Project planning notes
Brake control/safe brake control ... 224
Encoder settings ... 223
Encoder/safety encoder ... 223
Motors ... 223
MOVIDRIVE® modular/system/technology ... 222
Number of testable brakes ... 225
Safety sub-functions ... 223
Systems with mechanical backlash ... 224
User units ... 223
Protection devices ... 355
Protective separation ... 19, 355

Q

Quantization error
Acceleration ... 196
Position ... 195
Speed ... 195

R

RCD (residual current device) ... 149, 353
Remove stored data ... 621
Repair ... 620
Repairs ... 623
Replacing the safety key of a safety option ... 619
Requirements
External safety controller ... 191
Requirements for brake control ... 126
Requirements for safe absolute encoders
CDx75 ... 200
FBPS617i ... 200
Requirements for startup ... 417
Requirements for the barcode encoder ... 199
Reset ... 508
Residual current device ... 149, 353
Response times
Calculation of response times ... 252
General ... 252
Responses to fault reset ... 512
Restoring the delivery state ... 499
Restriction of use ... 13
Rights to claim under limited warranty ... 9
Rotor adjustment ... 117
Rotor position measurement ... 117

S

Safe digital inputs ... 72
Safe digital inputs (F-DI.)
Discrepancy time monitoring ... 207
Interlocking ... 208
Possible connections ... 206
Safe digital inputs (F-DI..)
Active sensors (two-channel) ... 388
Contact-equipped sensors (single-channel) ... 385
Contact-equipped sensors (two-channel) ... 386
Pulsed voltage supply and crossfault monitoring ... 209
Sensors with semiconductor outputs (OSSD, two-channel) ... 390
Signal monitoring ... 209
Safe digital outputs ... 73
Safe digital outputs (F-DO..)
Actuator (one-channel, sourcing output) ... 394
Capacitive loads ... 211
General ... 209
Inductive loads ... 211
Information about line diagnostics and test pulses ... 211
Internal safe digital output F-DO_STO ... 212
Ohmic loads ... 211

31972098/EN – 8/24

Safety concept
Assist CS.. 187
Identification and authentication 175
Notes on stop categories 174
Pluggable safety key 174
Report and safety check 175
Restrictions 186
Safety concept of Assist CS..
Safety parameters 187
Test concept and test procedure 188
Safety conditions
Encoder requirements 193
Safety controller, external 191
Requirements 191
Safety controllers, requirements 396
Safety encoders approved by SEW-EURODRIVE
for AC motors and asynchronous servomotors 194
for servomotors 194
Safety notes
Designation in the documentation 7
Installation 19
Meaning of the hazard symbols 8
Preliminary information 10
Regenerative operation 19
Setup 19
Structure of section-related 8
Safety relays, requirements 396
Safety requirements 188
Acceptance 206
Encoder cable requirements 205
Requirements for stopping in an emergency in accordance with EN 60204-1 (emergency stop) 193
Safety sub-functions
SBC – Safe Brake Control 177
SCA – Safe Cam 185
SDI – Safe Direction 183
SLA – Safely Limited Acceleration 185
SLI – Safely Limited Increment 184
SLP – Safely Limited Position 186
SLS – Safely Limited Speed 182
SOS – Safe Operating Stop 182
SS1-r – Safe Stop 1 179
SS1-t – Safe Stop 1 178
SS2-r – Safe Stop 2 181
SS2-t – Safe Stop 2 180
SSM – Safe Speed Monitoring 183
SSR – Safe Speed Range 184
STO – Safe Torque Off 177
Safety-relevant acceptance
Creating an acceptance report 498
Process 497
Publishing acceptance 499
Structure of the acceptance report 498
SBC – Safe Brake Control 177
SCA – Safe Cam 185
Scope of delivery 315
SDI – Safe Direction 183
Section-related safety notes 8
Selection of the braking resistor 138
Sensor supply 73
Separation, protective 19
Serial number 322
Service 507
Evaluating fault messages 507
Extended storage 621
Fault diagnostics 613
Fault messages 509
Fault states of the CS..A safety option 610
Important information about device replacement 617
Inspection/maintenance 623
Modification/handling with changes to the device 609
MOVISUITE® 507
Reset of fault messages 508
SEW-EURODRIVE Service 620
Shutdown 620
Shut-off responses 508
SEW-Workbench 113
Shutdown 620
Shut-off responses 508
Signal words in safety notes 7
SLA – Safely Limited Acceleration 185
SLI – Safely Limited Increment 184
SLP – Safely Limited Position 186
SLS – Safely Limited Speed 182
SOS – Safe Operating Stop 182
Speed control
ELSM® mode 117
U/f mode 115

31972098/EN – 8/24

VFC^{PLUS} mode ... 116
SS1-r – Safe Stop 1 ... 179
SS1-r safety sub-function with MOVISAFE® CS..A
Fault response during encoder fault ... 449
SS1-t – Safe Stop 1 ... 178
SS1-t safety sub-function with MOVISAFE® CS..A
Fault response during limit value violation ... 448
SS2-r – Safe Stop 2 ... 181
SS2-r safety sub-function with MOVISAFE® CS..A
Fault response during encoder fault ... 452
Fault response during limit value violation ... 451
SS2-t – Safe Stop 2 ... 180
SS2-t safety sub-function with MOVISAFE® CS..A
Fault response during encoder fault ... 450
Fault response during limit value violation ... 450
SSI encoder requirements ... 198
SSM – Safe Speed Monitoring ... 183
SSR – Safe Speed Range ... 184
Standard accessories ... 103
Standby mode ... 155
Startup ... 415
Adjusting the maximum test duration for load with unknown capacitance ... 439
Application-oriented ... 423
Connection to the engineering software ... 413
Control brake test ... 485
Lifting applications ... 415
Operating states of the CS..A safety option ... 501
Parameterizing the safety sub-functions ... 436
Restoring the delivery state ... 499
Safety notes ... 20
Safety option at the safety protocol ... 486
Safety-relevant acceptance ... 496
Startup information ... 415
With ex works parameters ... 418
Startup of fieldbus and higher-level F-PLC
Setting the PROFIsafe destination address ... 487
Startup requirements ... 417
Startup variants
Variant 1: Startup with default parameterization ... 437
Variant 2: With connection to safe communication (safety protocol) ... 438
Variant 3: Independent operation (without connection to safe communication) ... 438
Status LEDs
"F-ERR" LED ... 515
"F-RUN" LED ... 516
STO – Safe Torque Off ... 177
Storage temperature ... 77
System bus cable ... 296
System nameplate
Device status ... 322
Serial number ... 322
Year of manufacture ... 322

T

Target group ... 11
Technical data
BW.. braking resistors ... 79
CES11A multi-encoder card ... 54
CES12A multi-encoder card ... 55
Characteristic safety values CSB..A and CSS..A ... 74
General electrical data ... 60
General technical data ... 39, 59
HD.. output choke ... 98
HF.. output filter ... 96
Input/output card CID21A ... 53
Input/output card CIO21A ... 53
ND.. line choke ... 94
NF.. line filter ... 92
Safe digital inputs ... 72
Safe digital outputs ... 73
Sensor supply ... 73
STO safety sub-function ... 60
UEA31A SSI combi-box ... 65
USM21A interface adapter ... 77
X17 encoder interface of CSS31A and CSB31A ... 72
X17 encoder interface on CSA31A ... 61
ZD.. DC link choke ... 100
Technologies ... 27
Technology functions ... 35
Cam switch ... 35
Counter function ... 35
PID controller ... 35
Touchprobe ... 35
Temperature evaluation ... 360
Temperature sensor ... 360
Temperature switch ... 78

31972098/EN – 8/24

Terminal assignment
Basic device ... 374
CES11A multi-encoder card ... 380
HIPERFACE® encoder ... 378
HTL encoder ... 377
Information ... 373
Input/output card CID21A ... 379
Input/output card CIO21A ... 378
SEW-EURODRIVE encoder ... 378
SEW-EURODRIVE encoder with RS485 interface ... 378
Sin/cos encoder ... 377
TTL encoder ... 377
X15: Resolver ... 377
X16: MOVILINK® DDI ... 378
X17: CANopen encoder ... 383
X17: EnDat 2.1 encoder ... 381
X17: HIPERFACE® encoder ... 381
X17: SEW-EURODRIVE encoder ... 381
X17: SEW-EURODRIVE encoder with RS485 interface ... 381
X17: SSI and sin/cos combi encoder ... 382
X17: SSI encoder ... 382
X17: TTL, HTL and sin/cos encoder ... 380
X19: Incremental encoder simulation ... 383
Test rate in safe braking systems ... 214
One-off call-up of the brake test ... 215
Regular call-up of the brake test ... 215
Special feature for machines with access regulation ... 215
Thermal overload ... 369
Braking resistor ... 143
Tightening torques ... 351
Tools ... 29
Torque control
ELSM® control mode ... 117
VFC^{PLUS} mode ... 116
Touch guards
Installation ... 332
Removing ... 332
Trademarks ... 9
Transport information
Size 5 ... 14
Size 6 ... 15
Size 8 ... 16
Sizes 6 – 7 ... 15
Type designation ... 323

U

U/f control mode ... 34, 115
UEA31A SSI combi-box
Description ... 65
Dimension drawing ... 68
USM21A interface adapter
Part number ... 77
Technical data ... 77

V

VFC^{PLUS} control mode ... 34, 115

W

Warning notes
Structure of the embedded safety notes ... 8
Wiring diagrams
Brake control ... 404
Connection diagram of digital inputs ... 410
Power connection ... 401
Workbench ... 113

X

X18, X19 ... 67
X3224_1 ... 70
X3224_2 ... 70
X65 ... 67

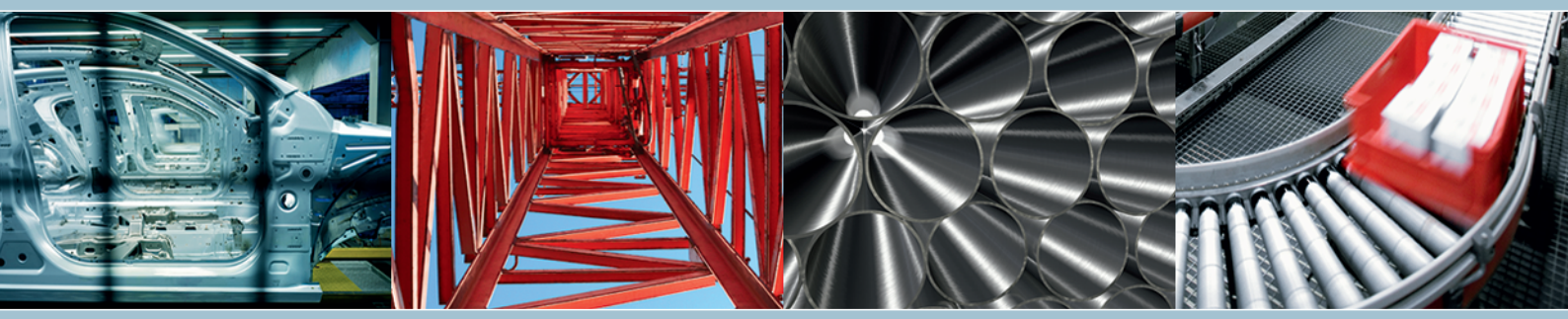
Y

Year of manufacture ... 322

Z

ZD.. DC link choke ... 100
Description ... 100
Dimension sheets ... 101
Dimensions ... 101
Part number ... 100
Technical data ... 100

31972098/EN – 8/24





SEW-EURODRIVE GmbH & Co KG
Ernst-Blickle-Str. 42
76646 BRUCHSAL
GERMANY
Tel. +49 7251 75-0
Fax +49 7251 75-1970
sew@sew-eurodrive.com
→ www.sew-eurodrive.com