SEW EURODRIVE

Product Manual

Inverter
MOVITRAC® advanced

Edition 05/2022

27787230/EN

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1 Product description

With its brand MOVI-C®, SEW-EURODRIVE offers a new generation of drive and automation technology. MOVI-C® is the modular automation system that enables the highest level of system and machine automation.

MOVI-C® comprises drive technology, motion control, control technology, and visualization.

MOVITRAC® advanced is the inverter for direct line connection, suitable for a wide range of applications – from simple open-loop speed control to servo drives. The product series is used for the direct connection to controllers via industrial communication networks such as PROFINET, EtherNet/IP™, Modbus TCP or EtherCAT®. In addition, a basic variant is available exclusively for control via digital and analog inputs.

MOVITRAC® advanced consists of:

- Basic device inverter
- Application level for using MOVIKIT® software modules of the "DRIVE" category
- Product variants with fully integrated MOVILINK® DDI interface for digital motor integration
- Optional keypads
- Optional energy module
- Product variants with fully integrated interfaces for connection to industrial communication networks
- Product variants with fully integrated extension for functional safety in functionally different versions
- Accessories for EMC-compliant installation
- Accessories for connecting and controlling motors and brakes
- Prefabricated motor and encoder cables

The core characteristics are as follows:

Consistency:	Entire MOVI-C® portfolio
Engineering software:	MOVISUITE®
Connection to controllers via:	• PROFINET/PROFIsafe • EtherNet/IP™ • Modbus TCP • EtherCAT®/SBus^{PLUS} • EtherCAT®/CiA402 • FailSafe over EtherCAT® (FSoE) • Ethernet POWERLINK (in preparation)
Data management:	• Via portable memory module • Via CBG01A, CBG11A, CBG21A keypads
Nominal line voltage:	• 3 × 380 – 500 V • 3 × 200 – 240 V • 1 × 200 – 240 V
Overload capacity:	150% of the nominal output current for 30 s
MOVILINK® DDI interface for digital motor integration:	Available as product variant

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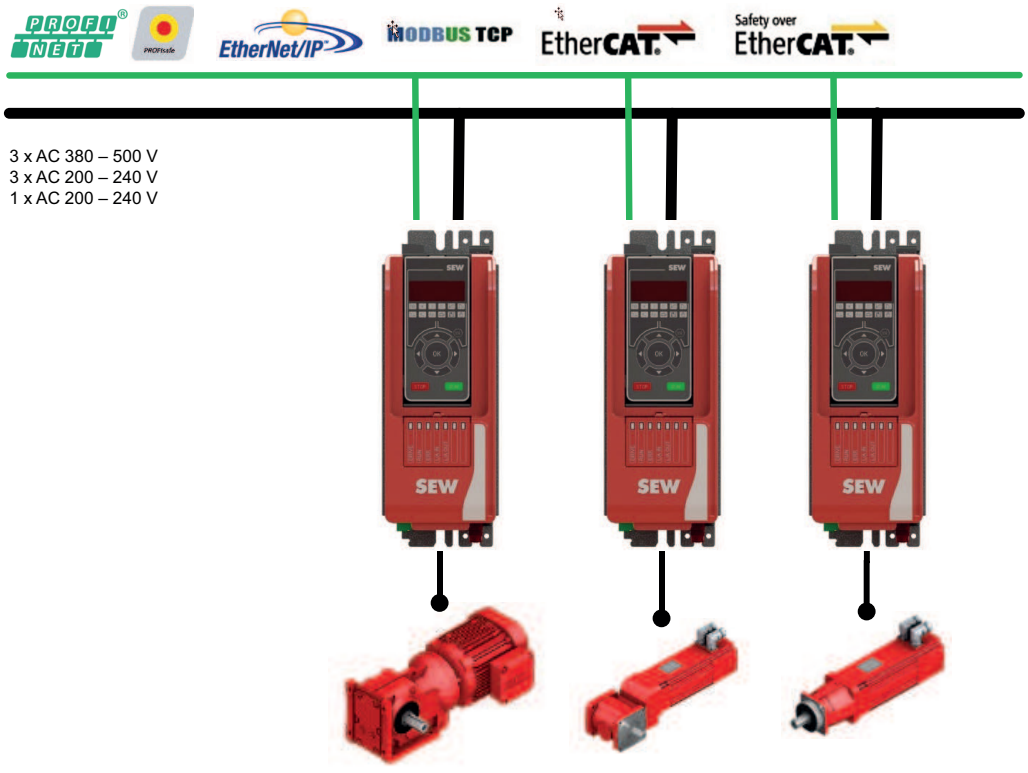
Safety function:	Available as product variant
Current range:	Output current 1 – 588 A
Control modes:	• V/f for simple applications with asynchronous motors • VFC^{PLUS} for precise control of asynchronous motors • CFC for dynamic control of asynchronous and synchronous servomotors • ELSM® for synchronous motors without encoders
Functions:	• Speed control and open-loop speed control • Torque control • Positioning control
Operable motors:	• Rotary and linear asynchronous motors with and without encoders • Rotary and linear synchronous motors with and without encoders
DC 24 V switched-mode power supply:	• Integrated in the inverter



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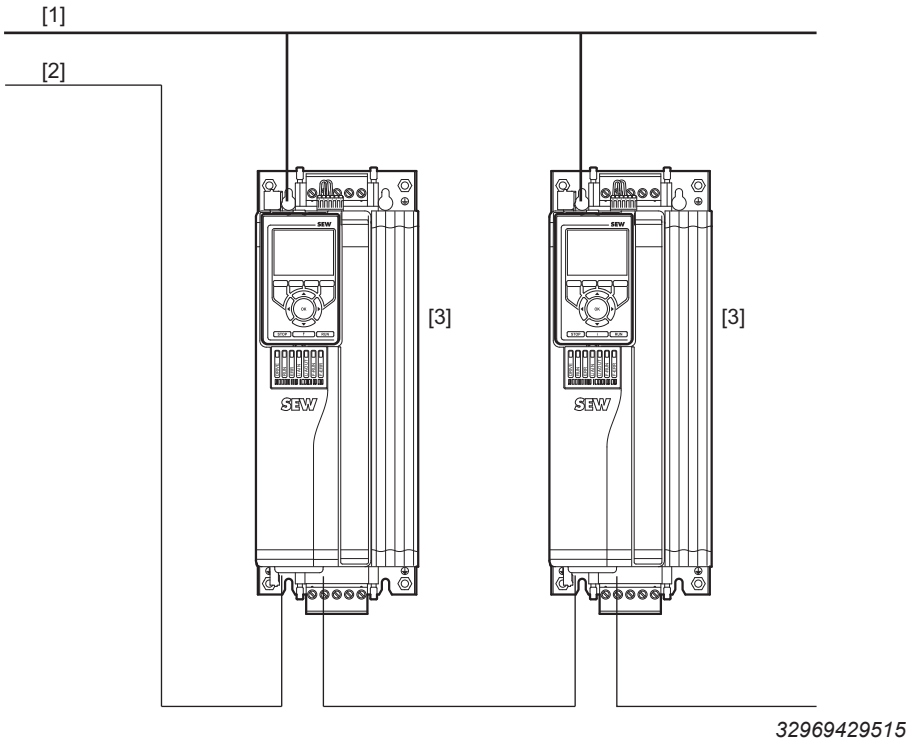
1.1 Connection variants

1.1.1 Operation on the fieldbus

MOVITRAC® advanced inverters can be used for direct control via fieldbus systems. The communication interfaces are integrated in the basic device depending on the device variant.



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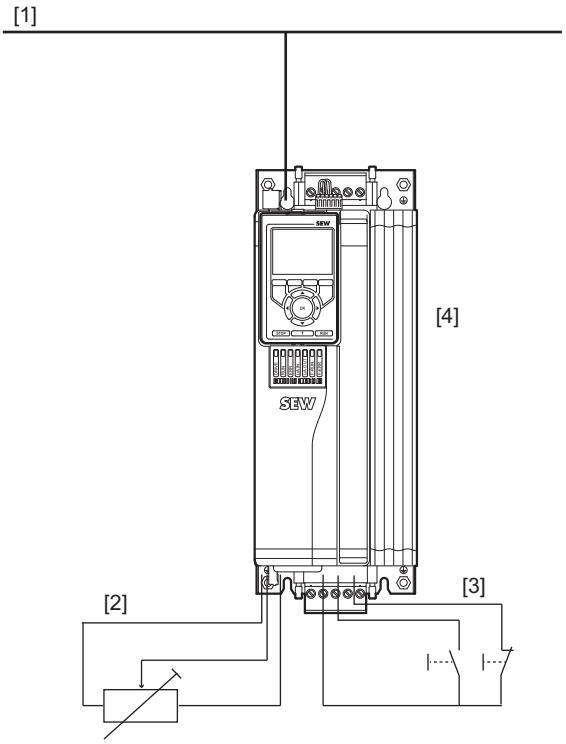
1 Line voltage
2 Industrial communication
3 MOVITRAC® advanced

1.1.2 Operation via terminals

MOVITRAC® advanced inverters can be controlled using digital and analog setpoints. The digital inputs and outputs as well as the analog inputs and outputs are integrated in every version of the basic device.



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1 Line voltage
2 Control cable analog
3 Control cable digital
4 MOVITRAC® advanced

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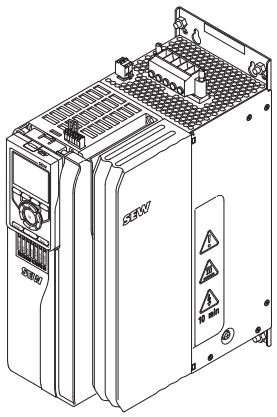
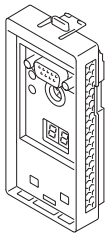
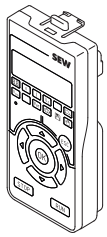
1.2 MOVITRAC® advanced at a glance

MOVITRAC® advanced	
	Description: (→ 🗎 15) Technical data: (→ 🗎 55) Dimension sheets: (→ 🗎 70) • Nominal output current: 1 – 588 A • Voltage ranges: – 1 × 200 – 240 V – 3 × 200 – 240 V – 3 × 380 – 500 V • Overload capacity: 150% of the nominal output current for 30 s For further information on this device, refer to the following documents: • "MOVITRAC® advanced inverter" operating instructions • "MOVITRAC® advanced inverter" product manual

Diagnostic module	
CDM11A 	Technical data: (→ 🗎 77) • 2-digit 7-segment display • Output of fault codes • Engineering interface • Connection to CBG11A, CBG21A and CBG22A For further information on this device, refer to the following documents: • "MOVITRAC® advanced inverter" operating instructions • "MOVITRAC® advanced inverter" product manual

Keypads	
CBG01A 	Technical data: (→ 🗎 80) • 5-digit 7-segment display • Output of fault codes • Startup of asynchronous motors with or without brake[1)], without encoder, without motor temperature evaluation • Saving and copying a parameter set For further information on this device, refer to the following documents: • "MOVITRAC® advanced inverter" operating instructions • "MOVITRAC® advanced inverter" product manual

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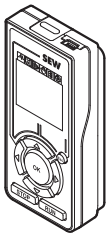
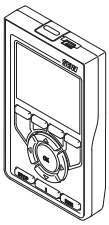
Keypads	
CBG11A 	Technical data: (→ 🗎 80) • 1.5" monochrome display (38 mm) • Startup of asynchronous motors with or without brake, without encoder, with or without motor temperature evaluation • Diagnostics • Saving and copying a parameter set • Connection to MOVISUITE® engineering software via keypad • Diagnostic module CDM11A is required as adapter • Language: EN • Door-mounting frame available For further information on this device, refer to the following documents: • "MOVITRAC® advanced inverter" operating instructions • "MOVITRAC® advanced inverter" product manual
CBG21A 	Technical data: (→ 🗎 80) • 2.4" color display (61 mm) • Language selection. Selectable languages: DE, EN, FR, ES, PT, ZH, RU • Startup of asynchronous motors and synchronous motors with or without brake, encoder, motor temperature evaluation • Diagnostics • Saving and copying several parameter sets • Firmware update of the inverter via USB connection • Connection to MOVISUITE® engineering software via keypad • Diagnostic module CDM11A is required as adapter • Door-mounting frame available For further information on this device, refer to the following documents: • "MOVITRAC® advanced inverter" operating instructions • "MOVITRAC® advanced inverter" product manual

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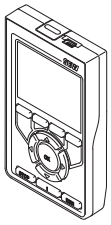
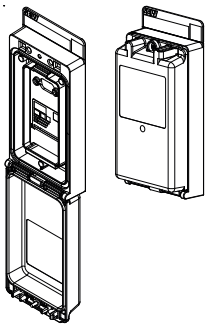
Keypads	
CBG22A 	Technical data: (→ 🗎 80) • 2.4" color display (61 mm) • Language selection. Selectable languages: DE, EN, FR, ES, PT, ZH, RU • Display of customer-specific information texts of the higher-level controller, diagnostics and manual mode by the operator • Connection to MOVISUITE® engineering software via keypad • Diagnostic module CDM11A is required as adapter • Door-mounting frame available For further information on this device, refer to the following documents: • "CBG22A local keypad with diagnostics, manual operation and process data interface" operating instructions • "MOVITRAC® advanced inverter" operating instructions • "MOVITRAC® advanced inverter" product manual

1) Firmware-dependent

Door-mounting frame	
COG11A 	Technical data: • Degree of protection: IP 65 Door-mounting frame (part number: 28265688) for the following keypads: • CBG11A • CBG21A • CBG22A For information on this device, refer to the "Installation instructions for COG11A" (28265688).

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1.2.1 Accessories

Accessories	
Prefabricated motor and encoder cables	"Description and technical data:" (→ 🗎 163)
Braking resistors	"Description and technical data:" (→ 🗎 81)
Line filter	"Description and technical data:" (→ 🗎 96)
Output filter	"Description and technical data:" (→ 🗎 102)
Line choke	"Description and technical data:" (→ 🗎 98)
Output choke	"Description and technical data:" (→ 🗎 104)
USM21A interface adapter	"Description and technical data:" (→ 🗎 78)
Valid motor encoders	"Description:" (→ 🗎 114)
Door-mounting frame	See "Installation instructions for COG11A" (28265688)
Engineering software	MOVISUITE®

Software modules	
MOVIKIT®	• DRIVE/MOTION category

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1.3 MOVITRAC® advanced product overview

Properties

- Coverage of a wide range of power ratings with finely graded performance classes.
- Suitable for TN/TT and IT voltage supply systems.
- The system buses EtherCAT®/SBus^{PLUS}, EtherCAT® with device profile CiA402 as well as the fieldbus interfaces EtherNet/IP™, Modbus TCP, POWERLINK and PROFINET are available for communication.
- 4-quadrant capable due to integrated brake chopper.
- High overload capacity of up to 150% of the nominal output current for 30 s.
- Optimized control modes with and without encoder feedback for asynchronous and synchronous motors.
- Energy-saving function realized by integrated flux optimization when operating asynchronous motors in the partial load range.
- Standby mode
- Optional drive safety functions for safe disconnection PLd via terminals or PLd via PROFIsafe according to EN 13849, see chapter "Functional safety".
- Simplified startup of third-party motors through automatic measurement.
- Universal operation in user units.

Device data 3 × AC 400 V

Type designation	Nominal output current	Recommended motor power ASM	Size	Technical data
	A	kW		
MCX91A-0010-5E3-4-..	1	0.25	0S	(→ 🗎 55)
MCX91A-0016-5E3-4-..	1.6	0.37	0S	
MCX91A-0020-5E3-4-..	2	0.55	0S	
MCX91A-0025-5E3-4-..	2.5	0.75	0S	
MCX91A-0032-5E3-4-..	3.2	1.1	0S	
MCX91A-0040-5E3-4-..	4	1.5	0S	
MCX91A-0055-5E3-4-..	5.5	2.2	0S	
MCX91A-0070-5E3-4-..	7	3	0L	
MCX91A-0095-5E3-4-..	9.5	4	0L	
MCX91A-0125-5E3-4-..	12.5	5.5	0L	
MCX91A-0160-5E3-4-..	16	7.5	0L	

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Type designation	Nominal output current	Recommended motor power ASM	Size	Technical data
	A	kW		
MCX91A-0240-5E3-4-..	24	11	3	
MCX91A-0320-503-4-..	32	15	4	
MCX91A-0460-503-4-..	46	22	4	
MCX91A-0620-503-4-..	62	30	5	
MCX91A-0750-503-4-..	75	37	5	
MCX91A-0910-503-4-..	91	45	5	
MCX91A-1130-503-4-..	113	55	6	
MCX91A-1490-503-4-..	149	75	6	(→ 🗎 55)
MCX91A-1770-503-4-..	177	90	6	
MCX91A-2200-503-4-..	220	110	7	
MCX91A-2500-503-4-..	250	132	7	
MCX91A-3000-503-4-..	300	160	7	
MCX91A-3800-503-4-..	380	200	8	
MCX91A-4700-503-4-..	470	250	8	
MCX91A-5880-503-4-..	588	315	8	

Device data 3 × AC 230 V

Type designation	Nominal output current	Recommended motor power ASM	Size	Technical data
	A	kW		
MCX91A-0017-2E3-4-..	1.7	0.25	0S	
MCX91A-0025-2E3-4-..	2.5	0.37	0S	
MCX91A-0034-2E3-4-..	3.4	0.55	0S	
MCX91A-0042-2E3-4-..	4.2	0.75	0S	
MCX91A-0055-2E3-4-..	5.5	1.1	0S	
MCX91A-0070-2E3-4-..	7	1.5	0L	
MCX91A-0093-2E3-4-..	9.3	2.2	0L	
MCX91A-0140-2E3-4-..	14	3.7	0L	(→ 🗎 59)
MCX91A-0213-2E3-4-..	21.3	5.5	3	
MCX91A-0290-203-4-..	29	7.5	4	
MCX91A-0420-203-4-..	42	11	4	
MCX91A-0570-203-4-..	57	15	5	
MCX91A-0840-203-4-..	84	22	5	
MCX91A-1080-203-4-..	108	30	6	

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Device data 1 × AC 230 V

Type designation	Nominal output current	Recommended motor power ASM	Size	Technical data
	A	kW		
MCX91A-0017-2E1-4-..	1.7	0.25	0S	(→ 62)
MCX91A-0025-2E1-4-..	2.5	0.37	0S	
MCX91A-0034-2E1-4-..	3.4	0.55	0S	
MCX91A-0042-2E1-4-..	4.2	0.75	0S	
MCX91A-0055-2E1-4-..	5.5	1.1	0L	
MCX91A-0070-2E1-4-..	7	1.5	0L	
MCX91A-0093-2E1-4-..	9.3	2.2	0L	
MCX91A-0110-2E1-4-..	11	3	0L	

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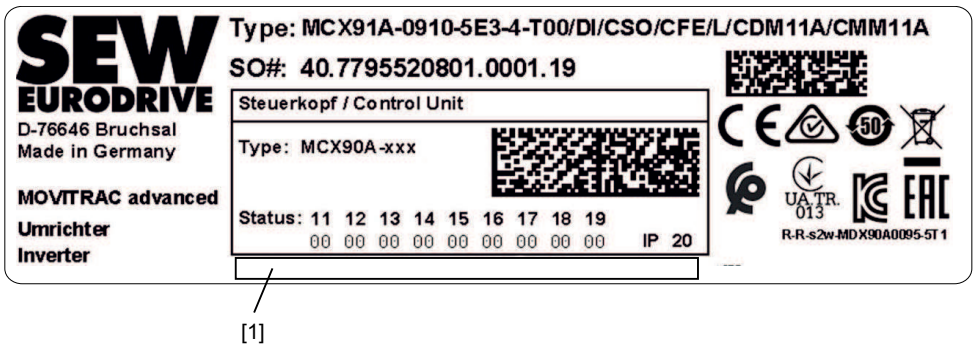
1.3.1 Free text line nameplate

The system nameplate of the MOVI-C® inverters 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 2 indices with 25 characters each and can be read electronically. The MOVISUITE® engineering software version 2.22 or higher is required for reading the data.



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[1] Free text

1.4 MOVITRAC® advanced variant overview

Within one variant, the combination of several selectable designs is possible.

Ethernet/IP™ devices can be equipped with the CSB and CSL options without safe communication. CIP safety communication is available as of firmware 4.0x of the safety options.

		PROFINET (-T0./.../CFN/...)				PROFINET (-T0./.../CFNB/...)				Ethernet/IP™, Modbus TCP (-T0./.../CFE/...)			
		MCX91A-...-T0./…/CFN/…				MCX91A-...-T0./…/CFNB/…				MCX91A-...-T0./…/CFE/…			
Application level	-../0/... -../1/... -../2/...												
MOVIKIT® version Velocity Drive installed at the factory	.../001/...												
MOVILINK® DDI	.../DI/...												
Safety functions #1	.../CSO/...												
Safety functions #2	.../CSB/...												
Safety functions #3	.../CSL/...												
MCX91A-0010-.. – 0160-5.3-.. MCX91A-0017-.. – 0140-2.3-.. MCX91A-0017-.. – 0110-2.1-..													
MCX91A-0240-.. – 5880-5.3-.. MCX91A-0213-.. – 1080-2.3-..													

		EtherCAT®/SBus^{PLUS} (-S0./...)				EtherCAT®/CiA402 (-E0./...)			
		MCX91A-...-S0./...				MCX91A-...-E0./...			
MOVIKIT® version Velocity Drive installed at the factory	.../001/...								
Application level	-../0/... -../1/... -../2/...								
MOVILINK® DDI	.../DI/...								
Safety functions #1	.../CSO/...								
Safety functions #2	.../CSB/...								
Safety functions #3	.../CSL/...								

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		EtherCAT®/SBus^{PLUS} (-S0./...)				EtherCAT®/CiA402 (-E0./...)			
		MCX91A-...-S0./...				MCX91A-...-E0./...			
MCX91A-0010-.. – 0160-5.3-.. MCX91A-0017-.. – 0140-2.3-.. MCX91A-0017-.. – 0110-2.1-..									
MCX91A-0240-.. – 5880-5.3-.. MCX91A-0213-.. – 1080-2.3-..									

		Powerlink/CiA402 (-L00./.../CFL/...)				Binary control (-00./...)	
		MCX91A-...-L00./.../CFL/...				MCX91A-...-000/…	
MOVIKIT® version Velocity Drive installed at the factory	.../001/...						
Application level	-../0/... -../1/... -../2/...						
MOVILINK® DDI	.../DI/...						
Safety functions #1	.../CSO/...						
Safety functions #2	.../CSB/...						
Safety functions #3	.../CSL/...						
MCX91A-0010-.. – 0160-5.3-.. MCX91A-0017-.. – 0140-2.3-.. MCX91A-0017-.. – 0110-2.1-..							
MCX91A-0240-.. – 5880-5.3-.. MCX91A-0213-.. – 1080-2.3-..							

	Available
	Not available

1. The application levels -/..1/... and -/..2/... cannot be selected for devices with the CiA402 device profile.
2. MOVIKIT® Velocity Drive is installed at the factory in the variants shown above. By configuring the devices accordingly, they can also be delivered without pre-installed MOVIKIT®.
3. The CMM11A memory module cannot be deselected for the designs "Safety functions #2 and #3".
4. The options for all devices are partially painted (/L), the CDM11A diagnostic module and the CMM11A memory module can be selected.

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1.5 MOVIKIT®software modules

MOVIKIT® software modules are pre-configured software modules for implementing simple drive functions, such as speed control and positioning, through to complex MotionControl functions, such as camming and robot control.

MOVIKIT®software modules of the "Motion" category are operated on the real-time operating system of the MOVI-C® CONTROLLER.

MOVIKIT®software modules of the "Drive" category are operated directly on the MOVITRAC® inverter.

The software modules are divided into the following categories:

- Category "Motion"

  The "Motion" category includes MOVIKIT® software modules that provide special motion control functions. This category also includes add-ins that can also be used for the software modules of other categories.

- Category "Drive"

  The "Drive" category includes MOVIKIT® software modules operated directly on the MOVITRAC® inverter.

Properties

- Wide range of functions.
- User-friendly user interface.
- It is only necessary to enter the parameters needed for the particular application.
- Guided parameterization instead of complicated programming.
- No programming experience required.
- No lengthy training or familiarization, which means quick configuration and startup.
- All motions are controlled directly in the inverter.

1.5.1 MOVIKIT® software modules of the "Motion" category

MOVIKIT® modules of the "Motion" category run on the MOVI-C® CONTROLLER. These modules are used exclusively in conjunction with the EtherCAT®/SBus^{PLUS} device variant (MCX91A-.../S0./...).

To use the modules, a license must be purchased for the MOVI-C® CONTROLLER. Application level "0" is sufficient for the inverter.

1.5.2 MOVIKIT® software modules of the "Drive" category

MOVIKIT® modules of the "Drive" category run on the basic unit. To be able to use the modules of the "Drive" category, the inverter must be ordered with the corresponding application level. The required application levels can be found in the following table.

Application level	MOVIKIT® Drive category software module
0	Standard delivery state: Authorization for MOVIKIT® Velocity Drive
1	Authorization for MOVIKIT® Positioning Drive, RapidCreepPositioning Drive
2	Authorization for customer-specific solutions

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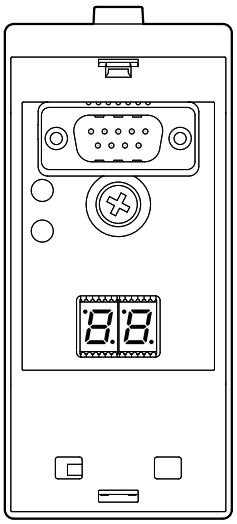
1.6 Product overview accessories

1.6.1 Diagnostic module CDM11A

The CDM11A diagnostic module represents the interface to the MOVISUITE® engineering software. The module also contains two 7-segment displays for displaying the device status.

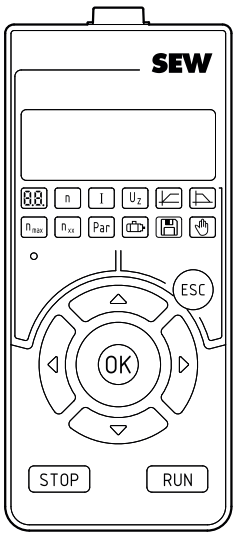


32676917771

The module is also required to use the CBG11A and CBG21A keypads.

1.6.2 CBG01A keypad

The CBG01A keypad enables operation, parameterization, and output of fault codes for the inverters. The keypad is connected directly to the basic device.



32676920843

Range of functions of the CBG01A:

- Startup of asynchronous motors without encoder, with or without brake, without motor sensor
- Access to all parameters

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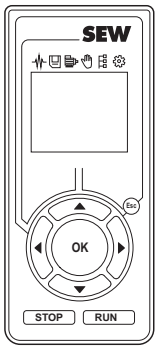
1.6.3 CBG11A keypad

The keypad enables convenient startup, operation, parameterization, and diagnostics of MOVI-C® inverters due to the full-text display.

The keypad has a mini USB interface with gateway function. A connection from the inverter to a PC can be established using this interface for engineering with MOVISUITE®.



30556389899

Range of functions of the CBG11A:

- Startup of asynchronous motors without encoder, with or without brake, with motor sensor
- Brake selection
- Temperature sensor selection
- Determining the load inertia
- Access to all parameters

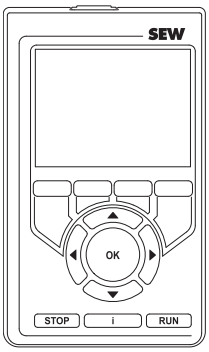
The CDM11A diagnostic module is required to place the keypad.

A COG11A door-mounting frame is available for the operator panel.

1.6.4 CBG21A keypad

The keypad enables convenient startup, operation, parameterization, and diagnostics of MOVI-C® inverters due to the full-text display.

The keypad has a mini USB interface with gateway function. A connection from the inverter to a PC can be established using this interface for engineering with MOVISUITE®.



30556392331

Range of functions of the CBG21A:

- Startup of asynchronous motors
- Startup of synchronous motors

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- Brake selection
- Temperature sensor selection
- Selection of encoders
- Determining the load inertia
- Optimization of the drive train in terms of clearance and rigidity
- Access to all parameters

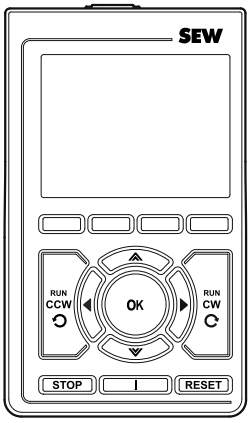
The CDM11A diagnostic module is required to place the keypad.

A COG11A door-mounting frame is available for the operator panel.

1.6.5 CBG22A keypad

The full-text display of the keypad allows for a convenient display of customer-specific information texts of the higher-level controller. It also allows for the operator to perform diagnostics and manual operation.

The keypad has a mini USB interface with gateway function. A connection from the inverter to a PC can be established using this interface for engineering with MOVISUITE®.



35206062859

Range of functions of the CBG22A:

- Can be used for diagnostic purposes

The CDM11A diagnostic module is required to place the keypad.

A COG11A door-mounting frame is available for the operator panel.

1.6.6 Door-mounting frame

For detailed information on door-mounting frames, refer to the "Installation instructions for COG11A" (28265688).

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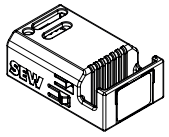
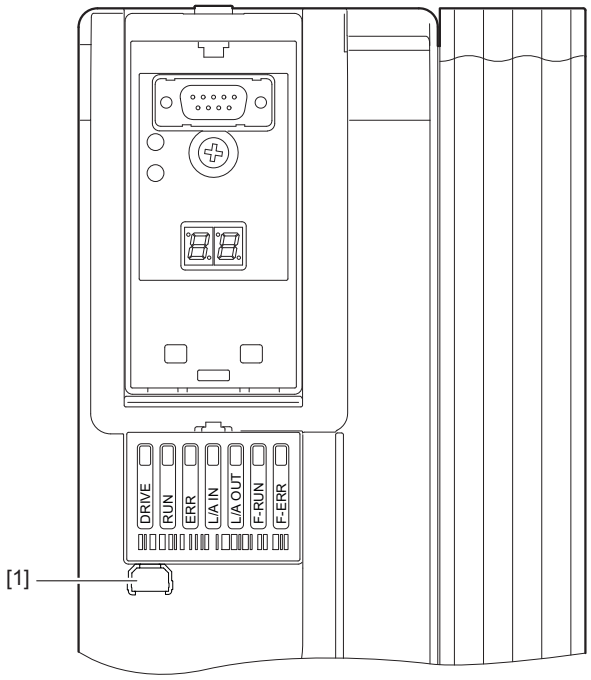
1.6.7 CMM11A memory module



25585405451

The pluggable memory module is supplied independently of the device variant.

For certain device variants, the memory module can be deselected when configuring the inverter. It is not possible to deselect the memory module if the device variant includes the CSB and CSL safety options.



32536703371

[1] Memory module

All device data is always stored up-to-date on the memory module. If a device needs to be replaced, the system can be started up again quickly without additional tools by simply replugging the memory module.

If a device variant with functional safety is used, the memory module also serves as a safety key.

The memory module can be simply removed or plugged in when it is switched off.

1.6.8 CFE fieldbus interface for Ethernet/IP™ and Modbus TCP

The fieldbus interface makes it possible to connect the inverter to EtherNet/IP™ or Modbus TCP-based, higher-level automation, configuration, and visualization systems. The fieldbus interface has the following characteristics:

- EtherNet/IP™ or Modbus TCP
- Media redundancy
- Integrated switch with cut-through procedure

When using the fieldbus interface, you can communicate directly with the devices via Ethernet and use the MOVISUITE® engineering software for startup, diagnostics, and parameterization purposes.

An integrated web server also makes it possible to access diagnostic values quickly and easily using a standard Internet browser. You can access this web server at the following address: http: //*IP address of the device*.

1.6.9 CFN fieldbus interface for PROFINET

INFORMATION

The inverters with the CFN and CFNB fieldbus interfaces are not compatible with each other. However, they can be operated together in mixed mode. Both fieldbus interfaces have different GSDML files.

The fieldbus interface makes it possible to connect the inverter to PROFINET-based, higher-level automation, project planning and visualization systems. The fieldbus interface has the following characteristics:

Properties	MOVITRAC® advanced
Designation	CFN
PROFINET	RT IRT (Isochronous Realtime)
Conformance class	C
Netload class	3
Topology detection (LLDP)	Yes
Automatic addressing (LLDP, DCP)	Yes
Media redundancy (MRP)	Yes
I&M data	I&M0 – I&M5
Application profiles	PROFIsafe, PROFIenergy
Shared device	Yes
Manufacturer ID	010Ahex
Baud rate	100 MBaud, full duplex
Connection technology	RJ45
Ethernet switch	Integrated
Ethernet switch switching technology	Cut through
Ethernet switch latency period	5.5 µs
Ethertype 8892hex	PROFINET

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Properties	MOVITRAC® advanced
Ethertype 88B5	Address Editor from SEW-EURODRIVE
Port numbers used	• 80 (http) • 161 (SNMP) • 310 (SEW Data Streaming) • PROFINET DCE/RPC Ports (dynamic via end point mapper)
GSD file name	GSDML-Vx.xy-SEW-MOVI-C-MOVITRAC-CFN-yyyymmdd-hhmmss
SEW engineering (firmware update, diagnostics)	Yes
Web server	Yes

When using the fieldbus interface, you can communicate directly with the devices via Ethernet and use the MOVISUITE® engineering software for startup, diagnostics, and parameterization purposes.

An integrated web server also makes it possible to access diagnostic values quickly and easily using a standard Internet browser. You can access this web server at the following address: http: //*IP address of the device*.

1.6.10 CFNB fieldbus interface for PROFINET

INFORMATION

The inverters with the CFN and CFNB fieldbus interfaces are not compatible with each other. However, they can be operated together in mixed mode. Both fieldbus interfaces have different GSDML files.

The fieldbus interface makes it possible to connect the inverter to PROFINET-based, higher-level automation, project planning and visualization systems. The fieldbus interface has the following characteristics:

Properties	MOVITRAC® advanced
Designation	CFNB
PROFINET	RT
Conformance class	B
Netload class	3
Topology detection (LLDP)	Yes
Automatic addressing (LLDP, DCP)	Yes
Media redundancy (MRP)	No
I&M data	I&M0 – I&M4
Application profiles	PROFIsafe
Shared device	No
Manufacturer ID	010Ahex
Baud rate	100 MBaud, full duplex
Connection technology	RJ45

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Properties	MOVITRAC® advanced
Ethernet switch	Integrated
Ethernet switch switching technology	Cut through
Ethernet switch latency period	TBA
Ethertype 8892hex	PROFINET
Ethertype 88B5	–
Port numbers used	• 161 (SNMP) • 310 (SEW Data Streaming) • PROFINET DCE/RPC Ports (dynamic via end point mapper)
GSD file name	GSDML-Vx.xy-SEW-MOVI-C-MOVITRAC-CFNB-yyyymmdd-hhmmss
SEW engineering (firmware update, diagnostics)	Yes
Web server	No

When using the fieldbus interface, you can communicate directly with the devices via Ethernet and use the MOVISUITE® engineering software for startup, diagnostics, and parameterization purposes.

An integrated web server also makes it possible to access diagnostic values quickly and easily using a standard Internet browser. You can access this web server at the following address: http: //*IP address of the device*.

1.6.11 Communication interface SBus^{PLUS}

The optional EtherCAT®/SBus^{PLUS} communication interface provides a powerful synchronous connection. EtherCAT® stations from SEW-EURODRIVE or other manufacturers can be controlled and diagnosed by a MOVI-C® CONTROLLER. The functions of the MOVI-C® CONTROLLER are:

- Freely programmable sequence control in accordance with IEC 61131 for automating drive and logic tasks.
- Central data storage for all MOVI-C® inverters from SEW-EURODRIVE at the EtherCAT®/SBus^{PLUS}.
- Plug-and-play device replacement through automatic data recovery.
- Central setpoint input for clock-synchronous drives and for auxiliary drives.
- Motion functions: Speed control, torque specification, position specification, phase-synchronous operation, cams, application modules, kinematic models.
- EtherCAT®/SBus^{PLUS} master for SEW-EURODRIVE components and for peripherals with EtherCAT® interface.
- Fieldbus device connection to higher-level control systems.
- Diagnostics and visualization of the automation system.

1.6.12 CSO/CSB/CSL safety options:

The MOVISAFE® CSO/CSB/CSL safety options provide further functional safety functions to EN IEC 61800-5-2 in addition to STO.

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A detailed description can be found in chapter "Functional safety".

	MOVISAFE® .../CSO/...	MOVISAFE® .../CSB/...	MOVISAFE® .../CSL/...
Safe inputs	–	4	4
Safe outputs	–	–	1
Safe stop functions	STO	STO, SS1-t	STO, SS1-t
Other functions	–	–	SBC, EDM
Safe motion	–	–	SLS, SSM, SS1-r, SDI
Safe communication	–	PROFIsafe, FSoE, CIP Safety™	PROFIsafe, FSoE, CIP Safety™
Safe encoder	–	–	EI7C-FS[1)]

1) EI7C-FS is only available for DR.71 – 132 and DRN71 – 132S motors

1.6.13 CLH21A shield plate extension

The CLH21A shield plate extension (mounting rail at a standard shield plate) is used to mount additional terminal blocks or modules to the converter shield plate.

The brake rectifier from SEW-EURODRIVE or a multi-level terminal block, for example, can be attached to the CLH21A.

1.6.14 CLH31A and CLH41A support plates with braking resistors

The CLH31A and CLH41A base plates with integrated braking resistors offer a space-saving solution for storing small braking resistors in the control cabinet. For assignment of the braking resistors, refer to the technical data.

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1.7 FCB concept

FCB = Function Control Block

The FCB concept describes the modular firmware design of MOVI-C® inverters. This feature ensures that a wide range of drive functions can be selected or deselected quickly and easily using control words.

All primary functions are selected as FCB. 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 is performed 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.

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

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1.7.1 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 "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.

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 teach mode without higher-level controller.

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

FCB 05 Speed control

The inverter can be operated as speed-controlled axis.

The user can specify profile values for acceleration, deceleration, and jerk as the basic conditions for speed control. The actual speed setpoint for the drive controller is generated in the controller cycle by a profile generator integrated in the inverter using the specified limit values.

FCB 06 Interpolated speed control

FCB 06 is used for cyclical 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 course of 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 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 by a profile generator integrated in the inverter using the specified limit values.

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 cyclical torque setpoint input from a higher-level controller.

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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 does not usually 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 (interpolate) intermediate values if it knows the controller cycle. The inverter can be set to different cycle times of higher-level controllers.

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 several positioning modes, which are described as follows:

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 the travel range is exceeded after calculation, the FCB issues an error.

Relative positioning:

The position setpoint in user units is interpreted as offset to the latest setpoint and is added to the last setpoint after conversion into system units.

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, an error is issued. The drive always turns in a positive direction to reach the position.

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, an error is issued. The drive always turns in a negative direction to reach the position.

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."

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If the position setpoint is outside this range, an error 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 of higher-level controllers.

In multi-axis applications, a higher-level controller usually calculates a track profile for several drive axes. The axis is only assigned setpoints (position, speed, torque, torque limits, precontrol values, inertia) that it has to follow. The axis limits the setpoints using the application limits. The course of the profile of the path curve is controlled by the controller.

The setpoint cycle of the controller does usually 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 can interpolate 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: Negative limit switch

6: Reference cam flush – limit switch positive

7: Reference cam flush – limit switch negative

8: Referencing to reference travel

9: Positive fixed stop

10: Negative fixed stop

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.

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FCB 14 Emergency stop

When FCB 14 is activated, the drive stops with the preset emergency stop deceleration.

Note that the application limits are not taken into account.

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.

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 disconnected from the load, which means also from the gear unit.

FCB 19 Position hold control

When FCB 19 is activated, the drive stops with speed control. After the standstill of the drive, the position is kept with position control as long as FCB 19 is active.

FCB 20 Jog mode

FCB 20 is used for 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 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 higher-level controller, use the manual mode of the MOVISUITE® engineering software, see "FCB 04" (→ 🗎 31).

FCB 21 Brake test

The 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 the various requirements. The test result "passed" or "failed" 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 external 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 two 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.

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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.

The 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 FCB 25 is generally recommended for third-party motors. FCB 18 must be executed afterward for encoder calibration with synchronous motors, if required.

FCB 26 Stop at user limits

FCB 26 is used for stops at user limits. The user limits are either available as local setpoints or initiate the deceleration ramp set via the fieldbus.

You can choose between a speed-controlled ramp and a position-controlled ramp. In contrast to other stop FCBs (FCB 13/FCB 14), the 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 deactivated. This makes it possible to always stop with position control.

FCB 26 provides lag error monitoring in position-controlled mode.

When the stop is reached, the brake remains released and the motor remains energized.

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1.7.2 Setpoints and limits in the FCBs

The following table lists which FCB uses which setpoints and profile values.

	Index		FCB													
			02	04	05	06	07	08	09	10	12	13	14	19	20	21	26
Setpoint buffer	8376																
Position		.1							x	x							
Speed		.11			x	x				x					x		
Torque		.21					x	x									
Acceleration precontrol		.31[1)]				x				x							
Mass moment of inertia		.41[1)]				x		x		x							
Torque precontrol		.51[1)]				x		x		x							
Correcting value of external position controllers		.61				x											
Profile value buffer	8377																
Maximum positive speed		.1					x	x	x								
Maximum negative speed		.11					x	x	x								
Maximum acceleration		.21			x				x						x		
Maximum deceleration		.31	x		x				x						x		x
Jerk time		.41			x		x		x						x		x
Maximum torque Q1 to Q4		.51[1)]			x	x	x	x	x	x							
Application limits	8357																
Speed, positive/negative		.10 .11		x	x	x	x	x	x	x	x				x		
Acceleration		.12		x	x				x		x			x	x		
Deceleration		.13	x	x	x				x		x	x		x	x	x	x
Jerk time		.14	x	x	x		x		x		x	x	x	x	x	x	x
Torque		.15[1)]	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Apparent output current		.16	x	x	x	x	x	x	x	x	x	x	x	x	x		x
Voltage		.17	x	x	x	x	x	x	x	x	x	x	x	x	x		x
Emergency stop deceleration		.20											x				
Behavior at standstill	8563/8564		x									x	x				
Lag error window	8509	.4 .14							x								x
Lag error response	8622	.3							x	x							x

1) These variables are not relevant in V/f control mode.

x = relevant in the FCB

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1.8 Control mode

The following control modes are available:

- V/f
- VFC^{PLUS}
- CFC
- ELSM®

1.8.1 Description of the control modes

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

V/f

V/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. 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.

V/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.

V/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.

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 motors. Therefore, 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 method 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 therefore not possible. An acceleration and torque precontrol is also not possible.

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. 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.

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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.

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).

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 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, however, stable stationary operation at stator frequency 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 either be mounted on the track or on the motor.

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

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.

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ELSM®

The ELSM® control mode allows the operation of permanent-field synchronous servomotors without 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 provides at least 150% I_0 of the motor throughout the rotor alignment process.

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/rotor position measurement

When the inverter is enabled in ELSM® control mode, the rotor position of the permanent-field synchronous motors 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 standstill. 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. A prerequisite for the measurement is the one-time determination of the complete motor parameters with the FCB 25 motor parameter measurement.

SEW-EURODRIVE recommends measuring the rotor position.

Adjusting the rotor:

If the complete motor data is not known, the rotor is moved to a defined position at each enable. A small motor movement depending on the motor pole number takes place during the adjustment. If a brake is used, this brake is released. The adjustment is completed after 1 s.

Speed control

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

Open-loop operation is active when starting from standstill 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 90% of the nominal output current of the connected motor is impressed to stabilize the drive, which is why the motor heats up significantly at standstill and at low speeds.

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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.

Flying start function

If it cannot be ensured that the motor is at standstill during the start, the flying start function must be activated. This way, the ELSM® control mode can also be enabled for a turning motor.

If the speed can be calculated plausibly, the control mode proceeds to speed-controlled operation. If this is not the case, the drive proceeds to the "rotor adjustment" or "rotor measurement" function and then to open-loop operation.

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1.9 Energy-saving functions

1.9.1 Flux optimization

Flux optimization is a function that allows for operating an asynchronous motor in control mode VFC^{PLUS} with minimal losses. The magnetic flux is managed depending on the torque setpoint, so that the motor is operated with minimum current and thus with minimized losses. 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.

The flux optimization can reduce magnetization losses in the motor by up to 70%.

1.9.2 Standby mode

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

The following functions are deactivated in standby operation:

- 7-segment display
- STO function
- Digital outputs at the basic device
- Power section control
- Fan in power section
- Optional: Encoder supply and encoder evaluation at the basic device.

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.

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1.10 Digital motor integration with MOVILINK® DDI interface

1.10.1 Digital motor integration

With the "digital motor integration", SEW-EURODRIVE presents a solution for integrating drive technology into the networked world. The MOVILINK® DDI digital data interface connects the inverter with the drive and connects the unconnected drive to the data network.

Characteristics:

- Voltage supply of the MOVILINK® DDI electronics via the inverter.
- Detection of the drive, its components and their properties.
- Data transmission for identification, startup, operation and diagnostics.
  - Extended electronic nameplate
  - Encoder data
  - Motor temperature
  - Data of additionally integrated or external sensors, for example, brake wear sensors

Assistance functions:

- Automatic startup of the drive (motors, gear units, sensors, actuators)
- Automatic startup of the speed controller with adjusted dynamics settings
- Automatic detection of a drive replacement. New startup with deviating input data

This makes detection, startup and communication with the drive as simple as with an USB interface between computer and external device.

1.10.2 MOVILINK® DDI interface

The MOVILINK® DDI interface connects inverters of the MOVI-C® modular automation system with drives. The MOVILINK® DDI interface is based on a coaxial data cable. Power supply of the motor electronics and communication with the drive are performed using the coaxial data cable.

MOVITRAC® advanced is equipped with the MOVILINK® DDI interface depending on the device variant.

Inverters from SEW-EURODRIVE can be connected to the drive in different ways depending on the requirement:

- Hybrid cable for single cable connection consisting of:
  - Motor cable
  - PE
  - Brake cable
  - Coaxial data cable
- Hybrid cable extension
- Separate coaxial data cable in addition to motor cable for dual cable connection
- Hybrid cable and coaxial data cable are available as alternative for fixed installation and for cable carrier installation.
- The motor can be connected via cable glands on the terminal box or plug connectors.

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1.11 Device replacement

Device replacement is simple with MOVITRAC® advanced. This can be done using the CMM11A memory module, the CBG.. keypad or a MOVI-C® CONTROLLER.

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1.12 MOVISUITE® engineering software

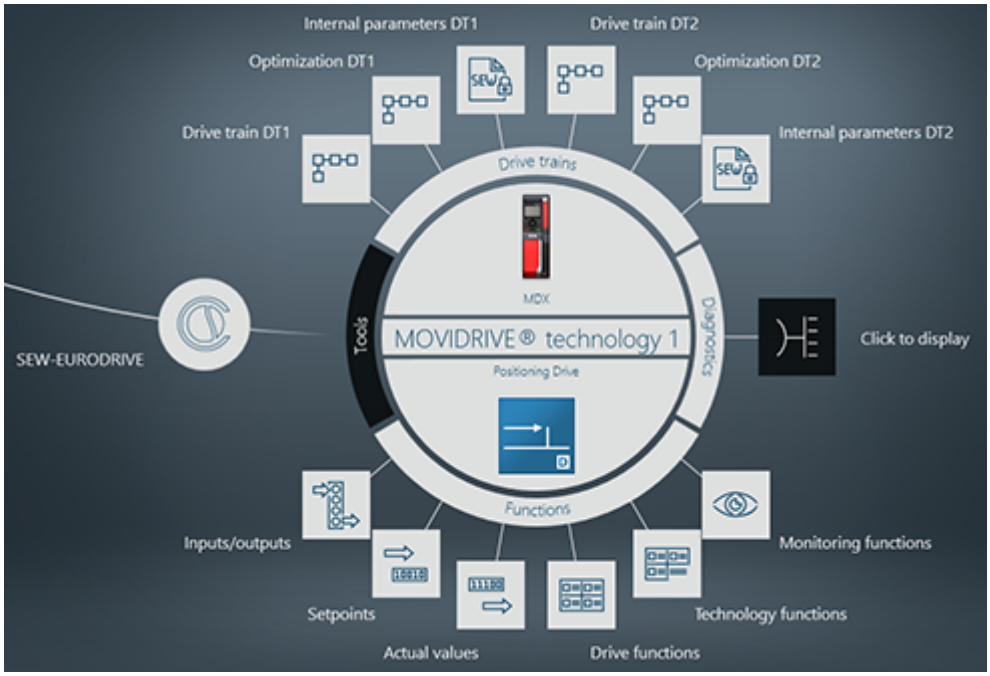
With its innovative design of the user interface and optimal user guidance, MOVISUITE® is a future-oriented engineering software from SEW-EURODRIVE.

The MOVISUITE® engineering software is the operating platform for all hardware and software components of the MOVI-C® modular automation system. The concept of the user interface enables users to configure, parameterize, as well as start up, and monitor their applications almost intuitively (simple auto startup with MOVILINK® DDI).

Using the various views, the users can switch to the suitable display mode depending on their requirements.

Circle view

In the circle view for example, single components can be edited in a clear structure.



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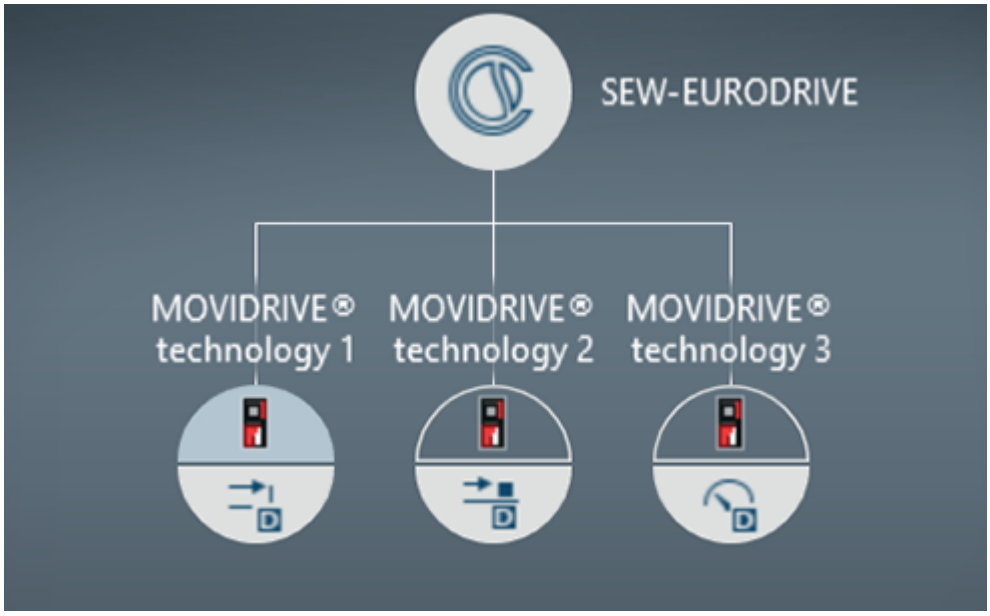
Tree view

The tree view provides an overview of the entire network. The tree view shows large systems and machines in a clear manner. With various analysis functions (digital scope) already integrated in the standard scope, MOVISUITE® allows for a coordinated position/speed/torque controller for dynamic setting of the applications.



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The view can be selected depending on the application and personal preferences; the functionality is identical in both views.

The user interface concept of MOVISUITE® allows to arrange the system structure using freely definable structure nodes. These structure nodes are displayed with a varying level of detail in the views mentioned above.

The data management has clearly marked transfer directions, and thus is clearly structured during data transmission.

The scan function enables the reading of available devices, and the creation of these devices as projects in MOVISUITE®.

The drive train can be set up from motor to gear unit using the product catalog. Furthermore, encoders, brakes, control modes, and user units can be selected and parameterized.

The data required for the drive train can typically be read off the nameplates of the motor and gear unit and entered, or selected via a catalog function in the engineering software.

Another variant is automatic identification of the gear unit motor data by output of the electronic nameplate stored in the motor encoder. During startup, the engineering software checks whether an electronic nameplate is present in the encoder and suggests the use of this data.

The Scope recording function is available for diagnostic purposes. This enables a diagnostics overview of connected devices and functions. Long-term data acquisition on the engineering PC hard disk is also possible.

Manual mode can be intuitively used for each application via the new interface.

1.12.1 Segment description

The startup procedure is divided into segments. The following steps illustrate an example of the startup procedure for an inverter.

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Drive train segment

Drive train	Configuring drive trains.

Interfaces segment

Default	Basic settings of the installed interfaces • Basic unit • Encoder 1
Optional	Basic settings of the options • Fieldbus • I/O card • Encoder 2 • MOVISAFE® CS..

Functions segment

Inputs/outputs	• Basic unit • I/O card
Setpoints	• Process data • PO data • Setpoint buffer • Fixed setpoints • Control word 1 – 3
Actual values	• PI data • Status word 1 – 3
Drive functions	• FCB 01 Output stage inhibit • FCB 05 Speed control • FCB 06 Interpolated speed control • FCB 08 Interpolated torque control • FCB 09 Positioning • FCB 10 Interpolated position control • FCB 12 Reference travel • FCB 08 Rotor position identification • FCB 20 Jog mode • FCB 21 Brake test • FCB 26 Stop at user limit
Monitoring functions	• Reference signals 1 • Reference signals 2 • Limit values 1 • Limit values 2 • Control functions 1 • Monitoring functions 2 • Output stage

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Advanced functions	• Parameter set • Auto reset • Standby mode • Touchprobe 1 • Touchprobe 2 • Cam switch

Information on the inverter

Device data	• Device identification • Main component • Subcomponents • Production data
Overview of fault responses	• Axis module • Power supply monitoring • Functions
Setup	• Permissions • Reset device parameters • Select memory source

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2 Technical data

2.1 Markings

2.1.1 Basic device

The inverter complies with the following directives and guidelines:

Mark	Definition
CE	The CE mark states 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 electric and electronic equipment • Ecodesign Directive 2009/125/EC
	The waste disposal of this product is performed in compliance with the WEEE Directive 2012/19/EU.
EAC	The EAC mark declares compliance with the requirements of the technical regulations of the Customs Union of Russia, Kazakhstan, and Belarus.
	The RCM mark declares compliance with the technical regulations of the Australian Communications and Media Authority (ACMA).
50	The China RoHS mark states compliance with Directive SJ/T 11364-2014 for limiting the use of hazardous substances in electric and electronic equipment and their packaging.
c UL us LISTED	The UL and cUL marks state UL approval. cUL is equivalent to CSA approval.
	The NM mark states compliance with the following Moroccan guidelines: • Low Voltage Directive N° 2573-14 (July 16, 2015) • EMC Directive N° 2574-14 (July 16, 2015)
	The KC mark declares compliance with §3 of Article 58-2 for the Korean Radio Wave Act.

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Mark	Definition
UKCA	The UKCA mark states the compliance with the following British guidelines: • Low Voltage Directive S.I. 2016/1101[2)] • EMC S. I. 2016/1091 • Machinery Safety S. I. 2008/1597 • Directive S. I. 2012/3032 for limiting the use of certain hazardous substances in electrical and electronic equipment • Ecodesign Regulation S. I. 2019/539

1) For products with functional safety, the requirements from the Low Voltage Directive are fulfilled by the Machinery Directive.

2) For products with functional safety, the requirements from the Low Voltage Directive are fulfilled by the Machinery Safety S.I. 2008/1597.

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2.1.2 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 electric 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 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 electric and electronic equipment
c UL us	The cUR mark states the UL approval for this component.

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NF.. line filter

Mark	Definition
	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.
	The cUR mark states the UL approval for this component.

ND.. line chokes

Mark	Definition
	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 electric 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.
	The UKCA mark states 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 electric and electronic equipment
	The cUR mark states the UL approval for this component.

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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 electric 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 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 electric and electronic equipment
c UL us	The cUR mark states the UL approval for this component.

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 electric 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 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 electric and electronic equipment
c UL us	The cUR mark states the UL approval for this component.

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2.2 General technical data

The following table lists the technical data for all inverters independent of

- Type
- Design
- Size
- Power rating

General specifications	
Interference immunity	Meets EN 61800-3; 2. Environment
Interference emission	Limit value class C2 according to EN 61800-3. The interference suppression level can be improved with relevant measures. A line filter for limit class C2 is required for the inverters listed below: • MCX91A-0320-.. – MCX91A-5880-503-.. • MCX91A-0290-.. – MCX91A-1080-203-.. Refer to chapter "EMC-compliant installation according to EN 61800-3" in the product manual for further information.
Ambient temperature ϑ_{amb}	0 °C to +40 °C without derating 40 °C to +55 °C with derating For further information, refer to chapter "Selection of an inverter > Derating".
Type of cooling	• Convection – MCX91A-0010 - 0025-5E3-.. – MCX91A-0017 - 0025-2E3-.. – MCX91A-0017 - 0025-2E1-.. • Built-in, temperature-controlled fan – From MCX91A-0032-5E3-.. – From MCX91A-0034-2E3-.. – From MCX91A-0034-2E1-..
Short-circuit current	The uninfluenced short-circuit current according to EN 61800-5-1 (ICC) is 5000 A.
Degree of protection according to EN 60529	
MCX91A-0010-.. – 0460-5.3-.. MCX91A-0017-.. – 0420-2.3-.. MCX91A-0017-.. – 0110-2E1-..	IP20, only with power connectors plugged in for grid and motor
from MCX91A-0620-503-.. from MCX91A-0570-203-..	IP10, optionally IP20, with the appropriate covers
Pollution class, overvoltage category, installation altitude	
Pollution class	2 in accordance with IEC 60664-1
Overvoltage category	III in accordance with IEC 60664-1
Installation altitude	Up to h ≤ 1000 m without restrictions. 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 creeping distances in accordance with EN 61800-5-1, you have to connect an overvoltage protection device in order to reduce the overvoltages from category III to category II.
Ambient conditions	
Climatic conditions	• Long-term storage (weatherproof): EN 60721-3-1 class 1K2 temperature -25 °C to +70 °C (in contrast to the standard) Non-condensing, no moisture condensation • Transport (weatherproof): EN 60721-3-2 class 2K3 temperature -25 °C to +70 °C Non-condensing; no moisture condensation • Operation (fixed installation, weatherproof): EN 60721-3-3 class 3K3 temperature 0 °C to +40 °C (deviating from norm) Non-condensing; no moisture condensation

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Ambient conditions	
Chemically active substances	• Extended storage (weatherproof): EN 60721-3-1 class 2C2, no corrosive gases, no salt mist (deviating from norm) • Transport (weatherproof): EN 60721-3-2 class 2C2, no corrosive gases, no salt mist, no sea water (deviating from norm) • Operation (fixed installation, weatherproof): EN 60721-3-3 class 3C2, no corrosive gases, no salt mist
Mechanically active substances	• Extended storage (weatherproof): EN 60721-3-1 class 1S1, no conductive dust • Transport (weatherproof): EN 60721-3-2 class 2S1 • Operation (fixed installation, weatherproof): EN 60721-3-3 class 3S1, no conductive dust

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2.3 Technical data of basic unit

2.3.1 Performance data 3 x AC 380 – 500 V

Size 0S

	Unit	MCX91A-...-5E3-4-..						
Type		**0010**	**0016**	**0020**	**0025**	**0032**	**0040**	**0055**
Size		**0S**						
Nominal output current I_N f_{PWM} = 4 kHz	A	1	1.6	2	2.5	3.2	4	5.5
Input								
Nominal line voltage (according to EN 50160) AC V_{line}		3 × 380 – 500 V						
Nominal line current AC I_{line}	A	0.9	1.4	1.8	2.3	2.9	3.6	5
Line frequency f_{line}	Hz	50 – 60 ± 5%						
Controlled rectifier		No						
X1 connection contacts		Plug connector – 1 conductor: 0.25 – 2.5 mm² – 2 conductors: 0.5 – 1 mm² (twin CES)[1)]						
Output								
Output voltage V_{out}	V	0 – V_{line}						
Motor power ASM P_{Mot}	kW	0.25	0.37	0.55	0.75	1.1	1.5	2.2
Nominal output current I_N f_{PWM} = 4 kHz	A	1	1.6	2	2.5	3.2	4	5.5
Overload capacity		150%: 30 s at f_{PWM} = 4 kHz						
Continuous output current at f = 0 Hz		75% × I_N with f_{PWM} = 4 kHz						
Apparent output power S_N	kVA	0.7	1.1	1.4	1.7	2.2	2.8	3.8
Nominal DC link voltage V_{NDCL}	V	DC 560 at V_{line} = 400 V						
Frequency f_{PWM}	kHz	4, 8, 16 (adjustable)						
Max. output frequency f_{max}	Hz	599 Recommendation: VFC^{PLUS} maximum 250 Hz, do not exceed all other control modes f_{PWM}/10.						
X2 connection contacts		Plug connector – 1 conductor: 0.25 – 2.5 mm² – 2 conductors: 0.25 – 1.5 mm² (twin CES)[1)]						
General								
Power consumption 24 V	W	Maximum 8.5 (depending on the device variant)						
Power section nominal power loss[2)]	W	7	11	15	19	27	34	50
Permitted number of times power may be switched on/off	min^{-1}	1						
Minimum switch-off time for power off	s	10						
Power section interference suppression		EMC filter limit value category C2 to EN 61800-3						
PE connection contacts		M4						
Mass	kg	1.7						
Brake chopper and braking resistor								
Minimum braking resistance value R_{BWmin}	Ω	90						
Brake chopper continuous power	kW	0.7	1.1	1.4	1.7	2.2	2.8	3.8
Brake chopper peak power		150% × brake chopper continuous power × 0.9						
X2 connection contacts		Plug connector – 1 conductor: 0.25 – 2.5 mm² – 2 conductors: 0.25 – 1.5 mm² (twin CES)[1)]						
Dimensions								
Width	mm	80						
Height of the basic device	mm	220						
Height of basic unit with shield plates	mm	303						
Depth	mm	160						

1) CES: Conductor end sleeve

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

Size 0L, 3

	Unit	MCX91A-...-5E3-4-..				
Type		**0070**	**0095**	**0125**	**0160**	**0240**
Size		**0L**				**3**
Nominal output current I_N f_{PWM} = 4 kHz	A	7	9.5	12.5	16	24
Input						
Nominal line voltage AC U_{line} (according to EN 50160)		3 × 380 – 500 V				
Nominal line current AC I_{line}	A	6.3	8.6	11.3	14.4	21.6
Line frequency f_{line}	Hz	50 – 60 ± 5%				
Controlled rectifier		No				
X1 connection contacts		Plug connector – 1 conductor: 0.25 – 4 mm² – 2 conductors: 0.25 – 2.5 mm² (twin CES)[1)]				
Output						
Output voltage V_{out}	V	0 – V_{line}				
Motor power ASM P_{Mot}	kW	3	4	5.5	7.5	11
Nominal output current I_N f_{PWM} = 4 kHz	A	7	9.5	12.5	16	24
Overload capacity		150%: 30 s at f_{PWM} = 4 kHz				
Continuous output current at f = 0 Hz		75% × I_N with f_{PWM} = 4 kHz				
Apparent output power S_N	kVA	4.8	6.6	8.7	11.1	16.8
Nominal DC link voltage V_{NDCL}	V	DC 560 at V_{line} = 400 V				
Frequency f_{PWM}	kHz	4, 8, 16 (adjustable)				
Max. output frequency f_{max}	Hz	599 Recommendation: VFC^{PLUS} maximum 250 Hz, do not exceed all other control modes f_{PWM}/10.				
X2 connection contacts		Plug connector – 1 conductor: 0.25 – 4 mm² – 2 conductors: 0.25 – 2.5 mm² (twin CES)[1)]				
General						
Power consumption 24 V	W	Maximum 8.5 (depending on the device variant)				20
Power section nominal power loss[2)]	W	63	83	120	147	236
Permitted number of times power may be switched on/off	min^{-1}	1				
Minimum switch-off time for power off	s	10				
Power section interference suppression		C2				
PE connection contacts		M4				
Mass	kg	2.7			2.8	5.3
Brake chopper and braking resistor						
Minimum braking resistance value R_{BWmin}	Ω	42			24	
Brake chopper continuous power	kW	4.8	6.6	8.7	11.1	16.8
Brake chopper peak power		150% × brake chopper continuous power × 0.9				
X2 connection contacts		Plug connector – 1 conductor: 0.25 – 4 mm² – 2 conductors: 0.25 – 2.5 mm² (twin CES)[1)]				
Dimensions						
Width	mm	80				105
Height of the basic device	mm	309				350
Height of basic unit with shield plates	mm	392				440
Depth	mm	170				245

1) CES: Conductor end sleeve

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

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size 4, 5, 6

	Unit	MCX91A-...-503-4-..							
Type		**0320**	**0460**	**0620**	**0750**	**0910**	**1130**	**1490**	**1770**
Size		**4**		**5**			**6**		
Nominal output current I_N f_{PWM} = 4 kHz	A	32	46	62	75	91	113	149	177
Input									
Nominal line voltage (according to EN 50160) AC V_{line}		3 × 380 – 500 V							
Nominal line current AC I_{line}	A	28.8	41.4	55.8	67.5	81.9	102	134	159
Line frequency f_{line}	Hz	50 – 60 ± 5%							
Controlled rectifier		Yes							
X1 connection contacts		Plug connector – 1 conductor: 0.5 – 16 mm² – 2 conductors: 0.25 – 6 mm² (twin CES)[1)]		M8			M10		
Output									
Output voltage V_{out}	V	0 – V_{line}							
Motor power ASM P_{Mot}	kW	15	22	30	37	45	55	75	90
Nominal output current I_N f_{PWM} = 4 kHz	A	32	46	62	75	91	113	149	177
Overload capacity		150%: 30 s at f_{PWM} = 4 kHz							
Continuous output current at f = 0 Hz		75% × I_N with f_{PWM} = 4 kHz							
Apparent output power S_N	kVA	22.6	32.7	44.4	53.8	65.4	78.5	104	124
Nominal DC link voltage V_{NDCL}	V	DC 560 at V_{line} = 400 V							
Frequency f_{PWM}	kHz	4, 8, 16 (adjustable)							
Max. output frequency f_{max}	Hz	599 Recommendation: VFC^{PLUS} maximum 250 Hz, do not exceed all other control modes f_{PWM}/10.							
X2 connection contacts		Plug connector – 1 conductor: 0.5 – 16 mm² – 2 conductors: 0.25 – 6 mm² (twin CES)[1)]		M8			M10		
General									
Power consumption 24 V	W	30		15			20		
Power section nominal power loss[2)]	W	282	438	600	760	974	1160	1332	1693
Permitted number of times power may be switched on/off	min^{-1}	1							
Minimum switch-off time for power off	s	10							
Power section interference suppression		Basic interference suppression integrated							
PE connection contacts		M6		M8			M10		
Mass	kg	6.2		11.7			23.7		
Brake chopper and braking resistor									
Minimum braking resistance value R_{BWmin}	Ω	13		9	5.4		4.2	2.7	
Brake chopper continuous power	kW	22.6	32.7	44.4	53.8	65.4	78.5	104	124
Brake chopper peak power		150% × brake chopper continuous power × 0.9							
X2 connection contacts		Plug connector – 1 conductor: 0.5 – 16 mm² – 2 conductors: 0.25 – 6 mm² (twin CES)[1)]		M8			M10		
Dimensions									
Width	mm	135		196			240		
Height of the basic device	mm	350		471			544		
Height with shield plates	mm	440		471			544		

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	Unit	MCX91A-...-503-4-..							
Type		**0320**	**0460**	**0620**	**0750**	**0910**	**1130**	**1490**	**1770**
Size		**4**		**5**			**6**		
Depth	mm	245		278			314		

1) CES: Conductor end sleeve

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

Size 7

	Unit	MCX91A-...-503-4-..		
Type		**2200**	**2500**	**3000**
Size		**7**		
Nominal output current I_N f_{PWM} = 4 kHz	A	220	250	300
Input				
Nominal line voltage (according to EN 50160) AC V_{line}		3 × 380 – 500 V		
Nominal line current AC I_{line}	A	198	225	270
Line frequency f_{line}	Hz	50 – 60 ± 5%		
Controlled rectifier		Yes		
X1 connection contacts		M12		
Output				
Output voltage V_{out}	V	0 – V_{line}		
Motor power ASM P_{Mot}	kW	110	132	160
Nominal output current I_N at the smallest possible PWM frequency	A	220	250	300
Overload capacity		150%: 30 s at the smallest possible PWM frequency		
Continuous output current at f = 0 Hz		75% × I_N at the smallest possible PWM frequency		
Apparent output power S_N	kVA	152	173	208
Nominal DC link voltage V_{NDCL}	V	DC 560 at V_{line} = 400 V		
Frequency f_{PWM}	kHz	4, 8 (adjustable)	2.5, 4, 8 (adjustable)	
Max. output frequency f_{max}	Hz	599 Recommendation: VFC^{PLUS} maximum 250 Hz, do not exceed all other control modes f_{PWM}/10.		
X2 connection contacts		M12		
General				
Power consumption 24 V	W	20		
Power section nominal power loss[1)]	W	2484	2818	3100
Permitted number of times power may be switched on/off	min^{-1}	1		
Minimum switch-off time for power off	s	10		
Power section interference suppression		Basic interference suppression integrated		
PE connection contacts		M12		
Mass	kg	84		
Brake chopper and braking resistor				
Minimum braking resistance value R_{BWmin}	Ω	2		
Brake chopper continuous power	kW	152	173	208
Brake chopper peak power		200% × brake chopper continuous power × 0.9		
X2 connection contacts		M12		
Dimensions				
Width	mm	320		
Height of the basic device	mm	990		
Height with shield plates	mm	990		
Depth	mm	393		

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

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2.3.2 Performance data 3 x AC 200 – 240 V

Size 0S

	Unit	MCX91A-...-2E3-4-..				
Type		**0017**	**0025**	**0034**	**0042**	**0055**
Size		**0S**				
Nominal output current I_N f_{PWM} = 4 kHz	A	1.7	2.5	3.4	4.2	5.5
Input						
Nominal line voltage (according to EN 50160) AC V_{line}		3 × 200 – 240 V				
Nominal line current AC I_{line}	A	1.5	2.3	3.1	3.8	5
Line frequency f_{line}	Hz	50 – 60 ± 5%				
Controlled rectifier		No				
X1 connection contacts		Plug connector – 1 conductor: 0.25 – 2.5 mm² – 2 conductors: 0.25 – 1.5 mm² (twin CES)[1)]				
Output						
Output voltage V_{out}	V	0 – V_{line}				
Motor power ASM P_{Mot}	kW	0.25	0.37	0.55	0.75	1.1
Nominal output current I_N f_{PWM} = 4 kHz	A	1.7	2.5	3.4	4.2	5.5
Overload capacity		150%: 30 s at f_{PWM} = 4 kHz				
Continuous output current at f = 0 Hz		75% × I_N with f_{PWM} = 4 kHz				
Apparent output power S_N	kVA	0.68	1	1.35	1.67	2.2
Nominal DC link voltage V_{NDCL}	V	DC 325 at V_{line} = 230 V				
Frequency f_{PWM}	kHz	4, 8, 16 (adjustable)				
Max. output frequency f_{max}	Hz	599 Recommendation: VFC^{PLUS} maximum 250 Hz, do not exceed all other control modes f_{PWM}/10.				
X2 connection contacts		Plug connector – 1 conductor: 0.25 – 2.5 mm² – 2 conductors: 0.25 – 1.5 mm² (twin CES)[1)]				
General						
Power consumption 24 V	W	Maximum 8.5 (depending on the device variant)				
Power section nominal power loss[2)]	W	10	16	25	32	44
Permitted number of times power may be switched on/off	min^{-1}	1				
Minimum switch-off time for power off	s	10				
Power section interference suppression		C2				
PE connection contacts		M4				
Mass	kg	1.7				
Brake chopper and braking resistor						
Minimum braking resistance value R_{BWmin}	Ω	60				
Brake chopper continuous power	kW	0.68	1	1.35	1.67	2.2
Brake chopper peak power		150% × brake chopper continuous power × 0.9				
X2 connection contacts		Plug connector – 1 conductor: 0.25 – 2.5 mm² – 2 conductors: 0.25 – 1.5 mm² (twin CES)[1)]				
Dimensions						
Width	mm	80				
Height of the basic device	mm	220				
Height of basic unit with shield plates	mm	303				
Depth	mm	160				

1) CES: Conductor end sleeve

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

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Size 0L, 3

	Unit	MCX91A-...-2E3-4-..			
Type		**0070**	**0093**	**0140**	**0213**
Size		**0L**			**3**
Nominal output current I_N f_{PWM} = 4 kHz	A	7	9.3	14	21.3
Input					
Nominal line voltage (according to EN 50160) AC V_{line}		3 × 200 – 240 V			
Nominal line current AC I_{line}	A	6.3	8.4	12.6	19.2
Line frequency f_{line}	Hz	50 – 60 ± 5%			
Controlled rectifier		No			
X1 connection contacts		Plug connector – 1 conductor: 0.25 – 4 mm² – 2 conductors: 0.25 – 2.5 mm² (twin CES)[1)]			
Output					
Output voltage V_{out}	V	0 – V_{line}			
Motor power ASM P_{Mot}	kW	1.5	2.2	3.7	5.5
Nominal output current I_N f_{PWM} = 4 kHz	A	7	9.3	14	21.3
Overload capacity		150%: 30 s at f_{PWM} = 4 kHz			
Continuous output current at f = 0 Hz		75% × I_N with f_{PWM} = 4 kHz			
Apparent output power S_N	kVA	2.8	3.7	5.6	8.5
Nominal DC link voltage V_{NDCL}	V	DC 325 at V_{line} = 230 V			
Frequency f_{PWM}	kHz	4, 8, 16 (adjustable)			
Max. output frequency f_{max}	Hz	599 Recommendation: VFC^{PLUS} maximum 250 Hz, do not exceed all other control modes f_{PWM}/10.			
X2 connection contacts		Plug connector – 1 conductor: 0.25 – 4 mm² – 2 conductors: 0.25 – 2.5 mm² (twin CES)[1)]			
General					
Power consumption 24 V	W	Maximum 8.5 (depending on the device variant)			20
Power section nominal power loss[2)]	W	51	71	107	174
Permitted number of times power may be switched on/off	min^{-1}	1			
Minimum switch-off time for power off	s	10			
Power section interference suppression		C2			
PE connection contacts		M4			
Mass	kg	2.7			5.3
Brake chopper and braking resistor					
Minimum braking resistance value R_{BWmin}	Ω	24		13	
Brake chopper continuous power	kW	2.8	3.7	5.6	8.5
Brake chopper peak power		150% × brake chopper continuous power × 0.9			
X2 connection contacts		Plug connector – 1 conductor: 0.25 – 4 mm² – 2 conductors: 0.25 – 2.5 mm² (twin CES)[1)]			
Dimensions					
Width	mm	80			105
Height of the basic device	mm	309			350
Height of basic unit with shield plates	mm	392			440
Depth	mm	170			245

1) CES: Conductor end sleeve

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

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size 4, 5, 6

	Unit	MCX91A-...-203-4-..				
Type		**0290**	**0420**	**0570**	**0840**	**1080**
Size		**4**		**5**		**6**
Nominal output current I_N f_{PWM} = 4 kHz	A	29	42	57	84	108
Input						
Nominal line voltage (according to EN 50160) AC V_{line}		3 × 200 – 240 V				
Nominal line current AC I_{line}	A	26.1	37.8	51.3	75.6	97.2
Line frequency f_{line}	Hz	50 – 60 ± 5%				
Controlled rectifier		Yes				
X1 connection contacts		Plug connector – 1 conductor: 0.5 – 16 mm² – 2 conductors: 0.25 – 6 mm² (twin CES)[1)]		M8		M10
Output						
Output voltage V_{out}	V	0 – V_{line}				
Motor power ASM P_{Mot}	kW	7.5	11	15	22	30
Nominal output current I_N f_{PWM} = 4 kHz	A	29	42	57	84	108
Overload capacity		150%: 30 s at f_{PWM} = 4 kHz				
Continuous output current at f = 0 Hz		75% × I_N with f_{PWM} = 4 kHz				
Apparent output power S_N	kVA	11.6	16.7	22.7	33.5	43
Nominal DC link voltage V_{NDCL}	V	DC 325 at V_{line} = 230 V				
Frequency f_{PWM}	kHz	4, 8, 16 (adjustable)				
Max. output frequency f_{max}	Hz	599 Recommendation: VFC^{PLUS} maximum 250 Hz, do not exceed all other control modes f_{PWM}/10.				
X2 connection contacts		Plug connector – 1 conductor: 0.5 – 16 mm² – 2 conductors: 0.25 – 6 mm² (twin CES)[1)]		M8		M10
General						
Power consumption 24 V	W	30		15		20
Power section nominal power loss[2)]	W	218	345	459	756	910
Permitted number of times power may be switched on/off	min^{-1}	1				
Minimum switch-off time for power off	s	10				
Power section interference suppression		Basic interference suppression integrated				
PE connection contacts		M6		M8		M10
Mass		6.2		11.7		23.7
Brake chopper and braking resistor						
Minimum braking resistance value R_{BWmin}	Ω	6.7		4.2	2.7	2
Brake chopper continuous power	kW	11.6	16.7	22.7	33.5	43
Brake chopper peak power		150% × brake chopper continuous power × 0.9				
X2 connection contacts		Plug connector – 1 conductor: 0.5 – 16 mm² – 2 conductors: 0.25 – 6 mm² (twin CES)[1)]		M8		M10
Dimensions						
Width	mm	135		196		240
Height of the basic device	mm	350		471		544
Height of basic unit with shield plates	mm	440		471		544
Depth	mm	245		278		314

1) CES: Conductor end sleeve

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

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2.3.3 Performance data 1 x AC 200 – 240 V

Size 0S

	Unit	MCX91A-...-2E1-4-..			
Type		**0017**	**0025**	**0034**	**0042**
Size		**0S**			
Nominal output current I_N f_{PWM} = 4 kHz	A	1.7	2.5	3.4	4.2
Input					
Nominal line voltage (according to EN 50160) AC V_{line}		1 × 200 – 240 V			
Nominal line current AC I_{line}	A	5.1	7	8.8	10.9
Line frequency f_{line}	Hz	50 – 60 ± 5%			
Controlled rectifier		Yes (precharge circuit)			
X1 connection contacts		Plug connector – 1 conductor: 0.25 – 2.5 mm² – 2 conductors: 0.25 – 1.5 mm² (twin CES)[1)]			
Output					
Output voltage V_{out}	V	0 – V_{line}			
Motor power ASM P_{Mot}	kW	0.25	0.37	0.55	0.75
Nominal output current I_N f_{PWM} = 4 kHz	A	1.7	2.5	3.4	4.2
Overload capacity		150%: 30 s at f_{PWM} = 4 kHz			
Continuous output current at f = 0 Hz		75% × I_N with f_{PWM} = 4 kHz			
Apparent output power S_N	kVA	0.68	1	1.35	1.67
Nominal DC link voltage V_{NDCL}	V	DC 325 at V_{line} = 230 V			
Frequency f_{PWM}	kHz	4, 8, 16 (adjustable)			
Max. output frequency f_{max}	Hz	599 Recommendation: VFC^{PLUS} maximum 250 Hz, do not exceed all other control modes f_{PWM}/10.			
X2 connection contacts		Plug connector – 1 conductor: 0.25 – 2.5 mm² – 2 conductors: 0.25 – 1.5 mm² (twin CES)[1)]			
General					
Power consumption 24 V	W	Max. 8.5			
Power section nominal power loss[2)]	W	15	24	36	48
Permitted number of times power may be switched on/off	min^{-1}	0.5			
Minimum switch-off time for power off	s	10			
Power section interference suppression		C2			
PE connection contacts		M4			
Mass	kg	1.7			
Brake chopper and braking resistor					
Minimum braking resistance value R_{BWmin}	Ω	60			
Brake chopper continuous power	kW	0.68	1	1.35	1.67
Brake chopper peak power		150% × brake chopper continuous power × 0.9			
X2 connection contacts		Plug connector – 1 conductor: 0.25 – 2.5 mm² – 2 conductors: 0.25 – 1.5 mm² (twin CES)[1)]			
Dimensions					
Width	mm	80			
Height of the basic device	mm	220			
Height of basic unit with shield plates	mm	303			
Depth	mm	160			

1) CES: Conductor end sleeve

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

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Size 0L

	Unit	MCX91A-...-2E1-4-..			
Type		**0055**	**0070**	**0093**	**0110**[1]
Size		**0L**			
Nominal output current I_N f_{PWM} = 4 kHz	A	5.5	7	9.3	11
Input					
Nominal line voltage (according to EN 50160) AC V_{line}		1 × 200 – 240 V			
Nominal line current AC I_{line}	A	14.8	16A	21.4	24.9
Line frequency f_{line}	Hz	50 – 60 ± 5%			
Controlled rectifier		Yes (precharge circuit)			
X1 connection contacts		Plug connector – 1 conductor: 0.25 – 4 mm² – 2 conductors: 0.25 – 2.5 mm² (twin CES)[2]			
Output					
Output voltage V_{out}	V	0 – V_{line}			
Motor power ASM P_{Mot}	kW	1.1	1.5	2.2	3
Nominal output current I_N f_{PWM} = 4 kHz	A	5.5	7	9.3	11
Overload capacity		150%: 30 s at f_{PWM} = 4 kHz			
Continuous output current at f = 0 Hz		75% × I_N with f_{PWM} = 4 kHz			
Apparent output power S_N	kVA	2.2	2.8	3.7	4.4
Nominal DC link voltage V_{NDCL}	V	DC 325 at V_{line} = 230 V			
Frequency f_{PWM}	kHz	4, 8, 16 (adjustable)			
Max. output frequency f_{max}	Hz	599 Recommendation: VFC^{PLUS} maximum 250 Hz, do not exceed all other control modes f_{PWM}/10.			
X2 connection contacts		Plug connector – 1 conductor: 0.25 – 4 mm² – 2 conductors: 0.25 – 2.5 mm² (twin CES)[2]			
General					
Power consumption 24 V	W	Max. 8.5			
Power section nominal power loss[3]	W	57	76	110	147
Permitted number of times power may be switched on/off	min^{-1}	0.5			
Minimum switch-off time for power off	s	10			
Power section interference suppression		C2			
PE connection contacts		M4			
Mass					
Brake chopper and braking resistor					
Minimum braking resistance value R_{BWmin}	Ω	60	24		13
Brake chopper continuous power	kW	2.2	2.8	3.7	4.4
Brake chopper peak power		150% × brake chopper continuous power × 0.9			
X2 connection contacts		Plug connector – 1 conductor: 0.25 – 4 mm² – 2 conductors: 0.25 – 2.5 mm² (twin CES)[2]			
Dimensions					
Width	mm	80			
Height of the basic device	mm	309			
Height of basic unit with shield plates	mm	392			
Depth	mm	170			

1) Using a line choke is mandatory with MCX91A-0110-2E1-4-..

2) CES: Conductor end sleeve

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

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2.4 Technical data of accessories

2.4.1 Installation accessories

Type designation	Part number	Plastic cover	Quantity	Scope of delivery	Description
MCX91A-0620 - 0910-503-..	28243625		10	Not included in scope of delivery	(→ 🖹 238)
MCX91A-0570 - 0840-203-..					
MCX91A-1130 - 1770-503-..	28244540				
MCX91A-1080-203-..					

Type designation	Part number	Support	Quantity	Scope of delivery	Description
MCX91A-1130 - 1770-503-..	28106229		1	Included in the scope of delivery	(→ 🖹 224)
MCX91A-1080-203-..					

2.4.2 Connector

The following list is used for re-ordering connectors.

Slot	Function	Size	Part number
X1	Line connection, 1-phase	Size 0S	25680498
X1	Line connection, 3-phase	Size 0S	25680501
X1	Line connection, 1-phase	Size 0L	25680536
X1	Line connection 3-phase	Size 0L	25680544
X2	Motor connection	Size 0S	25680528
X2	Motor connection for 3-phase device	Size 0L	25680560
X2	Motor connection for 1-phase device	Size 0L	25680552
X5	DC 24 V supply voltage	All	19148410
X6	Blind cover for STO slot	All	28132386
X6	STO-E connector (with jumpers)	All	28129458
X20	Signal connection, 10-pin	All	17990653
X21	Signal connection, 3-pin	All	17990688
X22	Signal connection, 4-pin	All	17990661
X60	Signal connection, 4-pin	All	17990661

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2.4.3 CLH21A shield plate extension

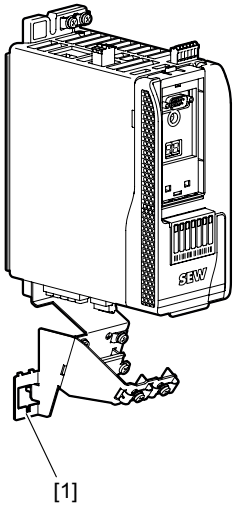
The CLH21A shield plate extension (mounting rail at a standard shield plate) is used to mount additional terminal blocks or modules to the converter shield plate.

The brake rectifier from SEW-EURODRIVE or a multi-level terminal block, for example, can be attached to the CLH21A.

The shield plate extension is used for the following inverters:

- MCX91A-0010 – 0160-5E3-..
- MCX91A-0017 – 0140-2E3-..
- MCX91A-0017 – 0110-2E1-..

Part number CLH21A: 28265572



35902404619

[1] Shield plate extension

2.5 Electronics data – signal terminals

	Terminal designation	Specification
General		
Design		In accordance with IEC 61131-2
Supply voltage		
Connection		External power supply 24 V in accordance with IEC 61131 24 V +20%/-10%
Assignment	X5:24 V	DC 24 V supply voltage
	X5:GND	Reference potential
Connection contacts	X5	Plug connector • 1 core – Rigid: 0.25 – 2.5 mm² (stripping length 10 mm) – Finely stranded: 0.25 – 2.5 mm² (stripping length 10 mm) – Finely stranded with CES[1)] with plastic collar: 0.25 – 2.5 mm² – Finely stranded with CES without plastic collar: 0.25 – 2.5 mm² • 2 cores – 0.5 – 1.5 mm² (twin CES)

1) CES: conductor end sleeve

STO terminals		
The following terminals are connected internally: • X6:1 and X6:3 • X6:2 and X6:4 Due to the current carrying capacity, a maximum of 10 devices can be connected to one another via terminal X6.		
Assignment	X6:1	F_STO_P: DC +24 V input Power consumption: 150 mW Input capacitance against F_STO_M and against GND: • Typical: 300 pF • Maximum: 500 pF
	X6:2	F_STO_M: DC 0 V input
	X6:3	F_STO_P: DC +24 V input Power consumption: 150 mW Input capacitance against F_STO_M and against GND: • Typical: 300 pF • Maximum: 500 pF
	X6:4	F_STO_M: DC 0 V input
	X6:5	VO24V STO: DC +24 V for supplying F_STO_P
	X6:6	GND: Reference potential for F_STO_M
Connection contacts	X6	Plug connector • 1 core – Rigid: 0.2 – 1.5 mm² (stripping length 10 mm) – Finely stranded: 0.2 – 1.5 mm² (stripping length 10 mm) – Finely stranded with CES[1)] with plastic collar: 0.14 – 0.75 mm² – Finely stranded with CES without plastic collar: 0.25 – 1.5 mm²

1) CES: conductor end sleeve

Digital inputs		
Cycle time input		2 ms
Quantity		6
Response time		100 µs plus cycle time

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Digital inputs		
Assignment	X20: 1 – 6	DI01 – DI06: For the selection option, see parameter menu All inputs are suitable for touchprobe function. Latency period < 100 µs, max. 2 touchprobe inputs can be configured. DI04, DI05, DI06: HTL encoder connection, maximum cable length: 50 m Master frequency input, maximum 120 kHz Current consumption per DI: 6 mA
	X20: 7	DC 24 V voltage output I_{max} = 50 mA
	X20: 8 GND	Reference potential
Connection contacts	X20	Plug connector • 1 core – Rigid: 0.2 – 1.5 mm² (stripping length 8 – 9 mm) – Finely stranded: 0.2 – 1.5 mm² (stripping length 8 – 9 mm) – Finely stranded with CES[1)] with plastic collar: 0.25 – 0.75 mm² – Finely stranded with CES without plastic collar: 0.25 – 1.5 mm²

1) CES: conductor end sleeve

Digital inputs/outputs		
Cycle time output		2 ms
Quantity		2
Response time		175 µs plus cycle time
Output current		I_{max} = 50 mA
Short-circuit protection		Yes
Assignment	X20: 7	DC 24 V voltage output I_{max} = 50 mA
	X20: 8 GND	Reference potential
	X20: 9 – 10	DIO01 – DIO02: For the selection option, see parameter menu
Connection contacts	X20	Plug connector • 1 core – Rigid: 0.2 – 1.5 mm² (stripping length 8 – 9 mm) – Finely stranded: 0.2 – 1.5 mm² (stripping length 8 – 9 mm) – Finely stranded with CES[1)] with plastic collar: 0.25 – 0.75 mm² – Finely stranded with CES without plastic collar: 0.25 – 1.5 mm²

1) CES: conductor end sleeve

Analog input and analog output		
Cycle time output		2 ms
Quantity		2
Response time		175 µs plus cycle time
Output current		I_{max} = 50 mA
Resolution		10 bit
Short-circuit protection		Yes
Assignment	X23.1	Reference voltage output: 10 V, I_{max} = 3 mA
	X23.2	Analog input (/AI1): 0 – 10 V, R_i ≥ 20 kΩ, 0(4) – 20 mA (R_i = 250 Ω) The input is related to GND. Analog input voltage or current, can be selected via S4 switch
	X23.3 GND	Reference potential
	X23.4	Analog input/output (AIO1) parameterizable: AI: 0 – 10 V, R_i≥ 20 kΩ AO: 0 – 10 V, R_i≥ 10 kΩ

Analog input and analog output		
Connection contacts	X23	Plug connector • 1 core – Rigid: 0.2 – 1.5 mm² (stripping length 8 – 9 mm) – Finely stranded: 0.2 – 1.5 mm² (stripping length 8 – 9 mm) – Finely stranded with CES[1)] with plastic collar: 0.25 – 0.75 mm² – Finely stranded with CES without plastic collar: 0.25 – 1.5 mm²

1) CES: conductor end sleeve

Safe digital inputs/digital outputs		
Number of F-DI		4
Number of F-DO		1
Response time		See chapter "Response times" (→ 🗎 512)
Assignment	X60:1 – 2, 5 – 6	Failsafe digital inputs F-DI00, F-DI01, F-DI02, F-DI03 Current consumption per F-DI ≤ 15 mA Input capacitance < 500 pF
	X60:3 – 4, 7 – 8	Reference potential for safe digital inputs
	X60:9	F-SS0 DC 24 V sensor voltage supply for safe digital inputs F-DI00 and F-DI02 Rated current = 150 mA, maximum inrush current 300 mA
	X60:10	F-SS1 DC 24 V sensor voltage supply for safe digital inputs F-DI01 and F-DI03 Rated current = 150 mA, maximum inrush current 300 mA
	X60:11 X60:12	F-DO00_M (not with CSB) F-DO00_P (not with CSB) Characteristics: • DC 24 V output in accordance with EN 61131-2 • Short circuit and overload protection • Rated current 150 mA
Connection contacts	X60	Plug connector • 1 core – Finely stranded: 0.2 – 1.5 mm² (stripping length 10 mm) – Finely stranded with CES[1)] with plastic collar: 0.14 – 0.75 mm² – Finely stranded with CES without plastic collar: 0.25 – 1.5 mm²

1) CES: conductor end sleeve

Relay output		
Quantity		1
Current-carrying capacity of relay contacts		DC 30 V, I_{max} = 0.8 A Do not connect any inductive loads to the relay contact.
Assignment	X22.1	DOR-C: Shared relay contact
	X22.2	DOR-NO: NO contact
	X22.3	DOR-NC: NC contact
Connection contacts	X22	Plug connector • 1 core – Rigid: 0.2 – 1.5 mm² (stripping length 8 – 9 mm) – Finely stranded: 0.2 – 1.5 mm² (stripping length 8 – 9 mm) – Finely stranded with CES[1)] with plastic collar: 0.25 – 0.75 mm² – Finely stranded with CES without plastic collar: 0.25 – 1.5 mm²

1) CES: conductor end sleeve

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Brake control/temperature input		
Assignment	X10:DB00/X10:DB0	DB00/DB0: - Brake control – Control braking contactor DC 24 V, max. 150 mA
	X10:GND	Reference potential
	X10: TF1	Sensor input for temperature sensor
	X10:GND	Reference potential
Connection contacts		Plug connector: MCX91A-0010 – 0460-5_3-.. MCX91A-0070 – 0290-2_3-..: MCX91A-0017 – 0110-2E1-.. • 1 core – Rigid: 0.2 – 1.5 mm² (stripping length 10 mm) – Finely stranded: 0.2 – 1.5 mm² (stripping length 10 mm) – Finely stranded with CES[1)] with plastic collar: 0.14 – 0.75 mm² – Finely stranded with CES without plastic collar: 0.25 – 1.5 mm² From MCX91A-0620-5_3-.. and from MCX91A-0420-2_3..: • 1 core – Rigid: 0.25 – 2.5 mm² (stripping length 10 mm) – Finely stranded: 0.25 – 2.5 mm² (stripping length 10 mm) – Finely stranded with CES[1)] with plastic collar: 0.25 – 2.5 mm² – Finely stranded with CES without plastic collar: 0.25 – 2.5 mm² • 2 cores – 0.5 – 1.5 mm² (twin CES)

1) CES: conductor end sleeve

Digital motor integration connection		
Quantity		1 (optional)
Connection contacts	X16	Coaxial connection for encoder with MOVILINK® DDI interface
Maximum line length		200 m

Connection for FS encoder (functional safety)		
Quantity		1 (optional)
Connection contacts	X18	Mini IO connector for EI7C-FS encoder
Maximum line length		100 m

Fieldbus connection		
Quantity		2
Connection contacts	IN X30/X40	RJ45 socket
	OUT X30/X41	

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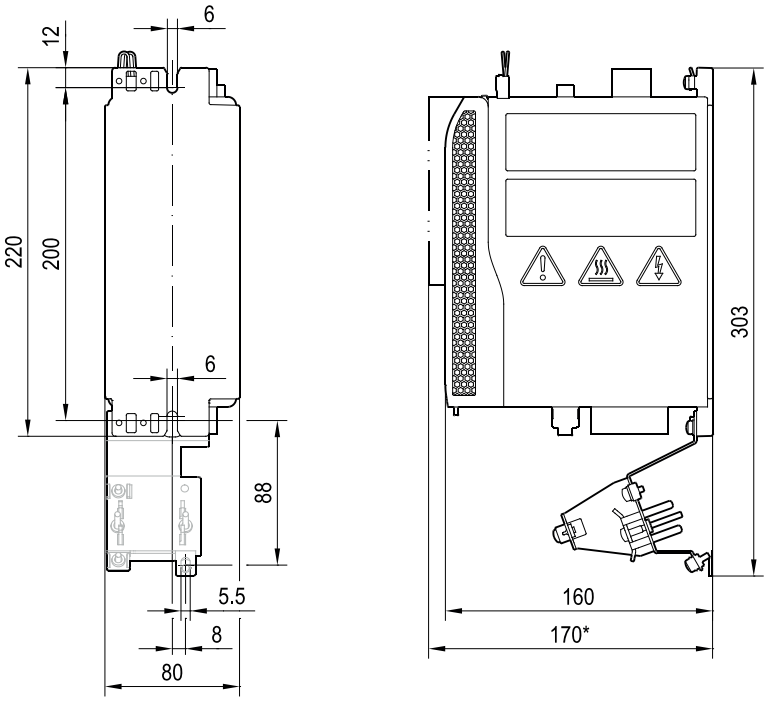
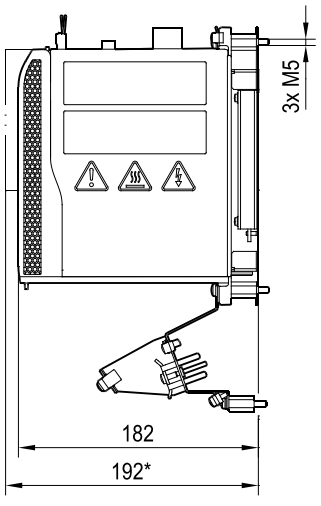
2.6 Dimension sheets

2.6.1 MCX91A-0010 – 0055-5E3-4-.., MCX91A-0017 – 0055-2E3-4-.., MCX91A-0017 – 0042-2E1-4-.. (size 0S), CLH21A, CLH31A

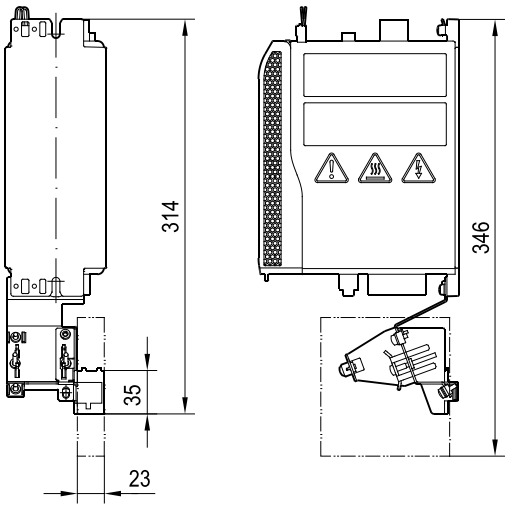


***+CBG11A / +CBG21A**

CLH31A



CLH21A



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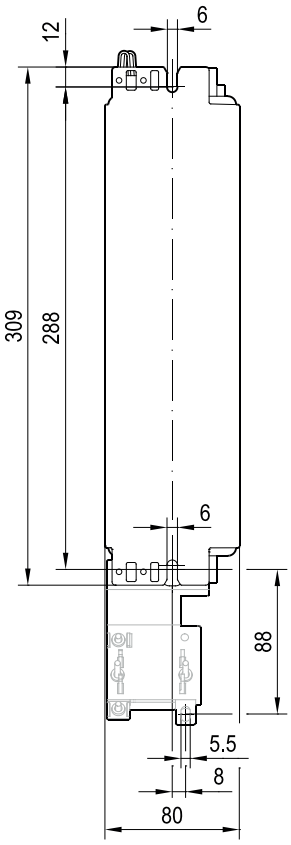
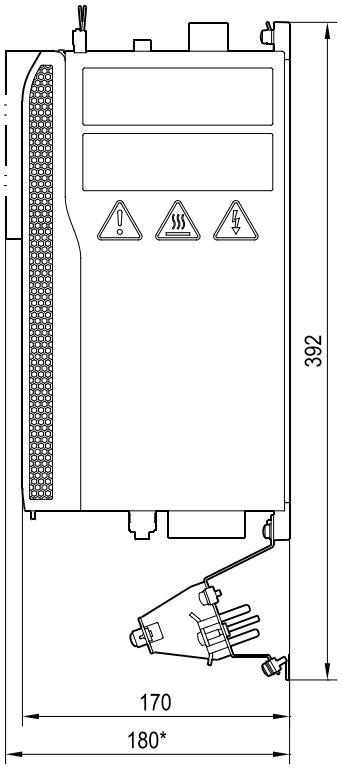
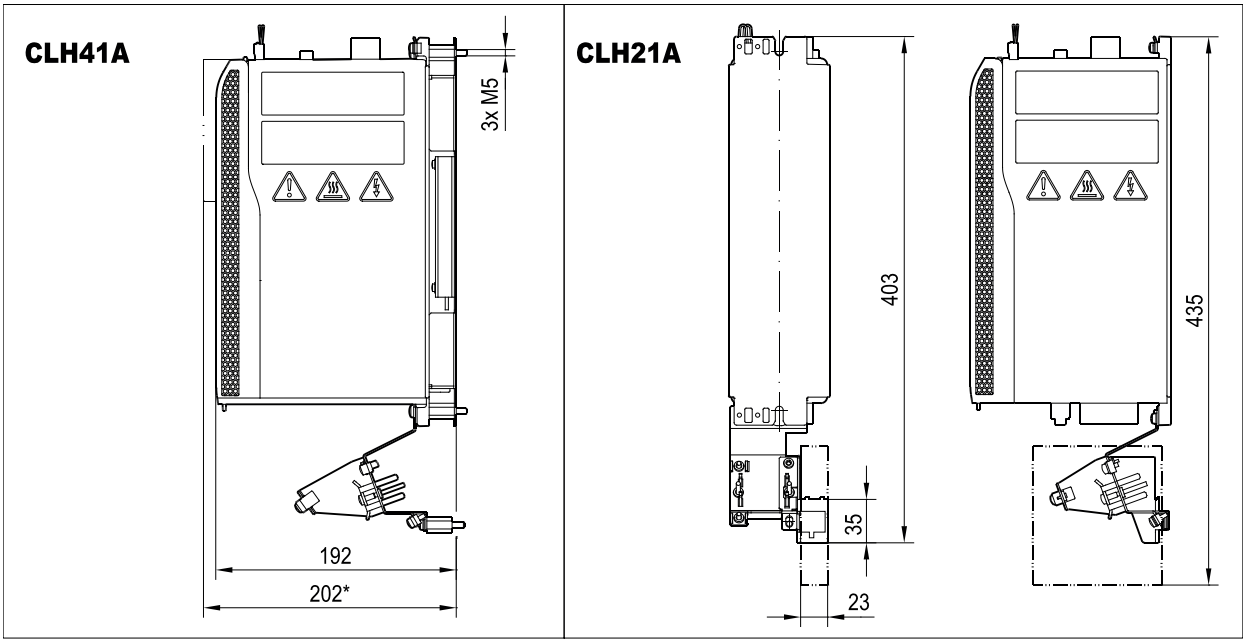
2.6.2 MCX91A-0070 – 0160-5E3-4-.., MCX91A-0070 – 0140-2E3-4-.., MCX91A-0055 – 0110-2E1-4-.. (size 0L), CLH21A, CLH41A



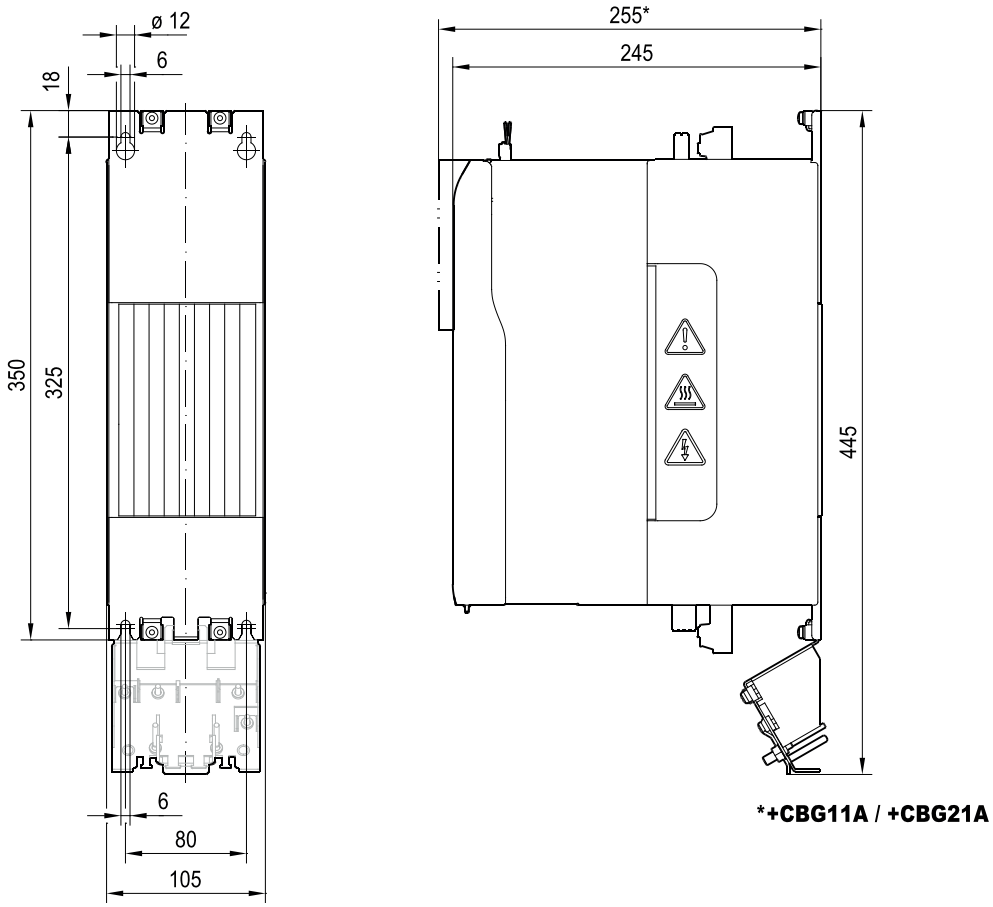


*+CBG11A / +CBG21A



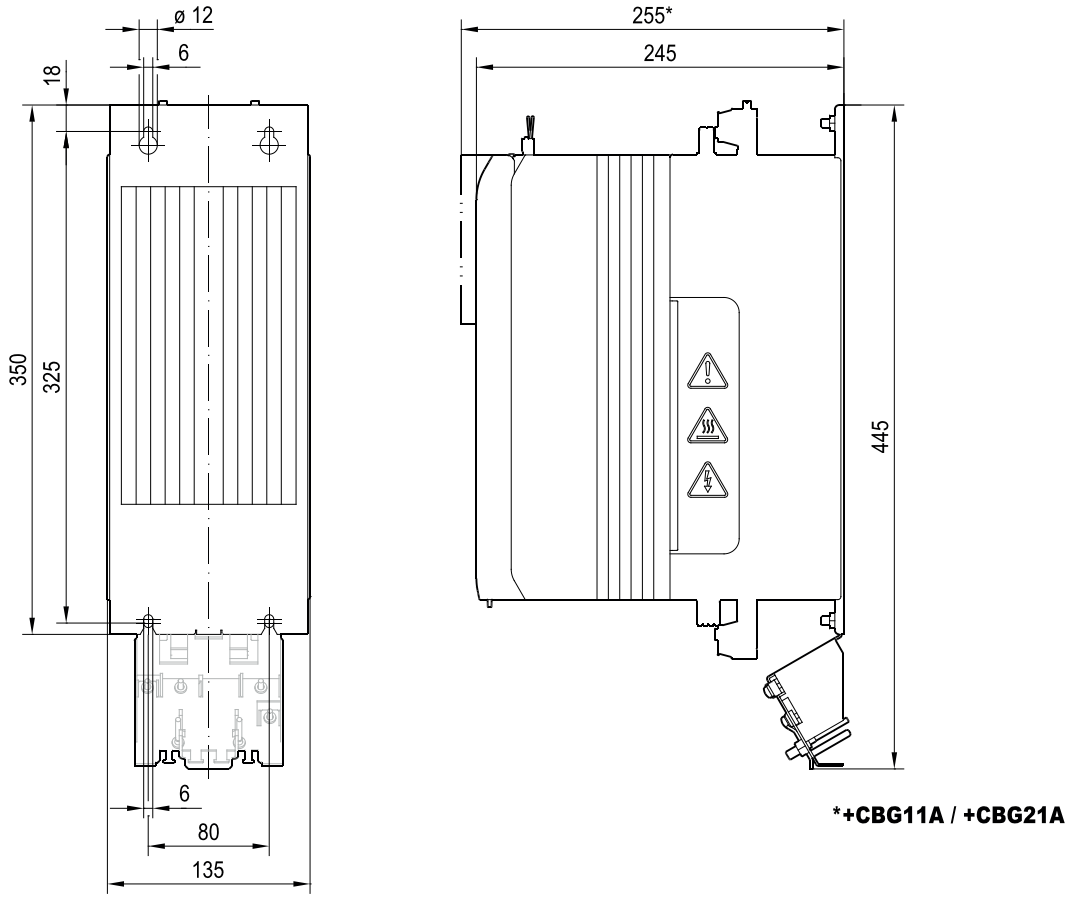
9007234502110347

2.6.3 MCX91A-0240-5E3-4-.., MCX91A-0213-2E3-4-.. (size 3)



9007234502112779

2.6.4 MCX91A-0320 – 0460-503-4-.., MCX91A-0290 – 0420-203-4-.. (size 4)



***+CBG11A / +CBG21A**

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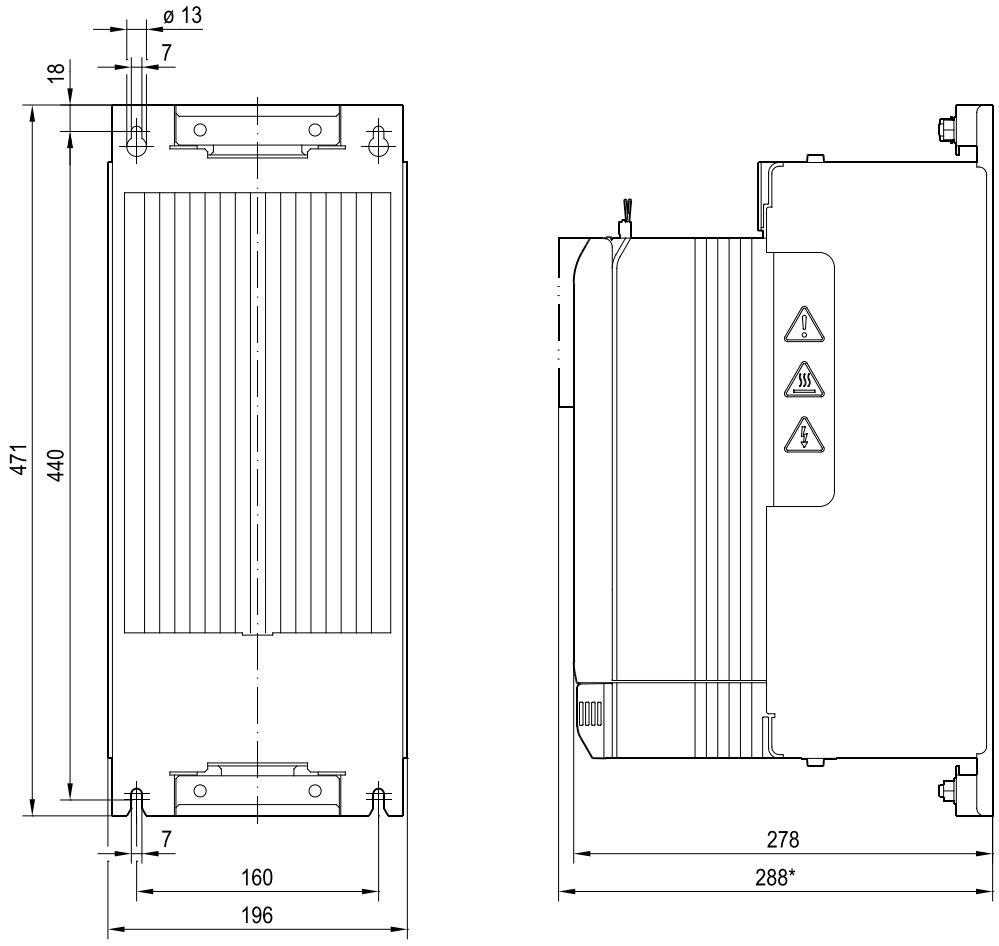
2.6.5 MCX91A-0620 – 0910-503-4-.., MCX91A-0570 – 0840-203-4-.. (size 5)



***+CBG11A / +CBG21A**

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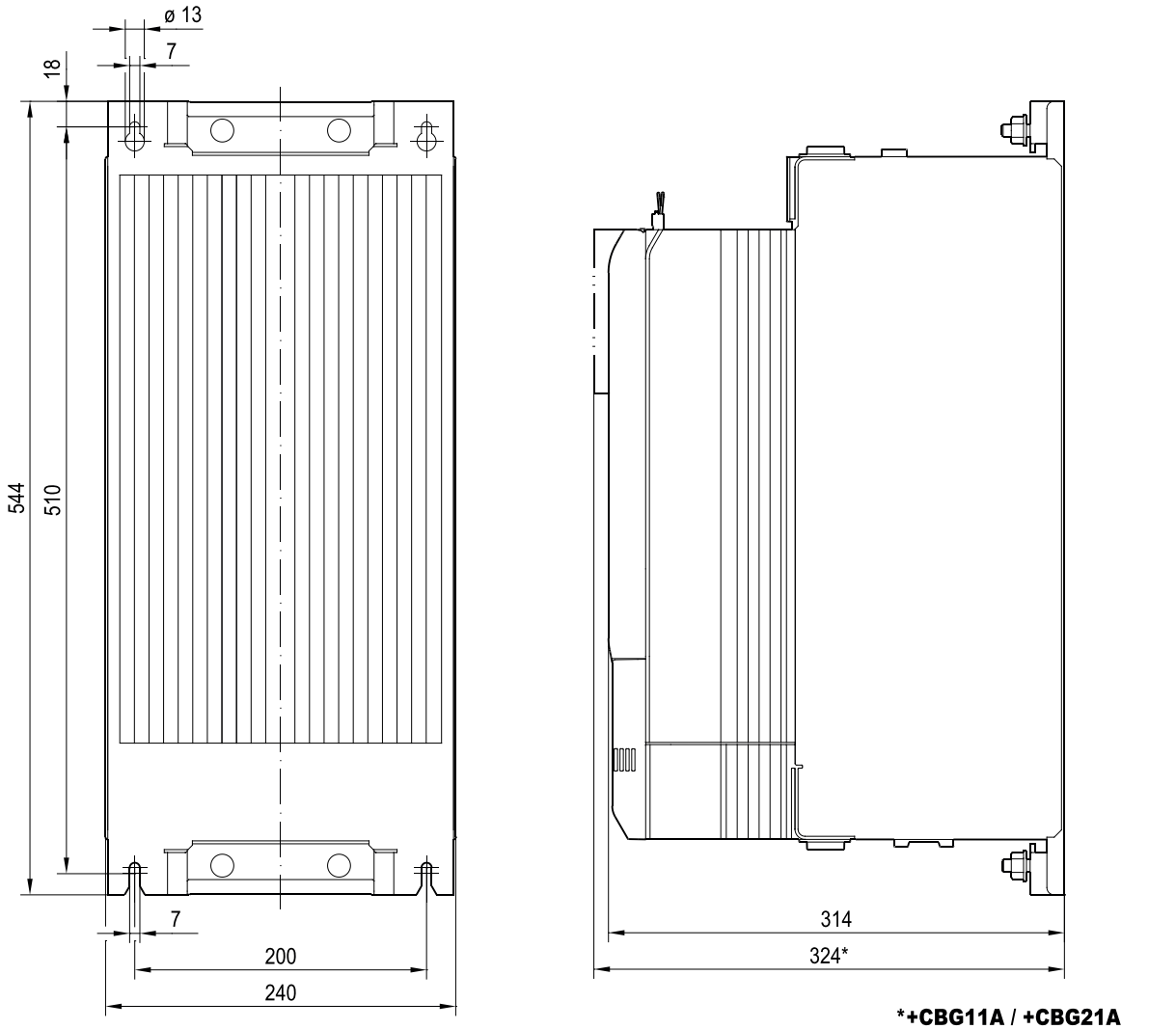
2.6.6 MCX91A-1130 – 1770-503-4-.., MCX91A-1080-203-4-.. (size 6)



***+CBG11A / +CBG21A**

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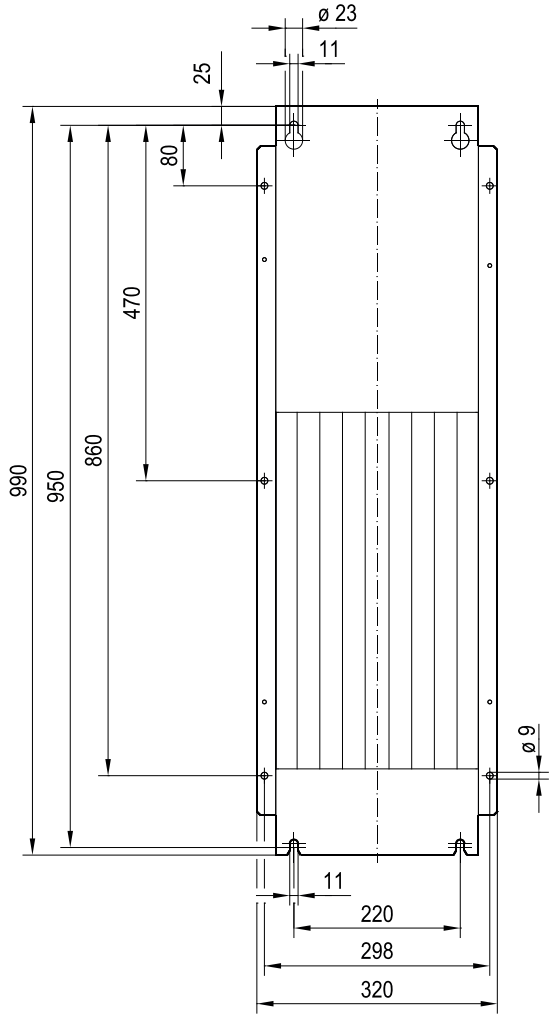
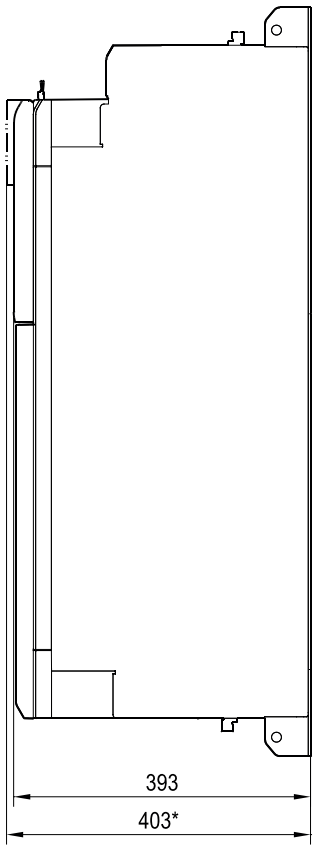
2.6.7 MCX91A-2200 – 3000-503-4-.. (size 7)





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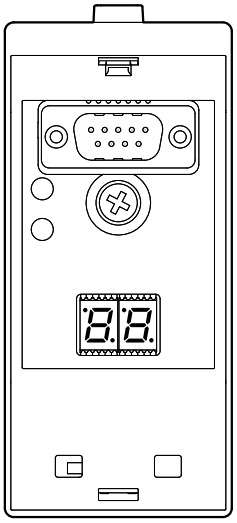
2.7 Diagnostic module CDM11A



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Power consumption	0.25 W
Dimensions	H: 100 mm
	B: 46 mm
	D: 20 mm
Screen type	2-digit 7-segment display
Engineering interface	D-sub, 9-pin
Part number	28265092

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2.8 USM21A interface adapter

USM21A	Technical data
Part number	28231449
Ambient temperature	0 °C to 40 °C
Storage temperature	-25 °C to 70 °C
Degree of protection	IP20
Dimensions	
Width	42 mm
Height	89 mm
Depth	25 mm

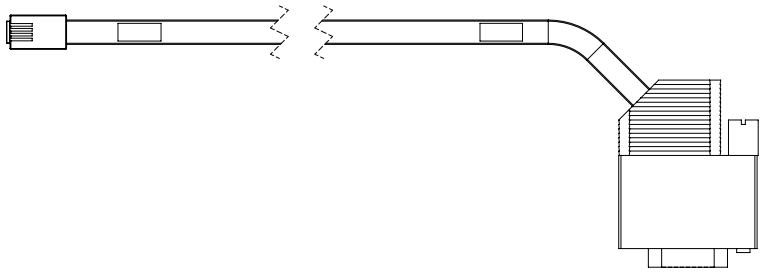
An order using part number 28231449 includes the following parts:

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

INFORMATION

To connect the inverter to the USM21A, you need an additional serial interface cable with an RJ10 connector and a 9-pin D-sub connector, part number 18123864.

This cable must be ordered separately.



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The CDM diagnostic module is required to connect the MOVITRAC® advanced inverter to the USM21A interface adapter.

The USM21A interface adapter can be used to perform a firmware update of the inverter.

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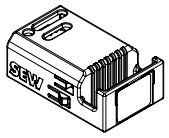
2.9 CMM11A memory module



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The pluggable memory module is supplied independently of the device variant.

For certain device variants, the memory module can be deselected when configuring the inverter. It is not possible to deselect the memory module if the device variant includes the CSB and CSL safety options.

CMM11A	Part number
Part number	28230760

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2.10 Keypads

Operating temperature	0 – 60 °C
Degree of protection	IP40 in accordance with EN 60529

CBG01A	
Power consumption	0.25 W
Dimensions	H: 100 mm
	B: 45 mm
	T: 19 mm
Screen type	5-digit 7-segment display
Part number	28269993
CBG11A	
Power consumption	0.6 W
Dimensions	H: 100 mm
	B: 45 mm
	D: 20 mm
Screen size W x H	28.5 mm × 23 mm
Diagonal screen measurement	1.5" (38 mm)
Screen resolution W × H	78 × 64 pixels
Screen type	Monochrome display
Engineering interface	Mini-USB socket
Connection interface	D-sub, 9-pin
Part number	28233646
CBG21A/CBG22A	
Power consumption	1.4 W
Dimensions	H: 110 mm
	B: 65 mm
	D: 20 mm
Screen size W x H	49 mm × 37 mm
Diagonal screen measurement	2.4" (61 mm)
Screen resolution W × H	320 × 240 pixels
Screen type	Color display
Engineering interface	Mini-USB socket
Connection interface	D-sub, 9-pin
Part number of the CBG21A	28238133
Part number of the CBG22A	28277554

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2.11 Technical data of braking resistors, filters, and chokes

2.11.1 Braking resistors type BW.../BW...-T

General

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 this, see the following tables "Technical data and assignment to an inverter".

A PTC 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.

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.

INFORMATION

Use of protection devices.

Use only the protection devices listed in the following section:

- Internal temperature switch T
- External bimetallic relay

→ See also the chapter "Protection of the braking resistor against thermal overload".

UL and cURus approval

The listed braking resistors have a cURus approval independent of the inverter.

Parallel connection of braking resistors

Identical braking resistors must be 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 of the BW...-T series.

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Technical data

Technical data

Braking resistor	Unit	BW120-001	BW100-002/M	BW100-001	BW100-002	BW100-006-T	BW168-T	BW268-T
Part number		1817601 1	2566451 4	0828171 8	0828165 3	1820419 8	1820133 4	1820417 1
Current-carrying capacity at 100% cdf	kW	0.03	0.15	0.1	0.2	0.6	0.8	1.2
Resistance value R_{BW}	Ω	117	100	100 ± 10%			68 ± 10%	
Tripping current I_{trip}	A	-	1.2	0.8	1	2.4	3.4	4.2
Design		PTC braking resistor	Flatpack resistor	Flat-type resistor		Wire resistor		
Power connections		Single conductors				Ceramic terminal 2.5 mm^2		
Wire length	mm	170	300	510		-		
Cable cross section	mm^2	0.5		1.5		-		
Tightening torque	Nm	-				0.5		
PE connection		-				M4		
PE tightening torque	Nm	-				1.8		
Degree of protection in accordance with EN 60529		IP20	IP40	IP54		IP20		
Ambient temperature ϑ_{amb}		-20 °C to +40 °C (Reduction 4% P_N/10 K to +60 °C)						
Mass	kg	0.95	1.4	0.3	0.6	3	3.6	4.9

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Technical data

Braking resistor	Unit	BW047-010-T	BW147-T	BW247-T
Part number		17983207	18201342	18200842
Current-carrying capacity at 100% cdf	kW	1	1.2	2
Resistance value R_{BW}	Ω	47 ± 10%		
Tripping current I_{trip}	A	4.6	5.1	6.5
Design		Wire resistor		
Power connections		Ceramic terminal 2.5 mm^2		
Tightening torque	Nm	0.5		
PE connection		M4		
PE tightening torque	Nm	1.8		
Degree of protection		IP20		
Ambient temperature ϑ_{amb}		-20 °C to +40 °C		
Mass	kg	4	4.9	6.7

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Technical data

Braking resistor	Unit	BW027-016-T	BW027-024-T	BW027-042-T
Part number		17983215	17983231	19155301
Current-carrying capacity at 100% cdf	kW	1.6	2.4	4.2
Resistance value R_{BW}	Ω	27 ± 10%		
Tripping current I_{trip}	A	7.7	9.4	12.5
Design		Wire resistor		Frame resistor
Power connections		Ceramic terminal 2.5 mm^2		
Tightening torque	Nm	0.5		
PE connection		M4		M5
PE tightening torque	Nm	1.8		2.5
Degree of protection		IP20		
Ambient temperature ϑ_{amb}		-20 °C to +40 °C		
Mass	kg	5.8	8	10

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Technical data

Braking resistor	Unit	BW015-016	BW015-042-T	BW015-075-T	BW915-T
Part number		17983258	19155328	19155271	18204139
Current-carrying capacity at 100% cdf	kW	1.6	4.2	7.5	16
Resistance value R_{BW}	Ω	15 ± 10%			
Tripping current I_{trip}	A	10.3	16.7	22.4	32.7
Design		Wire resistor	Frame resistor	Grid resistor mounting position 1	
Power connections		Ceramic terminal 2.5 mm^2	Ceramic terminal 4 mm^2	M8 stud	
Tightening torque	Nm	0.5	0.9	6	
PE connection		M4	M5	M6 stud	
PE tightening torque	Nm	1.8	2.5	3	
Degree of protection		IP20			
Ambient temperature ϑ_{amb}		-20 °C to +40 °C			
Mass	kg	5.8	10	12	32

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Technical data

Braking resistor	Unit	BW010-024	BW010-050-T	BW010-108-T
Part number		17983266	17983274	19155298
Current-carrying capacity at 100% cdf	kW	2.4	5	10.8
Resistance value R_{BW}	Ω	10 ± 10%		
Tripping current I_{trip}	A	15.5	22.4	32.9
Design		Wire resistor	Grid resistor mounting position 1	
Power connections		Ceramic terminal 2.5 mm^2	M8 stud	
Tightening torque	Nm	0.5	6	
PE connection		M4 stud	M6 stud	
PE tightening torque	Nm	1.8	3	
Degree of protection		IP20		
Ambient temperature ϑ_{amb}		-20 °C to +40 °C		
Mass	kg	8	11	17.5

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Technical data

Braking resistor	Unit	BW006-025-01[1)]	BW006-050-01[1)]	BW106-T	BW206-T
Part number		18200117	18200125	18200834	18204120
Current-carrying capacity at 100% cdf	kW	2.5	5	13.5	18
Resistance value R_{BW}	Ω	6 ± 10%			
Tripping current I_{trip}	A	20.4	28.9	47.4	54.8
Design		Grid resistor mounting position 1			
Power connections		M8 stud			
Tightening torque	Nm	6			
PE connection		M6 stud			
PE tightening torque	Nm	3			
Degree of protection		IP20			
Ambient temperature ϑ_{amb}		-25 °C to +40 °C			
Mass	kg	7.5	12	30	40

1) Braking resistor has a 1 Ω tap

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Technical data

Braking resistor	Unit	BW005-070	BW005-170-T	BW004-050-01	BW004-070-01
Part number		17983282	17983290	18200133	17967678
Current-carrying capacity at 100% cdf	kW	7	17	5	7
Resistance value R_{BW}	Ω	4.7 ± 10%		3.6 ± 10%	
Tripping current I_{trip}	A	38.6	60.1	32.6	38.6
Design		Grid resistor mounting position 1			
Power connections		M8 stud			
Tightening torque	Nm	6			
PE connection		M6 stud			
PE tightening torque	Nm	3			
Degree of protection		IP20			
Ambient temperature ϑ_{amb}		-20 °C to +40 °C			
Mass	kg	13	33	13	

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Technical data

Braking resistor	Unit	BW003-420-T	BW002-070
Part number		13302345	17983304
Current-carrying capacity at 100% cdf	kW	42	7
Resistance value R_{BW}	Ω	2.5	2.3 ± 10%
Tripping current I_{trip}	A	135.1	55.2
Design		Grid resistor mounting position 2	Grid resistor mounting position 1
Power connections		M12 stud	M8 stud
Tightening torque	Nm	15.5	6
PE connection		M10 stud	M6 stud
PE tightening torque	Nm	10	3
Degree of protection		IP20	
Ambient temperature ϑ_{amb}		-20 °C to +40 °C	
Mass	kg	93	33

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Technical data

Braking resistor	Unit	BW1.0-170
Part number		17985455
Current-carrying capacity at 100% cdf	kW	17
Resistance value R_{BW}	Ω	1 ± 10%
Tripping current I_{trip}	A	130.4
Design		Grid resistor mounting position 2
Power connections		M12 stud
Tightening torque	Nm	15.5
PE connection		M10 stud
PE tightening torque	Nm	10
Degree of protection		IP20
Ambient temperature ϑ_{amb}		-25 °C to +40 °C
Mass	kg	45

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Technical data of braking resistors with submounting plate

Braking resistor	Unit	CLH31A/ BW4	CLH31A/ BW2	CLH31A/ BW072-001	CLH31A/ BW100-001	CLH41A/ BW027-001	CLH41A/ BW047-001
Part number		28284712	28284720	28284739	28284755	28284747	28284763
Current-carrying capacity at 100% cdf	kW	0.025	0.025	0.1	0.1	0.1	0.1
Resistance value R_{BW}	Ω	88	175	72	100 ±10%	27	47
Tripping current I_{trip}	A	–	–	0.9	0.8	1.5	1.1
Design		PTC		Flat-type resistor			
Power connections		Single conductor					
Wire length	mm	170	170	510	510	510	510
Cable cross section	mm^2	0.75	0.75	1.5	1.5	1.5	1.5
Tightening torque	Nm	–	–	–	–	–	–
PE connection		–	–	–	–	–	–
PE tightening torque	Nm	–	–	–	–	–	–
Degree of protection in accordance with EN 60529		IP20	IP20	IP65	IP65	IP65	IP65
Ambient temperature ϑ_{amb}		–	–	-20 °C to +40 °C (Reduction 4% P_N/10 K to +60 °C)			
Mass	kg	0.08	0.08	0.3	0.3	0.3	0.3

The CLH31A and CLH41A braking resistors with submounting plate are supplied as a combination of submounting plate and integrated braking resistor. There is a choice of braking resistors with different ratings for each submounting plate.

Braking resistors mounted to the submounting plate may not achieve the load capacity specified in the table at 100% cdf. The specifications for the nominal power of the inverter can be observed in submounted operation at 4 kHz, 40 °C and 400 V.

Technical data BW..-T signal contact

Specifications for BW..-T	Design
Signal contact connection cross section	1 × 2.5 mm^2
Tightening torque of the signal contact	1 Nm
Switching capacity signal contact	DC 2 A / DC 24 V (DC11) AC 2 A / AC 230 V (AC11)
Switch contact (NC contact)	According to EN 60730

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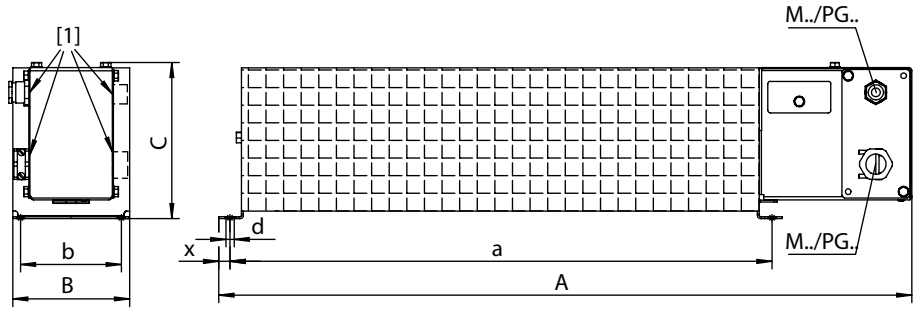
Dimension sheets and dimensions

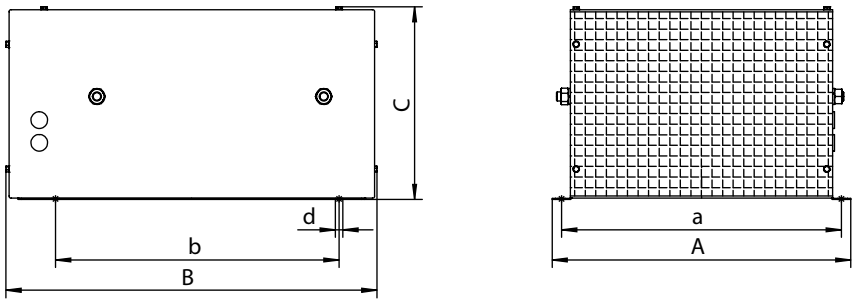
Wire resistor



18874863883

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	PG16 + M12
BW247-T	749	185	125	630	150	6.5	8	PG16 + 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			Fastening 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	–	–

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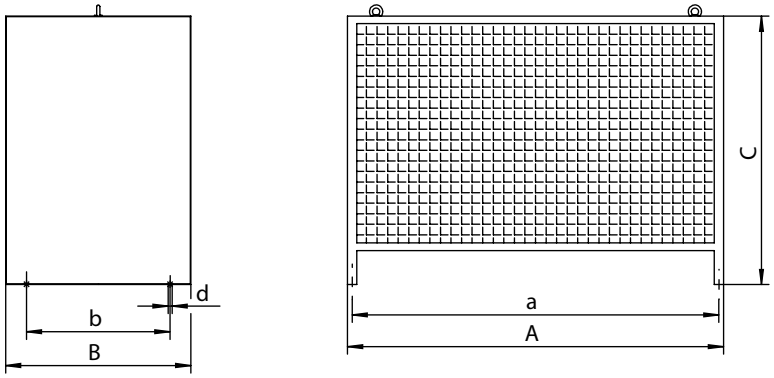
Grid resistor mounting position 2



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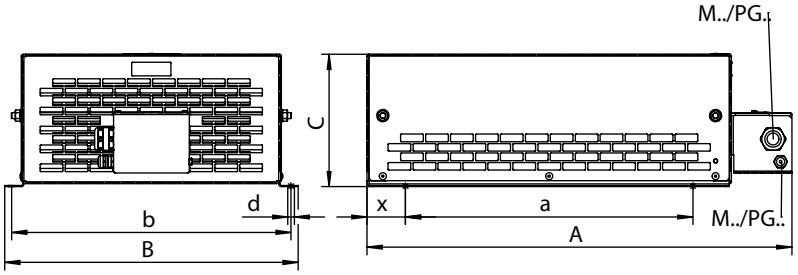
Braking resistor	Main dimensions in mm			Mounting dimensions in mm				Cable gland
	A	B	C	a	b	d	x	
BW003-420-T	995	490	710	970	380	10.5	—	—
BW1.0-170	490	795	490	380	770	10.5	—	—

Frame resistor



18874873611

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

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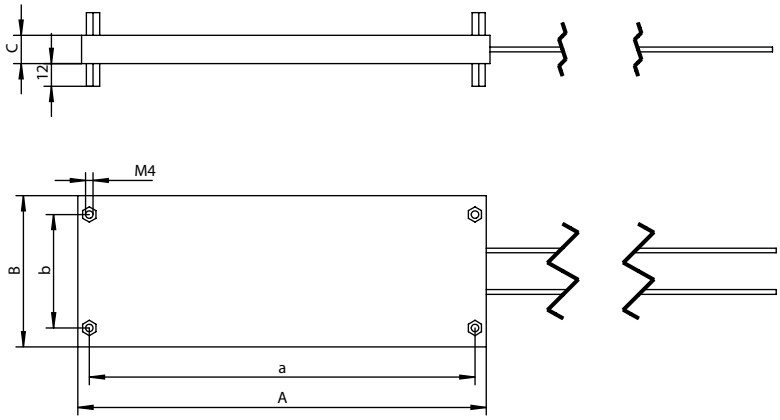
Flat-type resistor



18874878475

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

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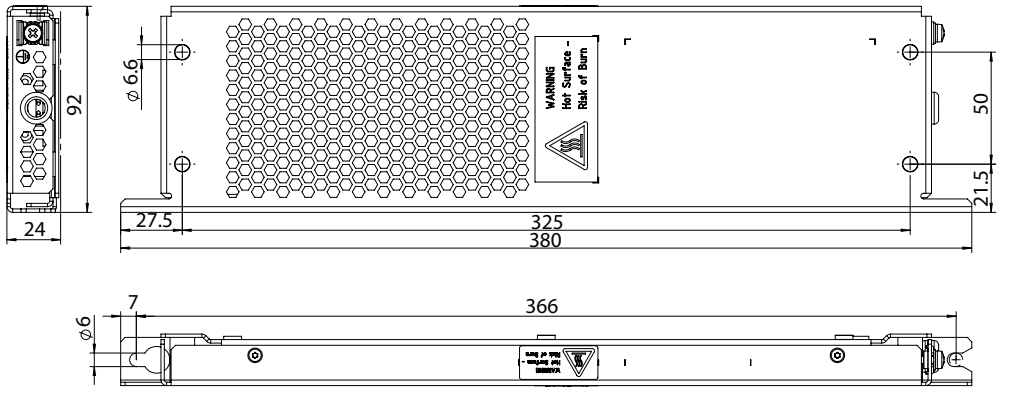
BW120-001 resistor



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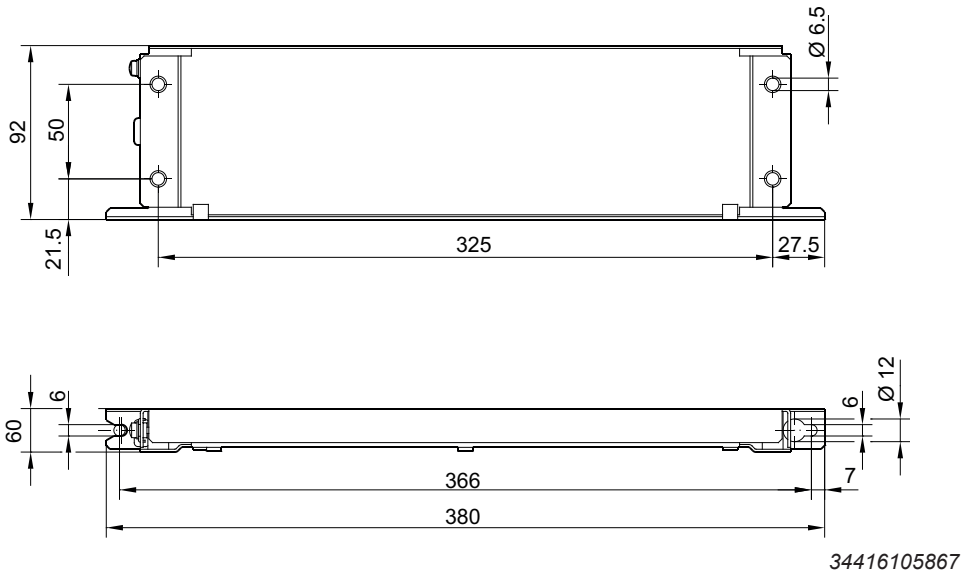
Length of connections: 130 mm

BW100-002/M resistor



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2.11.2 NF.. line filter

Line filters are used to suppress interference emission on the line side of inverters.

INFORMATION

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

UL and cURus approval

The listed line filters have a cURus approval independent of the inverter.

Technical data

Line filter	Unit	NF0055-503	NF0120-503	NF0220-503	NF0420-513	NF0910-523	NF1800-523	NF2700-503
Part number		17984319	17984270	17984300	17983789	17987504	17987865	18000576
Nominal line voltage (according to EN 50160) AC V_{line}	V	3 × 230 – 500 V						
Line frequency f_{line}	Hz	50 – 60 ± 5%						
Nominal current I_N	A	5.5	12	22	42	91	180	270
Nominal power loss	W	4	6	30	30	51.5	89	103
Ambient temperature ϑ_{amb}		0 °C to 45 °C (reduction: 3% I_N up to maximum 60 °C)						
Connection contacts L1/L2/L3 – L1'/L2'/L3'		Cage clamp terminals			Screw terminal			M12 stud
Cross section L1/L2/L3 – L1'/L2'/L3'	mm^2	Max. 6			2.5 – 16	10 – 50	16 – 120	–
Tightening torque L1/L2/L3 – L1'/L2'/L3'	Nm	-			2 – 4	3.5 – 6	12 – 20	14 – 20
PE connection contacts		M4 screw		M5 screw	M6 stud	M8 stud	M10 stud	M12 stud
PE tightening torque	Nm	1.5		3	6	12	23	30
Degree of protection		IP20 according to EN 60529						IP00
Mass	kg	1	1	1.4	3	5	9	15.8

Assignment

Line filter	NF0055-503	NF0120-503	NF0220-503	NF0420-513	NF0910-523	NF1800-523	NF2700-503
MCX91A-...-5_3-..	0010 – 0055	0070 – 0125	0160 – 0240	0320 – 0460	0620 – 0910	1130 – 1770	2200 – 3000
MCX91A-...-2_3-..	0017 – 0055	0070 – 0093	0140 – 0213	0290 – 0420	0570 – 0840	1080	–

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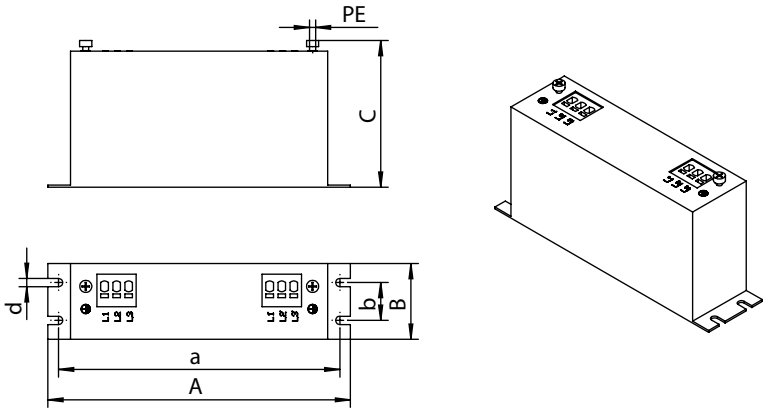
Dimension sheets and dimensions



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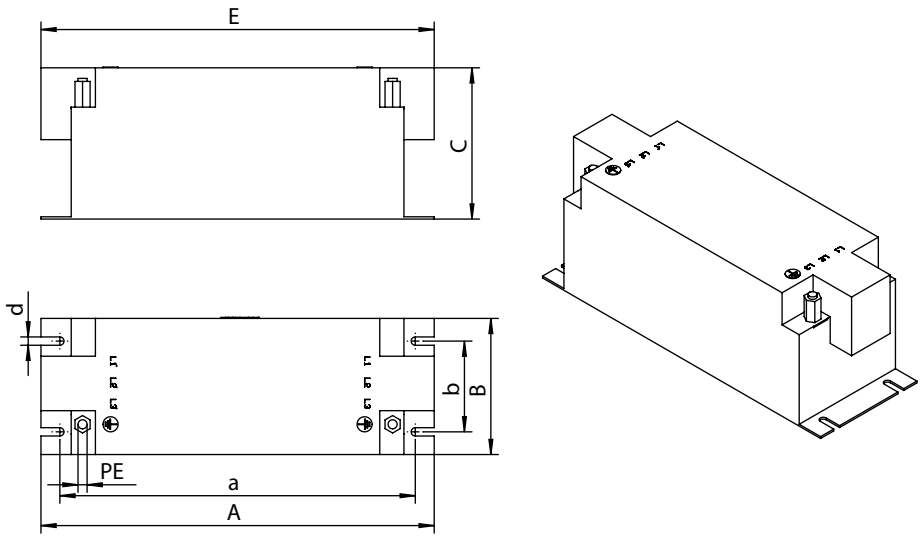
Line filter	Main dimensions in mm				Mounting dimensions in mm			Connection
	A	B	C	E	a	b	d	PE
NF0055-503	200	50	97	-	186	25	5.5	M4
NF0120-503	200	50	97	-	186	25	5.5	M4
NF0220-503	230	55	102	-	216	30	5.5	M4



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Line filter	Main dimensions in mm				Mounting dimensions in mm			Connection
	A	B	C	E	a	b	d	PE
NF0420-513	250	88	98	255	235	60	5.5	M6
NF0910-523	270	97	152	322	255	65	6.5	M8
NF1800-523	360	131	182	464	365	102	6.5	M10
NF2700-503	450	231	284	463	435	172	6.5	M12

2.11.3 Line choke ND..

Line chokes are used:

- To support overvoltage protection
- To smoothen the line current, to reduce harmonics
- For protection in the event of distorted line voltage
- To limit 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)
  - With 5 or more 3-phase devices
  - With 2 or more 1-phase devices

Using a line choke per inverter is mandatory with MCX91A-0110-2E1-4-..

UL and cURus approval

The listed line chokes have cURus approvals independent of the inverter.

Technical data and assignment

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 (according to EN 50160) AC V_{line}	V	3 × 230 – 500 V						
Nominal current I_N	A	7	16	30	42	91	180	300
Line frequency f_{line}	Hz	50 – 60 ± 5%						
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}		-10 °C to 45 °C (reduction: 3% I_N up to maximum 60 °C)						
Connection contacts L1/L2/L3 – L1'/L2'/L3'		Screw terminal						M12 stud
Cross section L1/L2/L3 – L1'/L2'/L3'	mm^2	0.2 – 4		0.2 – 10	2.5 – 16	10 – 50	16 – 120	–
Tightening torque L1/L2/L3 – L1'/L2'/L3'	Nm	0.5 – 1		1.2 – 2	2.5	3.5 – 6	12 – 20	15.5
PE connection contacts		M4 screw		M5 screw		M8 stud	M10 stud	2 × M10 stud
PE tightening torque	Nm	1.5		3		12	20	20
Degree of protection according to EN 60529		IPXXB				IPXXA		IP00
Mass	kg	0.5	1.3	1.95	1.82	4.4	10	36

Assignment

Line choke	ND0070-503	ND0160-503	ND0300-503	ND0420-503	ND0910-503	ND1800-503	ND3000-503
MCX91A-...-5_3-..	0010 – 0055	0070 – 0125	0160 – 0240	0320 – 0460	0620 – 0910	1130 – 1770	2200 – 3000
MCX91A-...-2_3-..	0017 – 0055	0070 – 0093	0140 – 0213	0290 – 0420	0570 – 0840	1080	-

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Technical data

Line choke		ND0250-201
Part number		18001424
Nominal line voltage V_L		1 × AC 200 V – 240 V, 50/60 Hz
Nominal current I_N	A	25
Nominal inductance	mH	1.17
Nominal power loss	W	27
Ambient temperature ϑ_{amb}		-10 °C to 40 °C
Connection contacts L1/L2/L3 – L1'/L2'/L3'	mm^2	Elevator clamp 0.2 – 16
Tightening torque L1/L2/L3 – L1'/L2'/L3'	Nm	1.2 – 2
PE connection contact	mm	Connection lug for tab connector 6.3 × 0.8
Degree of protection according to EN 60529		IP00
Mass	kg	1.5

Assignment

Line choke	ND0250-201
MCX91A-...-2_1-..	0110 (mandatory) 0017 – 0093 (optional)

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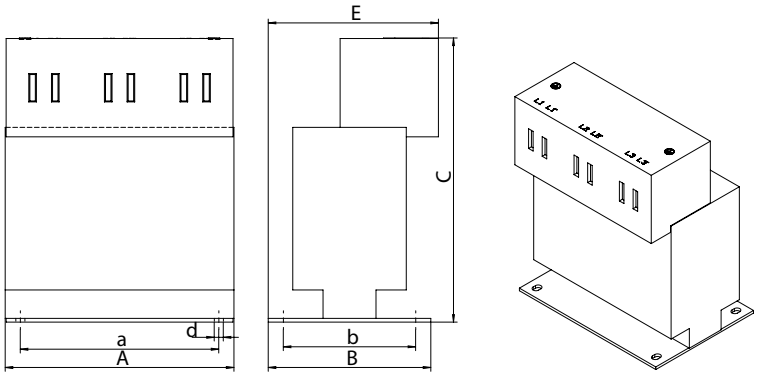
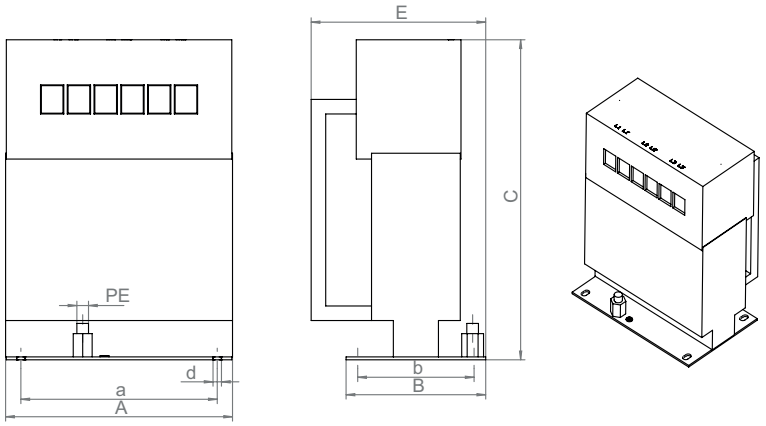
Dimension sheets and dimensions



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
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
ND0250-201	84	64	98	87	64	51.5	4.8	6.3 × 0.8



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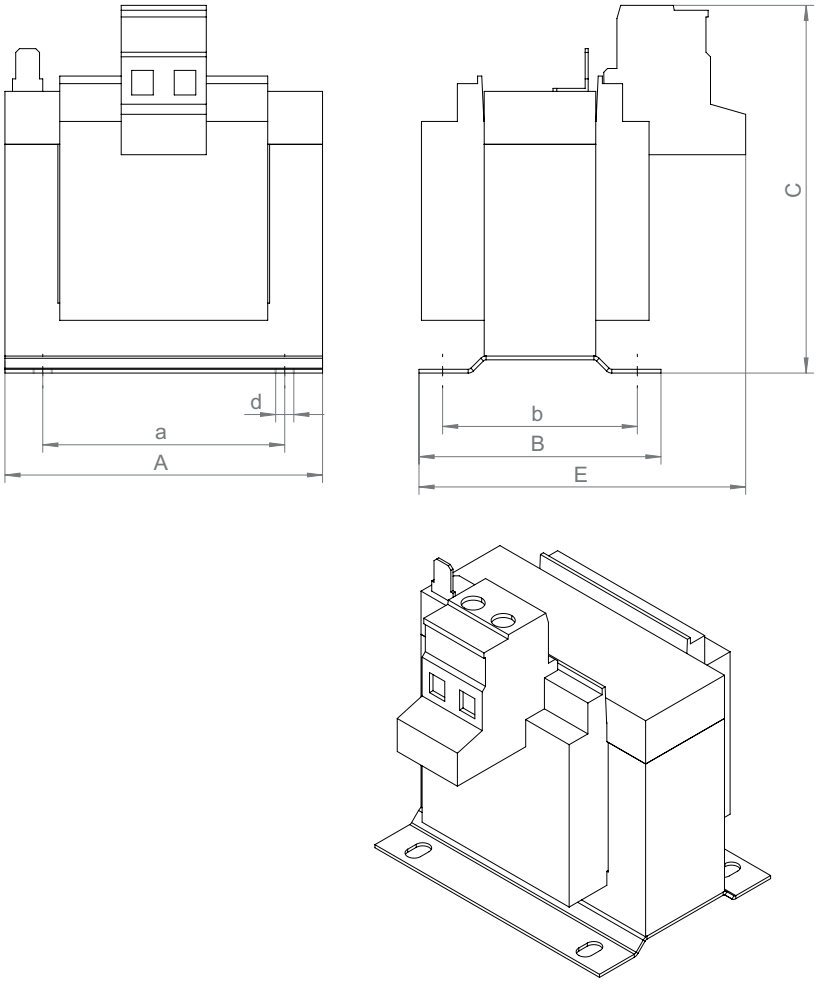

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2.11.4 HF.. output filter

Description of the output filter

HF.. type output filters are sine filters 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.

UL and cURus approval

The listed output filters have a cURus approval independent of the inverter.

Technical data

Output filter		HF0055-503	HF0125-503	HF0240-503	HF0460-503	HF0650-503	HF1150-503
Part number		17985110	17985129	17985137	17985145	17991277	17991269
Nominal voltage U_N		3 × AC 230 V – 500 V, 50/60 Hz					
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}		0 °C to 45 °C (reduction: 3% I_N/K up to maximum 60 °C)					
Connection contacts U1/V1/W1/UDC – U2/V2/W2	mm^2	Screw terminal 0.2 – 10		Screw terminal 2.5 – 16		Screw terminal 16 – 50	Screw terminal 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 stud				M8 stud	M10 stud
PE tightening torque	Nm	6				12	23
Degree of protection in accordance with EN 60529		IPXXB				IPXXA	
Mass	kg	8	18	25	40	48	68

Assignment

Output filter	HF0055-503	HF0125-503	HF0240-503	HF0460-503	HF0650-503	HF1150-503
MCX91A-...-5_3-..	0010 – 0055	0070 – 0125	0160 – 0240	0320 – 0460	0620	0750 – 0910
					1130 (Parallel connection of 2 filters)	1490 – 1770 (Parallel connection of 2 filters)
MCX91A-...-2_3-..	0017 – 0055	0070 – 0093	0140 – 0213	0290 – 0420	0840 (Parallel connection of 2 filters)	0570
						1080 (Parallel connection of 2 filters)
MCX91A-...-2E1-..	0017 – 0055	0070 – 0110	–	–	–	–

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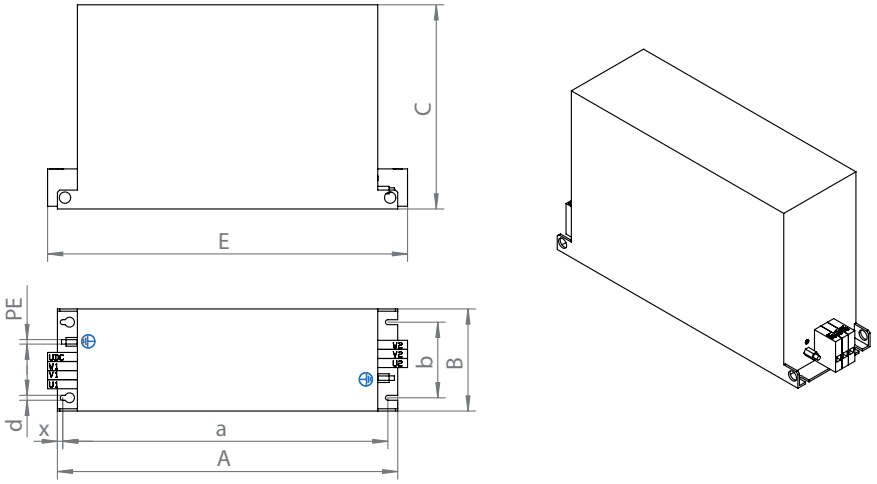
Dimension sheets and dimensions



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Output filter	Main dimensions in mm				Mounting dimensions in mm				Connection
	A	B	C	E	a	b	d	x	PE
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

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2.11.5 HD.. output chokes

Description of output chokes

HD.. type output chokes suppress interference emitted from unshielded motor cables.

UL and cURus approval

The listed output chokes have a cURus approval independent of the inverter.

Technical data

Output choke		HD0125-503	HD0240-503	HD0460-503	HD1000-503	HD2000-503	HD6000-503
Part number		17985153	17985188	17985161	17991307	17991250	17963362
Nominal voltage U_N		3 × AC 230 V – 500 V, 50/60 Hz					
Nominal current I_N	A	12.5	24	46	100	200	600
Nominal power loss	W	2.9	6	14	37	83	162
Ambient temperature ϑ_{amb}		0 °C to 45 °C (reduction: 3% I_N/K up to maximum 60 °C)					
Connection contacts U1/V1/W1/UDC – U2/V2/W2	mm^2	Screw terminal 0.2 – 10	Screw terminal 2.5 – 16		Screw terminal 16 – 50	Screw terminal 16 – 150	Copper rail 30 × 8, bore Ø12 mm
Tightening torque U1/V1/W1/UDC – U2/V2/W2	Nm	1.2 – 2	2 – 4		6 – 8	12 – 20	–
PE connection contact		M6 stud			M8 stud	M10 stud	M12 × 50
PE tightening torque	Nm	6			12	23	30
Degree of protection in accordance with EN 60529		IPXXB			IPXXA		IP00
Mass	kg	0.85	1.46	2.35	3	6.5	16

Assignment

Output choke	HD0125-503	HD0240-503	HD0460-503	HD1000-503	HD2000-503	HD6000-503
MCX91A-...-5_3-..	0010 – 0125	0160 – 0240	0320 – 0460	0620 – 0910	1130 – 1770	2200 – 3000
MCX91A-...-2_3-..	0017 – 0093	0140 – 0213	0290 – 0420	0570 – 0840	1080	–
MCX91A-...-2E1-..	0017 – 0110	–	–	–	–	–

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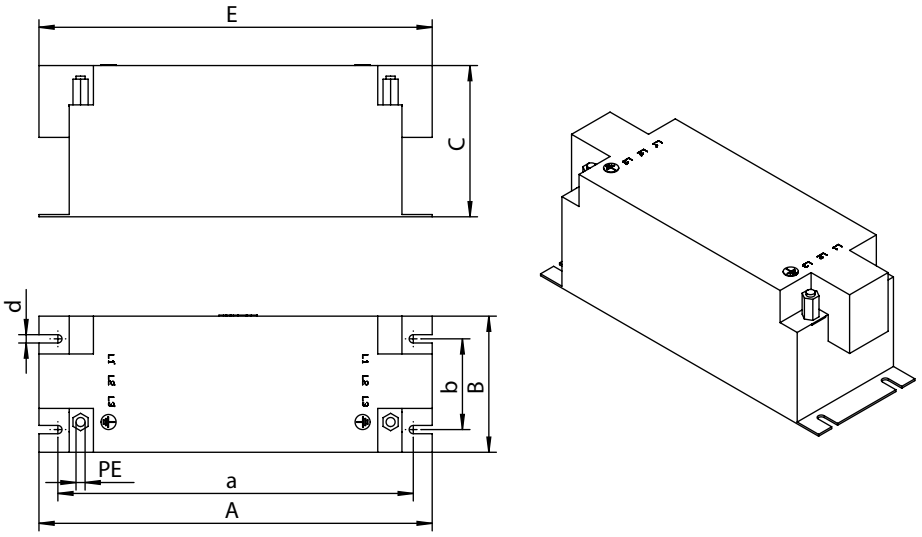
Dimension sheets and dimensions



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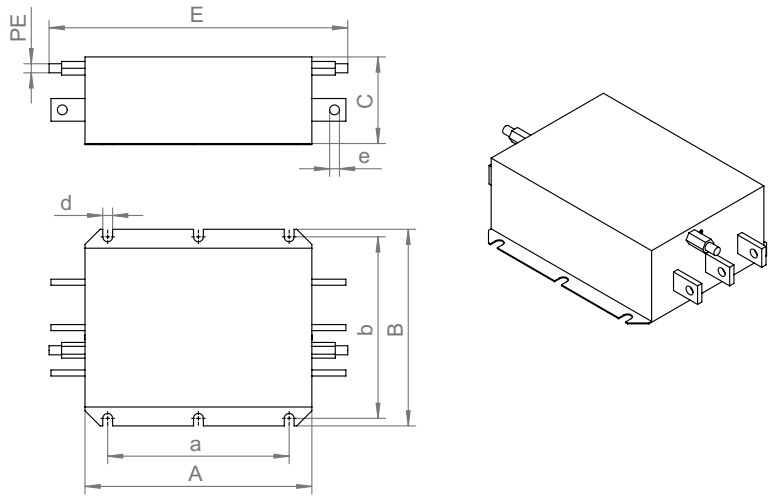
Output choke	Main dimensions in mm				Mounting dimensions in mm			Connection
	A	B	C	E	a	b	d	PE
HD0125-503	153	62.5	72.5	151	138	40	5.5	M6
HD0240-503	173	92.5	82.5	178	158	65	5.5	M6
HD0460-503	185	122.5	112.5	189	170	90	5.5	M6
HD1000-503	255	116	143.5	265	240	82	6.5	M8
HD2000-503	300	178	175	330	286	120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



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

3 Project planning

3.1 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. Other features are optimization of the various axis cycles including the selection of accessories and a fault check of the entire drive system configuration.

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 the SEW-Workbench allows for thoroughly specifying drive solutions from the entire range of products 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
- Electronic catalog with all products

The configuration software SEW-Workbench 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.

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3.2 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 powered by an inverter.

Necessary information regarding the machine to be driven
- Technical data and ambient conditions.
- Positioning accuracy.
- Speed setting range.
- Travel cycle calculation.

↓

Calculation of the relevant application data
- Travel diagram.
- Rotational speeds.
- Static, dynamic torques.
- Regenerative power.

↓

Gear unit selection
- Defining gear unit type, gear unit size, gear unit ratio, and gear unit design.
- Checking the positioning accuracy.
- Checking the gear unit load.
- Checking 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.).

↓

Selecting the inverter
- Selecting the communication variant.
- Selecting the safety feature.
- Determining the control mode.
- Motor/inverter assignment.
- Check if the inverters fulfill the duration and overload requirements.

↓

Selecting the braking resistor
- Checking if the braking resistor fulfills the duration and overload requirements.
- Observe braking resistor assignment.

↓

Selection of other system components
- Motor and supply system cables.
- Signal and encoder cables.
- EMC accessories.

↓

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

↓

Ensure that all requirements have been met.

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3.3 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.

3.3.1 General requirements for motors

Motors that can be connected

- Asynchronous motors with squirrel-cage rotor
- Permanent-field synchronous motors
- DR..J synchronous motors (LSPM technology) (in preparation)

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

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 by SEW-EURODRIVE have the required voltage endurance.

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

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 980 V.

The inverters pulse the DC voltage of the DC link U_{DC} to the supply cables 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 at inverters by SEW-EURODRIVE, their suitability has to be checked.

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Requirements for third-party motors

The connected third-party motor has to be designed in inverter mode for the relevant DC link voltage.

The inverters pulse the DC voltage of the DC link U_{DC} to the supply cables 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.

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

	Permitted input values	Realistic area
Nominal motor speed	0 – 36000 min^{-1}	0 – 36000 min^{-1}
Nominal motor current	0 – 10000 A	0 – 900 A
Nominal motor voltage	0 – 2000 V	0 – 690 V
Nominal motor torque	0 – 50000 Nm	0 – 50000 Nm
Rated motor frequency	0 – 20000 Hz	0 – 599 Hz
Number of pole pairs asynchronous/synchronous motor	1 – 64	1 – 64

Thermal motor protection

Thermal motor protection avoids overheating and, therefore, prevents irreparable damage from being caused 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 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[1)]

1) In preparation.

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)]

Motor series	Temperature sensor	Motor protection
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 in addition to the measured value, a thermal model protects the winding.
2) Depending on the motor size.
3) Comprehensive protection as one sensor per motor phase is included.
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.

Thermal motor protection without temperature sensor

Thermal motor protection without temperature sensor is an inverter function that can protect motors without temperature sensors (e.g. PTC thermistors, bimetallic switches) against 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 lists the requirements that must be met to use thermal motor protection without a temperature sensor.

Category	Requirements
Inverter	• MOVIDRIVE® modular, system, technology • MOVITRAC® advanced • MOVIMOT® flexible, advanced • MOVIPRO® technology
Firmware version	Version 7.0 or higher
Motor series	DRN.., DR2S..
Motor size	63 – 132M
Number of poles	4

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Boundary conditions

The following table lists the framework conditions that must be met to use thermal motor protection without a temperature sensor.

Category	Requirements
Type of cooling	Fan-cooled
Ambient temperature	-20 °C to +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.

It cannot be used for third-party motors.

For motors with speed sensor, SEW-EURODRIVE recommends using a thermal 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.

The thermal motor protection without temperature sensor has no memory, i.e. it does not take into account the current motor temperature after a switch-on/switch-off process. Therefore, it must be avoided that an overheated motor is immediately subject to another overload by switching the inverter off and on again. SEW-EURODRIVE recommends to perform a fault reset in the event of a fault message of the thermal motor protection without temperature sensor.

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3.3.2 Group drive and multi-motor drive

Temperature evaluation for group drive/multi-motor drive

- It is preferable to use TH bimetallic temperature switches for group drives on one inverter.
- The series connection of the TH contacts (normally closed) is not subject to any restriction if joint monitoring is provided.
- If TF temperature sensors are available in motors that are intended for a group drive, the temperature sensors of a maximum of 3 motors may be connected in parallel.

Permitted cable length for group drive/multi-motor drive

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

$l_{tot} \leq l_{max}/n$

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

l_{max} = Permitted motor lead length

$l_{tot} = l_1 + l_2 + .. + l_n$ (l_1, l_2, .. l_n = inverter-to-motor cable)

n = Number of motors connected in parallel

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.

After a suitable startup, operation is possible.

If motors with different power ratings are operated at the inverter in parallel, the motor with the largest power rating has to be set up.

- The total of the motor currents must not exceed the nominal output current of the inverter.

The maximum number of motors depends on the control mode:

Control mode	Number of motors
V/f	64

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.

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- The rotor position of the individual motors must not differ in 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. One of the motors has to be equipped with an encoder for the encoder feedback.
- Make sure the speed sensor is 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

3.3.3 Connecting explosion-protected AC motors

Observe the following instructions when connecting explosion-protected AC motors to the inverters:

- The inverter must be installed outside of 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 94/9/EC (ATEX 100a) or IEC 60079.
- The sensor input of the motor's temperature monitoring must not be used in potentially-explosive areas. 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 more information on the operation of explosion-protected AC motors, refer to the "Explosion-Protected AC Motors, Asynchronous Servomotors" operating instructions. You can order the operating instructions from SEW-EURODRIVE.

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3.3.4 General requirements for encoders

Valid motor encoders from SEW-EURODRIVE

The following overview shows the motor encoders that are valid for use. For information on the respective encoder cables, refer to chapter "Prefabricated cables" (→ 🗎 163).

Encoder designation	Signal type	Interface at the inverter
A...Z, E..Z	MOVILINK® DDI	X16
EI7C-FS	HTL (Functional Safety)	X18
EI.C, EK.C, EG.C, ES.C, EV.C	HTL	X20:4, X20:5, X20:6

X16 is available only in variant ../DI/..

X18 is available only in variant ../CSL/..

The encoder resolution of incremental encoders influences the control quality of speed and position control.

- A simple, non-dynamic positioning can be implemented with incremental encoders with low resolution (e.g.: EI7.). In addition, those encoders allow you to inexpensively check whether the motor is turning. These encoders are insufficient for speed control because increased speed noise is expected, especially at low speeds.
- Incremental encoders with higher resolution (e.g.: EK.C) are suitable for speed control and positioning.
- HTL encoders must be supplied with at least DC 24 V. Observe the connection voltage of the encoder.

Encoder with electronic nameplate

Electronic nameplates can only be evaluated for encoders from SEW-EURODRIVE that are suitable for digital motor integration.

The electronic nameplate allows for automatic identification of the drive. This channel can also be used to transmit further information to the inverter.

The advantages:

- Complete and correct identification of motor and gear unit.
- No manual data entry necessary
- Easy drive identification, even with drives that are difficult to access.
- Significant time savings during startup

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3.3.5 General requirements for the brake control

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

Brake control

Brakes are applied via digital output X10: (DB0; DB00) controlled on the inverter. When using a CS..A safety card, brake control can also be performed via an assigned safe F-DOx digital output of the safety card. It is not permitted to control them via other electronic devices or via controllers.

The digital output (DB0; DB00) is designed as 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.

With this, a power contactor with DC 24 V coil voltage or a suitable brake rectifier from SEW-EURODRIVE can be controlled. This power contactor is used to switch the brake.

The technical data of the safe digital outputs of the CS..a safety card are described in the corresponding documentation.

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

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 switched off for at least 100 ms before they can be switched on again.

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3.4 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.

3.4.1 Thermal limit characteristic curve

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

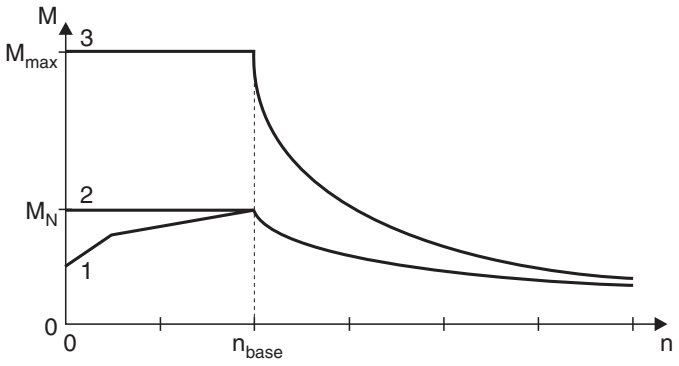
3.4.2 Dynamic limit characteristic curve

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_{max} and n_{base} depend on the motor/inverter combination. The values for M_{max} and n_{base} in the VFC^{PLUS}, CFC, ELSM® control modes can be found in the motor selection tables in chapter "Motor/inverter assignments".

Typical characteristic curve of asynchronous motors



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[1] S1 operation with self-cooling

[2] S1 operation with external cooling

[3] Mechanical limit for gearmotors

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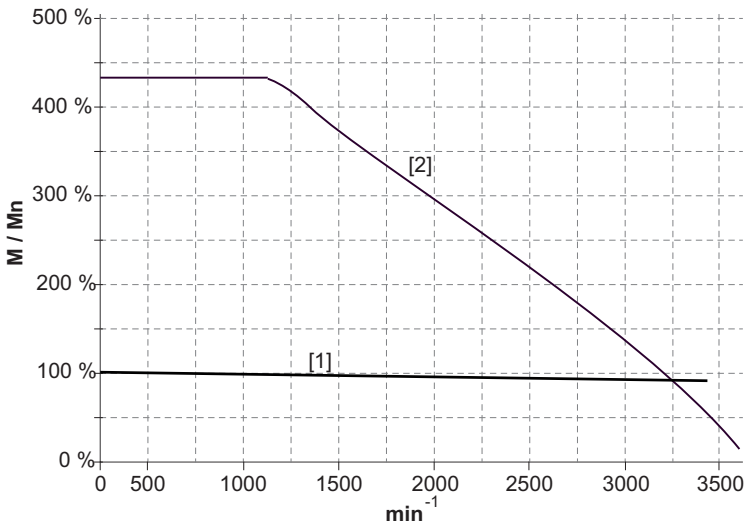
Typical characteristic curve of synchronous motors



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[1] Thermal limit characteristic curve S1 operation

[2] Dynamic limit torque

3.4.3 Motor selection for asynchronous motors

The mechanical resistance of the motor against the overload, which might exceed the permitted limit values, must be strictly checked.

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

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

3.4.4 Asynchronous motors in control mode VFC^{PLUS}

The control mode VFC^{PLUS} 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:

- Motor mode: 1% of the asynchronous motor nominal speed
- Generator mode: 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 of the drive can only be reversed 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 control mode VFC^{PLUS} 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 an quadratic relationship in the field weakening range.

3.4.5 Asynchronous motors in control mode V/f

The V/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 V/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.

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, speed controller parameterization is therefore not possible. An acceleration and torque precontrol is also not possible.

3.4.6 Asynchronous motors in control mode CFC

Either standard asynchronous motors (e.g. DRN.. motors) or asynchronous servomotors (e.g. DR2L../DRL.. motors) can be used in control mode CFC. SEW-EURODRIVE recommends using asynchronous servomotors to achieve optimum benefit from the advantages of the control mode CFC.

Standard asynchronous motors in control mode CFC

In comparison to control mode VFC^{PLUS}, higher dynamic properties can be achieved using CFC. The full motor magnetization is maintained in each operating state, so that the highest requirements on dynamics 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 operating mode VFC^{PLUS}. Power yield and energy efficiency are thus lower.

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

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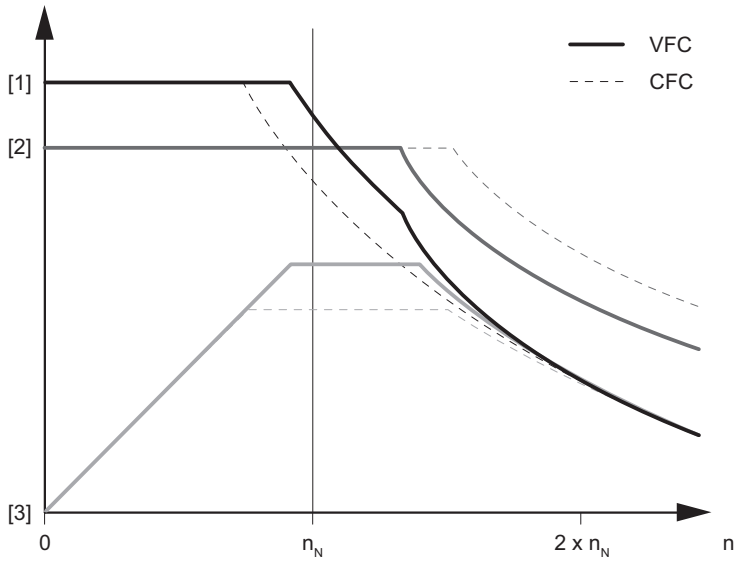

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[1] Torque [2] Current [3] Power rating

Asynchronous servomotors in control mode CFC

The high-quality mechanic design of the DRL../DR2L.. series asynchronous AC servomotors allows for dynamic overload values that exceed the values of the standard asynchronous motors in line or inverter operation. Due to these characteristics, the values of a synchronous servomotor are almost reached.

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}

3.4.7 Synchronous servomotors in control mode CFC

In general, synchronous servomotors and the corresponding inverters are designed for a high short-time overload capacity. This allows a multiple of the nominal torque.

When using the following motors in the higher speed ranges, it is recommended to only set the PWM frequencies 8 kHz or 16 kHz.

- CM3C63/71/80/100 with speed class above 3000 min^{-1}

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- CMP40/50/63 with speed class above 4500 min^{-1}
- CMP71/80/100 with speed class above 3000 min^{-1}

SEW-EURODRIVE recommends the use of the following temperature sensors:

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

3.4.8 Synchronous servomotors in control mode ELSM®

The control mode ELSM® allows for dynamic use of the entire speed range of the drive. Reversing and moving through the speed 0 are also possible. The speed must not permanently drop below the minimum speed of approx. 2% of the nominal motor speed.

When the control mode ELSM® is operated without encoder, the maximum motor torque is 150% M_0 of the connected motor.

The nominal output current of the inverter must not be lower than 1.5 × I_0 of the connected motor.

The maximum speed must not be dimensioned higher than the rated speed of the motor.

When using the following motors in the higher speed ranges, it is recommended to only set the PWM frequencies 8 kHz or 16 kHz.

- CM3C63/71/80/100 with speed class above 3000 min^{-1}
- CMP40/50/63 with speed class above 4500 min^{-1}
- CMP71/80/100 with speed class above 3000 min^{-1}

SEW-EURODRIVE recommends the use of the following temperature sensors:

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

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

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3.5 Selecting an inverter

The selection of the inverter is 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 up to 150% of the nominal output current for a short period of time.

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 power semiconductor and heat sink. Dynamic utilization monitors the permitted temperature of the barrier layer of the power semiconductors.

- Thermal capacity utilization

  The power semiconductors are limited by the maximally 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 given in the following section.

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

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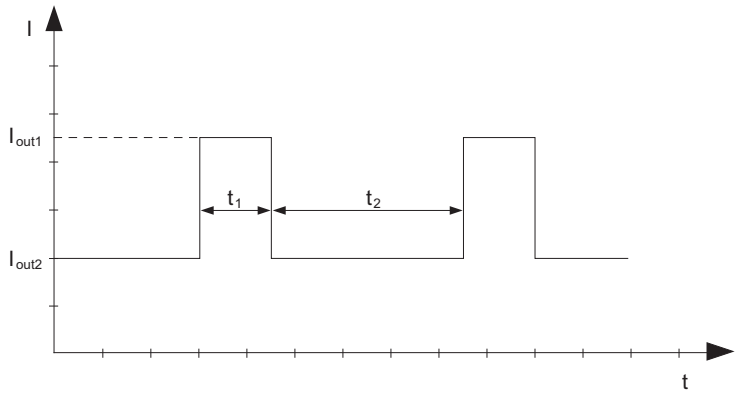
3.5.1 Overload capacity

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

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



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Examples of permitted current profiles

Overload capacity at f_{PWM} = 4 kHz, f_A ≥ 3 Hz, T_U ≤ 40 °C

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

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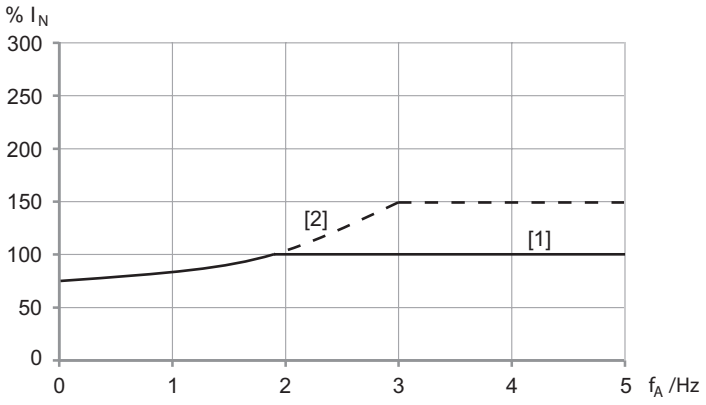
3.5.2 Derating

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 rms 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.



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[1] Continuous output current at f_{PWM} = 4 kHz

[2] Temporary overload current

Derating due to the installation altitude

SEW-EURODRIVE frequency inverters 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.

Up to h < 1000 m: without restrictions.

The following restrictions apply to heights ≥ 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, you have to connect an overvoltage protection device in order to reduce the overvoltages from category III to category II.

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Derating due to line voltage and temperature

Derating depending on the line voltage V_{line} and the ambient temperature T:

Inverter	f_{PWM}	U_{line}: 3 × 400 V	U_{line}: 3x 500 V
		Continuous current I_{cont}	
MCX91A-0010-5E3-4-.. – MCX91A-0025-5E3-4-..	4 kHz	$I_{duration}/I_N$ = 100% - (T - 40 °C) × 4% Operation up to max. 50 °C	I_{cont}/I_N = 80% Operation above 40 °C is not permitted.
	8 kHz	$I_{duration}/I_N$ = 75% - (T - 40 °C) × 2.7% Operation up to max. 50 °C	Operation at U_{line} > 400 V is not permitted.
	16 kHz	I_{cont}/I_N = 48% Operation above 40 °C is not permitted.	Operation at U_{line} > 400 V is not permitted.
MCX91A-0032-5E3-4-.. – MCX91A-0055-5E3-4-..	4 kHz	$I_{duration}/I_N$ = 100% - (T - 40 °C) × 2.67%	$I_{duration}/I_N$ = 80% - (T - 40 °C) × 2.15%
	8 kHz	$I_{duration}/I_N$ = 75% - (T - 40 °C) × 2%	$I_{duration}/I_N$ = 60% - (T - 40 °C) × 2.2%
	16 kHz	$I_{duration}/I_N$ = 50% - (T - 40 °C) × 1.9% Operation up to max. 50 °C	$I_{duration}/I_N$ = 30% - (T - 40 °C) × 1.4% Operation up to max. 50 °C
MCX91A-0070-5E3-4-.. – MCX91A-0160-5E3-4-..	4 kHz	$I_{duration}/I_N$ = 100% - (T - 40 °C) × 2.5%	$I_{duration}/I_N$ = 91% - (T - 40 °C) × 2.28%
	8 kHz	$I_{duration}/I_N$ = 75% - (T - 40 °C) × 1.9%	$I_{duration}/I_N$ = 65% - (T - 40 °C) × 2.32%
	16 kHz	$I_{duration}/I_N$ = 50% - (T - 40 °C) × 1.25% Operation is only permitted up to 50 °C	$I_{duration}/I_N$ = 35% - (T - 40 °C) × 1.6% Operation is only permitted up to 50 °C
MCX91A-0240-5E3-4-..	4 kHz	$I_{duration}/I_N$ = 100% - (T - 40 °C) × 2%	$I_{duration}/I_N$ = 91% - (T - 40 °C) × 1.85%
	8 kHz	$I_{duration}/I_N$ = 75% - (T - 40 °C) × 1.7%	$I_{duration}/I_N$ = 65% - (T - 40 °C) × 1.5%
	16 kHz	$I_{duration}/I_N$ = 50% - (T - 40 °C) × 1.2%	$I_{duration}/I_N$ = 40% - (T - 40 °C) × 1.35%
MCX91A-0320-5E3-4-.. – MCX91A-0460-5E3-4-..	4 kHz	$I_{duration}/I_N$ = 100% - (T - 40 °C) × 2%	$I_{duration}/I_N$ = 91% - (T - 40 °C) × 1.85%
	8 kHz	$I_{duration}/I_N$ = 75% - (T - 40 °C) × 1.7%	$I_{duration}/I_N$ = 65% - (T - 40 °C) × 1.5%
	16 kHz	$I_{duration}/I_N$ = 50% - (T - 40 °C) × 1.2%	$I_{duration}/I_N$ = 40% - (T - 40 °C) × 1.35%
MCX91A-0620-5E3-4-.. – MCX91A-0910-5E3-4-..	4 kHz	$I_{duration}/I_N$ = 100% - (T - 40 °C) × 2%	$I_{duration}/I_N$ = 91% - (T - 40 °C) × 1.85%
	8 kHz	$I_{duration}/I_N$ = 75% - (T - 40 °C) × 1.7%	$I_{duration}/I_N$ = 65% - (T - 40 °C) × 1.5%
	16 kHz	$I_{duration}/I_N$ = 42% - (T - 40 °C) × 1.3%	$I_{duration}/I_N$ = 34% - (T - 40 °C) × 1.3%
MCX91A-1130-5E3-4-.. – MCX91A-1770-5E3-4-..	4 kHz	$I_{duration}/I_N$ = 100% - (T - 40 °C) × 2%	$I_{duration}/I_N$ = 91% - (T - 40 °C) × 1.85%
	8 kHz	$I_{duration}/I_N$ = 75% - (T - 40 °C) × 1.7%	$I_{duration}/I_N$ = 65% - (T - 40 °C) × 1.5%
	16 kHz	$I_{duration}/I_N$ = 50% - (T - 40 °C) × 1.2%	$I_{duration}/I_N$ = 40% - (T - 40 °C) × 1.35%

Interpolate linearly for voltages between 400 V and 500 V.

Inverter	f_{PWM}	U_{line}: 3 × 230 V
		Continuous current I_{cont}
MCX91A-0017-2E3-4-.. – MCX91A-0025-2E3-4-..	4 kHz	$I_{duration}/I_N$ = 100% - (T - 40 °C) × 4% Operation up to max. 50 °C
	8 kHz	$I_{duration}/I_N$ = 75% - (T - 40 °C) × 2.7% Operation up to max. 50 °C
	16 kHz	I_{cont}/I_N = 48%. Operation above 40 °C is not permitted.
MCX91A-0034-2E3-4-.. – MCX91A-0055-2E3-4-..	4 kHz	$I_{duration}/I_N$ = 100% - (T - 40 °C) × 2.67%
	8 kHz	$I_{duration}/I_N$ = 75% - (T - 40 °C) × 2%
	16 kHz	$I_{duration}/I_N$ = 50% - (T - 40 °C) × 1.33%
MCX91A-0070-2E3-4-.. – MCX91A-0140-2E3-4-..	4 kHz	$I_{duration}/I_N$ = 100% - (T - 40 °C) × 2%
	8 kHz	$I_{duration}/I_N$ = 75% - (T - 40 °C) × 1.7%
	16 kHz	$I_{duration}/I_N$ = 50% - (T - 40 °C) × 1.2%
MCX91A-0213-2E3-4-..	4 kHz	$I_{duration}/I_N$ = 100% - (T - 40 °C) × 2%
	8 kHz	$I_{duration}/I_N$ = 75% - (T - 40 °C) × 1.7%
	16 kHz	$I_{duration}/I_N$ = 50% - (T - 40 °C) × 1.2%
MCX91A-0290-2E3-4-.. – MCX91A-0420-2E3-4-..	4 kHz	$I_{duration}/I_N$ = 100% - (T - 40 °C) × 2%
	8 kHz	$I_{duration}/I_N$ = 75% - (T - 40 °C) × 1.7%
	16 kHz	$I_{duration}/I_N$ = 50% - (T - 40 °C) × 1.2%
MCX91A-0570-2E3-4-.. – MCX91A-0840-2E3-4-..	4 kHz	$I_{duration}/I_N$ = 100% - (T - 40 °C) × 2%
	8 kHz	$I_{duration}/I_N$ = 75% - (T - 40 °C) × 1.7%
	16 kHz	$I_{duration}/I_N$ = 50% - (T - 40 °C) × 1.3%
MCX91A-1080-2E3-4-..	4 kHz	$I_{duration}/I_N$ = 100% - (T - 40 °C) × 2%
	8 kHz	$I_{duration}/I_N$ = 75% - (T - 40 °C) × 1.7%
	16 kHz	$I_{duration}/I_N$ = 50% - (T - 40 °C) × 1.2%

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Inverter	f_{PWM}	U_{line}: 1 × 230 V Continuous current I_{cont}
MCX91A-0017-2E1-4-.. – MCX91A-0025-2E1-4-..	4 kHz	$I_{duration}/I_N$ = 100% - (T - 40 °C) × 4% Operation up to max. 50 °C
	8 kHz	$I_{duration}/I_N$ = 75% - (T - 40 °C) × 2.7% Operation up to max. 50 °C Operation up to max. 50 °C
	16 kHz	I_{cont}/I_N = 48%. Operation above 40 °C is not permitted.
MCX91A-0034-2E1-4-.. – MCX91A-0042-2E1-4-..	4 kHz	$I_{duration}/I_N$ = 100% - (T - 40 °C) × 2.67%
	8 kHz	$I_{duration}/I_N$ = 75% - (T - 40 °C) × 2%
	16 kHz	$I_{duration}/I_N$ = 50% - (T - 40 °C) × 1.9% Operation up to max. 50 °C
MCX91A-0055-2E1-4-.. – MCX91A-0110-2E1-4-..	4 kHz	$I_{duration}/I_N$ = 100% - (T - 40 °C) × 2.5%
	8 kHz	$I_{duration}/I_N$ = 75% - (T - 40 °C) × 1.9%
	16 kHz	$I_{duration}/I_N$ = 50% - (T - 40 °C) × 1.25% Operation up to max. 50 °C

Derating of cable length

Derating due to the ambient temperature

Inverter U_{line}: 3 × 400 V, 3 × 500 V	Calculation of the cable length:
MCX91A-0010-5E3-4-.. – MCX91A-0025-5E3-4-..	L_{new}/L = 1 - (T - 40 °C) × 5.33% at f_{PWM} = 4 kHz L_{new}/L = 1 - (T - 40 °C) × 6.7% at f_{PWM} = 8 kHz

Inverter U_{line}: 3 × 230 V	Cable length
MCX91A-0017-2E3-4-.. – MCX91A-0025-2E3-4-..	L_{new}/L = 1 - (T - 40 °C) × 5.33% at f_{PWM} = 4 kHz L_{new}/L = 1 - (T - 40 °C) × 6.7% at f_{PWM} = 8 kHz

Inverter U_{line}: 1 × 230V	Cable length
MCX91A-0017-2E1-4-.. – MCX91A-0025-2E1-4-..	L_{new}/L = 1 - (T - 40 °C) × 5.33% at f_{PWM} = 4 kHz L_{new}/L = 1 - (T - 40 °C) × 6.7% at f_{PWM} = 8 kHz

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3.5.3 Characteristics of the control modes

INFORMATION

The values in the following tables only apply in case of a basic clock frequency of 4 kHz.

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	yes[1]	yes		yes		yes
Torque control	no	yes		yes		yes
Positioning	no	no	yes	yes		no
Flying start	no[2]	yes		yes		yes
Typical applications	Group drive, 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

ASM Asynchronous motors

LSPM Motors with LSPM technology (Line Start Permanent Magnet)

SM Synchronous motors

Characteristic values for dynamics

	V/f	VFC^{PLUS}	CFC	ELSM®
Torque control time	–	Approx. 2 ms[1]	Approx. 150 µs	Approx. 150 µs
Time constant speed controller	–	Approx. 4 – 6 ms	Approx. 2 ms	Approx. 6 ms
Speed ripple	Is mainly determined by the total mass moment of inertia, the torque ripple and 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 bits 0.001% M_{NMot}	32 bits 0.001% M_{NMot}	32 bits 0.001% M_{NMot}
Rotational speed	32 bits 0.0001 min^{-1}	32 bits 0.0001 min^{-1}	32 bits 0.0001 min^{-1}	32 bits 0.0001 min^{-1}
Position (increment/revolution)	–	16 bits	16 bits	–

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

Characteristic values for accuracy of torque and speed

	VFC^{PLUS} without encoder	VFC^{PLUS} with encoder	CFC	ELSM®
Speed accuracy	Depends on the accuracy of the motor parameters, therefore no general statement possible. A typical deviation is: $0.2 \times f_{nominal\ slip}$	Maximum deviation: $0.007\%\ n_{set}$	Is mainly determined by the total mass moment of inertia, the torque ripple and the mechanical structure. It is therefore not possible to specify a general value.	
Torque accuracy	$< 10\%\ M_N$ for $n > 0.2 \times n_N$	$< 5\%\ M_N$	–	–

Recommended output frequency

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

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FCBs that can be activated for selected control mode

FCB no.	Designation	V/f	VFC^{PLUS}	CFC	ELSM®
01	Output stage inhibit	+	+	+	+
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	Positioning control	–	+	+	–
10	Interpolated positioning control	–	+	+	–
12	Reference travel	–	+	+	+
18	Rotor position identification	–	–	+	–
19	Position hold control	–	+	+	–
20	Jog	–	+	+	–
21	Brake test	–	+	+	–

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3.6 Braking resistor selection

3.6.1 Tables of braking resistors

The following braking resistors are intended for use with MOVITRAC® advanced. The technical data is valid in the temperature range -20 °C to +40 °C.

Information on ambient temperature

For ambient temperatures of more than +40°C, the continuous power must be reduced by 4% for every 10 K. The tripping current must be reduced by 2% for every 10 K. Do not exceed a maximum ambient temperature of 80 °C.

Braking resistors

Braking resistor type BW..		Unit	BW120-001	BW100-001	BW100-002 /M	BW100-002	BW100-006 -T	BW168-T	BW268-T
Part number			18176011	08281718	25664514	08281653	18204198	18201334	18204171
Peak braking power		kW		6.9					
Continuous braking power	100% cdf	kW	0.03	0.1	0.2	0.2	0.6	0.8	1.2
Current-carrying capacity	50% cdf	kW	0.06	0.15	0.3	0.3	1.1	1.4	2.2
	25% cdf	kW	0.1	0.3	0.6	0.6	1.9	2.6	3.8
	12 % cdf	kW	0.18	0.5	1	1	3.6	4.8	7.2
	6 % cdf	kW	0.3	0.9	1.8	1.8	5.7	7.6	11.4
			Observe the regenerative power limit of the inverter. See chapter "Technical data of basic device".						
Resistance R_{BW}		Ω	117		100 ±10%			68 ±10%	
Tripping current I_{trip}		A	–	0.8	1		2.4	3.4	4.2

Braking resistor type BW..		Unit	BW047-010 -T	BW147-T	BW268-T	BW247-T	BW027-016 -T	BW027-024 -T	BW027-042 -T
Part number			17983207	18201342	18204171	18200842	17983215	17983231	19155301
Peak braking power		kW	14.6				25.4		
Continuous braking power	100% cdf	kW	1	1.2	1.2	2	1.6	2.4	4.2
Current-carrying capacity	50% cdf	kW	1.8	2.20	2.2	3.6	2.9	4.3	7.6
	25% cdf	kW	3.2	3.80	3.8	6.4	5.1	7.7	13.3
	12% cdf	kW	6	7.20	7.2	12.0	9.6	14.4	23.9
	6% cdf	kW	9.5	11.40	11	14.6	15.2	22.8	25.4
			Observe the regenerative power limit of the inverter. See chapter "Technical data of basic device".						
Resistance R_{BW}		Ω	47 ±10%		68 ±10%	47 ±10%	27 ±10%		
Tripping current I_{trip}		A	4.6	5.1	4.2	6.5	7.7	9.4	12.5

Braking resistor type BW..		Unit	BW015-016	BW015-042-T	BW015-075-T	BW915-T
Part number			17983258	19155328	19155271	18204139
Peak braking power		kW	45.7			
Continuous braking power	100% cdf	kW	1.6	4.2	7.5	16
Current-carrying capacity	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 inverter. See chapter "Technical data of basic device".			
Resistance R_{BW}		Ω	15 ±10%			
Tripping current I_{trip}		A	10.3	16.7	22.4	32.7

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Braking resistor type BW..		Unit	BW010-024	BW010-050-T	BW010-108-T
Part number			17983266	17983274	19155298
Peak braking power		kW	57.2		
Continuous braking power	100% cdf	kW	2.4	5	10.8
Current-carrying capacity	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 inverter. See chapter "Technical data of basic device".		
Resistance R_{BW}		Ω	10 ±10%		
Tripping current I_{trip}		A	15.5	22.4	32.9

Braking resistor type BW..		Unit	BW006-025-01	BW006-050-01	BW106-T	BW206-T
Part number			18200117	18200125	18200834	18204120
Peak braking power		kW	114.3			
Continuous braking power	100% cdf	kW	2.5	5	13.5	18
Current-carrying capacity	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 inverter. See chapter "Technical data of basic unit" (→ 🗎 55)			
Resistance R_{BW}		Ω	6 ±10%			
Tripping current I_{trip}		A	20.4	28.9	47.4	54.8

Braking resistor type BW..		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	
Continuous braking power	100% cdf	kW	7	17	5	7
Current-carrying capacity	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 inverter. See chapter "Technical data of basic unit" (→ 🗎 55)			
Resistance R_{BW}		Ω	4.7 ±10%		3.6 ±10%	
Tripping current I_{trip}		A	38.6	60.1	32.6	38.6

Braking resistor type BW..		Unit	BW003-420-T	BW002-070	BW1.0-170
Part number			13302345	17983304	17985455
Peak braking power		kW	274.4	298.3	686
Continuous braking power	100% cdf	kW	42	7	17
Current-carrying capacity	50% cdf	kW	71.4	11.9	28.9
	25% cdf	kW	126.0	21.0	51.0
	12 % cdf	kW	189.0	31.5	76.5
	6% cdf	kW	274.4	53.2	129.2
			Observe the regenerative power limit of the inverter. See chapter "Technical data of basic unit" (→ 🗎 55)		
Resistance R_{BW}		Ω	2.5 ±10%	2.3 ±10%	1 ±10%
Tripping current I_{trip}		A	135.1	55.2	130.4

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Braking resistor type BW..		Unit	CLH31A/BW4	CLH31A/BW2	CLH31A/ BW072-001	CLH31A/ BW100-001	CLH41A/ BW027-001	CLH41A/ BW047-001
Part number			28284712	28284720	28284739	28284755	28284747	28284763
Peak braking power		kW	–	–	9.5	6.9	25.4	14.6
Continuous braking power	100% cdf	kW	0.03	0.03	0.1	0.1	0.1	0.1
Current-carrying capacity	50% cdf	kW	0.04	0.04	0.15	0.15	0.15	0.15
	25% cdf	kW	0.07	0.07	0.3	0.3	0.3	0.3
	12 % cdf	kW	0.13	0.13	0.5	0.5	0.5	0.5
	6% cdf	kW	0.22	0.22	0.9	0.9	0.9	0.9
			Observe the regenerative power limit of the inverter. See chapter "Technical data of basic unit" (→ 🗎 55)					
Resistance R_{BW}		Ω	88	175	72	100	27	47
Tripping current I_{trip}		A	–	–	0.9	0.8	1.5	1.1

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3.6.2 Selection criteria

The selection of the braking resistor takes place via 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 following selection parameters 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.

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

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

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The cycle duration must not exceed 120 s.

The overload factor k can be determined using the diagrams in chapter "Overload factor k" (→ 🗎 133) and the cyclic duration factor cdf.

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

$$P_B = \frac{|P_1| \times t_1 + |P_2| \times t_2 + ... + |P_n| \times t_n}{t_1 + t_2 + ... + t_n}$$

P_B	Average braking power
P_n	Braking power section n
t_n	Braking time section n

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

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

$P_{100\%cdf}$	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.

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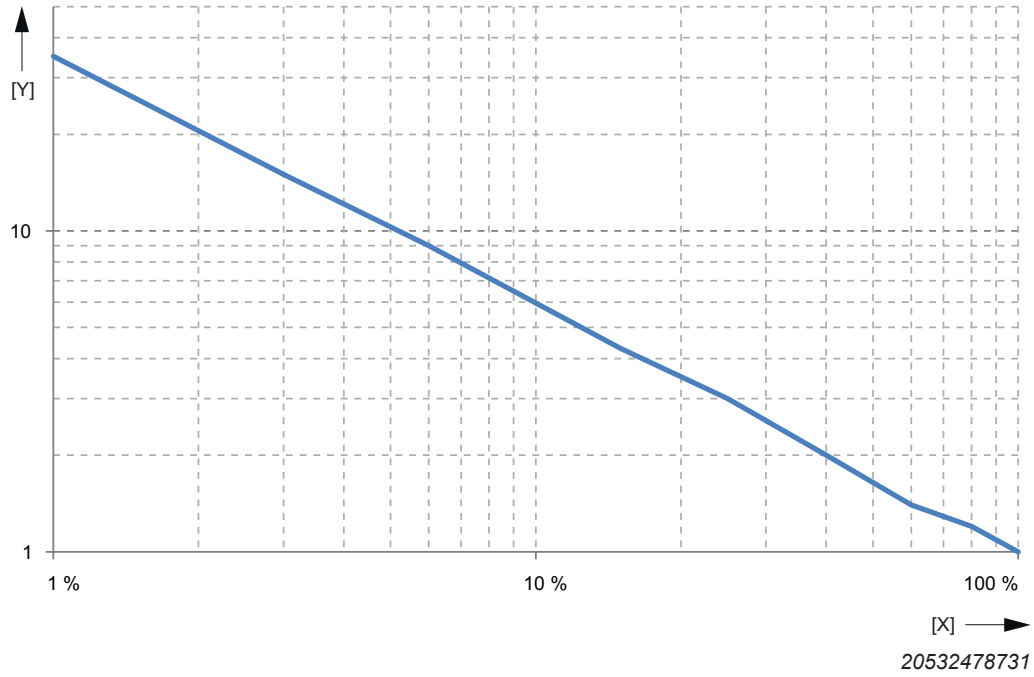
Overload factor k

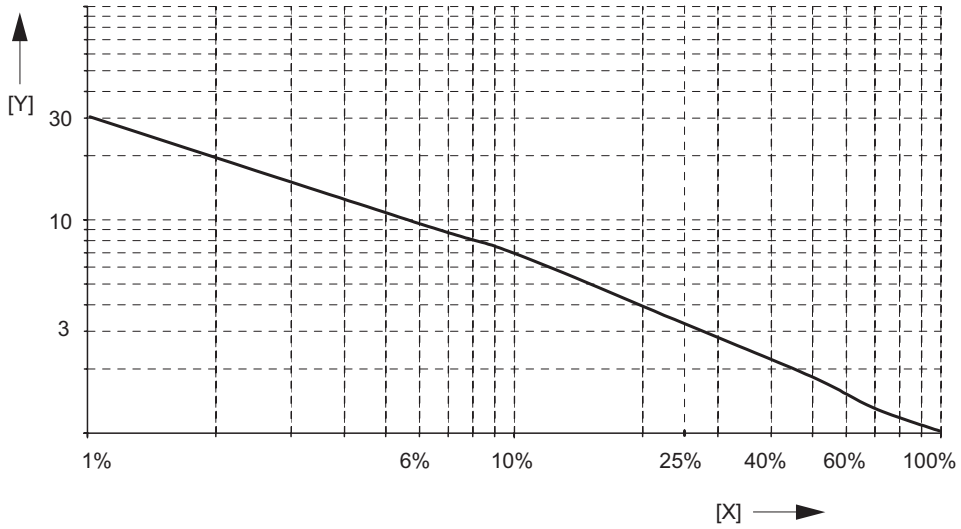
Flatpack resistors



X Cyclic duration factor in % (cdf)
Y Overload factor k (OF)

cdf in %	1	3	6	15	25	40	60	80	100
OF	35	15	9	4.3	3	2	1.4	1.2	1

Wire resistors, frame resistors



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X Cyclic duration factor in % (cdf)
Y Overload factor k (OF)

cdf in %	1	3	6	15	25	40	60	80	100
OF	30	15	9.5	5	3.2	2.2	1.5	1.12	1

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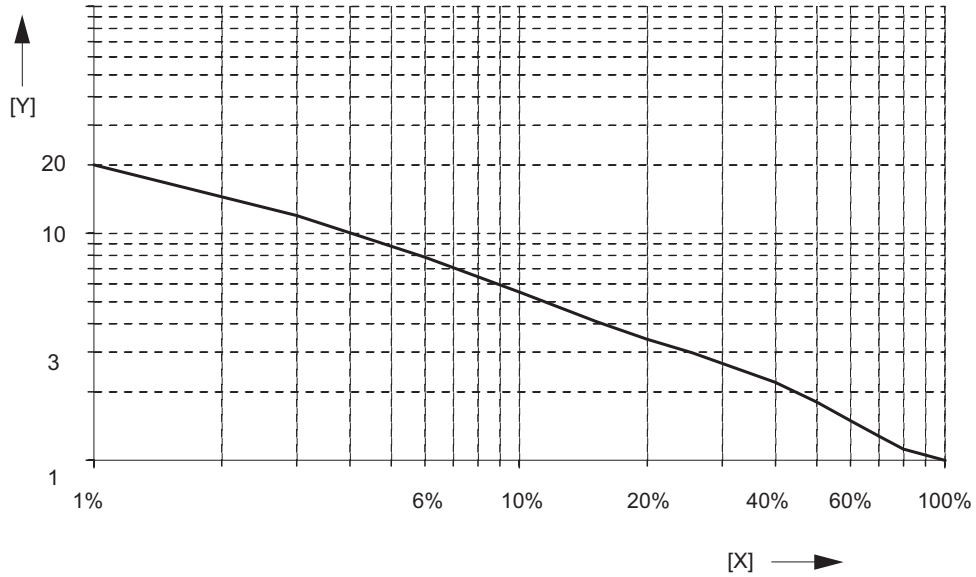
Grid resistors



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X Cyclic duration factor in % (cdf)
Y Overload factor k (OF)

cdf in %	1	3	6	15	25	40	60	80	100
OF	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:

$$P_{max} = \frac{U_{ZK\,max}^2}{R \times 1.4}$$

P_{max}	Maximum peak braking power that the braking resistor can absorb
U_{DCL_max}	Maximum DC link voltage of 650 V for 230 V devices and 980 V for 400 V devices
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 the 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 the chapter "Technical data of basic unit". 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.

3.6.3 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.

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

3.6.4 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.

Wiring diagrams for the situations described above can be found in the operating instructions in chapter "Protection of braking resistor against thermal overload".

3.6.5 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 a separate protection against thermal overload.
- The signal contacts (NC contacts) of the protection devices must be connected in series.

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3.6.6 Technical data and assignment to an inverter

Technical data

Braking resistor	Unit	BW120-001	BW100-002/M	BW100-001	BW100-002	BW100-006-T	BW168-T	BW268-T
Part number		1817601 1	2566451 4	0828171 8	0828165 3	1820419 8	1820133 4	1820417 1
Current-carrying capacity at 100% cdf	kW	0.03	0.15	0.1	0.2	0.6	0.8	1.2
Resistance value R_{BW}	Ω	117	100	100 ± 10%			68 ± 10%	
Tripping current I_{trip}	A	-	1.2	0.8	1	2.4	3.4	4.2
Design		PTC braking resistor	Flatpack resistor	Flat-type resistor		Wire resistor		
Power connections		Single conductors				Ceramic terminal 2.5 mm^2		
Wire length	mm	170	300	510		-		
Cable cross section	mm^2	0.5		1.5		-		
Tightening torque	Nm	-				0.5		
PE connection		-				M4		
PE tightening torque	Nm	-				1.8		
Degree of protection in accordance with EN 60529		IP20	IP40	IP54		IP20		
Ambient temperature ϑ_{amb}		-20 °C to +40 °C (Reduction 4% P_N/10 K to +60 °C)						
Mass	kg	0.95	1.4	0.3	0.6	3	3.6	4.9

Assignment

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

Braking resistor	BW120-001	BW100-002/M	BW100-001	BW100-002	BW100-006-T	BW168-T	BW268-T
MCX91A-...-5_3-..	0010 – 0055	0010 – 0055				-	-
MCX91A-...-2_3-..	-	-	-	-	-	0017 – 0055	
MCX91A-...-2_1-..	-	-	-	-	-	0017 – 0055	

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Technical data

Braking resistor	Unit	BW047-010-T	BW147-T	BW247-T
Part number		17983207	18201342	18200842
Current-carrying capacity at 100% cdf	kW	1	1.2	2
Resistance value R_{BW}	Ω	47 ± 10%		
Tripping current I_{trip}	A	4.6	5.1	6.5
Design		Wire resistor		
Power connections		Ceramic terminal 2.5 mm^2		
Tightening torque	Nm	0.5		
PE connection		M4		
PE tightening torque	Nm	1.8		
Degree of protection		IP20		
Ambient temperature ϑ_{amb}		-20 °C to +40 °C		
Mass	kg	4	4.9	6.7

Assignment

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

Braking resistor	BW047-010-T	BW147-T	BW247-T
MCX91A-...-5_3-..		0070 0095 0125	
MCX91A-...-2_3-..	-	–	–
MCX91A-...-2_1-..	-	–	–

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Technical data

Braking resistor	Unit	BW027-016-T	BW027-024-T	BW027-042-T
Part number		17983215	17983231	19155301
Current-carrying capacity at 100% cdf	kW	1.6	2.4	4.2
Resistance value R_{BW}	Ω	27 ± 10%		
Tripping current I_{trip}	A	7.7	9.4	12.5
Design		Wire resistor		Frame resistor
Power connections		Ceramic terminal 2.5 mm^2		
Tightening torque	Nm	0.5		
PE connection		M4		M5
PE tightening torque	Nm	1.8		2.5
Degree of protection		IP20		
Ambient temperature ϑ_{amb}		-20 °C to +40 °C		
Mass	kg	5.8	8	10

Assignment

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

Braking resistor	BW027-016-T	BW027-024-T	BW027-042-T
MCX91A-...-5_3-..	0160 0240		
MCX91A-...-2_3-..	0070 0093	0093	-
MCX91A-...-2_1-..	0070 0093	0093	-

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Technical data

Braking resistor	Unit	BW015-016	BW015-042-T	BW015-075-T	BW915-T
Part number		17983258	19155328	19155271	18204139
Current-carrying capacity at 100% cdf	kW	1.6	4.2	7.5	16
Resistance value R_{BW}	Ω	15 ± 10%			
Tripping current I_{trip}	A	10.3	16.7	22.4	32.7
Design		Wire resistor	Frame resistor	Grid resistor mounting position 1	
Power connections		Ceramic terminal 2.5 mm²	Ceramic terminal 4 mm²	M8 stud	
Tightening torque	Nm	0.5	0.9	6	
PE connection		M4	M5	M6 stud	
PE tightening torque	Nm	1.8	2.5	3	
Degree of protection		IP20			
Ambient temperature ϑ_{amb}		-20 °C to +40 °C			
Mass	kg	5.8	10	12	32

Assignment

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

Braking resistor	BW015-016	BW015-042-T	BW015-075-T	BW915-T
MCX91A-...-5_3-..	0320 0460 0750 (Parallel connection of 2 braking resistors) 0910 (Parallel connection of 2 braking resistors)			
MCX91A-...-2_3-..	0140 0213 0290 (Parallel connection of 2 braking resistors) 0420 (Parallel connection of 2 braking resistors)		-	-
MCX91A-...-2_1-..	0110		-	-

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Technical data

Braking resistor	Unit	BW010-024	BW010-050-T	BW010-108-T
Part number		17983266	17983274	19155298
Current-carrying capacity at 100% cdf	kW	2.4	5	10.8
Resistance value R_{BW}	Ω	10 ± 10%		
Tripping current I_{trip}	A	15.5	22.4	32.9
Design		Wire resistor	Grid resistor mounting position 1	
Power connections		Ceramic terminal 2.5 mm^2	M8 stud	
Tightening torque	Nm	0.5	6	
PE connection		M4 stud	M6 stud	
PE tightening torque	Nm	1.8	3	
Degree of protection		IP20		
Ambient temperature ϑ_{amb}		-20 °C to +40 °C		
Mass	kg	8	11	17.5

Assignment

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

Braking resistor	BW010-024	BW010-050-T	BW010-108-T
MCX91A-...-5_3-..	0620 1130 (Parallel connection of 2 braking resistors)		
MCX91A-...-2_3-..	0570 (Parallel connection of 2 braking resistors)		-

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Technical data

Braking resistor	Unit	BW006-025-01[1)]	BW006-050-01[1)]	BW106-T	BW206-T
Part number		18200117	18200125	18200834	18204120
Current-carrying capacity at 100% cdf	kW	2.5	5	13.5	18
Resistance value R_{BW}	Ω	6 ± 10%			
Tripping current I_{trip}	A	20.4	28.9	47.4	54.8
Design		Grid resistor mounting position 1			
Power connections		M8 stud			
Tightening torque	Nm	6			
PE connection		M6 stud			
PE tightening torque	Nm	3			
Degree of protection		IP20			
Ambient temperature ϑ_{amb}		-25 °C to +40 °C			
Mass	kg	7.5	12	30	40

1) Braking resistor has a 1 Ω tap

Assignment

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

Braking resistor	BW006-025-01	BW006-050-01	BW106-T	BW206-T
MCX91A-...-5_3-..	0750 0910 1490 (Parallel connection of 2 braking resistors) 1770 (Parallel connection of 2 braking resistors)			
MCX91A-...-2_3-..	-	0840 (Parallel connection of 2 braking resistors)		-

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Technical data

Braking resistor	Unit	BW005-070	BW005-170-T	BW004-050-01	BW004-070-01
Part number		17983282	17983290	18200133	17967678
Current-carrying capacity at 100% cdf	kW	7	17	5	7
Resistance value R_{BW}	Ω	4.7 ± 10%		3.6 ± 10%	
Tripping current I_{trip}	A	38.6	60.1	32.6	38.6
Design		Grid resistor mounting position 1			
Power connections		M8 stud			
Tightening torque	Nm	6			
PE connection		M6 stud			
PE tightening torque	Nm	3			
Degree of protection		IP20			
Ambient temperature ϑ_{amb}		-20 °C to +40 °C			
Mass	kg	13	33	13	

Assignment

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

Braking resistor	BW005-070	BW005-170-T	BW004-050-01	BW004-070-01
MCX91A-...-5_3-..	1130 2200 (Parallel connection of 2 braking resistors) 2500 (Parallel connection of 2 braking resistors) 3000 (Parallel connection of 2 braking resistors)		1490 1770	
MCX91A-...-2_3-..	0570 1080 (Parallel connection of 2 braking resistors)	1080 (Parallel connection of 2 braking resistors)	0840	

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Technical data

Braking resistor	Unit	BW003-420-T	BW002-070
Part number		13302345	17983304
Current-carrying capacity at 100% cdf	kW	42	7
Resistance value R_{BW}	Ω	2.5	2.3 ± 10%
Tripping current I_{trip}	A	135.1	55.2
Design		Grid resistor mounting position 2	Grid resistor mounting position 1
Power connections		M12 stud	M8 stud
Tightening torque	Nm	15.5	6
PE connection		M10 stud	M6 stud
PE tightening torque	Nm	10	3
Degree of protection		IP20	
Ambient temperature ϑ_{amb}		-20 °C to +40 °C	
Mass	kg	93	33

Assignment

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

Braking resistor	BW003-420-T	BW002-070
MCX91A-...-5_3-..	2200 2500 3000 3800 (Parallel connection of 2 braking resistors) 4700 (Parallel connection of 2 braking resistors) 5880 (Parallel connection of 2 braking resistors)	
MCX91A-...-2_3-..	1080	

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Technical data

Braking resistor	Unit	BW1.0-170
Part number		17985455
Current-carrying capacity at 100% cdf	kW	17
Resistance value R_{BW}	Ω	1 ± 10%
Tripping current I_{trip}	A	130.4
Design		Grid resistor mounting position 2
Power connections		M12 stud
Tightening torque	Nm	15.5
PE connection		M10 stud
PE tightening torque	Nm	10
Degree of protection		IP20
Ambient temperature ϑ_{amb}		-25 °C to +40 °C
Mass	kg	45

Assignment

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

Braking resistor	BW1.0-170
MCX91A-...-5_3-..	3800 4700 5880

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Technical data of braking resistors with submounting plate

Braking resistor	Unit	CLH31A/ BW4	CLH31A/ BW2	CLH31A/ BW072-001	CLH31A/ BW100-001	CLH41A/ BW027-001	CLH41A/ BW047-001
Part number		28284712	28284720	28284739	28284755	28284747	28284763
Current-carrying capacity at 100% cdf	kW	0.025	0.025	0.1	0.1	0.1	0.1
Resistance value R_{BW}	Ω	88	175	72	100 ±10%	27	47
Tripping current I_{trip}	A	–	–	0.9	0.8	1.5	1.1
Design		PTC		Flat-type resistor			
Power connections		Single conductor					
Wire length	mm	170	170	510	510	510	510
Cable cross section	mm^2	0.75	0.75	1.5	1.5	1.5	1.5
Tightening torque	Nm	–	–	–	–	–	–
PE connection		–	–	–	–	–	–
PE tightening torque	Nm	–	–	–	–	–	–
Degree of protection in accordance with EN 60529		IP20	IP20	IP65	IP65	IP65	IP65
Ambient temperature ϑ_{amb}		–	–	-20 °C to +40 °C (Reduction 4% P_N/10 K to +60 °C)			
Mass	kg	0.08	0.08	0.3	0.3	0.3	0.3

The CLH31A and CLH41A braking resistors with submounting plate are supplied as a combination of submounting plate and integrated braking resistor. There is a choice of braking resistors with different ratings for each submounting plate.

Braking resistors mounted to the submounting plate may not achieve the load capacity specified in the table at 100% cdf. The specifications for the nominal power of the inverter can be observed in submounted operation at 4 kHz, 40 °C and 400 V.

Assignment of braking resistors with support plate

Braking resistor	CLH31A/ BW4	CLH31A/ BW2	CLH31A/ BW072-001	CLH31A/ BW100-001	CLH41A/ BW027-001	CLH41A/ BW047-001
MCX91A-...-5_3-..	–	0010 – 0055	–	0010 – 0055	0160	0070 – 0125
MCX91A-...-2_3-..	0017 – 0055	–	0017 – 0055	–	0070 – 0140	–
MCX91A-...-2_1-..	0017 – 0042	–	0017 – 0042	–	0070 – 0110	–

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Technical data BW..-T signal contact

Specifications for BW..-T	Design
Signal contact connection cross section	1 × 2.5 mm^2
Tightening torque of the signal contact	1 Nm
Switching capacity signal contact	DC 2 A / DC 24 V (DC11) AC 2 A / AC 230 V (AC11)
Switch contact (NC contact)	According to EN 60730

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3.7 Supply system cable and motor cable

3.7.1 Supply system cable

Dimensioning of the supply system cable generally takes place plant-specifically and depends on the design of the line connection. The structure of a line connection is described in chapter "Power connection". Observe the country-specific and plant-specific regulations when selecting the cross section of the supply system cable.

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 cable cross sections listed in the table. Cables with these cross sections can be used if the following conditions are met:

- The single-core cables are made of copper with PVC insulation.
- The cables are routed in cable ducts according to IEC 60204-1 installation type C at 40 °C ambient temperature.

MCX91A-…-5_3	0010	0016	0020	0025	0032	0040	0055	0070	0095
Nominal line current AC I_{line}	0.9 A	1.4 A	1.8 A	2.3 A	2.9 A	3.6 A	5 A	6.3 A	8.6 A
Supply system cable L1/L2/L3	1.5 mm²								
Fuse/miniature circuit breaker	10 A								

MCX91A-…-5_3	0125	0160	0240	0320	0460	0620	0750	0910
Nominal line current AC I_{line}	11.3 A	14.4 A	21.6	28.8 A	41.4 A	55.8 A	67.5 A	81.9 A
Supply system cable L1/L2/L3	2.5 mm²		4 mm²	6 mm²	10 mm²	16 mm²	25 mm²	mm²
Fuse/miniature circuit breaker	16 A		25 A	32 A	50 A	63 A	80 A	A

MCX91A-…-2_3	0017	0025	0034	0042	0055
Nominal line current AC I_{line}	1.5 A	2.3 A	3.1 A	3.8 A	5 A
Supply system cable L1/L2/L3	1.5 mm²				
Fuse/miniature circuit breaker	10 A				

MCX91A-…-2_3	0070	0093	0140	0213	0290	0420	0570
Nominal line current AC I_{line}	6.3 A	8.4 A	12.6 A	19.2 A	26.1 A	37.8 A	51.3 A
Supply system cable L1/L2/L3	1.5 mm²		2.5 mm²		6 mm²	10 mm²	16 mm²
Fuse/miniature circuit breaker	10 A		16 A	20 A	32 A	50 A	63 A

MCX91A-…-2_1	0017	0025	0034	0042	0055	0070	0093	0110
Nominal line current AC I_{line}								
Supply system cable L1/L2/L3								
Fuse/miniature circuit breaker								

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.

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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

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

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3.7.2 Motor cable

Cable length

The maximum motor cable length listed below must not be exceeded.

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.

MCX91A...-5_3 With U_{line} = 3 × AC 400 V	0010 – 0025	0032 – 0160	0240	0320 – 1770	2200 – 2500	3000	3800 – 5880
	Maximum motor cable length in m						
	Shielded cable						
PWM frequency							
2.5 kHz	-	-	-	-	-	400	400
4 kHz	50/100[1)]	100	400	400	400	300	300
8 kHz	25	70	300	300	300	200	-
16 kHz	12.5	40	200	200	-	-	-

1) The following conditions must be met at a cable length of 100 m: Line voltage: ≤ 400 V; clock frequency: 4 kHz; max. ambient temperature: ≤ 35 °C; no derating permitted

MCX91A...-5_3 With U_{line} = 3 × AC 400 V	0010 – 0025	0032 – 0160	0240	0320 – 1770	2200 – 2500	3000	3800 – 5880
	Maximum motor cable length in m						
	Unshielded cable						
PWM frequency							
2.5 kHz	-	-	-	-	-	1200	1200
4 kHz	100	200	1200	1200	1200	900	900
8 kHz	50	140	900	900	900	600	-
16 kHz	25	80	600	600	-	-	-

MDCX91A...-2_3 With U_{line} = 3 × AC 230 V	0017 – 0025	0032 – 0140	0213	0290	0420
	Maximum motor cable length in m				
	Shielded cable				
PWM frequency					
4 kHz	50	100			
8 kHz	25	70			
16 kHz	12.5	40			

MDCX91A...-2_3 With U_{line} = 3 × AC 230 V	0017 – 0025	0032 – 0140	0213	0290	0420
	Maximum motor cable length in m				
	Unshielded cable				
PWM frequency					
4 kHz	100	200			
8 kHz	50	140			
16 kHz	25	80			

MDCX91A...-2_1 With U_{line} = 1 × AC 230 V	0017	0025	0034	0042	0055	0070	0093	0110
	Maximum motor cable length in m							
	Shielded cable							
PWM frequency								
4 kHz								
8 kHz								
16 kHz								

MDCX91A...-2_1 With U_{line} = 1 × AC 230 V	0017	0025	0034	0042	0055	0070	0093	0110
	Maximum motor cable length in m							
	Unshielded cable							
PWM frequency								
4 kHz								
8 kHz								
16 kHz								

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Voltage drop

Select the cable cross section of the motor cable so the voltage drop is as small as possible. An excessively high voltage drop means that the full motor torque is not achieved.

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3.8 Signal lines

3.8.1 Encoder cables

SEW-EURODRIVE recommends using shielded encoder cables.

Encoder designation	Signal type	Maximum permitted cable length
A...Z, E..Z	MOVILINK® DDI	200 m
EI7C-FS	HTL (Functional Safety)	100 m
EI.C, EK.C, EG.C, ES.C, EV.C	HTL	50 m

3.8.2 Digital inputs/outputs and DC 24 V supply

The maximum permitted cable length of the connections on the inputs and outputs and on terminal X6 (STO) is 30 m.

An exception to this cable length is the connection of an HTL encoder because it requires a shielded cable.

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3.9 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.

3.9.1 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 and C2 in accordance with EN 61800-3, the measures listed in the tables must be taken. Limit value class C3 is achieved with all inverters without additional measures.

Limit class C2

Inverter	Measures		
	On the line side	On the motor side	
	NF line filter	HF output filter HD output choke	Shielded cables
MCX91A-0010 – 0055-5E3-..	–	–	yes
MCX91A-0017 – 0055-2E3-.. MCX91A-0017 – 0042-2E1-..	–	HD or HF	–
MCX91A-0070 – 0160-5E3-..	–	–	yes
MCX91A-0070 – 0140-2E3-.. MCX91A-0055 – 0110-2E1-..	–	HD[1] Or HF[1]	–
MCX91A-0240-5E3-..	–	–	yes
MCX91A-0213-2E3-..	–	HD or HF	–
MCX91A-0320 – 1490-5.3-..	NF	–	yes
MCX91A-0290 – 1080-203-..	NF	HD or HF	–

1) C2 is achieved in a cable-bound manner, additional measures are required for radiation, e.g. installation in a metallic cable duct.

INFORMATION

No EMC limit values are specified for interference emission in voltage supply systems without a grounded star point (IT systems).

3.10 Components on the output side

3.10.1 General information on using an output filter

- Output filters may only be used up to a maximum output frequency of 250 Hz on the inverter.
- The inverter utilization increases by 10% during operation with output filter. This must be taken into account when designing the inverter.
- Noise is generated 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.

3.10.2 Control mode of inverter

Operate output filters in V/f and VFC^{PLUS} control modes only. When starting up the inverter with the MOVISUITE® engineering software, set "Operation with output filter".

3.10.3 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.

Observe the following notes:

- Operation with DC link connection
  - Nominal filter current ≥ 65 A: Minimum clock frequency = 8 kHz, this must be set permanently.
- Operation without DC link connection
  - Maximum clock frequency = 8 kHz
  - The maximum shielded motor cable length is 200 m.

3.10.4 Voltage drop

Observe the following voltage drop at the output filter during project planning:

- 400 V ≤ 6.5%
- 500 V ≤ 5%

These values refer to an output frequency of 50 Hz.

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3.10.5 Derating – Current-dependent 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

  150 – 250 Hz
  - Nominal filter current ≤ 46 A

    Derating: Filter current = 100% - 0.1% × (output frequency - 150 Hz)
  - Nominal filter current ≥ 65 A

    Derating: Filter current = 100% - 0.2% × (output frequency - 150 Hz)

  0 – 20 Hz
  - 400 V without/with DC link connection, 500 V without DC link connection:

    No derating
  - 500 V DC link connection, nominal filter current ≤ 46 A

    Derating: Filter current = 70% + 1.5% × output frequency (in the range from 0 to 20 Hz)
  - 500 V DC link connection, nominal filter current ≥ 65 A

    Derating: Filter current = 10% + 9% × output frequency (in the range from 0 to 10 Hz)

  Short-time operation without speed derating (e.g. startup)
  - Filter current 100% for 5 min every 60 min permitted

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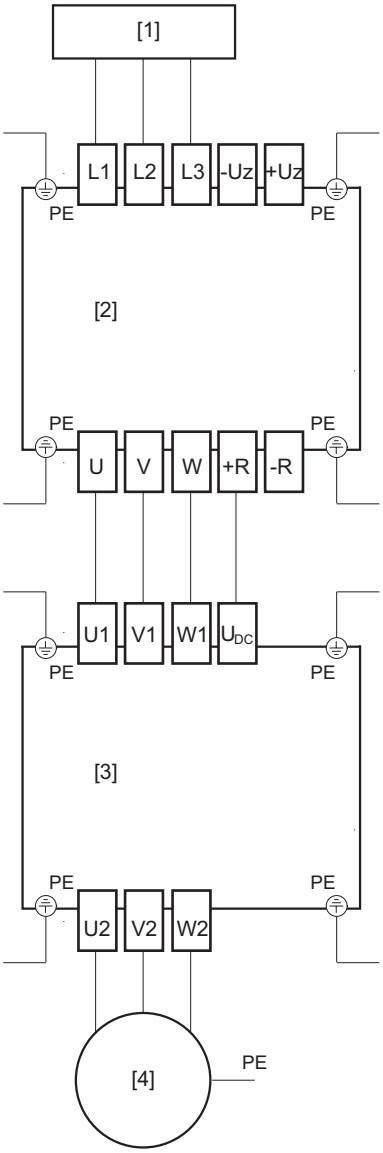
3.10.6 Wiring diagram



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

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3.11 Line components

3.11.1 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	Requirement
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 10% higher than the nominal line current of the inverter

Adhere to the country-specific and system-specific regulations when carrying out the fusing. If required, observe the notes in the chapter "UL-compliant installation".

3.11.2 Line contactor

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

For more information on operation with a line contactor, refer to the chapter "Line connection".

INFORMATION

If necessary, use a line contactor in utilization category AC-3 (IEC 158-1) or better.

The line contactor must be installed before the line filter and the line choke.

INFORMATION

Observe the information for electrical installation of a line contactor.

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3.11.3 Line filter NF..

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 selection of the line filter depends on the nominal line current and the line voltage of the frequency inverter.

Select the line filter type based on the following table.

Technical data

Line filter		NF0055-503	NF0120-503	NF0220-503	NF0420-513	NF0910-523	NF1800-523	NF2700-503
Part number		17984319	17984270	17984300	17983789	17987504	17987865	18000576
Nominal line voltage V_L		3 × AC 230 V – 500 V, 50/60 Hz						
Nominal current I_N	A	5.5	12	22	42	91	180	270
Nominal power loss	W	4	6	30	30	51.5	89	
Ambient temperature ϑ_{amb}		0 °C to 45 °C (reduction: 3% I_N up to maximum 60 °C)						
Connection contacts L1/L2/L3 – L1'/L2'/L3'	mm^2	Cage clamp terminals max. 6			Screw terminal 2.5 – 16	Screw terminal 10 – 50	Screw terminal 16 – 120	M12 stud
Tightening torque L1/L2/L3 – L1'/L2'/L3'	Nm	–			2 – 4	3.5 – 6	12 – 20	14 – 20
PE connection contacts		M4 screw		M5 screw	M6 stud	M8 stud	M10 stud	M12 stud
PE tightening torque	Nm	1.5		3	6	12	23	30
Degree of protection		IP20 according to EN 60529						IP00
Mass	kg	1	1	1.4	3	5	9	

Assignment

Line filter	NF0055-503	NF0120-503	NF0220-503	NF0420-513	NF0910-523	NF1800-523	NF2700-503
MCX91A-...-5_3-..	0010 – 0055	0070 – 0125	0160 – 0240	0320 – 0460	0620 – 0910	1130 – 1770	2200 – 3000
MCX91A-...-2_3-..	0017 – 0055	0070 – 0093	0140 – 0213	0290 – 0420	0570 – 0840	1080	–

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3.11.4 Line choke ND..

The main reason for using line chokes is the reduction of grid disturbances that may occur due to harmonic currents. In addition, line chokes improve the overvoltage protection.

Connect a line choke for limiting the inrush current:

- With 5 or more 3-phase devices
- With 2 or more 1-phase devices

Using a line choke per inverter is mandatory with MCX91A-0110-2E1-4-..

Select the line choke based on the following table.

Technical data and assignment

Technical data

Line choke		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 V_L		3 × AC 230 V – 500 V, 50/60 Hz						
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}		-10 °C to 45 °C (reduction: 3% I_N up to maximum 60 °C)						
Connection contacts L1/L2/L3 – L1'/L2'/L3'	mm^2	Screw terminal 0.2 – 4		Screw terminal 0.2 – 10	Screw terminal 2.5 – 16	Screw terminal 10 – 50	Screw terminal 16 – 120	M12 stud
Tightening torque L1/L2/L3 – L1'/L2'/L3'	Nm	0.5 – 1		1.2 – 2	2.5	3.5 – 6	12 – 20	15.5
PE connection contact		M4 screw		M5 screw		M8 stud	M10 stud	2 × M10 stud
PE tightening torque	Nm	1.5		3		12	20	10
Degree of protection according to EN 60529		IPXXB				IPXXA		IP00
Mass	kg	0.5	1.3	1.95	1.82	4.4	10	36

Assignment

Line choke	ND0070-503	ND0160-503	ND0300-503	ND0420-503	ND0910-503	ND1800-503	ND3000-503
MCX91A-...-5_3-..	0010 – 0070	0095 – 0160	0240 – 0320	0460	0620 – 0910	1130 – 1770	2200 – 3000
MCX91A-...-2_3-..	0017 – 0070	0093 – 0140	0213 – 0290	0420	0570 – 0840	1080	–

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Technical data

Line choke		ND0250-201
Part number		18001424
Nominal line voltage V_L		1 × AC 200 V – 240 V, 50/60 Hz
Nominal current I_N	A	25
Nominal inductance	mH	1.17
Nominal power loss	W	27
Ambient temperature ϑ_{amb}		-10 °C to 40 °C
Connection contacts L1/L2/L3 – L1'/L2'/L3'	mm^2	Elevator clamp 0.2 – 16
Tightening torque L1/L2/L3 – L1'/L2'/L3'	Nm	1.2 – 2
PE connection contact	mm	Connection lug for tab connector 6.3 × 0.8
Degree of protection according to EN 60529		IP00
Mass	kg	1.5

Assignment

Line choke	ND0250-201
MCX91A-...-2_1-..	0110 (mandatory) 0017 – 0093 (optional)

3.11.5 Residual current device

⚠ WARNING

No protection against electric shock if an incorrect type of residual current device is used.

Severe or fatal injuries.

- The product can cause direct current in the PE conductor. If a residual current device (RCD) or a residual current monitoring device (RCM) is used for protection in the event of a direct or indirect contact, only a type B RCD or RCM is permitted on the supply end of the product.

- If the use of a residual current device is not mandatory according to the standards, SEW-EURODRIVE recommends not to use a residual current device.

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3.12 24 V supply voltage selection

The MCX91A-... inverters have an internal 24 V voltage supply that can also be supported externally.

For inverters of sizes 3 – 8, the 24 V switched-mode power supply has a power of 80 W.

For inverters of sizes 0S and 0L, the internal 24 V switched-mode power supply has a power of 15 W. Observe the following:

- Devices without safety option do not require an external backup voltage. In this case, a total of 300 mA is available at the outputs. The maximum load of the MOVILINK® DDI connection is 150 mA. The actual current consumption of the MOVILINK® DDI connection must be subtracted from the 300 mA.
- Devices with safety option (CSB, CSL) must have an external backup voltage. This backup voltage must not be interrupted; otherwise, the safety options are not supplied.
- The following applies to both cases:

  If the device is supported by an external supply, the entire supply is provided by the external power supply unit. In this case, the MOVILINK® DDI connection can be loaded with a maximum of 500 mA. For all other device outputs, the limitation of the technical data applies.

If a 24 V backup voltage is necessary, it must be switched on before the line voltage and switched off after the line voltage.

3.12.1 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. The 24 V voltage supply must provide the sum of all powers.

INFORMATION

The power peaks during switch-on (caused by internal capacitances present in the devices) must not be taken into consideration as those capacitances are very small. Commercially available switched-mode power supplies can reliably switch on the maximally occurring capacities.

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3.12.2 Power consumption of the 24 V supply

Tables for the power demand of the 24 V supply depending on the modules in use and on the installed options.

Inverter 3 × AC 400 V **Inverter 3 × AC 230 V** **Inverter 1 × AC 230 V**	**Power consumption (without I/O, motor encoder, motor brake)** **W**		
	PROFINET		
	-T0./../CSO/CFN	**-T0./../DI/CSO/CFN**	**-T0./../DI/CSL/CFN**
	-T0./../CSO/CFNB	**-T0./../DI/CSO/CFNB**	**-T0./../DI/CSL/CFNB**
	Ethernet/IP™, Modbus TCP		
	-T0./../CSO/CFE	**-T0./../DI/CSO/CFE**	**-T0./../DI/CSL/CFE**
	POWERLINK		
	-L00/../CSO/CFL	**-L00/../DI/CSO/CFL**	**-L00/../DI/CSL/CFL**
Sizes 0S and 0L	6	6.5	8.5
Sizes 1,2,3,6,7	20	20.5	22.5
Size 4	30	30.5	32.5
Size 5	15	15.5	17.5

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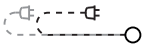
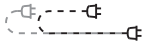
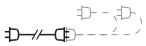
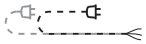
4 Prefabricated cables

4.1 Meaning of the symbols

Icon	Meaning
	Connection cables: Connector → connector for fixed installation
	Connection cable extension: Connector → connector for fixed installation
	Connection cables: Connector → encoder connection cover for fixed installation
	Connection cables: Connector → encoder connection cover for cable carrier installation
	Connection cables: Connector → connector for cable carrier installation
	Connection cable extension: Connector → connector for cable carrier installation
	Connection cables: Connector → open end for fixed installation
	Connection cables: Connector → open end for cable carrier installation

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4.2 Power cables for CM3C.. motors

The exact assignment of the cable cross sections to the motor types depending on the speed class and cable length can be found in the corresponding motor catalog.

4.2.1 Power cables for fixed installation

Cable type	Connector type	Thread	Cable cross section	Part number	
				prefabricated cable	Replacement mating connectors[1]
Motor cable	SM11	M23	4 × 1.5 mm²	28125002	13354698
	SM12		4 × 2.5 mm²	28125029	13354698
	SM14		4 × 4 mm²	28125045	13354264
	SMB6	M40	4 × 6 mm²	28125061	13421778
	SMB10		4 × 10 mm²	28125096	13421751
	SMB16		4 × 16 mm²	28125126	13421670
Brakemotor cable BK.. brake[2] or BZ.D	SB11	M23	4 × 1.5 mm² + 3 × 1 mm²	28125207	13354698
	SB12		4 × 2.5 mm² + 3 × 1 mm²	28125223	13354698
	SB14		4 × 4 mm² + 3 × 1 mm²	28125258	13354264
	SBB6	M40	4 × 6 mm² + 3 × 1.5 mm²	28125274	13421778
	SBB10		4 × 10 mm² + 3 × 1.5 mm²	28125290	13421751
	SBB16		4 × 16 mm² + 3 × 1.5 mm²	28125312	13421670
Brakemotor cable BZ.. brake	SB11	M23	4 × 1.5 mm² + 3 × 1 mm²	28125339	13354698
	SB12		4 × 2.5 mm² + 3 × 1 mm²	28125355	13354698
	SB14		4 × 4 mm² + 3 × 1 mm²	28125371	13354264
	SBB6	M40	4 × 6 mm² + 3 × 1.5 mm²	28125401	13421778
	SBB10		4 × 10 mm² + 3 × 1.5 mm²	28125436	13421751
	SBB16		4 × 16 mm² + 3 × 1.5 mm²	28125452	13421670

1) The complete connector service pack always includes the following parts: Power connector, insulation inserts, female contacts. No differentiation is made between motor and brakemotor plug connectors.

2) Power cable for brakemotors with BK.. brake: 3-core cable, only 2 cores are used.

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4.2.2 Power cables for cable carrier installation

Cable type	Connector type	Thread	Cable cross section	Part number	
				prefabricated cable	Replacement mating connectors[1]
Motor cable	SM11	M23	4 × 1.5 mm²	28125010	13354698
	SM12		4 × 2.5 mm²	28125037	13354256
	SM14		4 × 4 mm²	28125053	13354264
	SMB6	M40	4 × 6 mm²	28125088	13421778
	SMB10		4 × 10 mm²	28125118	13421751
	SMB16		4 × 16 mm²	28125134	13421670
Brakemotor cable BK.. brake[2] or BZ.D	SB11	M23	4 × 1.5 mm² + 3 × 1 mm²	28125215	13354256
	SB12		4 × 2.5 mm² + 3 × 1 mm²	28125231	13354256
	SB14		4 × 4 mm² + 3 × 1 mm²	28125266	13354264
	SBB6	M40	4 × 6 mm² + 3 × 1.5 mm²	28125282	13421751
	SBB10		4 × 10 mm² + 3 × 1.5 mm²	28125304	13421751
	SBB16		4 × 16 mm² + 3 × 1.5 mm²	28125320	13421670
Brakemotor cable BZ.. brake	SB11	M23	4 × 1.5 mm² + 3 × 1 mm²	28125347	13354256
	SB12		4 × 2.5 mm² + 3 × 1 mm²	28125363	13354256
	SB14		4 × 4 mm² + 3 × 1 mm²	28125398	13354264
	SBB6	M40	4 × 6 mm² + 3 × 1.5 mm²	28125428	13421751
	SBB10		4 × 10 mm² + 3 × 1.5 mm²	28125444	13421751
	SBB16		4 × 16 mm² + 3 × 1.5 mm²	28125460	13421670

1) The complete connector service pack always includes the following parts: Power connector, insulation inserts, female contacts. No differentiation is made between motor and brakemotor plug connectors.

2) Power cable for brakemotors with BK.. brake: 3-core cable, only 2 cores are used.

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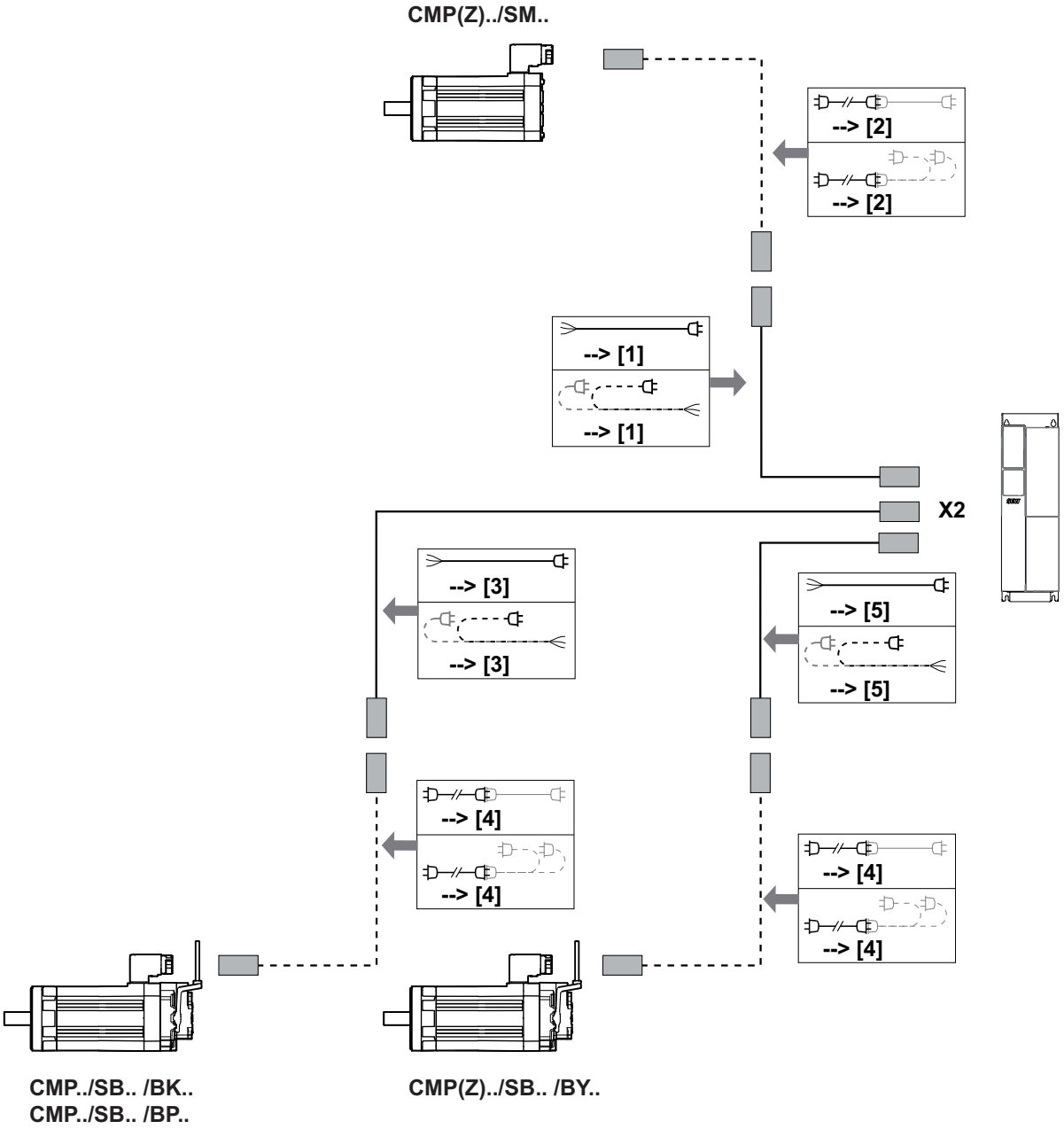
4.3 Power cables for CMP.. motors

4.3.1 Overview



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[1] Motor cable ../SM.. (→ 🗎 167)

[2] Motor extension cable ../SM.. (→ 🗎 168)

[3] Brakemotor cable ../SB.. for brake /BK and /BP (→ 🗎 169)

[4] Brakemotor extension cable ../SB.. for /BK, /BP and /BY brake (→ 🗎 171)

[5] Brakemotor cable ../SB.. for brake /BY (→ 🗎 170)

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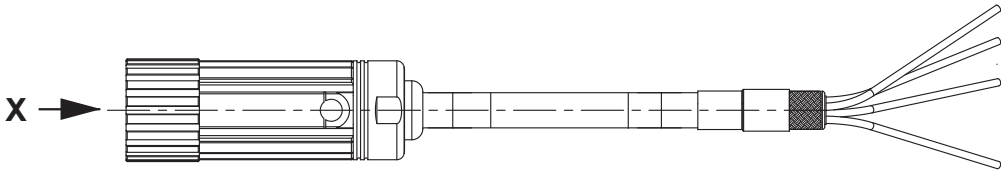
4.3.2 Motor cables with connector on motor end

Illustration of motor cable



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Types of CMP.. motor cables

Plug connector	Number of cores and cable cross section	Part number	Installation type
SM11	4 × 1.5 mm²	05904544	Fixed installation
SM11	4 × 1.5 mm²	05906245	Cable carrier installation
SM12	4 × 2.5 mm²	05904552	Fixed installation
SM12	4 × 2.5 mm²	05906253	Cable carrier installation
SM14	4 × 4 mm²	05904560	Fixed installation
SM14	4 × 4 mm²	05904803	Cable carrier installation
SMB6	4 × 6 mm²	13350269	Fixed installation
SMB6	4 × 6 mm²	13350293	Cable carrier installation
SMB10	4 × 10 mm²	13350277	Fixed installation
SMB10	4 × 10 mm²	13350307	Cable carrier installation
SMB16	4 × 16 mm²	13350285	Fixed installation
SMB16	4 × 16 mm²	13350315	Cable carrier installation
SMC16	4 × 16 mm²	18148476	Fixed installation
SMC16	4 × 16 mm²	18148484	Cable carrier installation
SMC25	4 × 25 mm²	18148581	Cable carrier installation
SMC35	4 × 35 mm²	18148697	Cable carrier installation

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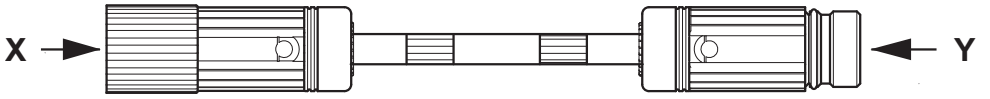
Illustration of motor extension cable



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Types of CMP.. motor extension cables

Plug connector	Number of cores and cable cross section	Part number	Installation type
SM11	4 × 1.5 mm^2	13332457	Cable carrier installation
SM12	4 × 2.5 mm^2	13332465	Cable carrier installation
SM14	4 × 4 mm^2	13332473	Cable carrier installation
SMB6	4 × 6 mm^2	13350021	Cable carrier installation
SMB10	4 × 10 mm^2	13350048	Cable carrier installation
SMB16	4 × 16 mm^2	13350056	Cable carrier installation
SMC16	4 × 16 mm^2	18156819	Cable carrier installation
SMC25	4 x 25 mm^2	18156827	Cable carrier installation
SMC35	4 x 35 mm^2	18156835	Cable carrier installation

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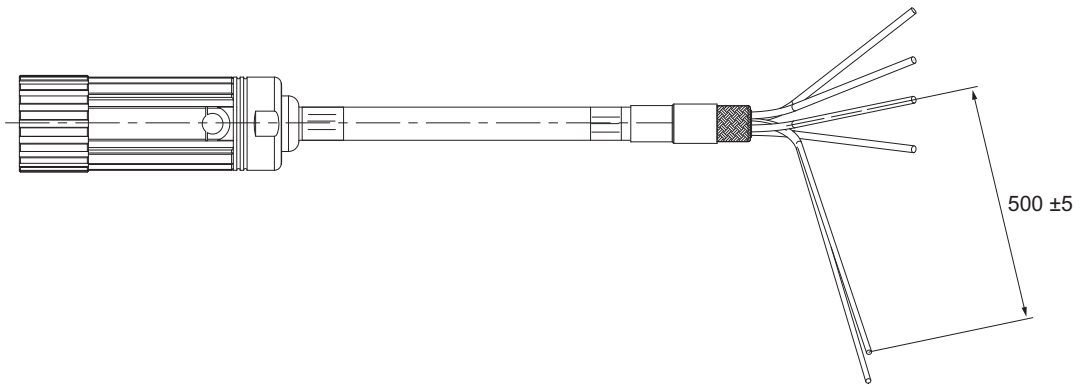
4.3.3 Brakemotor cables for BP/BK brake with connector at motor end

Illustration of CMP.. brakemotor cable



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Types of CMP.. brakemotor cables

Plug connectors	Number of cores and cable cross section	Part number	Installation type
SB11	4 × 1.5 mm^2 + 3 × 1 mm^2	13354345	Fixed installation
SB11	4 × 1.5 mm^2 + 3 × 1 mm^2	13354388	Cable carrier installation
SB12	4 × 2.5 mm^2 + 3 × 1 mm^2	13354353	Fixed installation
SB12	4 × 2.5 mm^2 + 3 × 1 mm^2	13354396	Cable carrier installation
SB14	4 × 4 mm^2 + 3 × 1 mm^2	13354361	Fixed installation
SB14	4 × 4 mm^2 + 3 × 1 mm^2	13421603	Cable carrier installation
SBB6	4 × 6 mm^2 + 3 × 1.5 mm^2	13350196	Fixed installation
SBB6	4 × 6 mm^2 + 3 × 1.5 mm^2	13350234	Cable carrier installation
SBB10	4 × 10 mm^2 + 3 × 1.5 mm^2	13350218	Fixed installation
SBB10	4 × 10 mm^2 + 3 × 1.5 mm^2	13350242	Cable carrier installation
SBB16	4 × 16 mm^2 + 3 × 1.5 mm^2	13350226	Fixed installation
SBB16	4 × 16 mm^2 + 3 × 1.5 mm^2	13350250	Cable carrier installation

INFORMATION

As for the power cables for brakemotors with BP../BK.. brakes only two signal cables are required, the third signal core is cut off during cable assembly.

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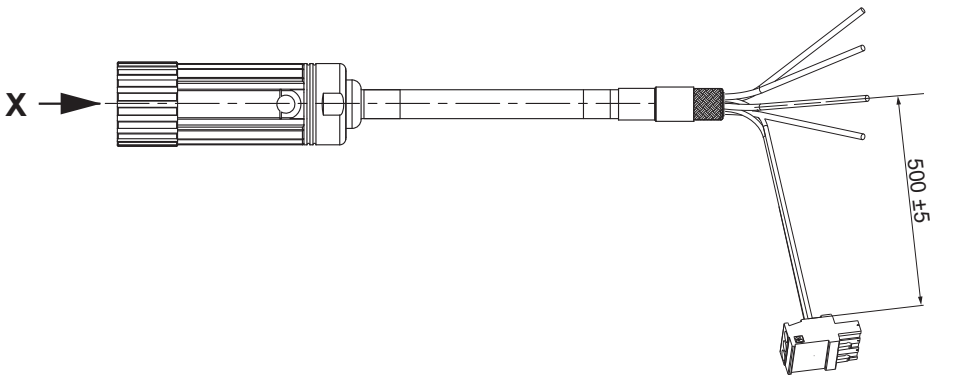
4.3.4 Brakemotor cables for BY brake with connector at motor end

Illustration of CMP.. brakemotor cable



14824163467

Types of CMP.. brakemotor cables

Plug connector	Number of cores and cable cross section	Part number	Installation type
SB11	4 × 1.5 mm^2 + 3 × 1 mm^2	13354272	Fixed installation
SB11	4 × 1.5 mm^2 + 3 × 1 mm^2	13354302	Cable carrier installation
SB12	4 × 2.5 mm^2 + 3 × 1 mm^2	13354280	Fixed installation
SB12	4 × 2.5 mm^2 + 3 × 1 mm^2	13354310	Cable carrier installation
SB14	4 × 4 mm^2 + 3 × 1 mm^2	13354299	Fixed installation
SB14	4 × 4 mm^2 + 3 × 1 mm^2	13354329	Cable carrier installation
SBB6	4 × 6 mm^2 + 3 × 1.5 mm^2	13350129	Fixed installation
SBB6	4 × 6 mm^2 + 3 × 1.5 mm^2	13350153	Cable carrier installation
SBB10	4 × 10 mm^2 + 3 × 1.5 mm^2	13350137	Fixed installation
SBB10	4 × 10 mm^2 + 3 × 1.5 mm^2	13350161	Cable carrier installation
SBB16	4 × 16 mm^2 + 3 × 1.5 mm^2	13350145	Fixed installation
SBB16	4 × 16 mm^2 + 3 × 1.5 mm^2	13350188	Cable carrier installation
SBC16	4 × 16 mm^2 + 3 × 1.5 mm^2	18148514	Fixed installation
SBC16	4 × 16 mm^2 + 3 × 1.5 mm^2	18148522	Cable carrier installation

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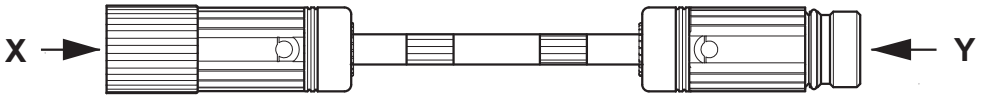
4.3.5 Extension cables for BP.., BK.., BY.. brakes

Illustration of brakemotor extension cable



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Types of CMP.. brakemotor extension cables

Plug connector	Number of cores and cable cross section	Part number	Installation type
SB11	4 × 1.5 mm^2 + 3 × 1 mm^2	13354221	Cable carrier installation
SB12	4 × 2.5 mm^2 + 3 × 1 mm^2	13354248	Cable carrier installation
SB14	4 × 4 mm^2 + 3 × 1 mm^2	13354337	Cable carrier installation
SBB6	4 × 6 mm^2 + 3 × 1.5 mm^2	13350099	Cable carrier installation
SBB10	4 × 10 mm^2 + 3 × 1.5 mm^2	13350102	Cable carrier installation
SBB16	4 × 16 mm^2 + 3 × 1.5 mm^2	13350110	Cable carrier installation
SBC16	4 × 16 mm^2 + 3 × 1.5 mm^2	18156843	Cable carrier installation

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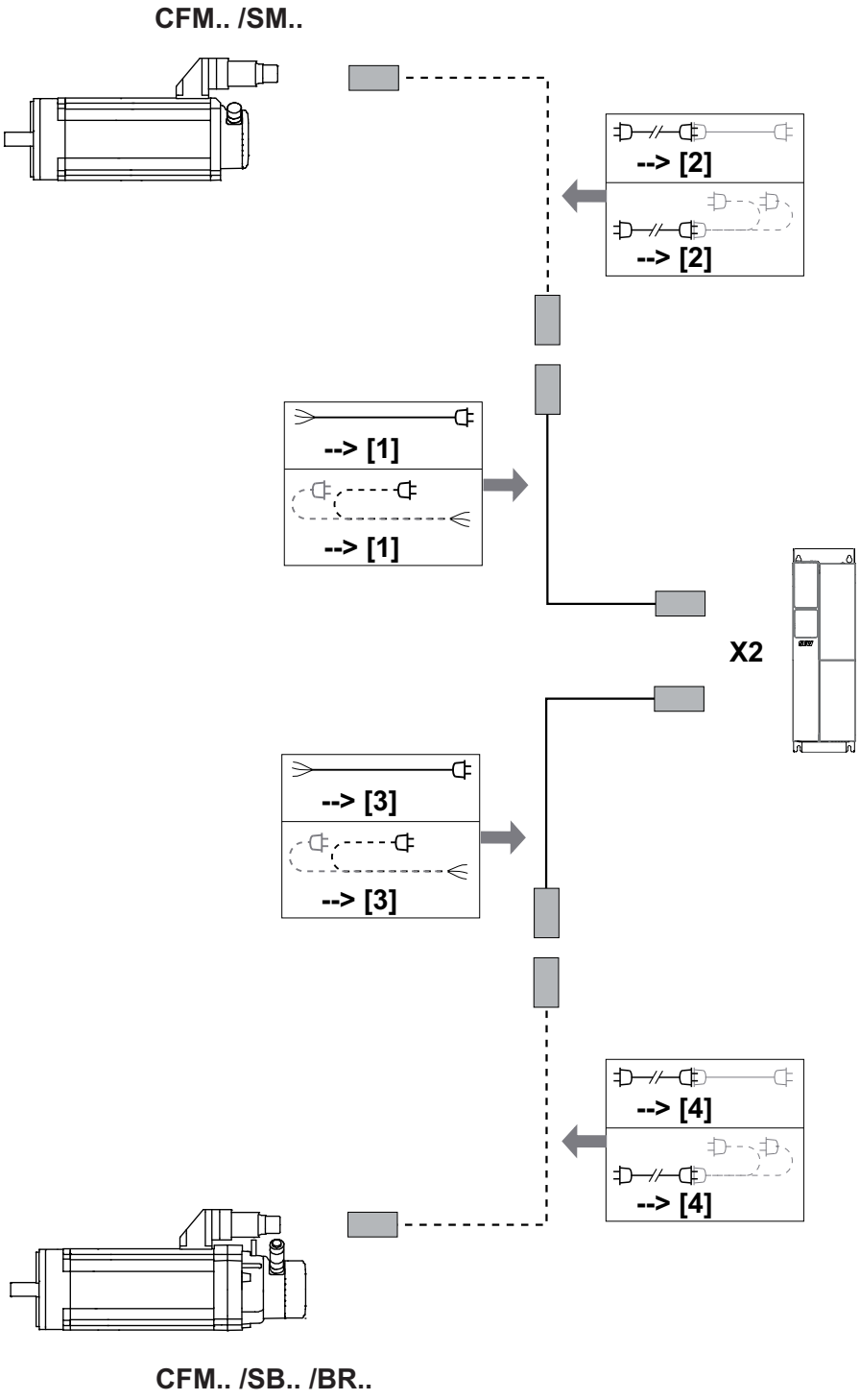
4.4 Power cables for CFM.. motors

4.4.1 Overview



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[1] Motor cable ../SM.. (→ 🗎 173)

[2] Motor extension cable ../SM.. (→ 🗎 174)

[3] Brakemotor cable ../SB.. /BR (→ 🗎 175)

[4] Brakemotor extension cable ../SB.. /BR (→ 🗎 176)

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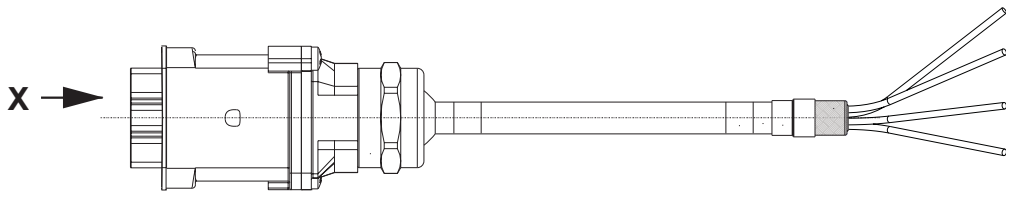
4.4.2 Motor cables

Illustration of motor cable



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Types of motor cables

The cables are equipped with a connector for motor connection and conductor end sleeves for inverter connection.

Plug connector	Number of cores and cable cross section	Part number	Installation type
SM51/SM61	4 × 1.5 mm²	01991795	Fixed installation
SM51/SM61	4 × 1.5 mm²	13331140	Cable carrier installation
SM52/SM62	4 × 2.5 mm²	01991817	Fixed installation
SM52/SM62	4 × 2.5 mm²	13331159	Cable carrier installation
SM54/SM64	4 × 4 mm²	01991833	Fixed installation
SM54/SM64	4 × 4 mm²	01991841	Cable carrier installation
SM56/SM66	4 × 6 mm²	0199185X	Fixed installation
SM56/SM66	4 × 6 mm²	01991868	Cable carrier installation
SM59/SM69	4 × 10 mm²	01991876	Fixed installation
SM59/SM69	4 × 10 mm²	01991884	Cable carrier installation

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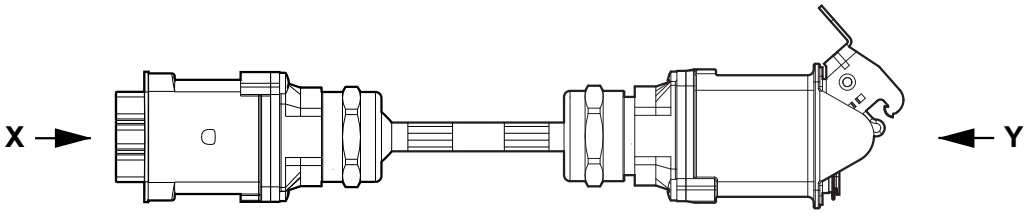
4.4.3 Motor extension cables

Illustration of motor extension cable



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Types of motor extension cables

The cables are equipped with a connector and adapter for extending the CFM.. motor cable.

Plug connector	Number of cores and cable cross section	Part number	Installation type
SM51/SM61	4 × 1.5 mm²	01995499	Fixed installation
SM51/SM61	4 × 1.5 mm²	13331183	Cable carrier installation
SM52/SM62	4 × 2.5 mm²	01995510	Fixed installation
SM52/SM62	4 × 2.5 mm²	13331191	Cable carrier installation
SM54/SM64	4 × 4 mm²	01995537	Fixed installation
SM54/SM64	4 × 4 mm²	01995545	Cable carrier installation
SM56/SM66	4 × 6 mm²	01995553	Fixed installation
SM56/SM66	4 × 6 mm²	01995561	Cable carrier installation
SM59/SM69	4 × 10 mm²	0199557X	Fixed installation
SM59/SM69	4 × 10 mm²	01995588	Cable carrier installation

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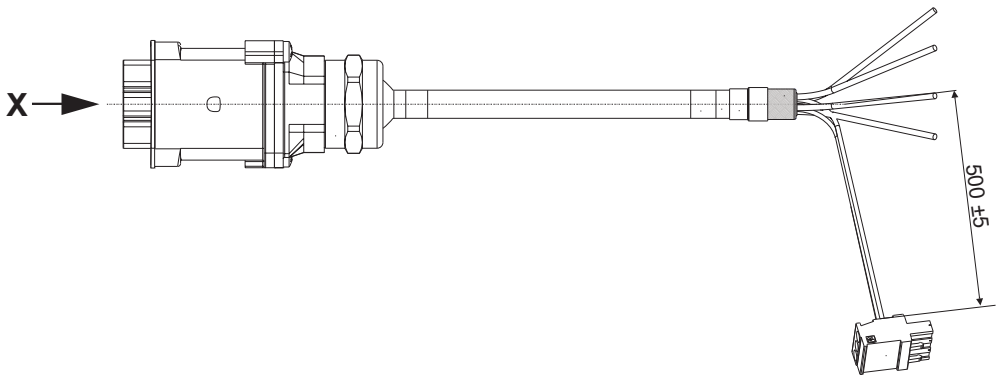
4.4.4 Brakemotor cables

Illustration of brakemotor cable



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Types of brakemotor cables

Plug connector	Number of cores and cable cross section	Part number	Installation type
SB51/SB61	4 × 1.5 mm² + 3 × 1.0 mm²	01991892	Fixed installation
SB51/SB61	4 × 1.5 mm² + 3 × 1.0 mm²	13331167	Cable carrier installation
SB52/SB62	4 × 2.5 mm² + 3 × 1.0 mm²	01991914	Fixed installation
SB52/SB62	4 × 2.5 mm² + 3 × 1.0 mm²	13331175	Cable carrier installation
SB54/SB64	4 × 4 mm² + 3 × 1.0 mm²	01991930	Fixed installation
SB54/SB64	4 × 4 mm² + 3 × 1.0 mm²	01991949	Cable carrier installation
SB56/SB66	4 × 6 mm² + 3 × 1.5 mm²	01991957	Fixed installation
SB56/SB66	4 × 6 mm² + 3 × 1.5 mm²	01991965	Cable carrier installation
SB59/SB69	4 × 10 mm² + 3 × 1.5 mm²	01991973	Fixed installation
SB59/SB69	4 × 10 mm² + 3 × 1.5 mm²	01991981	Cable carrier installation

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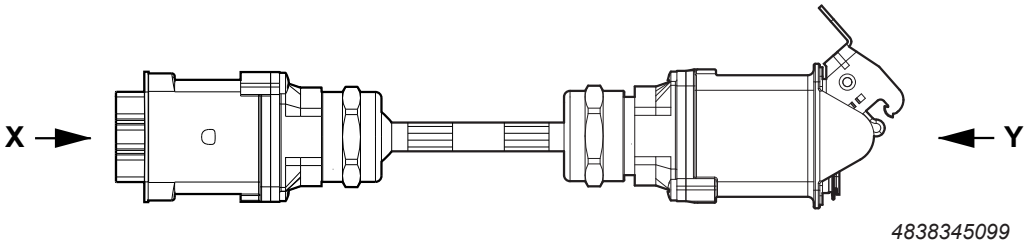
4.4.5 Brakemotor extension cables

Illustration of brakemotor extension cable



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Types of brakemotor extension cables

Plug connector	Number of cores and cable cross section	Part number	Installation type
SK51/SK61	4 × 1.5 mm^2 + 3 × 1.0 mm^2	0199199X	Fixed installation
SK51/SK61	4 × 1.5 mm^2 + 3 × 1.0 mm^2	13331205	Cable carrier installation
SK52/SK62	4 × 2.5 mm^2 + 3 × 1.0 mm^2	01992015	Fixed installation
SK52/SK62	4 × 2.5 mm^2 + 3 × 1.0 mm^2	13331213	Cable carrier installation
SK54/SK64	4 × 4 mm^2 + 3 × 1.0 mm^2	01992031	Fixed installation
SK54/SK64	4 × 4 mm^2 + 3 × 1.0 mm^2	0199204X	Cable carrier installation
SK56/SK66	4 × 6 mm^2 + 3 × 1.5 mm^2	01992058	Fixed installation
SK56/SK66	4 × 6 mm^2 + 3 × 1.5 mm^2	01992066	Cable carrier installation
SK59/SK69	4 × 10 mm^2 + 3 × 1.5 mm^2	01992074	Fixed installation
SK59/SK69	4 × 10 mm^2 + 3 × 1.5 mm^2	01992082	Cable carrier installation

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4.5 Cables for MOVILINK® DDI

The MOVILINK® DDI interface requires a coaxial cable for data transmission between motor and inverter.

If the motor control requires a cross section of up to 10 mm², the coaxial cable is routed in a hybrid cable.

With cross sections larger than 10 mm², the motor and brake control and the coaxial cable are routed in separate cables.

SEW-EURODRIVE offers prefabricated cables with M23/M40 plug connectors. If the connection is made via a cable gland, a FAKRAconnector is required on the coaxial cable.

If hybrid cables with open ends on both ends are used, the coaxial cable is connected to the motor and inverter with one FAKRA connector each.

SEW-EURODRIVE also offers hybrid cables that are already equipped with the FAKRA connector on both sides, or raw cables on a roll, for which the FAKRA connectors must be attached. The FAKRAconnectors can be assembled using the "MOVILINK® DDI Tool Set 1".

Single-cable technology up to 10 mm²

Prefabricated hybrid cables for motors with MOVILINK® DDI interface are structured as follows:

- 1 conductor for PE
- 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.

An M23 plug connector is always used for the coaxial cable on the motor side.

The following connection variants are available:

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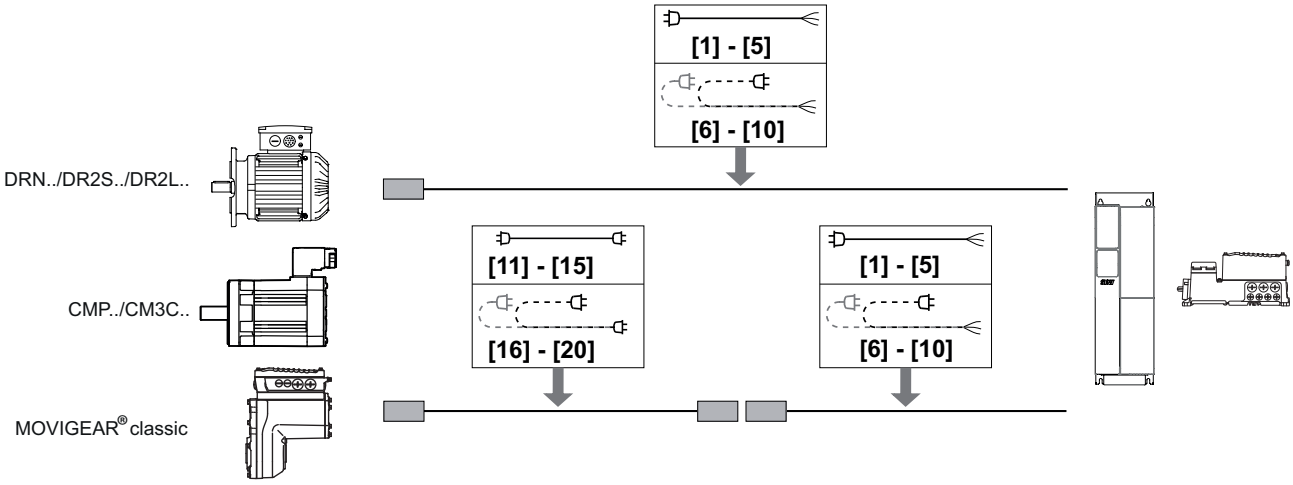
4.5.1 Hybrid cable with connector on the motor side, open end on the inverter side

The cable is used for the following inverters:

- MOVIDRIVE® modular/system/technology
- MOVITRAC® advanced
- MOVIMOT® flexible with cable gland



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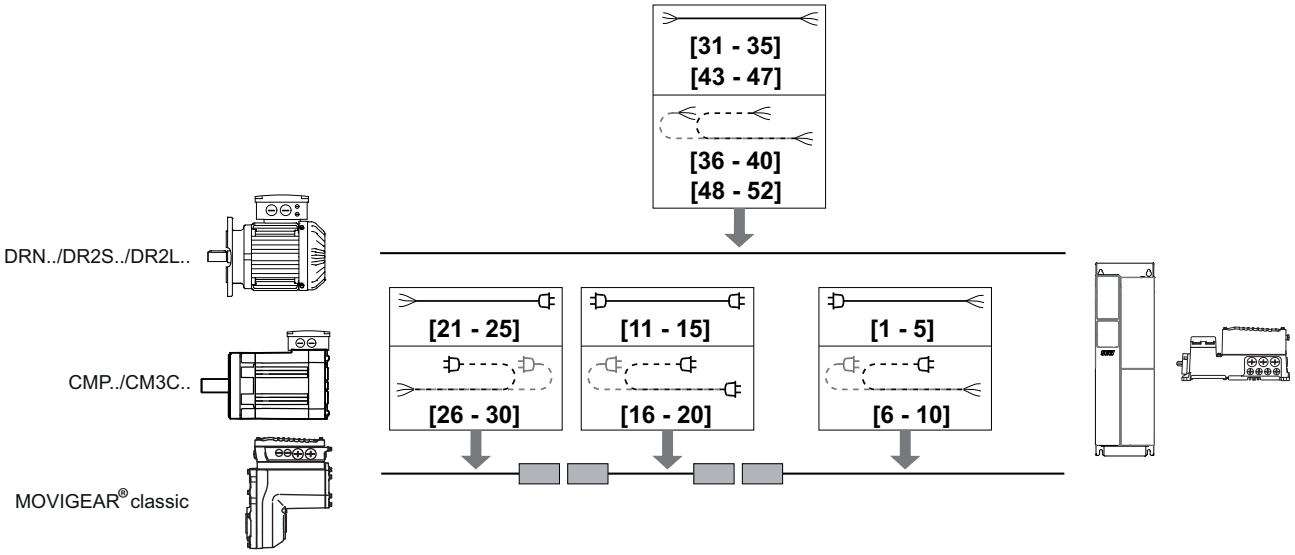
4.5.2 Hybrid cable with open end on the motor side, open end on the inverter side

The cable is used for the following inverters:

- MOVIDRIVE® modular/system/technology
- MOVITRAC® advanced
- MOVIMOT® flexible with cable gland



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4.5.3 Cable tables

Number	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

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Number	Part number	Cross section in mm²	Installation type	Motor connection	Motor side	Inverter side
[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
[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

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Number	Part number	Cross section in mm²	Installation type	Motor connection	Motor side	Inverter side
[41]	28129431	Coaxial cable	Cable carrier installation	SMCD/ SBCD/ KDD	M23	open
[42]	28138376	Coaxial cable	Cable carrier installation	SMCD/ SBCD/ KDD	M23	M23

The prefabricated cables "open on the motor side" and "open on the inverter side" (lines 31 – 40) can also be supplied as cable reels in lengths 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.

Number	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	open	open
[44]	28123409	4 × 2.5 + 4 × 1 + coaxial cable	Fixed installation	KD	open	open
[45]	28123417	4 × 4 + 4 × 1 + coaxial cable	Fixed installation	KD	open	open
[46]	28123425	4 × 6 + 4 × 1.5 + coaxial cable	Fixed installation	KD	open	open
[47]	28123433	4 × 10 + 4 × 1.5 + coaxial cable	Fixed installation	KD	open	open
[48]	28123336	4 × 1.5 + 4 × 1 + coaxial cable	Cable carrier installation	KD	open	open
[49]	28123344	4 × 2.5 + 4 × 1 + coaxial cable	Cable carrier installation	KD	open	open
[50]	28123352	4 × 4 + 4 × 1 + coaxial cable	Cable carrier installation	KD	open	open
[51]	28123360	4 × 6 + 4 × 1.5 + coaxial cable	Cable carrier installation	KD	open	open
[52]	28123379	4 × 10 + 4 × 1.5 + coaxial cable	Cable carrier installation	KD	open	open

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4.6 Motor cables for motors with MOVILINK® DDI interface

The following tables list the cables available for this connection.

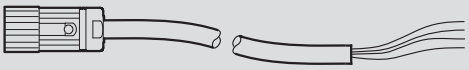
4.6.1 Connecting the motor cables for motors without brake with MOVILINK® DDI interface

Connecting the cables with connectors on the motor end for the following motors:

- DRN../DR2S../DR2L.. asynchronous motors
- CMP../CM3C. synchronous motors
- Drive unit MOVIGEAR® classic

The following table shows the core assignment of the cables:

Motor side



Inverter side

- MOVIDRIVE® modular
- MOVIDRIVE® system
- MOVIDRIVE® technology
- MOVITRAC® advanced

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	PE connection
DDI	DDI	DDI	Violet	VT		Coaxial connector	MOVILINK® DDI

Insulate each unconnected conductor end.

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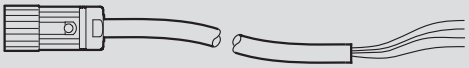
4.6.2 Connecting the motor cables for motors with BE or BZ brake with MOVILINK® DDI interface

Connecting the cables with connectors on the motor end for the following motors:

- DRN../DR2S../DR2L.. asynchronous motors
- CM3C.. synchronous motors

The following table shows the core assignment of the cables:

Motor side



Inverter side

- MOVIDRIVE® modular
- MOVIDRIVE® system
- MOVIDRIVE® technology
- MOVITRAC® advanced

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	PE connection
DDI	DDI	DDI	Violet	VT		Coaxial connector	MOVILINK® DDI

Insulate each unconnected conductor end.

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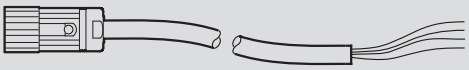
4.6.3 Connecting the motor cables for motors with BK, BZ..D or BP brake with MOVILINK® DDI interface

Connecting the cables with connectors on the motor end for the following motors:

- CMP../CM3C. synchronous motors

The following table shows the core assignment of the cables:

Motor side



Inverter side

- MOVIDRIVE® modular
- MOVIDRIVE® system
- MOVIDRIVE® technology
- MOVITRAC® advanced

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	Brake -	Yellow	YE	A	Not prefabricated	Brake connection -
B	+	Reserved	Orange	OG	B	Not prefabricated	Do not connect
C	N	Reserved	Pink	PK	C	Not prefabricated	Do not connect
D	2	Brake +	Violet	VT	D	Not prefabricated	Brake connection +
PE	PE	PE	Yellow/ green	YE/GN		Not prefabricated	PE connection
DDI	DDI	DDI	Violet	VT		Coaxial connector	MOVILINK® DDI

Insulate each unconnected conductor end.

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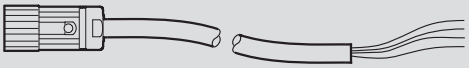
4.6.4 Connecting the motor cables for motors with integrated BGZ brake control

Connecting the cables with connectors on the motor end for the following motors:

- DRN../DR2S../DR2L.. asynchronous motors
- CMP../CM3C. synchronous motors

The following table shows the core assignment of the cables:

Motor side		**Inverter side**	• MOVIDRIVE® modular • MOVIDRIVE® system • MOVIDRIVE® technology • MOVITRAC® advanced

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	+	L2	Orange	OG	B	Not prefabricated	L2 (N) connection
C	N	Reserved	Pink	PK	C	Not prefabricated	Do not connect
D	2	L1	Violet	VT	D	Not prefabricated	L1 connection
PE	PE	PE	Yellow/ green	YE/GN		Not prefabricated	PE connection
DDI	DDI	DDI	Violet	VT		Coaxial connector	MOVILINK® DDI

Insulate each unconnected conductor end.

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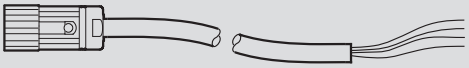
4.6.5 Connecting the motor cables for motors with integrated BSZ brake control

Connecting the cables with connectors on the motor end for the following motors:

- CMP../CM3C. synchronous motors

The following table shows the core assignment of the cables:

Motor side		Inverter side	• MOVIDRIVE® modular • MOVIDRIVE® system • MOVIDRIVE® technology • MOVITRAC® advanced

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	GND	Yellow	YE	A	Not prefabricated	GND connection
B	+	DC 23 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	PE connection
DDI	DDI	DDI	Violet	VT		Coaxial connector	MOVILINK® DDI

Insulate each unconnected conductor end.

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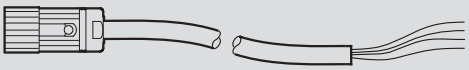
4.6.6 Connecting the motor cables for motors with integrated braking resistor

Connecting the cables with connectors on the motor end for the following motors:

- Drive unit MOVIGEAR® classic

The following table shows the core assignment of the cables:

Motor side



Inverter side

- MOVIDRIVE® modular
- MOVIDRIVE® system
- MOVIDRIVE® technology
- MOVITRAC® advanced

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		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	PE connection
DDI	DDI	DDI	Violet	VT		Coaxial connector	MOVILINK® DDI

Insulate each unconnected conductor end.

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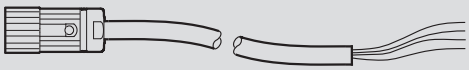
4.6.7 Connecting the coaxial cables with separate routing of power and signal cable

The power and signal cables 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**	• MOVIDRIVE® modular • MOVIDRIVE® system • MOVIDRIVE® technology • MOVITRAC® advanced

Contact M23	**Signal**	**Conductor color**	**Conductor color IEC 60757**	**Identification**	**Assembly**	**Description**
DDI	DDI	Violet	VT		Coaxial connector	MOVILINK® DDI

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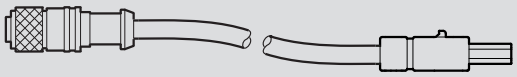
4.7 Encoder cable for EI7C-FS

4.7.1 Mini IO encoder cable to M12 socket

The safe EI7C FS encoder can be read via the X18 encoder interface only at an inverter with safety variant CSL.

Designation	Part number	Installation
Mini IO encoder cable to M12 socket, 8-pin	28118804	Fixed installation

Motor side



Inverter side

Contact M12	Signal	Conductor color	Conductor color IEC 60757	Contact Mini IO
1	+Ub	Red	RD	1
		Pink	PK	4
2	GND	Blue	BU	2
		Gray	GY	5
3	A	Brown	BN	3
4	$\overline{A}$	White	WH	6
5	B	Yellow	YE	7
6	$\overline{B}$	Green	GN	8
7, 8	n.c,	–	–	–

If cable carrier installation is required, SEW-EURODRIVE recommends using the encoder cable "Mini IO to M12 socket" for the area with fixed routing and using an extension cable with M12 connector to M12 socket for the area with cable carrier installation.

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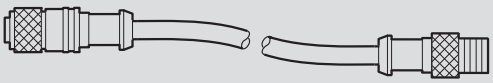
4.7.2 Extension cable with M12 socket to M12 connector

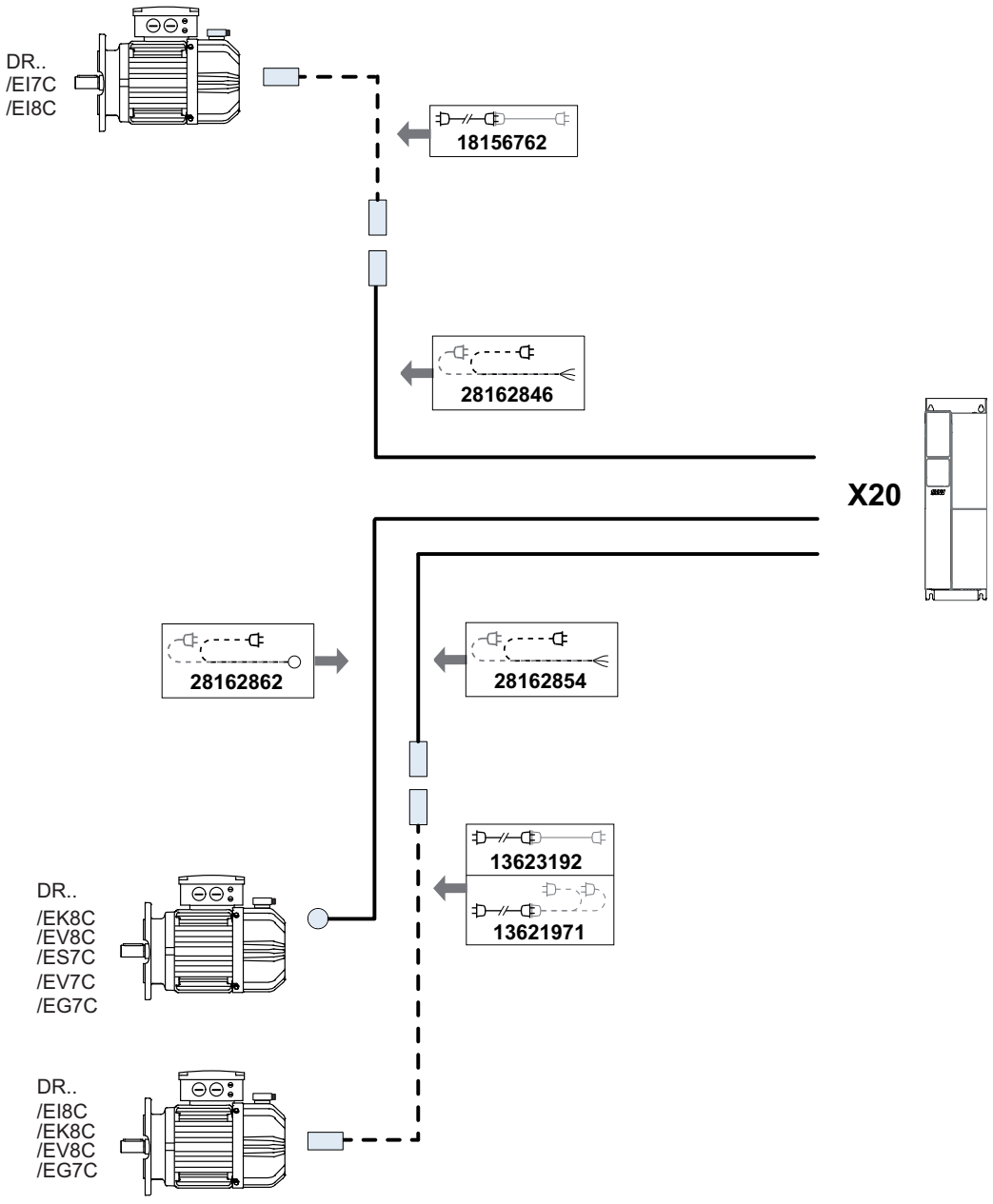
Designation	Part number	Installation
Extension cable with M12 socket to M12 connector, 8-pin	18148670	Fixed installation
	18158013	Cable carrier installation

Motor side  **Inverter side**

Contact M12	Signal	Conductor color	Conductor color IEC 60757	Contact M12
3	A	Brown	BN	3
4	$\overline{A}$	White	WH	4
5	B	Yellow	YE	5
6	$\overline{B}$	Green	GN	6
1	+Ub	Gray	GY	1
2	GND	Pink	PK	2
7, 8	n.c,	–	–	7, 8

4.8 Encoder cable for HTL encoders

4.8.1 Overview



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4.8.2 Encoder cable M12 socket to open end with conductor end sleeves for EI7C and EI8C encoders

To facilitate easy positioning, the EI7C HTL built-in encoder can be evaluated via each inverter with fieldbus interface using the X20 digital inputs, with exception of the binary variant.

To facilitate speed control and positioning, the EI8C HTL built-in encoder can be evaluated via each inverter with fieldbus interface using the X20 digital inputs, with exception of the binary variant.

Designation	Part number	Installation
M12 socket (8-pin) to open end with conductor end sleeves 4 × 2 × 0.25 mm^2	28162846	Cable carrier installation

Motor side **Inverter side**

Contact M12	Signal	Conductor color IEC 60757	Inverter contact	Open end Wire length in mm
1	+Ub	GY	External[1)]	500
2	GND	PK	External[1)]	500
3	A	BN	X20:4	250
5	B	YE	X20:5	250
6	C[2)]	GN	X20:6[2)]	250
7	TF+	RD	X10:TF1	250
8	TF-	BU	X10:GND	250

1) If the inverter is supported by an external DC 24 V voltage supply via X5, these wires can also be clamped under at terminal X5.

2) The C track is only used as an option with EI8C encoders. With the EI7C, this wire remains unused.

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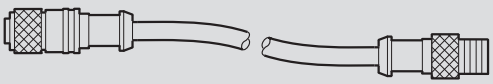
4.8.3 Extension cable with M12 socket to M12 connector

Designation	Part number	Installation
M12 socket (8-pin) to M12 connector 4 × 2 × 0.25 mm²	18156762	Fixed installation

Motor side  **Inverter side**

Contact M12	Signal	Conductor color	Conductor color IEC 60757	Contact M12
3	A	Brown	BN	3
4	$\overline{A}$	White	WH	4
5	B	Yellow	YE	5
6	$\overline{B}$	Green	GN	6
7	TF	Red	RD	7
8	TF-	Blue	BU	8
1	Ub	Gray	GY	1
2	GND	Pink	PK	2

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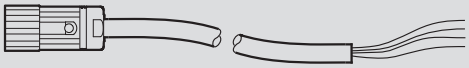
4.8.4 Encoder cable with M23 socket to open end with conductor end sleeves for high-resolution HTL encoder

To facilitate speed control and positioning, the high-resolution HTL built-in encoders by SEW-EURODRIVE can be evaluated via each inverter with fieldbus interface using the X20 digital inputs, with exception of the binary variant.

Designation	Part number	Installation
M23 socket (12-pin) to open end with conductor end sleeves 5 × 2 × 0.25 mm² + 2 × 0.5 mm²	28162854	Cable carrier installation

Motor side  **Inverter side**

Contact M23	Signal	Conductor color IEC 60757	Inverter contact	Open end Wire length in mm
1	C	BN	X20:6	250
3	A	RD	X20:4	250
5	B	YE	X20:5	250
9	TF+	GYPK	X10:TF1	250
10	TF-	RDBU	X10:GND	250
11	GND	PK	External[1)]	500
12	+Ub	GY	External[1)]	500

1) If the inverter is supported by an external DC 24 V voltage supply via X5, these wires can also be clamped under at terminal X5.

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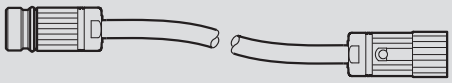
4.8.5 Extension cable with M23 socket to M23 connector for high-resolution HTL encoder

Designation	Part number	Installation
M23 socket (12-pin) to M23 connector 5 × 2 × 0.25 mm² + 2 × 0.5 mm²	13623192	Fixed installation
	13621971	Cable carrier installation

Motor side



Inverter side

Contact M23	Signal	Conductor color	Conductor color IEC 60757	Contact M23
3	A	Red	RD	3
4	$\overline{A}$	Blue	BU	4
5	B	Yellow	YE	5
6	$\overline{B}$	Green	GN	6
1	C+	Brown	BN	1
2	C-	White	WH	2
8	Data+	Black	BK	8
7	Data-	Violet	VT	7
12	Ub	Red-blue+gray	RD-BU+GY	12
11	GND	Gray-pink+pink	GY-PK+PK	11

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4.8.6 Encoder cable with connection cover to open end with conductor end sleeves for high-resolution HTL encoder

To facilitate speed control and positioning, the EK8C high-resolution HTL built-in encoder by SEW-EURODRIVE can be evaluated via each inverter with fieldbus interface using the X20 digital inputs, with exception of the binary variant.

Designation	Part number	Installation
Connection cover (10-pin) to open end with conductor end sleeves 5 × 2 × 0.25 mm² + 2 × 0.5 mm²	28162862	Cable carrier installation

Motor side **Inverter side**

Contact Connection cover	Signal	Conductor color IEC 60757	Inverter contact	Open end Wire length in mm
A	A	RD	X20:4	250
B	B	YE	X20:5	250
C	C	BN	X20:6	250
D	TF+	GYPK	X10:TF1	250
/D	TF-	RDBU	X10:GND	250
UB	+Ub	GY	External[1)]	500
⏚	GND	PK	External[1)]	500

1) If the inverter is supported by an external DC 24 V voltage supply via X5, these wires can also be clamped under at terminal X5.

4.9 System bus cable

The system bus cable is used for devices whose DC link is not connected.

The RJ45 connectors of the system bus cables and the sockets in the inverters have been checked for mechanical stability and contact reliability by SEW-EURODRIVE. SEW-EURODRIVE recommends using the system bus and module bus cables listed below. If other cables and connectors are used, SEW-EURODRIVE makes no statement about the quality of the plug-in connection.

NOTICE

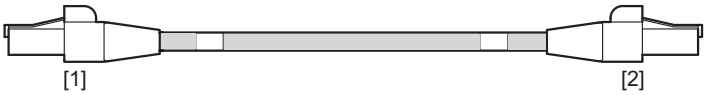
Using the wrong cables.

Inverter damage can occur.

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.

4.9.1 System bus cable

Figure of the cable



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[1] Connector, red [2] Connector, red

The 4-pin system bus cable for EtherCAT® and SBus^{PLUS} is used between the automation components. Some of these components are listed here as examples:

- MOVI-C® CONTROLLER
- MOVITRAC® advanced inverter
- PC with MOVISUITE® engineering software
- MOVI-PLC® I/O system
- Other EtherCAT® stations on the EtherCAT®/SBus^{PLUS}

The following lengths of the system bus cable are available for fixed installation.

Cable length	Part number	Cable assignment for MOVITRAC® advanced
0.29 m	18179959	MCX91A-.. with devices not directly next to each other
0.75 m	18167039	MCX91A-.. with devices not directly next to each other
1.5 m	18179975	MCX91A-.. with devices not directly next to each other
3.0 m	18167047	MCX91A-.. with devices not directly next to each other
5 m	18179983	MCX91A-.. with devices not directly next to each other
10 m	18179991	MCX91A-.. with devices not directly next to each other

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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.

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	

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5 General information

5.1 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.

5.2 Structure of the safety notes

5.2.1 Meaning of signal words

The following table shows the grading and meaning of the signal words for safety notes.

Signal word	Meaning	Consequences if disregarded
⚠ **DANGER**	Imminent hazard	Severe or fatal injuries
⚠ **WARNING**	Possible dangerous situation	Severe or fatal injuries
⚠ **CAUTION**	Possible 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.	

5.2.2 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.

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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 about suspended load
	Warning of automatic restart

5.2.3 Structure of embedded safety notes

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

This is the formal structure of an embedded safety note:

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

5.3 Decimal separator in numerical values

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

Example: 30.5 kg

5.4 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.

5.5 Content of the documentation

This documentation contains additional safety-related information and conditions for operation in safety-related applications.

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5.6 Other applicable documentation

Observe the corresponding documentation for all additional components.

5.7 Product names and trademarks

The brands and product names in this documentation are trademarks or registered trademarks of their respective titleholders.

5.7.1 Trademark of Beckhoff Automation GmbH

EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

5.7.2 Trademark of Beckhoff Automation GmbH

Safety over EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

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5.7.3 Trademarks of ODVA, Inc.

EtherNet/IP™, CIP™, CIP Safety™, ODVA® and ODVA CONFORMANT® are registered trademarks of ODVA, Inc.

5.8 Copyright notice

© 2022 SEW-EURODRIVE. All rights reserved. Unauthorized reproduction, modification, distribution or any other use of the whole or any part of this documentation is strictly prohibited.

5.9 Graphic presentation of the devices

In the present documentation, the inverters are shown with a plugged-in keypad only when that is necessary for explaining a presentation, a function, or an instruction.

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6 Safety notes

6.1 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.

6.2 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:

- National and regional safety and accident prevention regulations
- Warning and safety signs on the product
- All other relevant project planning documents, installation and startup instructions, and wiring diagrams
- Do not assemble, install or operate damaged products
- All system-specific specifications and conditions

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.

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6.3 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 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 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.

6.4 Network security and access protection

A bus system makes it possible to adapt electronic drive technology components to the particulars of the machinery within wide limits. There is a risk that a change of parameters that cannot be detected externally may result in unexpected but not uncontrolled system behavior and may have a negative impact on operational safety, system availability, or data security.

Ensure that unauthorized access is prevented, especially with respect to Ethernet-based networked systems and engineering interfaces.

Use IT-specific safety standards to increase access protection to the ports. For a port overview, refer to the respective technical data of the device in use.

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6.5 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.

Do not connect any other loads to the product. Never connect capacitive loads to the product.

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

- AC asynchronous motors with squirrel-cage rotor
- Permanent-field 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.

6.5.1 Hoist 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 is not permitted. In this control mode only applications of horizontal materials handling are permitted.

6.5.2 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.

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6.6 Functional safety technology

The product must not perform any safety functions without a higher-level safety system unless explicitly allowed by the documentation.

6.7 Transport

Inspect the shipment for damage as soon as you receive the delivery. Inform the shipping company immediately about any damage. If the product is damaged, it must not be assembled, installed or started up.

Observe the following notes when transporting the device:

- Ensure that the product is not subject to mechanical impact.

If necessary, use suitable, sufficiently dimensioned handling equipment.

Observe the information on climatic conditions in chapter "Technical data" of the documentation.

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6.8 Installation/assembly

Ensure that the product is installed and cooled according to the regulations in this documentation.

Protect the product from strong mechanical strain. Ensure that components are not deformed and insulation spaces are not changed, particularly during transportation and handling. Electrical components must not be mechanically damaged or destroyed.

Observe the notes in the chapter "Mechanical installation".

6.8.1 Restrictions of use

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

- Use in potentially explosive atmospheres
- 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

The product can be used at altitudes above 1000 m above sea level up to 3800 m above sea level under the following conditions:

- Taking the reduced continuous rated current into consideration, see the chapter "Technical data" of the documentation.
- Above 2000 m above sea level, the air and creeping distances are only sufficient for overvoltage class II according to EN 60664. If the installation requires overvoltage category III according to EN 60664 you have to reduce the overvoltages on the system side from category III to II using additional external overvoltage protection.
- If a protective electrical separation is required, then implement this outside the product at altitudes of more than 2000 m above sea level (protective separation in accordance with EN 61800-5-1 and EN 60204-1).

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6.9 Electrical installation

Ensure that all of the required covers are correctly attached after carrying out 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).

6.9.1 Required preventive measure

Make sure that the product is correctly attached to the ground connection.

6.9.2 Stationary application

Necessary preventive measure for the product:

Type of energy transfer	Preventive measure
Direct power supply	• Ground connection

6.9.3 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.

6.10 Protective separation

The product meets all requirements for protective separation of power and electronics connections in accordance with EN 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 EN 61800-5-1.

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6.11 Startup/operation

Observe the safety notes in chapters "Startup" and "Operation" in this documentation.

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.

When the device is switched on, dangerous voltages are present at all power connections as well as at any connected cables and terminals. This also applies even when the product is inhibited and the motor is at standstill.

Risk of burns due to arcing: Do not disconnect power connections during operation. Do not connect power connections 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 LED and other 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. Eliminating the cause of the problem or performing a reset may result in the drive restarting automatically. If, for safety reasons, this is not permitted for the drive-controlled machine, first disconnect the product from the supply system and then 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.

6.11.1 Energy storage unit

Products with a connected energy storage unit are not necessarily de-energized when they have been disconnected from the supply system. Usually, the energy storage unit stores sufficient energy to continue operation of the connected motors for a limited period of time. It is not sufficient to observe a minimum switch-off time.

Perform a shutdown as described in the documentation in the chapter "Service" > "Shutdown".

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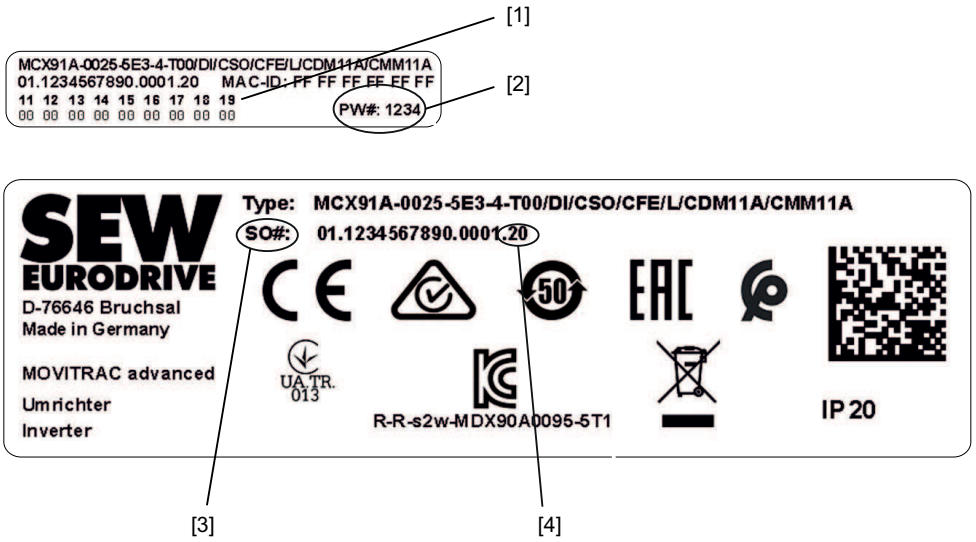
7 Device structure

7.1 Nameplates

The nameplates are presented as an example.

7.1.1 System nameplate

MCX91A-0010 – 0160-5E3.., MCX91A-0017 – 0093-2E3-.., MCX91A-0017 – 0110-2E1-..



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[1] Device status
[2] Master password MOVISAFE® CSB/CLS safety option
[3] Serial number
[4] Year of manufacture as part of the serial number. Example: 20 → year of manufacture 2020

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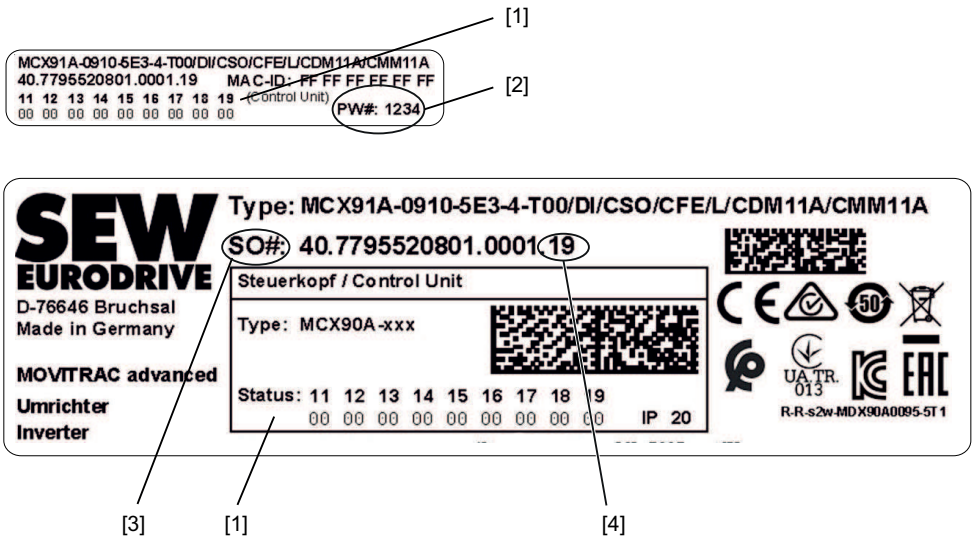
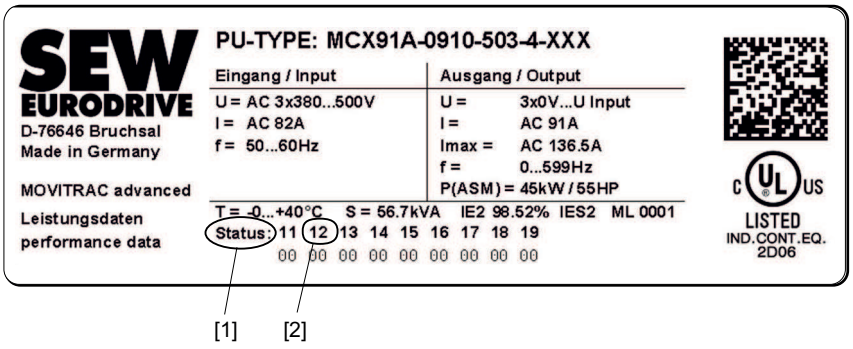
MCX91A-0240 – 1770-503-.., MCX91A-0213 – 1080-2E3-..



9007232359129867

[1] Device status
[2] Master password MOVISAFE® CSB/CLS safety option
[3] Serial number
[4] Year of manufacture as part of the serial number. Example: 19 → year of manufacture 2019

7.1.2 Performance data nameplate



9007232359127435

[1] Device status
[2] Firmware status

7.1.3 Product label

	Product label with QR code. 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.

7.2 Type code

Example: MCX91A-0125-5E3-4-T00		
Product name	MC	MOVITRAC®
Device type	X	• X = Single-axis inverter
Series	91	• 91 = With DC 24 V switched-mode power supply
Version	A	• A = Version status of the device series
Power class	0125	• 0125 = Nominal output current – e.g. 0125 = 12.5 A
Connection voltage	5	• 2 = AC 200 – 230 V • 5 = AC 380 – 500 V
EMC variant	E	• 0 = Basic interference suppression integrated • E = EMC filter limit value category C2 in accordance with EN 61800-3
Connection type	3	• 1 = Single-phase connection • 3 = Three-phase connection
Operating mode	4	• 4 = 4-quadrant operation
Variants	T	• 0 = Standard (without process data interface) • S = EtherCAT®/SBus^{PLUS} • T = Control via fieldbus • E = EtherCAT®/CiA402 device profile • L = Ethernet POWERLINK/CiA402 device profile
Technology level	0	• 0 = Standard design
Application level	0	• 0 = Standard/MOVIKIT® Velocity Drive • 1 = Activation of other MOVIKIT® modules • 2 = Customized solution
MOVIKIT®	/000	• 000 = Standard FCB control • 001 = MOVIKIT® Velocity Drive • ...
Unit designs		• /DI = MOVILINK® DDI • /CSO = STO PL d, control via input • /CSB = STO PL d, control via safe communication • /CSL = SBC, SLS, control via safe communication • /CFN = PROFINET communications variant • /CFNB = PROFINET communication variant • /CFE = EtherNet/IP^{TM} and Modbus TCP communications variant • /CFL = POWERLINK communications variant • /L = Design with coated printed circuit boards
Options		• /CMM = memory module • /CDM = diagnostic module

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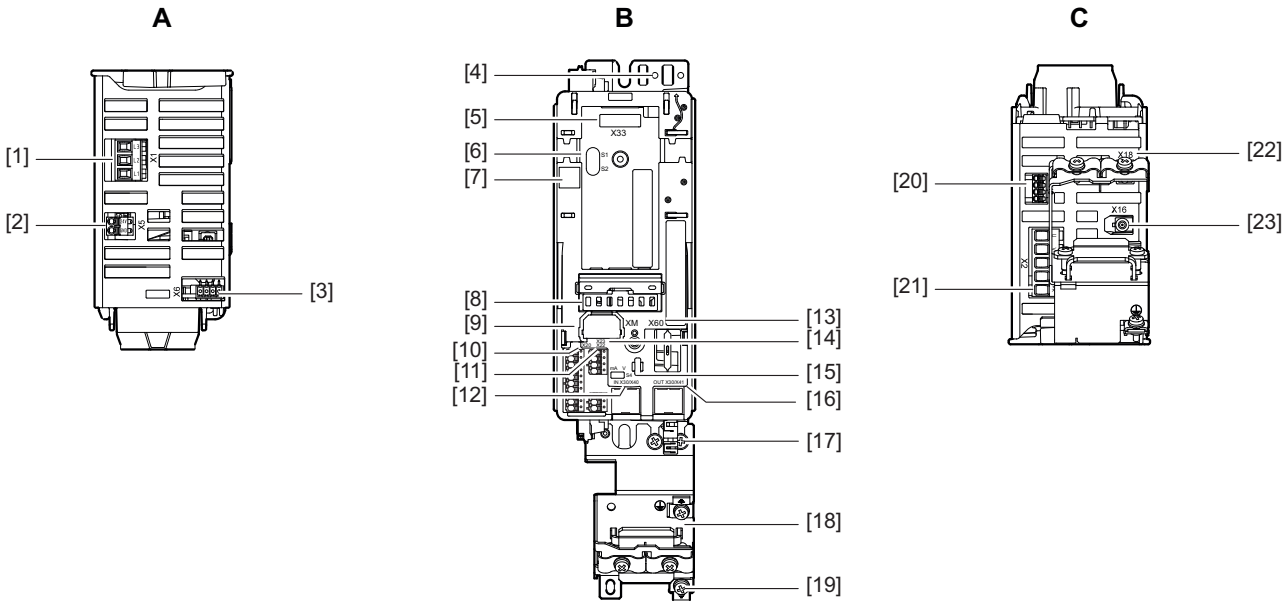
7.3 Device structure of the inverter

The elements shown in the device structures vary depending on the device variant.

7.3.1 MCX91A-0010 – 0055-5E3-4-.., MCX91A-0017 – 0055-2E3-4-.., MCX91A-0017 – 0042-2E1-4-.. (size 0S)



18014431160792203

A: View from top

[1] X1: Line connection

[2] X5: 24 V supply voltage

[3] X6: Connection for Safe Torque Off (STO)

B: View from front

[4] 2 × housing PE connection

[5] X33: Slot for CDM (access to service interface)

[6] S1/S2: EtherCAT® ID switch

[7] QR code product label

[8] Status LEDs

[9] Memory module

[10] X20: Digital inputs/outputs

[11] X22: Isolated relay contact

[12] X30/X40 IN: Fieldbus

[13] X60: Safe inputs/outputs

[14] X23: Analog inputs/outputs

[15] S4: Changeover analog input mA/V

[16] X30/X41 OUT: Fieldbus

[17] PE connection at housing

[18] Shield plate

[19] PE connection at housing

C: View from bottom

[20] X10: Brake control and motor temperature monitoring

[21] X2: Motor and braking resistor connection

[22] X18: Encoder connection

[23] X16: MOVILINK® DDI connection

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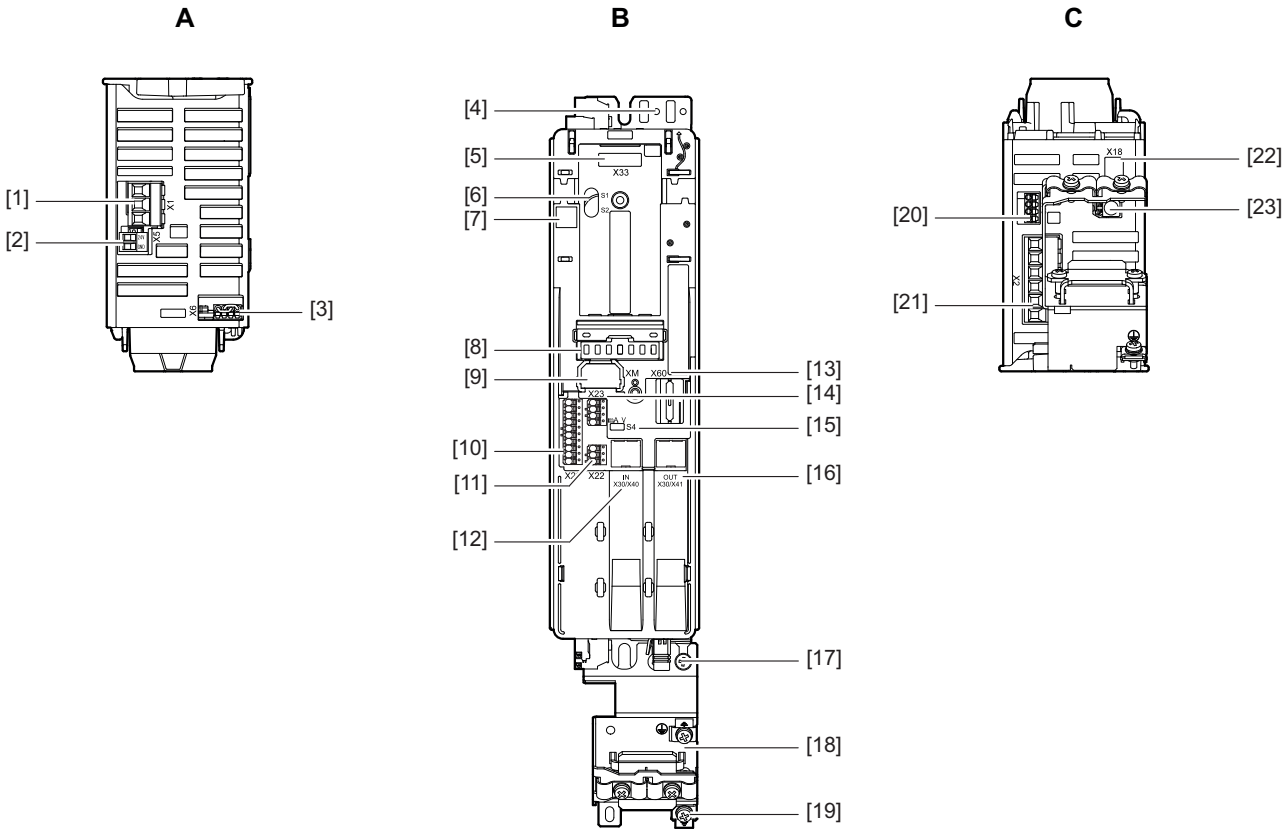
7.3.2 MCX91A-0070 – 0160-5E3-4-.., MCX91A-0070 – 0140-2E3-4-.., MCX91A-0055 – 0110-2E1-4-.. (size 0L)



9007231906048139

A: View from top

[1] X1: Line connection

[2] X5: 24 V supply voltage

[3] X6: Connection for Safe Torque Off (STO)

B: View from front

[4] 2 × housing PE connection

[5] X33: Slot for CDM (access to service interface)

[6] S1/S2: EtherCAT® ID switch

[7] QR code product label

[8] Status LEDs

[9] Memory module

[10] X20: Digital inputs/outputs

[11] X22: Isolated relay contact

[12] X30/X40 IN: Fieldbus

[13] X60: Safe inputs/outputs

[14] X23: Analog inputs/outputs

[15] S4: Changeover analog input mA/V

[16] X30/X41 OUT: Fieldbus

[17] PE connection at housing

[18] Shield plate

[19] PE connection at housing

C: View from bottom

[20] X10: Brake control and motor temperature monitoring

[21] X2: Motor and braking resistor connection

[22] X18: Encoder connection

[23] X16: MOVILINK® DDI connection

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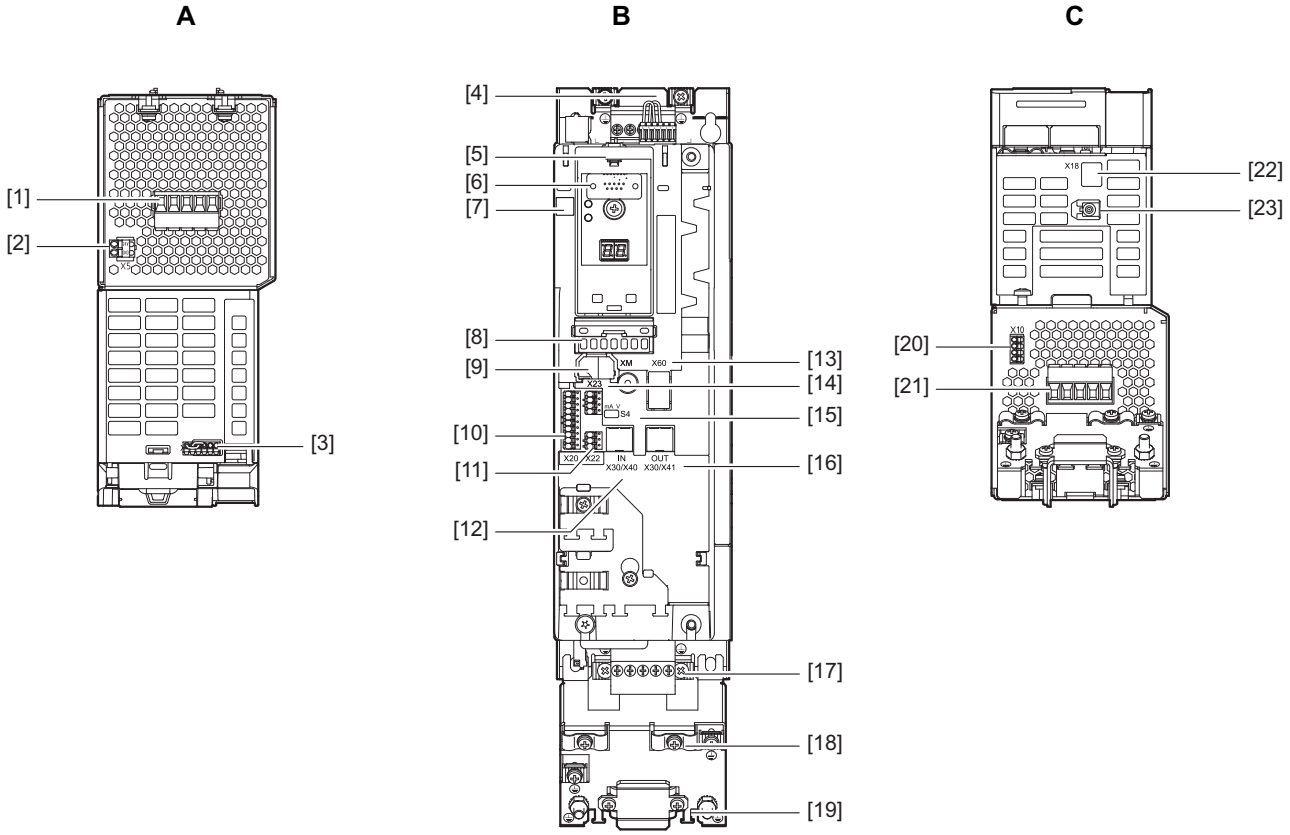
7.3.3 MCX91A-0240-5E3-4-.., MCX91A-0213-2E3-4-.. (size 3)



9007233010101771

A: View from top

[1] X1: Line connection

[2] X5: 24 V supply voltage

[3] X6: Connection for Safe Torque Off (STO)

B: View from front

[4] 2 × housing PE connection

[5] X33: Slot for CDM (access to service interface)

[6] S1/S2: EtherCAT® ID switch

[7] QR code product label

[8] Status LEDs

[9] Memory module

[10] X20: Digital inputs/outputs

[11] X22: Isolated relay contact

[12] X30/X40 IN: Fieldbus

[13] X60: Safe inputs/outputs

[14] X23: Analog inputs/outputs

[15] S4: Changeover analog input mA/V

[16] X30/X41 OUT: Fieldbus

[17] PE connection at housing

[18] Shield plate

[19] PE connection at housing

C: View from bottom

[20] X10: Brake control and motor temperature monitoring

[21] X2: Motor and braking resistor connection

[22] X18: Encoder connection

[23] X16: MOVILINK® DDI connection

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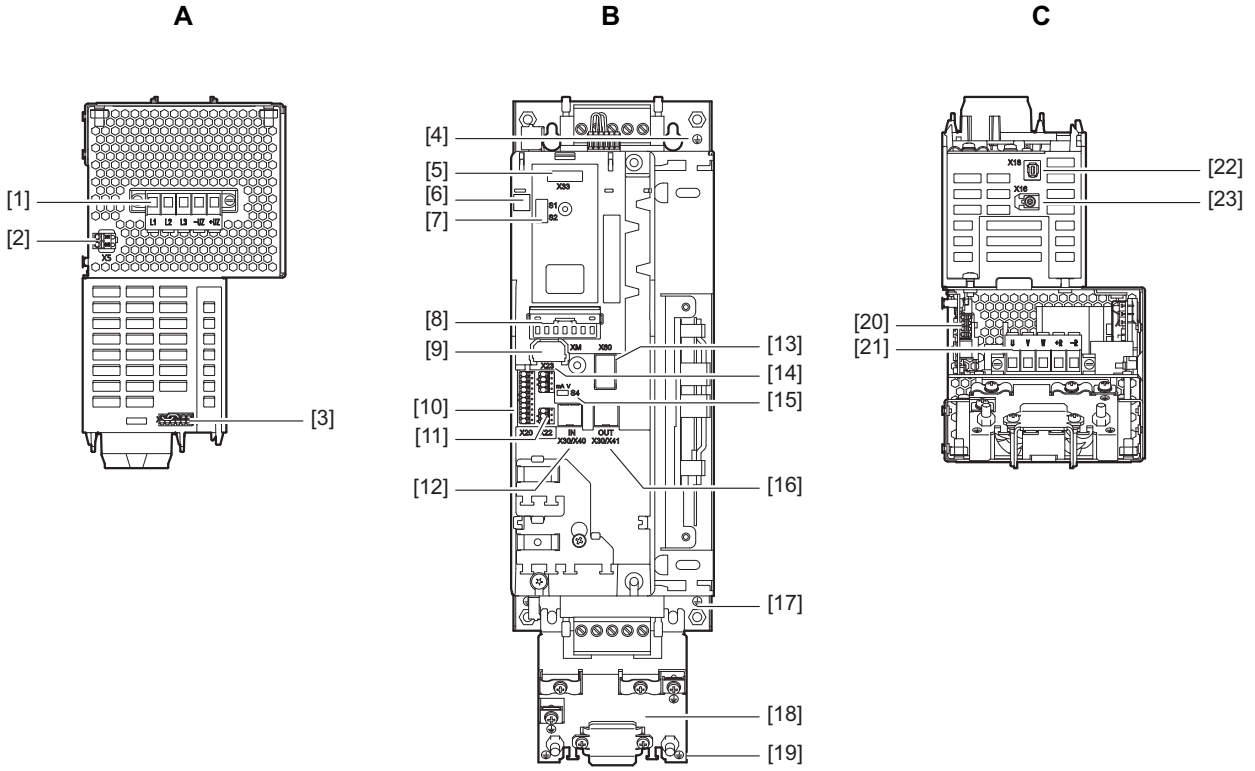
7.3.4 MCX91A-0320 – 0460-503-4-.., MCX91A-0290 – 0420-203-4-.. (size 4)



9007231820579851

A: View from top

[1] X1: Line connection

[2] X5: 24 V supply voltage

[3] X6: Connection for Safe Torque Off (STO)

B: View from front

[4] 2 × housing PE connection

[5] X33: Slot for CDM (access to service interface)

[6] QR code product label

[7] S1/S2: EtherCAT® ID switch

[8] Status LEDs

[9] Memory module

[10] X20: Digital inputs/outputs

[11] X22: Isolated relay contact

[12] X30/X40 IN: Fieldbus

[13] X60: Safe inputs/outputs

[14] X23: Analog inputs/outputs

[15] S4: Changeover analog input mA/V

[16] X30/X41 OUT: Fieldbus

[17] PE connection at housing

[18] Shield plate

[19] PE connection at housing

C: View from bottom

[20] X10: Brake control and motor temperature monitoring

[21] X2: Motor and braking resistor connection

[22] X18: Encoder connection

[23] X16: MOVILINK® DDI connection

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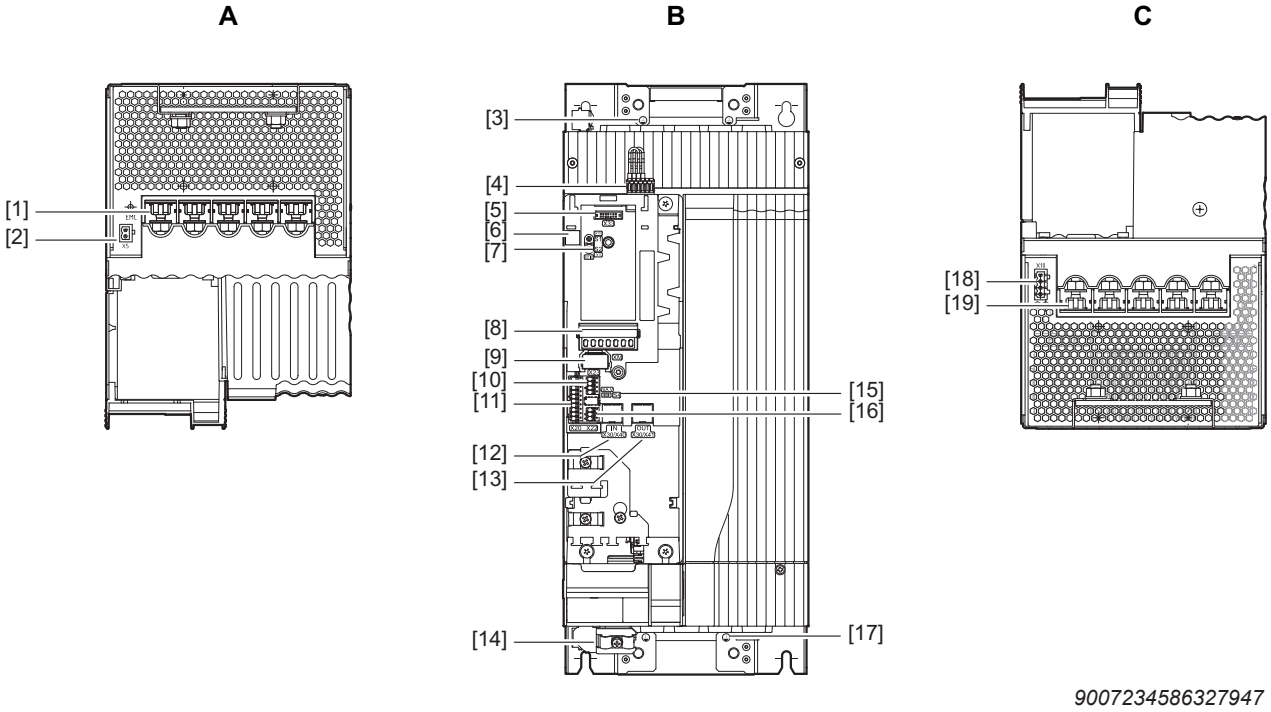
7.3.5 MCX91A-0620 – 0910-503-4-.., MCX91A-0570 – 0840-203-4-.. (size 5)



9007234586327947

A: View from top

[1] X1: Line connection

[2] X5: 24 V supply voltage

B: View from front

[3] PE connection at housing

[4] X6: Connection for Safe Torque Off (STO)

[5] X33: Slot for CDM (access to service interface)

[6] QR code product label

[7] S1/S2: EtherCAT® ID switch

[8] Status LEDs

[9] Memory module

[10] X23: Analog inputs/outputs

[11] X20: Digital inputs/outputs

[12] X30/X40 IN: Fieldbus

[13] X30/X41 OUT: Fieldbus

[14] Shield plate

[15] S4: Changeover analog input mA/V

[16] X22: Isolated relay contact

[17] PE connection at housing

C: View from bottom

[18] X10: Brake control and motor temperature monitoring

[19] X2: Motor and braking resistor connection

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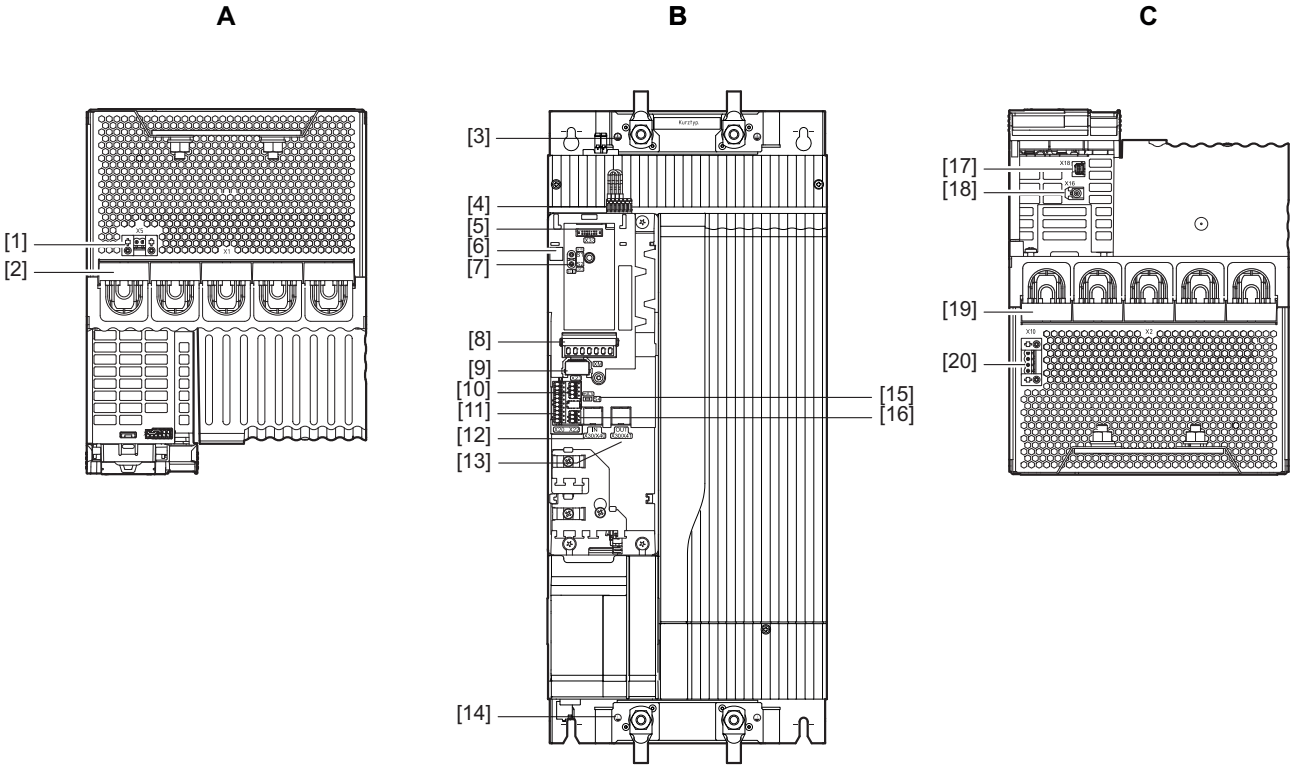
7.3.6 MCX91A-1130 – 1770-503-4-.., MCX91A-1080-203-4-.. (size 6)



9007234586331275

A: View from top

[1] X5: 24 V supply voltage
[2] X1: Line connection

B: View from front

[3] PE connection at housing
[4] X6: Connection for Safe Torque Off (STO)
[5] X33: Slot for CDM (access to service interface)
[6] QR code product label
[7] S1/S2: EtherCAT® ID switch
[8] Status LEDs
[9] Memory module
[10] X23: Analog inputs/outputs
[11] X20: Digital inputs/outputs
[12] X30/X40 IN: Fieldbus
[13] X30/X41 OUT: Fieldbus
[14] PE connection at housing
[15] S4: Changeover analog input mA/V
[16] X22: Isolated relay contact

C: View from bottom

[17] X18: Encoder connection
[18] X16: MOVILINK® DDI connection
[19] X2: Motor and braking resistor connection
[20] X10: Brake control and motor temperature monitoring

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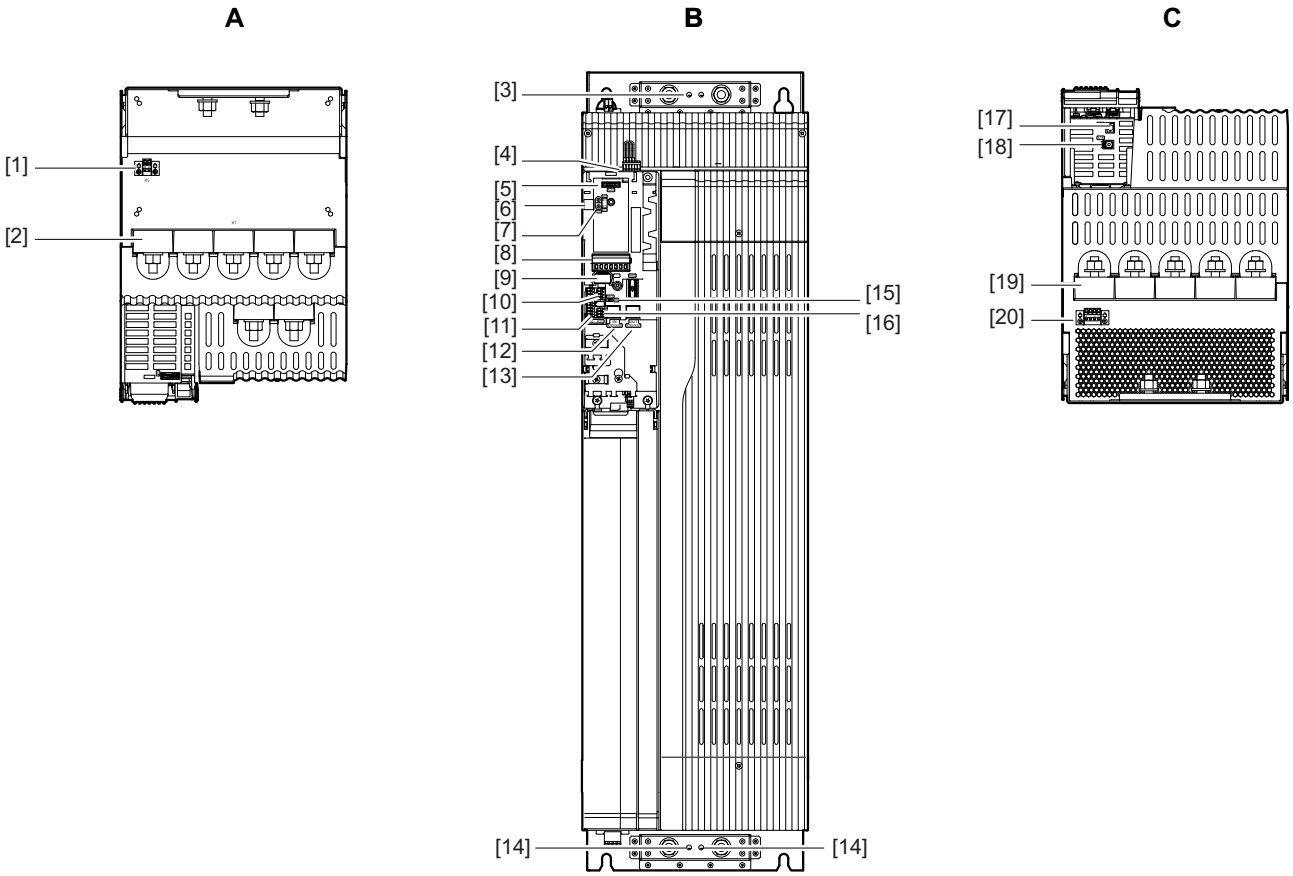
7.3.7 MCX91A-2200 – 3000-503-4-.. (size 7)



36226240395

A: View from top

[1] X5: 24 V supply voltage
[2] X1: Line connection

B: View from front

[3] PE connection at housing
[4] X6: Connection for Safe Torque Off (STO)
[5] X33: Slot for CDM (access to service interface)
[6] QR code product label
[7] S1/S2: EtherCAT® ID switch
[8] Status LEDs
[9] Memory module
[10] X23: Analog inputs/outputs
[11] X20: Digital inputs/outputs
[12] X30/X40 IN: Fieldbus
[13] X30/X41 OUT: Fieldbus
[14] PE connection at housing
[15] S4: Changeover analog input mA/V
[16] X22: Isolated relay contact

C: View from bottom

[17] X18: Encoder connection
[18] X16: MOVILINK® DDI connection
[19] X2: Motor and braking resistor connection
[20] X10: Brake control and motor temperature monitoring

8 Installation

8.1 Permitted tightening torques

MCX91A-....-5_3-..	0010 – 0055	0070 – 0160	0240	0320 – 0460	0620 – 0910	1130 – 1770	2200 – 3000	3800 – 4700
MCX91A-....-2_3-..	0017 – 0055	0070 – 0140	0213	0290 – 0420	0570 – 0840	1080	–	–
MCX91A-....-2_1-..	0017 – 0042	0055 – 0110	–	–	–	–	–	–

Screw connection		Tightening torques in Nm						
Line connection	X1	0.5 – 0.6		1.7 – 1.8	8.5 – 9.5	10 – 15	14 – 20	14 – 20
Motor and braking resistor connection	X2	0.5 – 0.6		1.7 – 1.8	8.5 – 9.5	10 – 15	14 – 20	14 – 20
Terminal screw for TN/IT systems	EMC	1.2 – 1.7	1 – 1.2					
PE connections		1.2 – 1.5		3 – 4	6 – 10	10 – 15	14 – 20	14 – 20
Other M4 screw connections at the shield plate and front option		1.4 – 1.6						

NOTICE

Failure to adhere to prescribed tightening torques.

Possible inverter damage.

- Always adhere to the stipulated tightening torques. Otherwise, excessive heat can develop, causing damage to the inverter.
- An excessive tightening torque can cause damage.

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8.2 Permissible cross-sections of the terminals

8.2.1 Single conductor, without conductor end sleeve, rigid and flexible

Inverter MOVITRAC® advanced	Terminal designation	Terminal type	Stripping length in mm	Cable cross section in mm²			
				Rigid		Flexible	
				Minimum	Maximum	Minimum	Maximum
Control unit							
All inverters	X20	Spring terminal	9	0.2	1.5	0.2	1.5
	X22		9	0.2	1.5	0.2	1.5
	X6		10	0.2	1.5	0.2	1.5
	X60		10	0.2	1.5	0.2	1.5
Power section							
All inverters	X5	Spring terminal	10	0.2	2.5	0.2	2.5
MCX91A-0010 – 0160-5E3-..	X10		10	0.2	1.5	0.2	1.5
MCX91A-0240 – 0460-503-..	X10		10	0.2	1.5	0.2	1.5
MCX91A-0620 – 1770-503-..	X10		10	0.2	2.5	0.2	2.5
MCX91A-0010 – 0055-5E3-..	X1	Screw terminal[1].	8	0.2	2.5	0.2	2.5
MCX91A-0070 – 0160-5E3-..	X1		10	0.2	10	0.2	6
MCX91A-0240-5E 3-..	X1		10	0.2	10	0.2	6
MCX91A-0320 – 0460-503-..	X1		12	0.75	16	0.75	16
MCX91A-0010 – 0055-5E3-..	X2		8	0.2	2.5	0.2	2.5
MCX91A-0070 – 0160-5E3-..	X2		10	0.2	10	0.2	6
MCX91A-0240-5E 3-..	X2		10	0.2	10	0.2	6
MCX91A-0320 – 0460-503-..	X2		12	0.75	16	0.75	16

1) SEW-EURODRIVE recommends using conductor end sleeves for installation with screw terminals and a flexible conductor

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8.2.2 Single conductor, without conductor end sleeve, with or without plastic collar

Inverter MOVITRAC® advanced	Terminal designation	Terminal type	Stripping length in mm	Cable cross section in mm²			
				Plastic collar			
				With		Without	
				Minimum	Maximum	Minimum	Maximum
Control unit							
All inverters	X20	Spring terminal	9	0.25	1.5	0.25	0.75
	X22		9	0.25	1.5	0.25	0.75
	X6		10	0.14	0.75	0.25	1.5
	X60		10	0.14	0.75	0.25	1.5
Power section							
All inverters	X5	Spring terminal	10	0.25	2.5	0.25	2.5
MCX91A-0010 – 0160-5E3-..	X10		14	0.14	0.75	0.25	1.5
MCX91A-0240 – 0460-503-..	X10		10	0.14	0.75	0.25	1.5
MCX91A-0620 – 1770-503-..	X10	Screw terminal	10	0.25	2.5	0.25	2.5
MCX91A-0010 – 0055-5E3-..	X1		8	0.25	2.5	0.25	2.5
MCX91A-0070 – 0160-5E3-..	X1		10	0.25	4	0.25	6
MCX91A-0240-5E3-..	X1		10	0.25	4	0.25	6
MCX91A-0320 – 0460-503-..	X1		12	0.5	10	0.5	16
MCX91A-0010 – 0055-5E3-..	X2		8	0.25	2.5	0.25	2.5
MCX91A-0070 – 0160-5E3-..	X2		10	0.25	4	0.25	6
MCX91A-0240-5E3-..	X2		10	0.25	4	0.25	6
MCX91A-0320 – 0460-503-..	X2		12	0.5	10	0.5	16

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8.2.3 Double conductor, without conductor end sleeve, with plastic collar

Inverter MOVITRAC® advanced	Terminal designation	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 inverters	X20	Spring terminal	-	-	-	-	-
	X22		-	-	-	-	-
	X6		-	-	-	-	-
	X60		-	-	-	-	-
Power section							
All inverters	X5	Spring terminal	10	0.5	1.5	-	-
MCX91A-0010 – 0160-5E3-..	X10		14	-	-	-	-
MCX91A-0240 – 0460-503-..	X10		10	-	-	-	-
MCX91A-0620 – 1770-503-..	X10	Screw terminal	10	0.5	1.5	-	-
MCX91A-0010 – 0055-5E3-..	X1		8	0.5	1	0.25	1
MCX91A-0070 – 0160-5E3-..	X1		10	0.25	2.5	0.25	1.5
MCX91A-0240-5E3-..	X1		10	0.25	2.5	0.25	1.5
MCX91A-0320 – 0460-503-..	X1		12	0.5	6	0.5	4
MCX91A-0010 – 0055-5E3-..	X2		8	0.5	1	0.25	1
MCX91A-0070 – 0160-5E3-..	X2		10	0.25	2.5	0.25	1.5
MCX91A-0240-5E3-..	X2		10	0.25	2.5	0.25	1.5
MCX91A-0320 – 0460-503-..	X2		12	0.5	6	0.5	4

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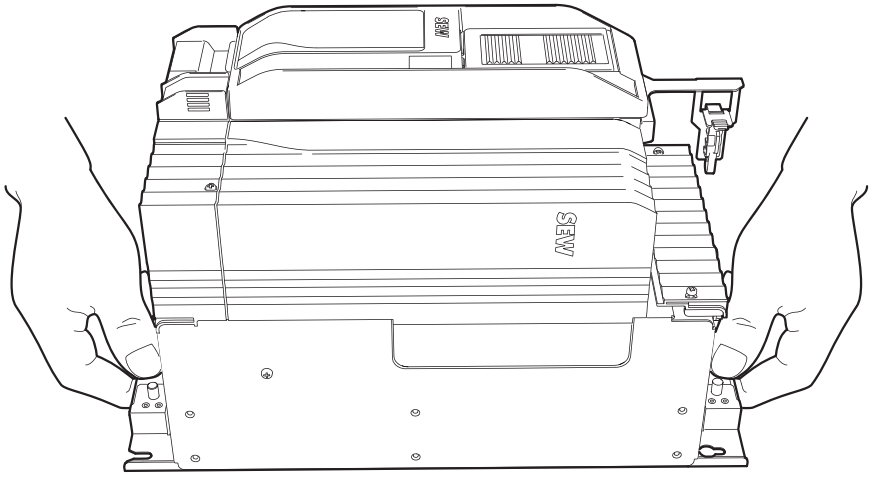
8.3 Special aspects when transporting the devices

The rear wall of the housing of the following devices is designed in such a way that you can grip them securely by hand to lift and transport the inverters without damaging them.

- MCX91A-0620 – 1770-5_3-..
- MCX91A-0570 – 1080-203-..



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NOTICE

Incorrect lifting and transporting of the inverter.

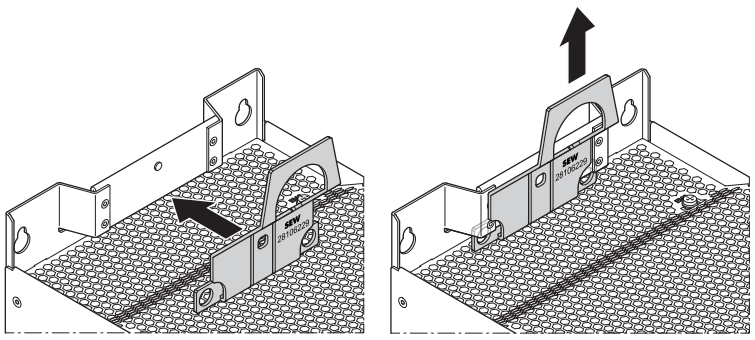
Inverter damage can occur.

- When you lift or transport the inverter, use only the intended handling points for transportation at the rear wall of the housing to avoid any damage. Do not grip the inverter at any plastic parts or covers when lifting it.

The following devices must be transported with a lifting eye due to their weight:

- MCX91A-1130 – 1770-5_3-..
- MCX91A-1080-203-..

The lifting eye is attached to the top of the housing; see the following figure.



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The lifting eye can be attached to hoists using suitable slings.

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8.4 Mechanical installation

⚠ CAUTION

Risk of injury to persons and damage to property.

Never install defective or damaged products.

- Before installing any products, check them for external damage. Replace any damaged products.

NOTICE

Risk of damage to property due to mounting surfaces with poor conductivity.

Inverter damage can occur.

- The mounting plate in the control cabinet must be conductive over a large area for the mounting surface of the inverter (metallically pure, good conductivity). An EMC-compliant installation of the inverter can only be achieved with a mounting plate that is conductive over a large area.

8.4.1 Bore patterns

Inverter	Dimensions of the device base plate in mm							Drilling template
	A	B	C	D	E	F	G	
MCX91A-0010 – 0055-5E3-.. MCX91A-0017 – 0042-2E3-.. MCX91A-0017 – 0042-2E1-..	80	40	220	200	12	6	10	1
MCX91A-0070 – 0160-5E3-.. MCX91A-0055 – 0093-2E3-.. MCX91A-0055 – 0110-2E1-..	80	40	309	288	12	6	10	
MCX91A-0240-5E3-.. MCX91A-0140 – 0213-2E3-..	105	80	350	325	12	6	18	2
MCX91A-0320 – 0460-5_3-.. MCX91A-0290 – 0570-2_3-..	135	80	350	325	12	6	18	
MCX91A-0620 – 0910-5_3-.. MCX91A-0840 – 1080-2_3-..	196	160	471	440	13	7	18	
MCX91A-1130 – 1770-5_3-..	240	200	544	510	13	7	18	
MCX91A-2200 – 3000-5_3-..	320	220	990	950	23	11	25	
MCX91A-3800 – 5880-5_3-..								

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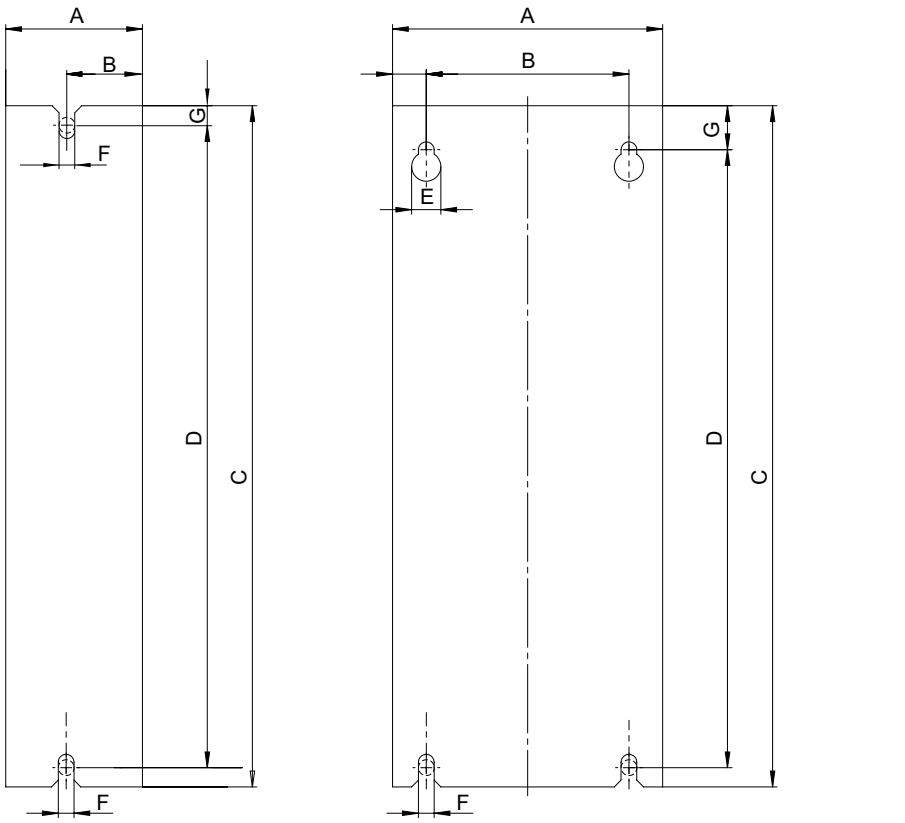

Hole pattern 1 Hole pattern 2

8.4.2 Minimum clearance and mounting position

When installing the inverters in the control cabinet, observe the following:

- 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 within the area of the warm exhaust air of other devices.
- Install the inverters only vertically. Do not install them horizontally, tilted or upside down.
- Clearance at the side is not necessary. The units can be arranged directly next to one another.

INFORMATION

Special bending spaces are required according to EN 61800-5-1 for cables with a cross section of 10 mm^2 and larger. This means the clearance must be increased if required.

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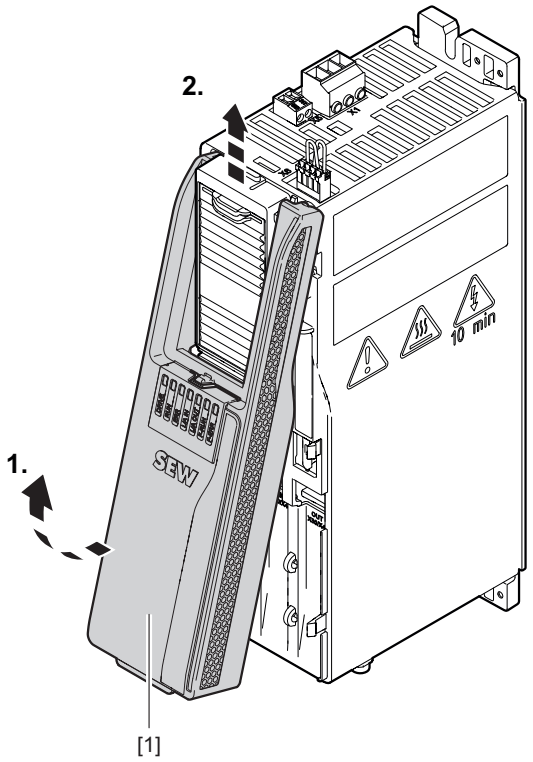
8.5 Covers

8.5.1 Safety covers

The inverter is equipped with a safety cover [1].

Removing the safety cover



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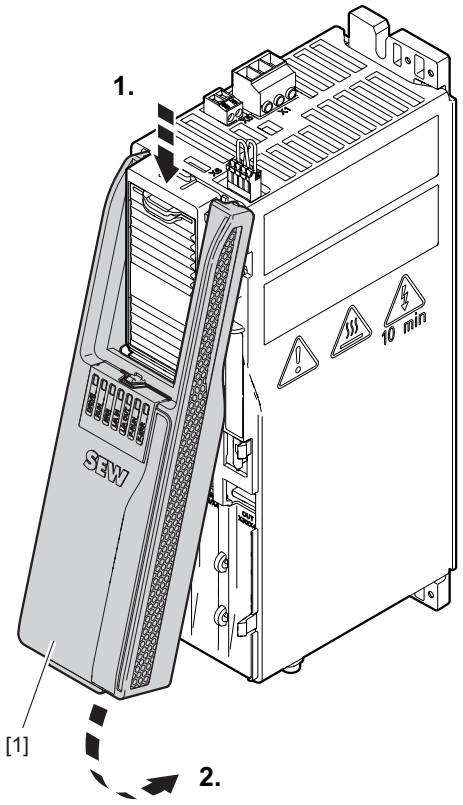
1. The safety cover [1] has a latching mechanism at the bottom. Pull the lower part of the safety cover away from the inverter to unlatch it.
2. Pivot the safety cover forward and lift it to remove it from the application inverter.

Installing the safety cover



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3. Place the safety cover [1] into the upper recess and move it towards the inverter until it clicks into place.
4. Always install the safety cover [1] after having worked on the application inverter.

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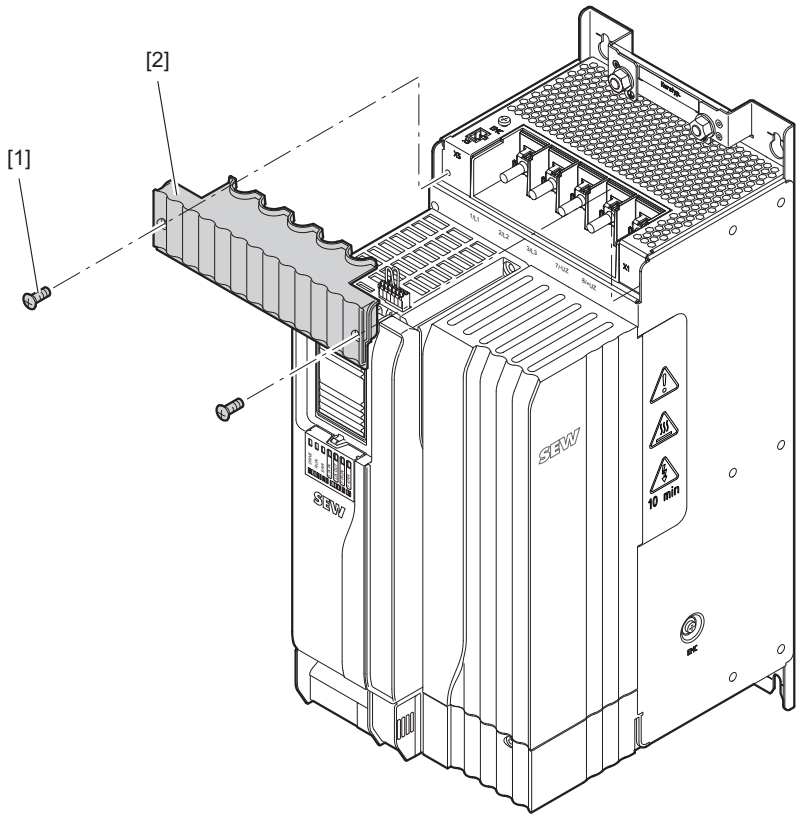
8.5.2 Touch guards

With the following devices, the touch guards must be removed for the line connection and the connection of the motor and the braking resistor:

- MCX91A-0620 – 1770-503-..
- MCX91A-0570 – 1080-203-..

Line connection



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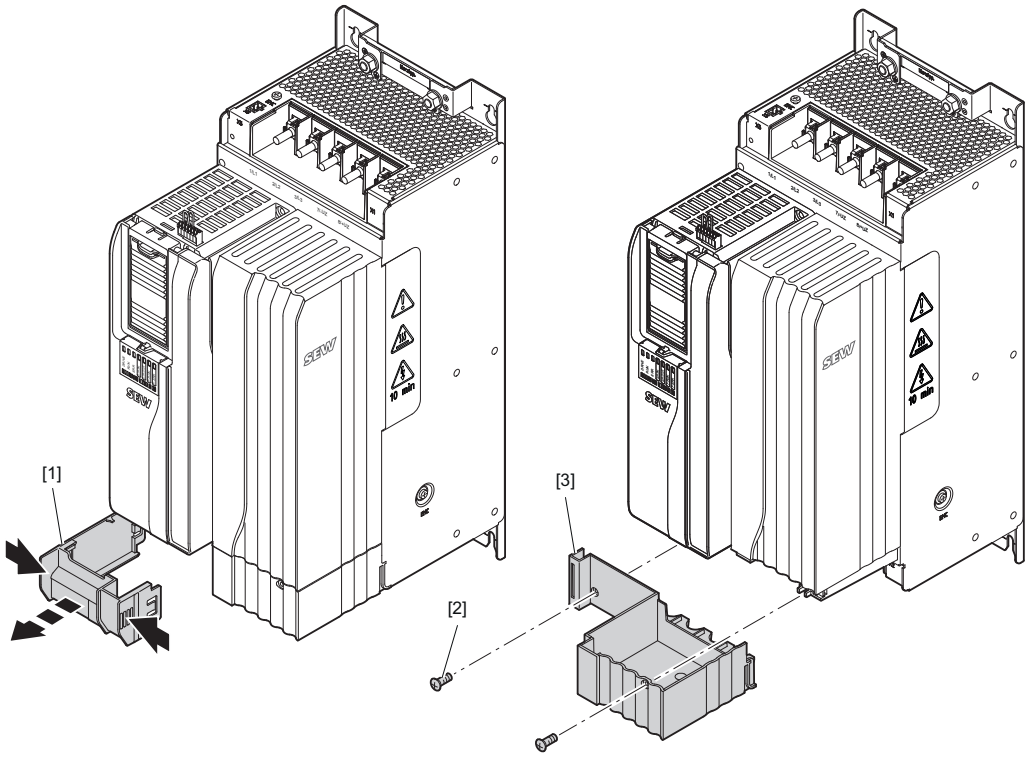
1. Remove the 2 screws [1] on the upper touch guard [2].
2. Remove the touch guard [2].

Connection motor/ braking resistor



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3. Push the plastic clips of the touch guard [1] to the inside and remove the touch guard [1] by moving it to the front.
4. Remove the 2 screws [2] and remove the touch guard [3] by moving it to the front.

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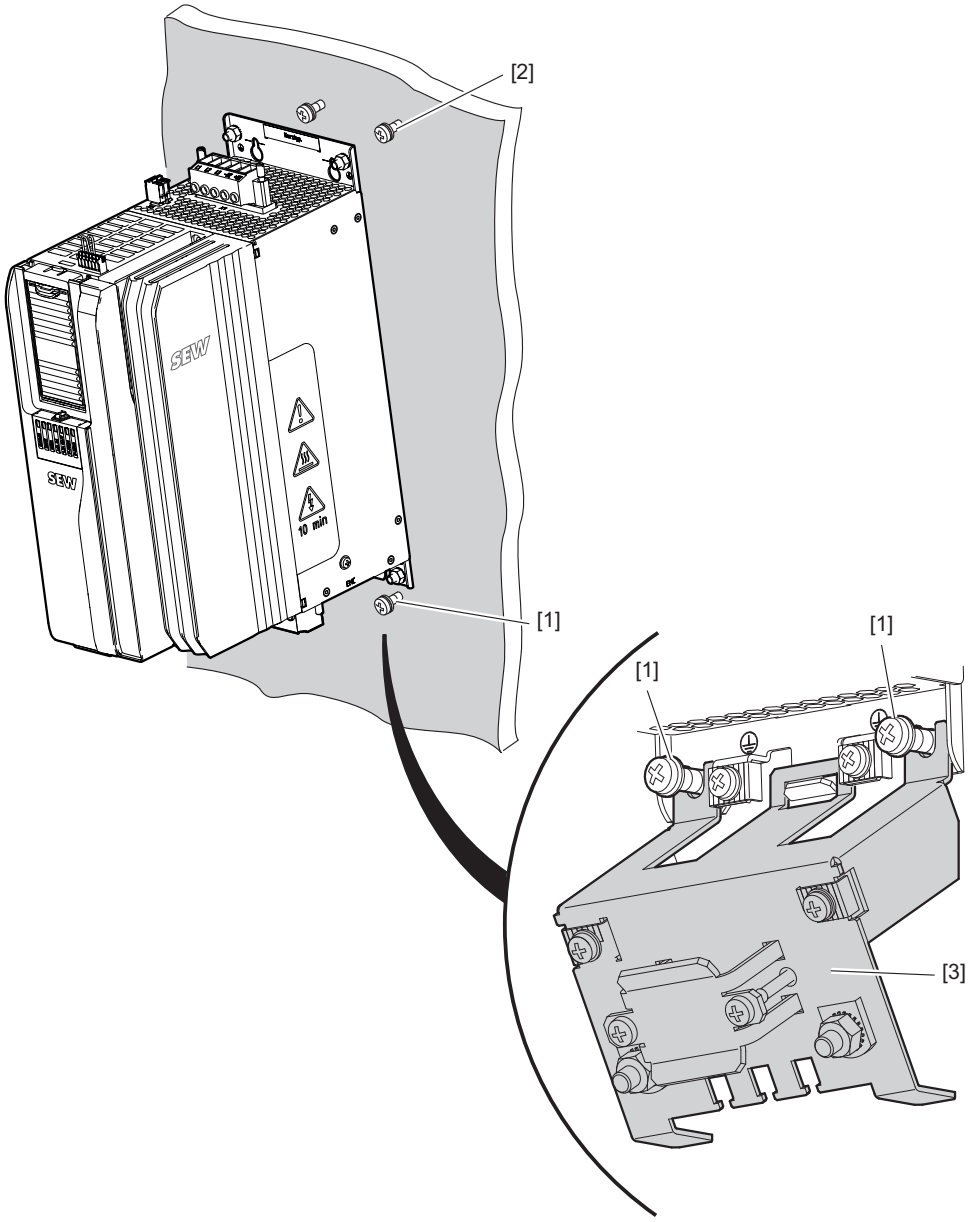
8.6 Control cabinet installation

8.6.1 Inverter and bottom shield plate

The retaining screws [1] and [2] are screwed into the prepared tapped holes in the mounting plate in the control cabinet but not tightened.

1. Place the inverter with the slotted holes in the device base plate onto the retaining screws [1] from the top.



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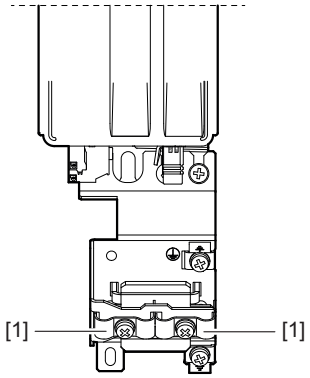
2. Push the inverter backwards to insert the retaining screws [2] into the upper holes in the device base plate.
3. Lower the inverter.
4. Install the shield plate [3] as shown above. This work step applies to the inverters MCX9_A-0010 – 0460-5_3-.. and MCX9_A-0017 – 0420-2_3-..
5. Tighten the retaining screws [1] and [2].

8.6.2 Special aspects of the lower shield plate

Cables with RJ45 connectors must be mechanically fastened to the lower shield plate.

With the following inverters, the cables must be attached to the screw connection points [1] of the lower shield plate.

- MCX91A-0010 – 0160-5_3-..
- MCX91A-0017 – 0140-2_3-..
- MCX91A-0017 – 0110-2_1-..



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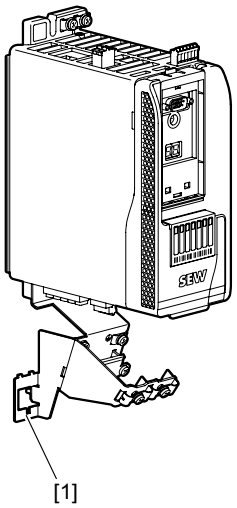
[1] Screw connection points

8.6.3 CLH21A shield plate extension

The CLH21A shield plate extension (mounting rail at a standard shield plate) is used to mount additional terminal blocks or modules to the converter shield plate.

The brake rectifier from SEW-EURODRIVE or a multi-level terminal block, for example, can be attached to the CLH21A.



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[1] Shield plate extension

8.7 Electrical installation

⚠ DANGER

Dangerous voltage levels may still be present inside the device and at the terminal strips up to 10 minutes after the inverter has been disconnected from the power supply.

Severe or fatal injuries from electric shock can occur.

To prevent electric shocks:

- Disconnect the inverter from the power supply and wait 10 minutes before removing the safety covers.

⚠ DANGER

A leakage current > 3.5 mA can occur when operating the inverter.

Severe or fatal injuries from electric shock can occur.

To avoid dangerous shock currents in accordance with EN 61800-5-1, strictly observe the following:

- 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 PE conductor with a cable cross-section of 10 mm^2.
- Supply system cable 10 mm^2 – 16 mm^2:
  - Route a copper PE conductor with the cable cross-section of the supply system cable.
- Supply system cable 16 mm^2 – 35 mm^2:
  - Route a copper protective earth 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 a residual current device is used for protection against direct and indirect contact in isolated cases, it must be universal current-sensitive (RCD type B).

INFORMATION

Installation with protective separation.

The inverter meets all requirements for protective separation of power and electronics connections in accordance with EN 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.

8.7.1 General 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 connection to the screws in order to prevent litz strands from escaping.

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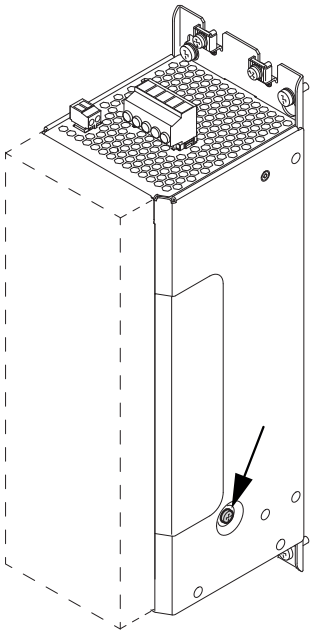
8.7.2 Permitted voltage systems

Information on voltage systems	Information on 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 adhering to specific measures. The measures are described in chapter "Use in IT systems".
Voltage systems with grounded outer conductor.	Use only for nominal line voltages up to max. 240 V.

8.7.3 Use in IT systems

To ensure IT system capability, the terminal screw shown in the following figures must be removed from the inverter.

Inverters	Position of the terminal screw
MCX91A-0010 – 0160-5_3-.. MCX91A-0017 – 0140-2_3-.. MCX91A-0017 – 0110-2_1-..	See chapter "Deactivating the EMC capacitors" (→ 🗎 235).
MCX91A-0240 – 0460-5_3-.. MCX91A-1130 – 1770-503-.. MCX91A-0213 – 0420-2_3-.. MCX91A-1080-203-..	

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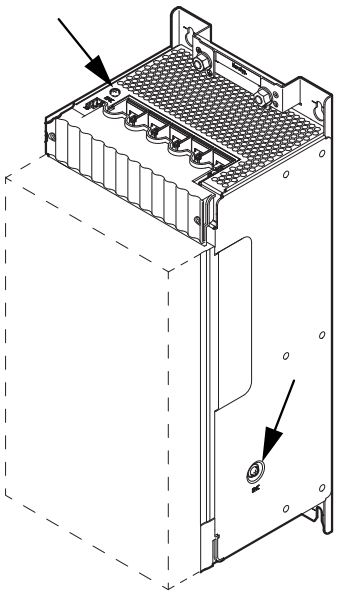
Inverters	Position of the terminal screw
MCX91A-0620 – 0910-503-.. MCX91A-0570 – 0840-203-..	

INFORMATION

EMC limit values

No EMC limit values are specified for interference emission in voltage supply systems without a grounded star point (IT systems). The effectiveness of line filters is severely limited.

Deactivating the EMC capacitors

With the devices MCX91A-0010 – 0160-5E3-.., MCX91A-0017 – 0140-2E3-.., and MCX91A-0017 – 0110-2_1-.., the EMC capacitors are deactivated as described below.

1. Disconnect the inverter from the power.
2. Check if the inverter is de-energized.
3. Remove all connectors.
4. If applicable: Remove the filler plug at terminal position X6.
5. Remove the CDM11A diagnostic module.
6. Remove the electronics shield clamp.
7. Remove the retaining screws in the center of the housing front.
8. Remove the housing.
9. **⚠ CAUTION!**
   Destruction of the device. Touch the printed circuit board only at the edge, never at electronic components.

   Remove both retaining screws [1] and [2] from the printed circuit board.
10. Place both screws into the plastic insulation pieces included in the delivery.
11. Re-fasten the screws to the printed circuit board.
12. Close the unit.

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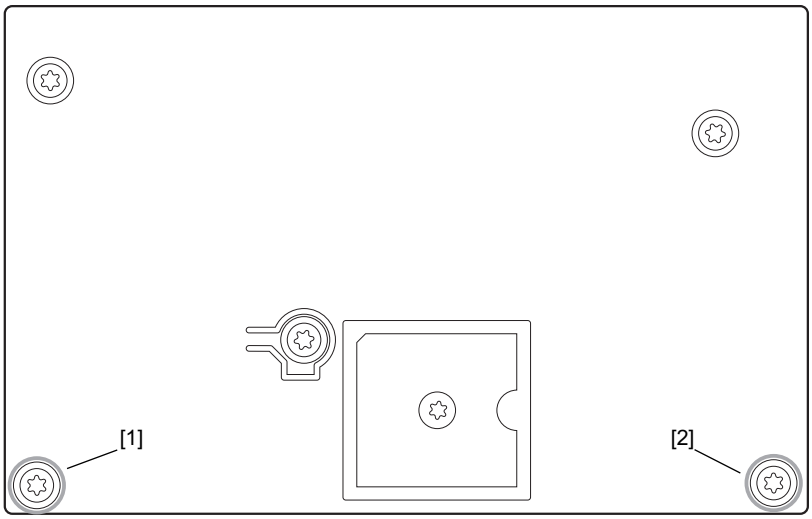
13. Identify the device by marking the respective point on the nameplate.



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8.7.4 Line fuses, fuse types

Type class	Requirement
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 10% higher than the nominal line current of the inverter

8.7.5 Line connection

- The line contactor must always be located upstream of the line filter.
- Use only line contactors of utilization category AC-3 (EN 60947-4-1) or higher.
- Do not use the line contactor for jog mode, but only for switching the inverter on and off. The FCB 20 "Jog" must be used for jog mode.
- Observe the required dimensioning of the cable cross-section for UL-compliant installing.

For the terminal assignment for line connection of the various sizes, refer to chapter "Terminal assignment".

Observe a minimum switch-off time of 10 s for the inverter. Do not switch the power on more than once per minute.

NOTICE

Non-compliance with the minimum switch-on/switch-off times

Inverter damage can occur.

Adhere to the specified times and intervals.

- Observe the minimum switch-off time of 10 s before switching the power back on.

- With 3-phase devices, do not switch on the supply system more frequent than once every 60 seconds.
- With 1-phase devices, do not switch on the supply system more frequent than once every 120 seconds.

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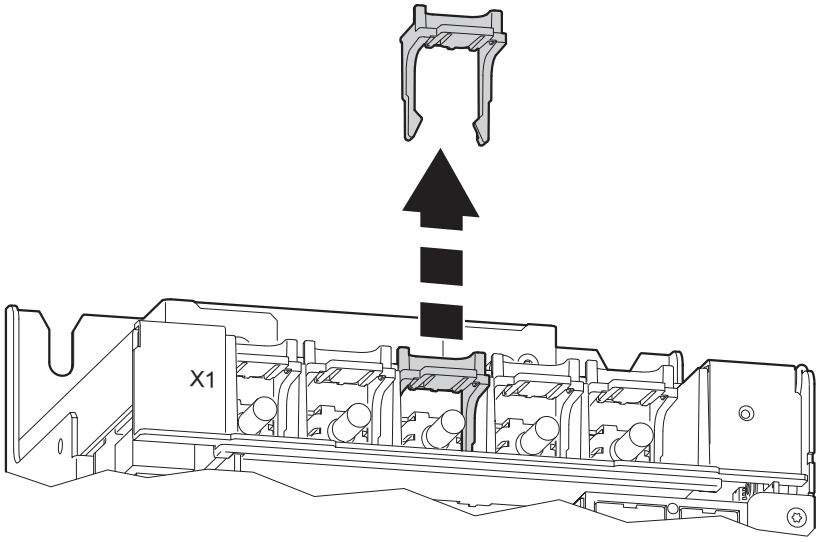
Special aspects for the line connection

Note that the IP20 degree of protection is achieved with the following devices only if the terminal studs are protected with special plastic covers against contact.

- MCX91A-0620 – 1770-5_3-..
- MCX91A-0570 – 1080-2_3-..

These covers must be ordered separately; see the chapter "Installation accessories" (→ 🗎 64).

1. Remove any plastic covers that are inserted in the terminal strip.



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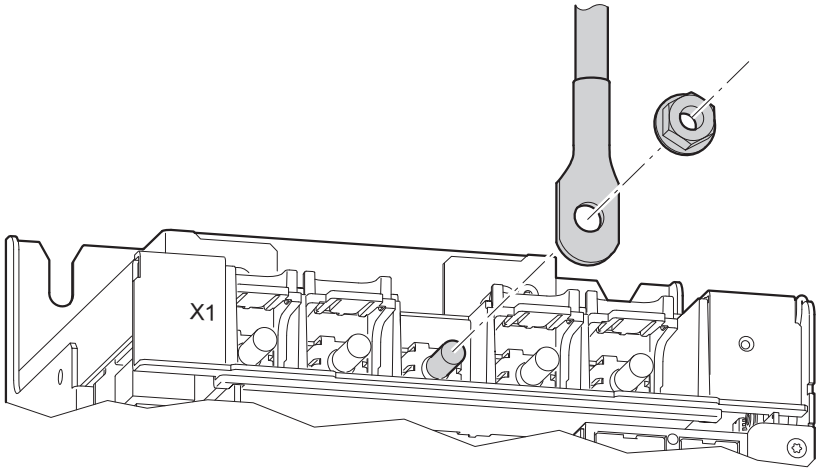
2. Connect the cables.



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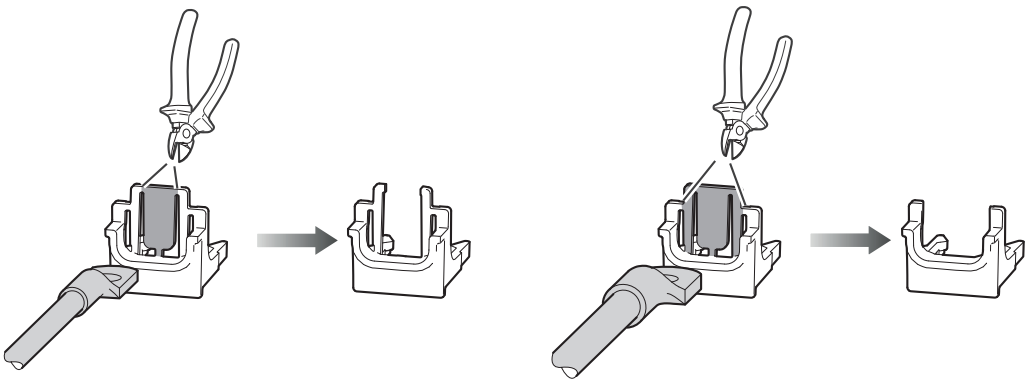
3. The plastic covers must be removed in different ways depending on the used cross section.



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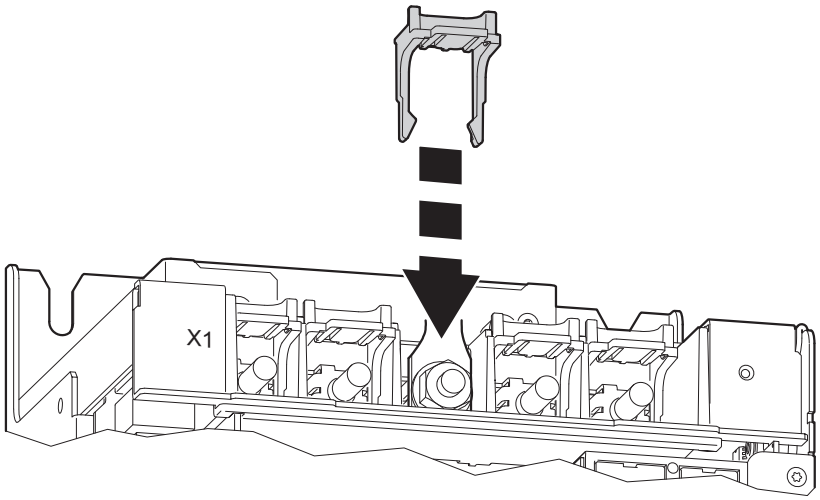
4. Attach the plastic covers at the individual connections.



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8.7.6 Motor connection

For the terminal assignment for motor connection of the various devices, refer to chapter "Terminal assignment".

NOTICE

Connecting capacitive loads to the inverter.

Damage to the inverter.

- Only connect ohmic/inductive loads (motors).
- Never connect capacitive loads.

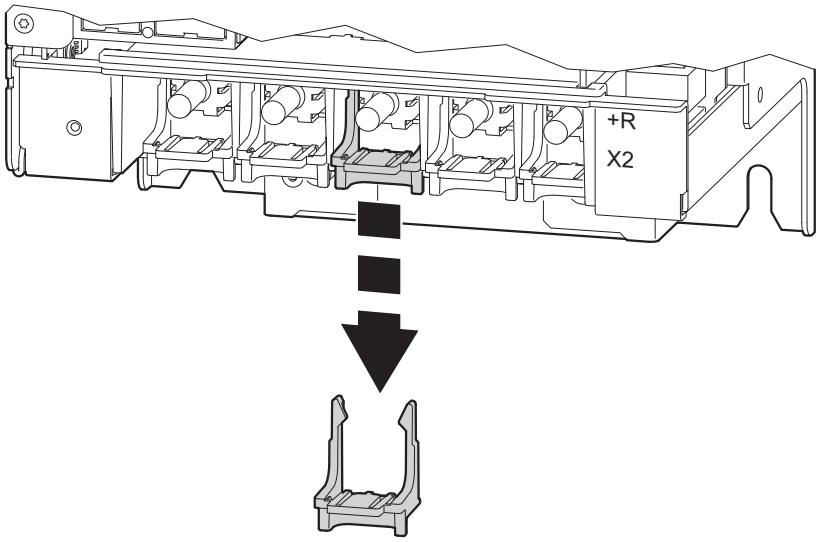
Special aspects for the motor connection

Note that the IP20 degree of protection is achieved with the following devices only if the terminal studs are protected with special plastic covers against contact.

- from MCX91A-0620 – 1770-5_3-..
- from MCX91A-0570 – 1080-2_3-..

These covers must be ordered separately, see the chapter "Installation accessories" (→ 🗎 64).

1. Remove any plastic covers that are inserted in the terminal strip.



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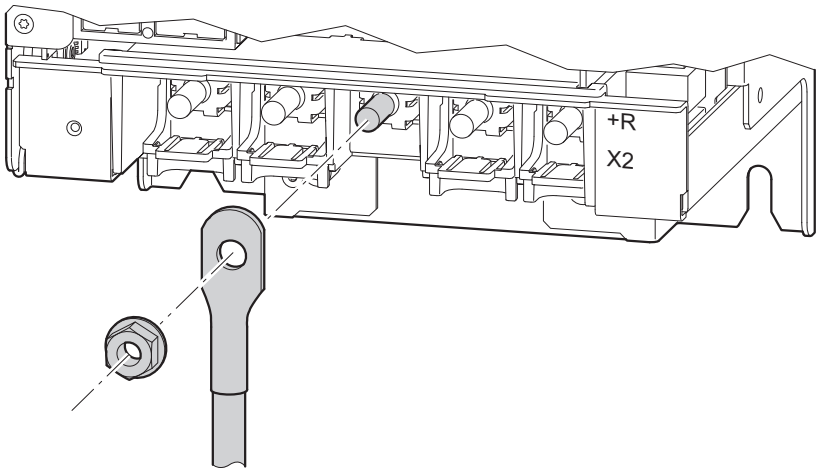
2. Connect the cables.



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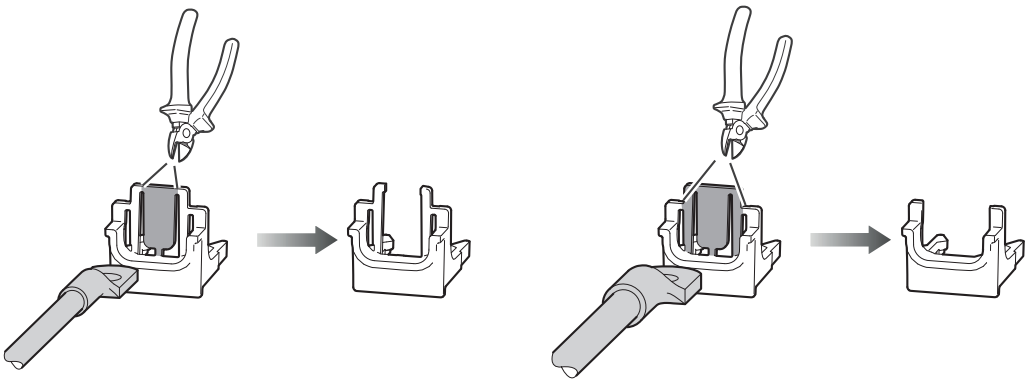
3. The plastic covers must be removed in different ways depending on the used cross section.



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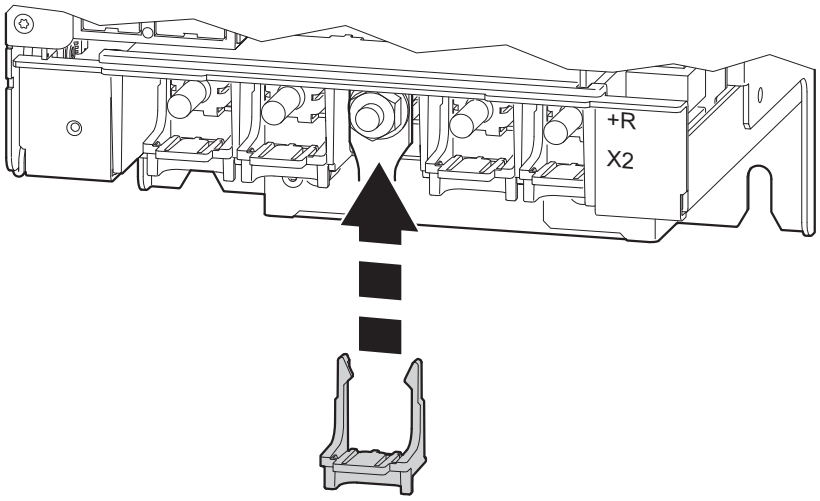
4. Attach the plastic covers at the individual connections.



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8.7.7 Line contactor

The following table provides an overview of when a line contactor is required and what kind of preventive measures must be taken for the used braking resistor, see also chapter "Protection of the braking resistor against thermal overload" in the Product Manual.

Inverter type	Braking resistor type	Protective element/preventive measure	Line contactor required?
MCX91A-0010 – 0240-5E3-..	No BR	–	no
	BW... flat design	–	no
MCX91A-0017 – 0213-2E3-..	BW... as PTC	–	no
	BW...	External bimetallic relay	yes
MCX91A-0017 – 0110-2E1-..	BW...-T	External bimetallic relay	yes
from MCX91A-0320-503-..	No BR	–	no
	BW... flat design	–	no
	BW... as PTC	–	no
	BW...	External bimetallic relay	no
from MCX91A-0290-203-..	BW...-T	Temperature contact evaluation	no
		External bimetallic relay	no

When connecting a braking resistor, an external DC 24 V voltage supply must be provided for the inverter with the following inverter types without line contactor:

- from MCX91A-0320-503-..
- from MCX91A-0290-203-..

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8.7.8 24 V supply voltage

The MCX91A-... inverters have an internal 24 V voltage supply that can also be supported externally.

For inverters of sizes 3 – 8, the 24 V switched-mode power supply has a power of 80 W.

For inverters of sizes 0S and 0L, the internal 24 V switched-mode power supply has a power of 15 W. Observe the following:

- Devices without safety option do not require an external backup voltage. In this case, a total of 300 mA is available at the outputs. The maximum load of the MOVILINK® DDI connection is 150 mA. The actual current consumption of the MOVILINK® DDI connection must be subtracted from the 300 mA.
- Devices with safety option (CSB, CSL) must have an external backup voltage. This backup voltage must not be interrupted; otherwise, the safety options are not supplied.
- The following applies to both cases:

  If the device is supported by an external supply, the entire supply is provided by the external power supply unit. In this case, the MOVILINK® DDI connection can be loaded with a maximum of 500 mA. For all other device outputs, the limitation of the technical data applies.

If a 24 V backup voltage is necessary, it must be switched on before the line voltage and switched off after the line voltage.

The maximally permitted length of the 24 V supply cable is 30 m.

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8.7.9 Brake chopper output

NOTICE

Connecting capacitive loads to the output of the brake chopper.

Connecting inductive loads to the output of the brake chopper.

Damage to the inverter.

- Only connect ohmic loads (braking resistors) to the output of the brake chopper.
- Never connect capacitive or inductive loads to the output of the brake chopper.

The braking resistor is connected to the +R and -R terminals of the inverter.

The maximum permitted cable length between braking resistor and inverter is 100 m.

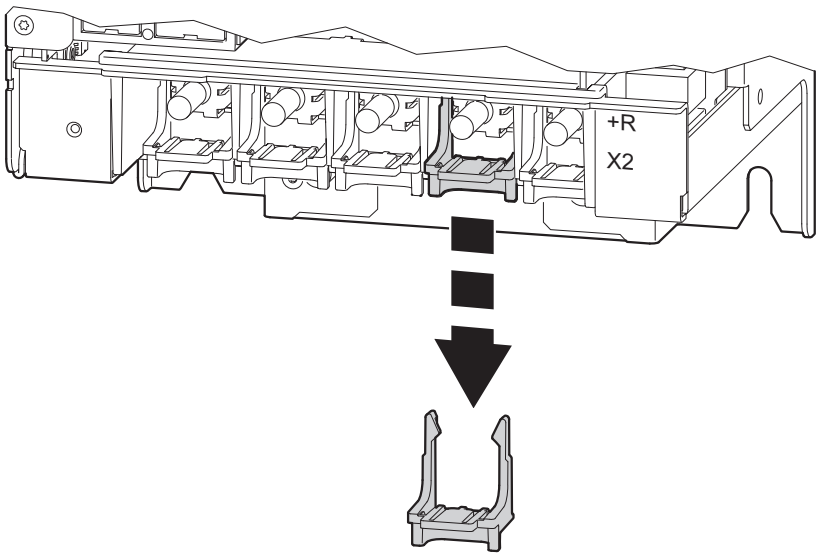
Special aspects when connecting the braking resistor

Note that the IP20 degree of protection is achieved with the following devices only if the terminal studs are protected with special plastic covers against contact.

- from MCX91A-0620 – 1770-5_3-..
- from MCX91A-0570 – 1080-2_3-..

These covers must be ordered separately; see the chapter "Installation accessories" (→ 🗎 64).

1. Remove any plastic covers that are inserted in the terminal strip.



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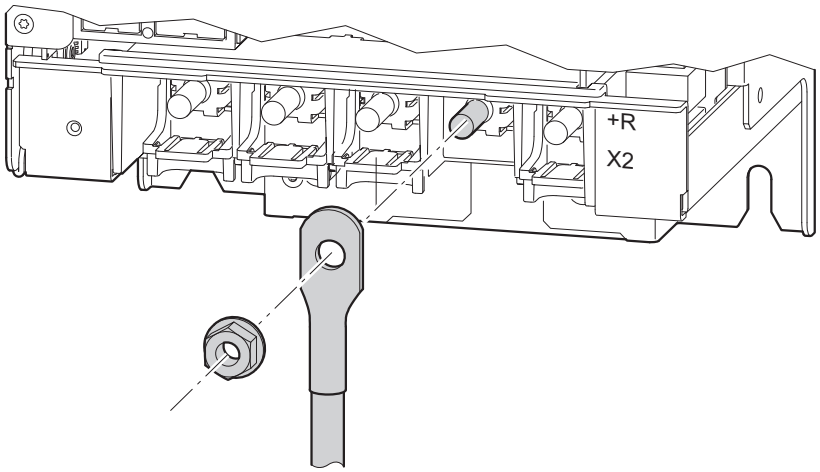
2. Connect the cables.



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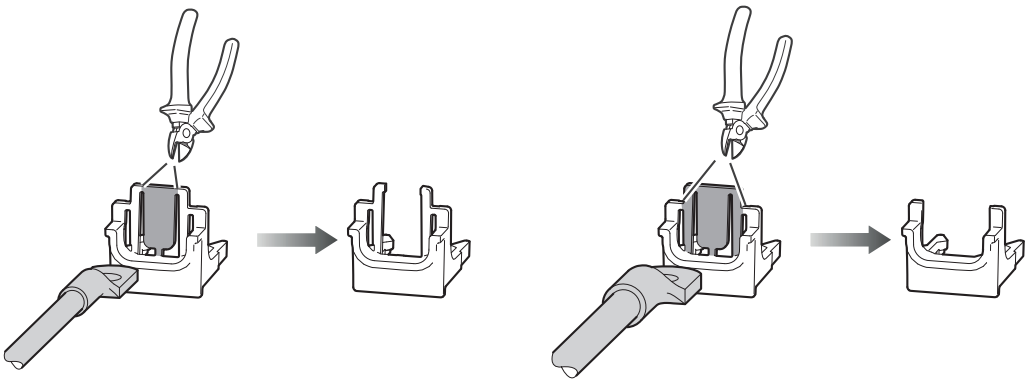
3. The plastic covers must be removed in different ways depending on the used cross section.



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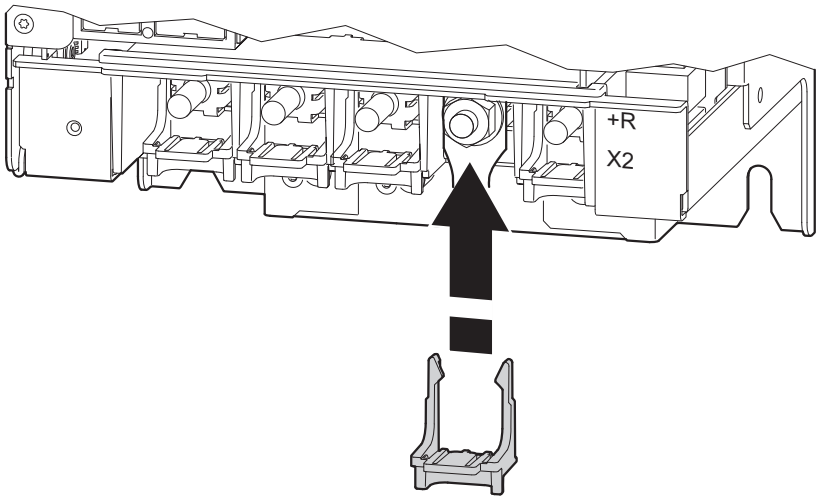
4. Attach the plastic covers at the individual connections.



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8.7.10 Temperature evaluation of the motor

The temperature can be evaluated in 3 ways:

- via terminal X10
- Via MOVILINK® DDI
- Via thermal protection model for motors from SEW-EURODRIVE

⚠ WARNING

Dangerous contact voltages at the terminals of the inverter when connecting the wrong temperature sensors.

Severe or fatal injuries from electric shock.

- Connect only temperature sensors with protective separation from the motor winding to the temperature evaluation. Otherwise, the requirements for protective separation are not met. Dangerous contact voltages may occur at the terminals of the inverter via the signal electronics in the event of a fault.

- It is preferable to use TH bimetallic temperature switches for group drives on one inverter.
- The series connection of the TH contacts (normally closed) is not subject to any restriction if joint monitoring is provided.
- If TF temperature sensors are available in motors that are intended for a group drive, the temperature sensors of a maximum of 3 motors may be connected in parallel.

8.7.11 Brake output

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 to also use 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.

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8.7.12 Inputs/outputs

NOTICE

Damage to the digital inputs and digital outputs.

The digital inputs and digital outputs are not electrically isolated. Incorrectly applied voltages can damage the digital inputs and digital outputs.

- Do not apply a voltage > DC 30 V to the digital inputs and digital outputs.
- The digital inputs and outputs are dimensioned according to IEC 61131-2.

If you route the cables outside the control cabinet, you have to shield them irrespective of the length.

When connecting the shielding, ensure equipotential bonding.

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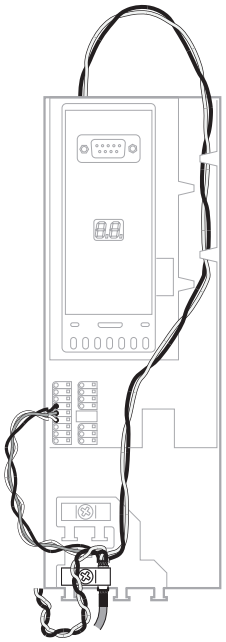
8.7.13 Encoders

Installation notes for encoder connection

- To ensure a flawless shield connection, an EMC screw fitting must be used for the cable entry of the signal cable.
- For drives with a plug connector, connect the shield on the encoder plug.
- 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 connector.
  - At the inverter onto the shield plate.
- Route the encoder cable separately from the power cables.
- When HTL encoders and encoder cables with open end are used, the conductors for motor protection (TF), encoder tracks, and voltage supply must be twisted in pairs up to where they are clamped; see the following illustration.



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- HTL encoders must be supplied with at least DC 24 V. Observe the connection voltage of the encoder.

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Prefabricated cables

SEW-EURODRIVE offers pre-fabricated cables for connecting encoders. SEW-EURODRIVE recommends to use these prefabricated cables.

Encoder cables

SEW-EURODRIVE recommends using shielded encoder cables.

Encoder designation	Signal type	Maximum permitted cable length
A...Z, E..Z	MOVILINK® DDI	200 m
EI7C-FS	HTL (Functional Safety)	100 m
EI.C, EK.C, EG.C, ES.C, EV.C	HTL	50 m

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Encoder connection

Encoder	Inverter connection	Conductor color[1] according to IEC 60757	Information
MOVILINK® DDI	X16	-	Coaxial cable
EI7C-FS	X18	-	Mini IO
Encoder with M12 connector			
EI7C, EI8C	X20:4	BN	A-track at DI04
	X20:5	YE	B-track at DI05
	X20:6	GN	C track on DI06[2]
	X10:TF1	RD	TF+
	X10:GND	BU	TF-
	External[3]	GY	+Ub
	External[2]	PK	GND
Encoder with M23 connector or encoder connection cover			
EI8C, EH1C, EK8C, EH7C, EV8C, ES1C, ES7C, ES2C, EG7C, EV1C, EV7C, EV2C	X20:4	RD	A-track at DI04
	X20:5	YE	B-track at DI05
	X20:6	BN	C-track at DI06 (optional)
	X10:TF1	GYPK	TF+
	X10:GND	RDBU	TF-
	External[2]	GY	+Ub
	External[2]	PK	GND
Encoder with direct connection			
HTL encoder:[4] not by SEW-EURODRIVE	X20:4	-	A-track at DI04
	X20:5	-	B-track at DI05
	X20:6	-	C-track at DI06 (optional)
	X10:TF1	-	TF+
	X10:GND	-	TF-
	External[2]	-	+Ub
	External[2]	-	GND

1) For encoder cables by SEW-EURODRIVE
2) The C track can only be used with EI8C. With the EI7C, this wire remains unused.
3) Encoder supply via external 24 V voltage supply
4) maximally 56 kHz

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8.8 Braking resistors

The supply cables to the braking resistors carry a high pulsed DC voltage during nominal operation.

⚠ DANGER

Dangerous pulsed DC voltage of up to 980 V.

Severe or fatal injuries from electric shock.

To prevent electric shocks:

- Disconnect the inverter from the power supply and wait 10 minutes before working on a braking resistor or its supply cables.
- Never operate the inverter without touch guards and installed closing covers.

Braking resistors become very hot during operation.

⚠ WARNING

The surfaces of the braking resistors will reach temperatures of up to 250 °C when the braking resistors are loaded with the nominal power.

Severe burns.

To prevent burns:

- Do not touch any braking resistor.
- Select a suitable installation location for the braking resistors such as the control cabinet roof.

8.8.1 Permitted installation of braking resistors

The surfaces of the resistors become very hot if loaded with nominal power. The installation location of the resistor must be designed in accordance with the high temperatures. For this reason, braking resistors are usually mounted on the control cabinet roof.

The following minimum clearances must be observed for convection cooling depending on the continuous braking power and the mounting type.

Continuous braking power at 100% cdf	Mounting type	Lateral clearance or clearance between resistors in mm	Downward clearing in mm	Upward clearing in mm
Up to 1 kW	Horizontal	200	0	350
	Vertical	150	250	300
Up to 10 kW	Horizontal	300	0	650
	Vertical	250	350	600
Up to 22 kW	Horizontal	400	0	750
	Vertical	350	400	700
Up to 44 kW	Horizontal	500	0	850
	Vertical	Not permitted	Not permitted	Not permitted

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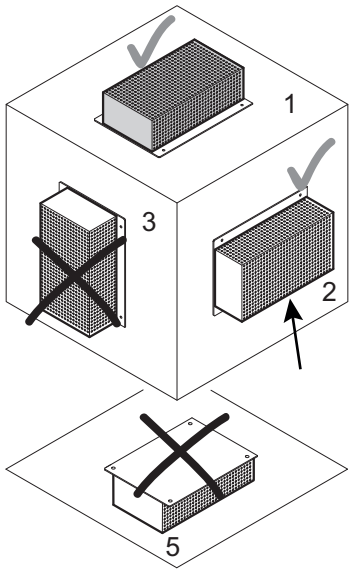
NOTICE

Overheating of the braking resistor.

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.

Observe the following permitted mounting positions when installing the resistors:

- Grid resistor, frame resistor



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Braking resistors BW003-420-T and BW1.0-170 may only be used in position 1.

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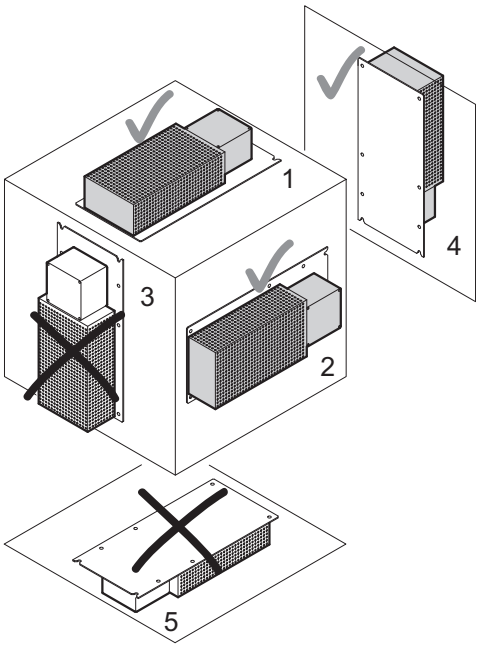
- Wire resistor



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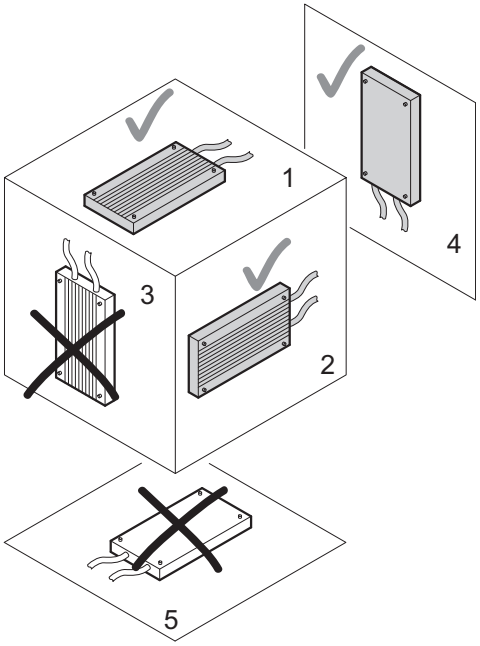
- Flat-type resistor



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8.8.2 Protection of braking resistor against thermal overload

INFORMATION

PTC braking resistor

A PTC braking resistor goes to high resistance in the event of overload.

INFORMATION

Flat-type resistor

Flat-type resistors have internal thermal protection (fuse cannot be replaced) that interrupts the current circuit in the event of overload. The project planning guidelines and the documented assignments of the drive inverter and braking resistor must be adhered to.

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 a separate protection against thermal overload.
- The signal contacts (NC contacts) of the protection devices must be connected in series.

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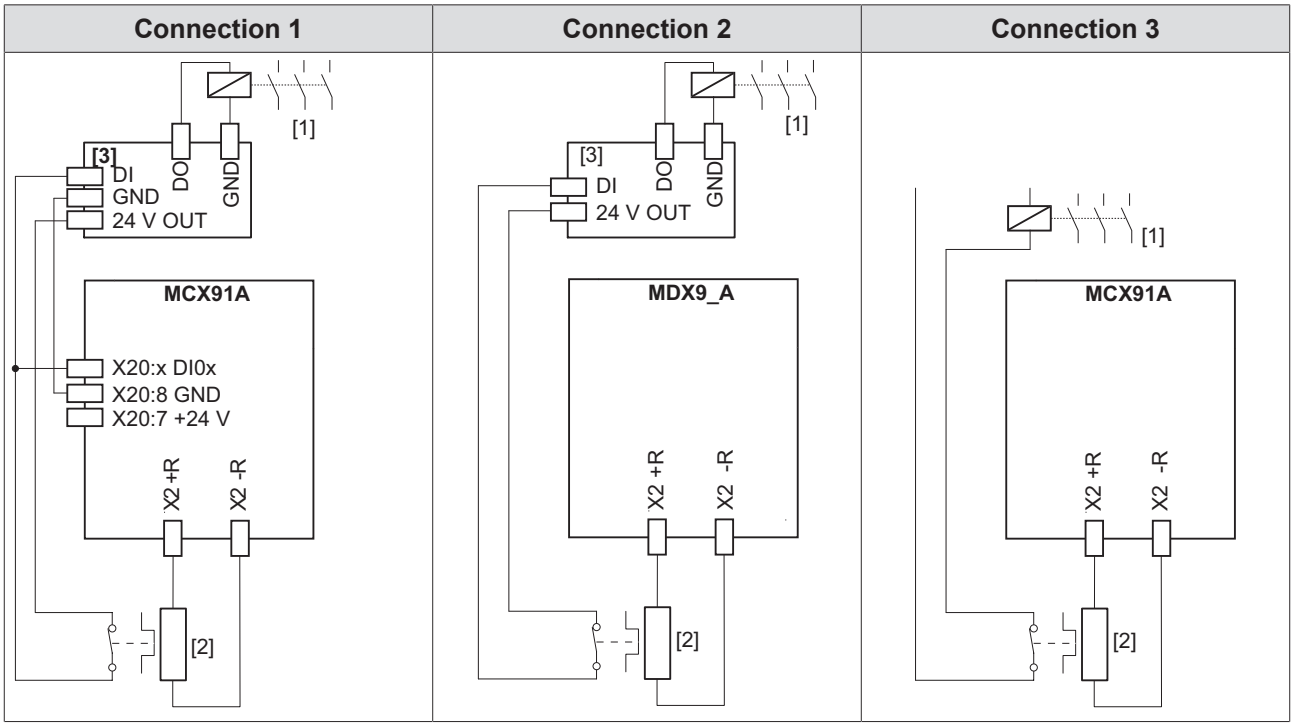
Internal temperature switch -T

Inverter: MCX91A-0010 – 0240-5_3-.., MCX91A-0017 – 0213-2_3-..

If a BW...-T braking resistor with internal temperature switch is used with these inverters, then 3 connections are possible.



[1] Line contactor

[2] Braking resistor

[3] PLC

Note that the reference potential GND of the digital inputs on the controller must be the same as the reference potential of the inverter when connection 1 is used.

- Connection 1

  The digital input of the inverter connected to the signal contact of the internal temperature switch must be parameterized to the function "External braking resistor fault".

  – If the thermal circuit breaker trips, the signal is evaluated in the inverter and the PLC.

  – If the thermal circuit breaker trips, the PLC must interrupt the power supply.

  – If the thermal circuit breaker trips, the inverter switches to "Output stage inhibit".

- Connection 2

  – If the thermal circuit breaker trips, the signal is evaluated only in the PLC.

  – If the thermal circuit breaker trips, the PLC must interrupt the power supply.

  – If the thermal circuit breaker trips, 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

– If the thermal circuit breaker trips, the signal directly affects the line contactor.
– This does not require a response by the PLC.
– If the thermal circuit breaker trips, there is no direct response in the inverter.

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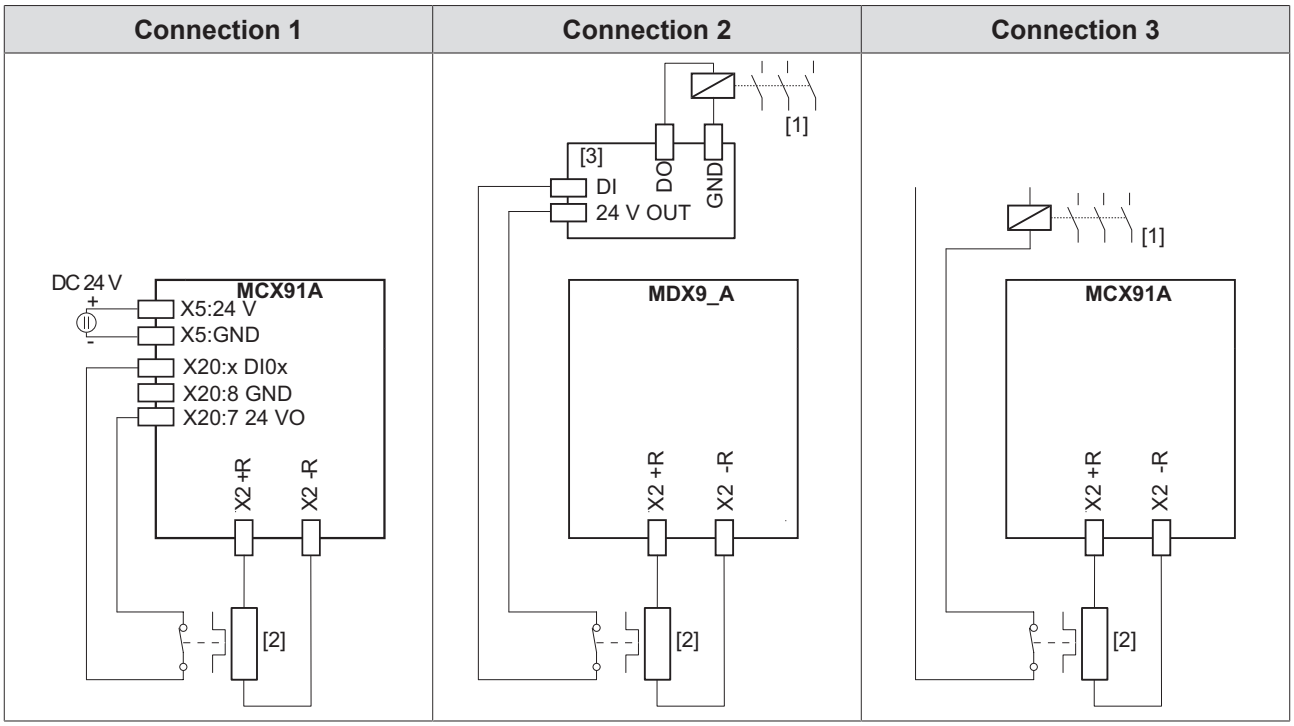
Inverters: from MCX91A-0320-5_3-.., from MCX91A-0290-2_3-..

If a BW...-T braking resistor with internal temperature switch is used with these inverters, then 3 connections are possible.



[1] Line contactor

[2] Braking resistor

[3] PLC

- Connection 1

  The digital input of the inverter connected to the signal contact of the internal temperature switch must be parameterized to the function "External braking resistor fault".

  – If the thermal circuit breaker trips, the signal is evaluated in the inverter.

  – This does not require a response by the PLC.

  – It is not required to disconnect the supply system connection with 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.

  – If the thermal circuit breaker trips, the inverter switches all axis modules to "Output stage inhibit".

INFORMATION

When using connection variant 1 (connection of braking resistor without line contactor), the inverter must be supplied with external DC 24 V.

- Connection 2

  – If the thermal circuit breaker trips, the signal is evaluated only in the PLC.

  – If the thermal circuit breaker trips, the PLC must interrupt the power supply.

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  - If the thermal circuit breaker trips, 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
  - If the thermal circuit breaker trips, the signal directly affects the line contactor.
  - This does not require a response by the PLC.
  - If the thermal circuit breaker trips, there is no direct response in the inverter.

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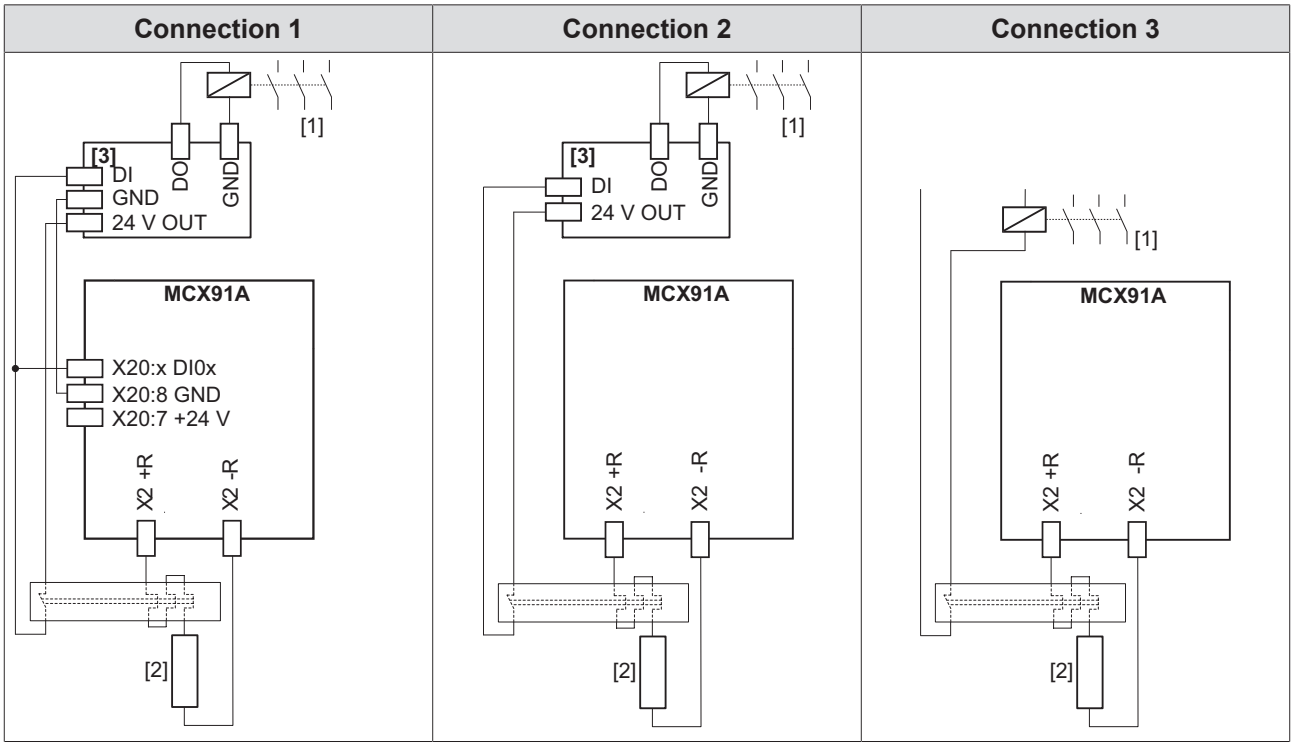
External bimetallic relay

Inverter: MCX91A-0010 – 0240-5_3-.., MCX91A-0017 – 0213-2_3-..

If an external bimetallic relay is used with the inverter, there are 3 possible connections.



[1] Line contactor

[2] Braking resistor

[3] PLC

Note that the reference potential GND of the digital inputs on the controller must be the same as the reference potential of the inverter when connection 1 is used.

- Connection 1

  The digital input of the inverter connected to the signal contact of the external bimetallic relay must be parameterized to the function "External braking resistor fault".

  – If the thermal circuit breaker trips, the signal is evaluated in the inverter and the PLC.

  – If the thermal circuit breaker trips, the PLC must interrupt the power supply.

  – If the thermal circuit breaker trips, the inverter switches to "Output stage inhibit".

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- Connection 2
  - If the thermal circuit breaker trips, the signal is evaluated only in the PLC.
  - If the thermal circuit breaker trips, the PLC must interrupt the power supply.
  - If the thermal circuit breaker trips, 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
  - If the thermal circuit breaker trips, the signal directly affects the line contactor.
  - This does not require a response by the PLC.
  - If the thermal circuit breaker trips, there is no direct response in the inverter.

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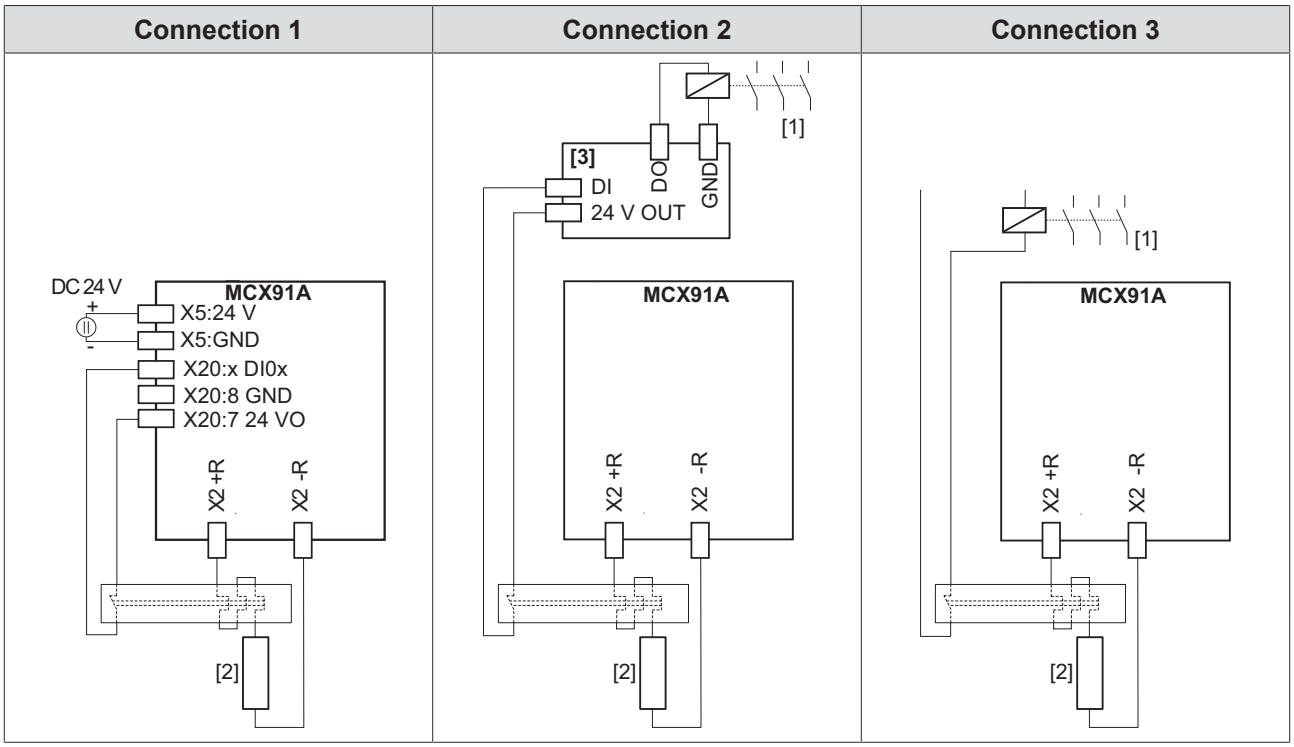
Inverters: from MCX91A-0320-5_3-.., from MCX91A-0290-2_3-..

If an external bimetallic relay is used with the inverter, there are 3 possible connections.



[1] Line contactor

[2] Braking resistor

[3] PLC

- Connection 1

  The digital input of the inverter connected to the signal contact of the external bimetallic relay must be parameterized to the function "External braking resistor fault".

  – If the thermal circuit breaker trips, the signal is evaluated in the inverter.

  – This does not require a response by the PLC.

  – It is not required to disconnect the supply system connection with an external switching device.

  – If the thermal circuit breaker trips, the inverter switches to the operating state "Output stage inhibit".

  – If an internal short circuit in the brake chopper is detected by the inverter, the inverter interrupts the energy supply by inhibiting the rectifier.

INFORMATION

When using connection variant 1 (connection of braking resistor without line contactor), the inverter must be supplied with external DC 24 V.

- Connection 2

  – If the thermal circuit breaker trips, the signal is evaluated only in the PLC.

  – If the thermal circuit breaker trips, the PLC must interrupt the power supply.

  - If the thermal circuit breaker trips, 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
  - If the thermal circuit breaker trips, the signal directly affects the line contactor.
  - This does not require a response by the PLC.
  - If the thermal circuit breaker trips, there is no direct response in the inverter.

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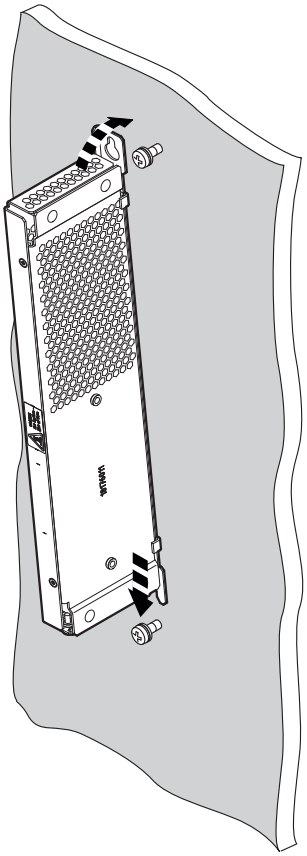
8.8.3 Installation of the braking resistors BW120-001 and BW100-002/M

The braking resistors BW120-001 and BW100-002/M can be used for the MCX91A-0020 - 0055-5E3-4-.. and MCX91A-0017 - 0055-2E3-4-.. inverters. Mounting is only carried out in an upright position next to an inverter.

The minimum lateral distance from adjacent components and walls can be reduced to 10 mm, contrary to the generally permissible mounting of braking resistors.

The minimum distance from components/ceilings above can be reduced to 100 mm, contrary to the generally permissible mounting of braking resistors.



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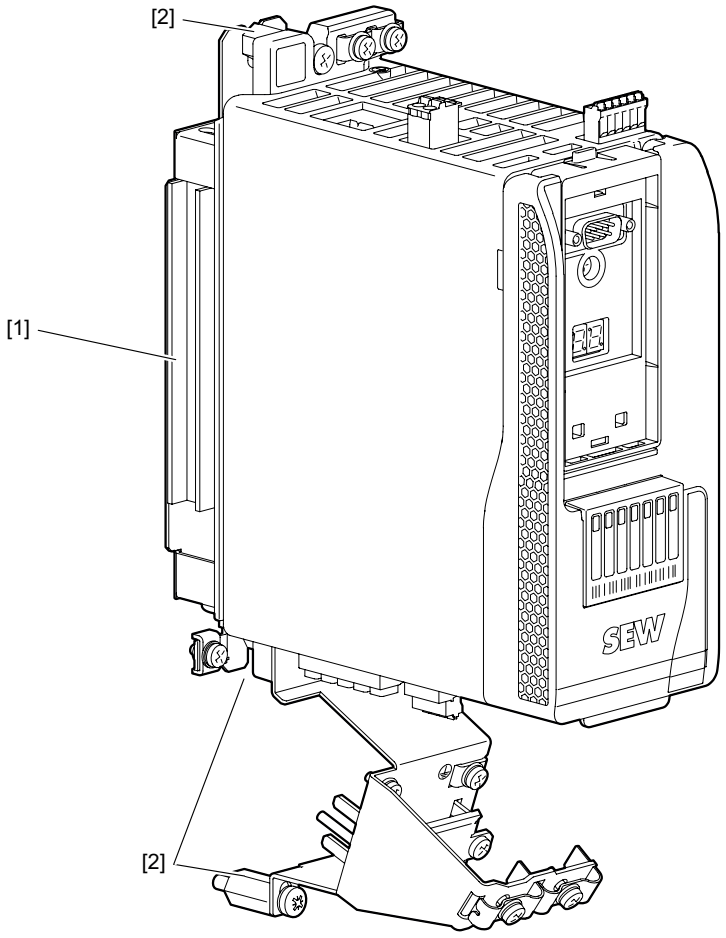
8.8.4 Mounting the CLH31A and CLH41A braking resistors with support plate

The CLH31A and CLH41A braking resistors with support plate are supplied as a combination of a support plate and an integrated braking resistor. There is a choice of braking resistors with different ratings for each support plate, see chapter "Technical data of braking resistors with submounting plate" (→ 🗎 146).

During mounting, make sure no connection wires are pinched.

Use the fastening bolts (3 pieces) included in the scope of delivery to mount the inverter and the support plate in the control cabinet. Refer to the dimension sheets for the bore positions of the fastening bolt.



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[1] Braking resistor with support plate
[2] Fastening bolt

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8.9 NF.. line filter

- Install the line filter close to the power supply module/inverter but outside the minimum clearance for cooling. The line filter must not be heated by the exhaust air of the power supply module/inverter.
- Do not wire any other consumers between the line filter and the power supply module/inverter.
- The connection cable between line filter and power supply module/inverter does not have to be shielded.
- Limit the length of the cable between the line filter and the power supply module/inverter to the required length.
- Do not switch between the line filter and power supply module/inverter.

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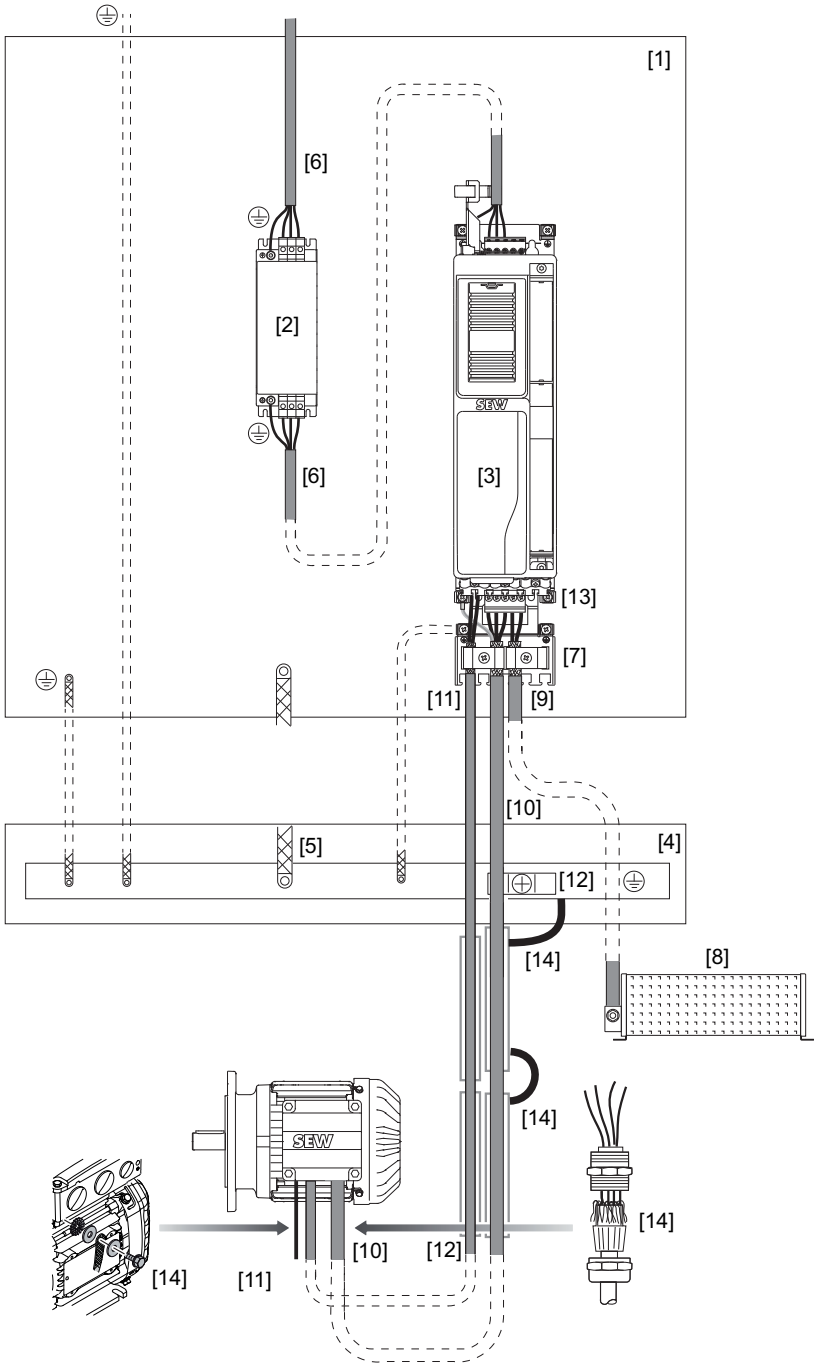
8.10 EMC-compliant installation



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[1] Galvanized mounting plate
[2] Line filter
[3] Inverters
[4] PE busbar
[5] HF connection of PE busbar/mounting plate
[6] Supply system cable
[7] Power shield plate
[8] Braking resistor
[9] Braking resistor cable
[10] Motor cable
[11] Brake cable
[12] Grounding clamp
[13] Electronics shield plate
[14] HF connection

The information in this chapter will help you to optimize the system with respect to electromagnetic compatibility, or to eliminate already existing EMC interferences.

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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".

Compliance with limit class C2 has been tested in a CE-typical drive system. SEW-EURODRIVE can provide detailed information on request.

8.10.1 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.

Mount the line filter and inverter on a shared mounting plate if possible. Make sure they are connected over a large area and with good conductivity.

8.10.2 HF equipotential bonding in the system

Make sure that there is a suitable equipotential bonding between the system, the control cabinet, the machine structure, the cable ducts, and the drives.

Connect the individual sections together in an HF-capable manner.

From an electrical safety perspective, the PE busbar is the star point. However, the PE connection does not replace either the HF grounding or the shielding.

In terms of EMC, it is advantageous if the mounting plate is used as a star point with respect to HF equipotential bonding.

Perform the following measures for a suitable 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.

8.10.3 Cable installation

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.

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8.10.4 Supply system cable connection

The supply system cable can be connected to the line choke and/or line filter using twisted unshielded single conductors or using unshielded cables.

If necessary, shielded cables may improve EMC.

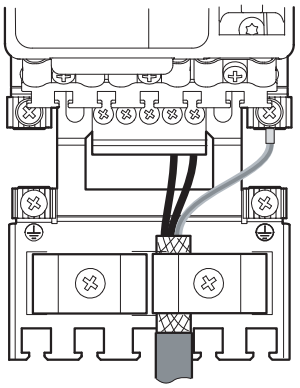
8.10.5 Line filter connection

Limit the length of the connection lead between the line filter and the inverter to the absolute minimum needed.

You must never route filtered and unfiltered cables together. For this reason, route incoming and outgoing line filter cables separately.

8.10.6 Braking resistor connection

For connecting braking resistors, use two closely twisted cores or a shielded power cable. In the case of shielded cables, connect the braided shields over the entire circumference. Use the designated shield plates at the basic device to connect the shield.



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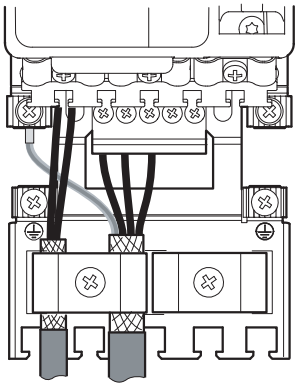
8.10.7 Motor and brake connection

Use shielded motor cables only. Connect the braided shield of the motor cable at both ends over its entire circumference to the power shield plate at the inverter.

Provide shielded cables for the brake supply. The shield of the brake cable can be connected to the power shield plate at 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.



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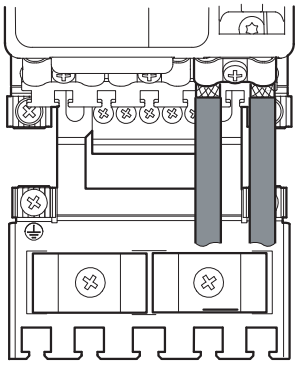
SEW-EURODRIVE recommends using prefabricated cables.

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).

8.10.8 Control cable connection

Ensure that the digital inputs are connected with unshielded individual cores. 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.



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8.10.9 Encoder connection

SEW-EURODRIVE recommends the use of prefabricated encoder cables.

The shield of prefabricated cables from SEW-EURODRIVE is connected via the connector.

8.10.10 Shielding connection

Ensure that there is an HF-compatible shield connection, e.g. by using grounding clamps or EMC cable glands, so that the braided shield has a large connection surface.

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8.11 Terminal assignment of basic unit

INFORMATION

Reference potentials inside the device.

The device-internal reference potential is designated as GND in the following table.

All reference potentials GND are internally connected to PE.

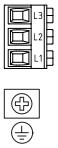
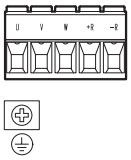
INFORMATION

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 chapter "Technical data".

8.11.1 MCX91A-0010 – 0055-5E3-.. and MCX91A-0017 – 0055-2E3-.. (size 0S)

Representation	Terminal	Connection	Brief description
	X1:L1	L1	Line connection
	X1:L2	L2	
	X1:L3	L3	
	⏚	PE	PE connection
	X2:U	U	Motor connection
	X2:V	V	
	X2:W	W	
	X2:-R	-R	Braking resistor connection
	X2:+R	+R	
	⏚	PE	PE connection

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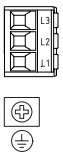
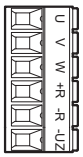
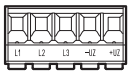
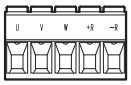
8.11.2 MCX91A-0070 – 0160-5E3-.. and MCX91A-0070 – 0140-2E3-.. (size 0L)

Representation	Terminal	Connection	Brief description
	X1:L1	L1	Line connection
	X1:L2	L2	
	X1:L3	L3	
	⏚	PE	PE connection
	X2:U	U	Motor connection
	X2:V	V	
	X2:W	W	
	X2:-R	-R	Braking resistor connection
	X2:+R	+R	
	X2:-U_Z	-U_Z	DC link connection -U_Z (+U_Z connection at +R)
	⏚	PE	PE connection

8.11.3 MCX91A-0240-5E3-.. and MCX91A-0213-2E3-.. (size 3)

Representation	Terminal	Connection	Brief description
	X1:L1	L1	Line connection
	X1:L2	L2	
	X1:L3	L3	
	X1:-U_Z	-U_Z	DC link connection
	X1:+U_Z	+U_Z	
	⏚	PE	PE connection
	X2:U	U	Motor connection
	X2:V	V	
	X2:W	W	
	X2:+R	+R	Braking resistor connection
	X2:-R	-R	
	⏚	PE	PE connection

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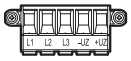
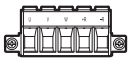
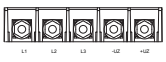
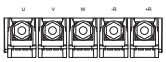
8.11.4 MCX91A-0320 – 0460-503-.. and MCX91A-0290 – 0420-203-.. (size 4)

Representation	Terminal	Connection	Brief description
	X1:L1	L1	Line connection
	X1:L2	L2	
	X1:L3	L3	
	X1:-U_Z	-U_Z	DC link connection
	X1:+U_Z	+U_Z	
	⏚	PE	PE connection
	X2:U	U	Motor connection
	X2:V	V	
	X2:W	W	
	X2:+R	+R	Braking resistor connection
	X2:-R	-R	
	⏚	PE	PE connection

8.11.5 MCX91A-0620 – 1770-503-.. and MCX91A-0570 – 1080-203-.. (size 5, size 6)

Representation	Terminal	Connection	Brief description
	X1:L1	L1	Line connection
	X1:L2	L2	
	X1:L3	L3	
	X1:-U_Z	-U_Z	DC link connection
	X1:+U_Z	+U_Z	
	⏚	PE	PE connection
	X2:U	U	Motor connection
	X2:V	V	
	X2:W	W	
	X2:+R	+R	Braking resistor connection
	X2:-R	-R	
	⏚	PE	PE connection

8.11.6 MCX91A-0017 – 0042-2E1-.. (size 0S)

Representation	Terminal	Connection	Brief description
	X1:N	N	Line connection
	X1:L1	L1	
	⏚	PE	PE connection

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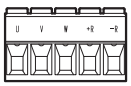
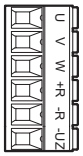
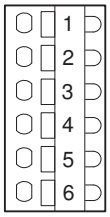
Representation	Terminal	Connection	Brief description
	X2:U	U	Motor connection
	X2:V	V	
	X2:W	W	
	X2:-R	-R	Braking resistor connection
	X2:+R	+R	
	⏚	PE	PE connection

8.11.7 MCX91A-0055 – 0110-2E1-.. (size 0L)

Representation	Terminal	Connection	Brief description
	X1:N	N	Line connection
	X1:L1	L1	
	⏚	PE	PE connection
	X2:U	U	Motor connection
	X2:V	V	
	X2:W	W	
	X2:-R	-R	Braking resistor connection
	X2:+R	+R	
	⏚	PE	PE connection

8.11.8 Inverter in CSO design

Representation	Terminal	Connection	Brief description
	X6:1	F_STO_P	F_STO_P: DC +24 V input
	X6:2	F_STO_M	F_STO_M: DC 0 V input
	X6:3	F_STO_P	F_STO_P: DC +24 V input
	X6:4	F_STO_M	F_STO_M: DC 0 V input
	X6:5	VO24_STO	F_STO_P: DC 24 V supply
	X6:6	GND	Reference potential

8.11.9 All inverters

Representation	Terminal	Connection	Brief description
	X5:24 V	24V_in	DC 24 V supply voltage
	X5:GND	GND	Reference potential

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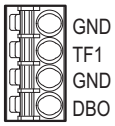
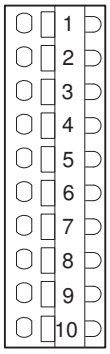
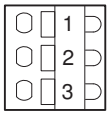
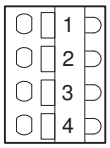
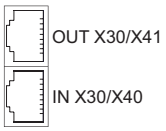
Representation	Terminal	Connection	Brief description
	X10:DB0/ DB00	DB00	Brake control
	X10:GND	GND	Reference potential
	X10:TF1	TF1	Sensor input for temperature evaluation of the motor
	X10:GND	GND	Reference potential
	X20:1	DI01	Digital input 1
	X20:2	DI02	Digital input 2
	X20:3	DI03	Digital input 3
	X20:4	DI04	Digital input 4
	X20:5	DI05	Digital input 5
	X20:6	DI06	Digital input 6
	X20:7	VO24	DC 24 V voltage output
	X20:8	GND	Reference potential
	X20:9	DIO01	Digital input/output
	X20:10	DIO02	Digital input/output
	X22:1	DOR-C	Shared relay contact
	X22:2	DOR-NO	NO contact
	X22:3	DOR-NC	NC contact
	X23:1	REF	+10 V reference voltage output
	X23:2	AI1	Analog input voltage or current (can be selected via S4)
	X23:3	GND	Reference potential
	X23:4	AIO1	Analog input or analog output

8.11.10 inverter with fieldbus

Representation	Terminal	Connection	Brief description
	OUT X30/ X41	X30 OUT X41	- System bus OUT X30/IN X30 with MCX91A-..-S00 – EtherCAT® OUT X30/In X30 with MCX91A-..-E00
	IN X30/ X40	X30 IN X40	- PROFINET X40/X41 with MCX91A-..-T00/CFN and -T0./../CFNB – Ethernet X40/X41 with MCX91A-..-T00/CFE – POWERLINK/CiA402 X40/X41 with MCX91A-..-L0../CFL

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8.11.11 Inverter with CSB/CSL

Representation	Terminal	Connection	Brief description
	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 digital inputs/outputs
	X60:4	GND	Reference potential for safe digital 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 digital inputs/outputs
	X60:8	GND	Reference potential for safe digital 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 CSB)
	X60:12	F-DO00_P	Safe digital output F-DO00_P (not with CSB)

8.11.12 Inverter with MOVILINK® DDI

Representation	Terminal	Connection	Assignment
	X16	Coaxial connection	MOVILINK® DDI

8.11.13 Inverter with CSL

Representation	Terminal	Connection	Assignment
	X18	Mini IO	Encoder connection for EI7C-FS

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8.12 Wiring diagrams

8.12.1 General information on the wiring diagrams

- For technical data of the power electronics and the control electronics, refer to chapter "Technical data" (→ 🗎 48).
- For the terminal assignment and connections, refer to chapter "Terminal assignment".

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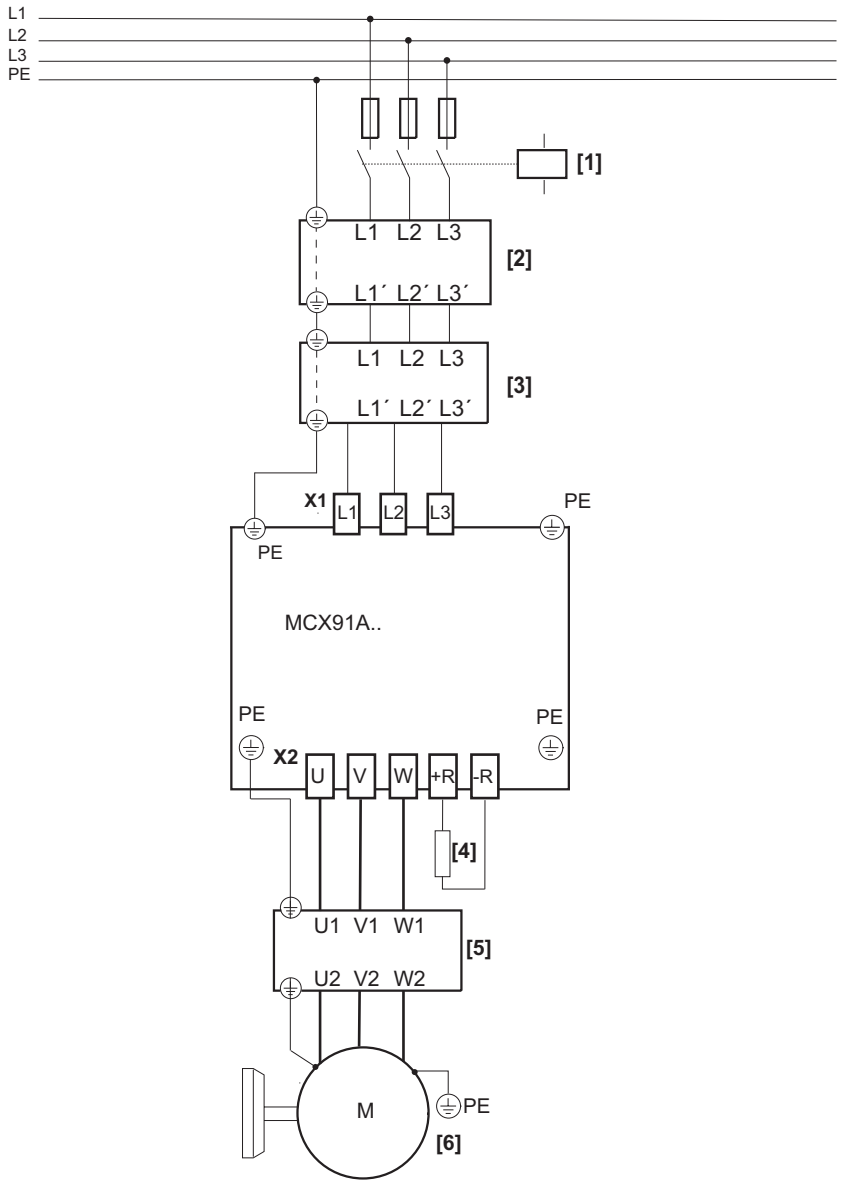
8.12.2 Power connection

Wiring of the power connections with line contactor, line choke, line filter, and output choke - MCX91A-0010 – 0055-5_3-.., MCX91A-0017 – 0042-2_3-...



9007230381084043

[1] Line contactor
[2] Line choke (optional)
[3] Line filter (optional)
[4] Braking resistor (optional)
[5] Output choke
[6] Motor

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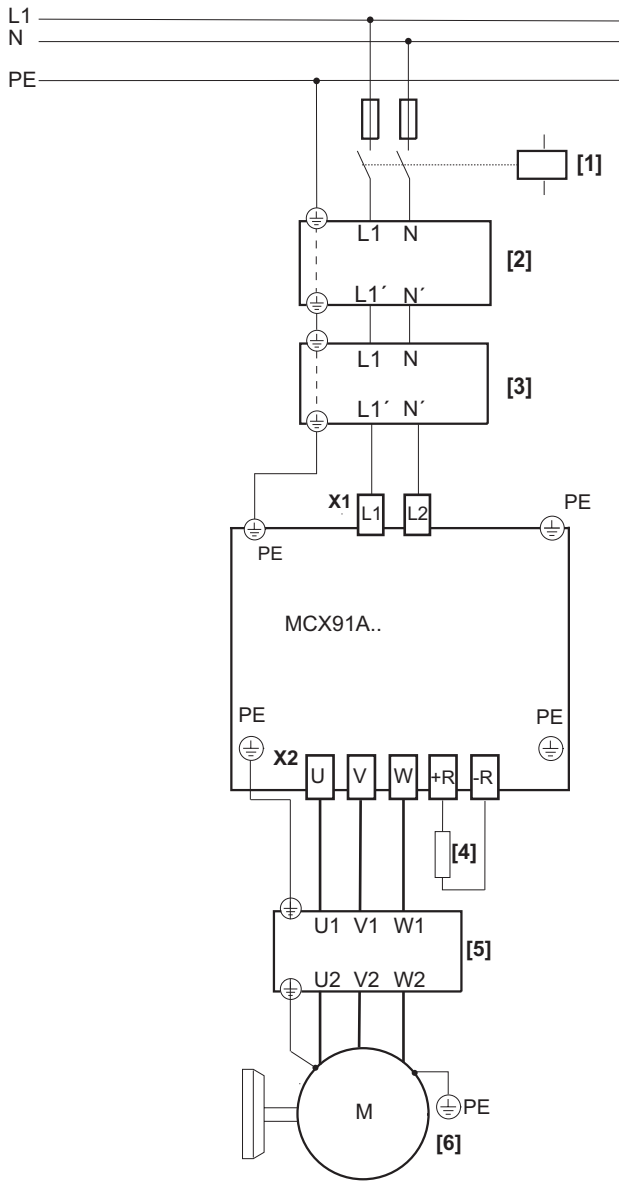
Wiring of the power connections with line contactor, line choke, line filter, and output choke - MCX91A-0017 – 0110-2_1-...

INFORMATION

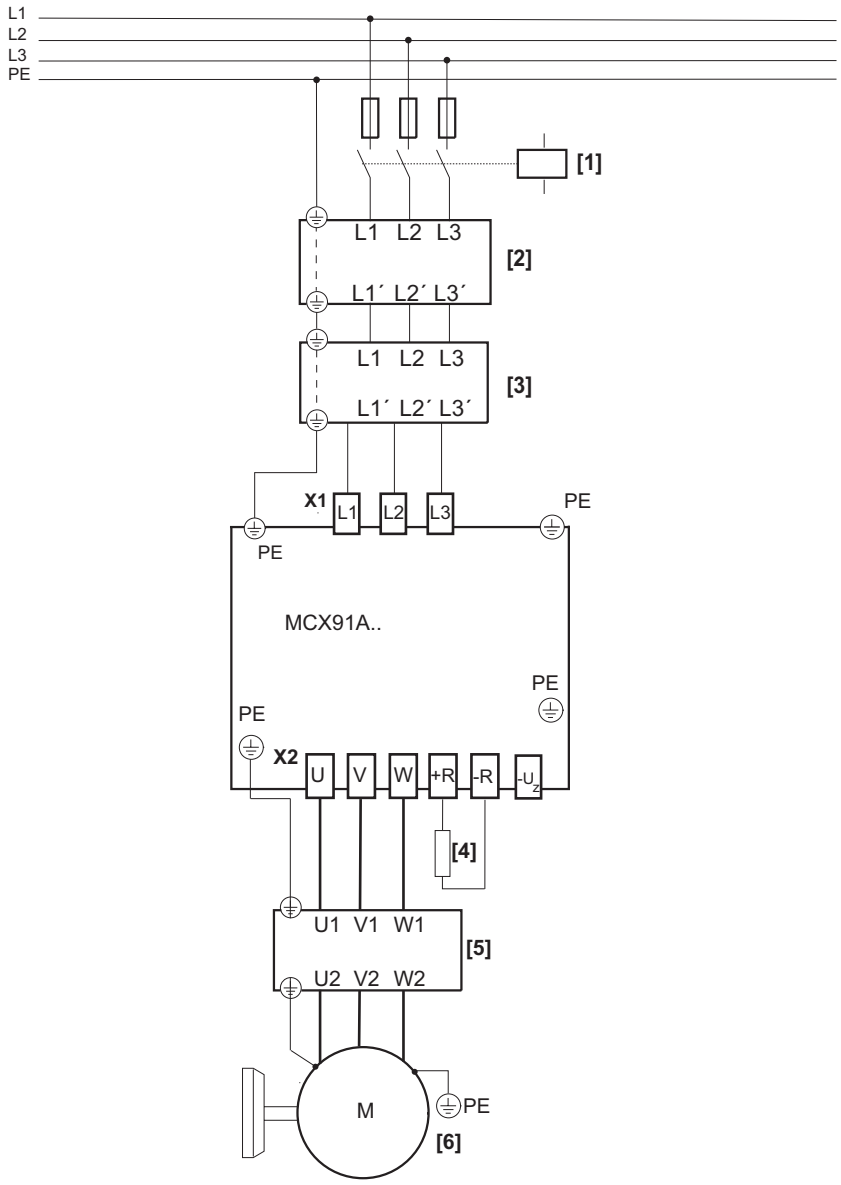
The line choke must be used with the MCX91A-0110-2E1-.. inverter.



18014431042088587

[1] Line contactor
[2] Line choke (optional)
[3] Line filter (optional)
[4] Braking resistor (optional)
[5] Output choke
[6] Motor

Wiring of the power connections with line contactor, line choke, line filter, and output choke - MCX91A-0070 – 0240-5_3-.., MCX91A-0055– 0213-2_3-...



9007230159093003

[1] Line contactor
[2] Line choke (optional)
[3] Line filter (optional)
[4] Braking resistor (optional)
[5] Output choke
[6] Motor

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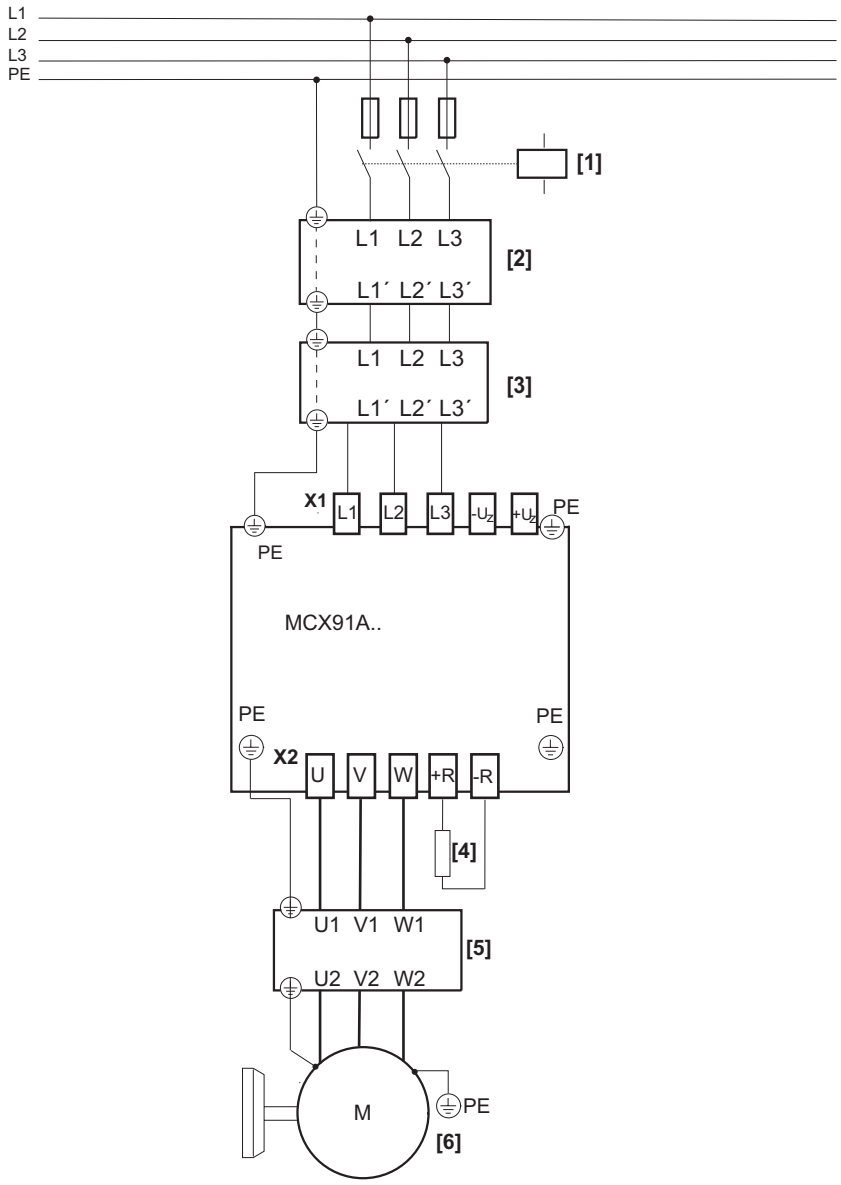
Wiring of the power connections with line contactor, line choke, line filter, and output choke – from MCX91A-0320-5_3-..., from MCX91A-0290-2_3...



9007229658855435

[1] Line contactor
[2] Line choke (optional)
[3] Line filter (optional)
[4] Braking resistor (optional)
[5] Output choke
[6] Motor

Wiring of the power connections with line choke, line filter, output choke, without line contactor

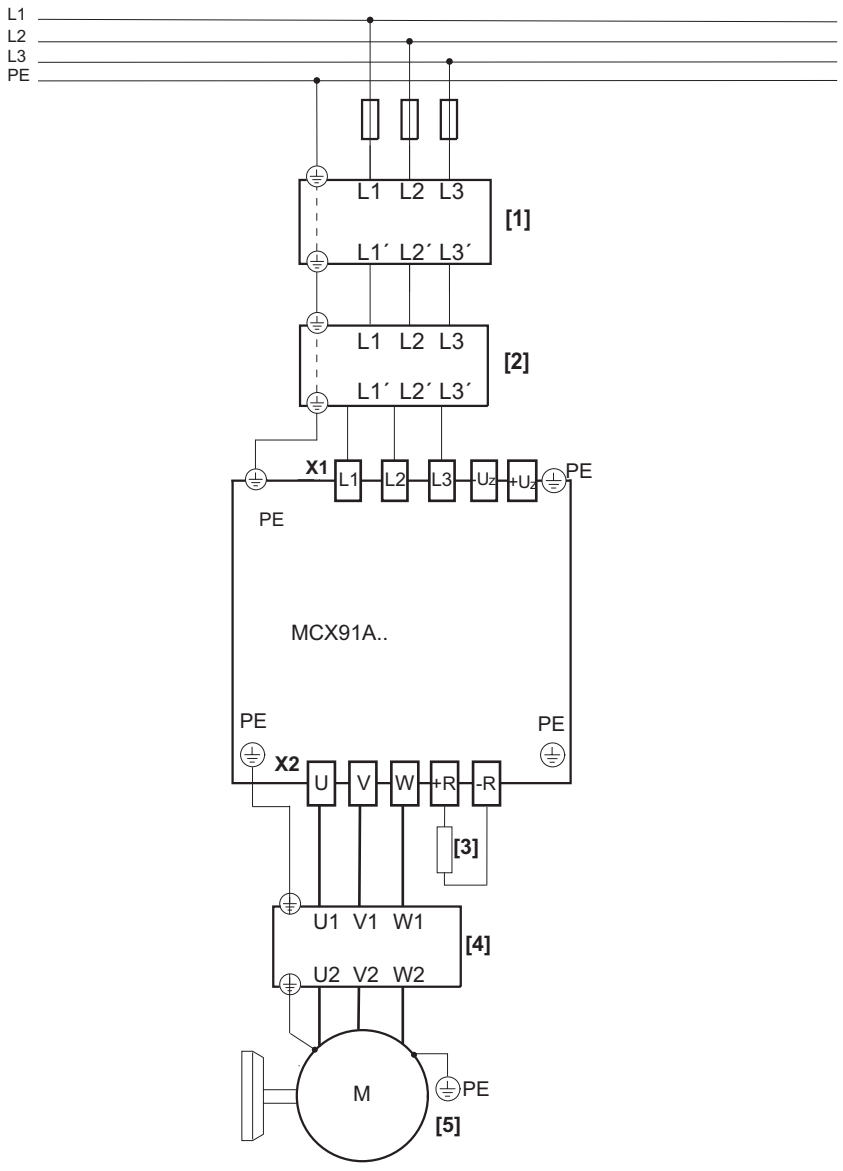
Refer to the table in chapter "Line contactor" (→ 🗎 242) to find out which inverters can be operated without a line contactor.

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.

Refer to the chapter "Line contactor" (→ 🗎 242) for the necessary measures.



9007229658857867

[1] Line choke (optional)
[2] Line filter (optional)
[3] Braking resistor (optional)
[4] Output choke
[5] Motor

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INFORMATION

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. The connected digital input must be parameterized for monitoring the braking resistor temperature evaluation.

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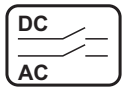
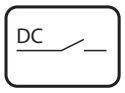
8.12.3 Brake control

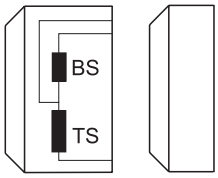
Key:



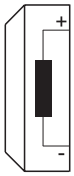
Cut-off in the DC and AC circuits
(rapid brake application)



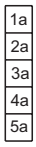
Cut-off in the DC circuit



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

INFORMATION

The selection of the brake control and the shown connection diagrams only represent one of the many possibilities. Observe the catalogs and operating instructions of the motors for more information and installation notes.

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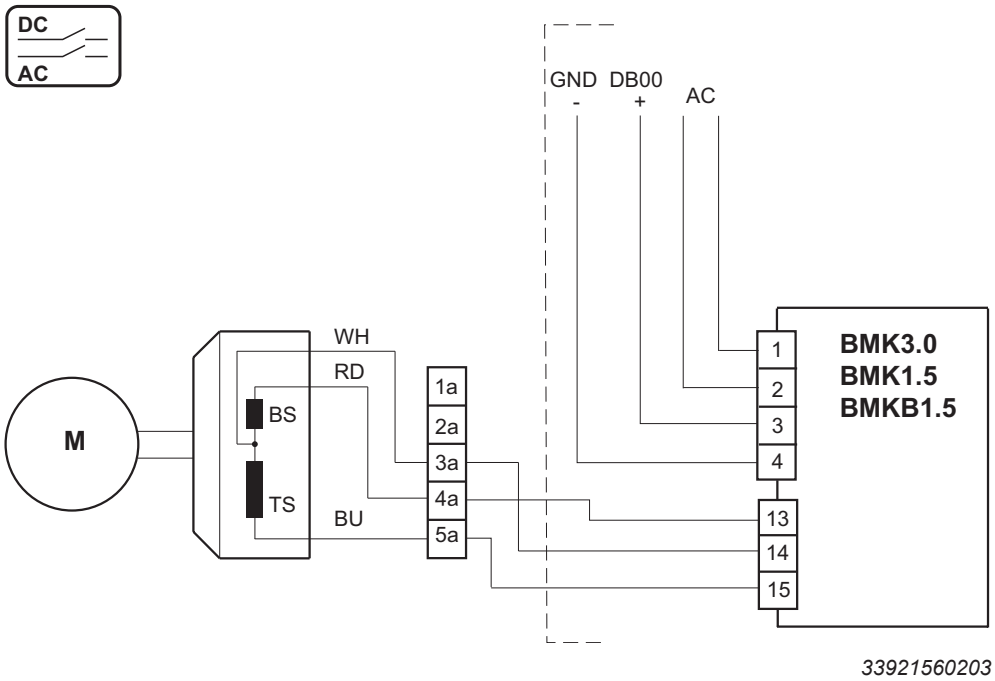
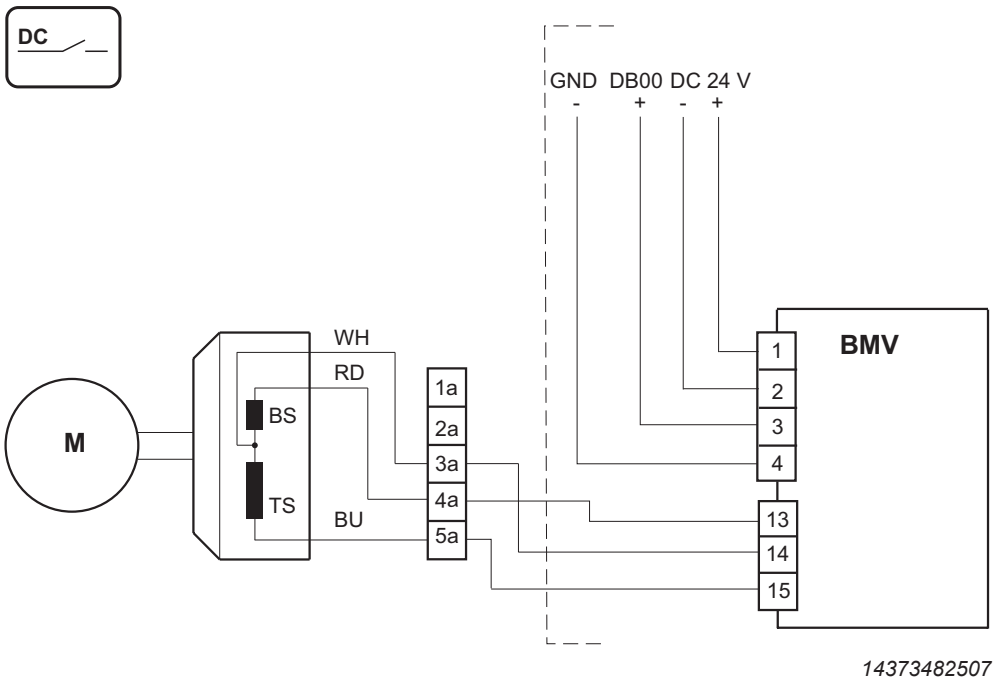
BMK. brake control



33921560203

BMV brake control – 2 coils



14373482507

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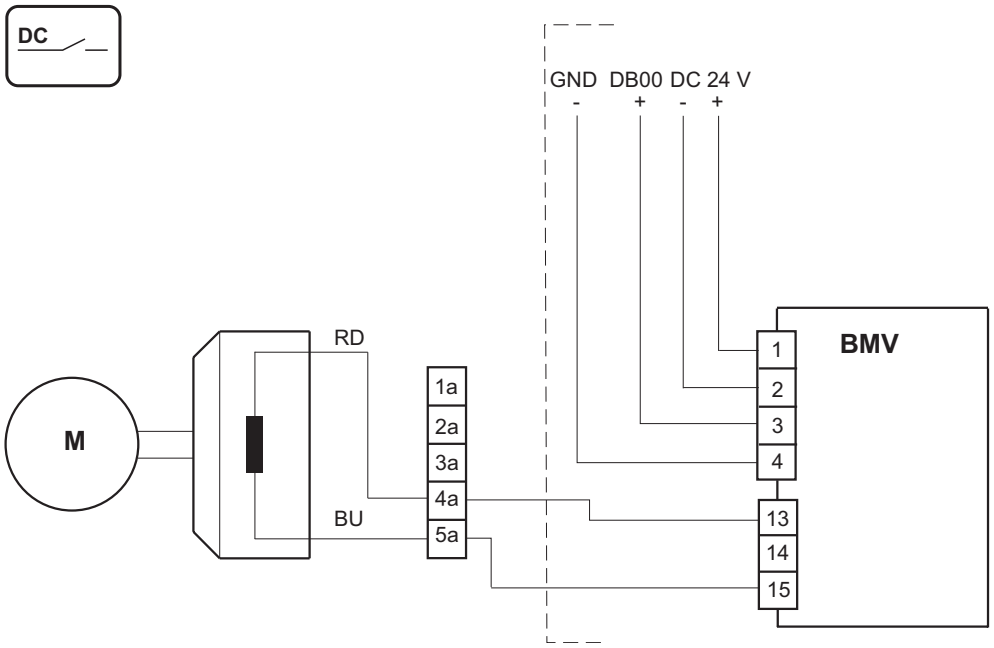
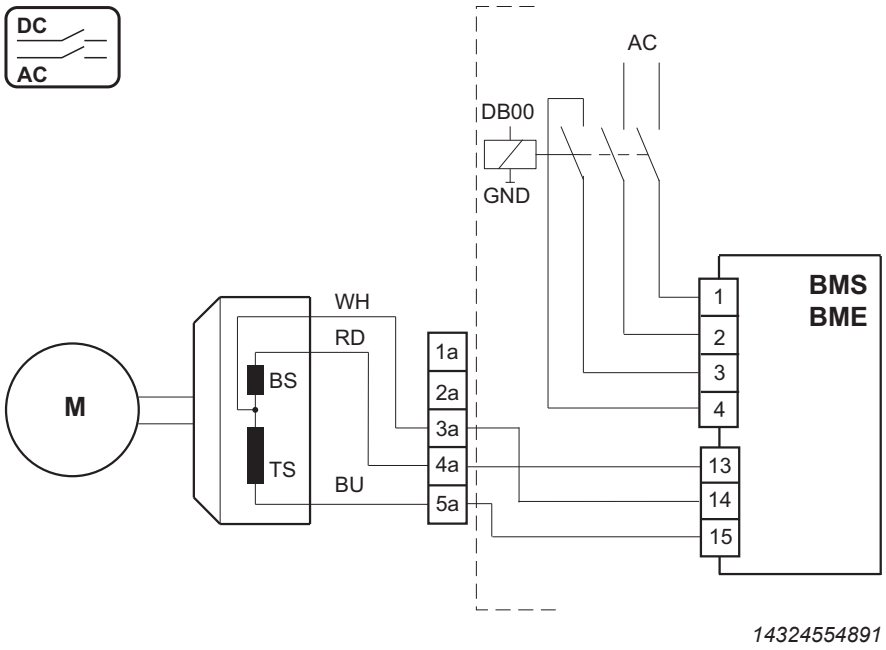
BMV brake control – 1 coil



14373494923

BMS, BME brake control



14324554891

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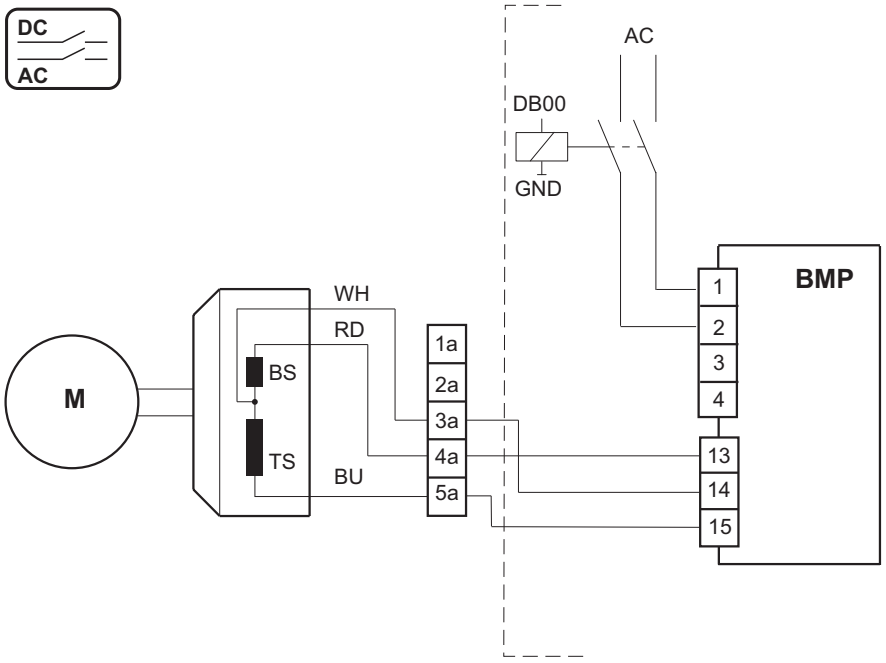
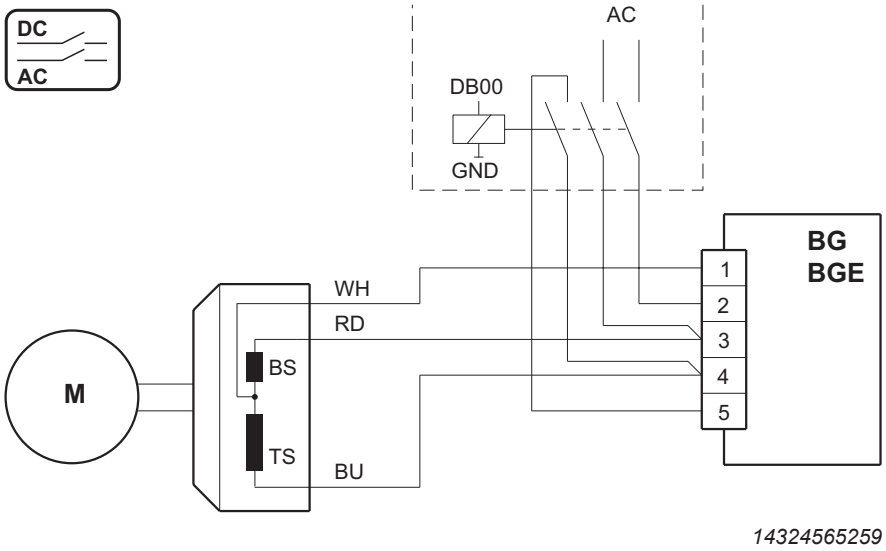
BMP brake control



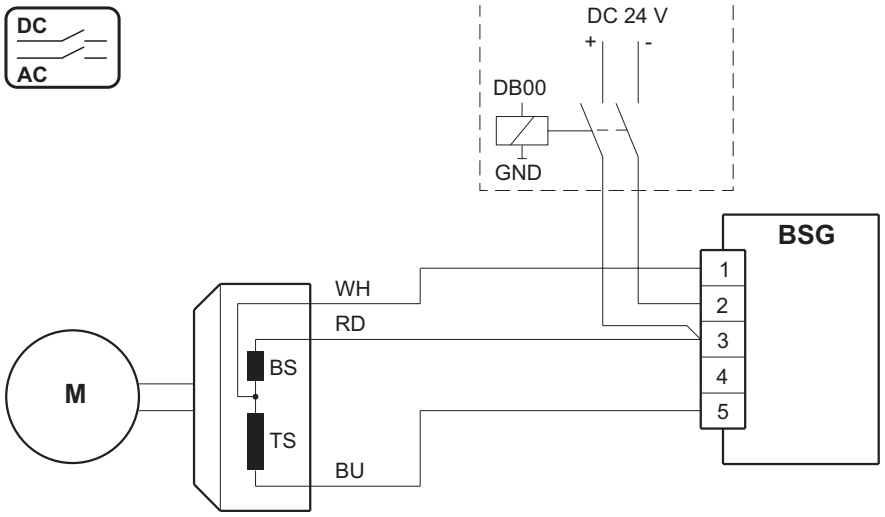
14324544523

BG, BGE brake control



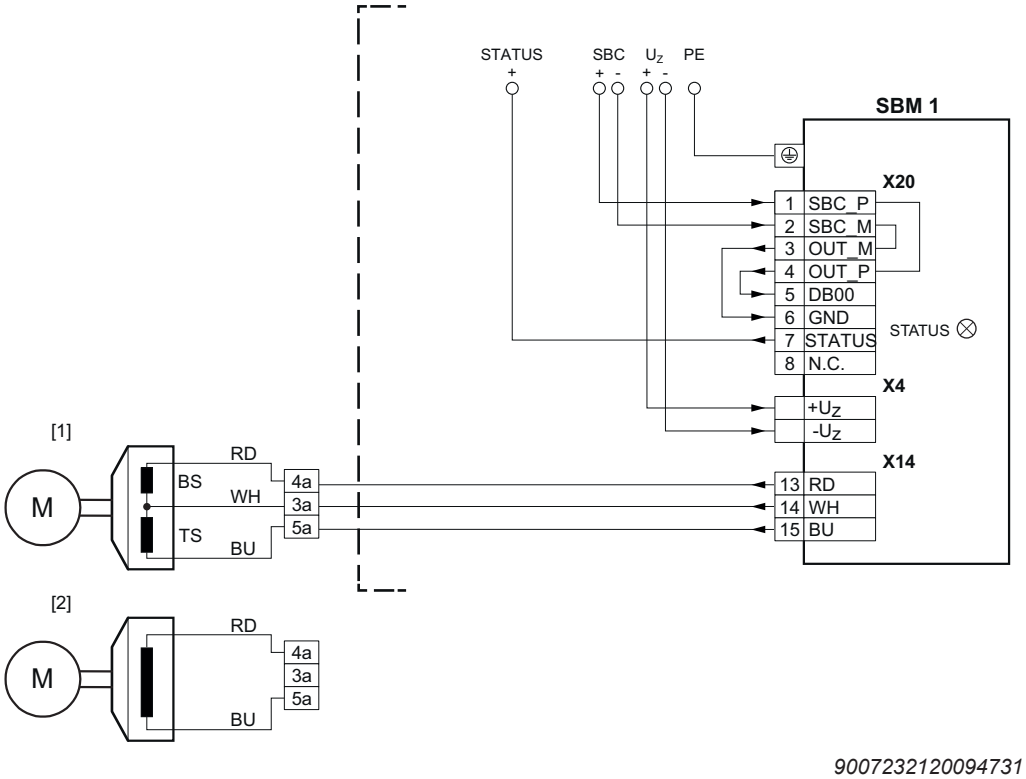
14324565259

BSG brake control



14324597131

Brake control SBM with 1 control cable



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.

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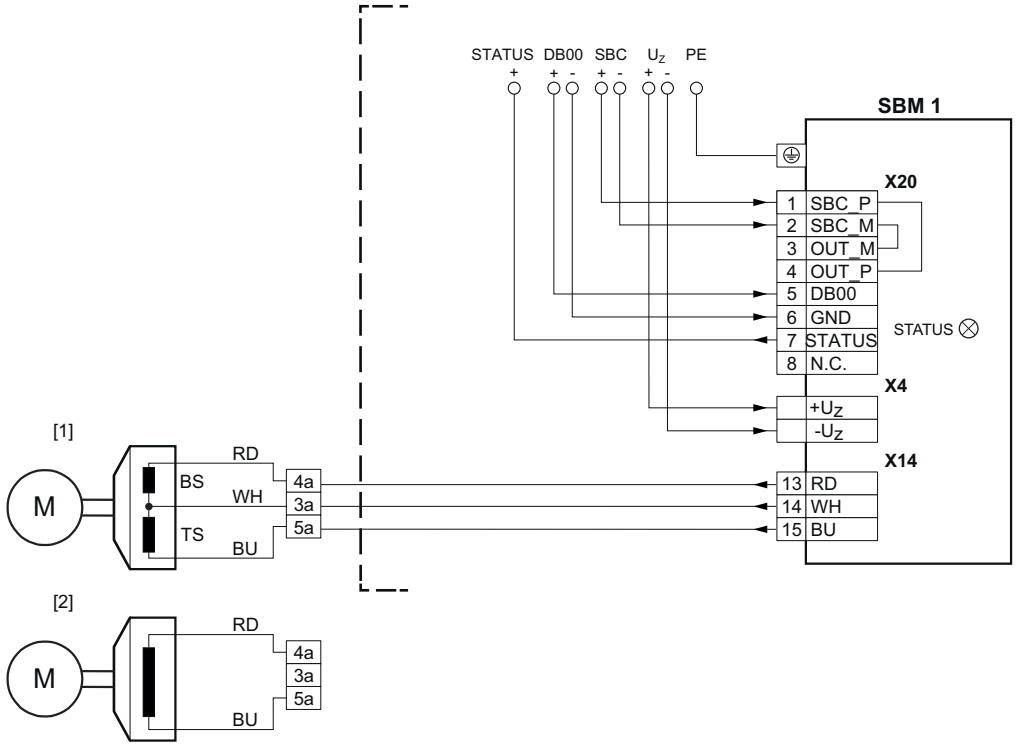
Brake control SBM with 2 control cables



9007232118783115

[1] Connection of the brake with 3-wire technology (standard)

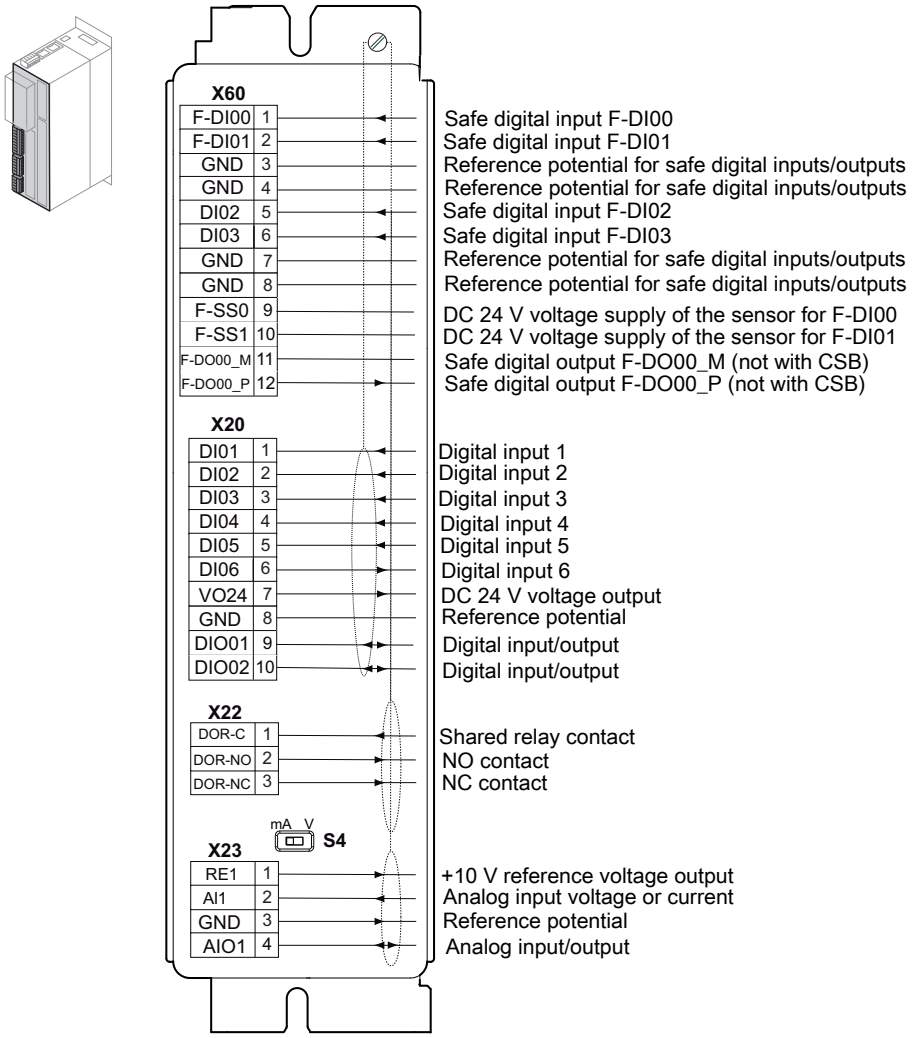
[2] Connection of the brake with 2-wire technology (optional). In this case, there is no connection from terminal X14:14 of the brake module to terminal 3a of the auxiliary terminal strip.

8.12.4 Electronics connection

For the assignment of the signal terminals and connections, refer to chapter "Terminal assignment of basic unit" (→ 🗎 271).

Wiring of the control electronics – front

The assignment of the digital inputs/outputs is different depending on the device variant.



9007230010138507

X20 Digital inputs/outputs
X22 Isolated relay contact
X23 Analog inputs/analog outputs
S4 Changeover switch between voltage input and current input at X23:2 (AI)

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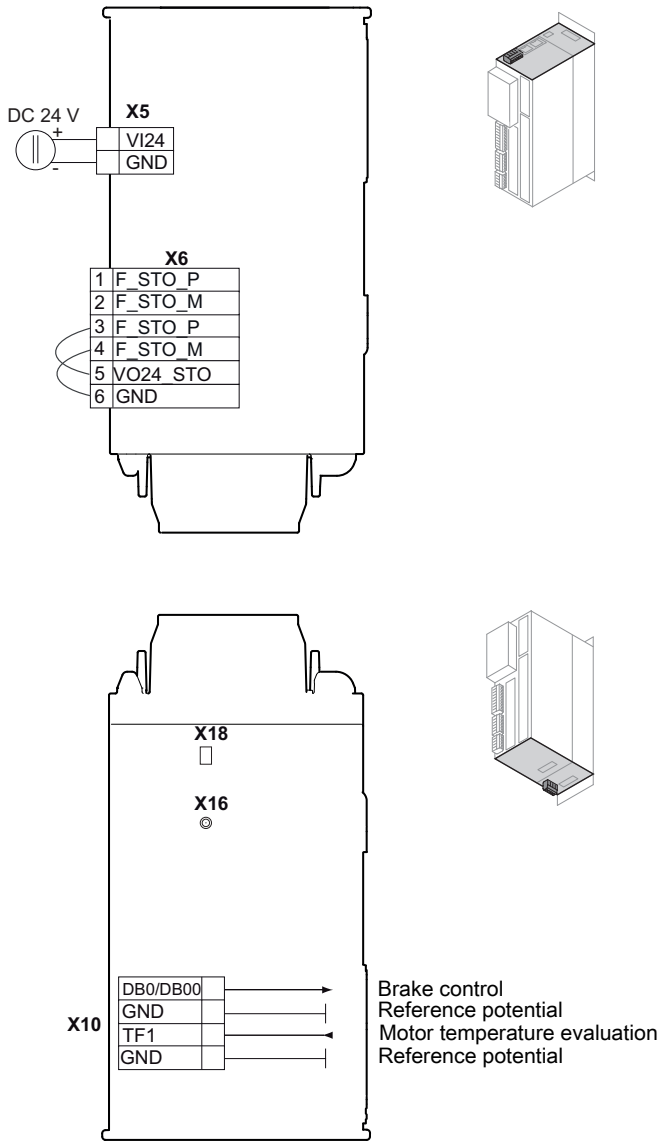
Wiring of the control electronics – top and bottom



36028827928345867

- X5 24 V supply voltage
- X6 Connection for Safe Torque Off (STO)
  If safety option CSB and CSL are installed, X6 has no function.
- X10 Connection of brake control and motor temperature monitoring
- X16 Digital motor integration connection
- X18 Connection of EI7C-FS encoder

8.13 UL-compliant installation

INFORMATION

Due to UL requirements, the following chapter is always printed in English independent of the language of the documentation.

INFORMATION

UL and cUL approval for the following devices is in preparation:

- Devices of sizes 7 and 8
- 1 x 230 V devices

8.13.1 (Field Wiring) Power Terminals

- Use 75 °C copper wire only.
- Tightening torque and wire size for field wiring terminals:

MCX91A-…-5_3-..		0010 – 0055	0070 – 0160	0240	0320 – 0460	0620 – 0910	1130 – 1770	2200 – 3000	3800 – 5880
MCX91A-…-2_3-..		0017 – 0055	0070 – 0140	0213	0290 – 0420	0570 – 0840	1080	–	–
MCX91A-…-2_1-..		0017 – 0042	0055 – 0110	–	–	–	–	–	–
Unit Size		0S	0L	3	4	5	6	7	8
Screw connection		Tightening torques in in.lbs							
Line connection	X1	4.4 – 5.3			15.0 – 15.9	75.2 – 84.1	88.5 – 132.8	123.9 – 177.0	123.9 – 177.0
Motor and braking resistor connection	X2	4.4 – 5.3			15.0 – 15.9	75.2 – 84.1	88.5 – 132.8	123.9 – 177.0	123.9 – 177.0
PE connections		10.6 – 13.3			26.6 – 35.4	53.1 – 88.5	88.5 – 132.8	123.9 – 177.0	123.9 – 177.0
Other M4 screw connections		12.4 – 14.2							

8.13.2 Short Circuit Current Rating

Suitable for use on a circuit capable of delivering not more than 65,000 rms symmetrical amperes when protected by fuses, inverse time circuit breakers or Type E Combination Motor Controllers as described in the tables below:

- MOVITRAC® MCX91B 0010 – 5880 (400 V units only)
  - The max. voltage is limited to 500 V.
- MOVITRAC® MCX91B 0017 – 0140 (230 V units only)
  - The max. voltage is limited to 240 V.

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8.13.3 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).

For maximum branch circuit protection see table below:

Single 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 values)**	**Type E Combination Motor Controller, mfd by Siemens, Type Sirius (rated 480V/277V)**
MCX91A-0017-2.3-4-…(0S)	20 A / 250 V	20 A / 240 V	3RV2011-1GA10, 6.3 A
MCX91A-0025-2.3-4-…(0S)	25 A / 250 V	25 A / 240 V	3RV2011-1HA10, 8.0 A
MCX91A-0034-2.3-4-…(0S)	30 A / 250 V	30 A / 240 V	3RV2011-1JA10, 10 A
MCX91A-0042-2.3-4-…(0S)	40 A / 250 V	30 A / 240 V	3RV2011-4AA10, 16 A
MCX91A-0055-2.3-4-…(0S)	40 A / 250 V	30 A / 240 V	3RV2011-4AA10, 16 A
MCX91A-0070-2.3-4-…(0L)	60 A / 250 V	30 A / 240 V	3RV2011-4BA10, 20 A
MCX91A-0093-2.3-4-…(0L)	60 A / 250 V	30 A / 240 V	3RV2011-4DA10, 25 A
MCX91A-0110-2.3-4-…(0L)	60 A / 250 V	30 A / 240 V	3RV2011-4EA10, 32 A

Three Phase 200 – 240 V Voltage Range SCCR: 65 kA / 240 V			
Model	**Non Semiconductor Fuses (currents are maximum values)**	**Inverse-Time Circuit Breaker (currents are maximum values)**	**Type E Combination Motor Controller, mfd by Siemens, Type Sirius (rated 480V/277V)**
MCX91A-0017-2.3-4-…(0S)	6 A / 250 V	15 A / 240 V min.	3RV2011-1AA10, 1.6 A
MCX91A-0025-2.3-4-…(0S)	6 A / 250 V	15 A / 240 V min.	3RV2011-1CA10, 2.5 A
MCX91A-0034-2.3-4-…(0S)	10 A / 250 V	15 A / 240 V min.	3RV2011-1EA10, 4.0 A
MCX91A-0042-2.3-4-…(0S)	15 A / 250 V	15 A / 240 V min.	3RV2011-1EA10, 4.0 A
MCX91A-0055-2.3-4-…(0S)	20 A / 250 V	20 A / 240 V min.	3RV2011-1GA10, 6.3 A
MCX91A-0070-2.3-4-…(0L)	25 A / 250 V	25 A / 240 V min.	3RV2011-1HA10, 8.0 A
MCX91A-0093-2.3-4-…(0L)	30 A / 250 V	30 A / 240 V min.	3RV2011-1JA10, 10 A
MCX91A-0140-2.3-4-…(0L)	30 A / 250 V	30 A / 240 V min.	3RV2011-4AA10, 16 A
MCX9.A-0213-2.3-4-… (3)	60 A / 600 V Class: CA, CB, CD, CF, G, J, K-1, K-5, RK1, RK5, T	60 A / 500 V min.	3RV2021-4DA10, 25 A
MCX91A-0290-2.3-4-... (4)	60 A / 600 V Class: CA, CB, CD, CF, G, J, K-1, K-5, RK1, RK5, T	60 A / 500 V min.	3RV2031-4EA10, 32 A
MCX91A-0420-2.3-4-... (4)	125 A / 600 V Class: J, K-1, RK1, T	125 A / 500 V min.	3RV2031-4VA10, 45 A
MCX91A-0570-2.3-4-... (5)	125 A / 600 V Class: J, K-1, RK1, T	125 A / 500 V min.	3RV2041-4JA10, 63 A
MCX91A-0840-2.3-4-... (5)	225 A / 600 V Class: J, T	225 A / 500 V min.	3RV2041-4YA10, 93 A
MCX91A-1080-2.3-4-... (6)	225 A / 600 V Class: J, T	225 A / 500 V min.	3RV2041-4YA10, 93 A

Voltage rating of BCP is permitted to be higher.

Three Phase 380 – 500 V Voltage Range SCCR: 65 kA / 500 V			
Model	**Non Semiconductor Fuses (currents are maximum values)**	**Inverse-Time Circuit Breaker (currents are maximum values)**	**Type E Combination Motor Controller, mfd by Siemens, Type Sirius (rated 480V/277V)**
MCX91A-0010-5.3-4-…(0S)	3 A / 600 V	15 A / 500 V min.	3RV2011-0JA10, 1.0 A
MCX91A-0016-5.3-4-…(0S)	3 A / 600 V	15 A / 500 V min.	3RV2011-1AA10, 1.6 A
MCX91A-0020-5.3-4-…(0S)	6 A / 600 V	15 A / 500 V min.	3RV2011-1CA10, 2.5 A
MCX91A-0025-5.3-4-…(0S)	6 A / 600 V	15 A / 500 V min.	3RV2011-1CA10, 2.5 A

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Three Phase 380 – 500 V Voltage Range SCCR: 65 kA / 500 V			
Model	**Non Semiconductor Fuses (currents are maximum values)**	**Inverse-Time Circuit Breaker (currents are maximum values)**	**Type E Combination Motor Controller, mfd by Siemens, Type Sirius (rated 480V/277V)**
MCX91A-0032-5.3-4-…(0S)	10 A / 600 V	15 A / 500 V min.	3RV2011-1EA10, 4.0 A
MCX91A-0040-5.3-4-…(0S)	10 A / 600 V	15 A / 500 V min.	3RV2011-1EA10, 4.0 A
MCX91A-0055-5.3-4-…(0S)	20 A / 600 V	20 A / 500 V min.	3RV2011-1GA10, 6.3 A
MCX91A-0070-5.3-4-…(0L)	25 A / 600 V	25 A / 500 V min.	3RV2011-1HA10, 8.0 A
MCX91A-0095-5.3-4-…(0L)	30 A / 600 V	30 A / 500 V min.	3RV2011-1JA10, 10 A
MCX91A-0125-5.3-4-…(0L)	30 A / 600 V	30 A / 500 V min.	3RV2011-4AA10, 16 A
MCX91A-0160-5.3-4-…(0L)	30 A / 600 V	30 A / 500 V min.	3RV2021-4BA10, 20 A
MCX91A-0240-5.3-4-…(3)	60 A / 600 V Class: CA, CB, CD, CF, G, J, K-1, K-5, RK1, RK5, T	60 A / 500 V min.	3RV2021-4DA10, 25 A
MCX91A-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 min.	3RV2031-4EA10, 32 A
MCX91A-0460-5.3-4-… (4)	125 A / 600 V Class: J, K-1, RK1, T	125 A / 500 V min.	3RV2031-4VA10, 45 A
MCX91A-0620-5.3-4-… (5)	125 A / 600 V Class: J, K-1, RK1, T	125 A / 500 V min.	3RV2041-4JA10, 63 A
MCX91A-0750-5.3-4-… (5)	125 A / 600 V Class: J, K-1, RK1, T	125 A / 500 V min.	3RV2041-4KA10, 75 A
MCX91A-0910-5.3-4-… (5)	225 A / 600 V Class: J, T	225 A / 500 V min.	3RV2041-4YA10, 93 A
MCX91A-1130-5.3-4-… (6)	225 A / 600 V Class: J, T	225 A / 500 V min.	–
MCX91A-1490-5.3-4-… (6)	225 A / 600 V Class: J, T	225 A / 500 V min.	–
MCX91A-1770-5.3-4-… (6)	225 A / 600 V Class: J, T	225 A / 500 V min.	–
MCX91A-2200-5.3-4-… (7)	600 A / 600 V Class: J, K-1, L, RK1, T	600 A / 500 V min.	–
MCX91A-2500-5.3-4-… (7)	600 A / 600 V Class: J, K-1, L, RK1, T	600 A / 500 V min.	–
MCX91A-3000-5.3-4-… (7)	600 A / 600 V Class: J, K-1, L, RK1, T	600 A / 500 V min.	–
MCX91A-3800-5.3-4-… (8)	800 A / 600 V Class: T	800 A / 500 V min.	–
MCX91A-4700-5.3-4-… (8)	800 A / 600 V Class: T	800 A / 500 V min.	–
MCX91A-5880-5.3-4-… (8)	800 A / 600 V Class: T	800 A / 500 V min.	–

Voltage rating of BCP is permitted to be higher.

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

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8.13.4 Motor Overload Protection

MOVITRAC® advanced is 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.

8.13.5 Surrounding Air Temperature Rating

For surrounding air temperature rating refer to chapter “General technical data”.

8.13.6 Derating

For derating refer to chapter “Selecting an inverter” of the Product Manual.

8.13.7 Other Ratings

Type rating	Open Type
Pollution Degree	2
Overvoltage Category	III
Max. Altitude	2000 m

8.13.8 Wiring Diagrams

For wiring diagrams, refer to chapter “Wiring Diagrams”.

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9 Startup

9.1 General

9.1.1 Lifting applications

⚠ WARNING

Danger of fatal injury if the hoist falls.

Severe or fatal injuries.

- The inverter is not designed for use as a safety device in lifting applications. Use monitoring systems or mechanical protection devices to ensure safety.

9.1.2 Connecting power

NOTICE

Undercutting the minimum switch-off time of the line contactor.

Irreparable damage to the inverter or unforeseeable malfunctions.

Adhere to the specified times and intervals.

- After disconnection from the supply system, observe a minimum switch-off time of 10 s.
- Do **not switch on/off** the power supply system **more than once per minute**, for single-phase inverters MCX91A-..-2E1-4-... only every 2 minutes!

9.1.3 Connecting the cables

NOTICE

Cables may only be connected and plugged in a de-energized state.

Irreparable damage to the inverter or unforeseeable malfunctions.

- De-energize the inverter.

9.1.4 Risk of crushing

⚠ DANGER

Risk of crushing if the motor starts up unintentionally.

Serious or fatal injuries can occur.

- Binary device: Prevent unintentional starting of the motor, e.g. by setting STO or by setting the 24 V operation.
- Bus device: Disconnect the motor.
- Additional safety precautions must be taken, depending on the application, to avoid injury to personnel and damage to machinery.

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9.2 Startup requirements

The following requirements apply to startup:

- You have installed the inverter correctly, both mechanically and electrically.
- You have configured the inverter and connected drives correctly.
- Safety measures prevent accidental startup of the drive.
- Safety precautions prevent danger to persons or machines.

You can perform the startup in different ways:

- If you use a power-adjusted motor, you can dispense with startup (operation without startup), depending on the requirements.
- You can perform startup using a keypad or the MOVISUITE® engineering software.

- Required hardware for startup with MOVISUITE® engineering software:
  - USM21A interface adapter (28231449), CDM11A diagnostic module (28265092) and serial interface cable RJ10 → d-sub-9 (18123864)

    or
  - CBG11A/CBG21A keypad and USB cable A → Mini B (25643517)

Part number	Scope of delivery
28231449	• USM21A interface adapter • Serial interface cable with 2 × RJ10 connectors • USB cable (A-B)
18123864	• Serial interface cable RJ10 → D-sub -9
25643517	• USB cable (A-B)

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9.3 Operation without startup

Motor

The inverter is set to operate a motor in delivery state according to the specification "Motor power ASM P_{Mot}" (corresponds to the specification P(ASM) on the nameplate of the inverter).

Signal terminals

If an inverter is delivered without a MOVIKIT® software module, the following pre-assigned terminal functions are available:

Digital inputs	
DI01	FCB 05 – fixed setpoints positive direction of rotation
DI02	FCB 05 – fixed setpoints negative direction of rotation
DI03	Fixed speed setpoint bit 0
DI04	Fixed speed setpoint bit 1
DI05	Fault reset
DI06	No function

Digital outputs	
DB00	Brake output
DOR	No function

Configurable digital inputs/digital outputs	
DIO01	No function (set as input)
DIO02	No function (set as input)

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9.4 Startup with MOVISUITE® engineering software

The inverters are started up using the MOVISUITE® engineering software from SEW-EURODRIVE.

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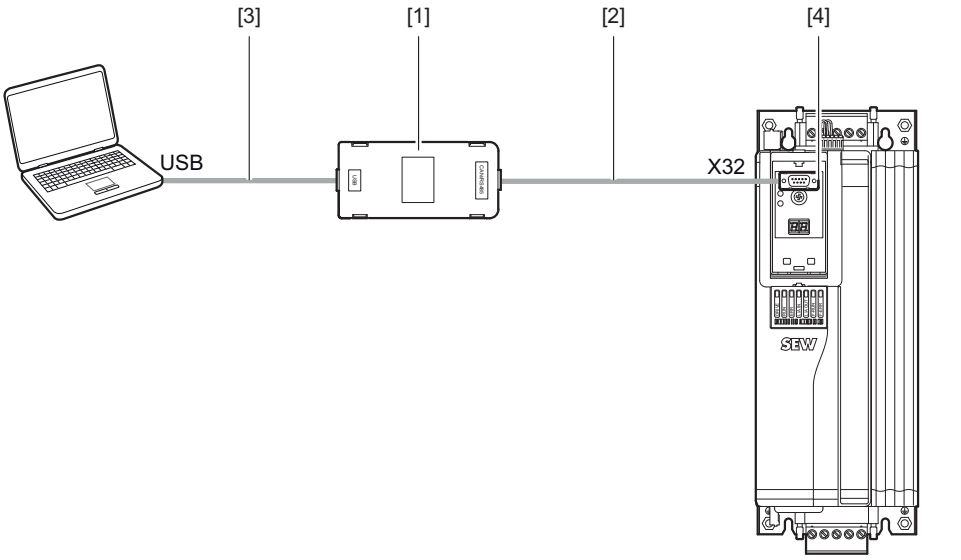
The motor is started up in drive train 1 or drive train 2.

When using a motor from SEW-EURODRIVE, select the motor type from the catalog.

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.

9.4.1 Connection to MOVISUITE® via CDM11A and USM21A



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[1] Interface adapter USM21A, part number: 28231449

[2] Serial interface cable with an RJ10 connector and a 9-pin D-sub connector, part number 18123864.

This cable is necessary for the connection of the interface adapter to the inverter, and must be ordered separately.

[3] Commercially available USB connection cable, type USB A-B. The cable is included in the scope of delivery of the interface adapter.

[4] Diagnostic module CDM11A

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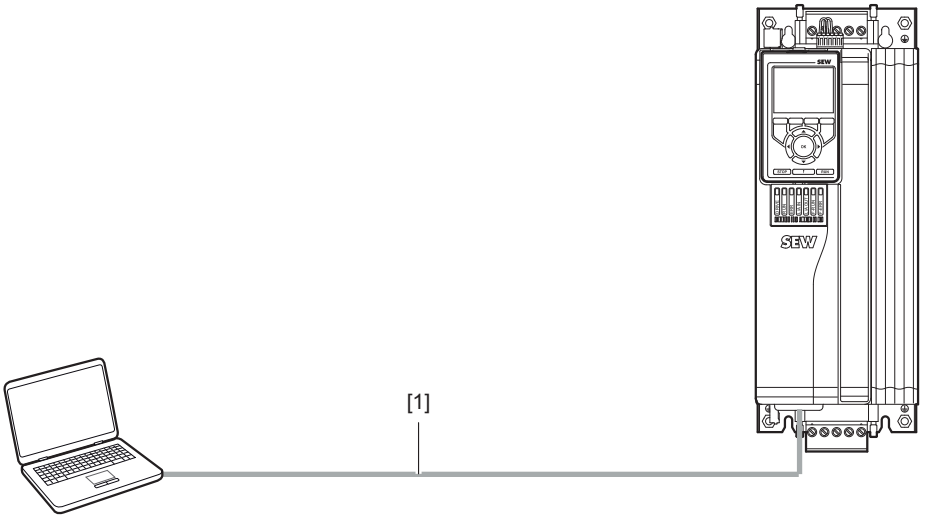
9.4.2 Connection to MOVISUITE® via fieldbus interface

The following description refers to the PROFINET, Ethernet/IP™, POWERLINK fieldbus interfaces.

The CDM11A diagnostic module is required to connect the keypad.



35273973643

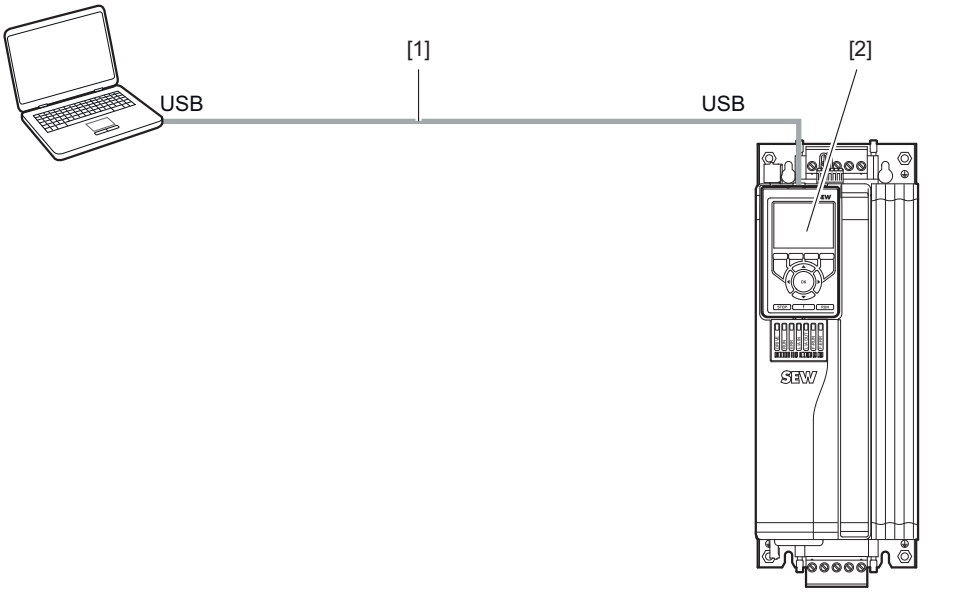
[1] Conventional Ethernet cable

- Activate "Ethernet" at Communication/Network type.

The inverter can only be scanned if you assign an IP address to the inverter. The assignment is made using an external addressing tool.

9.4.3 Connection to MOVISUITE® via keypad

The connection to the MOVISUITE® engineering software can be made using the CBG11A and CBG21A keypads. The CDM11A diagnostic module is required to connect the keypad.



32667701259

[1] USB cable, type USB A-Mini-B, 25643517

[2] Keypad, here by way of example, CBG21A plugged onto CDM11A diagnostic module

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9.5 EtherCAT® ID

It is not strictly necessary to set one of the EtherCAT® IDs. The slaves are automatically addressed by the master as standard. 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 in the EtherCAT® variant ..E00 using the hexadecimal switches S1 and S2. With these switches, you can set a decimal EtherCAT® ID between 1 and 255 in hexadecimal notation.

The ID serves as a unique device identification 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).

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9.5.1 Setting the EtherCAT® ID

An EtherCAT® ID can be permanently assigned to the inverter in the EtherCAT® variant ..E00 using the hexadecimal switches S1 and S2. With these switches, you can set a decimal EtherCAT® ID between 1 and 255 in hexadecimal notation.

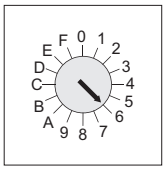
The ID serves as a unique device identification of the respective EtherCAT® slave for the EtherCAT® master. The EtherCAT® ID is not an EtherCAT® address.

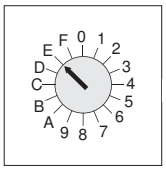
The EtherCAT® ID is always assigned by the EtherCAT® master. In the delivery state of the inverter, the ID is set to 0 by default (S1 = 0 and S2 = 0).

It is not strictly necessary to set one of the EtherCAT® IDs. The slaves are automatically addressed by the master as standard.

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.

Required ID, decimal	ID, hexadecimal	Setting S1 (x10)	Setting S2 (x1)
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 (x10)  6

S2 EtherCAT® ID (x1)  E

The EtherCAT® ID "110" is set as an example in the illustration above.

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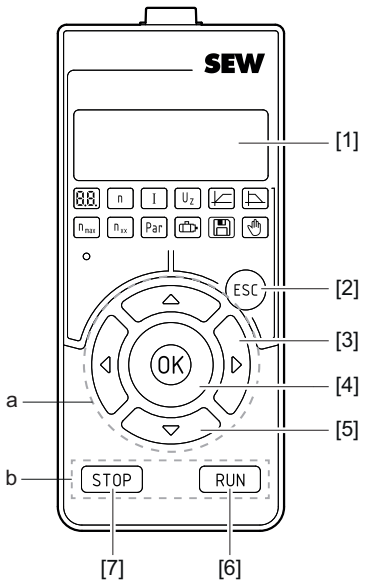
9.6 Startup with the CBG01A keypad

With the CBG01A keypad, only asynchronous motors with or without brake (firmware-dependent), without motor sensor and without encoder can be started up.

The startup of other motors can only be carried out with the CBG21A keypad or with the MOVISUITE® engineering software.

9.6.1 CBG01A keypad



32733276939

[1] 5-digit 7-segment display

[2] Escape key

a = Navigate in the menu

[3] Right/left arrow keys

[4] Confirm entry

[5] Up/down arrow keys

b = Manual mode operating range

[6] RUN key

[7] STOP key

To open the main menu, press the <Esc> key. Press the <right/left> arrow keys to select functions in the main menu. Confirm your selection with the <OK> key.

When entering numbers, you must confirm the proposed or entered number with the <OK> key.

To return to the previous step in the menu, press the escape key.

Symbols used

The available functions are shown with pictograms in the keypad display.

Inverter status, FCB number, fault number

Actual speed in min^{-1}

Actual current in A

DC link voltage in V

Fixed setpoints – acceleration 1, 2 in $(min \times s)^{-1}$

Fixed setpoints – deceleration 1, 2 in $(min \times s)^{-1}$

Maximum speed in min^{-1}

Fixed setpoints – speed in min^{-1}

Parameter

Startup

Data management

Manual mode

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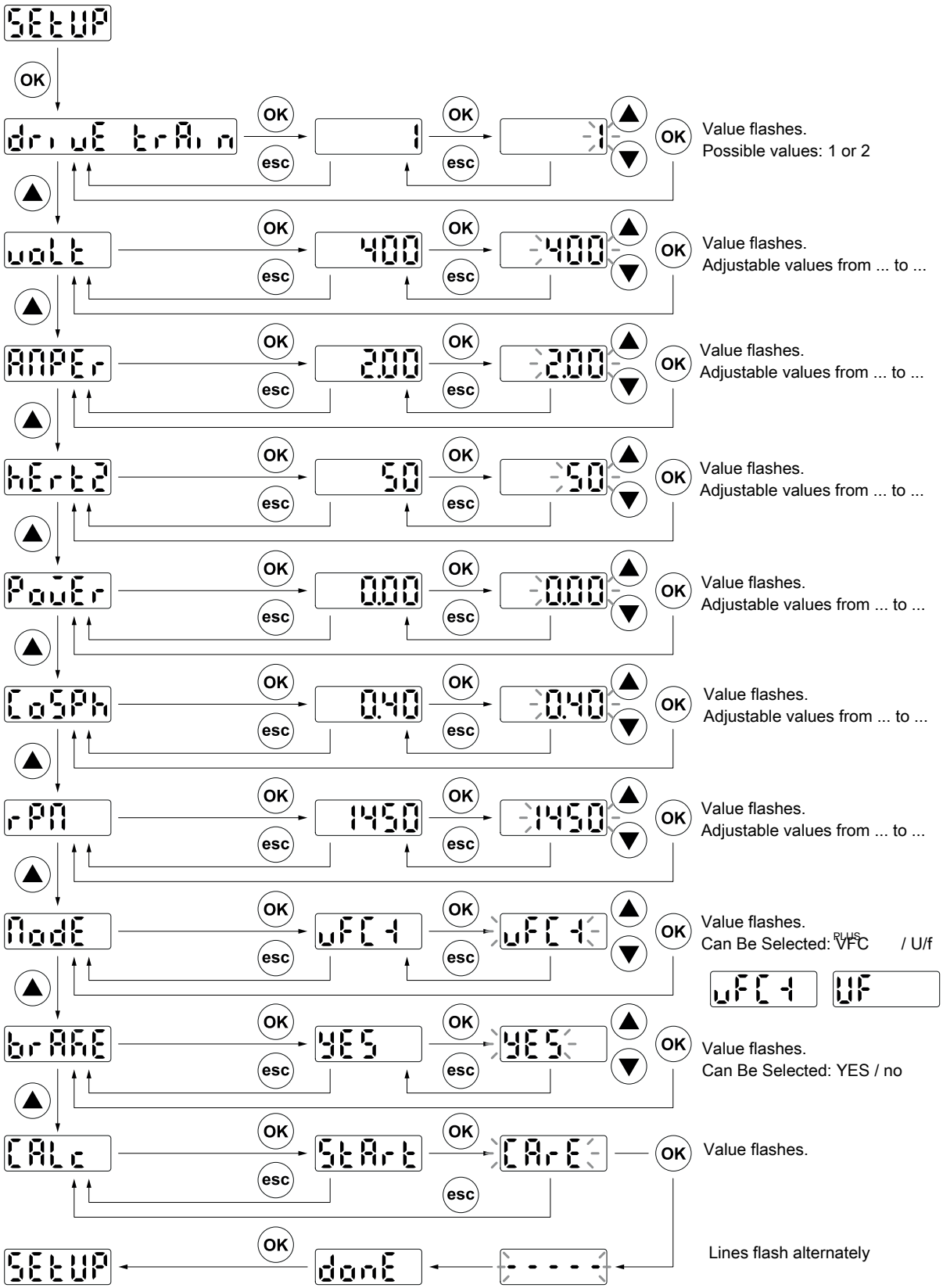
9.6.2 Startup procedure for motor startup



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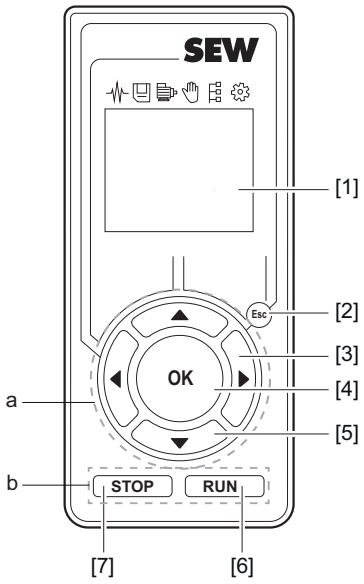
9.7 Startup with the CBG11A keypad

You can perform the startup intuitively with a CBG11A keypad using the symbols and functions shown in the display.

Only asynchronous motors without encoder can be started up with the CBG11A keypad. The startup of other motors can only be performed with the CBG21A keypad or with the MOVISUITE® engineering software.

9.7.1 CBG11A keypad

The user interface of this keypad is in English.



9007225173448203

[1] Display

[2] Esc key

a = Navigate in the menu

[3] Right/left arrow keys

[4] Confirm entry

[5] Up/down arrow keys

b = Manual mode operating range

[6] RUN key

[7] STOP key

To open the main menu, press the <Esc> key. Press the <right/left> arrow keys to select functions in the main menu. Confirm your selection with the <OK> key.

When entering numbers, you must confirm the proposed or entered number with the <OK> key. The digit of the number that is currently editable is then shown underlined. You can use the <up/down> arrow keys to change the value of the digit. Use the <right/left> arrow keys to switch the digit to be edited within the number.

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Symbols used

The available functions are shown with pictograms in the keypad display.

Diagnostics

Data management

Startup

Manual mode

Parameter tree

Keypad settings

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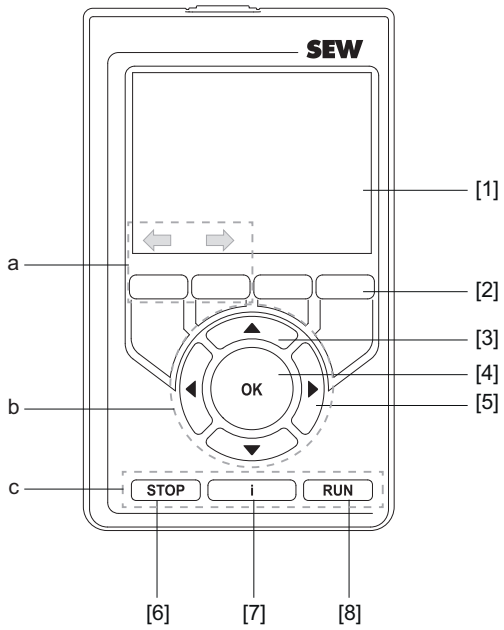
9.8 Startup with the CBG21A keypad

You can perform the startup intuitively with a CBG21A keypad using the symbols and functions shown in the display.

Asynchronous motors and synchronous motors can be started up with the CBG21A keypad.

9.8.1 CBG21A keypad

The user interface of this keypad is multilingual.



25894023563

[1] Color display

[2] 4 function keys that are assigned according to the context. The assigned functions are shown in the display above the keys

a = Permanently assigned with Back/Next

b = Navigate in the menu

[3] Up/down arrow keys

[4] Confirm entry

[5] Right/left arrow keys

c = Manual mode operating range

[6] STOP key

[7] Information key

[8] RUN key

Choice boxes are activated with <OK>, and the selection is then made with the <up/down> arrow keys. Confirm the selection with <OK>.

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When entering numbers, you must confirm the proposed or entered number with the <OK> key. The digit of the number that is currently editable is then shown with a colored background. You can use the <up/down> arrow keys to change the value of the digit. Use the <right/left> arrow keys to switch the digit to be edited within the number.

Symbols used

Startup

Manual mode

Drive train optimization

Application

Diagnostics

Parameters

Data management

Keypad settings

Start menu

MOVISAFE® CS..

Gateway

Back

Next

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9.9 Firmware update

- Connect the inverter to the MOVISUITE® engineering software.
- Open MOVISUITE® and select the corresponding device.
- Right-click to open the context menu. You can open the firmware loader via the "Tools" menu item.
- Now select the corresponding target version of the firmware and transfer it to the selected component by pressing the "Accept selected firmware" button.
- Do not disconnect the communication link during a firmware update, and ensure that the voltage supply is not interrupted.

9.10 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.

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9.11 Control of control signal sources

The following description requires the use of the MOVISUITE® engineering software.

Depending on the version of the inverter, it is controlled via the digital inputs/analog inputs or via fieldbus.

In principle, the user is free to configure the respective interface individually or to use the SEW standard interface.

Various MOVIKIT® software modules are available for this purpose.

This offers the following benefits:

- Application-specific functionalities
- Standard interface from SEW-EURODRIVE
- Automated parameterization of the interface
- MOVIKIT®-specific diagnostics and manual operation

9.11.1 Control via terminals

Analog setpoints and fixed setpoints can be used for control via the terminals. If no MOVIKIT® is loaded ex-works, the source is set to "No source" under "Setpoints/basic setting" and the inverter can be controlled via terminals.

The following applies:

- Digital inputs
  - DI00: Output stage enable (DI00 is not led out to terminal X20 and therefore cannot be used)
  - DI01: Fixed setpoint – positive direction of rotation
  - DI02: Fixed setpoint – negative direction of rotation
  - DI03: Fixed speed setpoint bit 0
  - DI04: Fixed speed setpoint bit 1
  - DI05: Fault reset
  - DI06: No function
- Configurable digital inputs/digital outputs
  - DIO01: No function
  - DIO02: No function
- Digital outputs
  - DB00: Brake output
  - DOR: No function
- Analog input AI1

  If no "Fixed speed setpoint" bit is selected, the AI1 is taken over as speed setpoint source. The set numerator/denominator scaling in user units applies.

  Speed setpoint (user units) = AI1 value × 15/100
- Configurable analog input/analog output AIO1
  - AIO1: No function

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9.11.2 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.

9.11.3 Control via MOVIKIT® software module

The MOVIKIT® software modules have firmly defined interfaces.

When using the MOVISUITE® engineering software, MOVIKIT® modules can be selected and added via the software catalog.

For further information on using and operating the MOVIKIT® modules, refer to the corresponding documentation.

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9.12 Application-related startup

The following lists applications with specific settings for startup.

Startup is performed using the MOVISUITE® engineering software.

9.12.1 Pumps and fans

- The control mode to be used depends on the motor type.
- Switch the slip compensation off.
- Activate the flying start function.
- In the V/f control mode, the direct current brake is effective.

9.12.2 Hoist

The following parameters must be taken into account and set for a hoist:

- 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 is maintained as present at the time of opening the speed control loop. 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) and set it.

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9.12.3 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	
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

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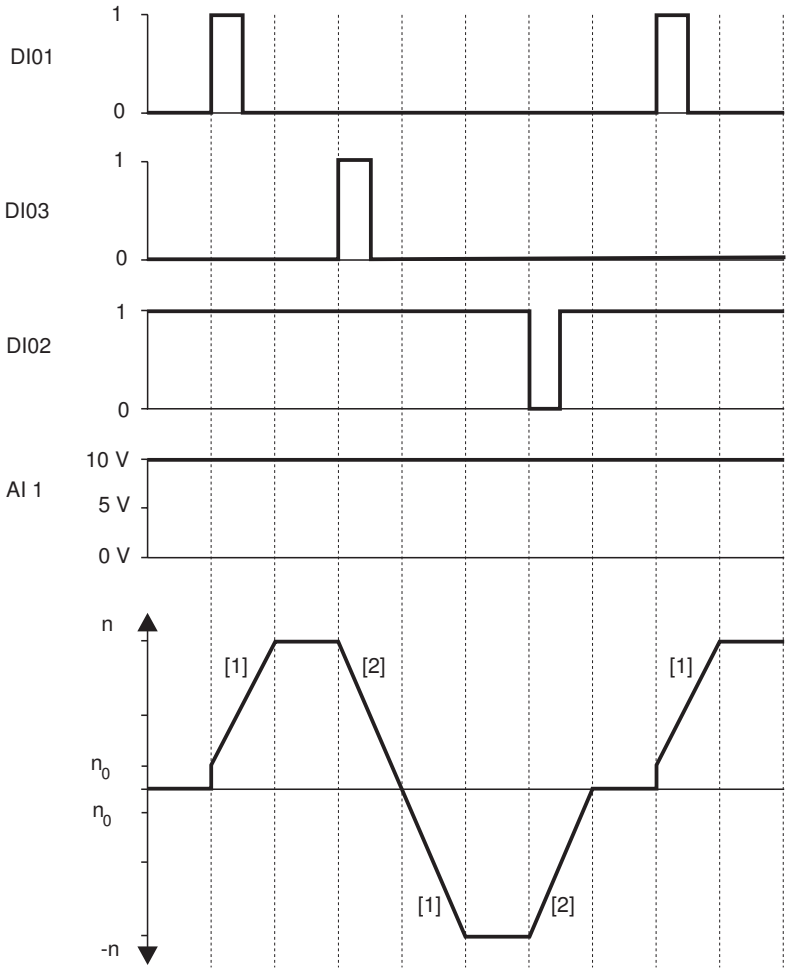
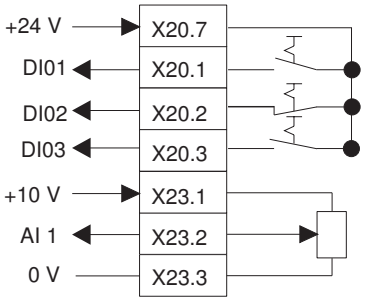
Cycle diagram





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[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 1 Setpoint input AI1
n Motor speed
n_0 Start/stop speed

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9.12.4 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.

Parameterization example

Description	Index	Function	Comment
Basic settings Setpoint source	8366.4	No source	
Setpoints/speed	8376.11	Fixed setpoints – velocity	
Fixed setpoints/operating mode	8354.20	Motor potentiometer/fixed setpoint	
Fixed setpoints/analog setpoint source	8354.25	No source	
Setpoints/max. Acceleration	8377.21	Selection of the source	Default setting: Application limit
Setpoints/max. Deceleration	8377.31	Selection of the source	Default setting: Application limit
Minimum speed*			In preparation (planned for FW10)
Save setpoint	8369.2	Off	Behavior after "mains 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

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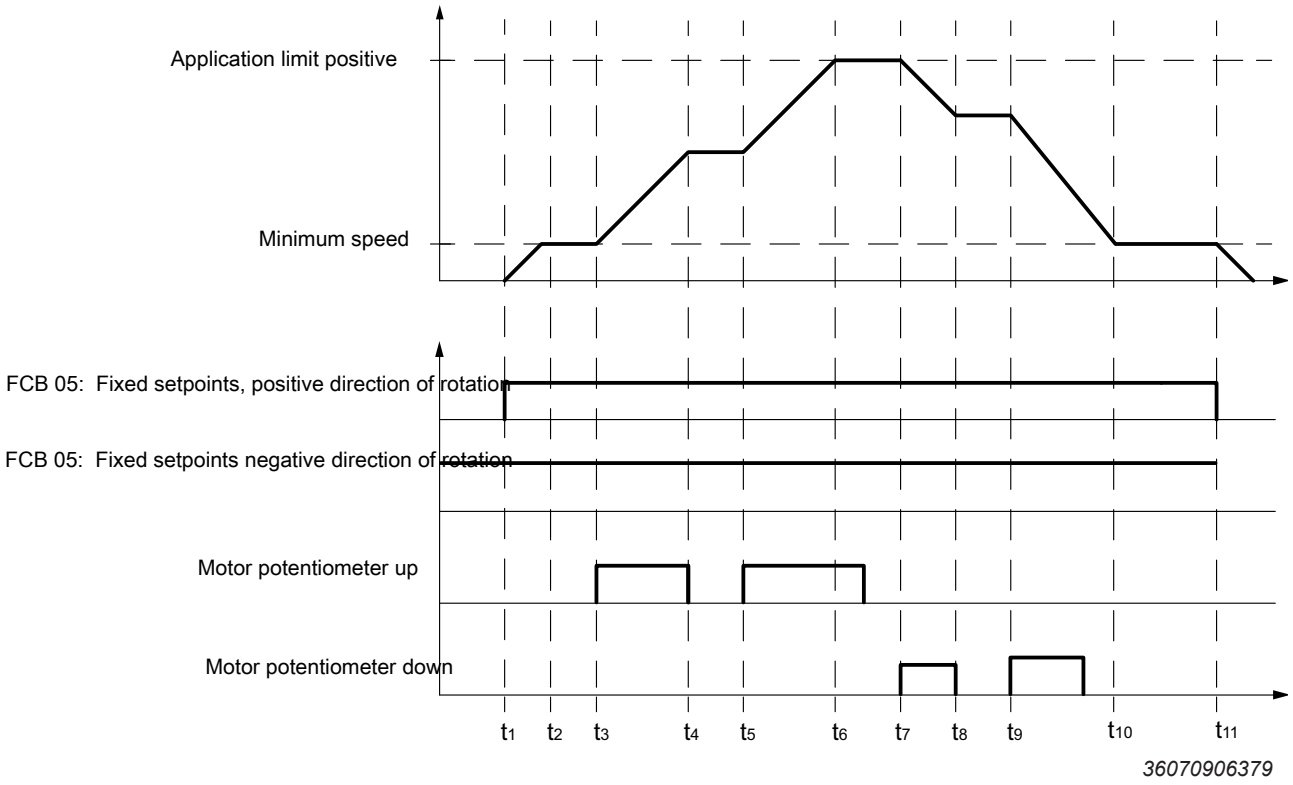
Description	Index	Function	Comment
Digital input 5	8334.14	Reset	Pushbutton, NO contact

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[1)].
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 acceleration ramp (index 8377.21).
t_4 - t_5 If no signal is present any longer at "Motor potentiometer", 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 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 deceleration ramp (index 8377.31) until 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".

1) in preparation

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9.12.5 Positioning and speed control with HTL encoders

- Start up the drive train with HTL encoders.
- Insert the MOVIKIT® "Positioning Drive" software module.
- Assign inputs DI04 (track A), DI05 (track B) and optional DI06 (track C).

Restrictions for the EI7C encoder:

Only simple positioning tasks can be implemented in combination with the MOVIKIT® "Positioning Drive" software module and the EI7C encoder. The achievable accuracy is 1/4 motor revolutions.

Due to the low encoder resolution, observe the following:

- Speed control is not possible.
- Position control at speed 0 is not possible, so you must inhibit the output stage when the "in position" signal is displayed. If a brake is installed, you must parameterize it so that it is applied.
- SEW-EURODRIVE recommends to set the lag range accordingly and to set the control to soft.

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10 Operation

10.1 General information

⚠ DANGER

Dangerous voltages present at cables and motor terminals.

Severe or fatal injuries from electric shock

- Dangerous voltages are present at the output terminals and the cables and motor terminals connected to them when the device is switched on. This also applies even when the device is inhibited and the motor is at standstill.
- The fact that the operation LED is no longer illuminated does not indicate that the inverter has been disconnected from the power supply and no longer carries any voltage.
- Before you touch the power terminals, check that the inverter has been disconnected from the power supply.
- Observe the general safety notes in the "Safety notes" chapter and the notes in the "Electrical installation" chapter.

⚠ DANGER

Risk of crushing if the motor starts up unintentionally.

Serious or fatal injuries

- Binary device: Prevent unintentional starting of the motor, e.g. by setting STO or by setting the 24 V operation.
- Bus device: Disconnect the motor.
- Additional safety precautions must be taken, depending on the application, to avoid injury to personnel and damage to machinery.

NOTICE

Switching the motor output at the inverter with enabled output stage.

Inverter damage

- The motor output of the inverter may be switched or disconnected only when the output stage is inhibited.

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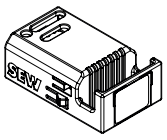
10.2 CMM11A memory module



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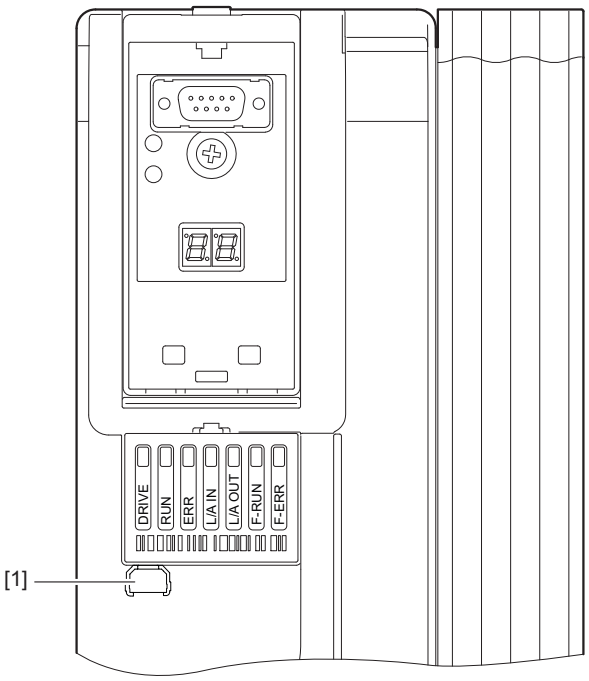
The pluggable memory module is supplied independently of the device variant.

For certain device variants, the memory module can be deselected when configuring the inverter. It is not possible to deselect the memory module if the device variant includes the CSB and CSL safety options.



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[1] Memory module

All device data is always stored up-to-date on the memory module. If a device needs to be replaced, the system can be started up again quickly without additional tools by simply replugging the memory module.

If a device variant with functional safety is used, the memory module also serves as a safety key.

The memory module can be simply removed or plugged in when it is switched off.

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10.2.1 Instructions on the use of the memory module when exchanging a device

The prerequisite for the error-free exchange of an inverter is that the same options must be installed in the new device as in the original one.

If this is not the case, the error message "25.70 NV memory initialization" is displayed. You can acknowledge the fault by opening the "Fault reset with parameter acceptance" menu item in the context menu, and you must ensure that the information that was provided via the previous options (e.g. encoder signals via encoder option) reach the inverter through different means or are deselected.

Alternatively, the device can also be reset to the delivery state. A new startup is then required.

If a memory module is removed during operation, the following error message is displayed: "33.13 System initialization: Memory module removed".

This fault status can be acknowledged with a fault reset.

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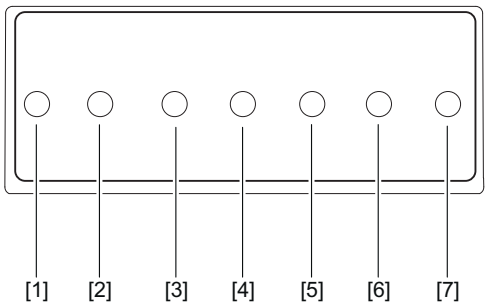
10.3 LED display

10.3.1 Status and operating displays

The device label depends on the device variant/function. Consequently, not all LEDs are labeled for all device variants. The following labeling shows the maximum expansion of the respective variant.



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LED	PROFINET IO EtherNet/IP™ Modbus TCP	SBus^{PLUS} EtherCAT®	POWERLINK	Binary control
1	DRIVE	DRIVE	DRIVE	DRIVE
2	US1/MS	RUN	BE	–
3	BF/NS	ERR	BS	–
4	L/A X40	L/A IN	L/A X40	–
5	L/A X41	L/A OUT	L/A X41	–
6	F-RUN	F-RUN	F-RUN	–
7	F-ERR	F-ERR	F-ERR	–

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10.3.2 LED displays – basic unit

"DRIVE" LED

The listed frequencies always refer to a certain period duration, i.e. a phase-in and phase-out of the LED and not to the entire pattern.

For states in which the LED lights up in multiple colors, the following pattern is always used:

Color 1 → off → color 1 → off → color 2 → off → color 2 → off = 4 periods

LED	Operating state	Meaning	Measure
Off	Not ready for operation	The supply and/or backup voltage is not connected.	Enable voltage.
Yellow Flashes 4 Hz	Not ready for operation	Initialization phase/system startup.	Wait until the process is completed.
Yellow Pulse 250 ms on, 5 s off	Not ready for operation	The inverter is in standby mode.	Exit standby mode.
Red Flashes 1 Hz	Not ready for operation	A fault occurred, the cause can be eliminated by the user.	For possible measures, refer to chapter "Fault description" (→ 🗎 339).
Red Steady light	Not ready for operation	A fault occurred, the cause cannot be eliminated by the user.	For further information, refer to chapter "Fault description" (→ 🗎 339).
Yellow/red Flashes with changing colors, 0.5 Hz (2 x yellow, 2 x red)	Ready for operation	A warning is present. The output stage is inhibited.	For possible measures, refer to chapter "Fault description" (→ 🗎 339).
Green/red Flashes with changing colors, 0.5 Hz (2 × green, 2 × red)	Ready for operation	A warning is present. The output stage is enabled.	For possible measures, refer to chapter "Fault description" (→ 🗎 339).
Green/yellow Flashes with changing colors, 4 Hz (2 × green, 2 × yellow)	Not ready for operation	Automatic startup is performed via the MOVILINK®DDI interface.	Wait until startup has been completed.
Green/yellow Flashes with changing colors, 0.5 Hz (2 × green, 2 × yellow)	Ready for operation Device inhibited	STO is active.	Deactivate STO.
Yellow Flashes 0.5 Hz	Not ready for operation	The system is not ready for operation.	Check the cause why "not ready" was issued using the MOVISUITE® engineering software, via the operator panel or the controller.

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LED	Operating state	Meaning	Measure
Yellow Flashes 1 Hz	Ready for operation. Manual mode/local mode/prioritized terminal control status	The device is ready for operation, waiting for enable.	–
Green Flashes 1 Hz	Unit enabled. Manual mode/local mode/prioritized terminal control status	The output stage is enabled.	–
Yellow Flashes 2 Hz	Ready for operation	The brake is released without drive enable.	–
Yellow Steady light	Ready for operation Device inhibited	The device is ready for operation; the output stage is inhibited.	–
Green Flashes 4 Hz	Unit enabled. Current limit active.	The drive is at the current limit.	Reduce the load.
Green Steady light	Device enabled	The output stage is enabled.	–

"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 once**	"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.

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"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 not been reached. However the "Change" parameter is set to "0x01:change/error".
Red **Flashing**	Invalid configuration A general configuration error has occurred.
Red **Flashing once**	Unprompted 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.
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.

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10.3.3 Fieldbus variants PROFINET CFN and PROFINET CFNB

"BF" LED

This LED indicates the status of the PROFINET interface. The state includes communication link, bus error and process data configuration.

Status	Possible cause	Measure
Off	Fault-free operating state. The PROFINET device is exchanging data with the PROFINET controller (Data Exchange state).	–
Red Permanently lit	Connection to the PROFINET controller has failed. Bus communication has been interrupted.	Check the PROFINET connection of the PROFINET device. Check all the cables in the PROFINET network.
	The PROFINET controller is not in operation.	Check the PROFINET controller.
	The PROFINET device does not detect a PROFINET baud rate.	Check the configuration of the PROFINET controller.
Yellow Permanently lit	There is a connection to the PROFINET controller, but the configuration of the PROFINET network is faulty. The following faults may have occurred: • A hardware module was selected that does not support the PROFINET interface. • The standard process data and the safe process data have been assigned mixed to the PROFINET device.	Check the configuration of the PROFINET controller.

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"US1" LED

This LED indicates the status of the PROFINET interface. The state includes the start-up, normal operation, error mode and energy-saving operation operating modes.

Status	Possible cause	Measure
Yellow, flashing Cyclic duration factor: 250 ms Switch-off time: 250 ms	The PROFINET interface box is just starting up after a reset.	–
Green Permanently lit	The PROFINET interface is operating without faults.	–
Green, flashing Cyclic duration factor: 500 ms Switch-off time: 3000 ms	The PROFINET interface is in energy-saving mode (PROFIenergy mode).	–
Red Permanently lit	The PROFINET interface box has detected a fault. **Information:** A timeout of the PROFINET connection is not an internal fault.	Switch the device off and back on again. If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

"LNK/ACT" LED

Status	Meaning
All LEDs Green Permanently lit	A physical connection to another Ethernet node was detected. Currently, no data is being exchanged via the Ethernet port.
All LEDs Flashing green Cyclic duration factor: 500 ms Switch-off time: 500 ms	The blink test has been activated to localize the Ethernet nodes visually.
All LEDs Off	No physical connection to further Ethernet nodes was detected.
LED at the respective Ethernet port Green/yellow, flashing	Data is being sent or received via the Ethernet port.

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10.3.4 EtherNet/IP™ and Modbus TCP CFE fieldbus variant

"NS" LED

LED	Meaning	Measure
– **Off**	Device is switched off. No DC 24 V supply.	• Check the DC 24 V voltage supply. • Switch on the device again.
	The IP address is not set.	• Set the IP address.
Green **Flashing**	The connection to the Ethernet master has failed. The device does not detect a connection to the Ethernet master (bus error).	• Check the Ethernet connection of the device. • Check all Ethernet connections.
Green **Illuminated**	The IP address is set. The Ethernet connection has been established.	–
Red **Flashing**	Timeout delay of the controlling connection has expired. The state is reset by restarting communication.	• Check the fieldbus connection. • Check the master/scanner. • Check all Ethernet connections.
Red **Illuminated**	Conflict detected in IP address assignment.	• Check whether there is another device with the same IP address in the network. • Change the IP address of the device. • Check the DHCP settings for IP address assignment of the DHCP server (only when using a DHCP server).
Red/green **Flashing**	The device performs a LED test. This state may only be active for a short time during startup.	–
	The device has received the designated target unit network ID (TUNID). The LED will keep flashing until the device has received the APPLY_TUNID service and the validation is successfully completed.	

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"MS" LED

LED	Meaning	Measure
– **Off**	No power supply or DC 24 V supply.	• Check the voltage supply.
Green **Flashing**	The device has not been configured yet.	• Configure the device. • Check the DHCP server connection (only if DHCP is activated and in persistent status).
Green **Illuminated**	Device OK.	–
Red **Flashing**	A correctable fault has occurred on the device.	• Check whether there is another device with the same IP address in the network. • Change the IP address of the device. • Check the DHCP settings for IP address assignment of the DHCP server (only when using a DHCP server).
Red **Illuminated**	A fault that cannot be corrected has occurred on the device.	• Switch on the device again. • Reset the device to the factory settings. • If this fault occurs repeatedly, replace the device or contact SEW-EURODRIVE Service.
Red/green **Flashing**	The device performs a LED test. This state may only be active for a short time during startup.	–
	The device is waiting for a target unit network ID (TUNID).	Assign a target unit network ID (TUNID) to the device.
	Device parameter setting is required.	Check the parameterization of the safety options.

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"LNK/ACT" LED

Status	Meaning
All LEDs Green Permanently lit	A physical connection to another Ethernet node was detected. Currently, no data is being exchanged via the Ethernet port.
All LEDs Flashing green Cyclic duration factor: 500 ms Switch-off time: 500 ms	The blink test has been activated to localize the Ethernet nodes visually.
All LEDs Off	No physical connection to further Ethernet nodes was detected.
LED at the respective Ethernet port Green/yellow, flashing	Data is being sent or received via the Ethernet port.

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10.3.5 Fieldbus variant POWERLINK CFL

"BS" LED

LED	Meaning
Off	"INIT" state The interface is in "INIT" state.
Green **Flickering**	"BASIC ETHERNET Mode" state None of the SoA, SoC, PReq, or PRes message types detected.
Green **Flashing once**	"PRE_OPERATIONAL_1Mode" state Only acyclic communication is possible.
Green **Flashing twice**	"PRE_OPERATIONAL_2Mode" state Acyclic and cyclic communication are possible. Process data are not valid.
Green **Flashing three times**	"READY_TO_OPERATE_Mode" state
Green **Flashing**	"STOPPED_Mode" state
Green **Illuminated**	"OPERATIONAL Mode" state

"BE" LED

LED	Meaning	Measure
Off	Transition to "OPERATIONAL_Mode" state	–
	Software reset of the NMT state machine (start basic node initialization)	–
	Transition to "BASIC_ETHERNET_Mode" state after a timeout of the SoC, PReq, Pres, and SoA message types.	–
Red **Illuminated**	POWERLINK cycle time exceeded.	Check/adjust the network.
	The number of managing nodes (MN) in the POWERLINK network is > 1.	Check/adjust the network. Configure only 1 managing node.
	Invalid Ethernet frame format, e.g. wrong Ethernet CRC (redundancy checksum)	Check/adjust the network.
	Loss of frame	Check/adjust the network.
	Frame collision	Check/adjust the network.
	Invalid IP address	Set a valid IP address.

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"LNK/ACT" LED

Status	Meaning
All LEDs Green Permanently lit	A physical connection to another Ethernet node was detected. Currently, no data is being exchanged via the Ethernet port.
All LEDs Flashing green Cyclic duration factor: 500 ms Switch-off time: 500 ms	The blink test has been activated to localize the Ethernet nodes visually.
All LEDs Off	No physical connection to further Ethernet nodes was detected.
LED at the respective Ethernet port Green/yellow, flashing	Data is being sent or received via the Ethernet port.

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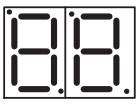
10.4 7-segment display

The 7-segment display is only available when the CDM diagnostic module is used.

10.4.1 Operating displays



- The two 7-segment displays indicate the operating state of the inverter.

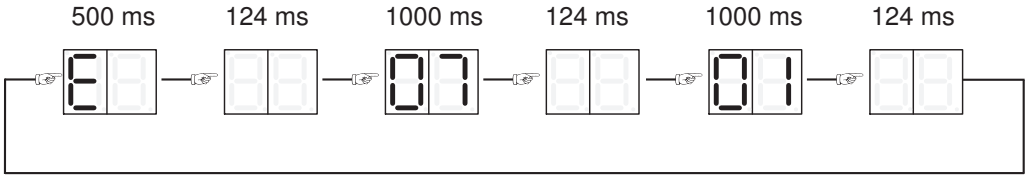
10.4.2 Error display

The inverter detects any faults that occur and displays them as fault code. Each fault is clearly defined by its fault code and corresponding attributes, as shown below:

- Fault response
- Final state after executing the fault response
- Type of reset response.

The fault codes are displayed as flashing numeric values in the inverter.

The fault code is displayed in the following display sequence:



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In the example, a 2-digit fault code with subfault is shown; in this example, fault 07.01.

10.5 Operating displays

10.5.1 7-segment display – CDM11A diagnostic module

Display	Description	State	Comment/action
Displays during boot process			
b0 b1 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 yet possible.	• Waiting for boot process to finish. • Device stays in this condition: Device is defective.

Display	Description	State	Comment/action
Displays of different device statuses			
.	Energy-saving mode		Energy-saving mode active
00	DC link voltage missing.	• Status: Not ready • Output stage is inhibited. • Communication is possible.	Check supply system.
C0 Flashing	Module bus is not ready.		Check the module bus connection.
C1 Flashing	Startup state		Startup state is active.
C2 Flashing	STO active	• Status: Not ready • Output stage is inhibited. • Communication is possible.	The function Safe Torque Off is active.
C3 Flashing	Synchronization with bus is incorrect. Process data processing not available.		• Check the bus connection. • Check synchronization setting at device and controller. • Check process data settings at device and controller.
C4 Flashing	Encoder evaluation is not ready.		• Encoders are being initialized. • Device stays in this condition: – 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 incomplete.		
C7 Flashing	Power section not ready.		
C8 Flashing	External device not ready.		

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Display	Description	State	Comment/action
C9 Flashing	Data flexibilization layer not ready.		
Cd Flashing	Parameter download running.		
CA	MOVILINK® DDI not ready		MOVILINK® DDI interface not ready

Display	Description	State	Comment/action
Displays during initialization processes (parameters will be reset to default values)			
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		

Display	Description	State	Comment/action
Displays in normal operation			
01	Output stage inhibit	• Output stage is inhibited.	The drive is not actuated by the output stage. The brake is applied; without the brake, the motor coasts to a halt. The FCB 01 can be selected from various sources.
AC	Auto Configuration	Data is transferred to the inverter via the MOVILINK® DDI interface.	Motor is started up via the MOVILINK® DDI interface.

Display	Description	State	Comment/action
02	Default stop	For further information, refer to the description of the FCBs.	Drive function (FCB) "Default stop" active, if not 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, e.g. in the 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, e.g. in the higher-level controller.
12	Reference travel		The drive performs reference travel.
13	Stop at application limits		Deceleration at the application limit. FCB 13 is active if no other FCB is selected with the default FCB 02.
14	Emergency stop		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 when the brake is applied.
25	Motor parameter measurement		Motor parameter measurement active.
26	Stop at user limits		Serves to stop at user limits.

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10.6 Fault description

10.6.1 Fault 1 Output stage monitoring

Subfault: 1.1 **Description: Short circuit in motor output terminals**		
	Response: Output stage inhibit	
	Cause	Measure
	Overcurrent in output stage or faulty output stage control detected, and output stage inhibited by hardware.	Possible causes for overcurrent are short circuit at the output, excessive motor current, or a defective power output stage.

Subfault: 1.2 **Description: Overcurrent in output stage**	
Response: Output stage inhibit	
Cause	Measure
Motor current too high.	Connect a smaller motor.
Current supply	Check the current supply.
Current transformer	Check the current transformer.
Ramp limit deactivated and set ramp time too short.	Increase the ramp time.
Phase module defective.	Check the phase module.
DC 24 V supply voltage unstable.	Check the DC 24 V supply voltage.
Interruption or short circuit on signal lines of phase modules.	Check the signal lines.

10.6.2 Fault 3 Ground fault

Subfault: 3.1 **Description: Ground fault**	
Response: Output stage inhibit	
Cause	Measure
Ground fault in the motor lead.	Eliminate ground fault in motor lead.
Ground fault in the inverter.	Eliminate ground fault in inverter.
Ground fault in the motor.	Eliminate ground fault in motor.
Ground fault in line components.	Eliminate ground fault in line components.

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10.6.3 Fault 4 Brake chopper

Subfault: 4.1 Description: Brake chopper overcurrent		
	Response: Output stage inhibit	
	Cause	Measure
	Excessive regenerative power.	Extend the deceleration ramps.
	Short circuit detected in braking resistor circuit.	Check the supply cable to the braking resistor.
	The braking resistor impedance is too low.	Check the technical data of the braking resistor.

Subfault: 4.2 Description: Brake chopper defective		
	Response: Output stage inhibit	
	Cause	Measure
	Output stage of brake chopper defective.	Replace the defective brake chopper.

10.6.4 Fault 6 Line fault

Subfault: 6.1 Description: Line phase failure		
	Response: Line phase failure	
	Cause	Measure
	Missing line phase detected.	Check the supply system cable.
	DC link voltage periodically too low.	Check the configuration of the supply system.
	Inadequate line voltage quality.	Check the supply (fuses, contactor).

10.6.5 Fault 7 DC link

Subfault: 7.1 Description: DC link overvoltage		
	Response: Output stage inhibit	
	Cause	Measure
	Maximum permitted DC link voltage limit exceeded and output stage inhibited by hardware.	– Extend the deceleration ramps. – Check the supply cable to the braking resistor. – Check the technical data of the braking resistor.

Subfault: 7.2 Description: DC link discharge failed		
	Response: Warning	
	Cause	Measure
	DC link voltage level not dropped below discharge threshold within discharge time.	Contact SEW-EURODRIVE Service.

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10.6.6 Fault 8 Speed monitoring

Subfault: 8.1 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 the delay time set for speed monitoring, or reduce the load.
	Encoder not connected correctly.	Check the encoder connection and direction of rotation. If necessary, increase the current limiting or reduce the acceleration values.
	Encoder has incorrect direction of rotation.	– Check encoder connection and direction of rotation. If necessary, increase current limiting or reduce acceleration values. – Check motor lead and motor, check line phases.

Subfault: 8.2 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 the delay time set for speed monitoring, or reduce the regenerative load.
	Encoder not connected correctly.	Check the encoder connection and direction of rotation. If necessary, increase the current limiting or reduce the deceleration values.
	Encoder has incorrect direction of rotation.	– Check the encoder connection and direction of rotation. If necessary, increase the current limiting or reduce the deceleration values. – Check motor lead and motor. Check the line phases.

Subfault: 8.3 Description: Maximum speed at motor shaft		
	Response: Output stage inhibit	
	Cause	Measure
	Actual speed exceeded "Maximum speed at motor shaft" limit value (index 8360.9 / 8361.9). This limit value is set at startup matching the motor and gear unit.	Reduce the maximum speed.

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10.6.7 Fault 9 Control mode

Subfault: 9.1 Description: Magnetization of motor not possible		
	Response: Output stage inhibit	
	Cause	Measure
	The user-defined current limit or output stage monitoring have reduced the possible maximum current to such a degree that the required magnetizing current cannot be set.	– Reduce the output stage utilization, e.g. by reducing the PWM frequency or reducing the load. – Increase the user-defined current limit.

Subfault: 9.2 Description: Requested operating mode not possible with active control mode		
	Response: Output stage inhibit	
	Cause	Measure
	The current FCB activated an operating mode. The active control mode does not support this operating mode, for example "positioning control" or "torque control" with V/f control mode.	– Use a control mode that supports the required operating mode. Connect an encoder if necessary. – Select an operating mode that is supported by the current control mode.

Subfault: 9.3 Description: Absolute rotor position not available		
	Response: Output stage inhibit	
	Cause	Measure
	The current control mode requires an absolute rotor position. The encoder selected for "Source of actual speed" does not provide an absolute rotor position.	Use an absolute encoder, or identify the rotor position using FCB 18.

Subfault: 9.4 Description: Correct current supply of motor not possible		
	Response: Output stage inhibit	
	Cause	Measure
	Failed to set required current during premagnetization.	– Check the cabling. – Deactivate the "current monitoring during premagnetization" function. – Deactivate the "current monitoring during initial position determination" function.

Subfault: 9.5 Description: Maximum output frequency exceeded		
	Response: Output stage inhibit	
	Cause	Measure
	Maximum output frequency exceeded.	Reduce the maximum speed.

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Subfault: 9.6 Description: Maximum model speed exceeded		
	Response: Output stage inhibit	
	Cause	Measure
	Speed of drive calculated in ELSM® control mode too high for motor control.	If possible, minimize the "Speed/position controller sampling cycle", or reduce the speed.

Subfault: 9.8 Description: Motor protection function – demagnetization	
Response: Output stage inhibit	
Cause	Measure
The fault can be caused as follows: – The motor is blocked. – The motor has already been operated at a speed below the transition speed for too long. – The motor has not been started up properly.	– Check the motor for blockage. – Check the drive selection. – Optimize the speed controller. – Perform motor startup again and run the drive function "FCB 25 Motor parameter measurement". – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

Subfault: 9.9 Description: Parameter measurement not possible with active motor type	
Response: Output stage inhibit	
Cause	Measure
A parameter measurement can only be performed for asynchronous motors and synchronous motors. Parameter measurement is not possible for reluctance motors and LSPM motors.	Select the correct motor type.

Subfault: 9.10 Description: Rotor stall monitoring	
Response: Output stage inhibit	
Cause	Measure
The current control cannot hold the load torque. The deviation between stationary setpoint voltage and actual voltage is too large.	Reduce the load torque (hoist) in the controlled system.

Subfault: 9.11 Description: Standstill current function	
Response: Output stage inhibit	
Cause	Measure
With the ELSM method, the standstill current function is possible only in combination with rotor position measurement.	– Enable rotor position measurement. – Check motor data.

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10.6.8 Fault 10 Data flexibility

Subfault: 10.1 **Description: Initialization**	
Response: Application stop + output stage inhibit	
Cause	Measure
Init task error.	The init task has issued a return code ! = 0. Check the program.

Subfault: 10.2 **Description: Illegal program command**	
Response: Application stop + output stage inhibit	
Cause	Measure
The version of the MOVIKIT® software module in use is not compatible with the current firmware version of the device.	– Use the latest firmware version of the device. – Adjust the firmware version of the device according to the version overview in the installation notes. – Adjust the version of the MOVIKIT® software module according to the version overview in the installation notes. – In the shortcut menu of the device, execute the "Adjust version and device" menu command.
Unknown program command (illegal opcode) detected in Data Flexibility program.	Contact SEW-EURODRIVE Service.

Subfault: 10.3 **Description: Memory access**	
Response: Application stop + output stage inhibit	
Cause	Measure
Memory area violated while accessing array.	For example, an array access results in writing beyond the permitted memory range. Check the program.

Subfault: 10.4 **Description: Stack**	
Response: Application stop + output stage inhibit	
Cause	Measure
Overflow of Data Flexibility stack detected.	Check the program.

Subfault: 10.5 **Description: Division by 0**	
Response: Application stop + output stage inhibit	
Cause	Measure
Division by 0.	Check the program.

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Subfault: 10.6 Description: Runtime		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	Runtime error/watchdog	Check the program. The program execution time exceeds the permitted time.
	PDI or PDO tasks.	Check the program. The execution time of the PDI or PDO task exceeds the permitted time.

Subfault: 10.7 Description: Calculation result of multiplication/division command too large		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	Calculation result of multiplication/division command exceeds 32 bits.	Check the program.
	Failed to write calculation result of multiplication/ division command into result variable.	Check the program.

Subfault: 10.8 Description: Illegal connection		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	Index used in connect not allowed.	Check the program. The index used either does not exist or is not permitted for access via process data; see parameter list.

Subfault: 10.9 Description: CRC code		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	Wrong CRC checksum of code.	Load the program again. The program memory is corrupt. Unauthorized write access to the program memory.

Subfault: 10.10 Description: Setpoint cycle time not supported		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	Non-supported setpoint cycle time parameterized.	Set the setpoint cycle time to the default value 1 ms.

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Subfault: 10.11 Description: No application program loaded		
	Response: Output stage inhibit	
	Cause	Measure
	No Data Flexibility application program loaded.	Load the program or disable Data Flexibility.

Subfault: 10.12 Description: Runtime warning		
	Response: Warning	
	Cause	Measure
	The program requires more runtime than configured.	Check the program.

Subfault: 10.99 Description: Unknown fault		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	Unknown Data Flexibility error.	Contact SEW-EURODRIVE Service.

10.6.9 Fault 11 Temperature monitoring

Subfault: 11.1 Description: Heat sink overtemperature		
	Response: Output stage inhibit	
	Cause	Measure
	Maximum permitted heat sink temperature exceeded. The capacity utilization is possibly too high.	– Reduce the load. – Reduce the rms value of the current. – Reduce the PWM frequency. – Ensure sufficient cooling. – Reduce the ambient temperature.

Subfault: 11.2 Description: Heat sink utilization – prewarning		
	Response: Heat sink utilization – prewarning	
	Cause	Measure
	High thermal load on heat sink of device, and prewarning threshold reached.	– Reduce the load. – Reduce the rms value of the output current. – Reduce the PWM frequency. – Ensure sufficient cooling. – Reduce the ambient temperature.

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Subfault: 11.3 Description: Device utilization		
	Response: Output stage inhibit	
	Cause	Measure
	The temperature has reached or exceeded the switch-off threshold. The mean output current is too high.	– Reduce the load. – Check motor/inverter combination.
	PWM frequency too high.	Reduce the PWM frequency.
	Ambient temperature too high.	Ensure sufficient cooling.
	Unfavorable air convection.	Check air convection.
	Fan defective.	Check the fan and replace if necessary.

Subfault: 11.5 Description: Electromechanical capacity utilization		
	Response: Output stage inhibit	
	Cause	Measure
	Electromechanical components of device overloaded by excessive continuous current.	Reduce the load. If necessary, reduce the rms value of the current.

Subfault: 11.6 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. – Reduce the PWM frequency. – Reduce the rms value of the current. – Reduce the ambient temperature.

Subfault: 11.7 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.

Subfault: 11.8 Description: Short circuit at temperature sensor of heat sink		
	Response: Output stage inhibit	
	Cause	Measure
	Short circuit at temperature sensor of heat sink.	Contact SEW-EURODRIVE Service.

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Subfault: 11.9 Description: Signal electronics overtemperature		
	Response: Output stage inhibit	
	Cause	Measure
	Maximum permitted signal electronics temperature exceeded.	– Reduce the load. – Reduce the ambient temperature.

Subfault: 11.10 Description: Wire break at temperature sensor of signal electronics		
	Response: Output stage inhibit	
	Cause	Measure
	Wire break at temperature sensor of signal electronics	Contact SEW-EURODRIVE Service.

Subfault: 11.11 Description: Short circuit at temperature sensor of signal electronics		
	Response: Output stage inhibit	
	Cause	Measure
	Short circuit at temperature sensor of signal electronics.	Contact SEW-EURODRIVE Service.

10.6.10 Fault 12 Brake

Subfault: 12.1 Description: Brake output fault		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	No brake connected.	Check the connection of the brake.
	Brake cable disconnected in switched-on state.	Check the connection of the brake.
	The brake was overloaded by an overcurrent > 2 A.	Check the sequential profile of brake control.
	The brake was overloaded by frequent connection (> 0.5 Hz).	Check the sequential profile of brake control.
	Monitoring works only with parameter setting "Brake installed" and "Brake applied".	Make sure that the connected brake is permitted.

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Subfault: 12.2 Description: DC 24 V brake voltage		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	DC 24 V supply voltage not within permitted tolerance of ±10%.	Check the DC 24 V supply voltage.
	Monitoring is only active with parameter settings “Brake installed” and “Brake applied”.	Check the parameter setting.

Subfault: 12.20 Description: Digital motor integration fault – critical	
Response: Output stage inhibit with self-reset	
Cause	Measure
The intelligent brake rectifier of digital motor integration has detected a critical component fault.	For the exact cause of the fault and for information on how to correct it, refer to the fault detected by the subcomponent.

Subfault: 12.21 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 component fault.	For the exact cause of the fault and for information on how to correct it, refer to the fault detected by the subcomponent.

Subfault: 12.22 Description: Digital motor integration warning	
Response: Warning with self-reset	
Cause	Measure
The intelligent brake rectifier of digital motor integration signaled a warning.	For the exact cause of the fault and for information on how to correct the warning, refer to the fault signaled by the subcomponent.

Subfault: 12.23 Description: Digital motor integration timeout	
Response: Output stage inhibit	
Cause	Measure
Communication with intelligent brake rectifier disrupted.	Check the connection.

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10.6.11 Fault 13 Encoder 1

Subfault: 13.1 **Description: 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 track signal wiring. – Check interference sources (e.g. from the area of EMC). – Replace 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.

Subfault: 13.2 **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.

Subfault: 13.3 **Description: Invalid data**	
Response: Encoder 1 – latest critical fault	
Cause	Measure
Invalid encoder nameplate data (measuring steps/pulses per revolution/multi-turn).	– Check the startup parameters. – Replace encoder. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

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Subfault: 13.4 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 interference sources (e.g. from the area of EMC). – 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.

Subfault: 13.5 Description: Internal warning		
	Response: Encoder – warning	
	Cause	Measure
	Encoder signaled warning.	– Check the wiring. – Check interference sources (light beam interrupted, reflector, signal cables, etc.). – Clean the sensor.

Subfault: 13.6 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 interference sources (e.g. from the area of EMC). – 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.

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Subfault: 13.7 **Description: Signal level too high**		
	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 gear ratio of the resolver in use. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

Subfault: 13.8 **Description: Signal 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. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

Subfault: 13.9 **Description: Quadrant check**		
	Response: Encoder 1 – latest critical fault	
	Cause	Measure
	Error checking quadrants (sine encoder).	– Switch the device off and on again. – Check the wiring. – Check interference sources (e.g. from the area of EMC). – 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.

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Subfault: 13.10 Description: Position tolerance range exceeded		
	Response: Encoder 1 – latest critical fault	
	Cause	Measure
	Position outside tolerance range.	– Check the startup parameters. – Check the wiring. – Check interference sources (light beam interrupted, reflector, signal cables, etc.). – Replace encoder. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

Subfault: 13.11 Description: Encoder data timeout		
	Response: Encoder 1 – latest critical fault	
	Cause	Measure
	Encoder process data triggered timeout state.	– Check interference sources (e.g. from the area of EMC). – Check the startup parameters. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

Subfault: 13.12 Description: Emergency		
	Response: Encoder 1 – latest critical fault	
	Cause	Measure
	Encoder signaled emergency.	– Check interference sources (e.g. from the area of EMC). – Check the startup parameters. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

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Subfault: 13.13 Description: Error during initialization		
	Response: Encoder 1 – latest fault	
	Cause	Measure
	Communication error during initialization.	With encoders from SEW-EURODRIVE: – Check the wiring. With encoders of other manufacturers: – Check the wiring. – Check the parameter setting in MOVISUITE®. – Compare the settings via DIP switches, display, USB interface, etc. on the encoder with the specifications in the operating instructions of the inverter or option (e.g. baud rate, node ID). INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

Subfault: 13.14 Description: Communication error		
	Response: Encoder 1 – latest fault	
	Cause	Measure
	Faulty communication with encoder.	– Check the voltage supply. – Check interference sources (e.g. from the area of EMC). – 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.

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Subfault: 13.15 Description: System error		
	Response: Encoder 1 – latest critical fault	
	Cause	Measure
	System error while evaluating encoder.	– Ensure that the multi-turn encoder is within the configured path range. – Check the limits. – Check for correct settings of encoder numerator/denominator factors. – Check interference sources (e.g. from the area of EMC). – Check the startup parameters. – Switch the device off and on 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.

Subfault: 13.16 Description: Permanent high level in signal cable – critical		
	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.

Subfault: 13.17 Description: Permanent high level in signal cable		
	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.

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Subfault: 13.18 **Description: Permanent low level in signal cable – critical**	
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.

Subfault: 13.19 **Description: Permanent low level in signal cable**	
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.

Subfault: 13.20 **Description: SSI encoder – critical fault**	
Response: Encoder 1 – latest critical fault	
Cause	Measure
SSI encoder signaled a critical fault.	– Check the startup parameters. – Check the settings at the SSI encoder. – Check the wiring. – Check interference sources (light beam interrupted, reflector, signal cables, etc.). – Replace encoder. INFORMATION In "Emergency mode" manual mode, you can move the drive even with a fault in an external position encoder.

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Subfault: 13.21 Description: SSI encoder – fault		
	Response: Encoder 1 – latest fault	
	Cause	Measure
	SSI encoder signaled a fault.	– Check the startup parameters. – Check the settings at the SSI encoder. – Check the wiring. – Check interference sources (light beam interrupted, reflector, signal cables, etc.). – Replace encoder. INFORMATION In "Emergency mode" manual mode, you can move the drive even with a fault in an external position encoder.

Subfault: 13.22 Description: Internal fault – critical		
	Response: Encoder 1 – latest critical fault	
	Cause	Measure
	Encoder signaled internal fault.	– Check the wiring. – Check interference sources (light beam interrupted, reflector, signal cables, etc.). – Replace encoder. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

Subfault: 13.23 Description: Internal fault		
	Response: Encoder 1 – latest fault	
	Cause	Measure
	Encoder signaled internal fault.	– Check the wiring. – Check interference sources (light beam interrupted, reflector, signal cables, etc.). – Replace encoder. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

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Subfault: 13.24 Description: Travel range exceeded		
	Response: Encoder 1 – latest fault	
	Cause	Measure
	Current position mode does not allow for larger travel range.	Check the travel range. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

Subfault: 13.25 Description: Error during encoder startup		
	Response: Output stage inhibit	
	Cause	Measure
	Fatal error during encoder startup.	Switch the device off and on again. INFORMATION In "Emergency mode" manual mode, you can move the drive using the motor encoder even if the external position encoder is faulty.

Subfault: 13.26 Description: Digital motor integration fault – critical		
	Response: Encoder 1 – latest critical fault	
	Cause	Measure
	Encoder of digital motor integration detected a component fault.	– Check interference sources. – Replace encoder.

Subfault: 13.27 Description: Digital motor integration fault		
	Response: Encoder 1 – latest fault	
	Cause	Measure
	Encoder of digital motor integration detected a component fault.	– Check interference sources. – Replace encoder.

Subfault: 13.28 Description: Digital motor integration warning		
	Response: Encoder – warning	
	Cause	Measure
	Encoder of digital motor integration signaled a warning.	Check interference sources.

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Subfault: 13.29 Description: Absolute position invalid		
	Response: Encoder 1 – latest fault	
	Cause	Measure
	Diagnostics error detected while evaluating absolute encoder position. Referencing is 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.

10.6.12 Fault 16 Startup

Subfault: 16.1 Description: Motor not started up	
Response: Output stage inhibit	
Cause	Measure
Motor not started up or not started up completely.	Perform complete motor startup.

Subfault: 16.2 Description: Cannot calculate controller parameters	
Response: Output stage inhibit	
Cause	Measure
Delay of encoder in use too long to calculate required filter coefficients.	Use an encoder with a shorter delay, or contact SEW-EURODRIVE Service.

Subfault: 16.3 Description: Thermal motor model not possible	
Response: Output stage inhibit	
Cause	Measure
Invalid parameters for thermal motor model or for drive enable although starting up thermal model not yet completed.	Check the parameters of the thermal motor model, and perform startup.

Subfault: 16.5 Description: Current limit smaller than magnetizing current of the motor	
Response: Output stage inhibit	
Cause	Measure
Current limit smaller than magnetizing current of the motor calculated by active control mode.	Increase the current limit. Required magnetizing current: See diagnostics parameters of control mode.

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Subfault: 16.6 Description: Control mode not possible		
	Response: Output stage inhibit	
	Cause	Measure
	When starting up a synchronous third-party motor, some control modes and drive functions are only permitted after a parameter measurement.	Perform a motor parameter measurement using the drive function FCB 25.
	Wrong control mode selected for the motor.	Choose a control mode that matches the selected motor.

Subfault: 16.7 Description: PWM frequency not possible		
	Response: Output stage inhibit	
	Cause	Measure
	The motor cannot be operated with the inverter. The motor requires a higher PWM frequency than the inverter can provide.	Use an inverter with a suitable PWM frequency range.
	Specified PWM frequency not allowed for this power output stage.	Choose another PWM frequency. The possible PWM frequencies can be found in the device configuration data.

Subfault: 16.8 Description: Temperature sensor motor 1		
	Response: Output stage inhibit	
	Cause	Measure
	Faulty startup of temperature sensor of motor 1.	Perform startup again.

Subfault: 16.9 Description: Temperature sensor motor 2		
	Response: Output stage inhibit	
	Cause	Measure
	Faulty startup of temperature sensor of motor 2.	Perform startup again.

Subfault: 16.10 Description: Actual position source not assigned		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	Active control mode requires an encoder for position mode.	– Assign actual position source in encoder assignment of the active drive train (Index 8565.3 or 8566.3). – If no encoder is installed, activate the FCBs only using "torque control" or "speed control" operating modes.

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Subfault: 16.11 Description: Motor data calculation error		
	Response: Output stage inhibit	
	Cause	Measure
	Motor startup not possible because of inconsistent motor data or wrong device configuration data.	Check the motor data for plausibility, or contact SEW-EURODRIVE Service.

Subfault: 16.12 Description: Motor data write sequence		
	Response: Output stage inhibit	
	Cause	Measure
	Subindex 1 not written to zero before writing electrical startup parameters (index 8357, 8360, 8394, 8420 or 8358, 8361, 8395, 8421).	Reset the error. Set parameters 8360/1 or 8361/1 to "0" before writing additional parameters.

Subfault: 16.13 Description: Several motor protection models are active		
	Response: Output stage inhibit	
	Cause	Measure
	More than one model active at the same time in thermal motor monitoring, e.g. for asynchronous motor and synchronous motor.	If the startup parameters were changed manually, switch off motor monitoring. In all other cases, contact SEW-EURODRIVE Service.

Subfault: 16.20 Description: Nominal speed too high or nominal frequency too low		
	Response: Output stage inhibit	
	Cause	Measure
	During startup using nameplate data: Nominal speed too high or nominal frequency too low. The resulting number of pole pairs is 0.	Enter plausible motor data (nominal speed and nominal frequency).

Subfault: 16.21 Description: Nominal slip negative		
	Response: Output stage inhibit	
	Cause	Measure
	During startup using nameplate data, the calculated nominal slip is negative: Nominal frequency too low, or nominal speed too high, or number of pole pairs too high.	Enter plausible motor data (nominal frequency, nominal speed, number of pole pairs).

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Subfault: 16.22 **Description: Specify the number of pole pairs**	
Response: Output stage inhibit	
Cause	Measure
During startup using nameplate data: It is not possible to calculate the number of pole pairs accurately from nominal frequency and nominal speed.	Enter the number of pole pairs.

Subfault: 16.23 **Description: Plausibility check failed**	
Response: Output stage inhibit	
Cause	Measure
During startup using nameplate data: The estimated nominal power does not match the entered nominal power.	Check entered nameplate data for plausibility.

Subfault: 16.24 **Description: Speed controller sampling cycle not possible with current PWM frequency or current control mode**	
Response: Application stop + output stage inhibit	
Cause	Measure
At a PWM frequency of "2.5 kHz", only the speed controller sampling cycle of 2 ms is permitted. For the ELSM® control mode, the only permitted speed controller sampling cycles are 1 ms and 2 ms.	Increase PWM frequency or increase sampling cycle of speed controller to 2 ms. Set the sampling cycle to 1 ms or 2 ms for ELSM® control mode.

Subfault: 16.25 **Description: User-defined current limit too low for standstill current**	
Response: Output stage inhibit	
Cause	Measure
User-defined current limit value too small for minimum standstill current.	Increase the user-defined current limit, or disable the standstill current function.

Subfault: 16.26 **Description: Nominal values incomplete or implausible**	
Response: Output stage inhibit	
Cause	Measure
During startup using nameplate data: Nominal voltage, nominal current, nominal speed or nominal torque are not entered or are not plausible.	Enter or check nominal voltage, nominal current, nominal speed, and nominal torque.

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Subfault: 16.27 Description: Maximum current or maximum torque not plausible		
	Response: Output stage inhibit	
	Cause	Measure
	During startup using nameplate data: Maximum current or maximum torque not entered, or maximum current and maximum torque not plausible.	Check the maximum current and maximum torque.

Subfault: 16.30 Description: Faulty EtherCAT® EEPROM configuration status	
Response: Warning	
Cause	Measure
Faulty EtherCAT®/SBusPLUS EEPROM configuration status. EEPROM not loaded; binary file not loaded.	Contact SEW-EURODRIVE Service.
Faulty EEPROM loading procedure.	Contact SEW-EURODRIVE Service.
Faulty EEPROM checksum.	Contact SEW-EURODRIVE Service.

Subfault: 16.40 Description: Data of selected motor not valid	
Response: Output stage inhibit	
Cause	Measure
Startup data set on replaceable memory module not valid for this motor.	Replace the memory module.

Subfault: 16.41 Description: Data of selected motor does not exist	
Response: Output stage inhibit	
Cause	Measure
No startup data set found on the replaceable memory module for the selected motor.	Check the selection and, if necessary, start up another motor or replace the memory module.

Subfault: 16.60 Description: Parameter setting for 3-wire control not valid	
Response: Warning	
Cause	Measure
No 3-wire control stop terminal configured.	Set stop terminal parameters.

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10.6.13 Fault 17 Internal processor fault

Subfault: 17.7 **Description: Exception error**	
Response: Output stage inhibit	
Cause	Measure
Exception trap in CPU.	Contact SEW-EURODRIVE Service.

Subfault: 17.8 **Description: NV data not loaded**	
Response: Output stage inhibit System state: Fault acknowledgment with CPU reset	
Cause	Measure
CPU was restarted several times by reset 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.

10.6.14 Fault 18 Software error

Subfault: 18.1 **Description: Motor management**	
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.

Subfault: 18.3 **Description: Task system – warning**	
Response: Warning	
Cause	Measure
A fault was detected during the processing of the internal task system. This may be a timeout for cyclical tasks, for example.	– Acknowledge the warning. – If the warning occurs repeatedly, contact SEW-EURODRIVE Service.

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Subfault: 18.4 Description: Task system – error		
	Response: Output stage inhibit System state: Fault acknowledgment with CPU reset	
	Cause	Measure
	A fault was detected during the processing of the internal task system. This may be a timeout for cyclical tasks, for example.	– Switch the device off and on again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

Subfault: 18.7 Description: Fatal 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, replace the device and send it together with the fault number to SEW-EURODRIVE. For further support, contact SEW-EURODRIVE Service.

Subfault: 18.8 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.

Subfault: 18.9 Description: Internal software error		
	Response: Output stage inhibit System state: Fault acknowledgment with CPU reset	
	Cause	Measure
	The software reports an unexpected event.	– Switch the device off and on again. – If the fault occurs repeatedly, replace the device and send it together with the fault number to SEW-EURODRIVE. For further support, contact SEW-EURODRIVE Service.

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Subfault: 18.10 Description: Watchdog		
	Response: Output stage inhibit	
	Cause	Measure
	Software no longer operates within intended cycle time.	– Switch the device off and on again. – If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

Subfault: 18.12 Description: Configuration data	
	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.	Update the firmware or load valid configuration data.

Subfault: 18.13 Description: Calibration data	
	Response: Output stage inhibit System state: Fault acknowledgment with CPU reset
Cause	Measure
Calibration data not plausible.	Load valid calibration data.

10.6.15 Fault 19 Process data

Subfault: 19.1 Description: Torque profile value violation	
	Response: Application stop + output stage inhibit
Cause	Measure
The set torque profile values are not plausible.	Adjust the torque profile values.

Subfault: 19.2 Description: Position setpoint violation	
	Response: Application stop + output stage inhibit
Cause	Measure
Position setpoint outside software limit switches.	Check position setpoint.
Position setpoint outside modulo range.	Check position setpoint.
Position in user unit generates number overflow in the system unit.	Check the position in user unit.

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Subfault: 19.3 Description: Speed profile value violation		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	The set speed profile values are not plausible. The speed profile values must be in the range of values >= 0.	Adjust the speed profile values.

Subfault: 19.4 Description: Acceleration profile value violation		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	The set acceleration profile values are not plausible. The acceleration profile values must be in the range of values >= 0.	Adjust the acceleration profile values.

Subfault: 19.5 Description: Drive function does not exist		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	Non-existent drive function (FCB) selected via process data.	Enter the correct FCB number.

Subfault: 19.6 Description: Mass moment of inertia setpoint violation		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	The set mass moment of inertia setpoints are not plausible. The mass moment of inertia setpoints must be in the range of values >= 0.	Adjust the setpoints for the mass moment of inertia.

Subfault: 19.7 Description: Referencing missing		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	Activated function permitted only with referenced encoder.	Reference the encoder first, then activate the function.

Subfault: 19.8 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.

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Subfault: 19.9 Description: Jerk setpoint violation		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	The set jerk values are not plausible.	Adjust jerk setpoints.

10.6.16 Fault 20 Device monitoring

Subfault: 20.1 Description: Supply voltage fault		
	Response: Output stage inhibit System state: Fault acknowledgment with CPU reset	
	Cause	Measure
	24 V power supply unit overloaded.	Check the project planning for the power demand.
	The internal electronics supply voltage or externally connected DC 24 V standby supply voltage is outside the permitted voltage range.	Check the voltage level of the external DC 24 V standby supply voltage and check for correct connection. If required, correct. – Acknowledge the fault. – If the fault occurs repeatedly, replace the device. For further support, contact SEW-EURODRIVE Service.

Subfault: 20.2 Description: Supply voltage overload		
	Response: Output stage inhibit	
	Cause	Measure
	For MOVIDRIVE® system, the current load of the current paths of the DC 24 V standby supply voltage inside the device is too high. The device signal output of the device was de-energized because of the fault message.	Identify the consumer that is overloading the internal supply voltage: 1. Remove all external consumers: – At the digital outputs of the basic device. – At options that may be present. – At all encoder connections. – At other consumers at the DC 24 V output voltage terminals. 2. Acknowledge the error. 3. Reconnect the consumers with the device, one after the other, until the fault message appears once again. 4. To eliminate the fault, connect a consumer with a lower current consumption or eliminate the short circuit.

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Subfault: 20.7 **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. For further support, contact SEW-EURODRIVE Service.

Subfault: 20.8 **Description: Fan warning**		
	Response: Warning with self-reset	
	Cause	Measure
	Fan function impaired.	Check the fan for proper functioning.

Subfault: 20.9 **Description: Fan fault**		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	Fan defective.	Contact SEW-EURODRIVE Service.

Subfault: 20.10 **Description: Fan supply voltage fault**		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	Supply voltage of fan missing.	Check the connection or establish a connection.

Subfault: 20.11 **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. – Before acknowledging the fault, make sure that both STO signals are switched to low level.

Subfault: 20.21 **Description: External 24 V backup voltage missing**		
	Response: Output stage inhibit System state: Fault acknowledgment with CPU reset	
	Cause	Measure
	In the current configuration, the device is only fully functional with external backup voltage.	Connect backup voltage and energize.

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Subfault: 20.23 Description: Power section temperature detection		
	Response: Output stage inhibit	
	Cause	Measure
	Fault in the device hardware. Power section does not provide temperature data.	– Acknowledge the fault. – If the fault occurs repeatedly, replace the device. For further support, contact SEW-EURODRIVE Service.

10.6.17 Fault 21 Digital motor integration 1

Subfault: 21.1 Description: Communication error		
	Response: Output stage inhibit	
	Cause	Measure
	Communication error detected on the interface of digital motor integration.	Check the cabling.

Subfault: 21.2 Description: Component 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.	Connect a suitable drive with digital motor integration for startup, or perform a new startup.

Subfault: 21.3 Description: Incompatible driving motor		
	Response: Output stage inhibit	
	Cause	Measure
	Connected drive not compatible with started-up drive.	Connect a drive that matches startup, or perform a new startup.

Subfault: 21.4 Description: Invalid label		
	Response: Output stage inhibit	
	Cause	Measure
	The connected drive contains invalid data.	Replace the drive.

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Subfault: 21.5 Description: Incompatible component		
	Response: Output stage inhibit	
	Cause	Measure
	The connected component of digital motor integration cannot be used with this inverter firmware.	Update inverter or component.

Subfault: 21.6 Description: Overload/short circuit on the interface		
	Response: Output stage inhibit	
	Cause	Measure
	Short circuit in the cabling of components of digital motor integration.	Check the cabling of the digital motor integration component.
	Voltage of digital motor integration component too low.	Check the voltage supply of the component.

Subfault: 21.7 Description: Continuous supply current of component too high		
	Response: Output stage inhibit	
	Cause	Measure
	Continuous supply current of component too high. The inverter cannot operate the components.	Use a component with lower supply current.

Subfault: 21.8 Description: Parameter error		
	Response: Output stage inhibit	
	Cause	Measure
	Error processing data from digital motor integration component.	Repeat the process in configuration state.
	The connected drive contains invalid data.	Replace the drive.

Subfault: 21.9 Description: Illegal hot plug		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	A component of digital motor integration was connected while the drive was enabled.	– Set the device to configuration state or switch it off. – Connect the component.
	A component of digital motor integration was connected while the device was in standby mode without switching off the encoder supply.	– Switch off encoder supply in standby mode. – Connect the component.

Subfault: 21.10 Description: Connection type configuration		
	Response: Output stage inhibit	
	Cause	Measure
	The connection type of the connected drive cannot be determined.	Set the connection type on the drive correctly.

Subfault: 21.11 Description: Illegal subcomponent		
	Response: Output stage inhibit	
	Cause	Measure
	The device cannot be operated with a subcomponent connected via digital motor integration.	Connect another subcomponent.

Subfault: 21.12 Description: Component/subcomponent not accessible – fault		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	A component/subcomponent of the digital motor integration is in the Device Update Manager.	Update the firmware of the component/subcomponent.

Subfault: 21.13 Description: Component/subcomponent not accessible – warning		
	Response: Warning	
	Cause	Measure
	A component/subcomponent of the digital motor integration is in the Device Update Manager.	Update the firmware of the component/subcomponent.

Subfault: 21.20 Description: Slave fault – critical		
	Response: Output stage inhibit	
	Cause	Measure
	A component of digital motor integration detected a critical component fault.	For the exact cause of the fault and for information on how to remedy it, refer to the fault signaled by the subcomponent.

Subfault: 21.21 Description: Component fault		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	A component of digital motor integration detected a component fault.	For the exact cause of the fault and for information on how to remedy it, refer to the fault signaled by the subcomponent.

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Subfault: 21.22 Description: Component warning		
	Response: Warning	
	Cause	Measure
	A component of digital motor integration signaled a warning.	For the exact cause of the fault and for information on how to correct the warning, refer to the fault signaled by the subcomponent.

Subfault: 21.23 Description: FDDI – critical fault		
	Response: Output stage inhibit	
	Cause	Measure
	FDDI – critical fault	TBD

Subfault: 21.24 Description: FDDI – fault		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	FDDI fault	–

Subfault: 21.25 Description: FDDI – warning		
	Response: Warning	
	Cause	Measure
	FDDI warning	–

10.6.18 Fault 23 Power section

Subfault: 23.1 Description: Warning		
	Response: Warning with self-reset	
	Cause	Measure
	Power section fault with fault response of the type "Warning".	See also "Power section subcomponent" fault status.

Subfault: 23.2 Description: Fault		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	Power section fault with fault response of the type "Standard".	See also "Power section subcomponent" fault status.

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Subfault: 23.3 Description: Critical fault		
	Response: Output stage inhibit	
	Cause	Measure
	Power section fault with fault response of the type "Critical fault".	See also "Power section subcomponent" fault status.

Subfault: 23.4 Description: Hardware fault		
	Response: Output stage inhibit	
	Cause	Measure
	A fault occurred in a hardware component of the power section, e.g.: Overcurrent hardware comparator.	– Check the current supply. – Increase the ramp time. – Check for correct motor size (the motor current is too high). – Contact SEW-EURODRIVE Service.
	Switched-mode power supply fault, hardware fault.	– Check the current supply. – Check the DC 24 V supply voltage.
	Fault at the gate driver of an IGBT.	Defect in the power output stage. Contact SEW-EURODRIVE Service.
	Invalid process data configuration. Status of control section and power section are not compatible.	Contact SEW-EURODRIVE Service.

Subfault: 23.5 Description: Invalid process data configuration		
	Response: Output stage inhibit	
	Cause	Measure
	Invalid process data configuration.	Contact SEW-EURODRIVE Service.

Subfault: 23.6 Description: Process data timeout		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	Power section communication interface detected process data timeout.	If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

Subfault: 23.7 Description: Parameter communication timeout		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	Power section communication interface detected timeout in parameter communication.	If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

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Subfault: 23.8 Description: Parameter communication error		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	Power section communication interface detected error in parameter communication.	If the fault occurs repeatedly, contact SEW-EURODRIVE Service.

Subfault: 23.9 Description: Firmware of power section corrupt		
	Response: Output stage inhibit	
	Cause	Measure
	Failed to update firmware on power section.	Update the firmware again.

10.6.19 Fault 25 Parameter memory monitoring

Subfault: 25.1 Description: Timeout warning		
	Response: Warning with self-reset	
	Cause	Measure
	Access to memory (R/W) takes longer than expected.	The error will be reset automatically after completed memory access.

Subfault: 25.2 Description: NV memory – runtime error		
	Response: Output stage inhibit System state: Fault acknowledgment with CPU reset	
	Cause	Measure
	Runtime error of non-volatile memory system.	– Reset the device. – If this error occurs repeatedly, replace the device. Contact SEW-EURODRIVE Service.

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Subfault: 25.6 Description: Incompatible device configuration		
	Response: Output stage inhibit	
	Cause	Measure
	The data set in the device was copied from another device, which differs from the current device in the device family, power, or voltage.	– Check whether the configuration is correct and repeat the startup, if necessary. – Acknowledge the fault by manual reset with parameter set acceptance. Setting under [Diagnostics] > [Status] > [Fault status] parameter "Manual fault reset".
	Replaceable memory module used by another device. Power, device family, or voltage differs from the current device.	– Check whether the configuration is correct and repeat the startup, if necessary. – Acknowledge the fault by manual reset with parameter set acceptance. Setting under [Diagnostics] > [Status] > [Fault status] parameter "Manual fault reset".
	The power section was replaced and differs in its power rating or voltage from the original power section.	– Check whether the configuration is correct and repeat the startup, if necessary. – Acknowledge the fault by manual reset with parameter set acceptance. Setting under [Diagnostics] > [Status] > [Fault status] parameter "Manual fault reset".

Subfault: 25.7 Description: NV memory initialization – error	
Response: Output stage inhibit	
Cause	Measure
Error initializing non-volatile memory system.	– Reset the device. – If this error occurs repeatedly, replace the device. Contact SEW-EURODRIVE Service.

Subfault: 25.10 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.

Subfault: 25.12 Description: Power section configuration data – CRC error	
Response: Output stage inhibit	
Cause	Measure
Faulty configuration data of power section.	Contact SEW-EURODRIVE Service.

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Subfault: 25.13 Description: Control electronics configuration data – CRC error		
	Response: Output stage inhibit	
	Cause	Measure
	Faulty configuration data of control electronics.	Contact SEW-EURODRIVE Service.

Subfault: 25.14 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.

Subfault: 25.15 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.

Subfault: 25.16 Description: Power section calibration data – CRC error		
	Response: Output stage inhibit	
	Cause	Measure
	Faulty calibration data of power section.	Contact SEW-EURODRIVE Service.

Subfault: 25.17 Description: Control electronics calibration data – CRC error		
	Response: Output stage inhibit	
	Cause	Measure
	Faulty calibration data of control electronics.	Contact SEW-EURODRIVE Service.

Subfault: 25.18 Description: Power section QA data – CRC error		
	Response: Warning	
	Cause	Measure
	Faulty quality assurance data of power section.	Contact SEW-EURODRIVE Service.

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Subfault: 25.19 Description: Control electronics QA data – CRC error	
Response: Warning	
Cause	Measure
Faulty quality assurance data of control electronics.	Contact SEW-EURODRIVE Service.

Subfault: 25.20 Description: Initialization error – basic device memory	
Response: Output stage inhibit	
Cause	Measure
Initialization error of the basic device memory.	Contact SEW-EURODRIVE Service.

Subfault: 25.21 Description: Runtime error – basic device memory	
Response: Emergency stop + output stage inhibit	
Cause	Measure
Runtime error in memory of basic device.	Contact SEW-EURODRIVE Service.

Subfault: 25.30 Description: Initialization error – replaceable memory module	
Response: Output stage inhibit	
Cause	Measure
The formatting of the replaceable memory module does not match.	Restore delivery state. NOTICE All the data on the replaceable memory module will be reset to default.
Initialization error of replaceable memory module after delivery state.	Contact SEW-EURODRIVE Service.

Subfault: 25.31 Description: Runtime error – replaceable memory module	
Response: Emergency stop + output stage inhibit	
Cause	Measure
Runtime error of replaceable memory module.	Contact SEW-EURODRIVE Service.

Subfault: 25.32 Description: Replaceable memory module not compatible	
Response: Output stage inhibit System state: Fault acknowledgment with CPU reset	
Cause	Measure
The inserted replaceable memory module cannot be used.	Replace the memory module.

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Subfault: 25.33 Description: Replaceable memory module with different device category		
	Response: Output stage inhibit	
	Cause	Measure
	The replaceable memory module is formatted and contains data from a device of a different device category. The data is not compatible and cannot be used.	– Replace the memory module. – Restore delivery state. Bear in mind that all data on the replaceable memory module will be reset to the default values.

Subfault: 25.50 Description: Runtime error – replaceable safety memory module		
	Response: Output stage inhibit System state: Fault acknowledgment with CPU reset	
	Cause	Measure
	Runtime error of the replaceable safety memory module.	Contact SEW-EURODRIVE Service.

Subfault: 25.51 Description: Initialization error – replaceable safety memory module		
	Response: Warning	
	Cause	Measure
	Initialization error of the replaceable safety memory module.	Contact SEW-EURODRIVE Service.

Subfault: 25.61 Description: Failure – restore point		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	Failed to create restore point.	Delete restore point.

Subfault: 25.70 Description: Incompatible card configuration		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	The current configuration of the cards does not match the state of the stored startup. For example, a card was removed that was still present during startup.	– Restore the original configuration of the cards. – Acknowledge the fault by manual reset with parameter set acceptance. Setting under [Diagnostics] > [Status] > [Fault status] parameter "Manual fault reset".

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10.6.20 Fault 26 External fault

Subfault: 26.1 Description: Terminal		
	Response: External fault	
	Cause	Measure
	Fault message about external fault source.	Programmable via 8622.5 (default: application stop (with output stage inhibit)).

Subfault: 26.3 Description: Power section emergency shutdown		
	Response: Output stage inhibit	
	Cause	Measure
	Power section requested external emergency shutdown because it detected critical fault.	Contact SEW-EURODRIVE Service.

Subfault: 26.4 Description: External braking resistor fault		
	Response: Response to external braking resistor fault	
	Cause	Measure
	External braking resistor's temperature switch connected to terminal tripped.	– Check the resistor mounting position. – Clean the resistor. – Check the configuration of the resistor. – Install a larger resistor. – Check the trip switch settings. – Optimize the travel cycle so that less regenerative operation energy arises. – Check the settings of the storage unit discharge function in the MOVIKIT® software module.

10.6.21 Fault 28 FCB drive functions

Subfault: 28.1 Description: FCB 11/12 – Timeout while searching zero pulse		
	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.

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Subfault: 28.2 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.

Subfault: 28.3 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.

Subfault: 28.4 Description: FCB 11/12 – Reference offset error	
Response: Emergency stop + output stage inhibit	
Cause	Measure
Error when 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.

Subfault: 28.5 Description: FCB 11/12 – Referencing not possible	
Response: Emergency stop + output stage inhibit	
Cause	Measure
The reference travel type "Absolute encoder position" is only permitted for absolute encoders in the position mode "Linear mode" or "Single-turn absolute position" (index 8381.10/8382.10).	– Adjust the operating mode of the encoder. – Use another reference travel type.
In the active drive train, the "Actual position source" parameter is set to "No encoder".	Assign "Actual position source", or do not perform any referencing.

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Subfault: 28.6 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 or reference cam that has not been selected was approached during reference travel to fixed stop.	Check whether the parameters set for reference travel are correct.
	During reference travel to fixed stop with selected hardware limit switch or reference cam, the fixed stop was reached without approaching the hardware limit switch or reference cam.	Check whether the parameters set for reference travel are correct.

Subfault: 28.7 Description: FCB 21 – Total torque greater than maximum torque at motor shaft		
	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 load torque.	– Reduce the torque input. – Change the direction of rotation. – Increase the power of the drive.

Subfault: 28.8 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 input. – Check the limit values of the inverter. – Check motor connection.

Subfault: 28.9 Description: FCB 18 – Rotor position identification not possible		
	Response: Output stage inhibit	
	Cause	Measure
	Rotor position identification started with incremental encoder but aborted prematurely.	– Restart the rotor position identification. – Check whether the encoder is connected correctly. – Check whether the encoder is defective.
	Result of rotor position identification cannot be stored in encoder.	Select "Inverter" as storage location.
	Combination of "Automatic" operating mode and "Encoder" storage location not permitted.	Set the operating mode to "Manual" or the storage location to "Inverter".

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Subfault: 28.10 Description: FCB 25 – Asymmetrical motor phases		
	Response: Output stage inhibit	
	Cause	Measure
	Significantly different values determined in the three phases while measuring stator resistances.	– Check whether the motor is connected correctly. – Check all contact points on the motor and inverter. – Check the motor and motor cable for damage.

Subfault: 28.11 Description: FCB 25 – At least one phase with high resistance		
	Response: Output stage inhibit	
	Cause	Measure
	At least one motor phase could not be measured during motor parameter measurement.	– Check whether the motor is connected correctly. – Check all contact points on the motor and inverter. – Check the motor and motor cable for damage.

Subfault: 28.12 Description: FCB 25 – Timeout during stator resistance measurement		
	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.

Subfault: 28.13 Description: FCB 25 – Characteristic curve identification not possible		
	Response: Output stage inhibit	
	Cause	Measure
	Motor parameter measurement does not allow for unique identification of the characteristic curve.	Contact SEW-EURODRIVE Service.

Subfault: 28.14 Description: Modulo min. and max. swapped		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	In the active data set, the value for "Modulo minimum" is greater than the value for "Modulo maximum"; see Monitoring functions\Limit values 1 or Monitoring functions\Limit values 2.	Swap the values for modulo minimum and modulo maximum.

Subfault: 28.15 Description: FCB 25 – Timeout		
	Response: Output stage inhibit	
	Cause	Measure
	Measuring rotor resistance, LSigma, or stator inductance not completed.	Contact SEW-EURODRIVE Service.

Subfault: 28.17 Description: FCB only possible for drive train 1		
	Response: Output stage inhibit	
	Cause	Measure
	The activated 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.

Subfault: 28.18 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.

Subfault: 28.19 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.

Subfault: 28.20 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 parameters “Load torque” and “Permitted load torque tolerance” as follows: Load torque ± permitted tolerance load torque	Match the settings in FCB 21 with the requirements of the system: – Check the load torque of the system. – Check the setting of the load torque. – Check the setting of the permitted tolerance. – Check the load torque. – Check the system.

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Subfault: 28.21 Description: FCB 09 – Position overshoot through changes to the active travel job		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	Due to changes to the target position or profile values during an active travel order, the drive must move beyond the target and then reverse to maintain the profile. Since reversing is prohibited in the active operating modes, the drive triggers a fault when the target position is exceeded and stops in the permitted direction.	Change the target position/profile values in such a way that stopping is still possible.

Subfault: 28.22 Description: FCB 09 – Touchprobe data source		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	For the "Remaining distance 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.

10.6.22 Fault 29 HW limit switches

Subfault: 29.1 Description: Positive limit switch hit		
	Response: HW limit switch – current drive train	
	Cause	Measure
	Positive hardware limit switch hit.	– Check hardware limit switch wiring. – Check target position. – Move clear of the hardware limit switch at negative speed.

Subfault: 29.2 Description: Negative limit switch hit		
	Response: HW limit switch – current drive train	
	Cause	Measure
	Negative hardware limit switch hit.	– Check hardware limit switch wiring. – Check target position. – Move clear of the hardware limit switch at positive speed.

Subfault: 29.3 Description: Limit switch missing		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	Both positive and negative hardware limit switches approached at the same time.	– Check hardware limit switch wiring. – Check the parameter setting of digital inputs. – Check the parameter setting of process output data.

Subfault: 29.4 Description: Limit switches swapped		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	Positive hardware limit switch hit at negative speed, or negative hardware limit switch hit at positive speed.	Check whether hardware limit switch connections are swapped.

10.6.23 Fault 30 Software limit switches

Subfault: 30.1 Description: Positive limit switch hit		
	Response: SW limit switches – current drive train	
	Cause	Measure
	Positive software limit switch hit.	– Check position of the software limit switch. – Check target position. – Move clear of software limit switch at negative speed.

Subfault: 30.2 Description: Negative limit switch hit		
	Response: SW limit switches – current drive train	
	Cause	Measure
	Negative software limit switch hit.	– Check position of the software limit switch. – Check target position. – Move clear of the software limit switch at positive speed.

Subfault: 30.3 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.

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Subfault: 30.4 Description: Distance too close		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	The range limited by the "SW limit switch negative" and "SW limit switch positive" parameters is smaller than the range set in the "SW limit switch noise suppression window" parameter.	Adjust the positions of the software limit switches or the width of the noise suppression window.

10.6.24 Fault 31 Thermal motor protection

Subfault: 31.1 Description: Temperature sensor wire break – motor 1		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	Connection to temperature sensor of motor 1 interrupted.	Check the wiring of the temperature sensor.

Subfault: 31.2 Description: Temperature sensor short circuit – motor 1		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	Short circuit in connection with temperature sensor of motor 1.	Check the wiring of the temperature sensor.

Subfault: 31.3 Description: Temperature sensor overtemperature – motor 1		
	Response: Output stage inhibit	
	Cause	Measure
	Temperature sensor of motor 1 signals overtemperature.	– Allow motor to cool down. – Check for motor overload. – Check whether the correct temperature sensor KY (KTY) was parameterized instead of PK (PT1000).

Subfault: 31.4 Description: Temperature model overtemperature – motor 1		
	Response: Output stage inhibit	
	Cause	Measure
	Temperature model of motor 1 signals overtemperature.	– Allow motor to cool down. – Check for motor overload. – Check whether the correct temperature sensor KY (KTY) was parameterized instead of PK (PT1000).

Subfault: 31.5 Description: Temperature sensor prewarning – motor 1		
	Response: Thermal motor protection 1 – prewarning threshold	
	Cause	Measure
	Temperature signaled by temperature sensor of motor 1 exceeds prewarning threshold.	Check for motor overload.

Subfault: 31.6 Description: Temperature model prewarning – motor 1		
	Response: Thermal motor protection 1 – prewarning threshold	
	Cause	Measure
	Temperature signaled by temperature model of motor 1 exceeds prewarning threshold.	Check for motor overload.

Subfault: 31.7 Description: UL temperature monitoring		
	Response: Output stage inhibit	
	Cause	Measure
	Temperature model of active motor signals over-temperature.	Check for motor overload.

Subfault: 31.8 Description: Communication timeout temperature sensor – motor 1		
	Response: Output stage inhibit	
	Cause	Measure
	Communication with temperature sensor is disrupted, e.g. via MOVILINK® DDI.	Check the cabling.

Subfault: 31.9 Description: Temperature too low at temperature sensor – motor 1		
	Response: Output stage inhibit	
	Cause	Measure
	Short circuit in connection with temperature sensor of motor 1. For long cables, a short circuit can be misinterpreted as a voltage value of a low temperature.	Check the wiring of the temperature sensor.
	Temperature signaled by temperature sensor of motor 1 below -50 °C.	– Check if a KTY temperature sensor is installed in the motor but the parameterization has been carried out for a PT1000 temperature sensor. – Heat the motor.

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Subfault: 31.11 Description: Temperature sensor wire break – motor 2		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	Connection to temperature sensor of motor 2 interrupted.	Check the wiring of the temperature sensor.

Subfault: 31.12 Description: Temperature sensor short circuit – motor 2		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	Short circuit in connection with temperature sensor of motor 2.	Check the wiring of the temperature sensor.

Subfault: 31.13 Description: Temperature sensor overtemperature – motor 2		
	Response: Output stage inhibit	
	Cause	Measure
	Temperature sensor of motor 2 signals overtemperature.	– Allow motor to cool down. – Check for motor overload. – Check whether the correct temperature sensor KY (KTY) was parameterized instead of PK (PT1000).

Subfault: 31.14 Description: Temperature model overtemperature – motor 2		
	Response: Output stage inhibit	
	Cause	Measure
	Temperature model of motor 2 signals overtemperature.	– Allow motor to cool down. – Check for motor overload. – Check whether the correct temperature sensor KY (KTY) was parameterized instead of PK (PT1000).

Subfault: 31.15 Description: Temperature sensor prewarning – motor 2		
	Response: Thermal motor protection 2 – prewarning threshold	
	Cause	Measure
	Temperature signaled by temperature sensor of motor 2 exceeds prewarning threshold.	Check for motor overload.

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Subfault: 31.16 Description: Temperature model prewarning – motor 2		
	Response: Thermal motor protection 2 – prewarning threshold	
	Cause	Measure
	Temperature signaled by temperature model of motor 2 exceeds prewarning threshold.	Check for motor overload.

Subfault: 31.18 Description: Communication timeout temperature sensor – motor 2		
	Response: Output stage inhibit	
	Cause	Measure
	Communication with temperature sensor is disrupted, e.g. via MOVILINK® DDI.	Check the cabling.

Subfault: 31.19 Description: Temperature too low at temperature sensor – motor 2		
	Response: Output stage inhibit	
	Cause	Measure
	Short circuit in connection with temperature sensor of motor 2. For long cables, a short circuit can be misinterpreted as a voltage value of a low temperature.	Check the wiring of the temperature sensor.
	Temperature signaled by temperature sensor of motor 2 below -50 °C.	– Check if a KTY temperature sensor is installed in the motor but the parameterization has been carried out for a PT1000 temperature sensor. – Heat the motor.

Subfault: 31.50 Description: Fault at temperature sensor 1		
	Response: Output stage inhibit	
	Cause	Measure
	Fault detected at temperature sensor 1 of the motor.	Observe main fault code and take measures according to the main fault.

Subfault: 31.51 Description: Fault at temperature sensor 2		
	Response: Output stage inhibit	
	Cause	Measure
	Fault detected at temperature sensor 2 of the motor.	Observe main fault code and take measures according to the main fault.

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Subfault: 31.52 Description: Fault at temperature sensor 3		
	Response: Output stage inhibit	
	Cause	Measure
	Fault detected at temperature sensor 3 of the motor.	Observe main fault code and take measures according to the main fault.

10.6.25 Fault 32 Communication

Subfault: 32.2 Description: EtherCAT®/SBusPLUS process data timeout		
	Response: Fieldbus – timeout response	
	Cause	Measure
	Timeout in process data transfer during EtherCAT®/SBusPLUS communication.	– Check the wiring of the system bus and module bus. – Check that the EtherCAT®/SBus^{PLUS} configuration is set correctly in the MOVI-C® CONTROLLER. – Check the EtherCAT®/SBusPLUS timeout configuration in the device.

Subfault: 32.3 Description: Faulty synchronization signal		
	Response: External synchronization	
	Cause	Measure
	Faulty synchronization signal period.	Check that the EtherCAT®/SBus^{PLUS} configuration is set correctly in the MOVI-C® CONTROLLER.

Subfault: 32.4 Description: No synchronization signal		
	Response: External synchronization	
	Cause	Measure
	No synchronization signal present.	Check that the EtherCAT®/SBus^{PLUS} configuration is set correctly in the MOVI-C® CONTROLLER.

Subfault: 32.5 Description: Synchronization timeout		
	Response: External synchronization	
	Cause	Measure
	Timeout while synchronizing to synchronization signal.	Check that the EtherCAT®/SBus^{PLUS} configuration is set correctly in the MOVI-C® CONTROLLER.

Subfault: 32.6 **Description: Copy parameter set**		
	Response: Output stage inhibit	
	Cause	Measure
	Error while downloading parameter set to device.	– Check the wiring of the system bus and module bus. – Restart download.

Subfault: 32.7 **Description: Application heartbeat timeout**		
	Response: Application heartbeat – timeout response	
	Cause	Measure
	Communication between application program (e.g. MOVIKIT® of the Drive or IEC Program module group) and device interrupted.	– Check status of the application program. – Restart application program.

Subfault: 32.8 **Description: Timeout user timeout**		
	Response: User timeout – timeout response	
	Cause	Measure
	The timeout time of the user timeout function elapsed	Write the parameter for triggering the user timeout function cyclically before the timeout time elapses.

Subfault: 32.12 **Description: Manual mode timeout**		
	Response: Manual mode – timeout response	
	Cause	Measure
	Communication connection to device 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.	– Reset the fault. – Restart manual mode.
	Scope measurement loaded from device.	– Reset the fault. – Restart manual mode.

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10.6.26 Fault 33 System initialization

Subfault: 33.1 **Description: Offset determination current measurement**	
Response: Output stage inhibit System state: Fault acknowledgment with CPU reset	
Cause	Measure
Error detected during current measurement.	Contact SEW-EURODRIVE Service.

Subfault: 33.2 **Description: Firmware CRC check**	
Response: Output stage inhibit System state: Fault acknowledgment with CPU reset	
Cause	Measure
Error checking firmware.	Contact SEW-EURODRIVE Service.

Subfault: 33.6 **Description: FPGA configuration**	
Response: Output stage inhibit	
Cause	Measure
Error checking FPGA configuration.	Contact SEW-EURODRIVE Service.

Subfault: 33.7 **Description: Function block compatibility error**	
Response: Output stage inhibit	
Cause	Measure
Error checking compatibility of function block.	Contact SEW-EURODRIVE Service.

Subfault: 33.8 **Description: SW function block configuration**	
Response: Output stage inhibit	
Cause	Measure
Error detected while checking configuration of software function block.	Contact SEW-EURODRIVE Service.

Subfault: 33.9 **Description: Power section hardware compatibility fault**	
Response: Output stage inhibit	
Cause	Measure
Firmware does not match hardware of power section.	Contact SEW-EURODRIVE Service.

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Subfault: 33.10 Description: Run-up timeout		
	Response: Output stage inhibit System state: Fault acknowledgment with CPU reset	
	Cause	Measure
	Timeout during system run-up.	Contact SEW-EURODRIVE Service.

Subfault: 33.11 Description: Hardware compatibility error		
	Response: Output stage inhibit	
	Cause	Measure
	Firmware does not match device.	Contact SEW-EURODRIVE Service.

Subfault: 33.12 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. The setting for the device parameter source is set to "Internal memory".	– Switch off the device. Remove the memory module and restart the device. – Change the parameter "Non-volatile memory source" to "Arbitrary" or "Replaceable memory module". Switch the device off and on again.

Subfault: 33.13 Description: Memory module removed		
	Response: Output stage inhibit System state: Fault acknowledgment with CPU reset	
	Cause	Measure
	The device was started without a memory module. This device variant can be operated without memory module.	Switch off the device, insert the memory module, and switch on the device again.
	The device was started without a memory module. For the parameter "NV memory source", however, the setting "Replaceable memory module" was defined.	– Switch off the device, insert the memory module, and switch on the device again. – Change the setting of the "NV memory source" to "Internal memory". Switch the device off and on again.
	Replaceable memory module removed during ongoing operation.	– Switch off the device, insert the memory module, and switch on the device again. – Change the setting of the "NV memory source" to "Internal memory". Switch the device off and on again.

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Subfault: 33.14 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.

Subfault: 33.15 Description: Firmware configuration		
	Response: Output stage inhibit System state: Fault acknowledgment with CPU reset	
	Cause	Measure
	The Device Update Manager detected a modified version of the application firmware.	Acknowledge the error. Doing so will update the configuration data of the Device Update Manager.
	The error occurs repeatedly several times. The Device Update Manager is outdated and cannot save the configuration.	Update the Device Update Manager.

Subfault: 33.18 Description: Fieldbus configuration		
	Response: Output stage inhibit System state: Fault acknowledgment with CPU reset	
	Cause	Measure
	The fieldbus variant is not compatible with the firmware variant of the main firmware: – With CiA402 firmware variants, only POWERLINK or EtherCAT® is possible. – With standard firmware variants, POWERLINK is not possible.	– Load appropriate variant of the main firmware. – Load appropriate variant of the fieldbus firmware. – For devices with pluggable fieldbus card, replace the card.

10.6.27 Fault 34 Process data configuration

Subfault: 34.1 Description: Changed process data configuration		
	Response: Application stop + output stage inhibit	
	Cause	Measure
	Process data configuration changed during active process data operation.	– Stop the process data and make your changes. Then start the process data again. – Perform a reset. Doing so will stop the process data, apply the changes, and restart the process data.

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10.6.28 Fault 35 Function activation

Subfault: 35.1 Description: Activation level – invalid activation key	
Response: Emergency stop + output stage inhibit	
Cause	Measure
The activation key was entered incorrectly.	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 allocated instance.
Activation key entered for technology level in parameter "Application level – activation key".	Enter the activation key in the correct parameter.

Subfault: 35.2 Description: Application level too low	
Response: Emergency stop + output stage inhibit	
Cause	Measure
The activated software module requires a higher application level.	Activation key was entered for required application level. You can read the required level from the parameter "Application level – Required level".

Subfault: 35.3 Description: Technology level too low	
Response: Emergency stop + output stage inhibit	
Cause	Measure
An activated technology function requires a higher technology level.	Enter an activation key for the required technology level. You can find the required level in the parameter 8438.13 "Technology level – Required level".

Subfault: 35.4 Description: Technology level – invalid activation key	
Response: Emergency stop + output stage inhibit	
Cause	Measure
The activation key was entered incorrectly.	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 allocated instance.
Activation key entered for application level in parameter "Technology level – activation key".	Enter the activation key in the correct parameter.

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10.6.29 Fault 37 Brake control

Subfault: 37.1 **Description: Brake control 1 status – monitoring**		
	Response: Brake rectifier 1 – status	
	Cause	Measure
	The switching state of the input signal "Brake control 1 – status" differs from the switching state of the brake output (DB 00).	– Check the cabling and voltage supply at brake control 1. – Check whether the selected cabling is compatible with brake control monitoring.

Subfault: 37.2 **Description: Brake control 1 – switching frequency**		
	Response: Brake rectifier 1 – switching frequency	
	Cause	Measure
	Permitted switching frequency of brake control exceeded.	Check the application.

Subfault: 37.3 **Description: Brake control 2 status – monitoring**		
	Response: Brake rectifier 2 – status	
	Cause	Measure
	The switching state of the input signal "Brake control 2 – status" differs from the switching state of the brake output (DB 00).	– Check the cabling and voltage supply at brake control 2. – Check whether the selected cabling is compatible with brake control monitoring.

Subfault: 37.4 **Description: Brake control 2 – switching frequency**		
	Response: Brake rectifier 2 – switching frequency	
	Cause	Measure
	Permitted switching frequency of brake control exceeded.	Check the application.

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10.6.30 Fault 42 Lag error

Subfault: 42.1 Description: Positioning lag error	
Response: Positioning lag error	
Cause	Measure
Encoder not connected correctly.	Check the connection of the encoder.
Position encoder inverted or not installed correctly at the track.	Check the installation and connection of the position encoder.
Wiring faulty.	– Check the wiring of encoder and motor. – Check the line phases.
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.	Set P component of the position controller to a larger value.
Speed controller parameterized incorrectly.	Check controller parameters.
Lag error window too small.	Increase the lag error window.
Mechanical components cannot move freely or are blocked.	– Check whether the mechanical components can move freely. – Check the mechanical components for blockage.

Subfault: 42.2 Description: Jog mode lag error	
Response: Output stage inhibit	
Cause	Measure
Encoder not connected correctly.	Check the connection of the encoder.
Position encoder inverted or not installed correctly at the track.	Check the installation and connection of the position encoder.
Wiring faulty.	– Check the wiring of encoder and motor. – Check the line phases.
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.	Set P component of the position controller to a larger value.
Speed controller parameterized incorrectly.	Check controller parameters.
Lag error window too small.	Increase the lag error window.
Mechanical components cannot move freely or are blocked.	– Check whether the mechanical components can move freely. – Check the mechanical components for blockage.

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Subfault: 42.3 Description: Standard lag error		
	Response: Output stage inhibit	
	Cause	Measure
	Encoder not connected correctly.	Check the connection of the encoder.
	Position encoder inverted or not installed correctly at the track.	Check the installation and connection of the position encoder.
	Wiring faulty.	– Check the wiring of encoder and motor. – Check the line phases.
	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.	Set P component of the position controller to a larger value.
	Speed controller parameterized incorrectly.	Check controller parameters.
	Lag error window too small.	Increase the lag error window.

10.6.31 Fault 44 Subcomponent power section

Subfault: 44.2 Description: Overcurrent phase U		
	Response: Remote – critical fault	
	Cause	Measure
	Overcurrent phase U.	– Rectify the short circuit. – Connect a smaller motor. – Increase the ramp time. – In the event of a defective output stage, contact SEW-EURODRIVE Service.

Subfault: 44.3 Description: Overcurrent phase V		
	Response: Remote – critical fault	
	Cause	Measure
	Overcurrent phase V.	– Rectify the short circuit. – Connect a smaller motor. – Increase the ramp time. – In the event of a defective output stage, contact SEW-EURODRIVE Service.

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Subfault: 44.4 Description: Overcurrent phase W		
	Response: Remote – critical fault	
	Cause	Measure
	Overcurrent phase W.	– Rectify the short circuit. – Connect a smaller motor. – Increase the ramp time. – In the event of a defective output stage, contact SEW-EURODRIVE Service.

10.6.32 Fault 45 Fieldbus card

Subfault: 45.1 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 power off and on again/perform a reset. – If the fault occurs repeatedly, replace the fieldbus interface or device and send it together with the fault number to SEW-EURODRIVE. For further support, contact SEW-EURODRIVE Service.

Subfault: 45.2 Description: Fieldbus interface – fault		
	Response: Fieldbus – timeout response	
	Cause	Measure
	Device detected fault on device-internal connection to fieldbus interface.	– Switch the device off and on again. – If the fault occurs repeatedly, replace the fieldbus interface or device and send it together with the fault number to SEW-EURODRIVE. For further support, contact SEW-EURODRIVE Service.

Subfault: 45.3 Description: Process output data timeout		
	Response: Fieldbus – timeout response	
	Cause	Measure
	Fieldbus interface detected timeout of process output data.	– Check the communication connection between the fieldbus master and the fieldbus interface for interruption. – Check the configuration of the fieldbus master. – Adjust the fieldbus timeout monitoring.

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Subfault: 45.5 Description: Engineering interface		
	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. – If the fault occurs repeatedly, replace the fieldbus interface or device and send it together with the fault number to SEW-EURODRIVE. For further support, contact SEW-EURODRIVE Service.

Subfault: 45.7 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 fault in the exchange of 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 an error in the internal exchange of process data, switch the device off and then on again.

Subfault: 45.9 Description: Fieldbus interface – warning		
	Response: Warning	
	Cause	Measure
	Device detected non-critical fault on device-internal connection to fieldbus interface.	– Switch the device off and on again. – If the fault occurs repeatedly, replace the fieldbus interface or device and send it together with the fault number to SEW-EURODRIVE. For further support, contact SEW-EURODRIVE Service.

Subfault: 45.50 Description: Fieldbus card – warning		
	Response: Warning with self-reset	
	Cause	Measure
	Fieldbus interface signals subcomponent fault of the type "warning".	Refer to the subcomponent fault of the fieldbus interface and take the measures required for eliminating the fault.

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Subfault: 45.51 Description: Fieldbus card – fault		
	Response: Fieldbus – timeout response	
	Cause	Measure
	Fieldbus interface signals subcomponent fault of the type "standard".	Refer to the subcomponent fault of the fieldbus interface and take the measures required for eliminating the fault.

Subfault: 45.52 Description: Fieldbus card – critical fault		
	Response: Fieldbus – timeout response	
	Cause	Measure
	Fieldbus interface signals subcomponent fault of the type "Critical fault".	Refer to the subcomponent fault of the fieldbus interface and take the measures required for eliminating the fault.

10.6.33 Fault 46 Safety card

Subfault: 46.1 Description: No response		
	Response: Output stage inhibit	
	Cause	Measure
	Failed to synchronize with subcomponent.	– Check device assignment of basic device and option. – Check card slot and installation and correct if necessary. – Restart the device. – Contact SEW-EURODRIVE Service.

Subfault: 46.2 Description: Invalid variant		
	Response: Output stage inhibit	
	Cause	Measure
	Plugged safety card design does not match inverter type.	– Remove the safety card. – Use the correct safety card design.
	For double axes, only designs without encoder interface can be used.	– Remove the option. – Use the design without encoder interface.
	For double axes, no encoder option must be plugged in.	Remove the option.

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Subfault: 46.3 Description: Internal communication timeout		
	Response: Output stage inhibit	
	Cause	Measure
	Communication interrupted between inverter and safety card.	Check card slot and installation and correct if necessary. Contact SEW-EURODRIVE Service if the error is still present.
	Safety card signals subcomponent fault of the type "warning".	Check card slot and installation and correct if necessary. Contact SEW-EURODRIVE Service if the error is still present.

Subfault: 46.50 Description: Warning		
	Response: Warning with self-reset	
	Cause	Measure
	Safety card signals subcomponent fault of the type "warning".	Observe the subcomponent fault of the safety card and take measures according to the subcomponent fault.

Subfault: 46.51 Description: Fault		
	Response: Emergency stop + output stage inhibit with self-reset	
	Cause	Measure
	Safety card signals subcomponent fault of the type "standard fault".	Observe the subcomponent fault of the safety card and take measures according to the subcomponent fault.

Subfault: 46.52 Description: System error		
	Response: Output stage inhibit with self-reset	
	Cause	Measure
	Safety card signals subcomponent fault of the type "system fault" or "critical fault".	Observe the subcomponent fault of the safety card and take measures according to the subcomponent fault.

10.6.34 Fault 51 Analog processing

Subfault: 51.1 Description: Analog current input 4 mA limit		
	Response: Warning with self-reset	
	Cause	Measure
	Input current below 4 mA.	Check the input current.

Subfault: 51.2 Description: Voltage/current changeover		
	Response: Output stage inhibit	
	Cause	Measure
	The hardware configuration for switching between voltage input and current input does not match the parameterization of the analog input.	Change the hardware configuration or the parameter setting.

10.6.35 Fault 52 Category 2 explosion protection function

Subfault: 52.1 Description: Startup error	
Response: Output stage inhibit	
Cause	Measure
No valid startup available.	Perform startup.

Subfault: 52.2 Description: Impermissible system function	
Response: Output stage inhibit	
Cause	Measure
Impermissible system function activated.	Disable impermissible functions when Ex protection function is active, such as "Activate standstill current" = "On" in the active control mode.

Subfault: 52.3 Description: Inverter too large	
Response: Output stage inhibit	
Cause	Measure
Ratio of inverter current to nominal motor current too large.	Check the assignment of motor and inverter, and check the dimensioning of the system.

Subfault: 52.4 Description: Parameterization of current limit characteristic	
Response: Output stage inhibit	
Cause	Measure
Error while setting parameters for current limit characteristic.	– Parameterize the current limit characteristic. – Perform startup again.

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Subfault: 52.5 Description: Time duration exceeded f < 5 Hz		
	Response: Emergency stop + output stage inhibit	
	Cause	Measure
	Duration of 60 s for f < 5 Hz exceeded.	Check the dimensioning of the system: If speed control = FCB05, increase the speed. If speed = 0, inhibit output stage / with stop FCBs, activate the brake function if a brake is installed.

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10.7 Fault responses

10.7.1 Default fault response

Fault response	Description
No response	The inverter ignores the event.
Warning with self-reset	The inverter sends 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 For 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 acknowledges the fault. The inverter automatically resumes the operation performed before the fault. The drive restarts automatically.

10.7.2 Parameterizable faults

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 fault	This parameter is used to 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	This parameter is used to 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	This parameter is used to 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

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Parameterizable faults	Description	Index no.	Possible fault response
Fieldbus – timeout	This parameter is used to set the device response to an EtherCAT®/SBus^{PLUS} timeout (timeout time, 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	This parameter is used to 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 active parameter set – prewarning.	8622.8	• No response • Warning • Application stop (with output stage inhibit) • Emergency stop (with output stage inhibit) • Inhibit output stage
Electromechanical utilization – prewarning	This parameter is used to set the device response to an exceeded prewarning threshold for electromechanical utilization (index 8336.2).	8622.10	• No response • Warning • Application stop (with output stage inhibit) • Emergency stop (with output stage inhibit) • Inhibit output stage
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	This parameter is used to 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	This parameter is used to 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

Parameterizable faults	Description	Index no.	Possible fault 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
Application heartbeat timeout	This parameter is used to 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

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11 Service

11.1 Electronics Service by SEW-EURODRIVE

If you are unable to rectify a fault, contact SEW-EURODRIVE Service. For addresses, refer to www.sew-eurodrive.com.

When contacting SEW-EURODRIVE Service, always specify the following information so that our service personnel can assist you more effectively:

- Information on the device type on the nameplate (e.g. type designation, serial number, part number, product key, purchase order number)
- Brief description of the application
- Fault message on the status display
- Nature of the fault
- Accompanying circumstances
- Any unusual events preceding the problem

11.2 Extended storage

If the devices are stored in a temperature range of 5 °C to 40 °C, no measures are required.

The following table lists the devices, time intervals, and measures that are required if the devices are stored outside the above-mentioned temperature range.

For all inverters other than the ones listed, **no** measures are required.

Devices	Time interval	Measure
All inverters	Every 2 years	Line connections: Connect the device to the line voltage for 5 minutes.
		Connect the device to 24 V for 5 minutes

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11.2.1 Procedure when maintenance has been neglected

If you have not performed maintenance regularly, SEW-EURODRIVE recommends that you increase the line voltage slowly up to the maximum voltage. This can be done, for example, by using a variable transformer for which the output voltage has been set according to the following overview. After you have completed the regeneration process, the device can be used immediately or stored again.

The following graduations are recommended:

AC 400/500 V devices:

- Stage 1: 0 V to AC 350 V within a few seconds
- Stage 2: AC 350 V for 15 minutes
- Stage 3: AC 420 V for 15 minutes
- Stage 4: AC 500 V for 1 hour

AC 230 V devices

- Stages 1, 2: 170 V
- Stage 3: 200 V
- Stage 4: 240 V

11.3 Device replacement

If a device needs to be replaced, the following procedures apply.

11.3.1 Exclusive use of the CMM.. memory module

If the inverter is equipped with a CMM.. memory module, the parameter and configuration settings are stored on the memory module. By plugging the memory module into another inverter, this data is available so that the inverter is immediately ready for operation for the specific application.

Instructions on the use of the memory module when exchanging a device

The prerequisite for the error-free exchange of an inverter is that the same options must be installed in the new device as in the original one.

If this is not the case, the error message "25.70 NV memory initialization" is displayed. You can acknowledge the error by opening the "Error reset with parameter acceptance" menu item in the context menu, and you must ensure that the information that was provided via the previous options (e.g. encoder signals via encoder option) reach the application inverter through different means or are deselected.

Alternatively, the device can also be reset to the delivery state. A new startup is then required.

If a memory module is removed during operation, the following error message is displayed: "33.13 System initialization: Memory module removed".

This fault status can be acknowledged with a fault reset.

SEW-EURODRIVE recommends operating the inverter only with an inserted memory module.

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11.3.2 Using a CBG.. keypad

When using a keypad, the parameter and configuration settings can be stored on the keypad. By plugging the keypad into another inverter and activating data transmission, data is transferred to the inverter. After the transmission is complete, the inverter is immediately ready for operation for the specific application.

11.3.3 Using a MOVI-C® CONTROLLER with or without CMM.. memory module

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.

The data is on the memory card of the MOVI-C® CONTROLLER. If the data management of the MOVI-C® CONTROLLER is not active, the memory source can be set in index 8431.20 (memory source) as follows:

- 0 - Any

  The parameter and configuration settings are written both to the internal device memory of the inverter and to the CMM.. memory module. Thus, the data is synchronized on both storage media.
- 1 - Internal memory

  The inverter reads or writes the parameter and configuration settings to the internal device memory of the inverter.
- 2 - Replaceable memory module

  The inverter reads or writes the parameter and configuration settings to the CMM... memory module.

11.3.4 Device replacement without error messages

Device replacement without error messages is only possible when using an identical replacement device. Deviating device configurations lead to error E25.06 and can be acknowledged with parameter acceptance (index 8365.5) via reset. The device can then be used without further startup.

11.4 Shutdown

To shut down the inverter, de-energize the inverter using appropriate measures.

⚠ 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.

11.5 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
- Rechargeable batteries
- Batteries

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.

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12 Functional safety

12.1 General information

12.1.1 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) in accordance with 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.

12.2 Integrated safety technology

3 safety options can be configured for the MOVITRAC® advanced inverter.

1. MOVISAFE® CSO safety option

   The STO safety subfunction is available via terminals with the MOVISAFE® CSO safety option.

2. MOVISAFE® CSB safety option

   The STO and SS1-t safety subfunctions are available via safe communication with the MOVISAFE® CSB safety option.

3. MOVISAFE® CSL safety option

   The SBC, STO and SS1-t safety subfunctions are available via safe communication with the MOVISAFE® CSL safety option. For example, the SLS and SDI safety subfunctions are available via EI7C FS for motion monitoring.

The described safety technology of the device has been developed and tested in accordance with the following safety requirements:

- MOVISAFE® CSB/CSL safety option:
  - SIL 2 according to EN 61800-5-2, EN 61508
  - PL d according to EN ISO 13849-1

This was certified by TÜV Rheinland. A copy of the TÜV certificate can be requested from SEW-EURODRIVE.

12.2.1 Safe state

For safety-related operation of the device, Safe Torque Off is defined as safe state (see STO safety subfunction). The safety concept is based on this definition.

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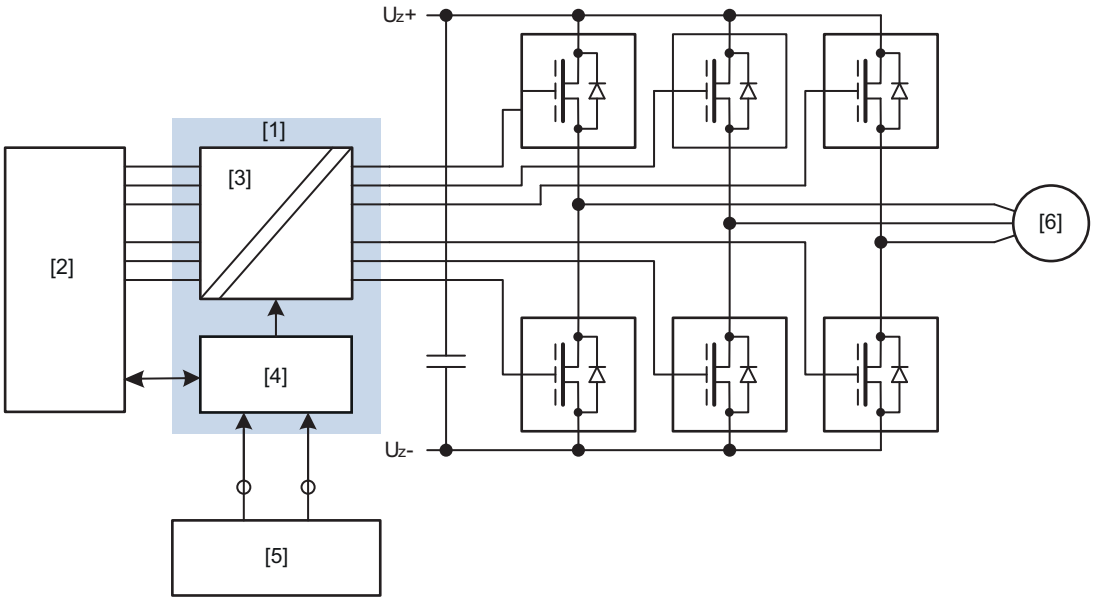
12.2.2 Safety concept STO

The device is supposed to be able to perform the safety subfunction "Safe Torque Off" in accordance with IEC 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 2-channel 24 V switching signal (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. With the CSB/CSL safety options, the STO function is performed using the safety option.
- An internal structure with diagnostics prevents the generation of pulse trains at the power output stage (IGBT).
- If the internal diagnostics detects a fault, the PWM signals are permanently switched off.
- 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.
- If the internal diagnostics of the STO circuit detects a fault, the PWM signals are locked, i.e. the 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 input F_STO_P off and on.

12.2.3 Schematic representation of the safety concept STO

With CSO safety option



33200049803

[1] STO function
[2] Drive controller
[3] Switching element
[4] Safety switching equipment
[5] External safety device (optional)
[6] Motor

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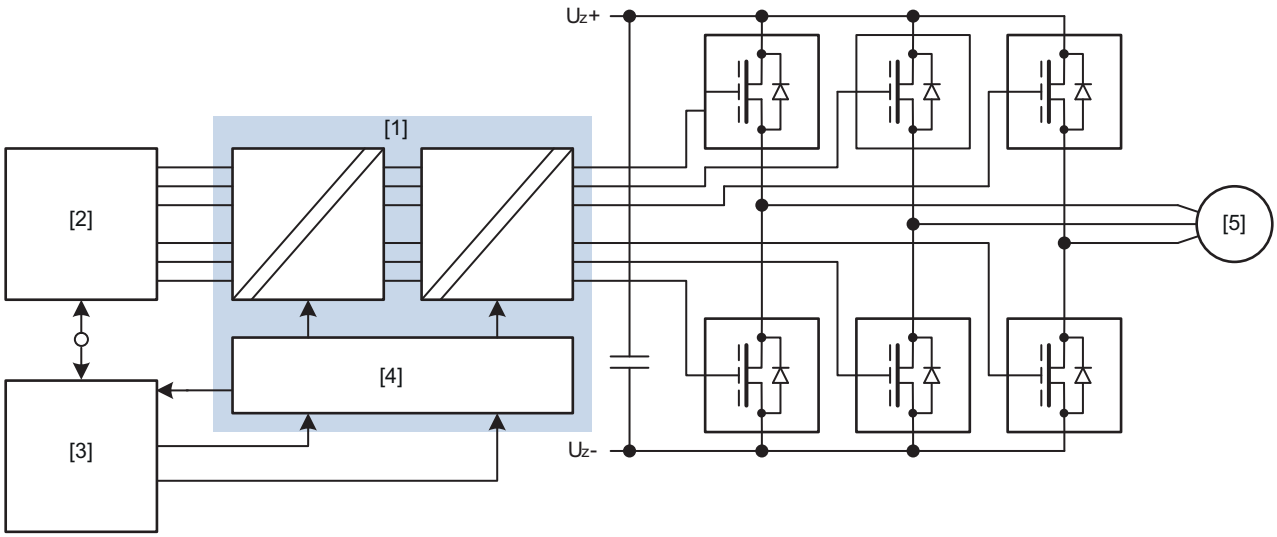
With CSB/CSL safety options



33207807755

[1] STO function
[2] Drive controller
[3] Safety option
[4] Diagnostics and inhibiting unit
[5] Motor

12.2.4 CSB/CSL safety concept

General

The CSB and CSL safety options are safe modules with safe digital inputs and outputs and, depending on the parameterization, with safe communication.

The CSB or CSL safety options are completely integrated into the MOVITRAC® advanced inverter. This means that the safety option internally activates the STO safety subfunction of the inverter. Instead of galvanic isolation of the drive from the supply system by means of contactors or switches, the disconnection via STO within the device safely prevents the control 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.

The safety concept is based on a safe state existing for all safe process values. A safe state of the safety option is defined as follows:

- The internal safe digital output F-DO_STO is disabled. This activates the STO safety subfunction.
- 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.

Notes on the stop categories according to EN 60204-1

- The STO safety subfunction corresponds to stop category 0.
- The SS1-r and SS1-t safety subfunctions correspond to stop category 1.

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Pluggable safety key

The safety key must already be plugged when activating the safety option and must not be removed while the safety option is active. The safety key is part of the data memory of the basic device.

The parameterization data of the MOVISAFE® CSB/CSL safety options is divided into application data and the key data set. The key data set ensures data integrity.

The application data are stored in the device. The application data are 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.

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 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 are available again immediately in the event of a device replacement.

The safety key contains the following data:

- Checksum of the application data set
- Checksum of the accepted data set
- Bus checksum (ParCRCBus)
- Parameters of the F protocol

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. Instead, the safety key ID can be read by the "Assist CS.." parameterization tool. To do this, the user must 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 by entering 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 device, 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.

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⚠ WARNING

Depending on the parameter setting the safety option does not control the STO safety subfunction. 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 master. The new ParCRC value must be transferred to the F-protocol master. 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.

Variants

- The safety options CSB and CSL are integrated safe electronics modules that can be operated with or without safe communication. The PROFIsafe, Safety over EtherCAT®, and CIP Safety™ profiles are available for safe communication. The safety options CSB and CSL are equipped with safe inputs and outputs (F-DI, F-DO) and are available in the following designs.

  CSB safety option:

  – 4 safe inputs

  CSL safety option:

  – 4 safe inputs

  – 1 safe 2-channel output
- The CSB/CSL safety options can release or safely deactivate the output stage of the inverter. The switching state of the safe internal digital output F-DO_STO, and consequently the STO safety subfunction, must be stable on "1" or stable on "0" once within 60 seconds for at least 2 seconds (2.5 seconds with extended diagnostics).
- The safety concept of the CSB/CSL safety options is based on the fact that a safe state exists for all safe process variables. For the CSB/CSL safety options, this value is "0" for all F-DI inputs and F-DO outputs.
- The CSB/CSL safety options were designed according to EN 61508 for SIL 2 and EN ISO 13849-1 for performance level d.
- In combination with the EI7C FS built-in encoder, the CSL safety option can safely monitor movement functions.

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12.2.5 Safety subfunctions according to EN 61800-5-2

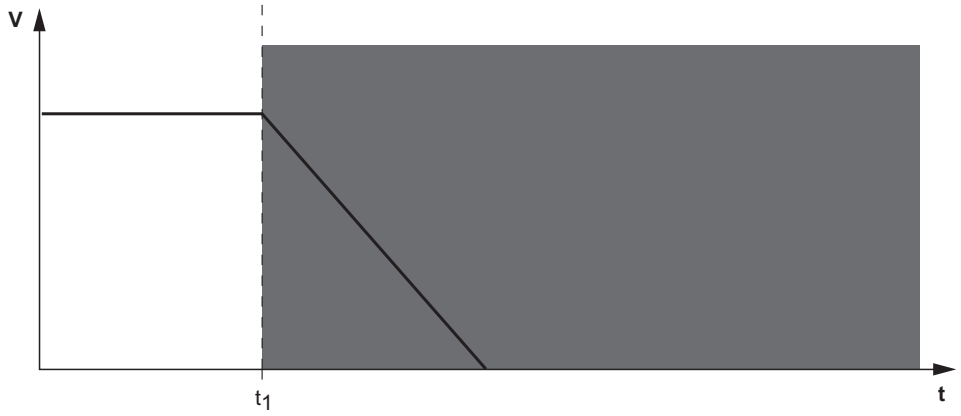
This chapter describes the safety subfunctions according to EN 61800-5-2. The following table shows the availability of the safety subfunctions described below, depending on the safety option used in each case.

Safety option	Safety sub-function						
	Idle state			Motion			
	STO	SBC	SS1-t	SS1-r	SLS	SSM	SDI
				With EI 7C FS only			
CSO	x		x[1)]				
CSB	x		x				
CSL	x	x	x	x	x	x	x

1) with suitable external control

STO – Safe Torque Off

If the STO function is activated, the drive inverter no longer supplies power to the motor. As a result, the drive cannot generate torque. This safety subfunction corresponds to a non-controlled stop according to EN 60204-1, stop category 0.



9007201225613323

= Safety subfunction active
v = Speed
t = Time
t_1 = Point of time when STO is triggered.

INFORMATION

The motor coasts to a halt or is stopped mechanically.

Controlled standstill is preferred, if possible.

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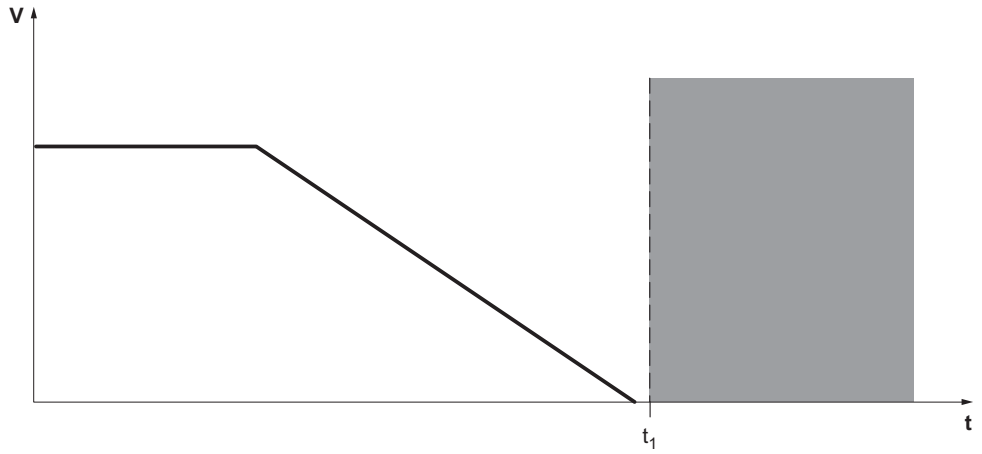
SBC – Safe Brake Control

The SBC function provides a safe output signal for controlling an external brake.



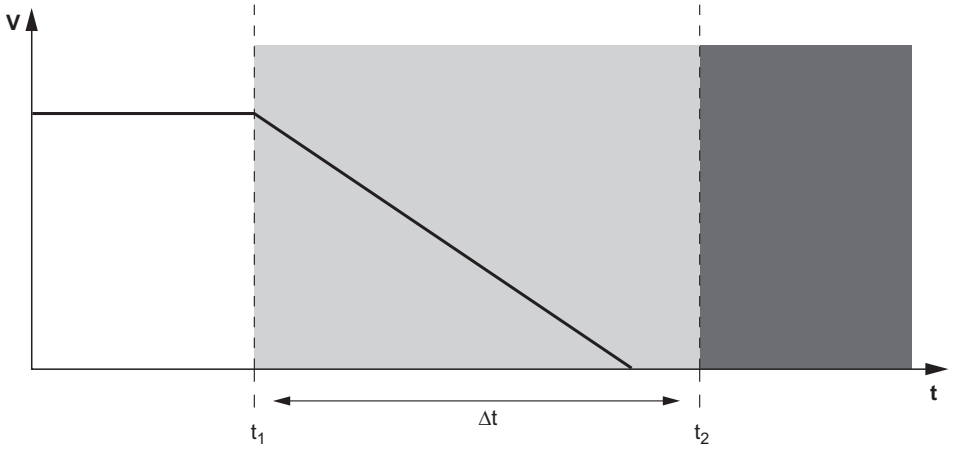
27021600043191563

= Safety subfunction activated
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 function is active, the drive inverter brings the motor to a standstill electrically. The STO safety subfunction will be triggered after a specified, safety-related time.

This safety subfunction corresponds to a controlled stop of the drive according to EN 60204-1, stop category 1.



9007201225618443

= Safety subfunction monitored
= STO safety subfunction active
v = Speed
t = Time
t_1 = Point of time when SS1-t is activated and motor deceleration is triggered.
t_2 = Point of time when STO is triggered.
Δt = Safety-related period of time

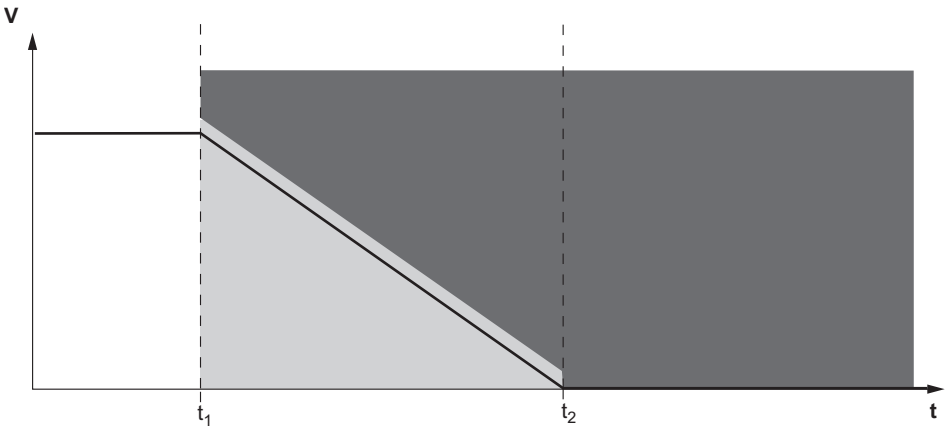
INFORMATION

- The SS1-t function does not monitor the stopping of the drive.
- The safety-related 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).

SS1-r – Safe Stop 1 with monitoring of the deceleration ramp

When the SS1-r function is active, the drive inverter brings the motor to a standstill electrically. The deceleration is monitored. The STO safety subfunction is triggered when the monitored deceleration is exceeded or when an idle state is reached.

This safety subfunction corresponds to a controlled stop of the drive according to EN 60204-1, stop category 1.



18014400480357003

= Safety subfunction monitored
= Safety subfunction triggers
v = Speed
t = Time
t_1 = Point in time when SS1-r is activated and motor deceleration is triggered.
t_2 = Point of time when STO is triggered.

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SLS – Safely Limited Speed

The SLS function prevents the drive from exceeding a specified speed. If the permitted speed is exceeded, the safety subfunction will be triggered and an error response will be initiated at the same time.

9007201225702923

= Safety subfunction monitored
= Safety subfunction triggers
v = Speed
t = Time
t_1 = Point in time at which SLS is activated.
t_2 = Point in time at which SLS is deactivated.

SSM – Safe Speed Monitoring

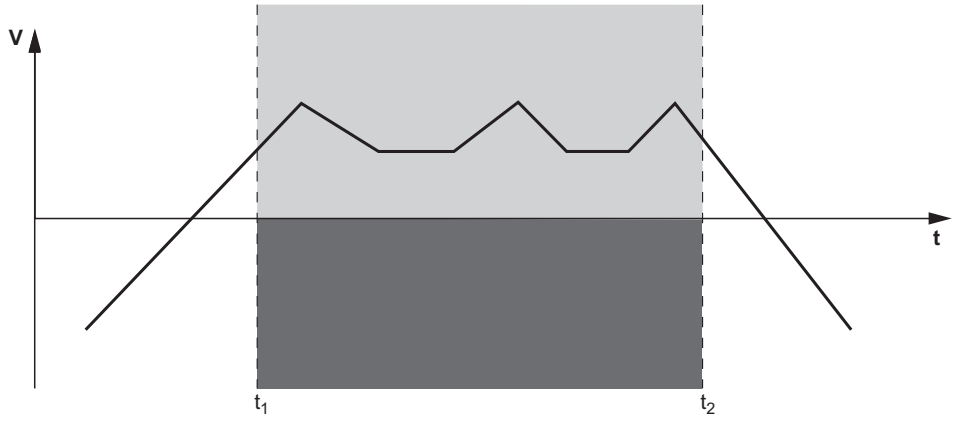
The SSM function monitors whether the drive exceeds a specified speed. An exceeding of the allowed speed is signaled.

9007201225702923

= Safety subfunction monitored
= Safety subfunction triggers
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 function prevents movement in an unintended direction. If this condition is violated, the safety subfunction will be triggered and an error response will be initiated at the same time (usually STO or SS1).



9007201225717643

= Safety subfunction monitored
= Safety subfunction triggers
v = Speed
t = Time
t_1 = Point in time when SDI is activated.
t_2 = Point in time when SDI is deactivated.

12.2.6 Limitations

- Note 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 subfunctions that require bringing the hazardous motion safely to a standstill, an additional safety brake system may be necessary on an application-specific basis.
- When using the SS1-t function as described in chapter "Safety subfunctions", the brake 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 it might even be accelerated in the worst case. In this case, the STO function is only activated after the set time delay has elapsed, see chapter "Safety subfunctions". The resulting danger must be taken into account in the risk assessment of the system/machine. Additional safety measures might have to be implemented.
- The STO function cannot prevent a possible jerk or DC braking.

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⚠ WARNING

The safety concept is only suitable for performing mechanical work on driven system/machine components.

When the STO signal is disconnected, the voltage is still present at the DC link of the device.

- 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.

INFORMATION

In the event of a safety-related disconnection of the DC 24 V supply voltage at the STO connection, the brake controller is switched off. The brake control in the device is not safety-related.

12.2.7 Safety concept of Assist CS..

Safety parameters

The CSB and CSL safety options have adjustable parameters for parameterizing the safety subfunctions.

The safety parameters determine the behavior of the corresponding safety subfunctions 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 CSB and CSL safety options are set using an engineering PC with the "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:

- Identify safety options.
- When establishing a connection to the safety option, the safety key ID must be entered in a dialog.
- Guided parameter setting procedure with the parameterization tool "Assist CS.." with integrated safety features such as plausibility check of entries during data transmission to the device.
- Completion of parameterization with an acceptance report to validate the safety subfunctions.

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12.3 Safety-related conditions

The requirement for safe operation is that the safety subfunctions of the device are properly integrated into an application-specific, higher-level safety subfunction. 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
- Operational requirements

12.3.1 Approved devices

The following device variants of MOVITRAC® are permitted for safety-related applications:

Device	Size
MOVITRAC® advanced	All sizes with CSO, CSB, CSL safety option

12.3.2 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 applies to temporary condensation, e.g. due to rapid changes of the ambient temperature.
- The wiring technology used must comply with the standard EN 60204-1.
- The safe control cables must be routed according to EMC guidelines and as follows:
  - Inside an electrical installation space: Single conductors can be routed.
  - 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

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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
- Observe without fail the values specified for safety components when designing the safety circuits.
- The STO signal (F_STO_P and F_STO_M) must not be used for feedback.
- For safety controller/safety relays, you must only use grounded voltage sources with protective electrical separation (PELV) in accordance with EN 61131-2 and EN 60204-1.
- When planning the installation, observe the technical data of the device.
- Do not use the port X6:4 (VO24_STO) of the device for safety-related applications. The voltage is only permitted to supply the port for the safe disconnection X6 when a jumper plug is plugged.
- For safety-related applications with the CSO device variant, the jumper plug at the STO input X6 must be removed. With the CSB and CSL device variants, the STO function is performed exclusively via the safety option. The STO input X6 has no function and must not be used for safety-relevant applications.
- When connecting an EI7C FS built-in encoder to the MOVITRAC® advanced, the encoder cable must not carry a TF signal.

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12.3.3 Requirements for the external safety controller

A safety relay can be used as an alternative to a safety controller. The following requirements apply accordingly.

- The safety controller and all other safety-related subsystems must be approved for at least the safety class that is required in the overall system for the respective application-related drive safety function.

  The following table shows an example of the required safety class of the safety controller:

Application	Safety controller requirements
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

- The wiring of the safety controller must be suitable for the required safety class (see manufacturer documentation). The STO input of the device can be switched with 2 channels (sourcing/sinking) or with 1 channel (sourcing).
- The values specified for the safety controller must be strictly adhered to when designing the circuit.
- No electro-sensitive protective equipment (such as a light grid or scanner) in accordance with EN 61496-1 or emergency stop buttons may be connected directly to the STO input. The connection must be made via a safety controller or a safety relay.
- To ensure protection against an unintended startup 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 be carried out only 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:
  - 2-channel, sourcing/sinking output:

    Short circuit of 24 V at F_STO_P (Stuck-at 1)

    Short circuit of 0 V at F_STO_M (Stuck-at 0)
  - 1-channel, sourcing output:

    With 1-channel connection, a fault exclusion is necessary for the wiring between the safety relay and the STO input.

2-channel, sourcing/sinking output:

- Test pulses can be present when the device is switched on or off:
  - The test pulses in the sourcing and sinking channel must not exceed 1 ms.
  - The next test pulse in the sourcing or sinking channel must only occur after a 2 ms time period at the earliest.
  - A maximum packet 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 test pulses must be monitored in the safety device. If a fault is detected, the safety device must initiate a suitable fault response.

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1-channel, sourcing output:

- In switched-off state, no switch-on test pulses must occur in the sourcing cable.
- In switched-on state:
  - The switch-off test pulse in 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 packet 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 test pulses must be monitored in the safety device. If a fault is detected, the safety device must initiate a suitable fault response.

12.3.4 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® CSB/CSL safety options.
- To meet the required safety level (PL/SIL), you must use suitable and appropriately qualified sensors and actuators and observe the permitted wiring diagrams (see chapter "Wiring diagrams") and information in the chapters "Safe digital inputs (F-DI.)" and "Safe digital output (F-DO00)". The permissible encoders are described in the chapter "Encoder requirements".

12.3.5 Encoder requirements

The EI7C FS built-in encoder is permitted for use with the CSL safety option. For more information on the EI7C FS built-in encoder, refer to the corresponding documentation.

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 fault for the actual position value, which is included in all position functions:

- EI7C FS: 7.5 °

Speed

The speed calculation for the EI7C FS built-in 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 error in the calculated speed value equals a maximum of 1% of the actual speed:

Error_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.

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Counting direction

For the process values to have identical signs also in the inverter, the encoder parameter *Counting direction (8708.6)* of the safety option CSL must be set as follows, depending on the inverter parameters *Direction of rotation reversal (8362.2)* and *Counting direction (8381.6)*:

Encoder parameters: • *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

Preventing the mechanical limit speed from being exceeded

To prevent the mechanical limit speed to be exceeded, the following switch-off thresholds are monitored by the CSL safety option.

Encoder type	**Switch-off threshold** **min^{-1}**	**Mechanical limit speed of the encoder** **min^{-1}**
EI7C FS	3800	5700

INFORMATION

Exceeding the switch-off threshold results in a fault message in the safety option with the fault response "STO" within 13 ms for EI7C FS. The fault response is executed by the STO circuit within another 2 ms.

Measures in the application must ensure that the mechanical limit speed is not reached during this time (13 ms).

12.3.6 Encoder cable 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:
  - 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).
  - 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 the following encoder signals must be in twisted pairs as follows:

    V_B and GND

    A+ and A-

    B+ and B-

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– 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.

12.3.7 Startup requirements

- To validate the implemented safety subfunctions, they must be documented and checked after successful startup (functional test).
- Observe the restrictions for safety subfunctions in chapter "Limitations". Non-safety-related parts and components that affect the result of the functional test (e.g. motor brake) must be deactivated, if necessary.
- For use of the device in safety-related applications, it is essential that you perform and document startup checks for the disconnecting device and the correct electrical connection.
- For the CSB and CSL 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 subfunction is shorter than the maximum permitted fault response time of the application. The maximum permitted 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.

12.3.8 Requirements for stopping in an emergency according to EN 60204-1 (emergency stop)

The CSB and CSL safety options, in combination with an emergency stop command device and the external control, are suitable for implementing an emergency stop according to 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.

12.3.9 Acceptance

The system manufacturer has to perform an overall evaluation for determining 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 subfunction.

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).

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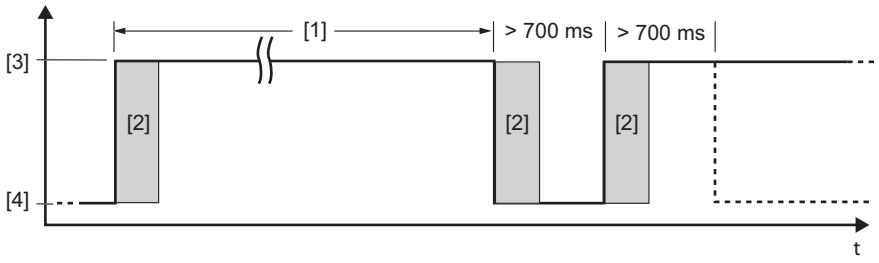
12.3.10 Operational requirements

- Operation is permitted only within the limits specified in the corresponding documentation. This applies to the CSO/CSB/CSL safety options as well as all connected devices.
- 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. This is why the STO input of the device must be requested with connected line voltage at least once every 12 months for PL d in accordance with ISO 13849-1 and SIL 2 IEC 61800-5-2 to achieve complete test coverage. Adhere to the following test procedure.



15205932683

[1] Maximum 12 months for PL d/SIL 2
[2] Internal diagnostics
[3] High: No STO
[4] Low: STO active

- To achieve complete test coverage after a device reset (e.g. after connecting the line voltage), the state transition (STO active → not active) can be started only > 700 ms later. The device signals "ready for operation" or "STO – Safe Torque Off" 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 line 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.

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12.4 Connection variants

12.4.1 General information

Generally, all the connection designs listed in this documentation are permitted for safety-relevant applications, insofar as the safety conditions arising from this documentation are satisfied. 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 are block diagrams whose only purpose is to show the safety subfunction(s) with the relevant components. For reasons of clarity, circuit-related measures that usually 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 installation errors.
- Detecting ground faults or short circuits in externally installed lines.
- Guaranteeing the required interference immunity against electromagnetic interference.

12.4.2 Requirements

Using 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 in accordance with chapters "Installation requirements" and "Requirements for the external safety controller".

All instructions by the manufacturer of the safety relay used in the particular application must be observed.

INFORMATION

If F_STO_P is connected to DC 24 V, and F_STO_M is connected to GND, STO is deactivated.

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. 30 m. Any 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 maximally permitted contact load of the safety device must be observed (see chapter "Technical data" > "Electronic data – Safety subfunctions").

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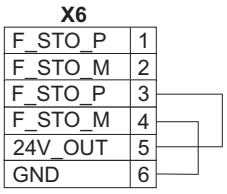
- You must comply with the permitted signal levels at the STO input and all other technical data of the device. The respective routing of the STO control cables and the voltage drop must be considered.
- Other requirements of the safety device manufacturer (such as protecting the output contacts against welding) must be strictly observed. The basic requirements for cable routing also apply.
- A calculation based on the technical data of the device must be performed separately for each case of group drive disconnection.
- A maximum of 20 devices may be used in a group disconnection. Due to the current carrying capacity, a maximum of 10 devices can be connected to one another via terminal X6.

12.4.3 Wiring diagrams

Delivery state

In the delivery state, the connections for safe disconnection at the STO terminal X6 are jumpered.



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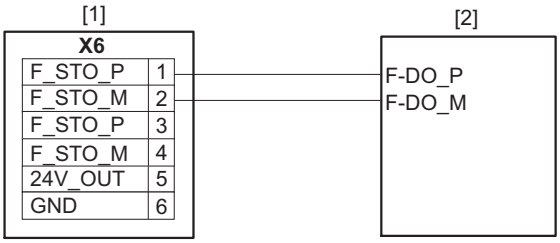
2-channel, sourcing/sinking output



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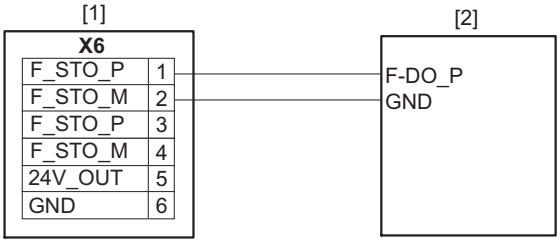
[1] STO terminal X6
[2] External safety device

1-channel, sourcing output



9007232451610251

[1] STO terminal X6
[2] External safety device

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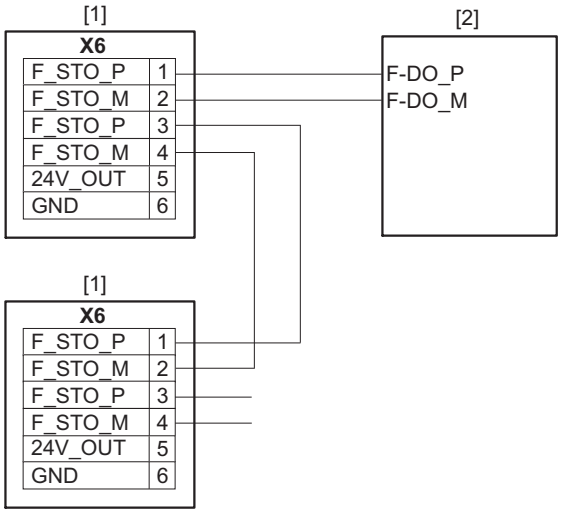
STO group disconnection, 2-channel, sourcing/sinking output



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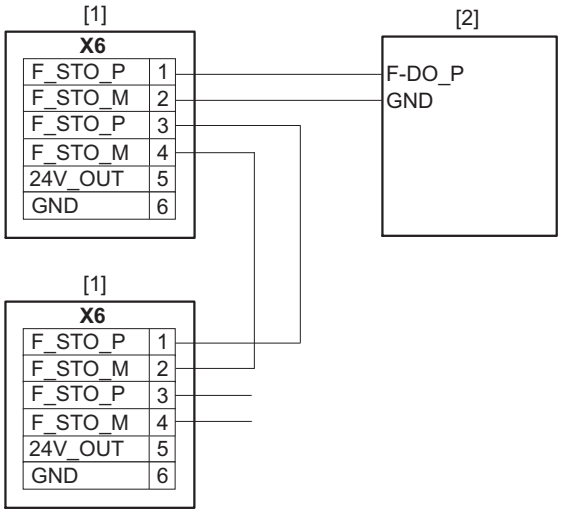
[1] STO terminal X6
[2] External safety controller

STO group disconnection, 1-channel, sourcing output



9007232451723915

[1] STO terminal X6
[2] External safety controller

12.4.4 Port X6 on the device

For detailed information on the X6 connection of the device, refer to chapter "Device structure of the inverter".

12.5 Electrical installation

12.5.1 Important information

⚠ WARNING

The external jumper plug X6 is plugged into MOVITRAC® advanced or a voltage is connected although a safety option is installed in MOVITRAC® advanced.

Severe or fatal injuries.

- If a safety option is installed in MOVITRAC® advanced, the X6 jumper plug has no function.

12.5.2 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.

12.5.3 Safe disconnection

If a MOVISAFE® CSB/CSL safety option is installed in MOVITRAC® advanced, the X6 connection has no function.

12.5.4 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.

Within the MOVISAFE® CSB/CSL safety options, signal processing of the safe digital inputs is performed in 2-channel mode. The safe digital inputs are therefore suitable for applications up to SIL 2 pursuant to EN 61508 and performance level d 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.

- 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 below. The range of connection variants might be limited depending on the sensor type. Note in addition the chapter "Requirements for external sensors and actuators" 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.

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Unassigned inputs need not be wired. An open input is always evaluated as a "0" signal. The safe state of the safe digital inputs is the output of "logical 0" on the associated process values.

The MOVISAFE® CSB/CSL safety options evaluate the digital inputs as follows.

Connection type 1-channel (NC contact):

Logic level input terminal F-DI.	Process value F-DI.
0	0
1	1

Connection type 2-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 2-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		

Discrepancy monitoring

The safety option carries out discrepancy time monitoring for input pairs in the 2-channel equivalent and 2-channel non-equivalent connection types. The discrepancy time monitoring verifies whether the two input signals are delivering error-free levels that match the switching state of the sensor. A deviation is tolerated for the parameterized discrepancy time. An input error 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.

The safety option carries out a switch test function for input pairs in the 2-channel equivalent and 2-channel non-equivalent connection types in order to verify the connected switch for correct switching behavior following a detected discrepancy error. 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 error so that the two input signals assume the required state for the switch test:

- Connection type; 2-channel equivalent
  - F-DI. = logical "0"
  - F-DI. + 1 = logical "0"
- Connection type; 2-channel non-equivalent
  - F-DI. = logical "0"
  - F-DI. + 1 = logical "1"

Only in this case can the discrepancy error be acknowledged; acknowledgment is otherwise impossible and the input remains in the discrepancy error.

Latching

A latching function is available for the safe digital inputs. This function can be activated via a parameter using the "Assist CS.." parameterization tool. Latching prevents a safety subfunction 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 latching safe digital input".
- Via a safe digital input that is parameterized as "Acknowledge latching 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 unlocking 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 latching function of an F-DI must not be activated:

- Acknowledge faults
- Acknowledge latched F-DI
- Muting
- Test mode

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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 error if the signal monitoring is active and the maximum duration has been exceeded.

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 *F-DI. Connection type* when connecting 2-channel sensors. There is no redundancy or discrepancy check with the "1-channel" setting.

Severe or fatal injuries.

- When connecting 2-channel sensors, the parameter *F-DI. connection type* must be set to "2-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.

Contact-equipped sensors (1-channel)

A 1-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 parameterization tool "Assist CS..":

- Choose the 1-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.

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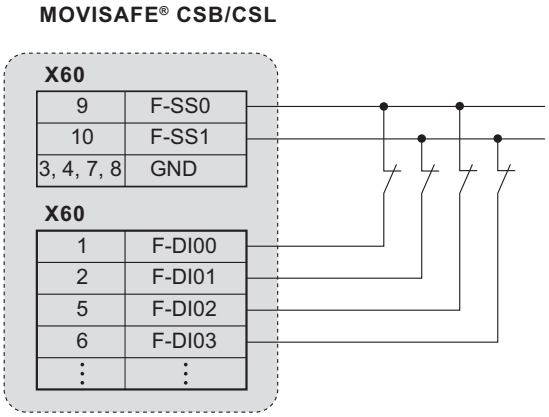
The following figure shows the MOVISAFE® CSB/CSL safety option with 1-channel sensors with contacts.



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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® CSB/CSL safety option **cannot** detect a short circuit between an F-SS. sensor supply 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® CSB/CSL safety option **cannot** detect crossfaults in the wiring. This configuration is **not** permitted for safe applications without further measures.

Severe or fatal injuries.

- A 1-channel sensor with crossfault monitoring can achieve a category 2 structure pursuant to EN ISO 13849-1.

Sensors with contact (2-channel)

A 2-channel contact-equipped sensor 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 "Terminal assignment".

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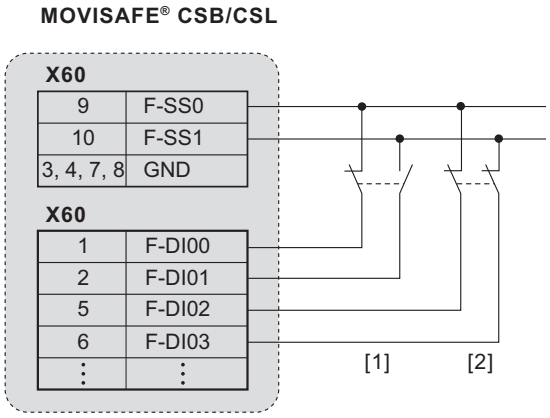
Settings in the parameterization tool "Assist CS..":

- Choose the 2-channel connection type.
- Activate or deactivate crossfault monitoring and pulsed sensor supply, depending on the safety requirements.

The following figure shows the MOVISAFE® CSB/CSL safety option with 2-channel sensors with contacts in the connection variants non-equivalent and equivalent.



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[1] 2-channel contact-equipped sensor in "non-equivalent" connection variant
[2] 2-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 2-channel, non-equivalent-switching sensor, the MOVISAFE® CSB/CSL safety option can detect a crossfault between the two digital inputs of an input pair.

⚠ WARNING

The MOVISAFE® CSB/CSL 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 2-channel, equivalent-switching sensor is used, the MOVISAFE® CSB/CSL safety option **cannot** detect crossfaults in the wiring.

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 (2-channel)

When connecting a 2-channel sensor with additional voltage supply, the voltage is supplied via an external DC 24 V power 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 2 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 "Terminal assignment".

Settings in the parameterization tool "Assist CS..":

- Choose the 2-channel connection type (equivalent/non-equivalent).
- Activate or deactivate the pulsed sensor supply, depending on the safety requirements.
- Parameterize the permitted discrepancy time between the two input signals of the sensor you are using.

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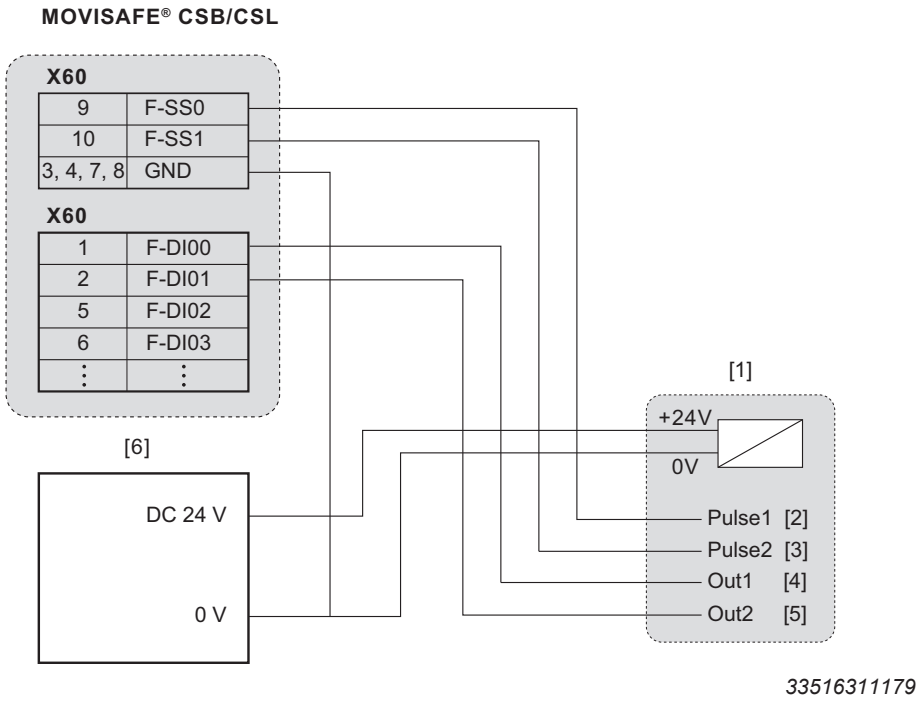
The following figure shows the MOVISAFE® CSB/CSL safety option with an active sensor (2-channel).



[1] Active 2-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® CSB/CSL 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, the MOVISAFE® CSB/CSL safety option **cannot** detect crossfaults in the wiring.

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, 2-channel)

When connecting an OSSD sensor, make sure that pulsed voltage supply is deactivated.

INFORMATION

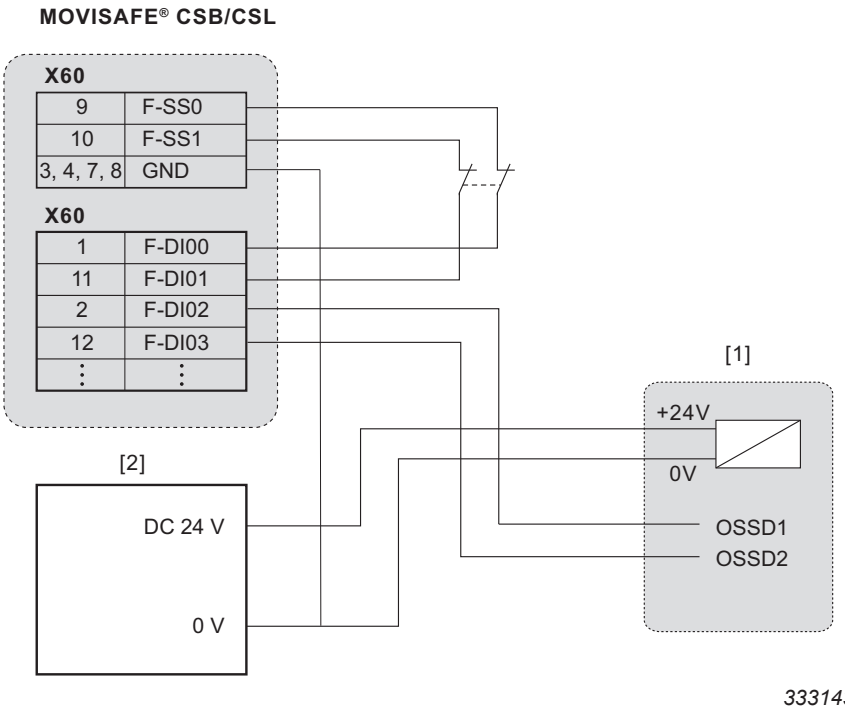
Deactivate the crossfault monitoring at the respective safe inputs of the OSSD-capable sensor technology.

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 sensors, the following two connection variants are possible (examples):

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 can be supplied via an external voltage supply.



[1] OSSD sensor (e.g. scanner or light grid)
[2] External DC 24 V voltage supply

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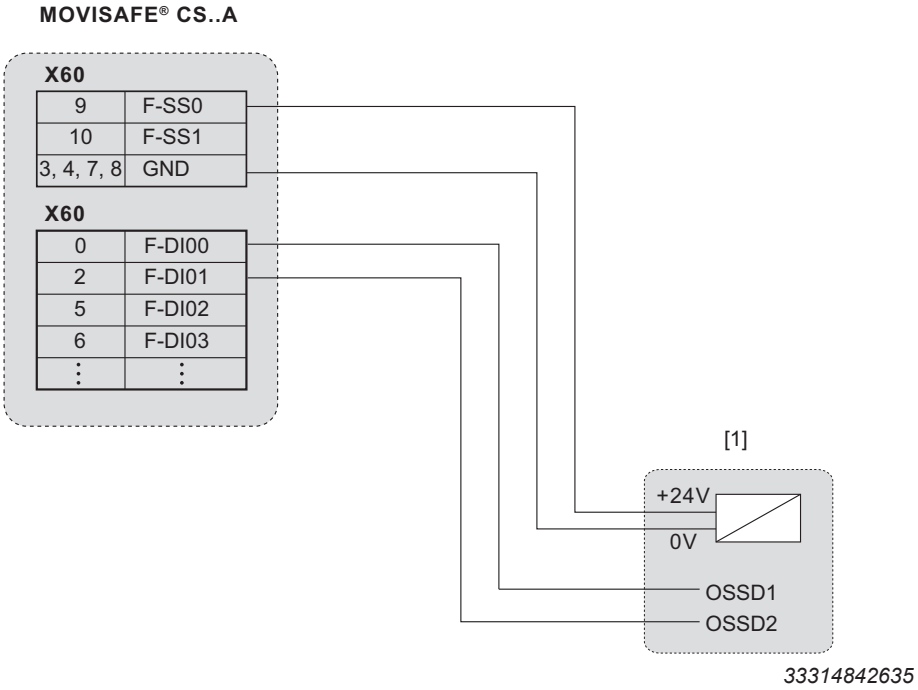
Variant 2

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 sensor (e.g. scanner or light grid)

INFORMATION

The performance level that can be achieved is mainly determined by the OSSD sensors used.

Use the external voltage supply for sensors that have a higher current consumption than the F-SS. sensor supply lines can provide.

12.5.5 Safe digital output (F-DO00)

General information

Signal processing of the safe digital output within the MOVISAFE® CSL safety option is performed in 2 channels. The safe digital output can therefore achieve SIL 2 pursuant to EN 61508 and performance level d 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 output F-DO00 via 2 channels, sourcing/sinking output, or via 1 channel, sourcing output.

The following functions can be assigned to the safe digital outputs:

- None

  Control of the safe digital output F-DO via the safe process data. If no safe process data has been activated, the safe digital output is open.

- STO

  F-DO behaves like F-DO_STO. Control via safe process data is not possible.

- SBC

  A brake is connected to the safe digital output. Control via safe process data is only possible indirectly via the STO safety subfunction. The basic device controls the brake when the STO safety subfunction is inactive. The SBC function can only be activated if a brake has been parameterized in the inverter in drive train 1.

Set the respective configuration during startup using the parameterization tool "Assist CS..".

1-channel, 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 permitted for the safe digital output F-DO00. The switching state of the safe digital output F-DO00 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 the safe digital output F-DO00. 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 blocks all outputs.

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 to units of the MOVI-C® modular system or one STO input and one safe SBM brake module.

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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" > "Safe digital outputs".

Inductive loads

Inductive loads are, for example, relays, contactors, and 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".

NOTICE

Operation of inductive loads without freewheeling diode can damage the MOVISAFE® CSL safety option.

Damage to the MOVISAFE® CSL safety option

- Inductive loads must always be connected via a freewheeling diode. The safe digital output of the MOVISAFE® CSL safety option does not have a freewheeling diode.
- Varistors and other overvoltage protection elements are not permitted.

Ohmic loads

Light bulbs are examples of ohmic loads.

- Lamps can be connected for display purposes. Note that an increased cold current flows when incandescent lamps or halogen lamps are switched on. The cold current must not exceed the permitted output current pursuant to EN 61131-2.

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.

For safe disconnection of MOVISAFE® CSL with maximally 10 MOVITRAC® advanced units, a test pulse duration of 1 ms is to be used.

Total capacitance must not exceed 1 µF with the maximum test pulse duration (5000 µs).

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For the 24 V switching output F-DO00, line diagnostics is always active regardless of the parameter setting.

⚠ WARNING

When line diagnostics is deactivated, the MOVISAFE® CSL safety option cannot detect a short circuit between a sourcing output (F-DO00_P) and the +24 V supply voltage, or between a sinking output (F-DO00_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-DO00_P) and the +24 V supply voltage.
- Or between a sinking output (F-DO00_M) and the reference potential.

The safe digital output F-DO00 is equipped with an optional wire break monitoring. The wire break monitoring checks whether the connected actuator is consuming a minimum current. If the actuator current is below the minimum value, the MOVISAFE® CSL 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").

Internal safe digital output F-DO_STO

The CSB/CSL safety options have one internal safe digital output F-DO_STO for switching the device-internal STO function of the inverter.

A maximum switching frequency of 10 Hz is permitted for the internal safe digital output F-DO_STO. The switching state of the internal safe digital output F-DO_STO must be stable for at least 2 seconds at least once within 60 seconds.

The internal safe digital output F-DO_STO is always operated in the connection type "2-channel sourcing" 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.

Actuator (2-channel, sourcing/sinking output)

[1] Actuator

Connect the actuator between F-DO00_P and F-DO00_M. The actuator can still be switched off in case of a crossfault in one of the connection lines, because the MOVISAFE® CSL safety option disconnects the sourcing and the sinking output terminal.

The input of the actuator must be isolated and without any connection to a reference potential. Inside the MOVISAFE® CSL safety option there is a switching element between F-DO00_M and the reference potential. With a non-isolated actuator, this switching element would be bridged. The redundancy of the sourcing and sinking output would no longer apply.

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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.

Fault detection using line diagnostics

The MOVISAFE® CSL safety option detects the following faults in the external wiring 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 reference as the MOVISAFE® CSL.
- Short circuit between the sinking output and the reference potential or a voltage < 6 V.

The MOVISAFE® CSL 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 output and sinking output
- Short circuit between sourcing output and GND
- Overload at every output
- Open circuit (with F-DO., if activated)

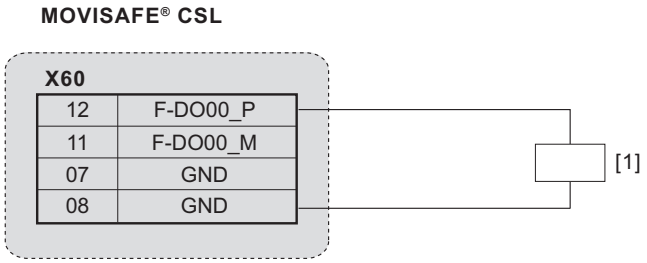
INFORMATION

In case of a short circuit, 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 drop that affects the operation of MOVITRAC® advanced and/or individual assemblies.

If the voltage supply is not stable enough, it may result in a reset and a restart of the MOVISAFE® CSL safety option.

- Make sure the voltage supply does not break down in the event of short circuits at the output.

Actuator (1-channel, sourcing output)



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[1] Actuator

Connect the actuator between F-DO00_P and the GND reference potential.

The actuator input need not be isolated.

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 138491.

The MOVISAFE® CSL safety option detects the following faults in the external wiring 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.

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The MOVISAFE® CSL safety option can also detect the following faults when the output is enabled:

- Short circuit between different sourcing outputs
- Short circuit between the P output and the reference potential 0 V
- Overload at every output
- Wire break F-DO., if activated)

⚠ WARNING

In case of a short circuit between the sourcing output and a 24 V supply voltage, the MOVISAFE® CSL safety option can no longer switch off the actuator and otherwise enter a safe state.

The line diagnostics function can detect the fault. However, the MOVISAFE® CSL 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

SEW-EURODRIVE recommends the sourcing/sinking output connection, if possible.

For safe outputs, refer also to details in the chapter "Technical data".

INFORMATION

In case of a short circuit, a high short-circuit current can occur for a short time. Depending on the 24 V supply voltage used, this can cause a voltage drop that affects the operation of MOVITRAC® advanced and/or individual assemblies.

If the voltage supply is not stable enough, it may result in a reset and a restart of the MOVISAFE® CSL safety option.

- Make sure the DC 24 V voltage supply does not break down in the event of short circuits at the output.

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12.5.6 Built-in encoder EI7C FS

Properties

The EI7C FS built-in encoder is a safe incremental encoder with 24 signal periods per revolution.

You may only use the EI7C FS built-in encoder in conjunction with the MOVISAFE® CSL safety option.

MOVISAFE® CSL can detect a minimum speed of 60 min^{-1} in connection with an EI7C FS built-in encoder.

MOVISAFE® CSL evaluates the signal of the EI7C FS built-in encoder.

MOVISAFE® CSL and the EI7C FS built-in encoder monitor the encoder signal. The MOVISAFE® CSL safety option detects interruptions and crossfaults in the encoder line. If a fault occurs, MOVISAFE® CSL activates the STO safety subfunction in MOVITRAC® advanced, and the torque is switched off safely.

Installation

Connect the EI7C FS built-in encoder to the X18 encoder interface of MOVITRAC® advanced via the encoder cable (part number 18118804) (see chapter "Encoder cable for EI7C FS").

⚠ 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® CSL safety option.
- You may only connect the encoder signals to the designated encoder interface of MOVITRAC® advanced. It is not permitted to connect other devices or assemblies.

INFORMATION

When connecting an EI7C FS built-in encoder to the MOVITRAC® advanced, the encoder cable must not carry a TF signal.

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12.6 Startup

12.6.1 Important information

⚠ WARNING

Unexpected and unwanted movement of the drive may occur during parameterization of the safety option.

Severe or fatal injuries.

- Before parameterization, make sure the system is in idle state.

INFORMATION

No safety subfunction is enabled in the delivery state of the safety option. The safety option permanently activates STO.

12.6.2 General startup instructions

INFORMATION

- The startup procedure for the standard functions of MOVITRAC® advanced is described in the "MOVITRAC® advanced inverter" operating instructions.
- If a brake is connected to the MOVITRAC® advanced, 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® CSB/CSL safety option and the safety subfunctions.
- Note the prerequisites for installation and operation of MOVISUITE®.
- The MOVISAFE® CSB and CSL safety options are supported by MOVISUITE® version 2.20 and higher.
- The CIP Safety™ safety protocol and the EDM diagnostics function are supported by the safety options as of firmware version 4.01, the basic unit firmware as of version 9.0 and MOVISUITE® as of version 2.30.
- Make sure that the PROFIsafe Slave Editor and the Assist CS.. parameterization tool are not used simultaneously in the system. The parameterization tool used must be open only once.
- 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 subfunction is active, the brake is controlled via the selected F-DO00. The safe digital output F-DO00 additionally performs the function of the brake control DB00. The DB00 connection on the basic device does not have to be used additionally. The SBM safe brake module (in size 3 or larger of MOVITRAC®advanced) can be used as a safe actuator for controlling the brake.

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12.6.3 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 how to set the parameters of the safety functions step-by-step.

1. Start **MOVISUITE®.**
2. **Scan the network.**

   Scan the network that contains your engineering interface to the MOVITRAC® 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 on the [Read safety key ID] button.
   - Check if the addressed device signals a read safety key ID operation via the "F-RUN" LED (see chapter "F-RUN LED"). This process may not take longer than a minute. After one minute, the device LED does not flash anymore and confirmation of the flash code is no longer accepted. In this case, restart the flash 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 is entered, the current parameterization of the CSB/CSL safety options 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.

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6. **Parameterization**

   Set the parameterization according to your safety-related requirements of your application.

   To parameterize the MOVISAFE® CSB/CSL safety options, 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 parameterization of the sensors and actuators are set in the "F-DI" and "F-DO" areas. The parameters of the safety subfunctions 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® CSB/CSL safety options.

   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® CSB/CSL safety options 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: Independent operation (without connection to safe communication)

The MOVISAFE® CSB/CSL safety options can be parameterized and operated without safe communication connection (independent operation).

Take into account the following constraints for this operating mode:

- The parameters of the MOVISAFE® CSB/CSL safety options are set using the "Assist CS.." parameterization tool.
- The safety-relevant acceptance of the system is supported by an acceptance protocol generated in the "Assist CS.." parameterization tool.

For startup, perform the following steps:

1. Parameterization of drive safety functions in the "Assist CS.." parameterization tool.
2. Startup of the standard functions.

   For detailed information, refer to chapter "Startup" in the "MOVITRAC® advanced“ operating instructions.
3. The acceptance is supported by the "Assist CS.." parameterization tool.

Variant 2: With connection to safe communication

The MOVISAFE® CSB/CSL safety options can be parameterized and operated (fieldbus connection) with connection to safe communication (e.g. PROFIsafe, Safety over EtherCAT®, CIP Safety™).

Take into account the following constraints for this operating mode:

- The parameters of the MOVISAFE® CSB/CSL safety options are set using the "Assist CS.." parameterization tool.
- The validation of the system is supported by an acceptance protocol generated in the "Assist CS.." parameterization tool.

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For startup, perform the following steps:

1. Parameterization of safety subfunctions in the "Assist CS.." parameterization tool.
2. Startup of the fieldbus and the higher-level F-PLC.
3. Startup of the standard functions.

   For detailed information, refer to chapter "Startup" in the "MOVITRAC® advanced“ operating instructions.
4. The acceptance is supported by the "Assist CS.." parameterization tool. When the acceptance protocol is created, the *ParCRCBus* parameter is updated and must be adjusted in the safety controller.

12.6.4 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 the safe digital output F-DO00, proceed as follows:

1. Select the safe digital output F-DO00. 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 the "Maximum duration test pulse A" display parameter (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 the "Maximum duration test pulse A" display parameter (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.

12.6.5 Starting up encoder systems

Encoder evaluation of the CSL safety option

The CSL safety option supports the EI7C FS safe encoder. The encoder used is considered a safe encoder. The following conditions are met:

- The encoder meets the prescribed safety requirements according to EN ISO 13849-1 and EN 62061.
- The encoder is approved for the use of speed/position-dependent safety subfunctions.

The safe encoder EI7C FS is connected to the standard inverter at X18.

In assist CS.., select the used encoder in the "Encoder" dialog via the "Encoder type" drop-down menu. All required encoder settings are applied. The parameter is marked with an "i" if the selection of the encoder differs from the set motor encoder in the drive train.

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12.6.6 Parameterizing safety subfunctions

Requirements

To use the safety subfunctions, certain process values must be available.

- For the SS1-r, SLS and SSM safety subfunctions, the process values "Speed" and "Acceleration" must be generated.
- The process value "position" is used for the SDI safety subfunction.
- All limit speeds of the safety subfunctions must be between the minimum speed and the maximum speed.

With the CSL safety option , the required process values are generated when the encoder is selected.

Proceed in this 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 transferred to the "assist CS.." parameterization tool.
3. Apply the encoder parameters to the safe configuration.
4. The safety subfunctions 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 subfunction with MOVISAFE® CSB/CSL

When the safety subfunction STO is activated, the internal safe digital output F-DO_STO and the safe digital output F-DO00, that are assigned to the STO function, are switched off. In the basic device, the function block *FCB01 Output stage inhibit* activated and the status STO is set.

If the *SBC enable* parameter is parameterized to "Yes", the safe digital output F-DO00 is switched off immediately when the STO function is activated if the SBC function is assigned to it. Once the time defined in the parameter *Brake application time* 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 subfunction, the internal safe digital output F-DO_STO and the safe digital output F-DO00 assigned to the STO/SBC function are switched off immediately.

If a limit value violation of a safety subfunction, 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 switched off.

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 disabled immediately.

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Activation

Number of instances: 1

The STO/SBC safety subfunction can be activated by 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/SBC safety subfunction is displayed in the following areas:

- MOVISAFE® CSB/CSL diagnostics, STO status
- Safe process input data (STO 1)

SS1-r safety subfunction with MOVISAFE® CSL

The SS1-r safety subfunction monitors the amount of motor deceleration within specified limits. The STO safety subfunction is activated if the motor speed drops below a specified limit value. When the limit speed is exceeded, the STO safety subfunction is activated without brake application delay.

If the SS1-r safety subfunction 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 subfunction is activated. The end speed of the speed ramp is the parameterized maximum speed.

If the *Ramp monitoring* parameter is set to "jerk-limited", monitoring of the jerk-limited speed ramp starts at the currently detected actual speed and the parameterized offset speed when the SS1-r safety subfunction is activated. The end speed of the speed value 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 final state of the STO function is activated.

If the *Inverter control* parameter is set to "active", activating the safety subfunction 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.

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 subfunction can be activated by the following sources:

- F-DI (function assignment)
- Safe process output data (SSx1, SSx2)

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Status

The status of the safety subfunction is displayed in the following areas:

- MOVISAFE® CSB/CSL diagnostics, speed function status
- Safe process input data (SSx1, SSx2)

Limit value violation

Due to the value limit violation, the STO safety subfunction is activated without brake application delay.

The value limit 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. The fault can only be acknowledged if the SSx function is deactivated. After fault acknowledgment, the final state of the SSx function is active immediately.

Encoder fault

If an encoder fault occurs, the STO safety subfunction 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.

SS1-t safety subfunction with MOVISAFE® CSB/CSL

The SS1-t safety subfunction monitors the parameterized time delay and triggers the STO safety subfunction once the time delay has elapsed.

If the parameter *Inverter control* is set to "active", activating the SS1-t safety subfunction 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 subfunction can be activated by the following sources:

- F-DI (function assignment)
- Safe process output data (SSx1, SSx2)

Status

The status of the safety subfunction is displayed in the following areas:

- MOVISAFE® CSB/CSL diagnostics, speed function status
- Safe process input data (SSx1, SSx2)

Limit value violation

Due to the value limit violation, the STO safety subfunction is activated without brake application delay.

The value limit 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. The fault can only be acknowledged if the SSx function is deactivated. After fault acknowledgment, the final state of the SSx function is active immediately.

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Encoder fault

If an encoder fault occurs, the STO safety subfunction 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.

SLS safety subfunction with MOVISAFE® CSL

The SLS safety subfunction 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 for exceeding the limit speed "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 parameterized to "linear", the monitoring of the linear speed ramp begins at the currently detected actual speed after the SLS safety subfunction 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 subfunction 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 parameterized to "No", the transition ramp begins at the lowest, previously monitored limit speed.

If no other SLS safety 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 finished.
- 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.

If the lowest monitored limit speed is lower than the parameterized limit speed of the last activated SLS, no transition ramp is calculated; 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 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.

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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 reduced 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 interpolated FCBs (e.g., FCB10).

Activation

Number of instances: 4

The SLS safety subfunction can be activated by 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:

- MOVISAFE® CSB/CSL diagnostics, speed function status
- Safe process input data (SLS1, SLS2, SLS3, SLS4)

Fault response

One of the following parameterized error responses can be activated:

- STO
- SSx 1
- SSx 2

  The fault response "SSx1" or "SSx2" can only be selected if the corresponding SSx instance is enabled.

SSM safety subfunction with MOVISAFE® CSL

The SSM function provides a safe output signal on the safe process data to indicate whether the motor speed is below a specified limit value.

A speed window can be activated for each instance of the SSM function. The speed window 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.

Activation

Number of instances: 4

The SSM function is permanently active.

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Status

If the limit values are exceeded, the status of the SSM safety subfunction switches to "0". If, taking into account the speed hysteresis, the actual speed is below the limit value, the status of the SSM safety subfunction changes back to "1". A parameterized speed filter delays the status change. An acknowledgment at standstill 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® CSL, speed function status
- Safe process input data (SSM1, SSM2, SSM3, SSM4)

Fault response

None.

Safety function SDI with MOVISAFE® CSL

The SDI function monitors the movement in blocked direction of rotation. The STO safety subfunction is activated when the configured tolerance is violated.

The function can be activated by means of a safe digital input F-DI via fast process data (SDI 1, SDI 2), or the function can be activated permanently if configured accordingly.

At the moment when the SDI safety subfunction is activated, the limit position is calculated based on the actual position detected by the encoder system and the parameters *Tolerance* and *Permitted direction of movement*. 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. This means the maximum distance to the actual position is the configured tolerance. The maximum speed must not be exceeded during 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 when a fault is acknowledged 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 when the fault is acknowledged. The SDI function does not monitor the speed.

Activation

Number of instances: 2

The SDI safety subfunction can be activated by the following sources:

- F-DI (function assignment)
- Safe process output data (SDI1, SDI2)
- Permanently activated

Status

If the SDI safety subfunction 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 subfunction is displayed in the following areas:

- MOVISAFE® CSL diagnostics, position function status
- Safe process input data (SDI1, SDI2)

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Fault response

When the limit position is exceeded, the STO safety subfunction is activated without brake application delay as fault response.

Encoder fault muting

⚠ WARNING

The active "Encoder fault muting" function deactivates the encoder-dependent safety subfunctions (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.
- Fault responses of all safety subfunctions are suppressed.
- The safe process data bit *F-PI_Muting_Enc-Err* is set.
- The safe process data bit *F-PI-ErrorState* remains set.
- The error code continues to be displayed.
- Activation of the STO safety subfunction is still possible without restriction. All other safety subfunctions become ineffective.

The "Encoder fault muting" function is automatically terminated in the following cases:

- Another fault is detected.
- A fault is acknowledged.
- 1 to 60 minutes after activation via F-DI or F-PA. The time is set 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.

Muting safe process output data (muting F-PO)

⚠ WARNING

An active "Muting F-PO" function deactivates encoder-dependent safety subfunctions (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 machinery.

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The "Muting safe process output data" function is activated by a 0 → 1 edge on 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.
- Fault responses of all safety subfunctions are suppressed.
- The *Encoder fault muting* bit is set in the safe process input data.
- Activating the STO safety subfunction 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 is detected.
- A fault is acknowledged.
- 1 to 60 minutes after activation via F-DI or F-PA. The time is set 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.

Test mode

The limit value violation of the safety subfunction SS1 can be tested when test mode is active.

The test mode suppresses the base device control (FCB selection).

Test mode is activated by a rising edge (0 → 1) at a safe digital input or via the safe process output data (F-PA).

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.

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 value violation, activation of STO safety subfunction).
- 5 minutes after activation.

EDM safety subfunction with MOVISAFE® CSL

The EDM (external device monitoring) safety subfunction diagnostics the connection of the external safe digital output F-DO00. The EDM function uses one or more safe F-DI digital inputs to monitor the external switching elements connected to a safe digital output. For this purpose, the auxiliary contacts of the external switching element are connected to the safe digital inputs F-DI of the CSL safety option.

The EDM function continuously 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 after the monitoring time has elapsed, the set fault response is triggered and the affected safe digital output F-DO is switched off. If the F-DO has the switching state "closed" and voltage is present, *the starting time T_1 (8705.32)* is used as the monitoring time. If the F-DO has the switching state "open" and no voltage is present at the F-DO, the *drop time T_2 (8705.33)* is used as

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the monitoring time. The monitoring times of the *start time T_1 (8705.32)* and the *drop time T_2 (8705.33)* must be greater than the input filter time. In addition, the discrepancy time in the monitoring time must be taken into account for a 2-channel safe digital input. The monitoring times for the *start time T_1 (8705.32)* and *the drop time T_2 (8705.33)* should be set to the same value. If different values are required for the application, the signal may only be changed again after the longer time has elapsed.

The monitoring time starts again each time the logical F-DO signal is changed. If the signal of the auxiliary contact bounces, the bounce must be filtered out via the *input filter time (8704.2)* of the F-DI. With constant control of the F-DO and after the monitoring time has elapsed, a level change of the input signal must lead to the execution of the error response.

An EDM instance can be enabled for the safe digital output F-DO:

- EDM 1 at F-DO 00

1 or 2 F-DI can be assigned to the EDM instance. The F-DI must not be parameterized in a locked manner. The auxiliary contacts of the external switching element can be designed as NO contact or typically as NC contact. It is the user's responsibility to ensure safety-related suitability.

The following tables show all fault-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: 1

The EDM instance is permanently activated with the enable.

Status

The status of the EDM safety subfunction 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".

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The status of the EDM safety subfunction is "0" if the EDM instance is not enabled or a fault response is performed.

Fault response

If the expected logical signals are not detected after the monitoring time has elapsed, the set fault response occurs:

- STO
- SSx1
- SSx2
- Only F-PI

  The fault response "F-PE" can only be executed if a safe protocol has been selected.

In addition to the set fault response, the EDM output is switched off.

The fault response is also performed when a fault is detected at one of the inputs assigned to the EDM function.

The fault response is executed until an acknowledgment is present.

12.6.7 Startup of the safety option at the safety protocol

Requirements for safe communication

Requirements regarding IT security regarding safety protocols must be checked in accordance with EN 61508-1, chapter "Hazard and risk analysis".

INFORMATION

Before making changes to the set safety protocol at the CSB/CSL safety option, you have to disconnect the F-master physically.

PROFIsafe safety protocol

INFORMATION

To control failsafe functions and for evaluation of the responses from the CSB/CSL safety option via PROFIsafe, the assignment of the individual bits within the safety protocol must be taken into account.

Requirements

- The CSB and CSL safety options support 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® CSB/CSL with PROFIsafe fieldbus connection via PROFINET:
  - TIA portal with STEP7 Safety option (for Siemens controllers)
  - Device description file of MOVITRAC® advanced or the MOVI-C® CONTROLLER in use.

    Download at www.sew-eurodrive.com. Always use the latest device description file.

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– To ensure that the safety option can be configured correctly in the device configuration, it must be ensured that the current version of the device description file is installed. The safety option must be configured in the device configuration using drag & drop from the hardware catalog into the slot of the SEW drive system that is enabled for this purpose. To establish fault-free PROFIsafe communication with the safety option, the following settings must be checked:
– F source address (F_Source_Add)
– F target 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

Besides parameterization of the safety subfunctions, the corresponding safety protocol and the target address must be set during startup.

Setting the safety protocol

The CSB/CSL safety options support multiple safety protocols. Select "PROFIsafe" under [F-communication] > [Configuration] in the "Assist CS.." parameterization tool.

Setting the destination address

The target address must be identical with the address set for the station 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.

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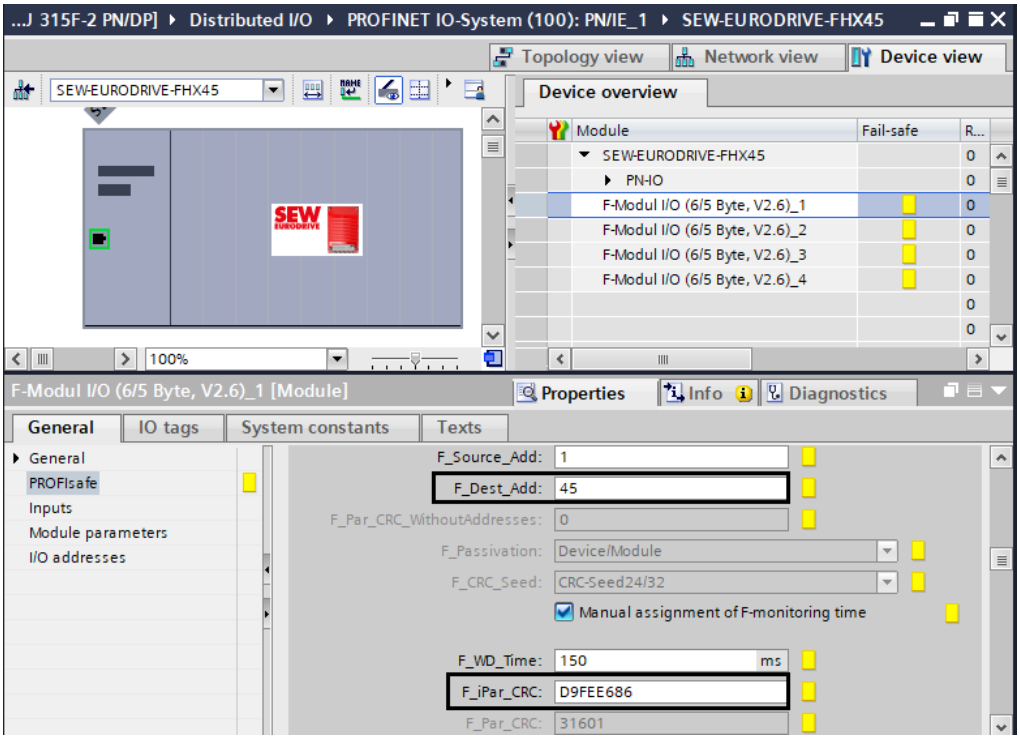
PROFIsafe host settings

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 CSB/CSL safety option.



9007227555231883

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 Safety over EtherCAT® (FSoE), the CSB/CSL safety options must be connected to a safety controller with FSoE master functionality.
- Firmware version 4.01 or higher is required for the CSB/CSL safety options.
- The basic unit firmware 9.0 or higher is required.
- MOVISUITE® engineering software version 2.30 or later (download from www.sew-eurodrive.com).
- Additional requirements when using MOVISAFE®CSB/CSL with fieldbus connection Safety over EtherCAT®:
  - ESI device description file (EtherCAT® XML file for MOVI-C®, MOVITRAC® advanced, MOVITRAC® advanced with CiA402). Download at www.sew-eurodrive.com. Always use the latest device description file.

Safety option settings

Besides parameterization of the safety subfunctions, the corresponding safety protocol and the F-addresses must be set during startup.

Setting the safety protocol

The CSB/CSL safety options support multiple safety protocols. To that end, select "FSoE" under [F-communication] > [Configuration].

Setting the F-address

The F-address must be identical to the address set for the slave in the FSoE master. Enter the correct F-address under [F-communication] > [Configuration] > [FSoE]. The used F-address must be unique within the FSoE network.

Setting the ParCRC bus

Transfer the ParCRC bus from the acceptance protocol 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 FSoE master SCU-1/EC in the SafePLC2 configuration tool

The standard inverters MOVITRAC ® advanced with the MOVISAFE ® CSB and CSL safety options are implemented and available as of version SafePLC2 1.7.1.8190.

Proceed as follows:

1. Start the SafePLC2 configuration tool.

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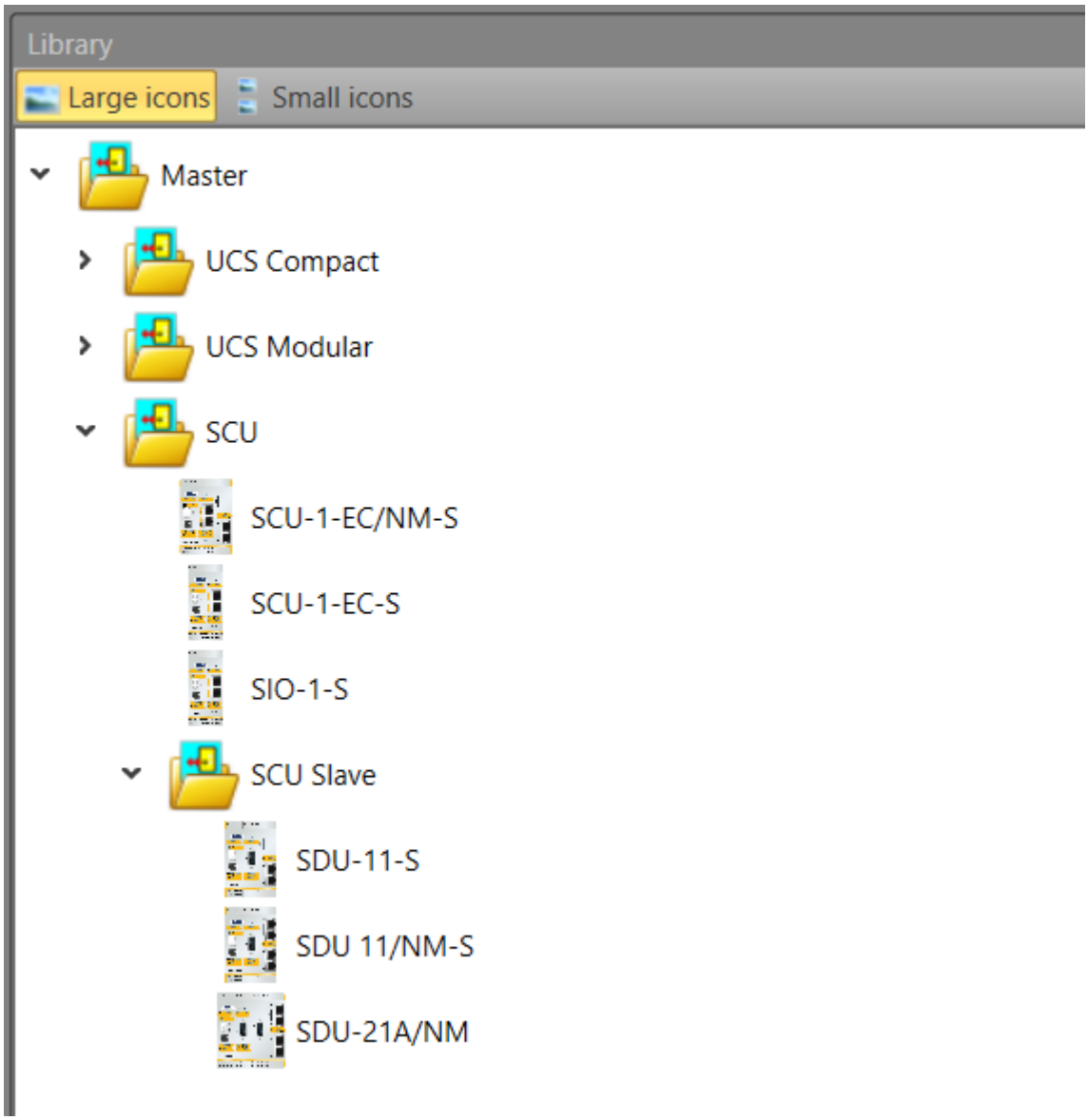
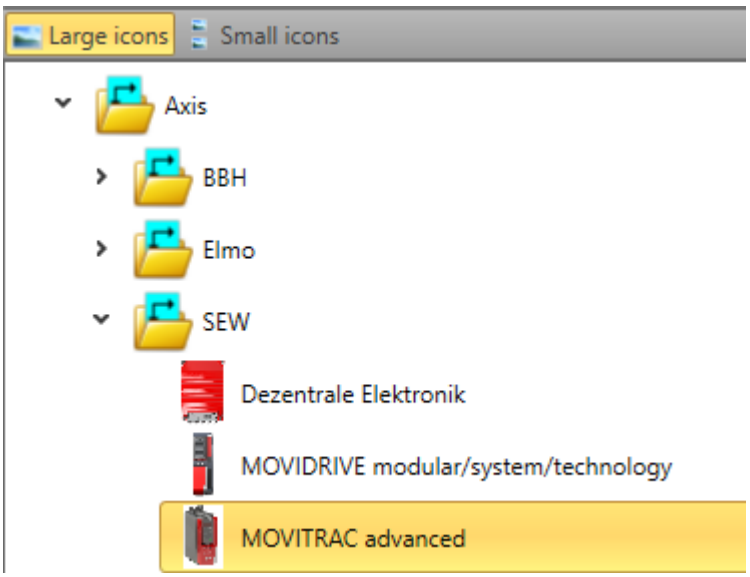
2. Integrate a corresponding FSoE master into the project.



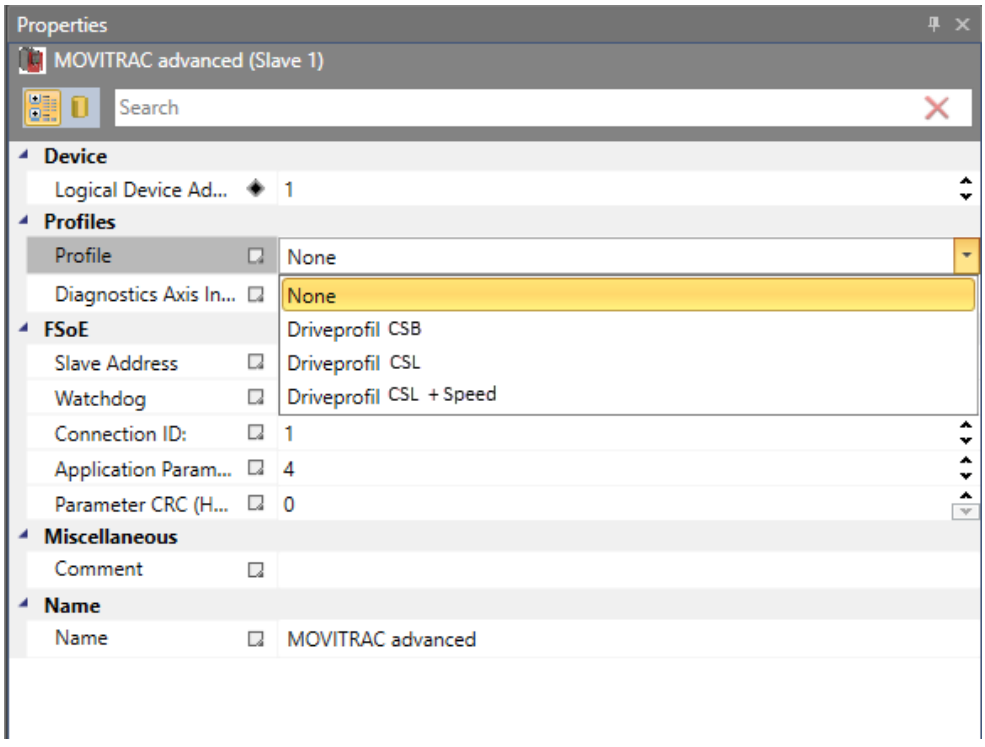
33765177227

3. The standard inverters MOVIDRIVE® advanced are available in the library under [Slaves] > [Axis]. Add a device into the project according to the wiring diagram.



36255924747

4. Select the profile matching the safety option used.



36255930635

5. Make the required settings.

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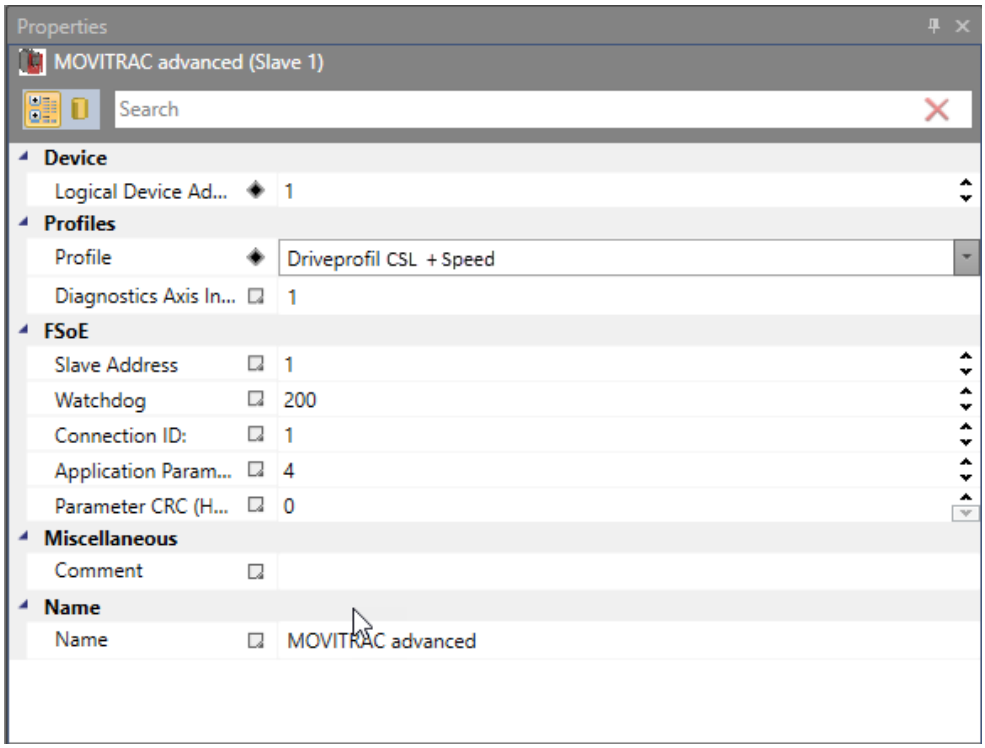

36256000523

- "Slave address" choice box

  Here you select the FSoE address specified in the "Assist CS.." parameterization tool in MOVISUITE®.

- "Watchdog" choice box

  Transmission is monitored via timers (watchdog) that are checked in each FSoE 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 safety option using the "Assist CS.." parameterization tool.

6. Call up the function diagram.

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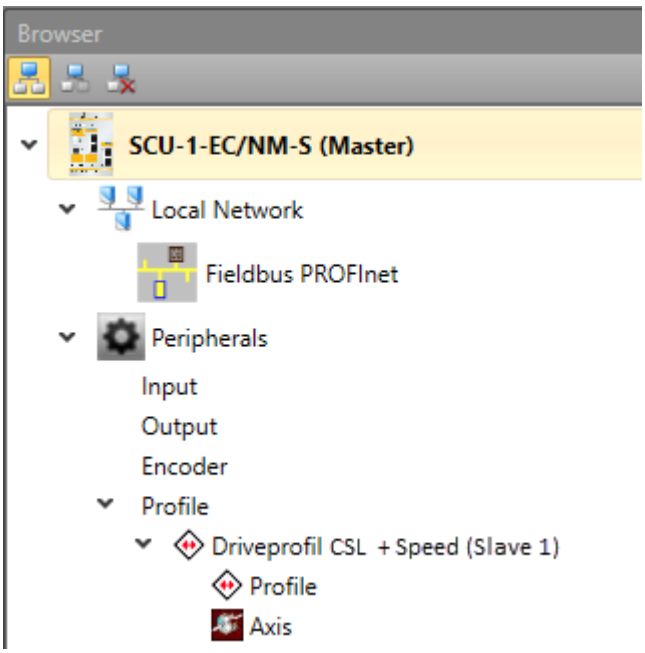
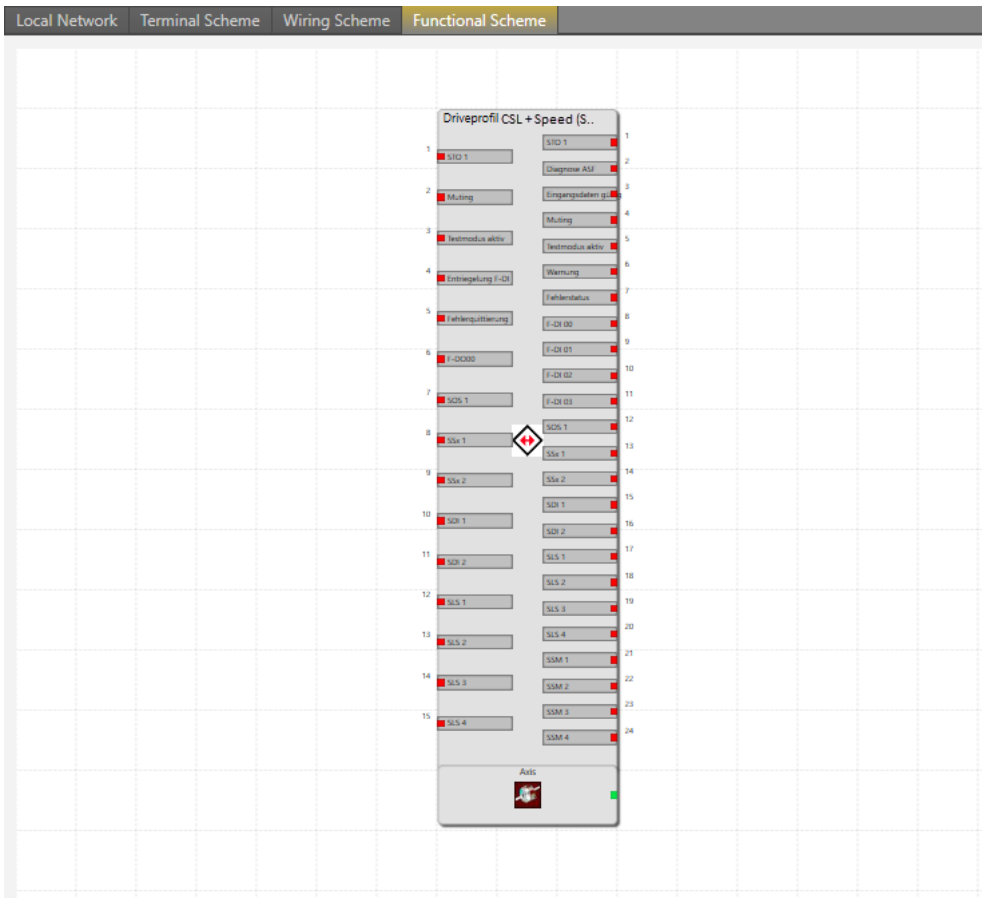
7. After creating the appropriate profile, transfer this profile to the function block diagram of the SafePLC2 configuration tool using the corresponding green arrow.



36256006795

8. In the function block diagram of the SafePLC2 configuration tool, you now have access to all available safety subfunctions of the safety option.



36256103435

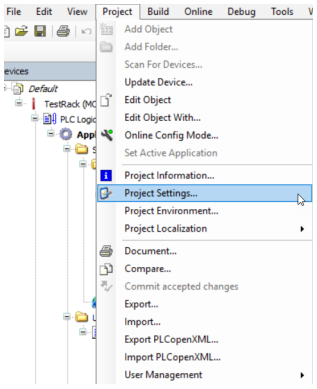
9. Load the configuration into the FSoE master module SCU.

Requirements in the IEC Editor

To being able to use FSoE communication between the FSoE master module SCU and the safety options in the inverter, it is necessary to activate this in the project settings in the IEC Editor.

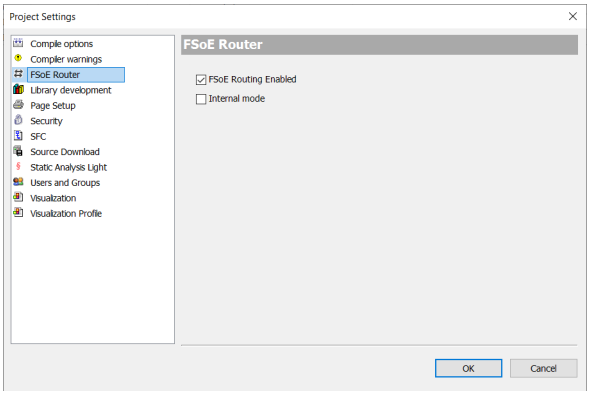
Proceed as follows:

1. Create or open a corresponding IEC project or MOVISUITE® project.
2. In the IEC Editor, click the [Project] > [Project Settings] menu item.



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.

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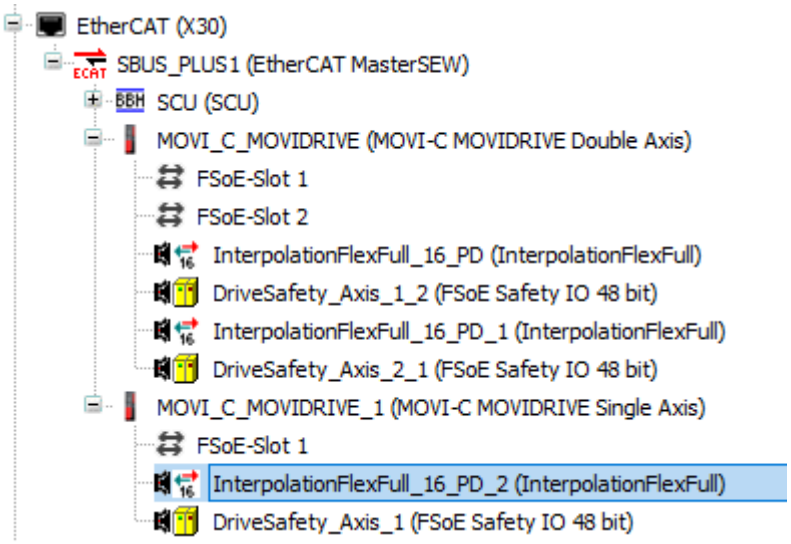

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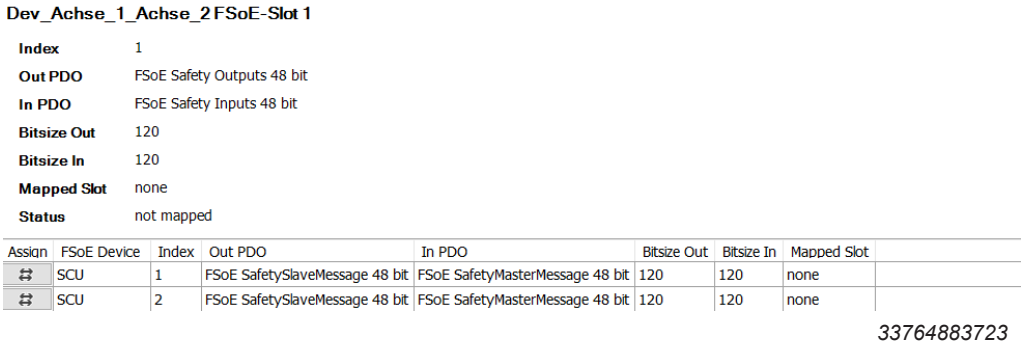
Proceed in this order:

1. Double-click an FSoE slot of the safety card option. The allocation window opens.



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 controller.
6. Create a boot project.
7. Restart the system.

CIP Safety™ safety protocol

Requirements

- For communication via CIP Safety™, the safety option must be connected to a fail-safe controller (F-originator) via Ethernet/IP™.
- To ensure that the safety option (target) can be configured correctly in the engineering tool of the fail-safe controller, it must be ensured that the current version of the electronic data sheet file (EDS file) is installed.
- Firmware version 4.01 or higher is required for the CS..A safety option.
- Firmware version 9.00 or higher is required for MOVITRAC® advanced.

- Firmware version 5.00 or higher is required for the CFE fieldbus option.
- MOVISUITE® engineering software version 2.30 or higher (download from www.sew-eurodrive.com).

General information

For startup, you must install the provided field test version of MOVISUITE®. Before installation, perform the following steps:

- Assign an IP address to the device.
- Establish a connection to the device from SEW-EURODRIVE.
- Make sure the Rockwell Controller is connected.

Taking communication via CIP Safety™ into operation

Generally, there are 2 ways to take communication via CIP Safety™ into operation:

1. With safety mechanisms: Assigning a safety target via CIP™
2. With safety mechanisms: Assigning a safety target via parameterization

Assigning a safety target via CIP

This chapter describes the basic procedure for starting up the CIP Safety™ communication if the connection parameters are assigned via CIP™ by the connection tool of the originator. Both parts – MOVISUITE® and RSLogix – are described.

MOVISUITE®

To configure the CIP Safety communication in MOVISUITE® using the integrated "Assist CS..." software tool, you must perform the following steps.

1. Scan the device.

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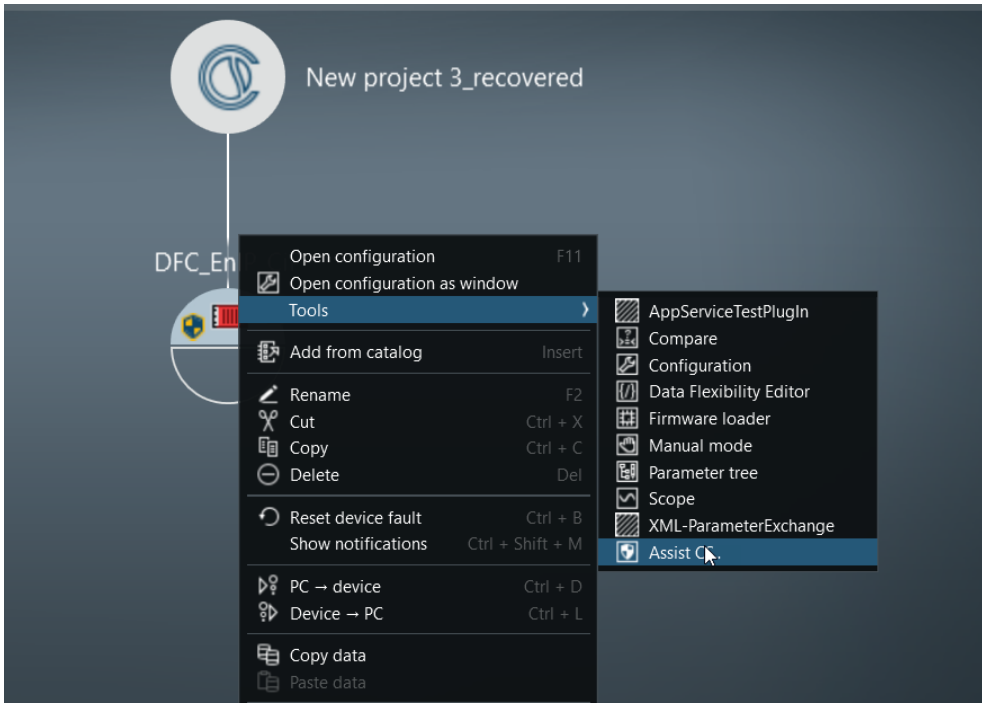
2. Right-click on the upper half of the device. In the "Tools" context menu, select the software tool "Assist CS..".



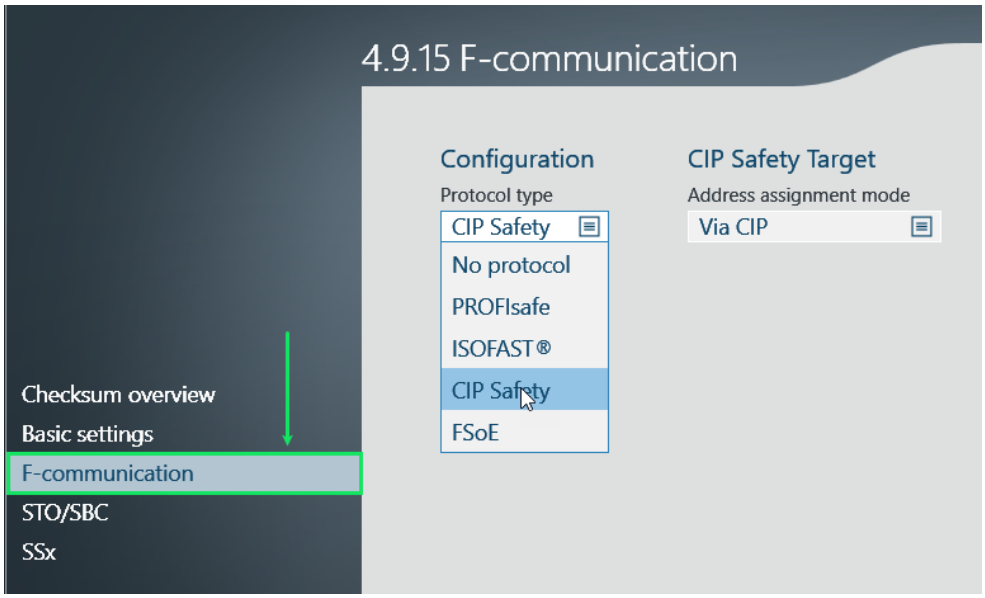
34912293259

3. Log in to the device. To do so, read out the ID of the safety key.

34912344587

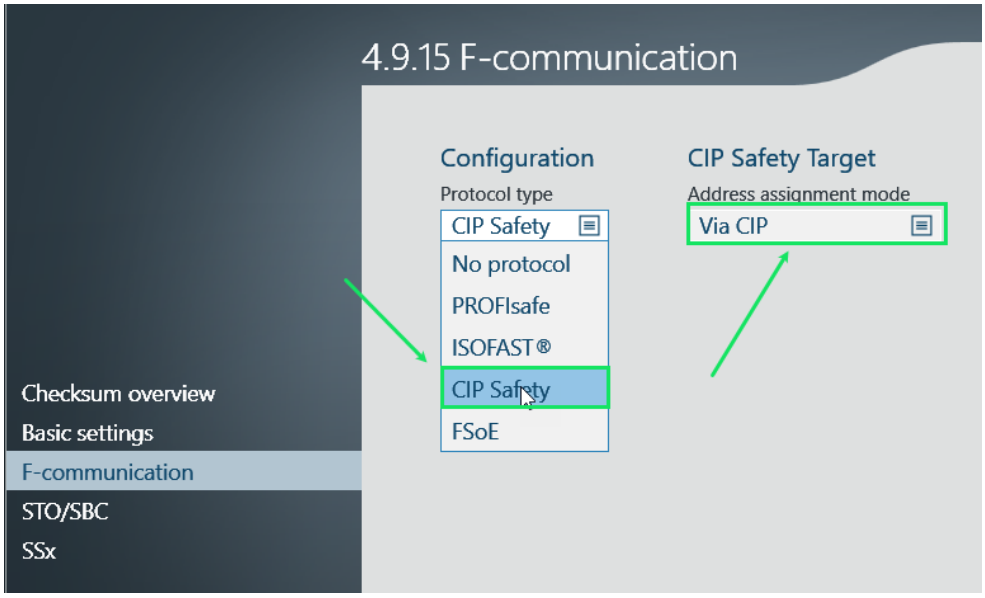
4. Make sure you are connected with the correct device. To do this, check the LED flashing pattern of the corresponding device.
5. Enter the password and log in. When logging in for the first time, you must enter the password twice.

6. To enable CIP safety communication, go to "F-communication".



34912504843

7. Select the entry "CIP Safety" under "Protocol type". Then set the mode for address assignment to "Via CIP".



34912509067

8. After completing the complete configuration, download the parameters to the safety option. Perform a transfer when the configuration is complete.

RSLogix Studio 5000

Configuration options

The following example configurations are possible:

- CSB safety option in the "Technology" profile variant
  - SafetyInput: 4 SINT

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  - SafetyOutput: 3 SINT
  - Exclusive Owner Input: 5 INT
  - Exclusive Owner Output: 5 INT

  In case more inputs/outputs are required for the Exclusive Owner Connection, up to 16 INT can be used.
- CSL safety option in the "Technology" profile variant
  - SafetyInput: 6 SINT
  - SafetyOutput: 5 SINT
  - Exclusive Owner Input: 5 INT
  - Exclusive Owner Output: 5 INT

  In case more inputs/outputs are required for the Exclusive Owner Connection, up to 16 INT can be used.
- CSL safety option in the "System" profile variant
  - SafetyInput: 12 SINT
  - SafetyOutput: 5 SINT
  - Exclusive Owner Input: 5 INT
  - Exclusive Owner Output: 5 INT

  In case more inputs/outputs are required for the Exclusive Owner Connection, up to 16 INT can be used.

configuration example

Perform the following steps to configure a safety device from SEW-EURODRIVE in RSLogix Studio 5000.

✓ Make sure you are using at least version 30 of the software.

✓ If necessary, configure and adjust the size of the safety inputs/outputs according to the safety option used and the communication profile (see chapter "Configuration options").

1. Start up the device as an Ethernet/IP™ station.

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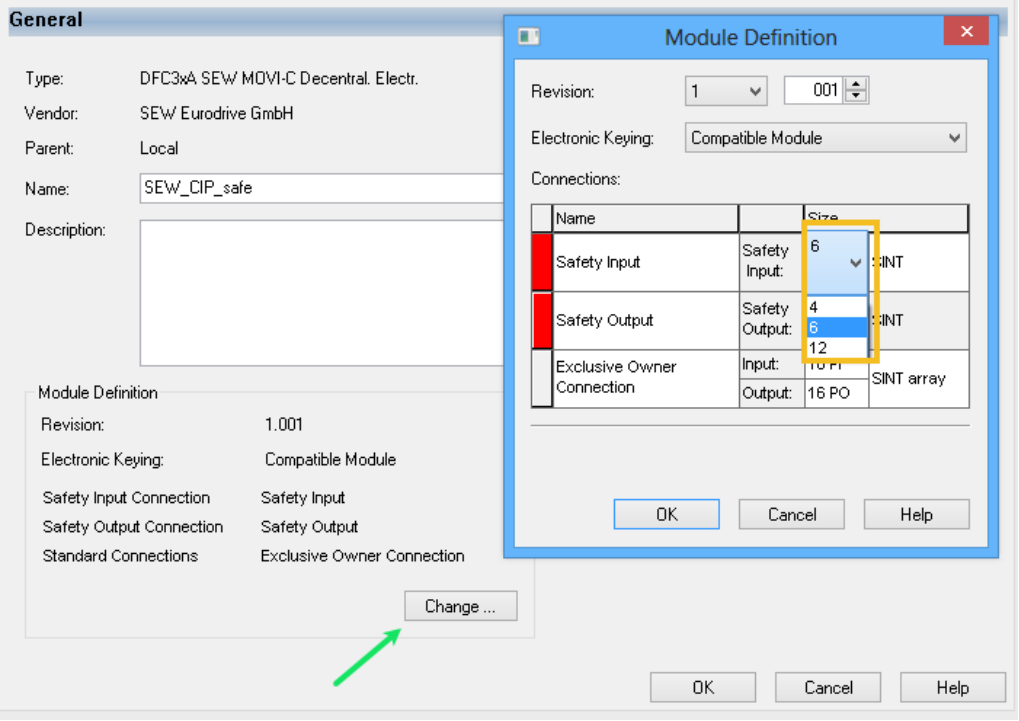
2. Check and configure the module definition by clicking "Change".



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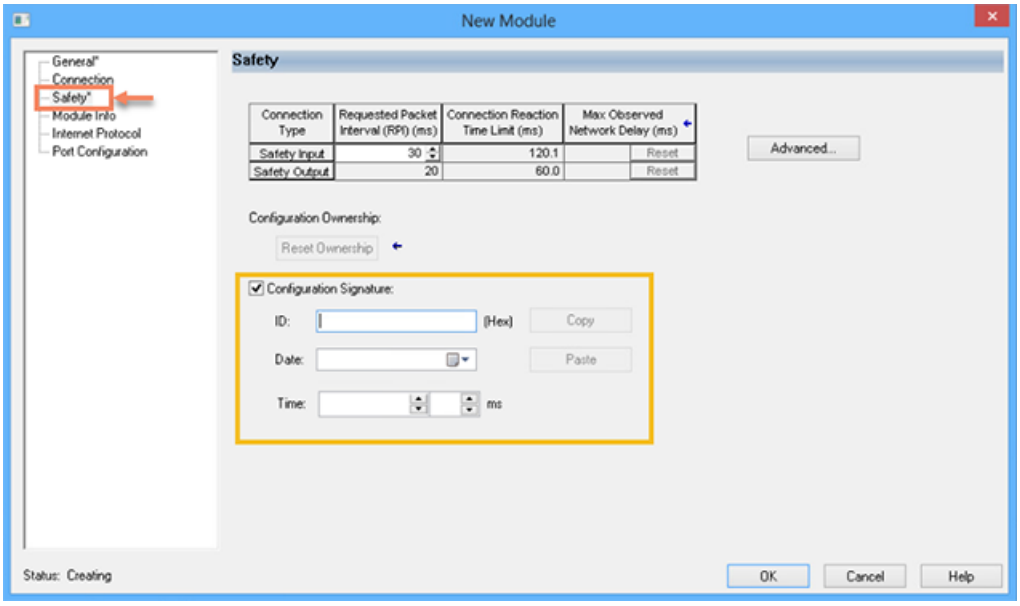
3. Go to the option "Safety" and enter the required information.



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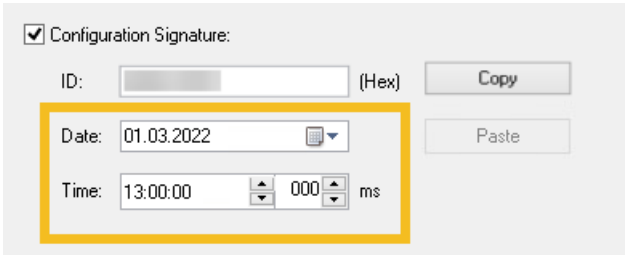
4. You must enter the following data under "Configuration Signature":



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- ID: Enter the value of the *check value SCCRC* parameter from MOVISUITE® here.
- Date: Select a specified date (reference: 01.03.2022 – dd.mm.yyyy).
- Time: Use the arrow keys to select a specified time stamp (reference: 13:00 UTC).
- Date: 01.03.2022, time: Depending on the respective time zone

  The system time of the computer on which the engineering tool of the originator is running is relevant.

The following UTC time stamps apply to CIP Safety:

UTC	Date	Time
-12	01.03.2022	00:00:00
-11	01.03.2022	01:00:00
-10	01.03.2022	02:00:00
-9	01.03.2022	03:00:00
-8	01.03.2022	04:00:00
-7	01.03.2022	05:00:00
-6	01.03.2022	06:00:00
-5	01.03.2022	07:00:00
-4	01.03.2022	08:00:00
-3	01.03.2022	09:00:00
-2	01.03.2022	10:00:00
-1	01.03.2022	11:00:00
0	01.03.2022	12:00:00
+1	01.03.2022	13:00:00
+2	01.03.2022	14:00:00
+3	01.03.2022	15:00:00
+4	01.03.2022	16:00:00
+5	01.03.2022	17:00:00
+6	01.03.2022	18:00:00
+7	01.03.2022	19:00:00
+8	01.03.2022	20:00:00
+9	01.03.2022	21:00:00
+10	01.03.2022	22:00:00

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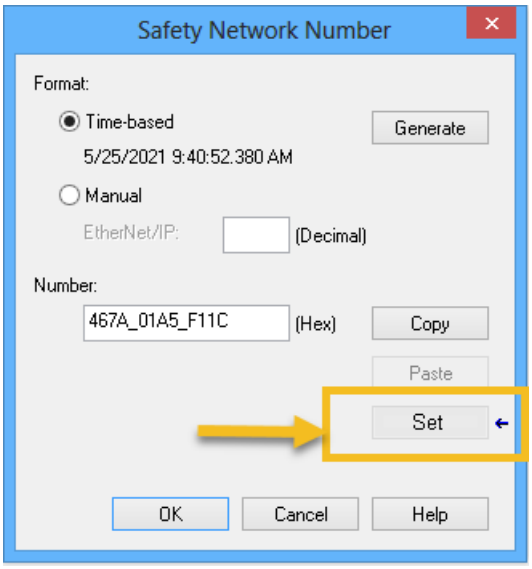
UTC	Date	Time
+11	02.03.2022	23:00:00
+12	02.03.2022	00:00:00
+12:45	02.03.2022	00:45:00
+13:00	02.03.2022	01:00:00
+13:45	02.03.2022	01:45:00
+14	02.03.2022	02:00:00

5. Make sure that you are in online mode of the RSLogix Studio 5000 engineering tool. Use the [Set] button to load the safety network number into the safety option and check the connection.



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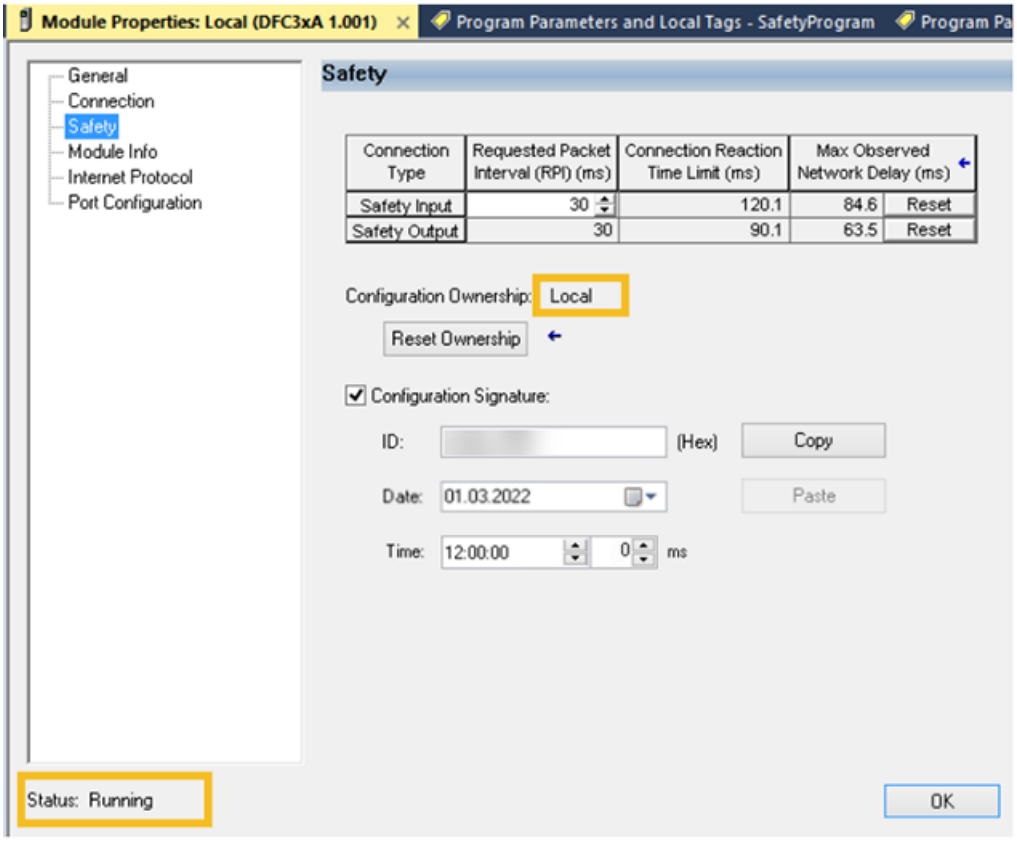
6. Check the connection.



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Assigning a safety target via parameterization

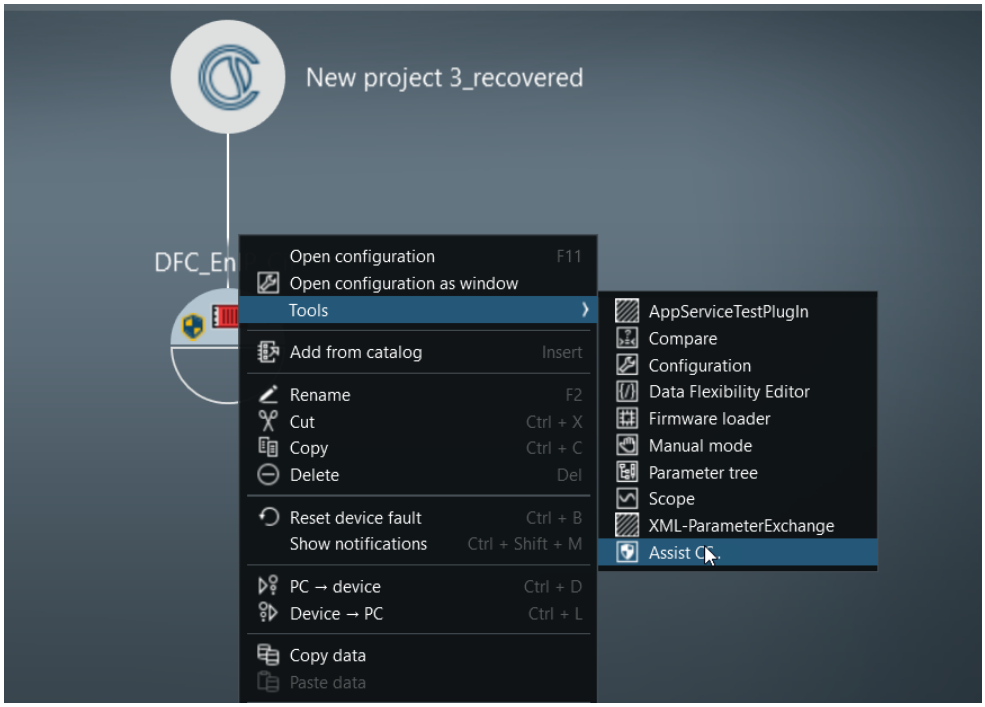
This chapter describes the basic procedure for starting up the CIP Safety communication when the safety target of CIP Safety is assigned by the master software via CIP. Both, MOVISUITE® and RSLogix are described.

MOVISUITE®

To configure the CIP Safety communication in MOVISUITE® using the integrated "Assist CS..." software tool, you must perform the following steps.

1. Scan the device.

2. Right-click on the upper half of the device. In the "Tools" context menu, select the software tool "Assist CS..".



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3. Log in to the device. To do so, read out the ID of the safety key.

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4. Make sure you are connected with the correct device. To do this, check the LED flashing pattern of the corresponding device.
5. Enter the password and log in. When logging in for the first time, you must enter the password twice.

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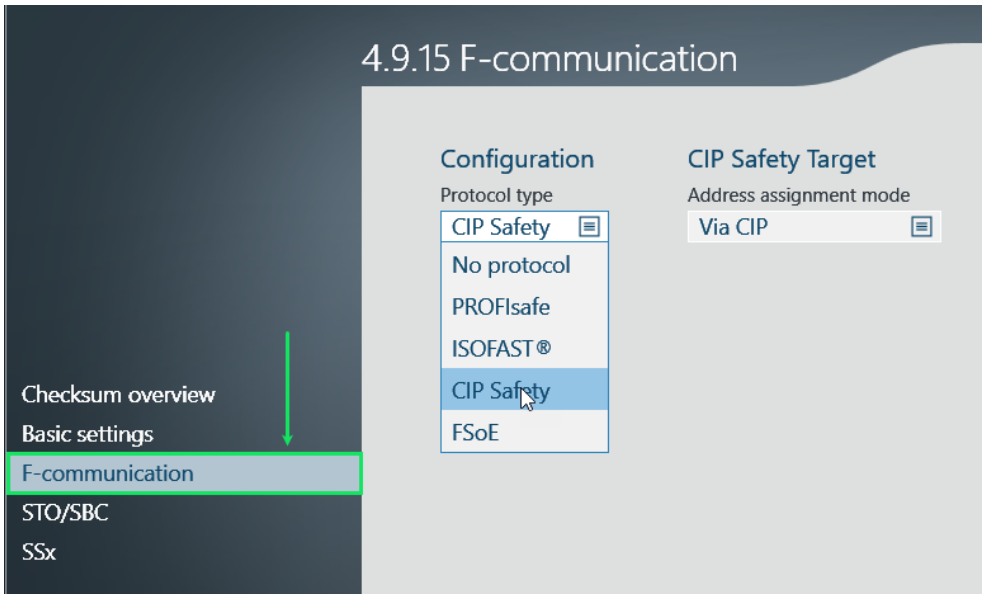
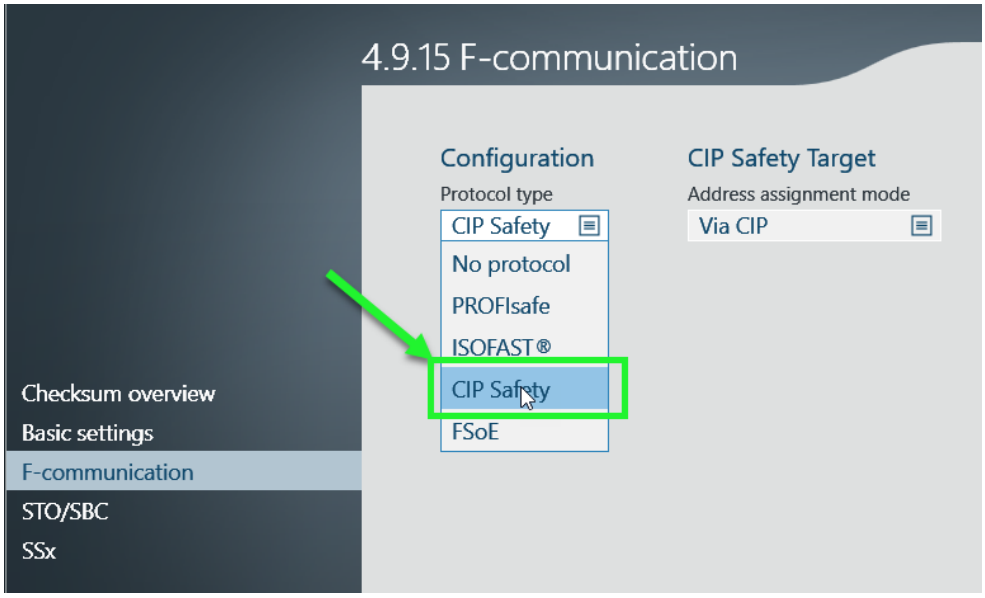
6. To enable CIP safety communication, go to "F-communication".



34912504843

7. Select the entry "CIP Safety" under "Protocol type".



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8. Then set the mode for address assignment ("Via parameterization").

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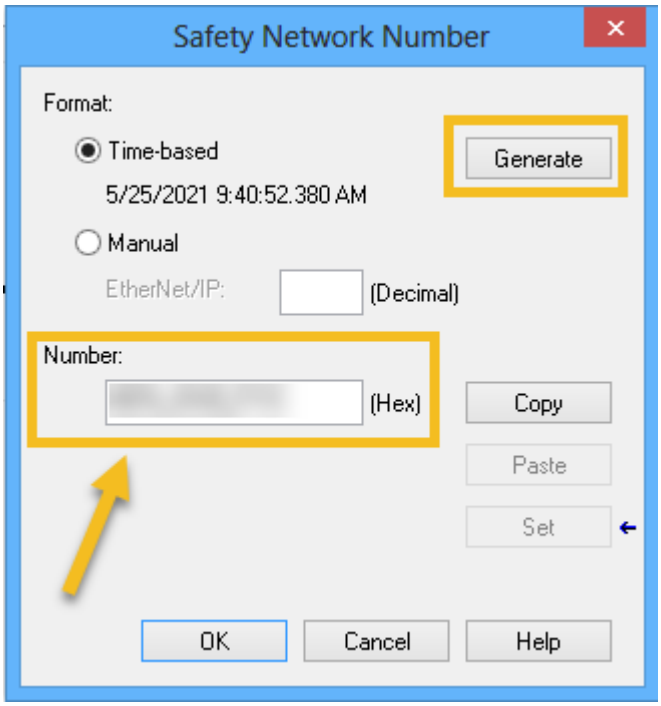
9. Enter the "Safety Network Number" that was generated in the RSLogix engineering tool.



34928239627

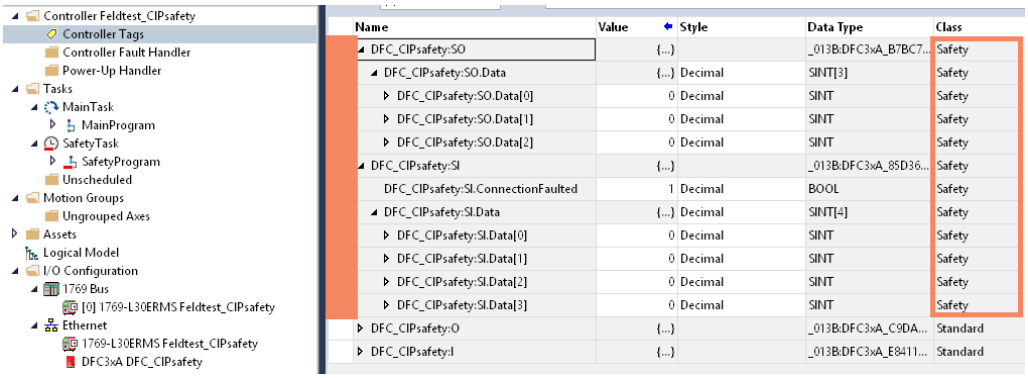
10. After completing the complete configuration, download the parameters to the safety option. Perform a transfer when the configuration is complete.

Programming in RSLogix Studio 5000

This chapter explains how to exchange data within the RSLogix Studio 5000 programming environment

Display of the device in "Controller Tags"

The device is displayed in the "Controller Tags" section as follows.



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Safety data and non-safety relevant data are displayed and marked accordingly (safety is highlighted here).

INFORMATION

The size of the process data interface with safety data corresponds to the number of bytes configured in the module configuration.

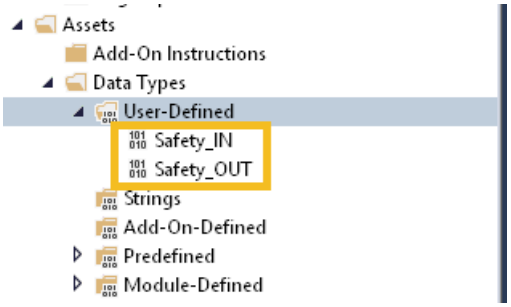
Data exchange in the program

To exchange data and information within the RSLogix program, user-defined data types and a mapping table must be configured and a small program must be written.

Creating user-defined data types

The data types to be created must correspond to the size of the safety process data interface. This may differ depending on the safety option. Safety option CSB is used here.

- Structure of the user-defined data



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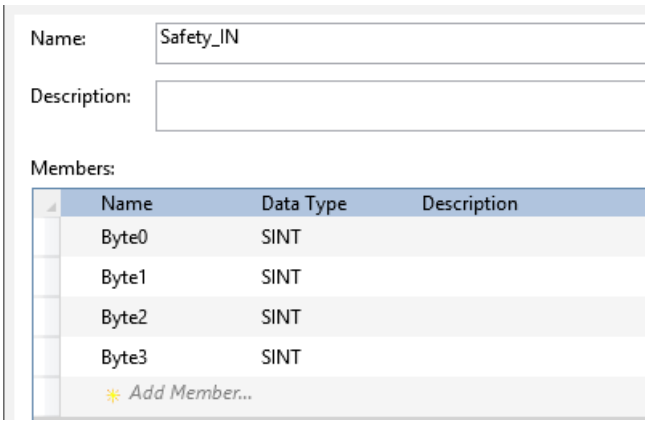
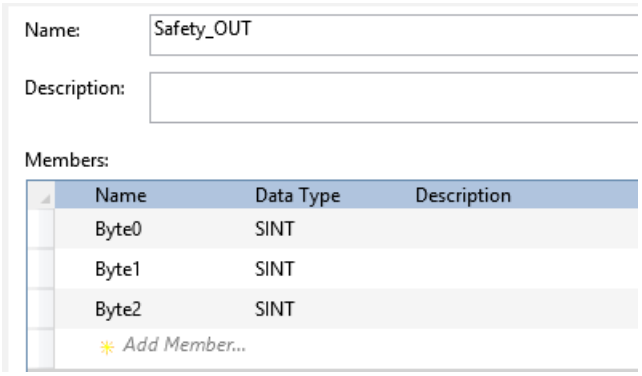
- Safety_IN (here: 4 bytes)



34928546059

- Safety_OUT (here: 3 bytes)



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The sizes of the IN and OUT structures must correspond to the real size of the interface.

INFORMATION

This is only a very brief example. It is also possible to split the interface into the individual bits of the interface.

Creating instances of user-defined data types

You must create instances to use the data types in the program. These must be marked as "Safety" or "Standard" depending on the use of the variables.

The variables/instances must be created in the "Controller Tags".

safeSafety_IN	Safety_IN	Safety
safeSafety_OUT	Safety_OUT	Safety
stdSafety_IN	Safety_IN	Standard
stfSafety_OUT	Safety_OUT	Standard

- Safety variables can only be changed in the safety program.
- Only default variables can be used in the non-safe program.

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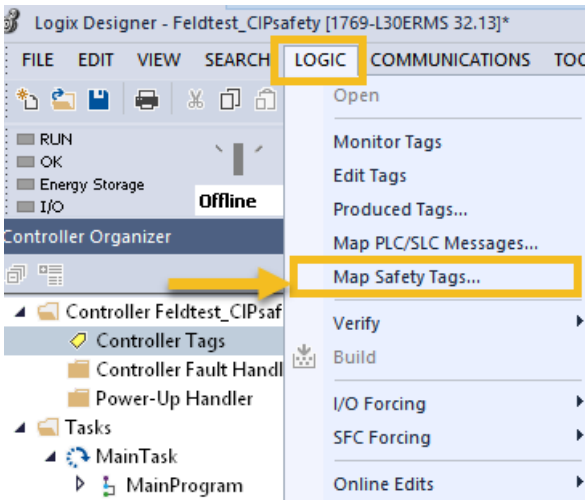
Data exchange between safety program and non-safe program

A mapping table must be created to exchange data between both program parts.



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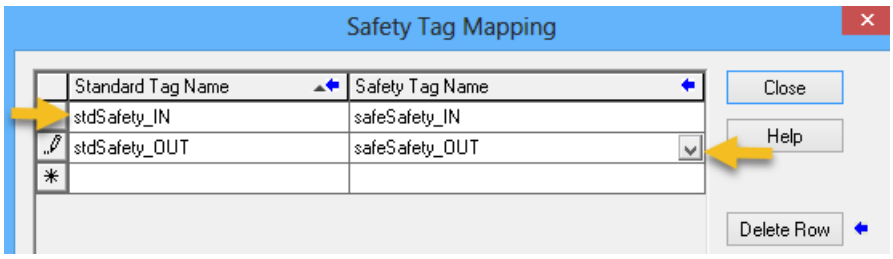
Here, the previously defined default and safety variables must be mapped to the corresponding variable.



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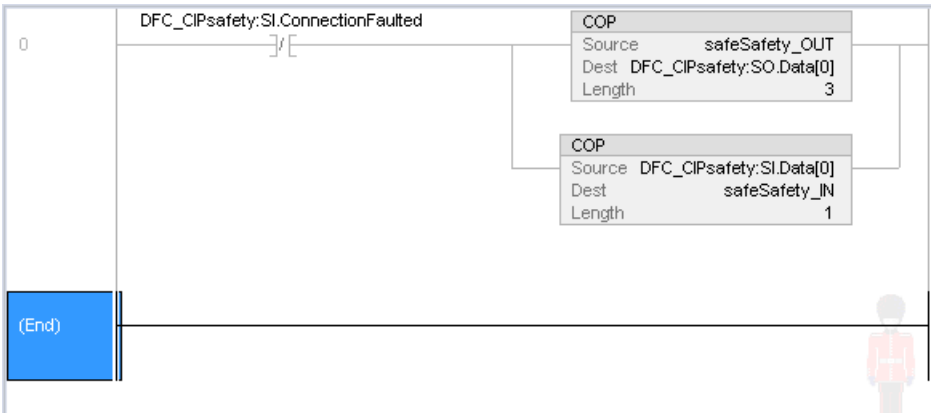
Creating a safety program

The following routine is the minimum realizable program that must be written to transfer information from the safety interface to the program or to send information from the program to the safety interface.



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12.6.8 Operating states

The MOVISAFE® CSB/CSL safety options distinguish between the following operating states:

- Operation
- Parameterization
- Safe state after critical error

"Operation" operating state

In the "Operation" operating state, the selected safety subfunctions are executed in accordance with the parameterization (see chapter "Safety subfunctions"). The safety subfunctions 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® CSB/CSL safety options are in the safe state and can be parameterized. If an error occurs during the parameterization, e.g., a violation of a plausibility rule, MOVISAFE® CSB/CSL remains in the “Parameterization” 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.

12.6.9 Safety-relevant acceptance

⚠ DANGER

Proper functioning of the safety subfunctions is not guaranteed without a safety-related acceptance.

Severe or fatal injuries.

- Verify every single safety subfunction.
- An individual acceptance report may be created only when the system is in idle state.

To ensure that safety subfunctions 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.. tool integrated in MOVISUITE® in the form of an acceptance protocol. 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 corresponding signatures ensure this by implementing 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 subfunctions. Verification is performed by means of the acceptance report.

For safety subfunctions that are not used, it is sufficient to verify whether the release is parameterized to "No".

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Procedure

After a successful startup, you must confirm that the data of the acceptance report matches the parameters on the safety option. You must identify and protocol the values parameterized for the user units, sensors and monitoring functions individually by performing a function test. 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 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 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

A fault injection test is not required for MOVISAFE® CS..A. 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 start point for a movement, e.g. a reference point.
2. Mark the start point.
3. In MOVISUITE®, read the positions of the encoders in the [Diagnostics] > [MOVISAFE® CS..A] > [Encoders] 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 Dialog [Diagnostics] > [MOVISAFE® CS..] > [Encoder], 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

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- 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 the "Create acceptance report" chapter.
2. If both values have been calculated correctly, the following is accepted:
   - User-defined 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-defined 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 result is used to verify internal normalizations and is 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

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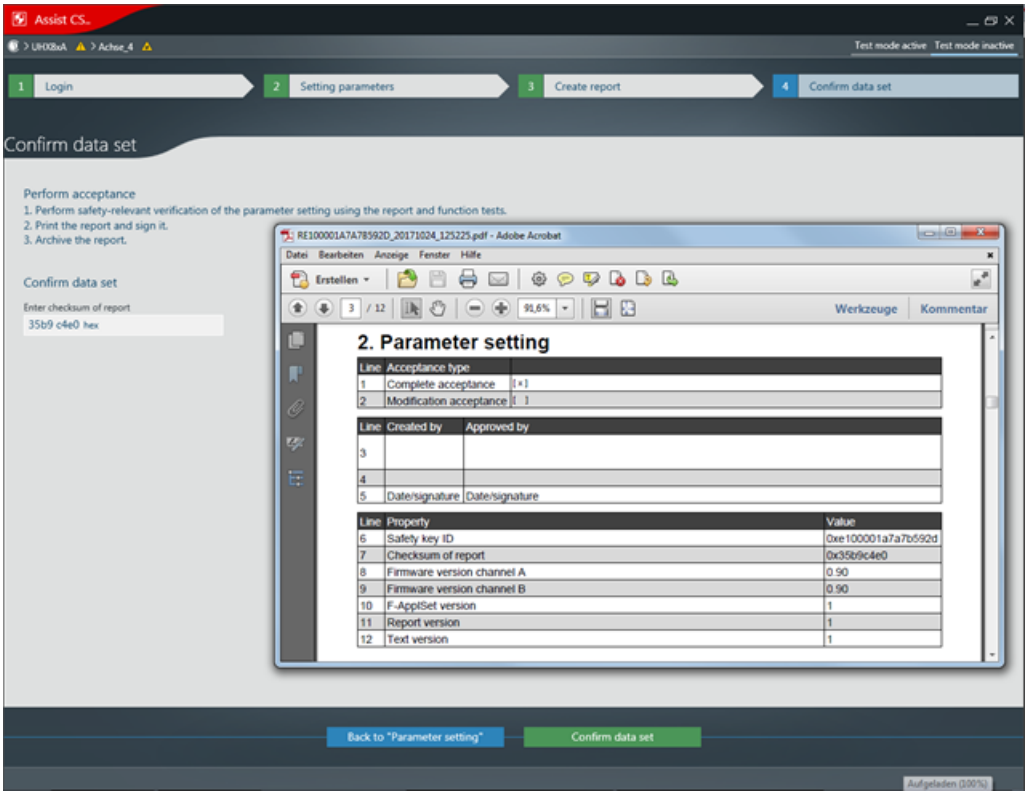
Publishing acceptance

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).



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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.

12.6.10 Restoring the delivery state

⚠ WARNING

Unexpected and unwanted movement of the drive can occur 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 delivery state.

No safety subfunction is enabled in the delivery state of the safety option. The safety option permanently activates STO.

The parameter setting for safe communication is not reset automatically. To do so, set the protocol to "No protocol" in the "Assist CS.." parameterization tool.

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®. After this, the data set is valid and behaves like after delivery. "Accepted" is not set.

INFORMATION

The parameters of the F-communication are not reset.

12.6.11 Reset the password

Proceed as follows:

1. You can find the option-specific master password on the small system nameplate behind the front flap of the device.
2. Open the "Assist CS.." parameterization tool. To open the main menu, click the red "Assist CS.." tile in the left upper corner.
3. Select the menu item "Change password". In the "Old password" edit box, enter the master password.
4. In the edit boxes "New password" and "Enter new password again", enter the new password. Confirm your entries.

   You can now parameterize the safety option in Assist CS...

12.6.12 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.

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12.7 Operation

12.7.1 Hazard caused by coasting of the drive

⚠ WARNING

Hazard caused by coasting of the drive. Without 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.

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12.8 Data exchange with higher-level controller

12.8.1 Introduction

MOVITRAC® advanced with integrated CSB/CSL safety option support parallel operation of standard and safe communication via a bus system or network. Safe communication is possible via PROFIsafe, Safety over EtherCAT®, and CIP Safety™.

The safe PROFIsafe communication can be carried out via PROFINET. To that end, the basic device with integrated safety option via PROFINET must be connected to a fail-safe controller (F-PLC).

Safe communication is possible via EtherCAT® with Safety over EtherCAT®. To that end, the basic device in the variant DSI with integrated safety option must be connected to a fail-safe controller (F-PLC) via EtherCAT®/SBus^{PLUS}.

Safe CIP Safety™ communication is possible via EtherNet/IP™. To that end, the basic device with integrated safety option directly via EtherNet/IP™ must be connected to a fail-safe controller (F-PLC).

To control safety subfunctions and to evaluate the responses from the safety option via PROFIsafe, Safety over EtherCAT® or CIP Safety™ take into account the assignment of the individual bits in the F-process input/output data.

In the "System" profile variant, an additional 16 bit and a 32 bit process value are transferred. The safe speed can be transferred via the process values.

12.8.2 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 of the MOVITRAC® advanced series with integrated CSB/CSL safety options.

MOVI-C® CONTROLLERs support a different number of devices.

MOVI-C® CONTROLLER	Number of safety options	Note
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 of all safe process data of the safety options)
UHX85-R	8	• Firmware V2.0 release 201703xxxx (March 2017) and older. • Object in the hardware catalog of the TIA portal: UHX84-R/UHX85-R V2.0

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MOVI-C® CONTROLLER	Number of safety options	Note
UHX85-R	24	Maximum of 24 safety options or maximum of 432 bytes of safe process data (sum 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

The following number of bytes is to be taken into account when routing:

- CSB: 14 bytes
- CSL in the "Technology" profile variant: 18 bytes
- CSL 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, the CSB safety option requires a total of 8 bytes for input data and 7 bytes for output data for the PROFIsafe telegram part and occupies 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) is required for data exchange via PROFIsafe with the CSB safety option.

For safe communication with "Technology" profile variant, the CSL safety options needs a total of 10 bytes for input data and 9 bytes for output data for the PROFIsafe telegram part and occupies 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 CSL safety option.

For safe communication with "System" profile variant, the CSL safety option needs a total of 16 bytes for input data and 9 bytes for output data for the PROFIsafe telegram part and occupies 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) is required for data exchange via PROFIsafe with the CSL safety option.

The remaining 4 bytes are required for the telegram backup according to the PROFIsafe specification.

PROFIsafe version 2.6

For safe communication, the CSB safety option requires a total of 9 bytes for input data and 8 bytes for output data for the PROFIsafe telegram part and occupies 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) 2.6 is required for data exchange via PROFIsafe with the CSB safety option.

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For safe communication with "Technology" profile variant, the CSL safety options needs a total of 11 bytes for input data and 10 bytes for output data for the PROFIsafe telegram part and occupies 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) 2.6 is required for data exchange via PROFIsafe with the CSL safety option.

For safe communication with "System" profile variant, the CSL safety option needs a total of 17 bytes for input data and 10 bytes for output data for the PROFIsafe telegram part and occupies 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) 2.6 is required for data exchange via PROFIsafe with the CSL safety option.

The remaining 5 bytes are required for the telegram backup according to the PROFIsafe specification.

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.
- 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 the user an interface in which he or she 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).

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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 reparameterization (not supported by the safety option).	0
Variables that the user can read.	DBX2.0	"F00008_198" (PASS-OUT)	BOOL	Run passivation	1
	DBX2.1	"F00008_198" (QBAD)	BOOL	1: Substitute values are output	1
	DBX2.2	"F00008_198" (ACK_REQ)	BOOL	1: Acknowledgment required for reintegration	0
	DBX2.3	"F00008_198" (IPAR_OK)	BOOL	Variable for reparameterization (not supported by the safety option).	0
	DBB3	"F00008_198" (DIAG)	BYTE	Service information	-

PASS_ON

With the PASS_ON variable, you can activate a passivation of the safety option. Passivation of the F-periphery takes place, provided that PASS_ON = "1".

ACK_NEC

After resolving an error, the safety option is reintegrated depending on the setting of the variable ACK_NEC.

- ACK_NEC = 0: Automatic reintegration.
- ACK_NEC = 1: Automatic reintegration following acknowledgment by the user.

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⚠ WARNING

Impermissible parameterization of the variable *ACK_NEC = 0*.

Severe or fatal injuries.

- The parameterization of the variable *ACK_NEC = 0* is permitted only if automatic reintegration is safe for the respective process.
- 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 only possible if 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, the F control system sets *ACK_REQ* to "0".

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 passivation. Substitute values are output.

DIAG — For service information purposes, the variable *DIAG* supplies non-failsafe information about faults that have occurred in the F control system. For further information, refer to the relevant F control system manual.

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.

12.8.3 Safety over EtherCAT® safety protocol

- For data exchange via Safety over EtherCAT® (FSoE) between the CSB/CSL safety options and a higher-level controller, the safety option in the "Technology" profile variant has the following process data assignment:
  - 6 bytes input data
  - 1 byte header data
  - 3 × 2 bytes of user data and 2 bytes of CRC, each in pairs
  - 2 byte connection ID
  - 6 bytes output data
  - 1 byte header data
  - 3 × 2 bytes of user data and 2 bytes of CRC, each in pairs
  - 2 byte connection ID
- For data exchange via Safety over EtherCAT® between the CSL safety option and a higher-level controller, the safety option in the "System" profile variant has the following process data assignment:
  - 12 bytes input data

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- 1 byte header data
- 6 × 2 bytes of user data and 2 bytes of CRC, each in pairs
- 2 byte connection ID
- 12 bytes output data
- 1 byte header data
- 6 × 2 bytes of user data and 2 bytes of CRC, each in pairs
- 2 byte connection ID

Profile data must be evaluated and made available in the "Little Endian" representation for Safety over EtherCAT®.

Integrating the 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 FSoE master.

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 FSoE program.
	Err Ack	Error reset/acknowledgment of safe communication.
	Module fault	TBA
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	TBA
	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 FSoE master and is not shown here.

Safety over EtherCAT® has validity information for its safe process data. This is transferred from master to slave for the process output data when the safety protocol is established and from slave to master for the process input data. If the master signals the message "invalid", all process output data on the slave side is reset. The slave always signals the message "valid" with the current process input data.

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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 master and slave.

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 master.

FSoE watchdog time

The FSoE connection monitoring time must be set in the master. The range of values is from 24 ms to 60000 ms.

12.8.4 CIP Safety™ safety protocol

To communicate via CIP Safety™, the safety option (target) must be connected to a fail-safe controller (F-Originator) via EtherNet/IP™.

CIP Safety™ data exchange with MOVISAFE® CSB

To exchange data between the safety option and a fail-safe controller via CIP Safety™, the CSB safety option have the module name "Safety output" and "Safety input" with the following process data assignment:

- "Technology" profile variant
  - 16 bytes input data

    The first 4 bytes contain the useful data from the FS protocol profile, and the remaining bytes are needed for the safety IO connection.
  - 14 byte output data

    The first 3 bytes contain the useful data from the FS protocol profile, and the remaining bytes are needed for the safety IO connection

CIP Safety™ data exchange with MOVISAFE® CSL

To exchange data between the safety option and a higher-level controller via CIP Safety™, the CSL safety option have the module name "Safety output" and "Safety input" with the following process data assignment:

- "Technology" profile variant
  - 20 bytes input data

    The first 6 bytes contain the useful data from the FS protocol profile, and the remaining bytes are needed for the safety IO connection.
  - 18 bytes input data

    The first 5 bytes contain the useful data from the FS protocol profile, and the remaining bytes are needed for the safety IO connection.
- "System" profile variant
  - 32 bytes input data

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The first 12 bytes contain the useful data from the FS protocol profile, and the remaining bytes are needed for the safety IO connection.

– 18 bytes input data

The first 5 bytes contain the useful data from the FS protocol profile, and the remaining bytes are needed for the safety IO connection.

Profile data must be evaluated and provided in CIP Safety™ in the "Little Endian" display.

Startup in the CIP Safety™ safety protocol

The safety option supports 2 types of startup in a CIP Safety™ network. It is selected via the *Address assignment mode* parameter with both parameter settings "Via CIP Safety™ originator" and "Via parameterization". In the delivery state, the *Address assignment mode* parameter is set to "Via CIP Safety™ originator". As a result, the startup can be executed via the engineering tool of the fail-safe controller.

After startup, the user must ensure that the fail-safe controller and the safety option are properly configured. The user must conduct their own user tests to verify that the configuration data has been properly downloaded. All address parameters are configured by a fail-safe controller or its engineering tool using CIP mechanisms.

Activating the CIP Safety™ safety protocol

In the delivery state, no safety protocol is activated in the safety option. This is the prerequisite that the CIP Safety™ safety protocol is activated in the safety option via the EtherNet/IP™ interface. The changeover is carried out in the parameter object with the class code 0x0F of the EtherNet/IP™ interface and the instance 4. To do so, the user must write the value "1" to the attribute 1 in the data object via the CIP™ service *Set_Attribute_Single*. In the safety option, the changeover to CIP Safety™ is carried out internally and is saved to non-volatile memory. Via the CIP™ service *Get_Attribute_Single*, you can read on the EtherNet/IP™ interface whether the CIP Safety™ function is activated or deactivated.

All address parameters are controlled by a fail-safe controller or its engineering tool via CIP™ mechanisms. The management rights of the CIP Safety™ target can only be reset via a safety reset type 2.

Addressing CIP Safety™

CIP Safety™ requires that an EtherNet/IP™ device must possess a unique network node number (Target Unique Network Identifier, TUNID). The TUNID consists of the IP address of the inverter and the Safety Network Number (SNN) together and is generated in the engineering tool of the fail-safe controller. The safety option retains its TUNID after the assignment. The TUNID is written to the safety key in non-volatile memory.

Safety Network Number (SNN)

The Safety Network Number (SNN) uniquely identifies a network in all the networks in the safety system. The SNN is responsible for assigning a unique number to each safety network or safety subnetwork in a system. The SNN constitutes part of the unique network node ID (unique network identifier, UNID).

The Safety Network Number (SNN) of the safety option must match the Safety Network Number of the assigned, fail-safe controller.

The safety option maintains its SNN after assignment. The SNN must first be reset before it can be reused with another value.

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SNN formats

The SNN is a hexadecimal number consisting of six bytes, and it can be configured in 2 formats:

- Time-based

  If the time-based format is selected, the SNN contains localized date and time information.

- Manual

  If the manual format is selected, the SNN contains a network type and must have a decimal value from 1 to 9999.

The following requirement must be fulfilled for this purpose:

- The inverter is already integrated into the Ethernet/IP™ network in the engineering tool of the originator.

Target Unit Network Identifier (TUNID)

CIP Safety™ requires that an EtherNet/IP™ device have a unique network node number (target unique network identifier, TUNID). The TUNID is composed of the inverter's IP address and the safety network number (SNN).

The safety option maintains its TUNID after assignment. The TUNID is stored in non-volatile memory on the safety key.

Assignment via MOVISUITE® Assist CS..

To assign the TUNID, the SNN must be read from the engineering tool of the fail-safe controller and added to MOVISUITE® Assist CS.. Furthermore, the target network ID (the device's IP address) must match the IP address of the EtherNet/IP™ interface connection and the configuration on the engineering tool of the fail-safe controller. To that end, the IP address of the EtherNet/IP™ interface connection must be read in MOVISUITE® and added to MOVISUITE® Assist CS..

The following requirements must all be fulfilled for this purpose:

- In Assist CS.., the CIP Safety™ protocol type must be selected in the F-communication menu, and the *Address assignment mode* parameter must be set to "Via parameterization".
- The inverter is already integrated in the EtherNet/IP™ network in the engineering tool of the fail-safe controller.
- The IP address and the SNN of the inverter are configured in the engineering tool of the fail-safe controller.
- The inverter is configured with the IP address.

Assigning the TUNID on the engineering tool of the fail-safe controller

The TUNID must be assigned to the "Safety Supervisor" CIP Safety™ object via specific CIP services using service codes *0x56 (Propose_TUNID)* and *0x57 (Apply_TUNID)*.

The following requirements must all be fulfilled for this purpose:

- The inverter is already integrated in the EtherNet/IP™ network in the engineering tool of the fail-safe controller.
- The IP address and the SNN of the inverter are configured in the engineering tool of the fail-safe controller.
- The inverter is configured with the IP address.

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- The TUNID contains the delivery value (default value; all bytes 0xFF)
- The CIP Safety™ object reports the "Waiting for TUNID" state in online mode.

The TUNID must first be reset before it can be reused with another value. This can take place via the CIP Safety™ service "Safety Reset".

Safety Configuration Identifier (SCID)

The Safety Configuration Identifier (SCID) is a combination of the Safety Configuration CRC (SCCRC) and the Safety Configuration Time Stamp (SCTS). The SCID is used to uniquely identify a configuration for the safety option and the fail-safe controller.

The Safety Configuration CRC (SCCRC) is the checksum (CRC) of the application-specific configuration data of the safety option.

Safety Configuration Time Stamp (SCTS) is the timestamp of the application-specific configuration of the safety option. The SCTS is transferred in CIP date-and-time format as a hex value.

The safety option has a statically defined SCTS with the value 0x02932E004792. This is equivalent to the timestamp 03/01/2022/12:00 p.m. In the MOVISUITE® engineering tool, the SCTS is calculated according to the locally configured local time of the computer system and shown via a display parameter.

The SCID displayed in the MOVISUITE® engineering tool must be accepted for the connection process if the user's intention is for the application-specific configuration data to be verified by the safety option when establishing a connection (SafetyOpen Type 2a). To that end, the user must read the SCCRC and SCTS values from the MOVISUITE® engineering tool and add them to the engineering tool of the fail-safe controller (recommended use).

If the user initiates establishing a connection with an SCID equal to zero, then the SCID is not reviewed in the safety option. In this case, the user themselves is responsible for ensuring that the fail-safe controller and the safety option have the right configuration (SafetyOpen Type 2b). The mechanism is supported but it is not recommended for productive use.

The safety option cannot be configured via a fail-safe controller in the connection process (SafetyOpen Type 1 is not supported).

CIP Safety™ service "Safety Reset"

The safety option can be reset by the "Safety reset" CIP Safety™ service on the Safety Supervisor object. During the process, the safety reset type 0 and 2 are supported.

- Safety reset type 0
  - The Ethernet™ interface connection is restarted
  - The safety option is restarted
- Safety reset type 2
  - The EtherNet/IP™ interface connection is restarted
  - The safety option is restarted
  - The safety option can reset the CIP Safety™ parameters TUNID, CFUNID, and OCPUNID to the default values. To that end, the existing "Bit Map" attribute in the service (Bit 2: TUNID, Bit 4: CFUNID, Bit 5: OCPUNID) is additionally evaluated.

The *AlarmEnable* and *WarningEnable* parameters are always reset to their default value.

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The following prerequisites have to be fulfilled:

- In Assist CS.., the CIP Safety™ protocol type must be selected in the "F-communication" menu, and the Address assignment mode parameter must be set to "Via CIP Safety™ originator".
- A valid parameterization must be present.
- The CIP communication connection must be blocked (inhibit).

12.8.5 F process data profile

CSL profile variant "Technology"

Process output data

Byte	Bit	Name	Value	Description
0	0	STO1	0	Activate STO.
			1	Deactivate STO.
	1	Reserve		
	2	Reserve		
	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	Reserve		
	2	Reserve		
	3	Reserve		
	4	Reserve		
	5	Reserve		
	6	Reserve		
	7	Reserve		

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Byte	Bit	Name	Value	Description
2	0	Reserve		
	1	EDM	0	No fault detected.
			1	Fault on at least one of the outputs assigned to the EDM function.
	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	Reserve		
	7	Reserve		
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	Reserve		
	5	Reserve		
	6	Reserve		
	7	Reserve		
4	0	Reserve		
	1	Reserve		
	2	Reserve		
	3	Reserve		
	4	Reserve		
	5	Reserve		
	6	Reserve		
	7	Reserve		

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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 drive safety function has determined the exceeding of a limit value.
			1	At least one selected drive safety function has determined the exceeding of a limit value or cannot execute limit value monitoring as a consequential error.
	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	Muting	0	The encoder fault muting function is not active, or a fault has occurred.
			1	The encoder fault muting function is active.
	5	Test mode active	0	Test mode for safety subfunctions is not active.
			1	Test mode for safety subfunctions 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.
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	Reserve		

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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	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	Reserve		
	7	Reserve		
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	Reserve		
	5	Reserve		
	6	Reserve		
	7	Reserve		
4	0	Reserve		
	1	Reserve		
	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		

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Byte	Bit	Name	Value	Description
5	0	Reserve		
	1	Reserve		
	2	Reserve		
	3	Reserve		
	4	Reserve		
	5	Reserve		
	6	Reserve		
	7	Qualifier actual value process 2	0	Process value 2 is not valid or not in use.
			1	Process value 2 is valid.

With the "System" profile variant, a 32-bit value is transmitted in addition to the bits described in the "Technology" profile variant.

Process value 2 (32 bits)

- Speed
- Rotational speed

The speed values are processed 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 motor speed value is indicated in system units. The numerical value is shown in 1E-4 rpm.

CSB profile variant "Technology"

Process output data

Byte	Bit	Name	Value	Description
0	0	STO1	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 the interlocked F-DI (0 → 1 edge).
	7	Fault acknowledgment	0	No acknowledgment.
			1	Error acknowledgment (0 → 1 edge).

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Byte	Bit	Name	Value	Description
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		

Process input data

Byte	Bit	Name	Value	Description
0	0	STO1	0	STO is not active. Safe disconnection of the drive is not active.
			1	STO signals the status "STO active". All outputs parameterized to STO are switched off.
	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 error-free operation.
			1	At least one warning in the safety option is active.
	7	Fault status	0	The safety option is in error-free operation.
			1	At least one fault at the safety option.

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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	Reserve		
2	0	Reserve		
	1	Reserve		
	2	SSX1	0	SSx1 is not active or limit violation/fault.
			1	SSx1 is active.
	3	SSX2	0	SSx2 is not active or limit 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		

12.8.6 Process input data (F-PI) substitute values

For all process data (F-PE) outgoing from the safety option, the value "0" is written as the substitute value. One exception is *Fault state*. For *Error state*, the value "1" is written as the substitute value in the case of an error-free protocol. In the case of a faulty F-protocol, the value "0" is written for *Error State*.

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12.8.7 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 wiring.

12.8.8 Response when canceling secure 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 subfunctions (including the STO safety subfunction) will be activated. This can lead to a jerky 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 configured SSX instance is set to "0". The other process data bits of the STO, SDI and SLS function retain the last value. All other process data bits will be set to "0". After the SSX ramp has reached the final state of STO, all the process data bits are set to "0".

With the "Safe communication error response" activated, the response time until activation of the STO safety subfunction is extended by the time of the parameterized SSX instance when communication is cut off.

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.

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12.9 Response times

Response times play a decisive role in the design and execution of safety subfunctions of systems and machines. In order to match the response time to the requirements of a safety subfunction, always take into account the entire system from sensor (or command device) to actuator. The following times are of particular importance in connection with the MOVISAFE® CSB/CSL safety option:

- Response time of the connected sensors
- PROFIsafe cycle time
- Processing time (cycle time) in the safety controller
- PROFIsafe monitoring time *F_WD_Time*
- Internal response times of the MOVISAFE® CSB/CSL safety options
- Response time of the actuators (e.g. frequency inverters)

Establish the response sequence for each safety subfunction in your application and determine the maximum response time for each case, taking into account the relevant manufacturer data. Observe in particular the information contained in the safety documentation of the safety controller used.

Details of the maximum response time of the MOVISAFE® CSB/CSL safety options can be found in chapter "Technical data". For detailed information regarding response time consideration for safe PROFIsafe communication, refer to the respective standard: IEC 61784-3-3.

12.9.1 Calculation of 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-PE).
- The response times of the safety options in relation to the safe digital outputs (F-DO) apply for ohmic loads ≤30 kΩ.

Encoders

All response times must be multiplied by the factor 1,002.

Calculation factor (formula symbol)	Calculation specification response time
EI7C built-in encoder:	
• Processing time encoder speed ($T_{_ENC_VEL}$)	3.5 × filter time speed (8708.4) + $1/n_{_actual}$ + $T_{_Task}$ + $T_{_Sys}$
• Processing time encoder positioning ($T_{_ENC_POS}$)	$T_{_Sys}$ + $T_{_Task}$
Response time encoder fault:	
• Deactivation F-DO_STO/ F-DO00	8 ms

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Calculation factor (formula symbol)	Calculation specification response time
• Setting fault status F-PI	12 ms

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 selection F-DI ($T_{_InputProcessing_F\text{-}DI}$)	Input filter time (8704.2) + 2 ms + $T_{_Sys}$ + 350 µs
Input processing with deselection F-DI: ($T_{_InputProcessing_F\text{-}DI_Deselection}$)	
• 1-channel	Input filter time (8704.2) + 51 ms + $T_{_Sys}$ + 350 µs
• 2-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 subfunctions are not taken into account)

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-PE)	$T_{_InputProcessing_F\text{-}DIx}$ + T_{Sys}
Response time (F-PO after F-DOx)	$T_{_InputProcessing_F\text{-}PO}$ + T_{Sys}
Response time (safe velocity (SV) after F-PI)	$T_{_ENC_VEL_COMBINED}$ + T_{Sys}

Selection of a safety subfunction via safe digital input

All response times must be multiplied by the factor 1,002.

Calculation factor	Calculation specification response time
STO	$T_{_InputProcessing_F\text{-}DI}$ + $T_{_Sys}$ + 1 ms
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) + 1 ms
SS1-t	$T_{_InputProcessing_F\text{-}DI}$ + $T_{_Sys}$ + SSx-t delay t1 (8706.8) + brake application time[1] (8706.15) + 1 ms

Calculation factor	Calculation specification response time
SLS	$T_{_InputProcessing_F\text{-}PO}$ + $T_{_Sys}$ + SSx-r monitoring delay t_2 (8706.23) + $v_{_Start}$/SSx-r deceleration a (8706.27) + SSx-r jerk time[2] t_3 (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 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 limit speed offset v (8706.36) - limit speed (8706.24)
SDI	$T_{_InputProcessing_F\text{-}DI}$ + $T_{_Sys}$

1) If SBC enable (8706.14) = no, then the brake application time = 0
2) If ramp monitoring = linear, then jerk time = 0.
3) Maximum speed (8707.1 or other SLS limit speed in the same effective direction

Selection of a safety subfunction 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 × $T_{_Sys}$ + 1 ms
SS1-r	$T_{_InputProcessing_F\text{-}PO}$ + 2 × $T_{_Sys}$ + 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) + 1 ms
SS1-t	$T_{_InputProcessing_F\text{-}PO}$ + 2 × $T_{_Sys}$ + SSx-t delay t_1 (8706.8) + brake application time[1] (8706.15) + 1 ms
SLS	$T_{_InputProcessing_F\text{-}PO}$ + $T_{_Sys}$ + SSx-r monitoring delay t_2 (8706.23) + $v_{_Start}$/SSx-r deceleration a (8706.27) + SSx-r jerk time[2] t_3 (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 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 limit speed offset v (8706.36) - limit speed (8706.24)
SDI	$T_{_InputProcessing_F\text{-}PO}$ + $T_{_Sys}$

1) If SBC enable (8706.4) = no, then the brake application time = 0
2) If ramp monitoring = linear, then jerk time = 0.
3) Maximum speed (8707.1 or other SLS limit speed in the same effective direction

Response time for limit violation with active fault response

All response times must be multiplied by the factor 1.002.

Calculation factor	Calculation specification response time
SSx-r	$T_{_ENC_VEL}$ + $T_{_Sys}$ + 1 ms
SLS with parameterized error response:	

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Calculation factor	Calculation specification response time
• STO	$T_{_ENC_VEL} + T_{_Sys}$ + 1 ms
• SS1-t	$T_{_ENC_VEL} + T_{_Sys}$ + SSx-t delay t_1 (8706.8) + brake application time[1](8706.15) + 1 ms
• SS1-r	$T_{_ENC_VEL} + T_{_Sys}$ + 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) + 1 ms
SDI	$T_{_ENC_POS} + T_{_Sys}$ + 1 ms

1) If SBC enable (8706.14) = no, then brake application time = 0

2) If ramp monitoring = linear, then jerk time = 0

Response time when reporting the limit value 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
SSx-r	$T_{_ENC_VEL} + 2 \times T_{_Sys}$
SLS with parameterized error response:	
• STO	$T_{_ENC_VEL} + 2 \times T_{_Sys}$
• SS1-t	$T_{_ENC_VEL} + 2 \times T_{_Sys}$ + SSx-t delay t_1 (8706.8) + brake application time[1] (8706.15)
• SS1-r	$T_{_ENC_VEL} + 2 \times T_{_Sys}$ + 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)
SSM	$T_{_ENC_VEL} + T_{_Sys}$
SDI	$T_{_ENC_POS} + 2 \times T_{_Sys}$

1) If SBC enable (8706.14) = no, then brake application time = 0

2) If ramp monitoring = linear, then jerk time = 0

Deselection of a safety subfunction via safe digital input

All response times must be multiplied by the factor 1.002.

Calculation factor (formula symbol)	Calculation specification response time
Response time ($T_{_InputProcessing_F\text{-}DI_Deselection}$)	$T_{_InputProcessing_F\text{-}DI_Deselection}$ + 16 ms

Deselection of a safety subfunction 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 ($T_{_InputProcessing_F\text{-}PO_Deselection}$)	$T_{_InputProcessing_F\text{-}PA}$ + 16 ms

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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-PE	$T_{_InputProcessing_F\text{-}DI_Deselection}$ + 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 deceleration t1 (8706.8) + Brake application time[1] (8706.15)
Additional fault response SS1-t and STO bit on F-PE	$T_{_InputProcessing_F\text{-}DI_Deselection}$ + Maximum (EDM pick-up delay (8705.32), EDM drop-out delay (8705.33)) + 2 × $T_{_Sys}$ + SSx-t deceleration 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-PE	$T_{_Inputprocessing_F\text{-}DI_Deselection}$ + Maximum (EDM Pick-up delay (**8705.32**), EDM Drop-out delay (8705.33)) + 2 x $T_{_Sys}$ + 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)
Reporting the EDM fault via F-PE	$T_{_InputProcessing_F\text{-}DI_Deselection}$ + Maximum (EDM pick-up delay (8705.32), EDM drop-out delay (8705.33)) + $T_{_Sys}$

1) If SBC enabled (8706.14) = no, then the brake application time = 0

2) If ramp monitoring = linear, then jerk time = 0

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12.10 Service

12.10.1 Modification/changes to the device

- Hardware changes

  Any changes to the CSB/CSL safety option can be performed only by SEW-EURODRIVE.
- Firmware modifications

  Only SEW-EURODRIVE is authorized to make changes to the firmware.
- Repair

  Only SEW-EURODRIVE is authorized to repair the CSB/CSL 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).

12.10.2 Status LEDs

⚠ WARNING

Danger due to incorrect interpretation of the LEDs "F-RUN" and "F-ERR"

Severe or fatal injuries.

- The LEDs are not safety-related and must not be used as a safety device.

INFORMATION

- "Slow" flashing frequency means that the LED is flashing at 0.5 Hz.
- "Fast" flashing frequency means that the LED is flashing at 2Hz.
- 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.

"F-RUN" LED

The following table shows the states of the "F-RUN" LED.

LED status	Meaning
Flashing sequence	Device identification for safety key ID query.
Red, slowly flashing	Device identification for parameterization.
Red, rapidly flashing	Firmware update, do not switch the device off.
Red	Critical fault (cannot be acknowledged).
Yellow	STO safety subfunction is active.
Yellow, flashing slowly	Device in the operating state with one or more of the following constraints: • The safety card controls inverters • Test mode

LED status	Meaning
Green, slowly flashing	Acceptance of the assembly has not yet taken place.
Green, rapidly flashing	• Device booting up or initializing • Device in parameterization state
Green	Device in operating state and parameter set approved.
Off	Device off.

"F-ERR" LED

The following table shows the states of the "F-ERR" LED.

LED status	Meaning
Flashing sequence	Device identification for safety key ID query.
Red	Critical fault, cannot be acknowledged.
Red, slowly flashing	• Fault can be acknowledged • Fault outside of the device, cabling system fault • Reaction to limit value overshoot active
Yellow, rapidly flashing	• Error suppression (muting) active • Emergency mode active
Yellow	Warning: Error connection basic device
Green, slowly flashing	Error in the operating state "Parameterization": • Error in parameterization • No parameterization exists • Current parameter set not consistent with the safety key • Inconsistent parameterization
Green	Fault-free operation.
Off	Device off.

12.10.3 Fault states of the MOVISAFE® CSB/CSL safety options

⚠ DANGER

A fault occurred at the MOVISAFE® CSB/CSL safety option 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.

Severe or fatal injuries.

- To prevent automatic restart in the aforementioned cases, the parameter *Error status after startup* (8703.240) must be parameterized to "Start inhibit". "Start inhibit" must be acknowledged.

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Fault classes

The occurring faults of the safety option are divided into 5 different fault classes. Depending on the fault class, the response described in the following table is carried out.

Fault class	Response
Message.	Entry in fault memory, no further response.
Warning.	Entry in fault memory, no further response.
Output fault, input fault, encoder fault.	Entry in fault memory and safe state of digital inputs and outputs as applicable.
System error.	Entry in fault memory and safe state of digital inputs and outputs.
Critical fault.	Entry in fault memory and safe state of digital inputs and outputs. No safe communication.

Message

No fault response is carried out in the case of a message. An entry is made in the fault memory. In addition, the corresponding fault code is transferred.

Warning

No error response is carried out in the case of a warning. An entry is made in the fault memory. In addition, the corresponding error code is transferred.

A 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.

Output fault, input fault, encoder fault

Output fault

If the safety option detects a fault at a safe digital output, all safe digital outputs are switched to the safe state. In addition, the STO safety subfunction is activated and the safety option is set to the safe state. In the FS protocol, the bit of the safe digital output F-DO0 is set to "0" and the bits for the safety subfunction STO and the fault are set to "1".

In addition, the corresponding fault code is transferred for the output fault that occurred.

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 digital 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 input fault that occurred.

INFORMATION

If a safe digital input is assigned to a safety subfunction via function assignment, then this safety subfunction is selected in the event of an input fault.

At a safe digital input with detected fault, the fault must first be resolved and the safe state established before acknowledging the input fault. In this way, a safety subfunction is not erroneously selected after acknowledgment of an input fault.

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Encoder fault

If the safety option detects a fault in the encoder system, this results in a warning if no safety subfunction is activated. The safety option continues to remain operational. If at least one safety subfunction is active, this leads to an encoder fault. The safety subfunctions change to the corresponding fault state. The corresponding fault code for the encoder fault that occurred is transferred.

In the case of faults in the encoder system that are assigned to the fault class "Encoder fault" or "System error", the corresponding fault response is initiated as soon as the fault or error is detected.

Acknowledging the encoder fault with activated safety subfunction leads to a restart of the safety subfunction.

INFORMATION

Acknowledgment of a limit value violation leads to a different behavior of the activated safety subfunction than the acknowledgment of an encoder fault.

The response to an encoder fault can be suppressed with the "Encoder fault muting" function. The "Encoder fault muting" function can be activated at a safe digital input or via the safe process data. Refer to the "Encoder fault muting" chapter for more information.

System error

In the case of a system fault, all safe digital inputs and all safe digital outputs are switched to the safe state. In addition, the STO safety subfunction is executed without delay and the safe digital outputs F-DO00 is disabled. The safety option is set to the safe state.

In the FS protocol, the bit of the safe digital output F-DO00 and the bits of the safe digital inputs F-DI00, F-DI01, F-DI02 and F-DI03 are set to "0". The bits for the safety subfunction STO and the fault are set to "1".

In addition, the corresponding fault code is transferred for the system error that occurred.

INFORMATION

If the safe digital output is assigned to a safety subfunction via the function assignment, this safety subfunction is selected in the case of a system error.

Critical fault

In the case of a critical fault, the safety option is set to the safe state. All safe digital inputs and all safe digital outputs are switched to the safe state. In addition, the STO safety subfunction is executed without 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.

Fault messages

If there is a fault in the safety option, the inverter indicates that the safety option is reporting a fault.

Measures for fault resolution and more information on causes can be found using the fault status of the safety option.

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Starting behavior of the safety option

⚠ DANGER

After a fault, the safety option automatically restarts if the supply voltage is turned 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 with 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 available for independent operation.

- "No start inhibit" parameter setting

  The safety option starts immediately. Observe 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 subfunction is active as long as start inhibit is active. Outputs assigned to the STO or SBC function are activated depending on the safety subfunction. If outputs are configured to "F-PO data", they will still be controlled by the higher-level controller. The outputs are not set to safe state

Start inhibit is deactivated if one of the following conditions is met:

- Fault acknowledgment completed
- Muting is activated

12.10.4 Fault diagnostics

The "Latest 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 first 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 as follows.

Subfault: 46.50 **Description: Warning**		
	Response: Warning with self-reset	
	Cause	Measure
	– The safety option signals a subcomponent fault of the type "warning".	See fault status "Subcomponent safety option"

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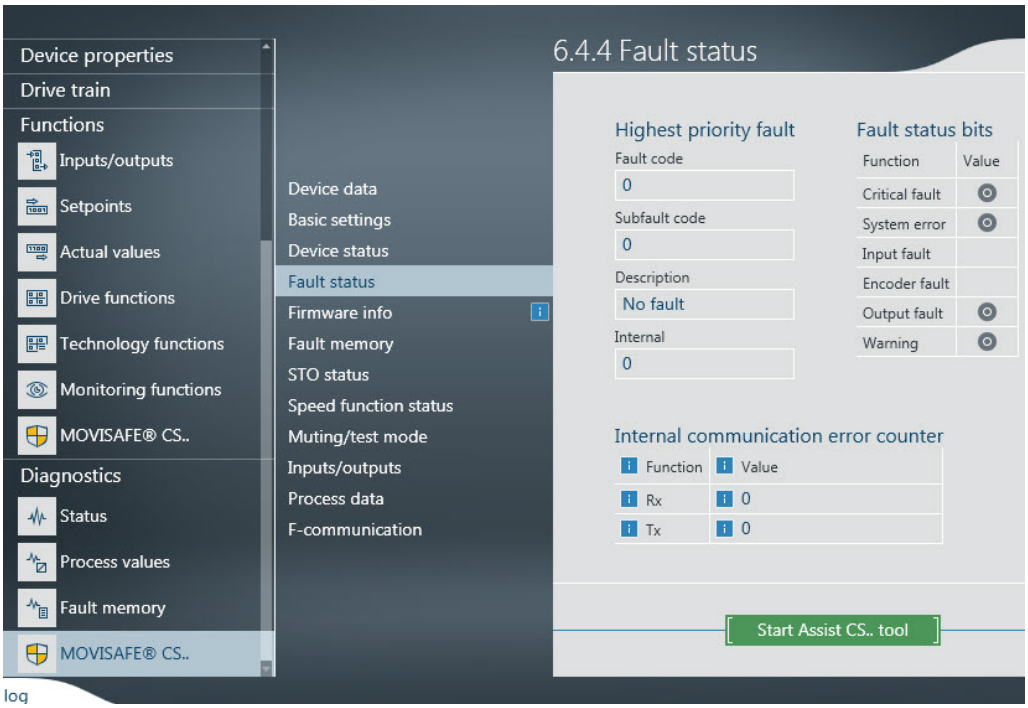
Subfault: 46.51 Description: Fault		
	Response: Emergency stop and output stage inhibit with self-reset	
	Cause	Measure
	– The safety option signals a subcomponent fault of the type "standard fault".	See fault status "Subcomponent safety option"

Subfault: 46.52 Description: Critical fault		
	Response: Output stage inhibit with self-reset	
	Cause	Measure
	– The safety option signals a subcomponent fault of the type "critical fault".	See fault status "Subcomponent safety option"

Diagnostics with MOVISUITE® Assist CS..

The current fault of the safety option is displayed with the corresponding fault description in the "Diagnostics" segment in the menu command [MOVISAFE® CS..] > [Fault status].



9007221132519563

Diagnostics with PROFIsafe connection

The safety option with PROFIsafe connection triggers a diagnostic alarm on the F-PLC in the data exchange between the F-PLC (fieldbus master) and the safety option (fieldbus slave) in case of a fault. Simultaneously, the associated fault code is transferred via the communication connection.

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The F-PLC responds to the dispatched 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).

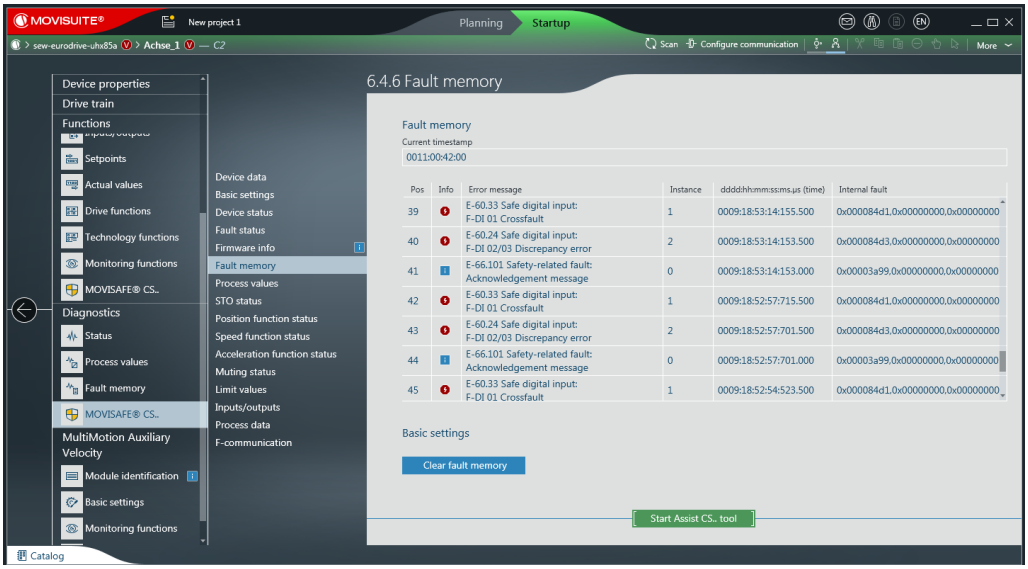
The safety option has PROFIsafe and assembly-specific fault codes. All fault codes of the safety option are listed in a fault table.

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 master. 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.

Fault memory

The current initial fault and all other subsequent faults are residually saved in the fault memory with associated timestamp.



9007221132546955

Additional messages for the errors are entered in the fault memory in the columns "Primary error" and "Sub-error". These are messages that do not directly trigger a fault response of the CSB/CSL safety option. Essentially, these are the message "Power On" (primary error 66 and sub-error 100) and the message "Acknowledgment message" (primary error 66 and sub-error 101).

In the "Pos" column, the position of the fault is displayed. In the "Info" column, an icon indicates the category of the fault. In the "Error message" column, the fault number, the main fault text and the subfault text is displayed. The actual value of the operating hours counter of the safety option is displayed in the "Time" column. The "Internal fault" column is used for internal purposes. The fault memory is organized as a ring memory. The most recently occurring error is shown in line 0 of the list. If there are more than 50 entries, the oldest fault is overwritten.

12.10.5 Acknowledgment

A fault or a limit value violation can be acknowledged 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, Safety over EtherCAT® or CIP Safety™, the exchange of safe data of the safety option must be fault-free. Faults can the be acknowledged by a rising edge via the "Fault acknowledgment" bit in the F-process output data.

A critical fault can only be acknowledged by switching the supply voltage off and on.

⚠ DANGER

Depending on the wiring, MOVISAFE® CSB/CSL can deactivate the STO safety subfunction after fault acknowledgment. This can cause an immediate restart of the system.

Severe or fatal injuries.

- Make sure that no persons enter the hazardous area of the system while acknowledging a fault.
- Make sure that the STO safety subfunction is active via F-DI or safe communication during fault acknowledgment.

Existing limit violations of the safety subfunctions 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.

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 subfunction is activated via F-DI or via safe communication and the SDI safety subfunction is deselected.
3. Acknowledge system error.
4. If necessary, select the deselected SDI safety subfunction again.

Acknowledging an input fault

An input fault can occur if one of the following functions is assigned to a 2-channel safe digital input F-DI in the function assignment.

- Unlatch F-DI
- Unlatch F-DI and acknowledge fault
- Muting
- Activate test mode

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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.

Acknowledging a limit value violation of a safety subfunction

Once a limit value violation of a safety subfunction has been identified, the status of this function becomes inactive. Furthermore, an error in the "Warning" class is set.

A limit value violation must always be acknowledged.

A limit value violation cannot be acknowledged by deactivating the safety subfunction. With the exception of this, the parameterization of the fault response is at "F-PE only". With the SSM safety subfunction, the fault is acknowledged by deactivating the safety subfunction.

Acknowledgment always affects all the safety subfunctions. The safety subfunction can continue to be activated during acknowledgment.

Parameterized speed filters of the safety subfunctions that have triggered a limit value violation are reset.

Please note the following behavior of the safety subfunctions during an acknowledgment:

- SDI:

  The limit positions are recalculated.
- SLS:

  The delay time and the transition ramp are **not** recalculated; the limit speed is immediately monitored.
- SS1:

  The deceleration time and the transition ramp are not recalculated; the final state becomes immediately active (STO activation).

12.10.6 "Emergency mode" function

The "emergency mode" function can only be triggered using the keypad. The "emergency mode" function automatically triggers the "Encoder fault muting" function (see chapter "Encoder fault muting") and the "Muting safe process output data (F-PO)" function (see chapter "Muting safe process output").

Safety notes

⚠ DANGER

Due to the "Emergency mode" function, immediate restart of the system is possible.

Severe or fatal injuries.

- Before activating the "Emergency mode" function, the user must undertake organizational measures for the protection of personnel and machinery.

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⚠ DANGER

The keypad is connected to the wrong device. This can cause immediate restart of the system.

Severe or fatal injuries.

- Before activating the "Emergency mode" function, the user must undertake organizational measures for the protection of personnel and machinery.
- The keypad must mechanically be connected to the correct device.
- Make sure that you can see the display of the keypad and the system at any time during emergency mode. The connection between the keypad and the device must be designed in such a way that it can be disconnected at any time without tools.

Requirements

- The "Emergency mode" function (index 8707.2) must be enabled.
- To start the "Emergency mode" function, an encoder fault or communication error must be pending in the F-protocol.

Starting the emergency mode

Do the following:

- Select "emergency mode" using the keypad.
- With the "F-ERR" LED (see chapter "F-ERR LED"), check if the correct device signals emergency mode. If the wrong device is flashing, activation of the emergency mode must be canceled immediately.
- If the correct device is selected, the emergency mode ID is displayed. Confirm signaling of the correct device. For this, enter the displayed emergency mode ID in reverse order and click OK.

Ending emergency mode

- You can end emergency mode in a safety-related manner by interrupting the connection between keypad and device.
- You cannot end emergency mode in a safety-related manner by selecting "End emergency mode" on the keypad.
- Emergency mode is automatically terminated after 5 minutes.

12.10.7 Device replacement

⚠ WARNING

An incorrect parameterization of the safety option is enabled if the CMM memory module with integrated safety key is inserted incorrectly.

Severe or fatal injuries.

- Make sure that the safety key matching the application is plugged into the correct system position.

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INFORMATION

A MOVITRAC® advanced with faulty CSB/CSL safety option must be taken out of operation within 100 hours.

Device replacement with MOVI-C® without PC

The MOVI-C® system offers the option to save the application-related data set for the inverter and the data set for the safety option on the memory module in the inverter or on the MOVI-C® CONTROLLER. This step must be performed in advance by the user with the MOVI-C® CONTROLLER.

The following steps must be performed for the actual device replacement:

1. Switch off the device to be replaced.
2. Remove the pluggable CMM memory module with integrated safety key from the device.
3. Replace the device (including MOVISAFE® CSB/CSL safety option).
4. Reinsert the CMM memory module with integrated safety key that was removed in step 2.
5. Carry out a functional test. The checking of all parameters is omitted.

The controller/inverter detects the device replacement automatically and loads the applicative data set to the MOVISAFE® CSB/CSL safety option. The localized key data set on the pluggable safety key ensures that the correct application data set has been loaded. The MOVISAFE® CSB/CSL safety option is subsequently in the same state that it was in before the device replacement. This means that the MOVISAFE® CSB/CSL safety option will be in the "Accepted" state again afterwards if it was in the "Accepted" state before the device replacement. In order to ensure correct connection of the sensors and actuators, a function test of the safety option is required in the case of automatic device replacement function.

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 CMM memory module with integrated safety key from the device.
4. Replace the device (including MOVISAFE® CSB/CSL safety option).
5. Reinsert the CMM memory module that was removed in step 3.
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 230 V) back on and perform a functional test of the system.

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12.11 Technical data

12.11.1 General electrical data

The CSB/CSL safety option is supplied with voltage by the basic device.

12.11.2 Encoder interface

Technical data of permitted safety encoders

Designation	Value/description	
Characteristics	Encoder interface for HTL encoder signals A, $\overline{A}$, B, $\overline{B}$	
Permitted safety encoders	EI7C FS	
Signal level	0 V – +3 V	Encoder track LOW (logic "0") Encoder track HIGH (logic "1")
Maximum operating speed EI7C FS	3600 min^{-1}	
Max. permitted input frequency	1520 Hz	
Response time of speed measurement	Calculation formula: Response time of speed measurement in ms = 13 + 7500/n [n] = min^{-1}	
Fault response time of speed measurement[1)]	No greater than the response time without error.	

1) The fault response time is the total time from when an internal error occurs or an external error in the encoder circuit is detected until the safe state is triggered by the safety option.

12.11.3 Safe digital inputs

F-DI00 – F-DI03	Value/description
Characteristics	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
Power demand (typical)	0.21 W at DC 24 V
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
Error response time with single-pole connection	No greater than the response time without error.
Edge steepness of input signal	> 120 V/s

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F-DI00 – F-DI03	Value/description
Input capacitance	< 500 pF

12.11.4 Sensor supply

F-SS0, F-SS1	Value/description
Characteristics	• DC 24 V output pursuant to EN 61131-2 • Short circuit and overload protection • No galvanic isolation
Rated current	150 mA
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 blocked)	< 0.1 mA

12.11.5 Safe digital outputs

F-DO00_P/M	Value/description
Properties	• DC 24 V output in accordance with EN 61131-2 • Short circuit and overload protection
Rated current	150 mA
Inrush current (≤ 10 ms)	300 mA
Leakage current (F-DOx blocked)	< 0.1 mA
Maximum switching frequency	10 Hz during operation
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
Capacitance to GND/PE (sourcing output only)	≤ 10 nF
Load capacitance with diode de-coupling	≤ 12 µF
Load inductance	≤ 100 µH

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F-DO00_P/M	Value/description
Load inductance with freewheeling diode	≤ 40 H
Minimum load resistance	> 130 Ω

12.11.6 MOVISAFE® CSO characteristic safety values

	Characteristic values pursuant to	
	EN 62061/IEC 61800-5-2	EN ISO 13849-1
Tested safety class/underlying standards	SIL 2	PL d
Probability of a dangerous failure per hour (PFH value)	30×10^{-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 subfunction	STO, SS1[1)] in accordance with IEC 61800-5-2	

1) With suitable external control

12.11.7 MOVISAFE® CSB/CSL characteristic safety values

	Characteristic values pursuant to	
	EN 62061/IEC 61800-5-2	EN ISO 13849-1
Tested safety class/underlying standards	SIL 2	PL d
Probability of dangerous failure per hour (PFH_D value)	7×10^{-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 subfunction	• STO, SS1, SLS, SSM, SDI, SBC • Safe digital inputs/outputs • Safe communication	

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13 Appendix

13.1 Abbreviation key

The following table lists the abbreviations that are used in this documentation together with their unit and meaning:

Abbreviation	Information on the nameplate	Unit	Meaning
ASM			Asynchronous motor
BG..			Inverter size
C	C	µF	Capacitance
f_{max}	f	Hz	Maximum output frequency
f_{line}	f	Hz	Line frequency
f_{PWM}		kHz	Frequency of the pulse width modulation
h		m	Installation altitude
HF			High frequency
I_{trip}		A	Tripping current (braking resistor)
I_{max}	Imax	A	Max. DC link current (specification on the nameplate)
I_{max}		A	Maximum output current (encoder cards)
I_{peak}		A	Output peak current (encoder cards)
$I_{A\ max}$		A	Max. output current
I_{Appl}		A	Total current of the application
I_N		A	Nominal output current/nominal current (filter, choke)
I_{line}	I	A	Nominal line current
I_{NDCL}	I	A	Nominal DC link current
L_N		mH	Inductance
LSPM			Line Start Permanent Magnet
asl		m	Above sea level, reference for altitudes above sea level
P_{eff}		kW	Effective power (braking resistor)
P_{max}		kW	Maximum power (braking resistor)
P_{Mot}	P(ASM)	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_{BW}		Ω	Value of the braking resistance
R_{BWmin}		Ω	Minimum value of the braking resistance
S_N	S	kVA	Apparent output power
SM			Synchronous motor
V_{out}	U	V	Motor output voltage
V_{BR}		V	Brake supply voltage

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Abbreviation	Information on the nameplate	Unit	Meaning
V_N		V	Nominal line voltage (filter, choke)
V_{line}	U	V	Connection voltage
V_{NDCL}	U	V	Nominal DC link voltage
V_{DCL}		V	DC link voltage
V_{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_U	T	°C	Ambient temperature
(+ES)			... with output stage inhibit

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	Hamburg	SEW-EURODRIVE GmbH & Co KG Hasselbinnen 11 22869 Schenefeld	Tel. +49 40298109-60 Fax +49 40298109-70 dc-hamburg@sew-eurodrive.de
	Saarland	SEW-EURODRIVE GmbH & Co KG Gottlieb-Daimler-Straße 4 66773 Schwalbach Saar – Hülzweiler	Tel. +49 6831 48946 10 Fax +49 6831 48946 13 dc-saarland@sew-eurodrive.de
	Ulm	SEW-EURODRIVE GmbH & Co KG Dieselstraße 18 89160 Dornstadt	Tel. +49 7348 9885-0 Fax +49 7348 9885-90 dc-ulm@sew-eurodrive.de
	Würzburg	SEW-EURODRIVE GmbH & Co KG Nürnbergerstraße 118 97076 Würzburg-Lengfeld	Tel. +49 931 27886-60 Fax +49 931 27886-66 dc-wuerzburg@sew-eurodrive.de
Drive Service Hotline / 24 Hour Service			0 800 SEWHELP 0 800 7394357
Great Britain			
Assembly Sales Service	Normanton	SEW-EURODRIVE Ltd. DeVilliers Way Trident Park Normanton West Yorkshire WF6 1GX	Tel. +44 1924 893-855 Fax +44 1924 893-702 http://www.sew-eurodrive.co.uk info@sew-eurodrive.co.uk
Greece			
Sales	Athens	Christ. Boznos & Son S.A. 12, K. Mavromichali Street P.O. Box 80136 18545 Piraeus	Tel. +30 2 1042 251-34 Fax +30 2 1042 251-59 http://www.boznos.gr info@boznos.gr
Hungary			
Sales Service	Budapest	SEW-EURODRIVE Kft. Csillaghegyí út 13. 1037 Budapest	Tel. +36 1 437 06-58 Fax +36 1 437 06-50 http://www.sew-eurodrive.hu office@sew-eurodrive.hu
Iceland			
Sales	Reykjavik	Varma & Vélaverk ehf. Knarrarvogi 4 104 Reykjavík	Tel. +354 585 1070 Fax +354 585)1071 https://vov.is/ vov@vov.is
India			
Registered Office Assembly Sales Service	Vadodara	SEW-EURODRIVE India Private Limited 302, NOTUS IT PARK, Sarabhai Campus, Beside Notus Pride, Genda Circle, Vadodara 390023 Gujarat	Tel. +91 265 3045200 Fax +91 265 3045300 http://www.seweurodriveindia.com salesvadodara@seweurodriveindia.com
Assembly Sales Service	Chennai	SEW-EURODRIVE India Private Limited Plot No. K3/1, Sipcot Industrial Park Phase II Mambakkam Village Sriperumbudur - 602105 Kancheepuram Dist, Tamil Nadu	Tel. +91 44 37188888 Fax +91 44 37188811 saleschennai@seweurodriveindia.com
	Pune	SEW-EURODRIVE India Private Limited Plant: Plot No. D236/1, Chakan Industrial Area Phase- II, Warale, Tal- Khed, Pune-410501, Maharashtra	Tel. +91 21 35 628700 Fax +91 21 35 628715 salespune@seweurodriveindia.com
Sales Service	Gurgaon	SEW-EURODRIVE India Private Limited Drive Center Gurugram Plot no 395, Phase-IV, UdyogVihar Gurugram , 122016 Haryana	Tel. +91 99588 78855 salesgurgaon@seweurodriveindia.com

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Indonesia			
Sales	Medan	PT. Serumpun Indah Lestari Jl.Pulau Solor no. 8, Kawasan Industri Medan II Medan 20252	Tel. +62 61 687 1221 Fax +62 61 6871429 / +62 61 6871458 / +62 61 30008041 sil@serumpunindah.com serumpunindah@yahoo.com http://www.serumpunindah.com
	Jakarta	PT. Cahaya Sukses Abadi Komplek Rukan Puri Mutiara Blok A no 99, Sunter Jakarta 14350	Tel. +62 21 65310599 Fax +62 21 65310600 csajkt@cbn.net.id
	Jakarta	PT. Agrindo Putra Lestari JL.Pantai Indah Selatan, Komplek Sentra Industri Terpadu, Pantai indah Kapuk Tahap III, Blok E No. 27 Jakarta 14470	Tel. +62 21 2921-8899 Fax +62 21 2921-8988 aplindo@indosat.net.id http://www.aplindo.com
	Surabaya	PT. TRIAGRI JAYA ABADI Jl. Sukosemolo No. 63, Galaxi Bumi Permai G6 No. 11 Surabaya 60111	Tel. +62 31 5990128 Fax +62 31 5962666 sales@triagri.co.id http://www.triagri.co.id
	Surabaya	CV. Multi Mas Jl. Raden Saleh 43A Kav. 18 Surabaya 60174	Tel. +62 31 5458589 Fax +62 31 5317220 sianhwa@sby.centrin.net.id http://www.cvmultimas.com
Ireland			
Sales Service	Dublin	Alperton Engineering Ltd. 48 Moyle Road Dublin Industrial Estate Glasnevin, Dublin 11	Tel. +353 1 830-6277 Fax +353 1 830-6458 http://www.alperton.ie info@alperton.ie
Israel			
Sales	Tel Aviv	Liraz Handasa Ltd. Ahofer Str 34B / 228 58858 Holon	Tel. +972 3 5599511 Fax +972 3 5599512 http://www.liraz-handasa.co.il office@liraz-handasa.co.il
Italy			
Assembly Sales Service	Milan	SEW-EURODRIVE S.a.s. di SEW S.r.l. & Co. Via Bernini,12 20033 Solaro (Milano)	Tel. +39 02 96 980229 Fax +39 02 96 980 999 http://www.sew-eurodrive.it milano@sew-eurodrive.it
Ivory Coast			
Sales	Abidjan	SEW-EURODRIVE SARL Ivory Coast Rue des Pêcheurs, Zone 3 26 BP 916 Abidjan 26	Tel. +225 27 21 21 81 05 Fax +225 27 21 25 30 47 info@sew-eurodrive.ci http://www.sew-eurodrive.ci
Japan			
Assembly Sales Service	Iwata	SEW-EURODRIVE JAPAN CO., LTD 250-1, Shimoman-no, Iwata Shizuoka 438-0818	Tel. +81 538 373811 Fax +81 538 373814 http://www.sew-eurodrive.co.jp sewjapan@sew-eurodrive.co.jp
Kazakhstan			
Sales Service	Almaty	SEW-EURODRIVE LLP 291-291A, Tole bi street 050031, Almaty	Tel. +7 (727) 350 5156 Fax +7 (727) 350 5156 http://www.sew-eurodrive.com kazakhstan@sew-eurodrive.com
	Tashkent	Representative Office SEW-EURODRIVE Representative office in Uzbekistan 95A Amir Temur ave, office 401/3 100084 Tashkent	Tel. +998 97 134 01 99 http://www.sew-eurodrive.uz sew@sew-eurodrive.uz
	Ulaanbaatar	IM Trading LLC Olympic street 28B/3 Sukhbaatar district, Ulaanbaatar 14230, MN	Tel. +976-77109997 Fax +976-77109997 imt@imt.mn

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Latvia			
Sales	Riga	SIA Alas-Kuul Katlakalna 11C 1073 Riga	Tel. +371 6 7139253 Fax +371 6 7139386 http://www.alas-kuul.lv info@alas-kuul.com
Lebanon			
Sales (Lebanon)	Beirut	Gabriel Acar & Fils sarl B. P. 80484 Bourj Hammoud, Beirut	Tel. +961 1 510 532 Fax +961 1 494 971 ssacar@inco.com.lb
Sales (Jordan, Kuwait , Saudi Arabia, Syria)	Beirut	Middle East Drives S.A.L. (offshore) Sin El Fil. B. P. 55-378 Beirut	Tel. +961 1 494 786 Fax +961 1 494 971 http://www.medrives.com info@medrives.com
Lithuania			
Sales	Alytus	UAB Irseva Statybininku 106C 63431 Alytus	Tel. +370 315 79204 Fax +370 315 56175 http://www.irseva.lt irmantas@irseva.lt
Luxembourg			
Representation: Belgium			
Macedonia			
Sales	Skopje	Boznos DOOEL Dime Anicin 2A/7A 1000 Skopje	Tel. +389 23256553 Fax +389 23256554 http://www.boznos.mk
Malaysia			
Assembly Sales Service	Johor	SEW-EURODRIVE SDN BHD No. 95, Jalan Seroja 39, Taman Johor Jaya 81000 Johor Bahru, Johor West Malaysia	Tel. +60 7 3549409 Fax +60 7 3541404 sales@sew-eurodrive.com.my
Mexico			
Assembly Sales Service	Quéretaro	SEW-EURODRIVE MEXICO S.A. de C.V. SEM-981118-M93 Tequisquiapan No. 102 Parque Industrial Quéretaro C.P. 76220 Querétaro, México	Tel. +52 442 1030-300 Fax +52 442 1030-301 http://www.sew-eurodrive.com.mx scmexico@seweurodrive.com.mx
Sales Service	Puebla	SEW-EURODRIVE MEXICO S.A. de C.V. Calzada Zavaleta No. 3922 Piso 2 Local 6 Col. Santa Cruz Buenavista C.P. 72154 Puebla, México	Tel. +52 (222) 221 248 http://www.sew-eurodrive.com.mx scmexico@seweurodrive.com.mx
Mongolia			
Technical Office	Ulaanbaatar	IM Trading LLC Olympic street 28B/3 Sukhbaatar district, Ulaanbaatar 14230, MN	Tel. +976-77109997 Tel. +976-99070395 Fax +976-77109997 http://imt.mn/ imt@imt.mn
Morocco			
Sales Service Assembly	Bouskoura	SEW-EURODRIVE Morocco SARL Parc Industriel CFCIM, Lot. 55/59 27182 Bouskoura Grand Casablanca	Tel. +212 522 88 85 00 Fax +212 522 88 84 50 http://www.sew-eurodrive.ma sew@sew-eurodrive.ma
Namibia			
Sales	Swakopmund	DB MINING & INDUSTRIAL SUPPLIES CC Einstein Street Strauss Industrial Park Unit1 Swakopmund	Tel. +264 64 462 738 Fax +264 64 462 734 anton@dbminingnam.com

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Netherlands			
Assembly Sales Service	Rotterdam	SEW-EURODRIVE B.V. Industrieweg 175 3044 AS Rotterdam Postbus 10085 3004 AB Rotterdam	Tel. +31 10 4463-700 Fax +31 10 4155-552 Service: 0800-SEWHELP http://www.sew-eurodrive.nl info@sew-eurodrive.nl
New Zealand			
Assembly Sales Service	Auckland	SEW-EURODRIVE NEW ZEALAND LTD. P.O. Box 58-428 82 Greenmount drive East Tamaki Auckland	Tel. +64 9 2745627 Fax +64 9 2740165 http://www.sew-eurodrive.co.nz sales@sew-eurodrive.co.nz
	Christchurch	SEW-EURODRIVE NEW ZEALAND LTD. 30 Lodestar Avenue, Wigram Christchurch	Tel. +64 3 384-6251 Fax +64 3 384-6455 sales@sew-eurodrive.co.nz
Nigeria			
Sales	Lagos	Greenpeg Nig. Ltd 64C Toyin Street Opebi-Allen Ikeja Lagos-Nigeria	Tel. +234-701-821-9200-1 http://www.greenpegltd.com sales@greenpegltd.com
Norway			
Assembly Sales Service	Moss	SEW-EURODRIVE A/S Solgaard skog 71 1599 Moss	Tel. +47 69 24 10 20 Fax +47 69 24 10 40 http://www.sew-eurodrive.no sew@sew-eurodrive.no
Pakistan			
Sales	Karachi	Industrial Power Drives Al-Fatah Chamber A/3, 1st Floor Central Commercial Area, Sultan Ahmed Shah Road, Block 7/8, Karachi	Tel. +92 21 452 9369 Fax +92-21-454 7365 seweurodrive@cyber.net.pk
Paraguay			
Sales	Fernando de la Mora	SEW-EURODRIVE PARAGUAY S.R.L Nu Guazu No. 642 casi Campo Esperanza Santisima Trinidad Asuncion	Tel. +595 991 519695 Fax +595 21 3285539 sewpy@sew-eurodrive.com.py
Peru			
Assembly Sales Service	Lima	SEW EURODRIVE DEL PERU S.A.C. Los Calderos, 120-124 Urbanizacion Industrial Vulcano, ATE, Lima	Tel. +51 1 3495280 Fax +51 1 3493002 http://www.sew-eurodrive.com.pe sewperu@sew-eurodrive.com.pe
Philippines			
Sales	Makati	P.T. Cerna Corporation 4137 Ponte St., Brgy. Sta. Cruz Makati City 1205	Tel. +63 2 519 6214 Fax +63 2 890 2802 mech_drive_sys@ptcerna.com http://www.ptcerna.com
Poland			
Assembly Sales Service	Łódź	SEW-EURODRIVE Polska Sp.z.o.o. ul. Techniczna 5 92-518 Łódź	Tel. +48 42 293 00 00 Fax +48 42 293 00 49 http://www.sew-eurodrive.pl sew@sew-eurodrive.pl
	Service	Tel. +48 42 293 0030 Fax +48 42 293 0043	24 Hour Service Tel. +48 602 739 739 (+48 602 SEW SEW) serwis@sew-eurodrive.pl
Portugal			
Assembly Sales Service	Coimbra	SEW-EURODRIVE, LDA. Av. da Fonte Nova, n.º 86 3050-379 Mealhada	Tel. +351 231 20 9670 Fax +351 231 20 3685 http://www.sew-eurodrive.pt infosew@sew-eurodrive.pt

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Romania			
Sales Service	Bucharest	Sialco Trading SRL str. Brazilia nr. 36 011783 Bucuresti	Tel. +40 21 230-1328 Fax +40 21 230-7170 http://www.sialco.ro sialco@sialco.ro
Russia			
Assembly Sales Service	St. Petersburg	ЗАО «СЕВ-ЕВРОДРАЙФ» 188660, Russia, Leningrad Region, Vse-volozhsky District, Korabselki, Aleksandra Nevskogo str. building 4, block 1 P.O. Box 36 195220 St. Petersburg	Tel. +7 812 3332522 / +7 812 5357142 Fax +7 812 3332523 http://www.sew-eurodrive.ru sew@sew-eurodrive.ru
Senegal			
Sales	Dakar	SENEMECA Mécanique Générale Km 8, Route de Rufisque B.P. 3251, Dakar	Tel. +221 338 494 770 Fax +221 338 494 771 http://www.senemeca.com senemeca@senemeca.sn
Serbia			
Sales	Belgrade	DIPAR d.o.o. Ustanicka 128a PC Košum, IV floor 11000 Beograd	Tel. +381 11 347 3244 / +381 11 288 0393 Fax +381 11 347 1337 office@dipar.rs
Singapore			
Assembly Sales Service	Singapore	SEW-EURODRIVE PTE. LTD. No 9, Tuas Drive 2 Jurong Industrial Estate Singapore 638644	Tel. +65 68621701 Fax +65 68612827 http://www.sew-eurodrive.com.sg sewsingapore@sew-eurodrive.com
Slovakia			
Sales	Bernolákovo	SEW-Eurodrive SK s.r.o. Priemyselná ulica 6267/7 900 27 Bernolákovo	Tel.+421 2 48 212 800 http://www.sew-eurodrive.sk sew@sew-eurodrive.sk
Slovenia			
Sales Service	Celje	Pakman - Pogonska Tehnika d.o.o. UI. XIV. divizije 14 3000 Celje	Tel. +386 3 490 83-20 Fax +386 3 490 83-21 pakman@siol.net
South Africa			
Assembly Sales Service	Johannesburg	SEW-EURODRIVE (PROPRIETARY) LIMITED 32 O'Connor Place Eurodrive House Aeroton Johannesburg 2190 P.O.Box 90004 Bertsham 2013	Tel. +27 11 248-7000 Fax +27 11 248-7289 http://www.sew.co.za info@sew.co.za
	Cape Town	SEW-EURODRIVE (PROPRIETARY) LIMITED Rainbow Park Cnr. Racecourse & Omuramba Road Montague Gardens Cape Town P.O.Box 36556 Chempet 7442	Tel. +27 21 552-9820 Fax +27 21 552-9830 Telex 576 062 bgriffiths@sew.co.za
	Durban	SEW-EURODRIVE (PROPRIETARY) LIMITED 48 Prospecton Road Isipingo Durban P.O. Box 10433, Ashwood 3605	Tel. +27 31 902 3815 Fax +27 31 902 3826 cdejager@sew.co.za
	Nelspruit	SEW-EURODRIVE (PROPRIETARY) LIMITED 7 Christie Crescent Vintonia P.O.Box 1942 Nelspruit 1200	Tel. +27 13 752-8007 Fax +27 13 752-8008 robermeyer@sew.co.za

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South Korea			
Assembly Sales Service	Ansan	SEW-EURODRIVE Korea Co., Ltd. 7, Dangjaengi-ro, Danwon-gu, Ansan-si, Gyeonggi-do, Zip 425-839	Tel. +82 31 492-8051 Fax +82 31 492-8056 http://www.sew-eurodrive.kr master.korea@sew-eurodrive.com
	Busan	SEW-EURODRIVE Korea Co., Ltd. 28, Noksansandan 262-ro 50beon-gil, Gangseo-gu, Busan, Zip 618-820	Tel. +82 51 832-0204 Fax +82 51 832-0230
Assembly Service	Siheung	SEW-EURODRIVE Korea Co., Ltd. 35, Emtibeui 26-ro 58beon-gil, Siheung-si, Gyeonggi-do	http://www.sew-eurodrive.kr
Spain			
Assembly Sales Service	Bilbao	SEW-EURODRIVE ESPAÑA, S.L. Parque Tecnológico, Edificio, 302 48170 Zamudio (Vizcaya)	Tel. +34 94 43184-70 http://www.sew-eurodrive.es sew.spain@sew-eurodrive.es
Sri Lanka			
Sales	Colombo	SM International (Pte) Ltd 254, Galle Raod Colombo 4, Sri Lanka	Tel. +94 1 2584887 Fax +94 1 2582981
Swaziland			
Sales	Manzini	C G Trading Co. (Pty) Ltd Simunye street Matsapha, Manzini	Tel. +268 7602 0790 Fax +268 2 518 5033 charles@cgtrading.co.sz www.cgtradingswaziland.com
Sweden			
Assembly Sales Service	Jönköping	SEW-EURODRIVE AB Gnejsvägen 6-8 553 03 Jönköping Box 3100 S-550 03 Jönköping	Tel. +46 36 34 42 00 Fax +46 36 34 42 80 http://www.sew-eurodrive.se jonkoping@sew.se
Switzerland			
Assembly Sales Service	Basel	Alfred Imhof A.G. Jurastrasse 10 4142 Münchenstein bei Basel	Tel. +41 61 417 1717 Fax +41 61 417 1700 http://www.imhof-sew.ch info@imhof-sew.ch
Taiwan			
Sales	Taipei	Ting Shou Trading Co., Ltd. 6F-3, No. 267, Sec. 2 Tung Huw S. Road Taipei	Tel. +886 2 27383535 Fax +886 2 27368268 Telex 27 245 sewtwn@ms63.hinet.net http://www.tingshou.com.tw
	Nan Tou	Ting Shou Trading Co., Ltd. No. 55 Kung Yeh N. Road Industrial District Nan Tou 540	Tel. +886 49 255353 Fax +886 49 257878 sewtwn@ms63.hinet.net http://www.tingshou.com.tw
Tanzania			
Sales	Daressalam	SEW-EURODRIVE PTY LIMITED TANZANIA Plot 52, Regent Estate PO Box 106274 Dar Es Salaam	Tel. +255 0 22 277 5780 Fax +255 0 22 277 5788 http://www.sew-eurodrive.co.tz info@sew.co.tz
Thailand			
Assembly Sales Service	Chonburi	SEW-EURODRIVE (Thailand) Ltd. 700/456, Moo.7, Donhuaroh Muang Chonburi 20000	Tel. +66 38 454281 Fax +66 38 454288 sewthailand@sew-eurodrive.com
Tunisia			
Sales	Tunis	T. M.S. Technic Marketing Service Zone Industrielle Mghira 2 Lot No. 39 2082 Fouchana	Tel. +216 79 40 88 77 Fax +216 79 40 88 66 http://www.tms.com.tn tms@tms.com.tn

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Turkey			
Assembly Sales Service	Kocaeli-Gebze	SEW-EURODRIVE Ana Merkez Gebze Organize Sanayi Böl. 400 Sok No. 401 41480 Gebze Kocaeli	Tel. +90 262 9991000 04 Fax +90 262 9991009 http://www.sew-eurodrive.com.tr sew@sew-eurodrive.com.tr
Ukraine			
Assembly Sales Service	Dnipropetrovsk	SEW-EURODRIVE, LLC Robochya str., bld. 23-B, office 409 49008 Dnipro	Tel. +380 56 370 3211 Fax +380 56 372 2078 http://www.sew-eurodrive.ua sew@sew-eurodrive.ua
United Arab Emirates			
Drive Technology Center	Dubai	SEW-EURODRIVE FZE PO Box 263835 Jebel Ali Free Zone – South, P.O. Box Dubai, United Arab Emirates	Tel. +971 (0)4 8806461 Fax +971 (0)4 8806464 info@sew-eurodrive.ae
Uruguay			
Assembly Sales	Montevideo	SEW-EURODRIVE Uruguay, S. A. Jose Serrato 3569 Esqina Corumbe CP 12000 Montevideo	Tel. +598 2 21181-89 Fax +598 2 21181-90 sewuy@sew-eurodrive.com.uy
USA			
Production Assembly Sales Service	Southeast Region	SEW-EURODRIVE INC. 220 Finch Rd P.O. Box 518 Wellford SC , 29385	Tel. +1 864 439-7537 Fax Sales +1 864 439-7830 Fax Production +1 864 439-9948 Fax Assembly +1 864 439-0566 Fax Confidential/HR +1 864 949-5557 http://www.seweurodrive.com cslyman@seweurodrive.com
Assembly Sales Service	Northeast Region	SEW-EURODRIVE INC. Pureland Ind. Complex 2107 High Hill Road, P.O. Box 481 Bridgeport, New Jersey 08014	Tel. +1 856 467-2277 Fax +1 856 845-3179 csbridgeport@seweurodrive.com
	Midwest Region	SEW-EURODRIVE INC. 2001 West Main Street Troy, Ohio 45373	Tel. +1 937 335-0036 Fax +1 937 332-0038 cstroy@seweurodrive.com
	Southwest Region	SEW-EURODRIVE INC. 202 W. Danieldale Rd. DeSoto, TX 75115	Tel. +1 214 330-4824 Fax +1 214 330-4724 csdallas@seweurodrive.com
	Western Region	SEW-EURODRIVE INC. 30599 San Antonio St. Hayward, CA 94544	Tel. +1 510 487-3560 Fax +1 510 487-6433 cshayward@seweurodrive.com
	Wellford	SEW-EURODRIVE INC. 148/150 Finch Rd. Wellford, S.C. 29385	Tel. +1 864 439-7537 Fax +1 864 661 1167 IGOrders@seweurodrive.com
	Additional addresses for service provided on request!		
Vietnam			
Sales	Ho Chi Minh City	SEW-EURODRIVE PTE. LTD. RO at Hochiminh City Floor 8, KV I, Loyal building, 151-151 Bis Vo Thi Sau street, ward 6, District 3, Ho Chi Minh City, Vietnam	Tel. +84 937 299 700 huytam.phan@sew-eurodrive.com
	Hanoi	MICO LTD Quảng Trị - North Vietnam / All sectors except Construction Materials 8th Floor, Ocean Park Building, 01 Dao Duy Anh St, Ha Noi, Viet Nam	Tel. +84 4 39386666 Fax +84 4 3938 6888 nam_ph@micogroup.com.vn http://www.micogroup.com.vn
Zambia			
Representation: South Africa			

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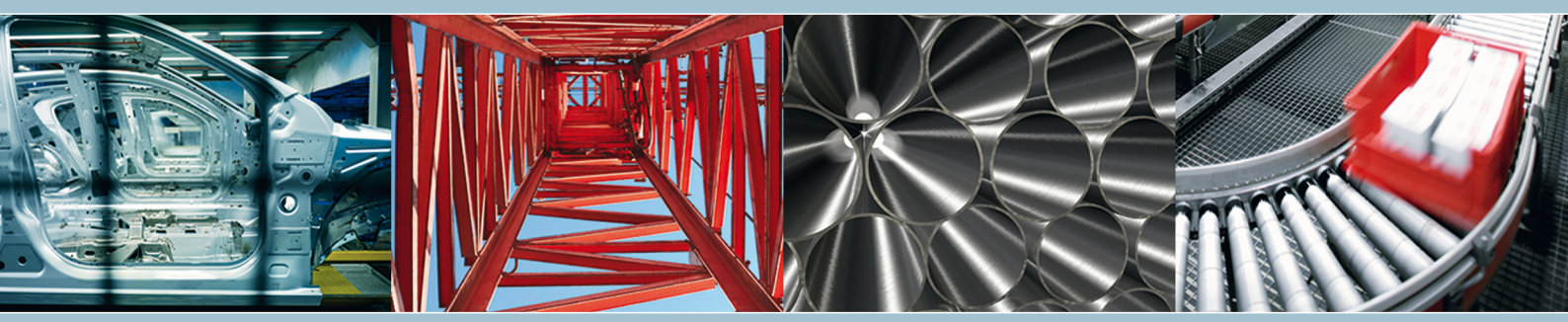

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