SEW EURODRIVE

Manual

MOVIDRIVE® modular/system/technology
MOVISAFE® CS..A Safety Card (Version 2)

Edition 03/2019

28482271/EN

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1 General information

1.1 About this documentation

The current version of the documentation is the original.

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

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

1.2 Structure of the safety notes

1.2.1 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.	

1.2.2 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 automatic restart

1.2.3 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.

1.3 Rights to claim under limited warranty

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

1.4 Content of the documentation

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

1.5 Other applicable documentation

This document supplements the operating instructions and limits the application notes according to the following information. Use this document only in connection with the operating instructions.

- "MOVIDRIVE® modular", "MOVIDRIVE® system" and MOVIDRIVE® technology" operating instructions
- Addendum to "Safety Encoders and Safety Brakes DR.., DRN.., DR2.., EDR.., EDRN.. AC Motors" operating instructions functional safety
- Addendum to the operating instructions "AK0H/AK1H Safety Encoders – CMP40 – 150, CMPZ71 – 100 Synchronous Servomotors Functional Safety".

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1.6 Decimal separator in numerical values

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

Example: 30.5 kg

1.7 Copyright notice

1.8 Product names and trademarks

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

1.8.1 Trademarks of Beckhoff Automation GmbH

EtherCAT® and Safety over EtherCAT® are registered trademarks and patented technologies, licensed by Beckhoff Automation GmbH, Germany.

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2 Safety notes

2.1 Preliminary information

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

2.2 Duties of the user

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

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

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

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

- 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.

2.3 Target group

Specialist for mechanical work

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

- Qualification in the mechanical area in accordance with the national regulations
- Familiarity with this documentation

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Specialist for electrotechnical work

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

- Qualification in the electrotechnical area in accordance with the national regulations
- Familiarity with this documentation

Additional qualification

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 units, systems, and circuits in accordance with the standards of safety technology.

Instructed persons

All work in the areas of transportation, storage, operation and waste disposal must be carried out by persons who are trained appropriately. The purpose of the instruction is that the persons are capable of performing the required tasks and work steps in a safe and correct manner.

2.4 Designated use

The product is intended for installation in inverters.

The product is a configurable safety control for realizing safety cutoffs and functions. The product is intended for use:

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

In the case of installation in electrical systems or machines, it is prohibited to start the proper operation of the product until it is determined that the machine meets the requirements stipulated in the local laws and directives.

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

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

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

2.5 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.

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If necessary, use suitable, sufficiently dimensioned handling equipment.

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

2.6 Installation/assembly

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

Protect the product from strong mechanical strain. The product and its mounting parts must never protrude into the path of persons or vehicles. Ensure that components are not deformed and insulation spaces are not changed, particularly during transportation and handling. Electric components must not be mechanically damaged or destroyed.

Observe the notes in chapter "Mechanical installation" (→ 🗎 43) in the documentation.

2.6.1 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

2.7 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).

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2.8 Definitions

- The designation "F-DI." stands for a safe input.
- The designation "F-DO." stands for a safe output.
- The designation "CS..A" is used as a generic term for all derivatives of the MOVISAFE® CS product series. If a particular derivative is referred to in the manual, then the complete designation is used.
- The term "safe" used in this manual refers to the classification as a safe function according to EN ISO 13849-1.
- The "Assist CS.." parameter tool is the parameterization interface in MOVISUITE® for the MOVISAFE® CS..A safety card.

2.9 Startup/operation

Observe the safety notes in the chapters "Startup" (→ 🗎 68) and "Operation" (→ 🗎 91) in the documentation.

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

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.

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.

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

Do not deactivate monitoring and protection devices of the machine or system even for a test run.

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

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3 Safety concept

3.1 General

The MOVISAFE® CS..A safety card is a safe assembly with safe digital inputs and outputs and, depending on the parameterization, safe communication.

MOVISAFE® CS..A is fully integrated in the MOVIDRIVE® modular/system/technology inverters. This means that MOVISAFE® CS..A inside the devices activates the STO drive safety function 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 MOVISAFE® CS..A safety card is defined as follows:

- The internal output F-DO_STO is disabled. This activates the STO drive safety function.
- All other existing safe digital outputs are disabled.
- With parameterized safe communication, either substitute values are sent for the data (i.e. all data is "0"), or the communication is interrupted.

3.2 Notes on stop categories

- The STO drive safety function corresponds to stop category 0.
- The SS1(c), SS1(b) and SS1(a) drive safety functions correspond to stop category 1.
- The SS2(c), SS3(b) and SS2(a) drive safety functions correspond to stop category 2.

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3.3 Pluggable safety key

The safety key must be inserted upon activation of the MOVISAFE® CS..A safety card and may not be removed when the safety card is activated.

The parameterization data of the MOVISAFE® CS..A safety card is divided into application-related data and the key data set. The key data set ensures the data integrity.

The application-related data is stored in the device. The application-related data is released with the aid of the key data set on the pluggable safety key. The safety card 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 released 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 secure 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, in the event of a device replacement, the application-related data and the communication data are available again immediately.

3.4 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. As an alternative, 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 parameterization tool Assist CS.. is connected to the correct device. The user is authenticated via the entry of a password.

3.5 Report and safety check

The acceptance report can be created once the parameters are downloaded. The acceptance of the safety card within the system can be carried out (see chapter "Requirements for startup") with this acceptance report. Following acceptance, this must be confirmed in the safety card. The confirmation is not a replacement for the test that must be carried out. The "Checksum of the report" of the safety card is announced as confirmation of the acceptance in the "Assist CS.." parameterization tool.

3.6 MOVISAFE® CS..A safety concept

- The MOVISAFE® CS..A safety card is an integrated, safe electronic assembly that can be operated with or without a safe communication. PROFIsafe, FSoE, and ISOFAST® are available for safe communication. MOVISAFE® CS..A is equipped with safe inputs and outputs (F-DI, F-DO) and is available in the following designs.

  MOVISAFE® CSB21A safety card:

  – 4 safe inputs

  MOVISAFE® CSS21A safety card:

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– 4 safe inputs
– 2 safe dual-channel outputs

MOVISAFE® CSB31A safety card:

– 4 safe inputs
– 2 safe dual-channel outputs
– Second encoder slot (not used for functional safety)

MOVISAFE® CSS31A safety card:

– 4 safe inputs
– 2 safe dual-channel outputs
– Second encoder slot (not used for functional safety)

- The MOVISAFE® CS..A safety card can release or safely deactivate the output stage of the inverter. The switching state of the internal output F-DO_STO, and thus the STO drive safety function, must 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 MOVISAFE® CS..A safety card is based on a safe state existing for all safe process values. For the MOVISAFE® CS..A, this value is "0" for all F-DI inputs and F-DO outputs.
- The MOVISAFE® CS..A safety card was designed pursuant to IEC 61508 for SIL3 and EN ISO 13849-1 for Performance Level e.
- The MOVISAFE® CSS21A and CSS31A safety cards can reliably monitor motion functions in conjunction with encoders.

3.7 Drive safety functions according to EN 61800-5-2

This chapter describes the drive safety functions pursuant to EN 61800-5-2. The following table shows the availability of the drive safety functions described below, depending on the respective MOVISAFE® CS..A safety card used.

MOVISAFE® safety card	Drive safety functions												
	Standstill			Motion									
	STO	SBC	SS1(c)	SS1(a) SS1(b)	SS2(c)	SS2(a) SS2(b)	SOS	SLS	SSM	SSR	SDI	SLI	SLA
				Only with FS encoder									
CSB21A	x		x										
CSS21A	x	x	x	x	x	x	x	x	x	x	x	x	x
CSB31A[1)]	x	x	x										
CSS31A[1)]	x	x	x	x	x	x	x	x	x	x	x	x	x

1) has a second encoder connection (not used for functional safety)

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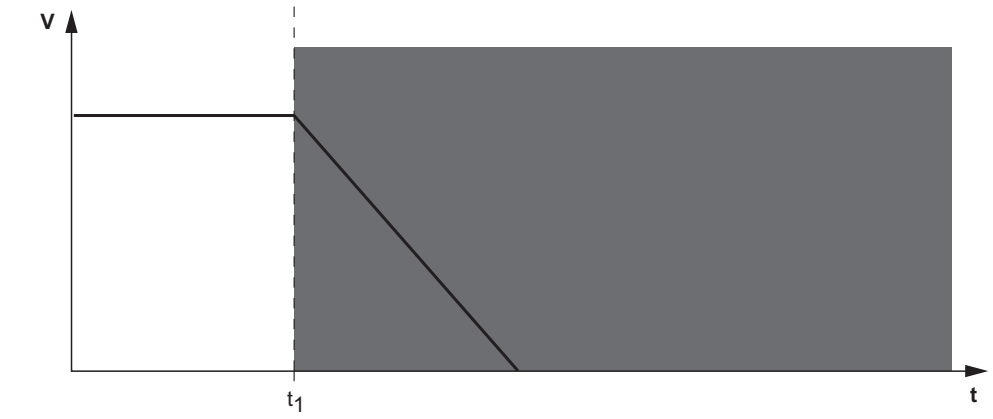
3.7.1 STO – Safe Torque Off

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 drive safety function corresponds to a non-controlled stop according to EN 60204-1, stop category 0.



9007201225613323

= Drive safety function 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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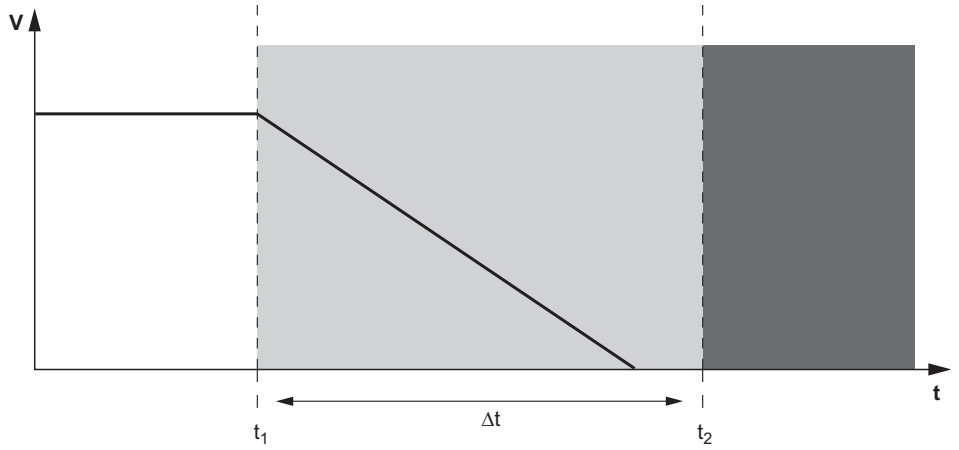
3.7.2 SS1(c) – Safe Stop 1 with time control

When the SS1(c) function is active, the inverter brings the motor to a standstill electrically. The drive safety function STO is triggered after a specified, safety-related time.

This drive safety function corresponds to a controlled stop of the drive according to EN 60204-1, stop category 1.



9007201225618443

= Drive safety function monitoring
= STO drive safety function active
v = Speed
t = Time
t_1 = Point of time when SS1(c) is activated and motor deceleration is triggered.
t_2 = Point of time when STO is triggered.
Δt = Safety-relevant period of time

INFORMATION

- The SS1(c) 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).

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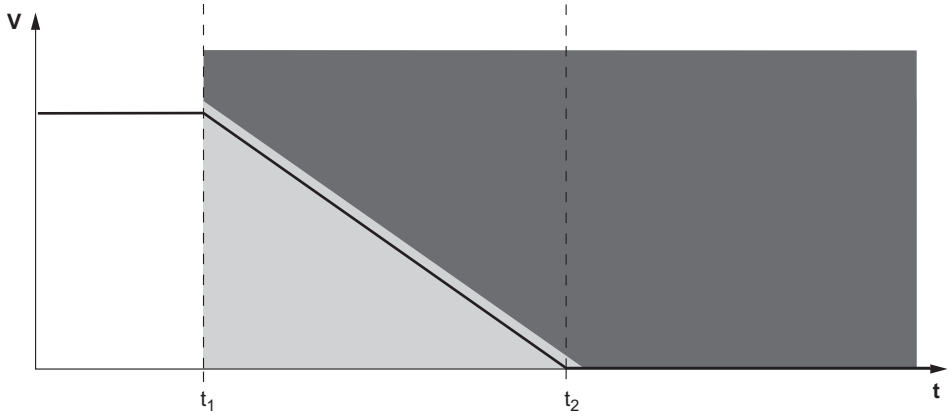
3.7.3 SS1(b) – Safe Stop 1 with monitoring of the deceleration ramp

When the SS1(b) function is active, the drive inverter brings the motor to a standstill electrically. The deceleration is monitored. The STO drive safety function is triggered when the monitored deceleration is exceeded or when standstill is reached.

This drive safety function corresponds to a controlled stop of the drive according to EN 60204-1, stop category 1.



9007201225616011

= Drive safety function monitoring
= Drive safety function trips
v = Speed
t = Time
t_1 = Point in time when SS1(b) is activated and motor deceleration is triggered.
t_2 = Point of time when STO is triggered.

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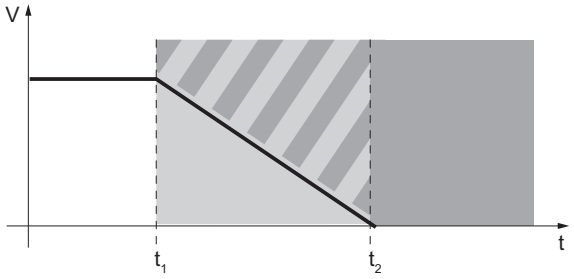
3.7.4 SS1(a) – Safe Stop 1 with control and monitoring of the deceleration ramp

When the SS1(a) function is active, the drive inverter brings the motor to a standstill electrically. The deceleration behavior is not controlled and monitored in a safety-related manner. The STO drive safety function is triggered when the monitored deceleration is exceeded or when standstill is reached.

This drive safety function corresponds to a controlled stop of the drive according to EN 60204-1, stop category 1.



28259416075

= Drive safety function controls and monitors
= STO drive safety function active
v = Speed
t = Time
t_1 = Point in time when SS1(a) is activated and motor deceleration is triggered.
t_2 = Point of time when STO is triggered.

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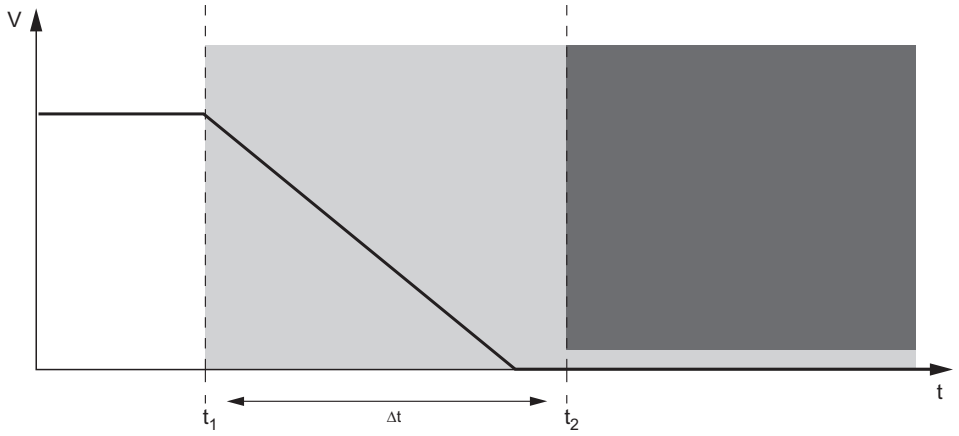
3.7.5 SS2(c) – Safe Stop 2 with time control

When the SS2(c) function is active, the drive inverter brings the motor to a standstill electrically. At standstill, the drive inverter delivers the power to keep the motor in position. The position must be safely monitored after a specified, safety-related time has elapsed (SOS function according to EN 61800-5-2). Any movement at standstill triggers the STO drive safety function. STO means that standstill has to be ensured by a mechanical brake.

This drive safety function corresponds to a controlled stop of the drive according to EN 60204-1, stop category 2.



9007201429937291

= Drive safety function monitoring
= STO drive safety function active
v = Speed
t = Time
t_1 = Point of time when SS2(c) is activated and motor deceleration is triggered.
t_2 = Time when SOS is triggered.
Δt = Safety-related period of time

INFORMATION

- The SS2(c) 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. It will not be de-energized until the time t_2 (STO).

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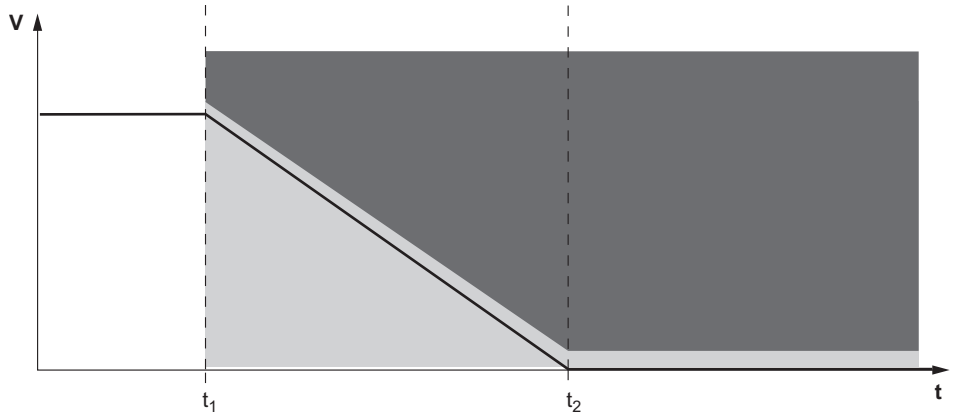
3.7.6 SS2(b) – Safe Stop 2 with monitoring of the deceleration ramp

When the SS2(b) function is active, the drive inverter brings the motor to a standstill electrically. The deceleration is monitored. The position must be safely monitored after standstill (SOS function according to EN 61800-5-2). The STO drive safety function will be triggered if the deceleration value is exceeded while stopping or if movement occurs during standstill. STO means that standstill has to be ensured by a mechanical brake.

This drive safety function corresponds to a controlled stop of the drive according to EN 60204-1, stop category 2.



9007201225698059

= Drive safety function monitoring
= STO drive safety function active
v = Speed
t = Time
t_1 = Point in time when SS2(b) is activated and motor deceleration is triggered.
t_2 = Time when SOS is triggered.

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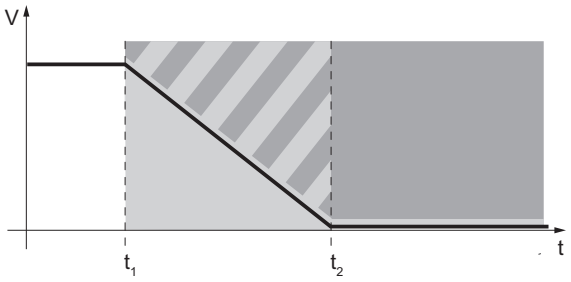
3.7.7 SS2(a) – Safe Stop 2 with control and monitoring of the deceleration ramp

When the SS2(a) function is active, the drive inverter brings the motor to a standstill electrically. The deceleration behavior is not controlled and monitored in a safety-related manner. The position must be safely monitored after standstill (SOS function according to EN 61800-5-2). The STO drive safety function will be triggered if the deceleration value is exceeded while stopping or if movement occurs during standstill. STO means that standstill has to be ensured by a mechanical brake.

This drive safety function corresponds to a controlled stop of the drive according to EN 60204-1, stop category 2.



28259419659

= Drive safety function controls and monitors
= STO drive safety function active
v = Speed
t = Time
t_1 = Point in time when SS2(a) is activated and motor deceleration is triggered.
t_2 = Time when SOS is triggered.

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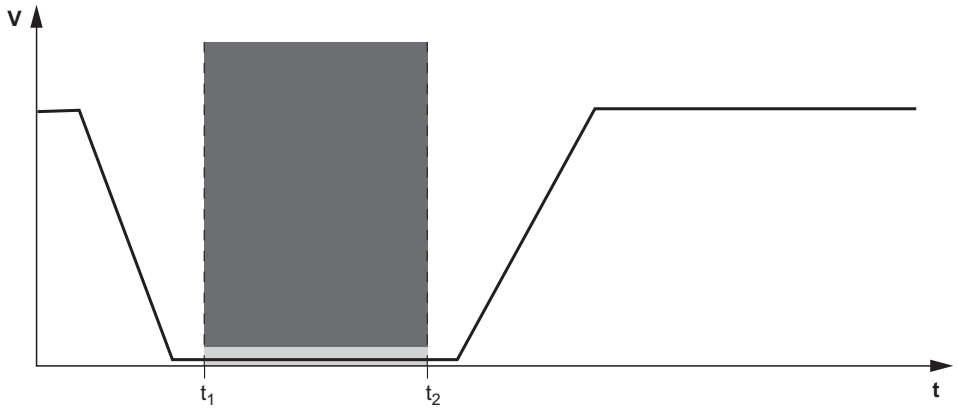
3.7.8 SOS – Safe Operating Stop

The SOS function prevents the motor from deviating from the stop position by more than a specified value. The drive inverter delivers the power to keep the motor in position. If the specified value is exceeded, the drive safety function will be triggered and an error response will be initiated at the same time.

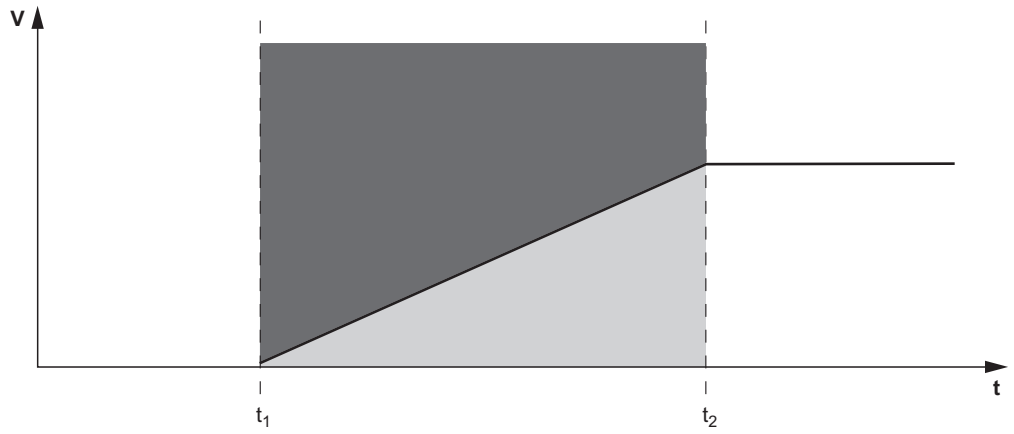


9007201225700491

= Drive safety function monitoring
= Drive safety function trips
v = Speed
t = Time
t_1 = Time when SOS is triggered.
t_2 = Point in time at which SOS is deactivated.

3.7.9 SLA – Safely Limited Acceleration

The SLA function prevents a movement from exceeding a specified acceleration value. If the permitted acceleration limit is exceeded, the drive safety function will be triggered and an error response will be initiated at the same time.



9007201225705355

= Drive safety function monitoring
= Drive safety function trips
v = Speed
t = Time
t_1 = Point in time at which SLA is activated.
t_2 = Point in time when SLA is deactivated.

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3.7.10 SLS – Safely Limited Speed

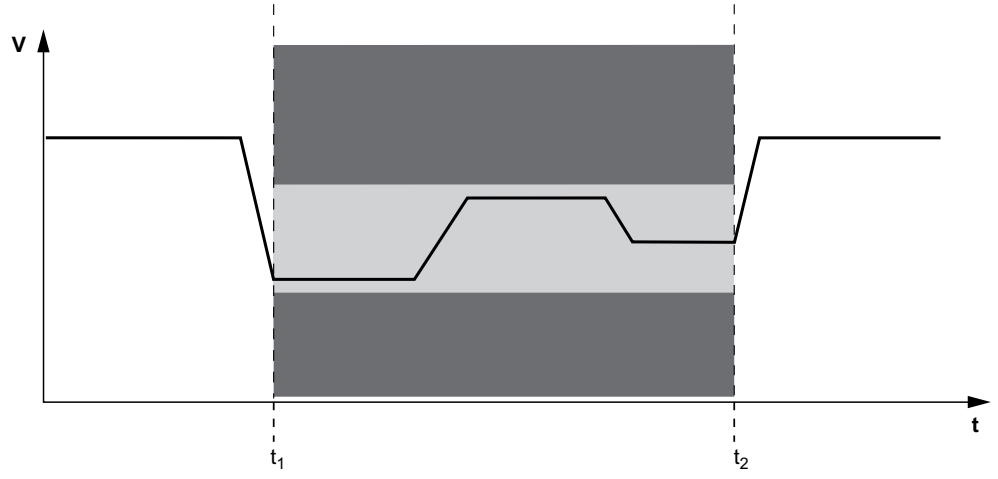
The SLS function prevents the drive from exceeding a specified speed. If the permitted speed is exceeded, the drive safety function will be triggered and an error response will be initiated at the same time.

9007201225702923

= Drive safety function monitoring
= Drive safety function trips
v = Speed
t = Time
t_1 = Point in time at which SLS is activated.
t_2 = Point in time at which SLS is deactivated.

3.7.11 SSR – Safe Speed Range

The SSR function prevents the speed of the drive from exceeding a specified range. If the permitted speed range is exceeded or not achieved, the drive safety function will be triggered and an error response will be initiated at the same time.



9007201659986827

= Drive safety function monitoring
= Drive safety function trips
v = Speed
t = Time
t_1 = Point in time at which SSR is activated.
t_2 = Point in time at which SSR is deactivated.

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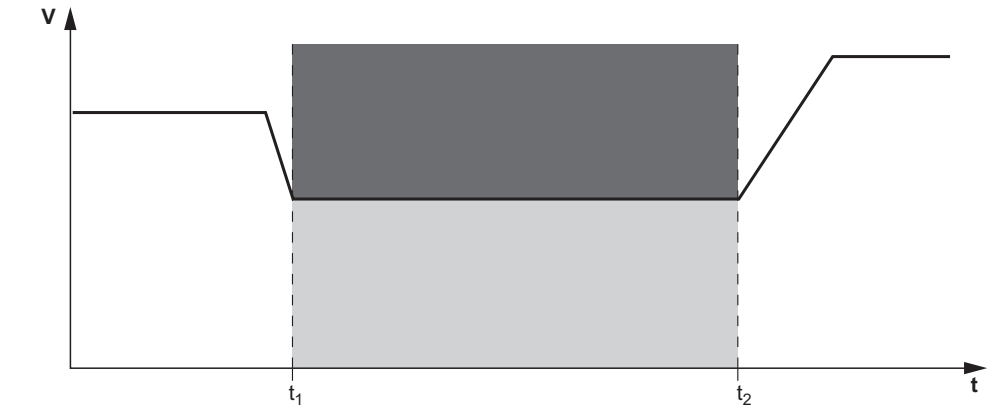
3.7.12 SSM – Safe Speed Monitoring

The SSM function monitors whether the drive exceeds a specified speed. An exceeding of the allowed speed is signaled.

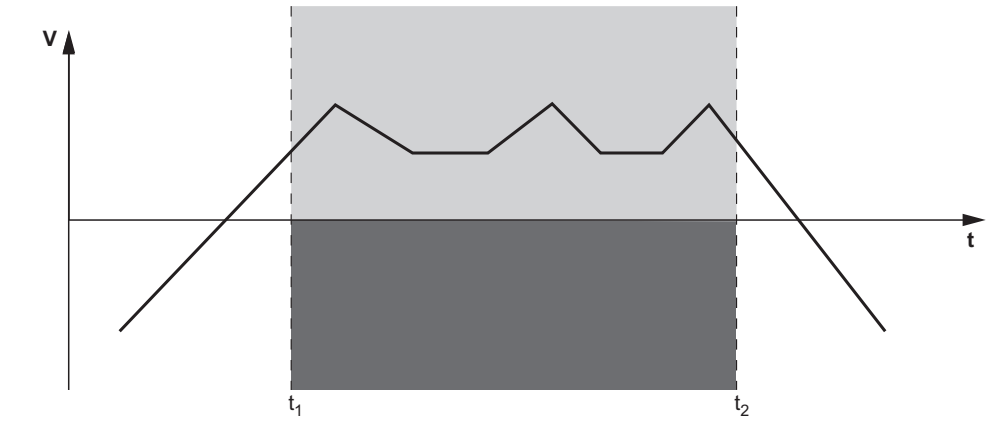


9007201225702923

= Drive safety function monitoring
= Drive safety function trips
v = Speed
t = Time
t_1 = Point in time at which SSM is activated.
t_2 = Point in time at which SSM is deactivated.

3.7.13 SDI – Safe Direction

The SDI function prevents movement in an unintended direction. If this condition is violated, the drive safety function will be triggered and an error response will be initiated at the same time (usually STO or SS1).



9007201225717643

= Drive safety function monitoring
= Drive safety function trips
v = Speed
t = Time
t_1 = Point in time when SDI is activated.
t_2 = Point in time when SDI is deactivated.

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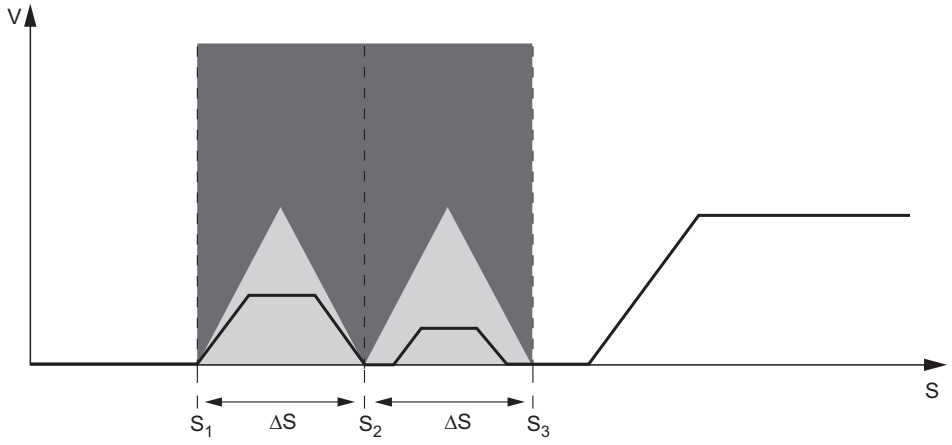
3.7.14 SLI – Safely Limited Increment

The SLI function prevents a movement from exceeding a specified increment. If the limit value of the increment is not respected, the drive safety function will be triggered and an error response will be initiated at the same time.

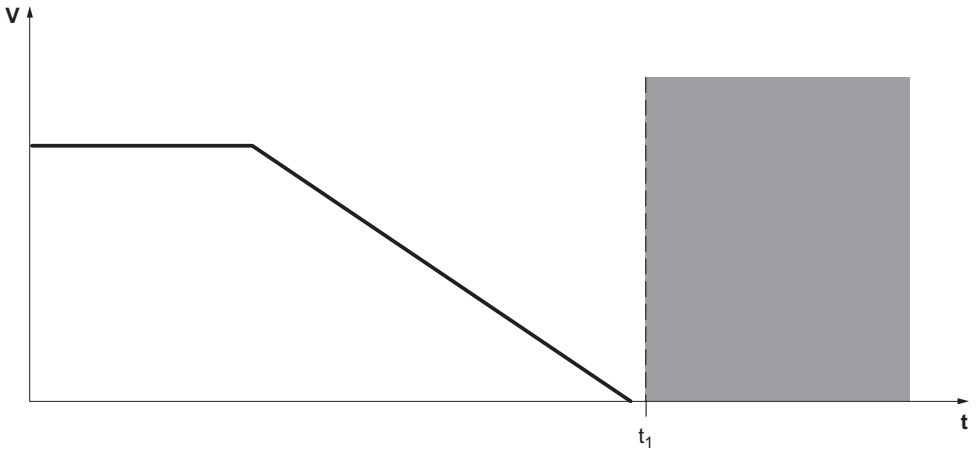


9007201225720459

= Drive safety function monitoring
= Drive safety function trips
v = Speed
s = Distance
s_1, s_2 = Point in time at which SLI is activated.
s_2, s_3 = Point in time at which SLI is deactivated.
Δs = Safe increment

3.7.15 SBC – Safe Brake Control

The SBC function provides a safe output signal for controlling an external brake.



27021600043191563

= Drive safety function activated
v = Speed
t = Time
t_1 = Point in time when SBC is triggered.

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3.8 Safety concept of Assist CS..

3.8.1 Safety parameters

For parameterization of the drive safety functions, MOVISAFE® CS.. A offers adjustable safety parameters.

The safety parameters determine the behavior of the corresponding drive safety functions and are therefore safety-related. All safety parameters are combined in the parameter set.

3.8.2 Test concept and test procedure

The parameters of the MOVISAFE® CS..A safety card 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 error-free, the safety concept prescribes the following measures:

- Identification of the MOVISAFE® CS..A.
- To establish a connection with the MOVISAFE® CS..A safety card, the safety key ID must be entered in a dialog box.
- Guided parameter setting procedure with the parameterization tool "Assist CS.." with integrated safety features such as plausibility check of entries.
- Completion of parameterization with an acceptance report to accept the drive safety functions.

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4 Safety requirements

4.1 Installation requirements

- Power cables and the safe control cables must be routed separately.
- The wiring technology used must comply with the standard EN 60204-1.
- The safe control cables of the MOVISAFE® CS..A safety card must be installed pursuant to EMC requirements. Observe the following information:
  - Observe the regulations applicable to the application and the information in the operating instructions for the inverter.
  - If the safe outputs and/or inputs are wired in a dual-channel configuration, the corresponding cables must be routed closely together. The cables should be of the same length.
- Make sure that no parasitic voltages can be generated in safe control cables.
- Outside of a closed installation room, safety-related control cables must be protected against external damage.
- Only voltage sources with protective separation (SELV/PELV) pursuant to EN 60204-1 and EN 61131-2 are permitted for any DC 24 V supply voltages to the MOVIDRIVE® modular/system/technology. In case of a single fault, the voltage between the outputs or between any output and grounded parts may not exceed 60 V DC. This also applies to sensors that are supplied by a separate voltage supply and connected to the MOVISAFE® CS..A safety card.
- The encoder cable must not carry a TF signal when connecting an EI7C FS built-in encoder to the MOVIDRIVE® modular/system/technology.
- The safety card must be protected against conductive dirt, e.g. by installing it in a control cabinet with degree of protection IP54 pursuant to IEC 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 in ambient temperature.

4.2 Encoder cable requirements

4.2.1 SINE/COSINE encoder cable

- Use a shielded encoder cable. Connect the shield at both ends.
- Max. length of the encoder cable: 100 m
- Use the prefabricated encoder cables from SEW-EURODRIVE. Observe the following requirements if you use other encoder cables:
  - Encoder cable length ≤ 50 m

    The cross section of each core of the encoder cable must be ≥ 0.25 mm^2. The resistance load per unit length of the cores must not exceed 78 Ω/km (at 20 °C).
  - Encoder cable length > 50 m:

    The cross section of the cores for the encoder voltage supply and GND must be ≥ 0.5 mm^2. The resistance load per unit length of these cores must not exceed 39 Ω/km. The resistance load per unit length of the signal cores must not exceed 78 Ω/km (at 20 °C).

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– Differential signal pairs (e.g. the track signals A and $\overline{A}$, B and $\overline{B}$, C and $\overline{C}$, Data + and Data-) must be routed via twisted cores.
– The encoder cable may exhibit 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.

4.2.2 HTL encoder cable

- 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 encoder signals must be conducted in twisted pairs as follows:

    U_B and GND

    A+ and A-

    B+ and B-
  – The encoder cable may exhibit 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.

4.3 Sensor and actuator requirements

- The project planner and the user of the system or machine are responsible for the number and utilization of external sensors and actuators for connection with the safe inputs and outputs of the MOVISAFE® CS..A safety card.
- To meet the required performance level (PL/SIL), you must use suitable and correspondingly qualified sensors and actuators, and observe the relevant wiring diagrams and information in the chapters "Safe inputs" and "Safe outputs". The permissible encoders are described in the chapter "Encoder requirements".

4.4 Startup requirements

Following parameterization and startup of the CS..A safety card, the system startup engineer must check and document whether all of the drive safety functions are being executed correctly.

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For MOVIDRIVE® applications with safe torque off

- as per stop category 0, 1, or 2 in accordance with EN 60204-1,
- and to prevent unexpected startup in accordance with EN ISO 14118,

you must, as a general rule, carry out and document startup checks of the disconnecting device and the correct wiring.

This is supported by the "Assist CS.." parameterization tool with an acceptance protocol.

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 drive safety function is then shorter than the maximum permitted fault response time of the application. The maximum permitted fault response time may not be exceeded!
- The user must ensure implementation of the requirements of the required safety integrity level (SIL) in accordance with IEC 61508 or performance level (PL) pursuant to EN ISO 13849-1.

4.5 Requirements for stopping in an emergency according to EN 60204-1 (emergency stop)

The MOVISAFE® CS..A safety cards, in combination with an emergency stop command device and the external control, are suitable for implementing an emergency stop in accordance with EN 60204-1.

⚠ WARNING

In the case of a pending travel command, the drive restarts after acknowledgment of the safety card.

Severe or fatal injuries.

- Cancel the travel command before acknowledging the safety card.

4.6 Encoder requirements

4.6.1 Permitted safety encoders

The following safety encoders are permitted for use with the MOVISAFE® CS..A safety cards. For further information on the safety encoders, refer to the corresponding documentation.

AC motors/asynchronous servomotors

- ES7S/EG7S
- AS7W/AG7W
- EI7C FS

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⚠ WARNING

Loss of the safety function due to use of out-of-date AS7W or AG7W safety encoders, e.g. in existing systems.

Severe or fatal injuries

✓ Use of the following safety encoders is not permitted with the MOVISAFE® CS..A safety cards:

- AS7W: Part numbers 13630733 and 13630768
- AG7W: Part number 13630849

→ Use the latest version of the AS7W/AG7W safety encoders.

Servomotors

- AK0H
- AK1H

In order to implement a drive safety function with AK0H or AK1H encoders, the motor must be started with the control mode CFC.

The following inverter settings are recommended:

- Activation of lag error monitoring
- Activation of speed monitoring
- Activation of encoder monitoring

4.6.2 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 °
- AK0H: 4.3 °
- AK1H: 0.53 °
- E..7S: 0.53 °
- A..7W: 0.27 °

Speed

The speed calculation determines the average speed in the time range set via the *Filter time speed SinCos (8708.3)* parameter:

Quantization error_v in 1/min =

(15 s x 1/min) / (PPR_count x parameterized_filter time)

In addition to the process-related quantization error, there is an additional actual speed error of 0.3%:

Error_v_SinCos = Actual speed x 0.3% + Quantization error_v

The speed calculation for the encoder EI7C FS 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:

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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.

Acceleration

The acceleration calculation determines the average acceleration in the time range set via the parameter *Filter time acceleration (8708.2)*. The quantization error that thereby occurs decreases as the filter time increases. In return, the response time increases in accordance with the filter time.

Quantization error_a in 1/min s =

(120 s x 1/min) / (PPR_count x (parameterized_filter time)^2)

In addition to the process-related quantization error, there is an additional actual acceleration error of 0.5%:

Error_a_SinCos = Actual acceleration x 0.5% + Quantization error_a

4.6.3 Counting direction

For the process values to have identical signs also in the inverter, the encoder parameter *Counting direction (8708.6)* of the MOVISAFE® CS..A safety card must be set as follows, depending on the inverter parameters *Direction of rotation reversal (8362.2)* and *Counting direction (8381.6)*:

***Direction of rotation reversal (8362.2)* setting**	**Encoder parameter *Counting direction (8708.6)* setting**	
	Inverter parameter *Counting direction (8381.6)* setting	
8362.2 = Off	8708.6 = Normal 8381.6 = Normal	8708.6 = Inverted 8381.6 = Inverted
8362.2 = On	8708.6 = Inverted 8381.6 = Normal	8708.6 = Normal 8381.6 = Inverted

4.6.4 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 MOVISAFE® CS..A safety card.

Encoder type	Switch-off threshold min^{-1}	Mechanical limit speed of the encoder min^{-1}
EI7C FS	3800	5700
AK0H	6329	9000
AK1H	6445	12 000
E.7S	3809	6000
A.7W	3809	6000

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Exceeding the switch-off threshold results in a fault message in the safety card with the fault response "STO" within 11 ms for sine/cosine encoders or 13 ms for EI7C FS. The fault response is executed by the STO circuit within another 2 ms.

Measures the application must ensure that the mechanical limit speed is not reached during this time (11 ms/13 ms).

4.7 Requirements for operation

Operation is permitted only within the limits specified in the corresponding documentation. This applies to the MOVISAFE® CS..A safety card as well as all connected devices.

4.8 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 function.

To validate the safety integrity level you can use the "SISTEMA" calculation tool from the Institut für Arbeitsschutz (Institute for Occupational Safety and Health of the German Social Accident Insurance).

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5 Device structure

5.1 Firmware version

The "MOVIDRIVE® modular/system/technology – MOVISAFE® CS..A safety card" manual (Version 2) applies to the MOVISAFE® CS..A safety card as of firmware version 2.05.

The "MOVIDRIVE® modular/system – MOVISAFE® CS..A safety card" manual (Version 1) applies to the MOVISAFE® CS..A safety card as of firmware version 1.05.

5.2 Type designation

The type designation MOVISAFE® CSxxA contains the following data:

CSxx1A	MOVISAFE® CS..A safety card/option	
CS	Series:	
	C	MOVI-C® option/option card
	S	Safety
x	Function:	
	B	Basic: Stop functions without encoder
	S	Standard: Motion functions with a safety encoder
x	Hardware design:	
	1	MOVITRAC®
	2	MOVIDRIVE® modular/system/technology without second encoder
	3	MOVIDRIVE® modular/system/technology with second encoder
	5	Electronics cover of the basic device (MOVI-C® decentralized electronics)
1	Design characteristic	
A	Technology version	

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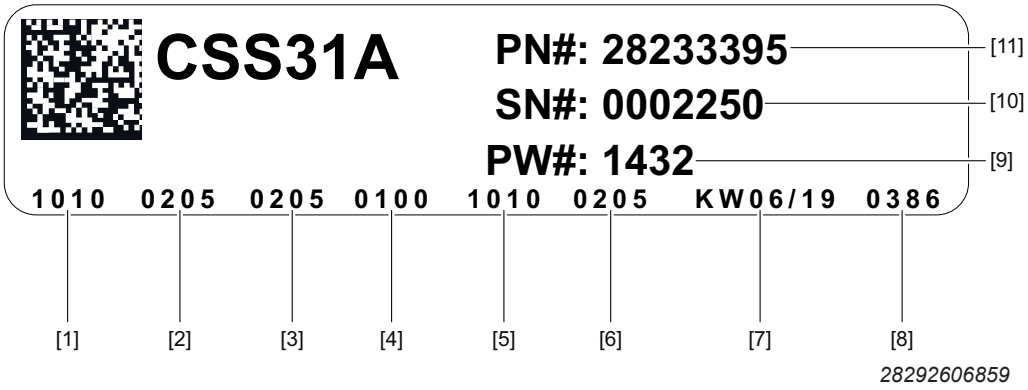
5.3 Nameplate

In addition to the device nameplates on the basic unit, a label is also attached to the rear of the CS..A safety card's front cover. The following figure shows an example label.



[1] Safety card hardware ID

[2] Channel A firmware version (0205 = firmware version 2.05)

[3] Channel B firmware version (0205 = firmware version 2.05)

[4] EEPROM data set

[5] Safety key hardware ID

[6] Safety key data set

[7] Date of production

[8] Internal inspection number

[9] Master password for password change

[10] Serial number

[11] Part number

5.4 Scope of delivery

- MOVISAFE® CS..A:
  - Option card with plug-in spring-loaded terminals on X60.
  - Safety key

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5.5 Compatibility

5.5.1 CS..A safety card firmware version and MOVIDRIVE® device status

Use of the CS..A safety card depends on:

- The firmware version of the CS..A safety card.
- The device status of the MOVIDRIVE® modular/system/technology application inverter. The values for the status-related positions given in the following tables are minimum values.

  The device status can be found on the inverter's system nameplate.

Device status MOVIDRIVE® modular single-axis (MDA90..-S00)

Size	Device status location									Firmware version of the CS..A safety card	
	1	2	3	4	5	6	7	8	9	1.05	2.05
1 – 6	xx	xx	xx	13 00	xx	xx	xx	11 00	-	OK	Remove the black centering pin before installing the CS..A option.
1 – 6	xx	xx	xx	13 00	xx	xx	xx	12 00	-	OK	OK

The "xx" entries have no effect on compatibility.

For a CS..A safety card with firmware version 1.05, MOVIDRIVE® firmware version 2.10 or higher is required.

For a CS..A safety card with firmware version 2.05, MOVIDRIVE® firmware version 4.00 or higher is required.

Device status MOVIDRIVE® modular double-axis (MDD9..-S00)

Size	Device status location									Firmware version of the CS..A safety card	
	1	2	3	4	5	6	7	8	9	1.05	2.05
2	xx	xx	xx	13 00	xx	xx	11 00	11 00	-	OK	Remove the black centering pin before installing the CS..A option.
2	xx	xx	xx	13 00	xx	xx	11 00	12 00	-	OK	OK
2	xx	xx	xx	10 00	xx	xx	11 00	12 00	-	OK	OK

The "xx" entries have no effect on compatibility.

For a CS..A safety card with firmware version 1.05, MOVIDRIVE® firmware version 2.10 or higher is required.

For a CS..A safety card with firmware version 2.05, MOVIDRIVE® firmware version 4.00 or higher is required.

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Device status MOVIDRIVE® system (MDX9.A..-S00)

Size	Device status location									Firmware version of the CS..A safety card	
	1	2	3	4	5	6	7	8	9	1.05	2.05
1 – 5	xx	xx	12 00	11 00	xx	xx	xx	xx	xx	OK	Remove the black centering pin before installing the CS..A option.
1 – 5	xx	xx	15 00	xx	xx	xx	xx	xx	xx	OK	OK

The "xx" entries have no effect on compatibility.

For a CS..A safety card with firmware version 1.05, MOVIDRIVE® firmware version 2.10 or higher is required.

For a CS..A safety card with firmware version 2.05, MOVIDRIVE® firmware version 4.00 or higher is required.

Device status MOVIDRIVE® technology (MDX9.A..-T00)

Size	Device status location									Firmware version of the CS..A safety card	
	1	2	3	4	5	6	7	8	9	1.05	2.05
1 – 5	xx	xx	15 00	xx	xx	-	-	-	-	Not permitted.	OK

The "xx" entries have no effect on compatibility.

For a CS..A safety card with firmware version 2.05, MOVIDRIVE® firmware version 4.00 or higher is required.

Device status MOVIDRIVE® modular single-axis CiA402 (MDA90..-E00)

Size	Device status location									Firmware version of the CS..A safety card	
	1	2	3	4	5	6	7	8	9	1.05	2.05
1 – 5	xx	xx	xx	13 00	xx	-	11 00	12 00	-	Not permitted.	OK

The "xx" entries have no effect on compatibility.

For a CS..A safety card with firmware version 2.05, MOVIDRIVE® firmware version 4.00 or higher is required.

Device status MOVIDRIVE® modular double-axis CiA402 (MDD9..-E00)

Size	Device status location									Firmware version of the CS..A safety card	
	1	2	3	4	5	6	7	8	9	1.05	2.05
2	xx	xx	xx	13 00	xx	xx	11 00	12 00	-	Not permitted.	OK
2	xx	xx	xx	10 00	xx	xx	11 00	12 00	-	Not permitted.	OK

The "xx" entries have no effect on compatibility.

For a CS..A safety card with firmware version 2.05, MOVIDRIVE® firmware version 4.00 or higher is required.

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Device status MOVIDRIVE® system CiA402 (MDX9.A.-E00)

Size	Device status location									Firmware version of the CS..A safety card	
	1	2	3	4	5	6	7	8	9	1.05	2.05
1 – 5	xx	xx	15 00	xx	xx	xx	xx	xx	-	Not permitted.	OK

The "xx" entries have no effect on compatibility.

For a CS..A safety card with firmware version 2.05, MOVIDRIVE® firmware version 4.00 or higher is required.

5.5.2 CS..A safety card firmware version and MOVISUITE® version

Use of the CS..A safety card depends on:

- The firmware version of the CS..A safety card.
- The version of the MOVISUITE® engineering software.

Firmware version 2.05 and later

CS..A safety cards with firmware version 2.05 and higher can only be used with MOVISUITE® engineering software version 2.1 and higher. The following table shows the available CS..A safety cards with the corresponding part numbers.

CS..A safety card	Firmware version	CS..A part number
CSB21A	2.05 and higher	28233360
CSS21A		28233379
CSB31A		28233367
CSS31A		28233395

Firmware version 1.05

CS..A safety cards with firmware version 1.05 can only be used with MOVISUITE® engineering software version 1.2 and 2.0.

When replacing cards during servicing, CS..A safety cards with firmware version 1.05 can be ordered as a service kit so that acceptance testing of the drive safety functions is not required due to the change in firmware. The following table shows the available safety kits with their corresponding part numbers.

Service kit part number	Service kit (= CS..A safety card with firmware version 1.05)	Valid for CS..A safety card
28261976	Service kit CSB21A /FW1.05	CSB21A
28261984	Service kit CSS21A /FW1.05	CSS21A
28261992	Service kit CSB31A /FW1.05	CSB31A
28262018	Service kit CSS31A /FW1.05	CSS31A

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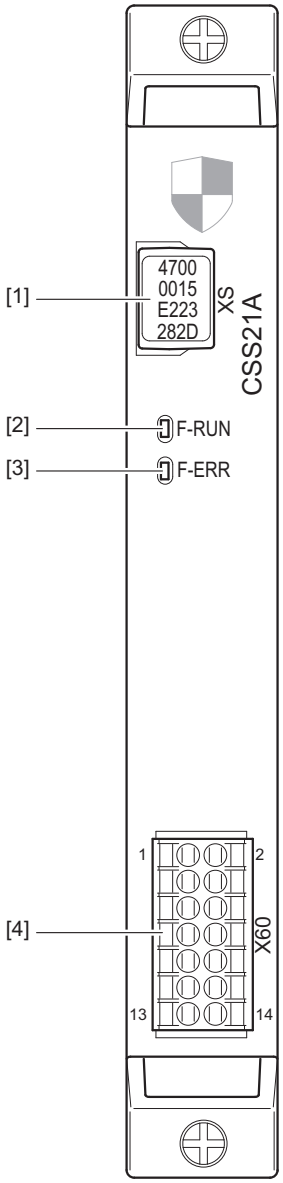
5.6 MOVISAFE® CSS21A/CSB21A



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[1] XS: Slot for the pluggable safety key
[2] "F-RUN" LED
[3] "F-ERR" LED
[4] X60: F-DIx and F-DOx connection

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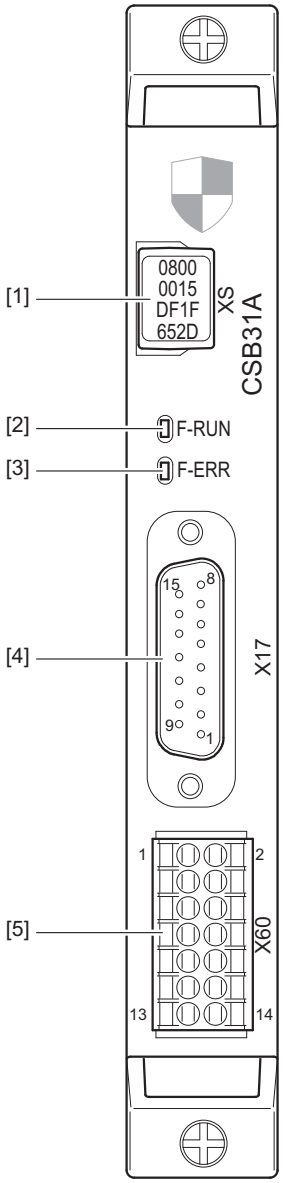
5.7 MOVISAFE® CSB31A/CSS31A



20370612875

[1] XS: Slot for the pluggable safety key
[2] "F-RUN" LED
[3] "F-ERR" LED
[4] X17: Connection of 2nd encoder (not used for functional safety)
[5] X60: F-DIx and F-DOx connection

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6 Mechanical installation

6.1 Before you start

Observe the following information before beginning with the installation or removal of the MOVISAFE® CS..A safety card:

- Disconnect the inverter from the power. Switch off the DC 24 V and the line voltage.
- Take appropriate measures to protect the option card from electrostatic discharge (use a discharge strap, wear conductive shoes, etc.) before touching it.
- **Before installing** the option card, remove the keypad and the front cover.
- **After installing** the option card, replace the front cover and the keypad.
- Keep the option card in its original packaging. Do not remove the option card from the original packaging until immediately before installation.
- Hold the option card by its edges only. Do not touch any of the components.

6.2 Installation of the MOVISAFE® CS..A safety card

The MOVISAFE® CS..A safety card can be installed only in the following inverters:

Inverter	MOVISAFE® CS.21A	MOVISAFE® CS.31A
MOVIDRIVE® modular – single-axis module MDA	Yes	Yes
MOVIDRIVE® modular – double-axis module MDD	Yes	No
MOVIDRIVE® system	Yes	Yes
MOVIDRIVE® technology	Yes	Yes

6.3 Installation of the MOVISAFE® CS..A – MOVIDRIVE® modular safety card

Observe the safety notes in chapter "Electrical Installation" in the inverter operating instructions.

INFORMATION

Requirements for installation.

The MOVISAFE® CS..A safety card can be installed only in option-capable axis modules.

1. Disconnect the application inverter from the power supply. Disconnect the DC 24 V supply and the line voltage. Remove the jumper plug X6.
2. Ensure electrostatic discharge with suitable measures before starting work. Suitable measures for equipotential bonding include, for example, the use of a discharge strap or wearing conductive shoes.

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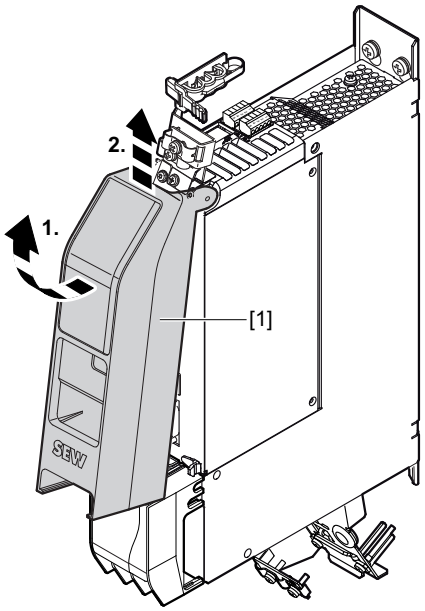
3. Remove the safety cover [1] from the front of the application inverter.



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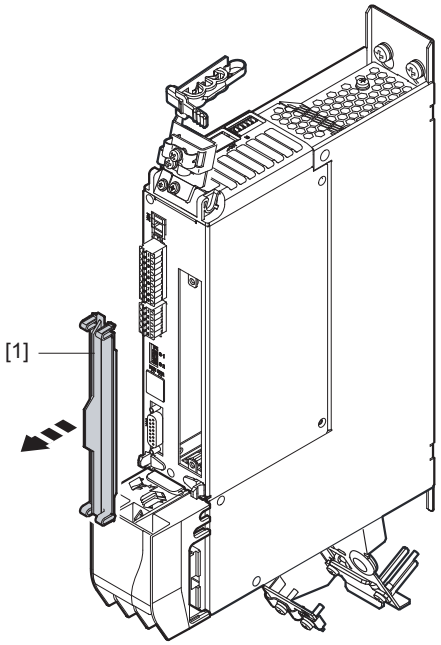
4. Remove the plastic cover [1] at the card slot.



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INFORMATION

Handling the card.

Hold the MOVISAFE® CS..A safety card only by the edges.

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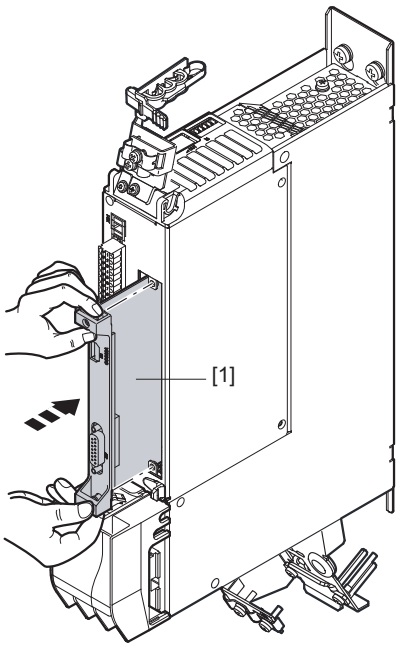
5. Take the MOVISAFE® CS..A safety card [1] and insert it in the slot with slight pressure.



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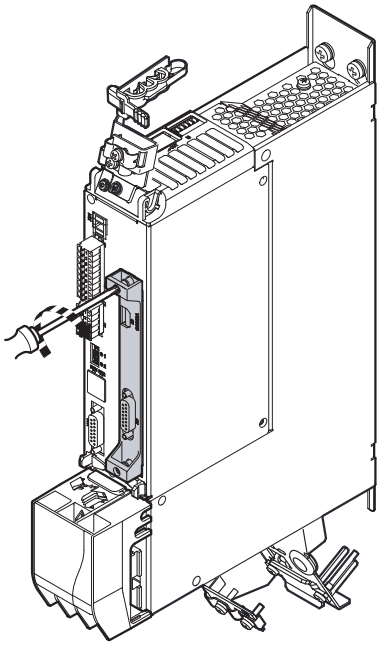
6. Screw the safety card tight with the specified tightening torque (0.6 – 0.8 Nm).



18014412495199371

7. Install the safety cover at the front side of the application inverter.

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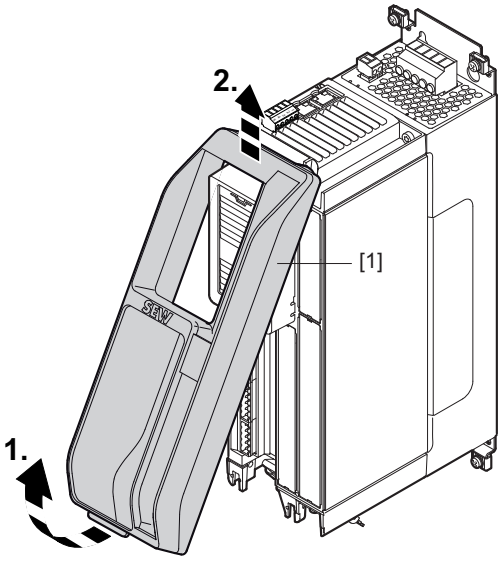
6.4 Installation of the MOVISAFE® CS..A safety card MOVIDRIVE® system/ technology

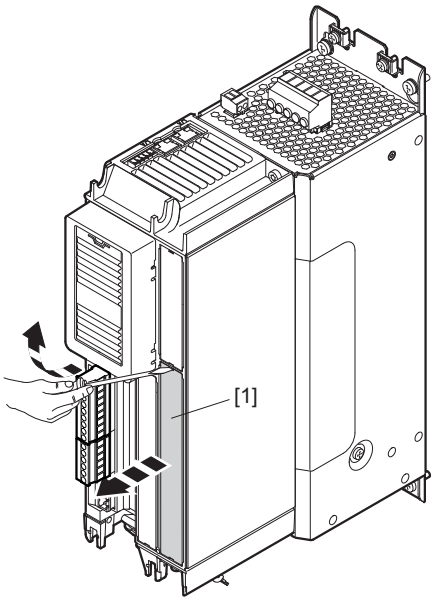
Observe the safety notes in chapter "Electrical installation" in the inverter operating instructions.

1. Disconnect the application inverter from the power supply. Disconnect the DC 24 V supply and the line voltage. Remove the jumper plug X6.
2. Ensure electrostatic discharge with suitable measures before starting work. Suitable measures for equipotential bonding include, for example, the use of a discharge strap or wearing conductive shoes.
3. Remove the safety cover [1] from the front of the application inverter.



14299394571

4. Remove the plastic cover [1] of the card slot using a screwdriver.



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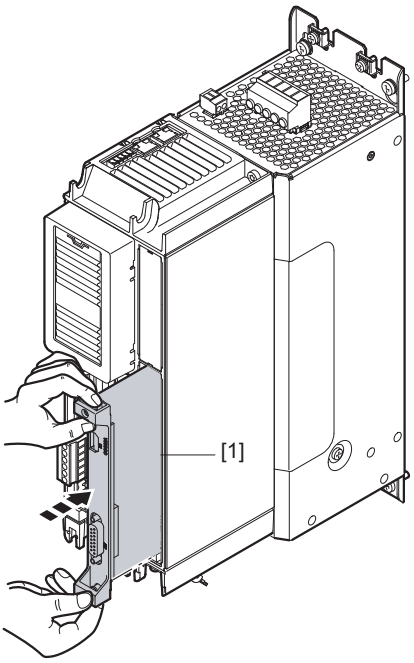
INFORMATION

Handling the card.

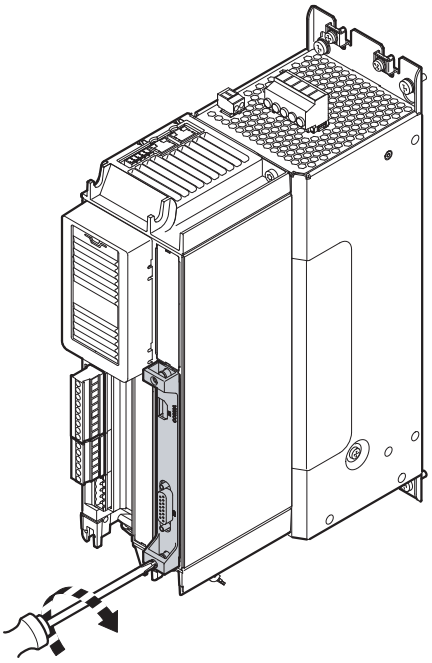
Hold the MOVISAFE® CS..A safety card only by the edges.

5. Take the MOVISAFE® CS..A safety card [1] and insert it in the slot with slight pressure.



15160623243

6. Screw the safety card tight with the specified tightening torque (0.6 – 0.8 Nm).



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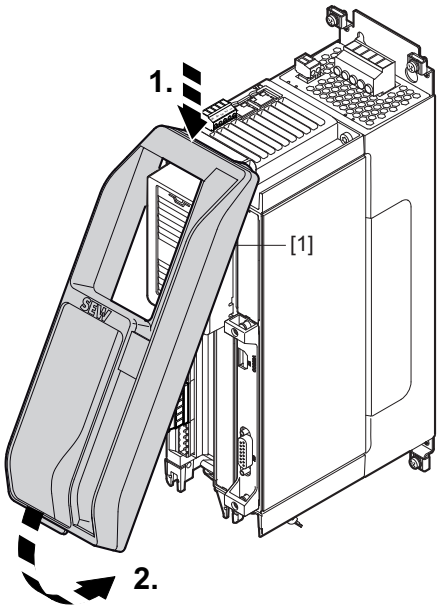
7. Install the safety cover [1] at the front of the application inverter.



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7 Electrical installation

7.1 Important note

⚠ WARNING

An external jumper plug X6 is plugged into the MOVIDRIVE® modular/system/technology or a voltage is connected to it, although a MOVISAFE® CS..A safety card is installed in the MOVIDRIVE® modular/system.

Severe or fatal injuries.

- The jumper plug X6 must not be plugged in if a MOVISAFE® CS..A safety card is installed in the MOVIDRIVE® modular/system/technology.
- No voltage may be connected.

7.2 Installation instructions

To guarantee electrical safety and fault-free operation, you must observe the general installation instructions and the notes in the MOVIDRIVE® modular, MOVIDRIVE® system, and MOVIDRIVE® technology operating 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.

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7.3 Terminal assignment

Description	LED/ Terminal	Function
F-RUN LED F-ERR LED	F-RUN LED F-ERR LED	The LEDs indicate the status of the CS..A safety card (see chapter "Diagnostics").
XS: Slot for safety key	XS	Slot for safety key
X17 (D-sub DA-15): Connecting second encoder (CSS31A and CSB31A only) **Not used for functional safety.**	X17:1 – 15	Assignment depends on connected encoder (see manual "MOVIDRIVE® modular system/technology – CES11A multi-encoder card").
X60: Connection of digital inputs (plug-in spring-loaded terminals)	X60:1 F-DI00	Safe digital input F-DI00.
	X60:2 F-DI01	Safe digital input F-DI01.
	X60:3 GND	Reference potential for safe inputs/outputs.
	X60:4 GND	Reference potential for safe inputs/outputs.
	X60:5 F-DI02	Safe digital input F-DI02.
	X60:6 F-DI03	Safe digital input F-DI03.
	X60:7 GND	Reference potential for safe inputs/outputs.
	X60:8 GND	Reference potential for safe inputs/outputs.
	X60:9 F-SS0	DC 24 V sensor voltage supply for safe digital inputs F-DI00 and F-DI02.
	X60:10 F-SS1	DC 24 V sensor voltage supply for safe digital inputs F-DI01 and F-DI03.
	X60:11 F-DO00_M	Safe digital output F-DO00_M (not with CSB21A).
	X60:12 F-DO00_P	Safe digital output F-DO00_P (not with CSB21A).
	X60:13 F-DO01_M	Safe digital output F-DO01_M (not with CSB21A).
	X60:14 F-DO01_P	Safe digital output F-DO01_P (not with CSB21A).

7.4 Safe disconnection

The jumper plug X6 at the inverter must be removed if a MOVISAFE® CS..A safety card is installed in the MOVIDRIVE® modular/system/technology. No external voltage must be connected to the X6 connection of the inverter.

7.5 Safe digital inputs (F-DI.)

The safe digital inputs (F-DI.) are connected at terminal X60. The following sections explain and describe the permitted connection options.

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2-channel signal processing of the safe digital inputs is realized in the MOVISAFE® CS..A safety card. The safe digital inputs are therefore suitable for applications up to SIL 3 pursuant to IEC 61508 and Performance Level e pursuant to EN ISO 13849-1. The following external sensors to be connected and their wiring must be in compliance with the required safety class.

- 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.

Unassigned inputs need not be wired. An open input is always read as a "0" signal. The safe state of the safe digital inputs is the output of "logical 0" on the associated process values.

The MOVISAFE® CS..A safety card evaluates the digital inputs as follows.

Connection type: Single-channel (NC contact):

Logic level input terminal F-DI.	Process value F-DI.
0	0
1	1

Connection type 2-channel equivalent click (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.

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The assignment is made pursuant to the following table: D.

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		

7.5.1 Discrepancy monitoring

The safety card carries out discrepancy time monitoring for input pairs in the dual-channel equivalent and dual-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 card carries out a switch test function for input pairs in the dual-channel equivalent and dual-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; Dual-channel equivalent
  - F-DI. = logical "0"
  - F-DI. + 1 = logical "0"
- Connection type; Dual-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.

7.5.2 Interlocking

An interlocking function is available for the secure digital inputs. This can be activated via a parameter with the parameter tool "Assist CS..". The interlocking prevents a drive safety function 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.

The acknowledgment can occur as follows:

- Via a safe digital input that is parameterized as "Acknowledgment of interlocking safe digital input".
- Via a safe digital input that is parameterized as "Acknowledgment of interlocking safe digital input and error".
- 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 card until an acknowledgment has been carried out.

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7.5.3 Signal monitoring

The signal monitoring detects when the input signal is in an undefined state (unstable state) for too long. The maximum duration for which an unstable state is permitted is calculated from the set filter time multiplied by the parameter value of the parameter *Signal monitoring* (Index 8704, Subindex 8). The function can also be deactivated with the value "0" via the *Signal monitoring* parameter. The safety card responds with an input error if the signal monitoring is active and the maximum duration has been exceeded.

7.5.4 Pulsed voltage supply and crossfault monitoring

For information about parameter setting and operating principles, refer to chapter "Startup".

If crossfault monitoring is used for a safe digital input F-DI, the following assignment between the sensor supply F-SS and the safe digital input F-DI must be adhered to:

- F-DI00, F-DI02 via the respective sensor to F-SS0.
- F-DI01, F-DI03 via the respective sensor to F-SS1.

Crossfault monitoring can be selected separately for each input.

If crossfault monitoring is not active (e.g. for sensors with OSSD output), the sensors can be supplied either from F-SS0 / F-SS1 or from another +24 V supply that has the same ground reference.

⚠ WARNING

Danger due to incorrect setting of the parameter *F-DI. Connection type* when connecting dual-channel sensors. There is no redundancy or discrepancy check with the "Single-channel" setting.

Severe or fatal injuries.

- When connecting dual-channel sensors, the parameter *F-DI. connection type* must be set to "Dual-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.

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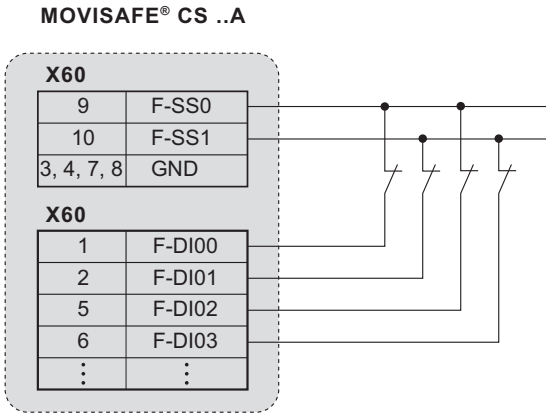
7.5.5 Contact-equipped sensors (single-channel)

A single-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 single-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.

The following figure shows the MOVISAFE® CS..A safety card with single-channel contact-equipped sensors.



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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 FDI and a sensor supply line not assigned to the input F-DI.
- Crossfault between a sensor supply line F-SS and a 24 V supply voltage if the digital input F-DI is assigned to the sensor supply and the switch contact belonging to F-DI is closed.
- Crossfault between the sensor supply lines F-SS themselves if the switch contact belonging to the digital input F-DI is closed.

⚠ WARNING

The MOVISAFE® CS..A safety card **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.

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⚠ WARNING

If crossfault monitoring is deactivated, the MOVISAFE® CS..A safety card **cannot** detect crossfaults in the cabling. This configuration is **not** permitted for safe applications without further measures.

Severe or fatal injuries.

- A single-channel sensor with crossfault monitoring can achieve a category 2 structure pursuant to EN ISO 13849-1.

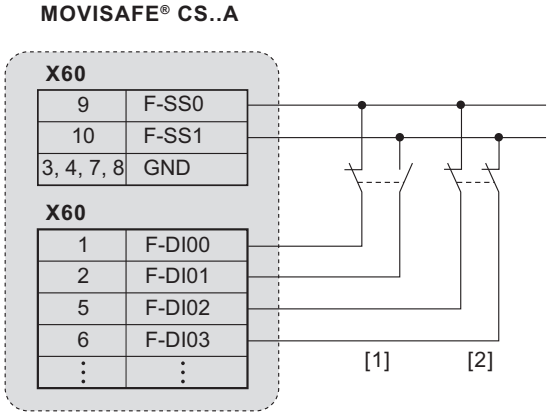
7.5.6 Sensors with contact (dual-channel)

A dual-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".

Settings in the parameterization tool "Assist CS..":

- Choose the dual-channel connection type.
- Activate or deactivate crossfault monitoring and pulsed sensor supply, depending on the safety requirements.

The following figure shows the MOVISAFE® CS..A safety card with contact-equipped dual-channel sensors in the non-equivalent and equivalent connection variants.



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[1] Dual-channel contact-equipped sensor in "non-equivalent" connection variant
[2] Dual-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.

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Operation without crossfault monitoring

When using a dual-channel, non-equivalent-switching sensor, the MOVISAFE® CS..A safety card can detect a crossfault between the two digital inputs of an input pair.

⚠ WARNING

The MOVISAFE® CS..A safety card **cannot** detect a short circuit between an F-SS. sensor supply and an associated safe digital input F-DI (jumpered sensor).

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 dual-channel, equivalent-switching sensor is used, the MOVISAFE® CS..A safety card **cannot** detect crossfaults in the cabling.

Severe or fatal injuries.

- Make sure that crossfaults are not possible at the safe digital inputs F-DI.

INFORMATION

Note that in the non-equivalent connection variant, the NC contact is connected to the sensor supply F-SS0.

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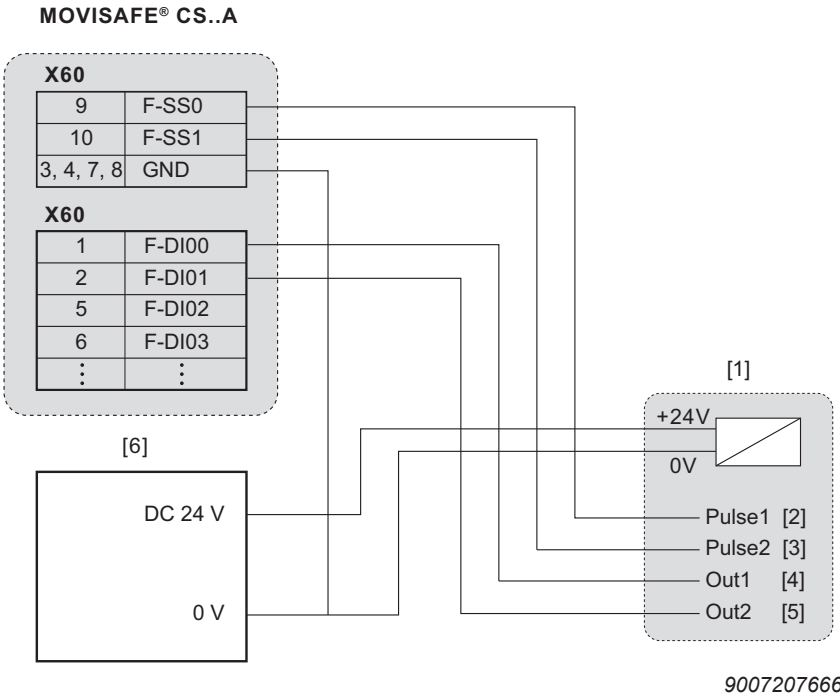
7.5.7 Active sensors (dual-channel)

When connecting a dual-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 dual-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.

The following figure shows the MOVISAFE® CS..A safety card with an active sensor (dual-channel).



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[1] Active dual-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 FDI and a sensor supply line not assigned to the input F-DI.

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- Crossfault between a sensor supply line F-SS and a 24 V supply voltage if the digital input F-DI is assigned to the sensor supply and the switch contact belonging to F-DI is closed.
- Crossfault between the sensor supply lines F-SS themselves if the switch contact belonging to the digital input F-DI is closed.

⚠ WARNING

The MOVISAFE® CS..A safety card **cannot** detect a short circuit between an F-SS. sensor supply and an associated safe digital input F-DI (jumpered sensor).

Severe or fatal injuries.

- Make sure that a short circuit between the sensor supply F-SS. and an associated safe digital input F-DI. is not possible.

⚠ WARNING

If crossfault monitoring is deactivated, the MOVISAFE® CS..A safety card **cannot** detect crossfaults in the cabling.

Severe or fatal injuries.

- Make sure that crossfaults are not possible at the safe digital inputs F-DI., or that they can be detected by the sensor.

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7.5.8 Sensors with semiconductor outputs (OSSD, dual-channel)

When connecting an OSSD-capable sensor, make sure that a pulsed voltage supply is activated for the voltage supply.

INFORMATION

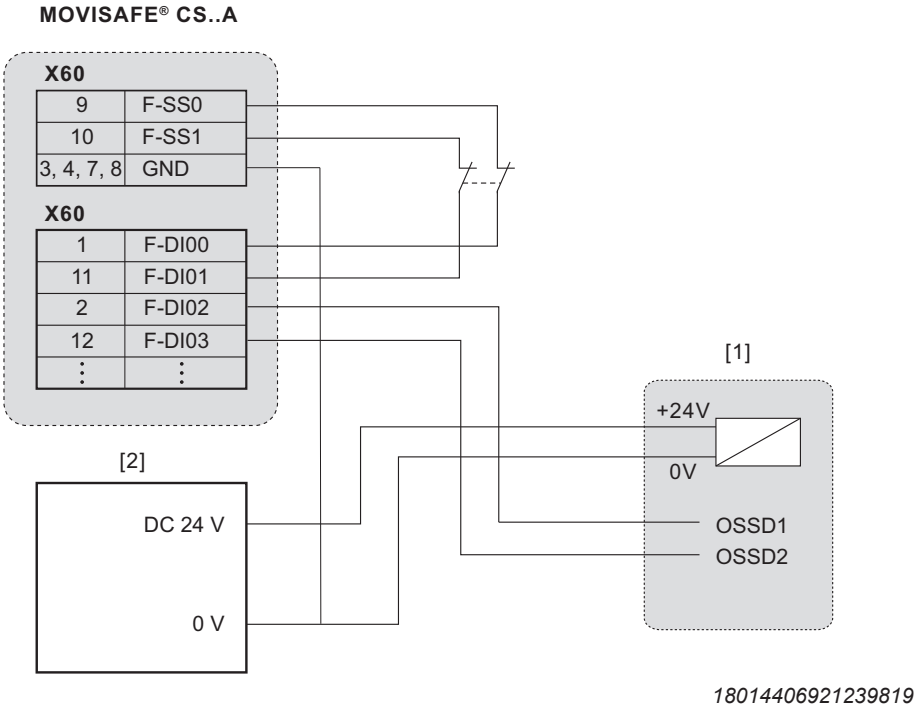
Deactivate the crossfault monitoring at the respective safe inputs if the OSSD-capable sensor technology.

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 used sensor.

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.



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[1] OSSD sensor (e.g. scanner or light grid)
[2] External DC 24 V voltage supply

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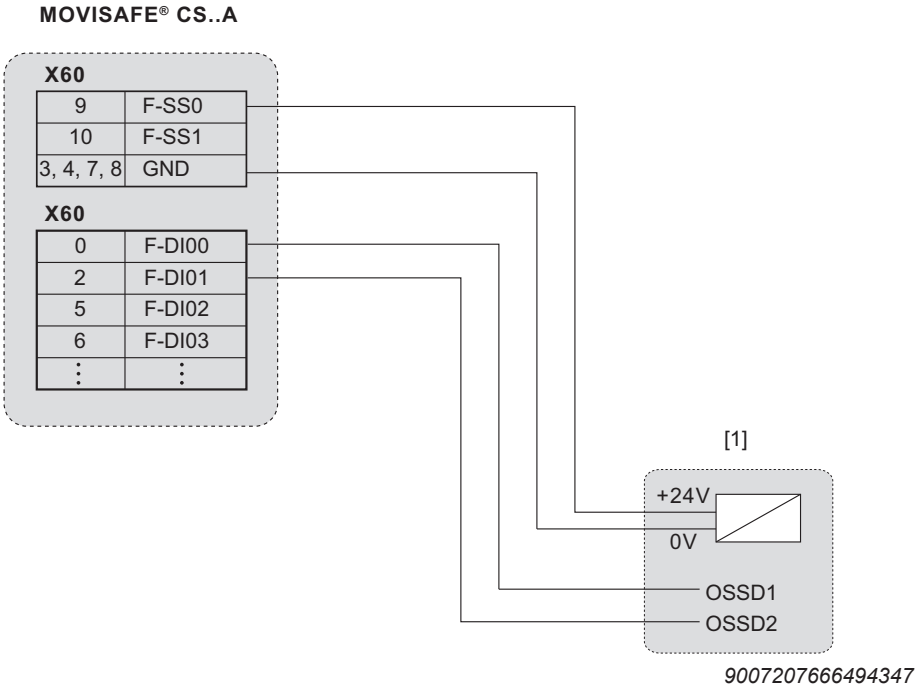
Variant 2

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 achievable Performance Level 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.

7.6 Safe digital outputs (F-DO.)

7.6.1 General

Signal processing of the safe digital outputs takes place inside the MOVISAFE® CS..A safety card in 2-channel format. The safe digital outputs can therefore achieve SIL 3 pursuant to IEC 61508 and Performance Level e pursuant to EN ISO 13849-1. The external actuators to be connected and their wiring must comply with the respective required safety class.

The actuators can be connected to the safe digital outputs F-DO00 and F-DO01 (not with MOVISAFE® CSB21A) via 2 poles, sourcing/sinking output, or single-pole, sourcing output.

Set the respective configuration during startup using the parameterization tool "Assist CS..".

Single-pole, sinking digital outputs are not permitted.

It is not necessary to use shielded cables for all safe digital outputs.

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Note the dependency of the achieved Performance Level (PL) and SIL on the selected connection variant of the safe digital outputs. For each of the two outputs F-DO00 and F-DO01, a maximum switching frequency of 10 Hz is possible with a processing cycle of less than one minute. In continuous duty, a maximum switching frequency of 0.5 Hz is possible. If a fault is detected by diagnostics, the "Output error" error response occurs, which blocks 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 24 V switch outputs F-DO00 and F-DO01. Diagnostics safely detects a wire break in the interrupted output current circuit.

If a wire break is detected, the "Output error" error response occurs, which blocks all outputs.

7.6.2 Capacitive loads

- A capacitive load of no more than 10 nF may 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 DIN 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".

7.6.3 Inductive loads

Inductive loads are, for example, relays, contactors, valves.

- Inductive loads always must be connected between sourcing and sinking outputs.
- The energy stored in the load inductance, which depends on the inductance value and the current, may not exceed the values specified in chapter "Technical data".

NOTICE

Operation of inductive loads without freewheeling diode may damage the MOVISAFE® CS..A safety card.

Damage to the MOVISAFE® CS..A safety card

- Inductive loads must always be connected via a freewheeling diode. The safe digital outputs of the MOVISAFE® CS..A safety card are not equipped with a freewheeling diode.
- Varistors and other overvoltage protection elements are not permitted.

7.6.4 Ohmic loads

Lamps 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 DIN EN 61131-2.

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7.6.5 Information about line diagnostics and test pulses

For monitoring of the cabling, the output circuit uses test pulses and thus detects faults in the external wiring. This means the output voltage is interrupted briefly (pulsed). The maximum duration of the interruption can be set in the F-DO parameter *Maximum test duration*. The required duration of test pulses is determined by the capacitances in the connected load, which affect the line diagnostics.

For the safe disconnection of MOVISAFE® CS..A with a maximum of 10 MOVIDRIVE® modular, MOVIDRIVE® system, and MOVIDRIVE® technology devices, 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 ms).

For the 24 V switching outputs F-DO00 and F-DO01, line diagnostics is always active regardless of the parameterization.

⚠ WARNING

When line diagnostics is deactivated, the MOVISAFE® CS..A safety card cannot detect a short circuit between a sourcing output (F-DO._P) and the +24 V supply voltage or between an M switching output (F-DO._M) and the reference potential.

Severe or fatal injuries.

Install the wiring in such a way that no short circuit is possible:

- Between a sourcing output (F-DO._P) and the +24 V supply voltage.
- or between an sinking output (F-DO._M) and the reference potential.

The outputs F-DO00 and F-DO01 are 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® CS..A safety card 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").

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7.6.6 F-DO_STO output

The safety card has one safe output for the device-internal STO function of the inverter. This output is electrically connected to the STO terminals of the device. This is why you must not connect anything to the external terminals.

With a processing cycle of less than 1 minute, a maximum switching frequency of 10 Hz is possible. In continuous duty (> 1 minute), a maximum switching frequency of 0.5 Hz is possible.

The safe F-DO_STO output is always operated in the connection type "1-pole sourcing" and must only be used for the STO function of the inverter. If the diagnostics implemented for the safe F-DO_STO output detects a fault, the error response "output error" occurs, which blocks all outputs.

Additional extended diagnostics can be activated for the F-DO_STO output. If a fault is detected by diagnostics, the "Output error" error response occurs, which blocks all outputs.

Extended diagnostics allows for the following settings:

- Setting "Test when deactivated"

  If this setting is active, the functionality of diagnostics in the STO connection of the inverter is tested right after the STO function is deactivated.

- Setting "Test when deactivated and time monitoring"

  This setting is identical to the "Test when deactivated" option. The safety card triggers an additional warning if diagnostics is not executed within 8 hours. Time monitoring works only properly if the card deactivates the STO function before the diagnostics interval of 8 hours is elapsed. The test is not performed when switching on the card.

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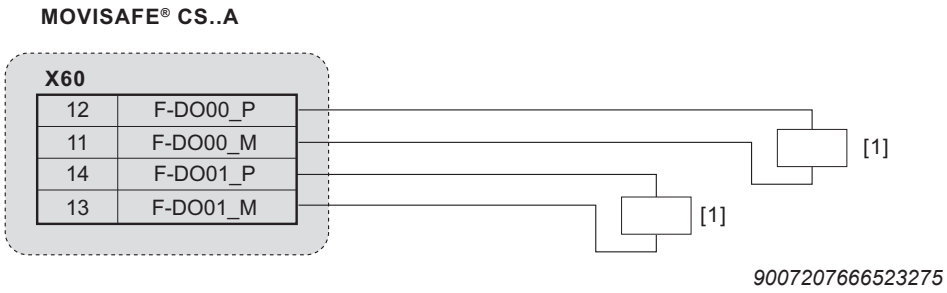
7.6.7 Actuator (dual-channel, sourcing/sinking output)



[1] Actuator

Connect the actuator between F-DO._P and F-DO._M. The actuator can still be switched off in case of a crossfault in one of the connection lines, because the MOVISAFE® CS..A safety option disconnects the sourcing and the sinking output terminals.

The input of the actuator must be isolated and without any connection to a reference potential. Inside the MOVISAFE® CS..A safety option there is a switching element between F-DO._M and the reference potential. With a non-isolated actuator, this switching element would be bridged. The redundancy of the sourcing and sinking output would no longer apply.

The sourcing / sinking connection variant is suitable for applications up to SIL 3 pursuant to IEC 61508 and Performance Level e pursuant to EN ISO 13849-1.

Fault detection using line diagnostics

The MOVISAFE® CS..A safety card detects the following faults in the external cabling when the output is switched on or off:

- Short circuit between sourcing output and a supply voltage that lies within the range of 15 - 30 V and has the same ground potential as the MOVISAFE® CS..A safety card.
- Short circuit between the sinking output and the reference potential or a voltage < 6 V.

The MOVISAFE® CS..A safety card also detects the following faults when the output is activated:

- 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 dip that limits the operation of MOVIDRIVE® modular or MOVIDRIVE® system and/or individual assemblies.

If the voltage supply is not stable enough, it may result in a reset and a restart of the MOVISAFE® CS..A safety card.

- Make sure the voltage supply does not collapse in case of output short circuits.

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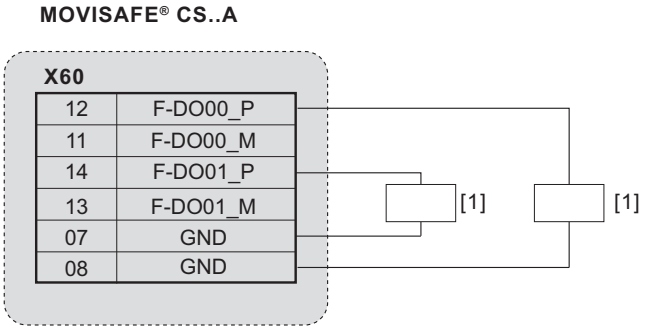
7.6.8 Actuator (dual-channel, sourcing output)

In dual-channel sourcing operation, the actuators are wired as follows.



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[1] Actuator

Connect the actuator on two channels between F-DO00_P and GND as well as F-DO01_P and GND. The actuator input need not be isolated. The dual-channel sourcing output connection variant is suitable for applications up to SIL 3 pursuant to IEC 61508 and Performance Level e pursuant to EN ISO 13849-1.

This connection type cannot be adjusted directly via a parameter, but is instead achieved by the following parameterization and control of the two outputs involved:

- Both outputs are parameterized as single-channel sourcing outputs.
- Both outputs are switched simultaneously. This can be achieved via a drive safety function (STO, SBC) assigned to both outputs or via the secure process output data F-PA (F-DO00 and F-DO01).

The MOVISAFE® CS..A safety card detects the following faults in the external cabling when the output is switched on or off:

- Short circuit between sourcing output and a supply voltage that lies within the range 15 - 30 V and has the same ground potential as the other assembly.

The MOVISAFE® CS..A safety card detects the following faults when the output is switched on:

- Short circuit between different sourcing outputs
- Short circuit between the P output and the reference potential
- Overload at every output
- Wire break (if activated)

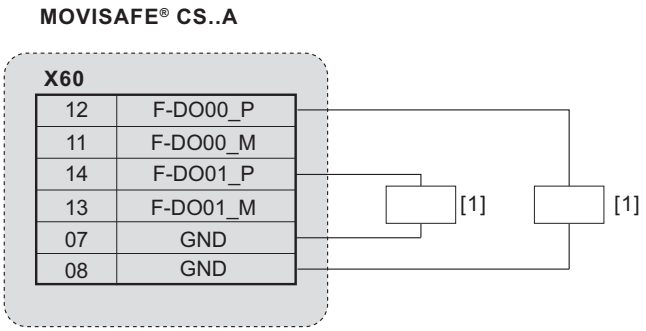
⚠ WARNING

In case of a short circuit between the sourcing output and a 24 V supply voltage, the MOVISAFE® CS..A safety card can no longer switch off the actuator, meaning that it can no longer switch to a safe state.

Severe or fatal injuries.

- Route the cables in such a way that no short circuit between the sourcing output and a +24 V supply voltage is possible.

7.6.9 Actuator (single-channel, sourcing output)



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[1] Actuator

Connect the actuator between F-DO._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 IEC 61508 and Performance Level d pursuant to EN ISO 13849-1.

The MOVISAFE® CS..A safety card detects the following faults in the external cabling when the output is switched on or off:

- Short circuit between sourcing output and a supply voltage that lies within the range 15 - 30 V and has the same ground potential as the assembly.

The MOVISAFE® CS..A safety card also detects the following faults when the output is activated:

- 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® CS..A safety card can no longer switch off the actuator nor otherwise switch over to a safe state.

The line diagnostics function can detect the fault. However, the MOVISAFE® CS..A safety card cannot switch over to the 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 between the sourcing output and a +24 V supply voltage is possible.
- 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 or using 2 parallel, sourcing outputs, if possible.

For safe outputs, refer also to details contained in the chapter "Technical data".

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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 dip that limits the operation of MOVIDRIVE® modular or MOVIDRIVE® system and/or individual assemblies.

If the voltage supply is not stable enough, it may result in a reset and a restart of the MOVISAFE® CS..A safety card.

- Make sure the DC 24 V voltage supply does not collapse in the event of output short circuits.

7.7 Built-in encoder EI7C FS

7.7.1 Features

The EI7C FS built-in encoder is a safe incremental encoder with 24 signal periods per revolution.

The MOVISAFE® CS..A can detect a minimum speed of 60 min^{-1} in connection with the EI7C FS built-in encoder.

The MOVISAFE® CS..A evaluates the signal of the EI7C FS built-in encoder.

The MOVISAFE® CS..A and the EI7C FS built-in encoder monitor the encoder signal. The MOVISAFE® CS..A safety card detects interruptions and crossfaults in the encoder line. If a fault occurs, the MOVISAFE® CS..A activates the drive safety function STO in the MOVIDRIVE® modular or MOVIDRIVE® system, and the torque is switched off safely.

Use only the EI7C FS built-in encoder in connection with MOVISAFE® CS..A.

7.7.2 Installation

Use a shielded cable to connect the EI7C FS built-in encoder to the matching encoder inputs of a MOVIDRIVE® modular or MOVIDRIVE® system.

⚠ WARNING

Incorrect wiring can disable the encoder function and monitoring features for the encoder.

Severe or fatal injuries.

- The encoder may be connected only to the MOVISAFE® CS..A safety card.
- The encoder signals may be connected only to the terminals of a MOVIDRIVE® modular or MOVIDRIVE® system intended for this purpose. It is not permitted to connect other devices or assemblies.

INFORMATION

- The encoder cable must not carry any TF signals when an EI7C FS built-in encoder is connected to the MOVIDRIVE® modular or MOVIDRIVE® system.
- The MOVISAFE® CS..A safety card can detect a minimum speed of 60 min^{-1} in connection with an EI7C FS built-in encoder.

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8 Startup

8.1 Important note

⚠ WARNING

Unexpected and unwanted movement of the drive may occur during parameterization of the safety card.

Severe or fatal injuries.

- Before parameterization, make sure the system is in idle state.

8.2 General startup instructions

INFORMATION

- The startup procedure of the standard functions of the MOVIDRIVE® modular/system is described in the respective operating instructions "MOVIDRIVE® modular", "MOVIDRIVE® system" or "MOVIDRIVE® technology".
- Before starting up the MOVISAFE® CS..A safety card, observe the firmware dependencies in chapter "Compatibility".
- If a brake is connected to the MOVIDRIVE® modular/system, 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 *Close brake with STO* parameter must be set to "On".
- The following chapters describe the additional startup procedure for the MOVISAFE® CS..A safety card and the drive safety functions.
- Note the prerequisites for installation and operation of MOVISUITE®.
- The MOVISAFE® CS..A safety card is supported by MOVISUITE® version 1.2 or higher.
- When starting up several similar devices with identical parameterization, the devices can be parameterized via the "Import/Export" function. Note that you must accept every single device to accomplish this.
- If the drive safety function SBC is active, the brake is controlled only via the selected F-DO. The safe digital output F-DO. additionally performs the function of the brake control DB00. The connection DB00 must not be used at the basic device. The BST safe brake module can be used as safe actuator for brake control.

8.3 Startup options

No drive safety function is approved in the delivery state of the safety card. A system error is issued. After acknowledging the system error, the safety card is fully functional. The safety card permanently activates STO.

8.3.1 Design 1: Independent operation (without connection to safe communication)

The MOVISAFE® CS..A safety card can be parameterized and operated without safe communication connection (independent operation).

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Take into account the following constraints for this operating mode:

- The parameters of the MOVISAFE® CS..A safety card 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 more detailed information, refer to chapter "Startup" in the "MOVIDRIVE® modular", "MOVIDRIVE® system" and MOVIDRIVE® technology" operating instructions.
3. The acceptance is supported by the "Assist CS.." parameterization tool.

8.3.2 Design 2: With PROFIsafe connection

The MOVISAFE® CS..A safety card can be parameterized and operated with PROFIsafe connection (fieldbus connection).

Take into account the following constraints for this operating mode:

- The parameters of the MOVISAFE® CS..A safety card 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.

For startup, perform the following steps:

1. Parameterization of drive safety functions in the "Assist CS.." parameterization tool.
2. Startup of the fieldbus and the higher-level F-PLC.
3. Startup of the standard functions.

   For detailed information, refer to chapter "Startup" in the "MOVIDRIVE® modular" and MOVIDRIVE® system" operating instructions.
4. The acceptance is supported by the "Assist CS.." parameterization tool.

8.4 Adjusting the maximum test duration for load with unknown capacitance

In order to determine the "Maximum test duration" parameter (Index 8705.2) for a load with unknown capacitance at a safe digital output (F-DO.), proceed as follows:

1. Select one of the two safe digital outputs, F-DO00 or F-DO01. Connect the load according to the selected connection type and set the "Connection type".
2. Set the "Maximum test duration" parameter (Index 8705.2) to the maximum value of 5000 µs.
3. Interconnect the selected output for at least 10 seconds.
4. Form the maximum value from the following values for the selected output:
   - Value of 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.

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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.

8.5 Parameterization of the drive safety functions

8.5.1 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.de).

INFORMATION

Only one "Assist CS.." parameterization tool at a time must be used in the system.

8.5.2 Parameterization procedure

This chapter describes the parameterization of the drive safety functions step-by-step.

1. Start **MOVISUITE®.**
2. **Scan the network.**

   Scan the network that contains your engineering interface to the MOVIDRIVE® 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 card 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 must only take 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.

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5. **Upload the current parameterization of the device.**

   Once the safety key ID is entered, the current parameterization of the CS..A safety card 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 card or the data set of the "Assist CS.." is used.

6. **Parameterization**

   Set the parameterization according to your safety-related requirements of your application.

   For parameterization of the MOVISAFE® CS..A safety card, call the individual sections in the parameter tree and enter the required 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. After that, in the "Function assignment" area, the parameters of the drive safety functions are set and assigned to the parameterized inputs/outputs.

   The "Assist CS.." parameterization tool creates a parameter set from all of the parameters.

7. **Transferring the parameter set to the device**

   Click the [Download] button to transfer the parameter set to the MOVISAFE® CS..A safety card.

   After the download, the transferred parameter set is checked for consistency and plausibility. Possibly existing inconsistencies or plausibility errors are displayed and can then be corrected.

Once the parameter set has been transferred to the MOVISAFE® CS..A safety card without any errors, you can start up the standard functions and, if required, make the connection to the higher-level safety controller (F-PLC).

8.5.3 STO drive safety function with MOVISAFE® CS..A

When the drive safety function STO is activated, the internal F-DO_STO output and the safe digital outputs F-DO, that are assigned to the STO function, are switched off.

If the parameter *SBC enable* is set to "yes", all safe digital outputs F-DO assigned to the SBC function will be switched off when the STO function is activated. Once the time defined in the parameter *brake application time* elapsed, the internal output F-DO_STO and all safe digital outputs F-DO assigned to the STO function are switched off with a delay.

If the ST function is activated due to a limit value violation of a drive safety function, the internal output F-DO_STO and all safe digital outputs F-DO assigned to the STO/SBC function are switched off immediately.

If a limit value violation of a drive safety function, a system error, or an output error occurs during the brake application delay, the brake application time is immediately stopped and the internal F-DO_STO output and all safe digital outputs F-DO assigned to the STO function are switched off. The safe digital outputs F-DO assigned to the SBC function are already switched off.

If the STO function is deactivated, the internal output F-DO_STO and all safe digital outputs F-DO assigned to the STO/SBC function are switched off immediately.

Activation

Number of instances: 1

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The STO/SBC drive safety function 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 drive safety function is displayed in the following areas:

- MOVISAFE® CS..A diagnostics, STO status
- Safe process input data (STO 1)

8.5.4 SS1(c) drive safety function with MOVISAFE® CS..A

The SS1(c) drive safety function monitors the parameterized time delay and triggers the STO drive safety function after the time delay elapsed.

If the parameter *Inverter control* is set to "active", activating the SS1(c) drive safety function results in the activation of the *FCB13 application stop* drive function in the inverter.

If the parameter *Inverter control* is set to "Not active", the inverter is not controlled.

Activation

Number of instances: 2 (SSx1, SSx2)

The drive safety function can be activated by the following sources:

- F-DI (function assignment)
- Safe process output data (SSx1, SSx2)

Status

The status of the drive safety function is displayed in the following areas:

- MOVISAFE® CS..A diagnostics, speed function status
- Safe process input data (SSx1, SSx2)

Limit value violation

Due to the value limit violation, the STO drive safety function 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 drive safety function is activated immediately without brake application delay. The status of the SSx function becomes inactive. The encoder fault must be acknowledged. The encoder fault cannot be acknowledged by deactivating the SSx function.

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INFORMATION

If an SSx instance is assigned to another drive safety function as fault response, the SLI function cannot be parameterized as finale state.

8.5.5 SS1(a/b) drive safety function with MOVISAFE® CS..A

The SS1(a/b) drive safety function monitors the motor deceleration within defined limits. The STO drive safety function is activated if the motor speed drops below a specified limit value. When the limit speed is exceeded, the STO drive safety function is activated without brake application delay.

If the SS1(a/b) drive safety function is activated, first the parameterized *Monitoring delay* (8706.9) applies. During the monitoring delay, the parameterized *Maximum speed* (8707.1) is monitored. Then the monitoring of the parameterized speed ramp starts.

If the *Ramp monitoring* is set to "linear", monitoring of the linear speed ramp at the detected current speed starts when the SS1(a/b) drive safety function is activated. The end speed of the speed ramp is the parameterized maximum speed.

If the *Ramp monitoring* is set to "jerk-limited", monitoring of the linear speed ramp at the detected current speed and the parameterized offset speed starts after the SS1(a/b) drive safety function 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 parameterized final state (STO, SOS, or SLI drive safety function) is activated.

If the parameter *Inverter control* is set to "active", activating the drive safety function results in the activation of the *FCB13 application stop* drive function in the inverter.

If the parameter *Inverter control* is set to "Not active", the inverter is not controlled.

If the parameter *Inverter control* is set to "Active with limitation", the stop ramp of the inverter is limited to the following values:

- Minimum value of the SSx delay
- Maximum value of the parameterized jerk time

Activation

Number of instances: 2 (SSx1, SSx2)

The drive safety function can be activated by the following sources:

- F-DI (function assignment)
- Safe process output data (SSx1, SSx2)

Status

The status of the drive safety function is displayed in the following areas:

- MOVISAFE® CS..A diagnostics, speed function status
- Safe process input data (SSx1, SSx2)

Limit value violation

Due to the value limit violation, the STO drive safety function is activated without brake application delay.

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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 drive safety function is activated immediately without brake application delay. The status of the SSx function becomes inactive. The encoder fault must be acknowledged. The encoder fault cannot be acknowledged by deactivating the SSx function.

INFORMATION

If an SSx instance is assigned to another drive safety function as fault response, the SLI function cannot be parameterized as finale state.

8.5.6 SS2(c) drive safety function with MOVISAFE® CS..A

The SS2(c) drive safety function monitors the parameterized time delay and triggers the SOS drive safety function after the time delay elapsed.

If the parameter *Inverter control* is set to "active", activating the SS2(c) drive safety function results in the activation of the *FCB19 application stop* drive function in the inverter.

If the parameter *Inverter control* is set to "Not active", the inverter is not controlled.

Activation

Number of instances: 2 (SSx1, SSx2)

The drive safety function can be activated by the following sources:

- F-DI (function assignment)
- Safe process output data (SSx1, SSx2)

Status

The status of the drive safety function is displayed in the following areas:

- MOVISAFE® CS..A diagnostics, speed function status
- Safe process input data (SSx1, SSx2)

Limit value violation

Due to the value limit violation, the STO drive safety function 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 drive safety function is activated immediately without brake application delay. The status of the SSx function becomes inactive. The encoder fault must be acknowledged. The encoder fault cannot be acknowledged by deactivating the SSx function.

INFORMATION

If an SSx instance is assigned to another drive safety function as fault response, the SLI function cannot be parameterized as finale state.

8.5.7 SS2(a/b) drive safety function with MOVISAFE® CS..A

The SS2(a/b) drive safety function monitors the motor deceleration within defined limits.

If the motor speed falls below a defined limit value, the SS2(a) drive safety function triggers the SOS function. The STO drive safety function is triggered if the motor speed exceeds via a specified limit value.

If the SS2(a/b) drive safety function is activated, first the parameterized *Monitoring delay* (8706.9) applies. During the monitoring delay, the parameterized *Maximum speed* (8707.1) is monitored. Then the monitoring of the parameterized speed ramp starts.

If the *Ramp monitoring* is set to "linear", monitoring of the linear speed ramp at the detected current speed starts when the SS2(a/b) drive safety function is activated. The end speed of the speed ramp is the parameterized maximum speed.

If the *Ramp monitoring* is set to "jerk-limited", monitoring of the linear speed ramp at the detected current speed and the parameterized offset speed starts after the SS2(a/b) drive safety function 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 parameterized final state (STO, SOS, or SLI drive safety function) is activated.

If the parameter *Inverter control* is set to "active", activating the drive safety function results in the activation of the *FCB19 application stop* drive function in the inverter.

If the parameter *Inverter control* is set to "Not active", the inverter is not controlled.

If the parameter *Inverter control* is set to "Active with limitation", the stop ramp of the inverter is limited to the following values:

- Minimum value of the SSx delay
- Maximum value of the parameterized jerk time

Activation

Number of instances: 2 (SSx1, SSx2)

The drive safety function can be activated by the following sources:

- F-DI (function assignment)
- Safe process output data (SSx1, SSx2)

Status

The status of the drive safety function is displayed in the following areas:

- MOVISAFE® CS..A diagnostics, speed function status
- Safe process input data (SSx1, SSx2)

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Limit value violation

Due to the value limit violation, the STO drive safety function 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 drive safety function is activated immediately without brake application delay. The status of the SSx function becomes inactive. The encoder fault must be acknowledged. The encoder fault cannot be acknowledged by deactivating the SSx function.

INFORMATION

If an SSx instance is assigned to another drive safety function as fault response, the SLI function cannot be parameterized as finale state.

8.5.8 SOS drive safety function with MOVISAFE® CS..A

The SOS drive safety function monitors the drive position with the parameterized positional tolerance.

When the SOS drive safety function is activated, of FCB 19 "Position hold control" is activated in the basic device. Based on the detected actual position and the parameterized positional tolerance, the positive and negative limit position is determined.

If the positive or negative limit position is exceeded, the error response (STO) is triggered. After a limit value violation, error acknowledgment leads to the limit positions being recalculated based on the current actual position.

Activation

Number of instances: 1

The SOS drive safety function can be activated by the following sources:

- F-DI (function assignment)
- Safe process output data (SOS1)
- Limit state of SS2 or SLI

Status

If the SOS drive safety function is activated and the determined limit position is not exceeded, the status of the SOS drive safety function is active. The status is displayed in the following areas:

- MOVISAFE® CS diagnostics, position function status
- Safe process input data (SOS1)

Fault response

When one of the limit positions is exceeded, the STO drive safety function is activated without brake application delay as error response.

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8.5.9 SLA drive safety function with MOVISAFE® CS..A

INFORMATION

The SLA drive safety function must not be used in combination with the EI7C FS built-in encoder.

The SLA function monitors the acceleration within the parameterized limit value.

The actual acceleration is monitored based on the following conditions:

- The speed is greater than the configured "Minimum speed for acceleration functions" (8707.6).
- The speed is increased.

If the speed is decreased, monitoring is not active.

A fault response (8706.32) is triggered if the configured limit acceleration (8706.73) is exceeded.

If the *Inverter control* parameter is set to "Active with limitation", the inverter acceleration is limited to the limit value of the SLA function minus the value set in the *Acceleration offset* parameter.

An exceeded limit acceleration must always be acknowledged. With the "Only F-PI" error response, the status of the SLA function is reset automatically if the limit acceleration is held again.

Activation

Number of instances: 2

The SLA safety function can be activated by the following sources:

- F-DI (function assignment)
- Safe process output data (SLA1, SLA2)
- Permanently activated

Status

If the SLA drive safety function is activated and the limit values are not exceeded, the status of the SLA drive safety function is active. The status is displayed in the following areas:

- MOVISAFE® CS..A diagnostics, acceleration function status
- Safe process input data (SLA1, SLA2)

Fault response

If one of the monitoring limits is exceeded, one of the following parameterized error responses can be activated:

- STO
- SSx1
- SSx2
- F-PE

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8.5.10 SLS drive safety function with MOVISAFE® CS..A

The SLS drive safety function monitors the actual speed for exceeding the parameterized limit speed. When the limit speed is exceeded, the parameterized fault response is triggered.

The speed filter allows 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.

If the *Ramp type* parameter is set to "linear", a linear transition ramp of the parameterized maximum speed or the current speed is monitored.

If the *Ramp type* parameter is set to "jerk-limited", a jerk-limited transition ramp of the parameterized maximum speed or the current speed is monitored.

Use the *Effective direction* parameter to define the direction of rotation in which the SLS function is effective:

- Only positive rotation
- Only negative rotation
- Both directions of rotation

Activation

Number of instances: 4

The SLS drive safety function 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® CS..A 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

8.5.11 SSR drive safety function with MOVISAFE® CS..A

The SSR function monitors the motor speed within the parameterized speed limits. The parameterized error response is issued when limit values are exceeded. The drive stops with STO or SS1 drive safety function, or safe process data transmit the information that limit values were exceeded to a safety controller.

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When limit values are exceeded and the fault response is STO or SSx, then the fault response must be acknowledged. No acknowledgment is required if the information that limit values were exceeded is reported to a safe controller. When the speed drops below the limit value, the status of the drive safety functions is set again taking account of the configured hysteresis (index 8706.57).

Once drive safety functions are activated, the actual speed is monitored for exceeding the maximum speed for the duration of the monitoring delay. After this time, the actual speed is monitored for leaving the range of upper and lower limit speed. Both the upper and the lower limit speed can be positive and negative.

A speed filter can be set for the SSR function. If a speed filter is set, it will be calculated separately for the upper and lower limit speed.

Activation

Number of instances: 2

The SSR drive safety function can be activated by the following sources:

- F-DI (function assignment)
- Safe process output data (SSR1, SSR2)
- Permanently activated

Status

The status of the SSR drive safety function is active if the SSR function is activated and the current speed is within the speed limits. If the speed limit is exceeded, the status of the SSR function is deactivated.

The status is displayed in the following areas:

- MOVISAFE® CS..A diagnostics, speed function status
- Safe process input data (SSR1, SSR2)

Fault response

If one of the speed limits is exceeded, one of the following parameterized error responses can be activated:

- STO
- SSX 1
- SSX 2
- Only F-PI

8.5.12 SSM drive safety function with MOVISAFE® CS..A

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

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The SSM function is permanently active.

Status

If the limit values are exceeded, the status of the SSM drive safety function switches to "0". If the limit values are held again, the status of the SSM drive safety function automatically switches to "1".

The status is displayed in the following areas:

- MOVISAFE® CS..A diagnostics, speed function status
- Safe process input data (SSM1, SSM2, SSM3, SSM4)

Fault response

None.

8.5.13 SDI drive safety function with MOVISAFE® CS..A

The SDI function monitors the movement in blocked direction of rotation. The STO drive safety function 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 drive safety function 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. In case of movement in the inhibited direction of movement or if a limit position is exceeded, an error 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 drive safety function can be activated by the following sources:

- F-DI (function assignment)
- Safe process output data (SDI1, SDI2)
- Permanently activated

Status

If the SDI drive safety function is activated and no movement is detected in the monitored direction of rotation, the status of the SDI function is active. The status of the SDI function is deactivated if movement in the monitored direction of rotation over the parameterized tolerance is detected.

The status of the SDI drive safety function is displayed in the following areas:

- MOVISAFE® CS..A diagnostics, position function status
- Safe process input data (SDI1, SDI2)

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Fault response

When the limit position is exceeded, the STO drive safety function is activated without brake application delay as error response.

8.5.14 SLI drive safety function with MOVISAFE® CS..A

The SLI drive safety function can be used to realize safe, relative position functions. The SLI function monitors whether the defined limits are exceeded. The defined limits are calculated based on the settings of the following parameters:

- *Increment*
- *Deceleration a*
- *Effective direction*
- *Maximum speed*

If the SLI function is activated, first the parameterized stop state is activated. The setting "Stop state STO" and "Stop state SOS" can then be used to deactivate the stop state with increment enable and the SLI function can monitor the parameterized limits.

If the stop state is parameterized to "No stop state", the parameterized limits are monitored without prior increment enable.

Once monitoring is activated, the limits are calculated based on the current position. The monitoring curve in effective direction is composed of the set increment and the delay.

Increment enable deactivates the stop state and the limit position is calculated:

- Positive limit position: Actual position plus increment
- Negative limit position: Actual position minus increment

The stop state is activated immediately when step enable is revoked. With the next increment enable, the limits are calculated again based on the actual position.

Activation

SLI drive safety function

Number of instances: 2

The SLI drive safety function can be activated by the following sources:

- F-DI (function assignment)
- Safe process output data (SLI1, SLI2)
- SSx1, SSx2 end state

SLI increment enable

Number of instances: 1

SLI increment enable is not time limited and is activated by a 0 → 1 edge on one of the following sources:

- F-DI (function assignment)
- Safe process output data (SLI increment enable)

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Status

The status of the SLI drive safety function is displayed in the following areas:

- MOVISAFE® CS..A diagnostics, acceleration function status
- Safe process output data (SLI1, SLI2)

Fault response

The STO drive safety function is activated as error response in one of the following cases:

- If a limit position is exceeded.
- If the braking distance in direction of movement in the parameterized effective direction is larger than the distance to the limit position.

8.5.15 Encoder fault muting

⚠ WARNING

The active function "Encoder fault muting" deactivates the encoder-dependent drive safety functions (except STO). This can cause immediate startup of the system.

Severe or fatal injuries.

- Before activation of the "Encoder fault muting" function, the user must undertake organizational measures for the protection of personnel and machinery.

The "encoder fault muting" function can be activated by a safe input F-DI, by the safe process output data (F-PO) or by starting emergency mode with the keypad. The activated function "Encoder fault muting" is signaled on the LED F-ERR by rapid yellow flashing. The "Encoder fault muting" function has the following effects:

- The opening of the internal output F-DO_STO is suppressed due to the encoder fault response.
- The error responses of all drive safety functions are suppressed.
- The safe process data bit *F-PE_Muting_Enc-Err* is set.
- The safe process data bit *F-PE-ErrorState* remains set.
- The error code continues to be displayed.
- Activation of the drive safety function STO continues to be possible without restriction. All other drive safety functions become deactivated.

The "Encoder fault muting" function is automatically exited in the following cases:

- Another error is detected.
- An error is acknowledged.
- 5 minutes after activation.

If the "Encoder fault muting" function has been automatically deactivated, all sources must first cancel the activation before another activation.

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8.5.16 Muting safe process output data (muting F-PO)

⚠ WARNING

The active function "Muting F-PO" deactivates the encoder-dependent drive safety functions (except STO). This can cause immediate startup of the system.

Severe or fatal injuries.

- Before activation of the "Muting F-PO" function, the user must undertake organizational measures for the protection of personnel and machinery.

The "Muting safe process output data" is activated by a 0 → 1 edge on a safe inputs F-DI or by starting the emergency mode using the keypad. The activated function "Muting F-PO" is signaled on the LED F-ERR by rapid yellow flashing. The "Muting F-PO" function has the following effects:

- The opening of the internal output F-DO_STO is suppressed due to the substitute values of the F-PO data.
- The error responses of all drive safety functions are suppressed.
- The *Encoder fault muting* bit is set in the safe process input data.
- Activating the STO drive safety function is still possible without any restrictions using the safe input F-DI.

The "Muting F-PO" function is automatically exited in the following cases:

- Another error is detected.
- An error is acknowledged.
- 5 minutes after activation.
- Connection to the keypad 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.

8.5.17 Test mode

The limit value violation of the drive safety function SS1, SS2 and SOS can be tested when test mode is active.

The test mode suppresses the base device control (FCB selection).

The test mode is activated by a rising edge (0 → 1) at a safe digital input or via the safe process output data (F-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.

The test mode is automatically exited in the following cases:

- During parameterization of the safety card.
- By opening the internal output F-DO_STO (e.g. error response, limit value violation, activation of drive safety function STO).
- 5 minutes after activation.

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8.6 Startup of the safety card at the F-protocol

8.6.1 Requirements for F-communication

Requirements regarding IT security regarding F-protocols must be checked in accordance with EN 61508-1, chapter "Hazard and risk analysis".

INFORMATION

Before making changes to the set F-protocol at the CS..A safety card you have to disconnect the F-master physically.

8.6.2 PROFIsafe protocol

INFORMATION

To control failsafe functions and for evaluation of the responses from the safety card CS..A via PROFIsafe, the assignment of the individual bits within of the F-protocol must be taken into account.

Requirements

- The CS..A safety cards support the 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 for using the MOVISAFE® CS..A with PROFIsafe fieldbus connection via PROFIBUS or PROFINET:
  - TIA portal with STEP7 Safety option (for Siemens controllers)
  - Device description file `GSDML-2.33-SEW-MOVI-C-MOVIDRIVE`.

    Download from www.sew-eurodrive.de. Always use the latest device description file.

Safety cards settings

Besides parameterization of the drive safety functions, the corresponding safety protocol and the PROFIsafe addresses must be set during startup.

Setting the safety protocol

The CS..A safety card supports several safety protocols. Select "PROFIsafe" under [F-communication] > [Configuration] in the "Assist CS.." parameterization tool.

Setting the PROFIsafe address

The PROFIsafe address must be identical to the address set for the slave in the PROFIsafe master. Enter the correct PROFIsafe address under [F-communication] > [Configuration] > [PROFIsafe]. The used PROFIsafe address must be unique within the fieldbus network.

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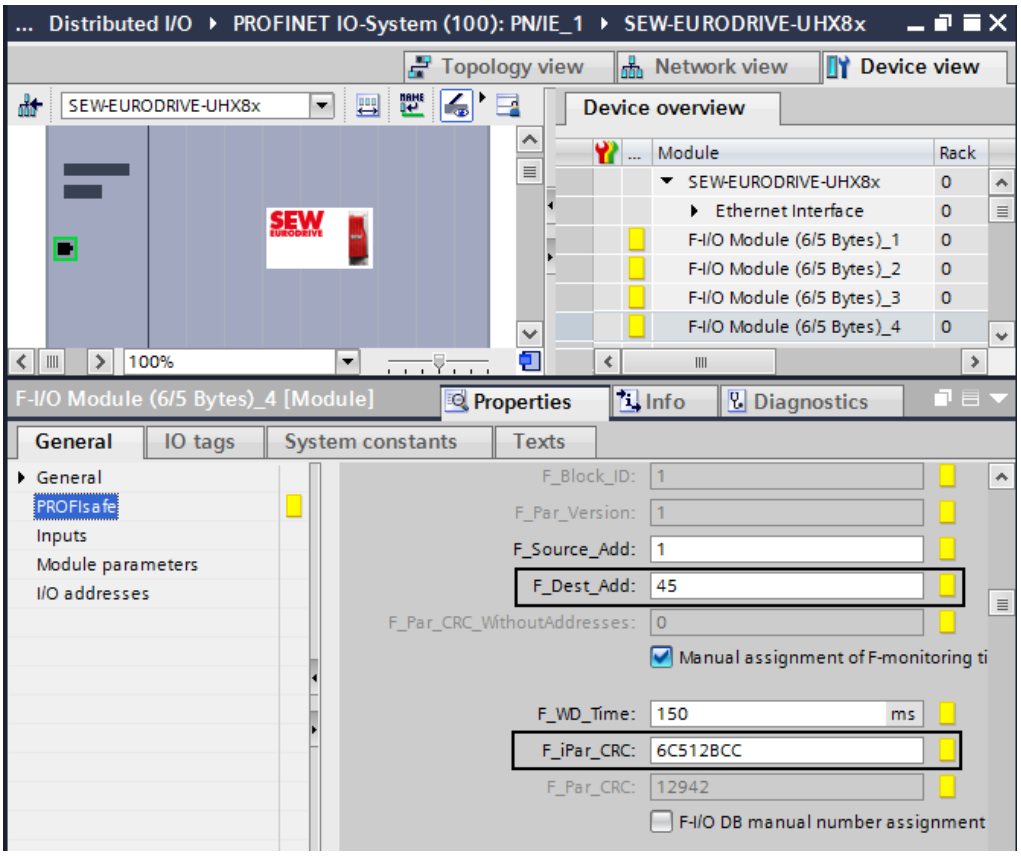
PROFIsafe master settings

The settings that must be made at the PROFIsafe master are shown in an example for an S71500F in the TIA portal.



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8.6.3 FSoE protocol

Requirements

- For communication over FSoE (Fail Safe over EtherCAT®), the CS..A safety card must be connected to a safety controller with FSoE master functionality.
- For a CS..A safety card, firmware version 2.05 or higher is required.
- MOVISUITE® engineering software version 2.1 or higher (Download via www.sew-eurodrive.de).
- Additional requirements for using the MOVISAFE® CS..A with FSoE fieldbus connection:
  - ESI device description file (EtherCAT® XML file for MOVI-C MOVIDRIVE® modular/system). Download from www.sew-eurodrive.de. Always use the latest device description file.

Safety cards settings

Besides parameterization of the drive safety functions, the corresponding safety protocol and the F addresses must be set during startup.

Setting the safety protocol

The CS..A safety card supports several safety protocols. For this, 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 card 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

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8.6.4 ISOFAST® protocol

Requirements

- For communication over ISOFAST® protocol, the CS..A safety card must be connected to a safety controller with ISOFAST® master functionality.
- For a CS..A safety card, firmware version 2.05 or higher is required.
- MOVISUITE® engineering software version 2.1 or higher (Download via www.sew-eurodrive.de).

Safety cards settings

During startup, apart from parameterization of the drive safety functions, you must set the corresponding safety protocol and the connection ID.

Setting the safety protocol

The CS..A safety card supports several safety protocols. For this, select "ISOFAST® slave" under [F-communication] > [Configuration].

Setting the connection ID

The connection ID of the ISOFAST® slaves must be unique within the ISOFAST® network independent of the used ISOFAST® version.

Using the *ISOFAST® format* parameter (index 8711.53), you can set 2 different ISOFAST® versions. The range of values of the connection IDs changes depending on the ISOFAST® version:

- Range of values for ISOFAST® version 1: 1 to 2046
- Range of values for ISOFAST® version 2: 1 to 65534

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8.7 Operating states

The MOVISAFE® CS..A safety card distinguishes between the following operating states:

- Operation
- Parameterization
- Safe state after critical error

8.7.1 Operating state "Operation"

In the "Operation" operating state, the selected drive safety functions are executed in accordance with the parameterization (see chapter "Drive safety functions"). The drive safety functions are selected either via the safe digital inputs or the F-process data. The external, safe digital outputs can be controlled directly via the F-process data if no function has been assigned to the safe digital outputs in the function assignment.

8.7.2 Operating state "Parameterization"

In the "Parameterization" operating state, the MOVISAFE® CS..A safety card is in safe state. The MOVISAFE® CS..A can be parameterized in this state. If an error occurs during parameterization, e.g., a violation of a plausibility rule, MOVISAFE® CS..A remains in "Parameterization" state.

8.7.3 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.

8.8 Safety-relevant acceptance

⚠ DANGER

Proper functioning of the drive safety functions is not guaranteed without a safety-related acceptance.

Severe or fatal injuries.

- Verify every single drive safety function.
- An individual acceptance report may be created only when the system is in idle state.

To ensure the correctly parameterized drive safety functions, you must perform verification 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 safety concept relies on the following basic assumptions. Parameters stored in the flash memory of the safety card 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 drive safety functions. verification occurs with the acceptance report.

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For unused drive safety functions, it is sufficient to verify whether the release is parameterized to "No".

8.8.1 Sequence

After a successful startup, you must confirm that the data of the acceptance report matches the parameters on the safety card. 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 card 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 and system controls.

8.8.2 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.

8.8.3 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 card
- Overview of checksums
- Communication data

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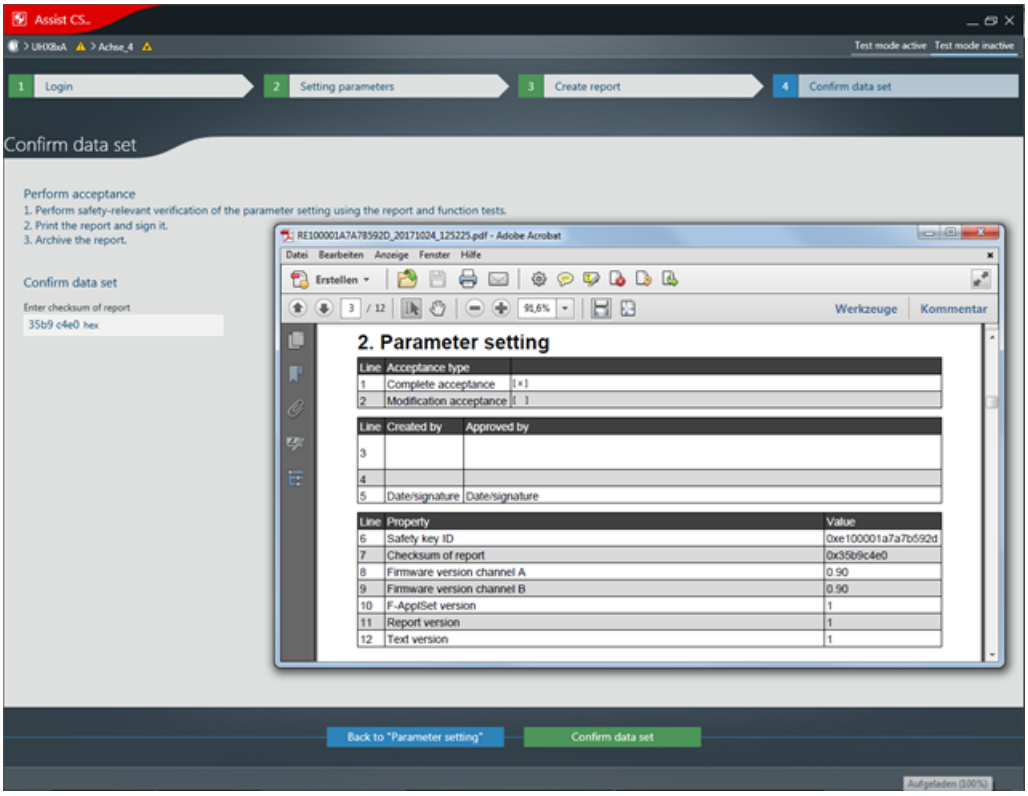
8.8.4 Confirming acceptance

The status of the safety card must be confirmed after completion of the safety technology verification. To confirm the data set, enter the checksum of the report in Assist CS.. (line 7 in the following figure).



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8.9 Restoring the delivery state

8.9.1 Requirements

Before restoring the delivery state, you must 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 drive safety function is approved in the delivery state of the safety card. The safety card permanently activates STO.

8.9.2 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.

8.10 Reset the password

8.10.1 Procedure

INFORMATION

When you insert or remove the safety card, adhere to the information in chapter "Mechanical installation".

Proceed as follows:

1. Switch off the system.
2. Remove the safety card. To reset the password, you require the master password of the safety card.
3. The master password of the card can be found on the label of the safety card.
4. Reinsert the safety card.
5. Switch on the system.
6. Open the "Assist CS.." parameterization tool. To open the main menu, click on red "Assist CS.." tile in the left upper corner.
7. Select the menu item "Change password". In the "Old password" edit box, enter the master password.
8. In the edit boxes "New password" and "Reenter new password", enter the new password. Confirm your entries.

   You can now parameterize the safety card in Assist CS...

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9 Operation

9.1 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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10 Data exchange with higher-level controller

10.1 Introduction

MOVIDRIVE® devices with integrated safety card support parallel operation of standard and safe communication via a bus system or network. The safe PROFIsafe communication can be carried out via PROFINET IO. To do so, the MOVI-C® CONTROLLER to which the MOVIDRIVE® modular/system with integrated safety card are connected must be connected to a failsafe controller (F-host) via PROFINET IO.

To control failsafe functions and for evaluation of the responses from the safety card via PROFIsafe, the assignment of the individual bits within the F-process input/output data must be taken into account.

10.1.1 Number of safety cards on the MOVI-C® CONTROLLER

Depending on the device design of the MOVI-C® CONTROLLER, the safe PROFIsafe communication can be routed to many different devices of the MOVIDRIVE® modular/system series with the integrated safety card.

The MOVI-C® CONTROLLERS UHX25A-N/UHX45A-N support 8 safety cards.

The MOVI-C® CONTROLLERs UHX84A-R/UHX85A-R support up to 24 safety cards, depending on the device firmware. You can read out the device firmware of the MOVI-C® CONTROLLER UHX84A-R/UHX85A-R in MOVISUITE® in the "Device data" > "Main components" > "System package" section.

- Firmware V2.0 Release 201703xxxx (March 2017) and older supports up to 8 safety cards. The non-safe process data can be configured starting at slot 9.

  For the MOVI-C® CONTROLLER UHX84-R/UHX85-R, the object "UHX84-R/UHX85-R V2.0" in the hardware catalog of the TIA portal must be used.
- Firmware V2.x or V3.0 Release 201707xxxx (July 2017) and later support 24 safety cards. The non-safe process data can be configured starting at slot 25.

  For this version, the object "UHX84-R/UHX85-R V3.0" in the hardware catalog of the TIA portal must be used.

10.2 F-periphery access of the safety card in the TIA portal

For safe communication, the CSB..A safety cards need 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).

For safe communication, the CSS..A safety cards need 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 remaining 4 bytes are required for the telegram backup according to the PROFIsafe specification.

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10.2.1 F-periphery-data component of the safety card

While compiling the configuration tool (HW Config), the system automatically generates an F periphery data component (DB) for each safety card. 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).

The following table shows the F periphery DB of the safety card:

	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 with safety card	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 card).	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 card).	0
	DBB3	"F00008_198" (DIAG)	BYTE	Service information	-

PASS_ON

With the PASS_ON variable, you can activate a passivation of the safety card. Passivation of the F periphery takes place provided that PASS_ON = "1".

ACK_NEC

After resolving an error, the safety card 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.

⚠ 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 card after the fault has been corrected, user acknowledgment with positive edge at the variable *ACK_REI* is required. Acknowledgement 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 card have been corrected. After successful acknowledgement, the F control system sets *ACK_REQ* to "0".

PASS_OUT

The variable *PASS_OUT* indicates whether there is a passivation of the safety card. Substitute values are output.

QBAD

Error in the data exchange with the safety card. 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.

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10.3 F process data profile

10.3.1 CSS21A/CSS31A profile design "Technology Standard"

Process output data

Byte	Bit	Name	Value	Description
0	0	STO1	0	Activate STO.
			1	Deactivate STO.
	1	SLI increment enable	0	Blockage of step motion.
			1	Release of a step. In the case of edge 0 → 1, the current position value is saved as a reference.
	2	SBT Clearance[1)]	0	Brake test selection blocked.
			1	Brake test selection possible.
	3	Reserve		
	4	Muting	0	Deactivate encoder muting.
			1	Activate encoder muting.
	5	Test mode active	0	Deactivate test mode.
			1	Activate test mode.
	6	Enable F-DI	0	No acknowledgment.
			1	Acknowledgment of the interlocked F-DI (0 → 1 edge).
	7	Error acknowledgment	0	No acknowledgment.
			1	Error acknowledgment (0 → 1 edge).
1	0	F-DO00	0	Switch off F-DO00 output (open).
			1	Switch on F-DO00 output (close).
	1	F-DO01	0	Switch off F-DO01 output (open).
			1	Switch on F-DO01 output (close).
	2	Reserve		
	3	Reserve		
	4	Reserve		
	5	Reserve		
	6	Reserve		
	7	Reserve		

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Byte	Bit	Name	Value	Description
2	0	SOS1	0	Activate SOS.
			1	Deactivate SOS.
	1	Reserve		
	2	SSX1	0	Activate SSx1.
			1	Deactivate SSx1.
	3	SSX2	0	Activate SSx2.
			1	Deactivate SSx2.
	4	SDI1	0	Activate SDI1.
			1	Deactivate SDI1.
	5	SDI2	0	Activate SDI2.
			1	Deactivate SDI2.
	6	SLI1	0	Activate SLI1.
			1	Deactivate SLI1.
	7	SLI2	0	Activate SLI2.
			1	Deactivate SLI2.
3	0	SLS1	0	Activate SLS1.
			1	Deactivate SLS1.
	1	SLS2	0	Activate SLS2.
			1	Deactivate SLS2.
	2	SLS3	0	Activate SLS3.
			1	Deactivate SLS3.
	3	SLS4	0	Activate SLS4.
			1	Deactivate SLS4.
	4	SSR1	0	Activate SSR1.
			1	Deactivate SSR1.
	5	SSR2	0	Activate SSR2.
			1	Deactivate SSR2.
	6	Reserve		
	7	Reserve		

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Byte	Bit	Name	Value	Description
4	0	SLA1	0	Activate SLA1.
			1	Deactivate SLA1.
	1	SLA2	0	Activate SLA2.
			1	Deactivate SLA2.
	2	Reserve		
	3	Reserve		
	4	Reserve		
	5	Reserve		
	6	Reserve		
	7	Reserve		

1) SBT function is not available.

Process input data

Byte	Bit	Name	Value	Description
0	0	STO1	0	STO is not active. Safe disconnection is not active.
			1	STO signals the status "STO active". All outputs parameterized to STO are switched off.
	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	SBT Active[1)]	0	Brake test is not active.
			1	Brake test is active.
	3	Input data valid	0	At least one of the F-DI process values sends a substitute value.
			1	All process values of the F-DI contain actual values.
	4	Muting	0	The encoder muting function is not active, or a fault has occurred.
			1	The encoder muting function is active.
	5	Test mode active	0	Test mode for drive safety functions is not active
			1	Test mode for drive safety functions is active.
	6	Warning	0	The safety card is in error-free operation.
			1	At least one warning in the safety card is active.
	7	Fault status	0	The safety card is in error-free operation.
			1	At least one error in the safety card.

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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	SOS1	0	SOS not active or limit violation/fault.
			1	SOS1 not active.
	1	Reserve		
	2	SSx1	0	SSx1 not active or limit violation/fault.
			1	SSx1 is active.
	3	SSx2	0	SSx2 not active or limit violation/fault.
			1	SSx2 is active.
	4	SDI1	0	SDI1 not active or limit violation/fault.
			1	SDI1 is active.
	5	SDI2	0	SDI2 not active or limit violation/fault.
			1	SDI2 is active.
	6	SLI1	0	SLI1 not active or limit violation/fault.
			1	SLI1 is active.
	7	SLI2	0	SLI2 not active or limit violation/fault.
			1	SLI2 is active.

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Byte	Bit	Name	Value	Description
3	0	SLS1	0	SLS1 not active or limit violation/fault.
			1	SLS1 is active.
	1	SLS2	0	SLS2 not active or limit violation/fault.
			1	SLS2 is active.
	2	SLS3	0	SLS3 not active or limit violation/fault.
			1	SLS3 is active.
	3	SLS4	0	SLS4 not active or limit violation/fault.
			1	SLS4 is active.
	4	SSR1	0	SSR1 not active or limit violation/fault.
			1	SSR1 is active.
	5	SSR2	0	SSR2 not active or limit violation/fault.
			1	SSR2 is active.
	6	Reserve		
	7	Reserve		
4	0	SLA1	0	SLA1 not active or limit violation/fault.
			1	SLA1 is active.
	1	SLA2	0	SLA2 not active or limit violation/fault.
			1	SLA2 is active.
	2	SSM1	0	SSM1 not active or limit violation/fault.
			1	SSM1 is active.
	3	SSM2	0	SSM2 not active or limit violation/fault.
			1	SSM2 is active.
	4	SSM3	0	SSM3 not active or limit violation/fault.
			1	SSM3 is active.
	5	SSM4	0	SSM4 not active or limit violation/fault.
			1	SSM4 is active.
	6	Reserve		
	7	Reserve		
5	0	Reserve		
	1	Reserve		
	2	Reserve		
	3	Reserve		
	4	Reserve		
	5	Reserve		
	6	Reserve		
	7	Reserve		

1) SBT function is not available.

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10.3.2 CSB31A profile design "Technology Bus F-DO"

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	Enable F-DI	0	No acknowledgment.
			1	Acknowledgment of the interlocked F-DI (0 → 1 edge).
	7	Error ac-know-ledgment	0	No acknowledgment.
			1	Error acknowledgment (0 → 1 edge).
1	0	F-DO00	0	Switch off F-DO00 output (open).
			1	Switch on F-DO00 output (close).
	1	F-DO01	0	Switch off F-DO01 output (open).
			1	Switch on F-DO01 output (close).
	2	Reserve		
	3	Reserve		
	4	Reserve		
	5	Reserve		
	6	Reserve		
	7	Reserve		
2	0	Reserve		
	1	Reserve		
	2	SSX1	0	Activate SSx1.
			1	Deactivate SSx1.
	3	SSX2	0	Activate SSx2.
			1	Deactivate SSx2.
	4	Reserve		
	5	Reserve		
	6	Reserve		
	7	Reserve		

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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 card is in error-free operation.
			1	At least one warning in the safety card is active.
	7	Fault status	0	The safety card is in error-free operation.
			1	At least one error in the safety card is active.
1	0	F-DI00	0	F-DI00 process value: "low" or fault.
			1	F-DI00 process value: "high".
	1	F-DI01	0	F-DI01 process value: "low" or fault.
			1	F-DI01 process value: "high".
	2	F-DI02	0	F-DI02 process value: "low" or fault.
			1	F-DI02 process value: "high".
	3	F-DI03	0	F-DI03 process value: "low" or fault.
			1	F-DI03 process value: "high".
	4	Reserve		
	5	Reserve		
	6	Reserve		
	7	Reserve		

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Byte	Bit	Name	Value	Description
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		

10.3.3 CSB21A profile design "Technology Bus STO"

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	Error ac-knowledg-ment	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 card is in error-free operation.
			1	At least one warning in the safety card is active.
	7	Fault status	0	The safety card is in error-free operation.
			1	At least one fault in the safety card.

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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		

10.3.4 Process input data (F-PI) substitute values

For all process data (F-PE) outgoing from the safety card, the value "0" is written as the substitute value. One exception is *Error 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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10.3.5 Process output data (F-PO) substitute values

In the F-controller, all bits described as "Reserve" must be set to "0". For drive safety functions that are unused, the bit must be set for the selection via the safe process output data (F-PA); otherwise, a fault in the encoder system leads immediately to an encoder fault.

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10.4 Acknowledgment of safety card

10.4.1 Acknowledgment of PROFIsafe data exchange

The PROFIsafe communication must be error-free for safe data exchange of the safety card via PROFIsafe. As soon as there is an acknowledgment request of the safety card via the *ACK_NEC* bit in the F-periphery data component, the user must trigger an acknowledgment by a rising edge via the *ACK_REI* bit.

10.4.2 Acknowledgment of safety card

As soon as the safe data exchange of the safety card via PROFIsafe is error-free, errors in the safety card can be acknowledged by a rising edge via the *Error acknowledgment* bit in the F-process output data.

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11 Response times

The response time plays a decisive role in the design and execution of drive safety functions in systems and machines. In order to match the response time to the requirements of a drive safety function, always take the entire system into account, from the sensor (or command device) to the actuator. The following times are of particular importance in connection with the MOVISAFE® CS..A safety card:

- 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® CS..A safety card
- Response time of the actuators (e.g. frequency inverters)

Establish the response sequence for each drive safety function 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® CS..A safety card can be found in the chapter "Technical data". For detailed information regarding response time consideration for safe PROFIsafe communication, refer to the respective standard: IEC 61784-3-3.

11.1 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 for the deactivation of the internal output F-DO_STO and the external safe digital outputs F-DO, as well as for setting the error status of the safe process input data (F-PE).
- The response times of the safety cards in relation to the safe digital outputs (F-DO) apply for ohmic loads ≤30 kΩ.

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11.1.1 Encoder

All response times must be multiplied by the factor 1,002.

Calculation factor (formula symbol)	Calculation specification response time
sine/cosine encoder: • Processing time encoder positioning ($T_{\_ENC\_POS}$)	$T_{\_Sys} + T_{\_Task}$
• Processing time encoder speed ($T_{\_ENC\_VEL}$)	Filter time speed (8708.3) + $T_{\_Task} + T_{\_Sys}$
• Processing time encoder acceleration ($T_{\_ENC\_ACC}$)	Filter time acceleration (8708.2) + 2 × $T_{\_Task} + T_{\_Sys}$
EI7C built-in encoder: • Processing time encoder speed ($T_{\_ENC\_VEL}$)	Filter time speed (8708.4) + $1/n_{\_Actual} + T_{\_Task} + T_{\_Sys}$
Response time encoder fault: • Deactivation F-DO_STO/ F-DOx • Setting error status F-PE	 8 ms 12 ms

11.1.2 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 • 2-channel	 Input filter time (8704.2) + 51 ms + $T_{\_Sys}$ + 350 µs Input filter time (8704.2) + 2 ms + $T_{\_Sys}$ + 350 µs
Response time of line diagnostics	30 ms (the response times of the drive safety functions are not taken into account)

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11.1.3 Safe communication

The response times for the safe communication always relate to the safe protocol and not to the external interface of the safety card. 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 ($T_{\_InputProcessing\_F\text{-}PA}$)	$2 \times T_{\_Task} + T_{\_Sys}$
Response time selection (F-DIx after F-PE)	$T_{\_InputProcessing\_F\text{-}DIx} + T_{Sys}$
Response time (F-PA after F-DOx)	$T_{\_InputProcessing\_F\text{-}PA} + T_{Sys}$

11.1.4 Selection of a drive safety function via a safe digital input in independent operation

All response times must be multiplied by the factor 1,002.

Calculation factor	Calculation specification response time
STO	$T_{\_InputProcessing\_F\text{-}DI} + T_{\_Sys}$ + brake application time[1](8706.15)
SOS	$T_{\_InputProcessing\_F\text{-}DI} + T_{\_Sys}$
SS1(b)	$T_{\_InputProcessing\_F\text{-}DI} + T_{\_Sys}$ + SSx(b) monitoring delay t_2 (8706.9) + brake application time[1] (8706.15) + Actual_speed/SSx(b) delay a (8706.10) + SSx(x) jerk time[2] t_3 (8706.11)
SS2(b)	$T_{\_InputProcessing\_F\text{-}DI} + T_{\_Sys}$ + SSx(b) monitoring delay t_2 (8706.9) + Actual_speed/SSx(b) delay a (8706.10) + SSx(x) jerk time[2] t_3 (8706.11)
SS1(c)	$T_{\_InputProcessing\_F\text{-}DI} + T_{\_Sys}$ + SSx(c) delay t1 (8706.8) + brake application time[1] (8706.15)
SS2(c)	$T_{\_InputProcessing\_F\text{-}DI} + T_{\_Sys}$ + SSx(c) delay t1 (8706.8)
SSx(b) with SLI	$T_{\_InputProcessing\_F\text{-}DI} + T_{\_Sys}$ + SSx(b) monitoring delay t_2 (8706.9) + Actual_speed/ SSx(b)delay a (8706.10) + SSx(x) jerk time[2] t_3 (8706.11)
SSx(c) with SLI	$T_{\_InputProcessing\_F\text{-}DI} + T_{\_Sys}$ + SSx(c) delay t1 (8706.8)
SLS	$T_{\_InputProcessing\_F\text{-}DI} + T_{\_Sys}$ + monitoring delay t_2 (8706.23) + (Maximum speed - limit speed (8706.24))/delay a (8706.27) + SSx(x) jerk time[2] t_3 (8706.28)
SSR	$T_{\_InputProcessing\_F\text{-}DI} + T_{\_Sys}$ + monitoring delay t2 (8706.53)
SDI	$T_{\_InputProcessing\_F\text{-}DI} + T_{\_Sys}$
SLI	$T_{\_InputProcessing\_F\text{-}DI} + T_{\_Sys}$
SLA	$T_{\_InputProcessing\_F\text{-}DI} + T_{\_Sys}$

1) If SBC release (8706.14) = no, then the brake application time = 0

2) With ramp monitoring = linear, the jerk time = 0

11.1.5 Selection of a drive safety function via safe communication

The response times for the safe communication always relate to the safe protocol and not to the external interface of the safety card. All response times must be multiplied by the factor 1,002.

Calculation factor	Calculation specification response time
STO: • Via F-PA	$T_{\_InputProcessing\_F\text{-}PA} + 2 \times T_{\_Sys}$ + brake application time[1](8706.15)

Calculation factor	Calculation specification response time
• Via F-DI	$T_{\_InputProcessing\_F\text{-}DI}$ + 2 × $T_{\_Sys}$ + brake application time[1] (8706.15)
SOS:	
• Via F-PA	$T_{\_InputProcessing\_F\text{-}PA}$ + $T_{\_Sys}$
• Via F-DI	$T_{\_InputProcessing\_F\text{-}DI}$ + $T_{\_Sys}$
SS1(b):	
• Via F-PA	$T_{\_InputProcessing\_F\text{-}PA}$+ 2 × $T_{\_Sys}$ + SSx(b) monitoring delay t_2 (8706.9) + brake application time[1] (8706.15) + Actual_speed (8700.79)/SSx(b) delay a (8706.10) + SSx(x) jerk time[2] t_3 (8706.11)
• Via F-DI	$T_{\_InputProcessing\_F\text{-}DI}$ + 2 × $T_{\_Sys}$ + SSx(b) monitoring delay t_2 (8706.9) + brake application time[1] (8706.15) + Actual_speed (8700.79)/SSx(b) delay a (8706.10) + SSx(x) jerk time[2] t_3 (8706.11)
SS2(b):	
• Via F-PA	$T_{\_InputProcessing\_F\text{-}PA}$ + $T_{\_Sys}$ + SSx(b) monitoring delay t_2 (8706.9) + brake application time[1] (8706.15) + Actual_speed (8700.79)/SSx(b) delay a (8706.10) + SSx(x) jerk time[2] t_3 (8706.11)
• Via F-DI	$T_{\_InputProcessing\_F\text{-}DI}$ + $T_{\_Sys}$ + SSx(b) monitoring delay t_2 (8706.9) + brake application time[1] (8706.15) + Actual_speed (8700.79)/SSx(b) delay a (8706.10) + SSx(x) jerk time[2] t_3 (8706.11)
SS1(c):	
• Via F-PA	$T_{\_InputProcessing\_F\text{-}PA}$ + 2 × $T_{\_Sys}$ + SSx(c) delay t_1 (8706.8) + brake application time[1] (8706.15)
• Via F-DI	$T_{\_InputProcessing\_F\text{-}DI}$ + 2 × $T_{\_Sys}$ + SSx(c) delay t_1 (8706.8) + brake application time[1] (8706.15)
SS2(c):	
• Via F-PA	$T_{\_InputProcessing\_F\text{-}PA}$ + $T_{\_Sys}$ + SSx(c) delay t_1 (8706.8)
• Via F-DI	$T_{\_InputProcessing\_F\text{-}DI}$ + $T_{\_Sys}$ + SSx(c) delay t_1 (8706.8)
SSx(b):	
• With end state SLI via F-PA	$T_{\_InputProcessing\_F\text{-}PA}$+ 2 × $T_{\_Sys}$ + SSx(b) monitoring delay t_2 (8706.9) + brake application time[1] (8706.15) + Actual_speed (8700.79)/SSx(b) delay a (8706.10) + SSx(x) jerk time[2] t_3 (8706.11)
• With end state SLI via F-DI	$T_{\_InputProcessing\_F\text{-}DI}$ + 2 × $T_{\_Sys}$ + SSx(b) monitoring delay t_2 (8706.9) + brake application time[1] (8706.15) + Actual_speed (8700.79)/SSx(b) delay a (8706.10) + SSx(x) jerk time[2] t_3 (8706.11)
SSx(c):	
• With end state SLI via F-PA	$T_{\_InputProcessing\_F\text{-}PA}$ + 2 × $T_{\_Sys}$ + SSx(c) delay t_1 (8706.8) + brake application time[1] (8706.15)
• With end state SLI via F-DI	$T_{\_InputProcessing\_F\text{-}DI}$ + 2 × $T_{\_Sys}$ + SSx(c) delay t_1 (8706.8) + brake application time[1] (8706.15)
SLS:	
• Via F-PA	$T_{\_InputProcessing\_F\text{-}PA}$ + $T_{\_Sys}$ + SSx(b) monitoring delay t_2 (8706.23) + (maximum speed - speed limit (8706.24))/SSx(b) delay a (8706.27) + SSx(x) jerk time[2] t_3 (8706.28)
• Via F-DI	$T_{\_InputProcessing\_F\text{-}DI}$ + $T_{\_Sys}$ + SSx(b) monitoring delay t_2 (8706.23) + (maximum speed - speed limit (8706.24))/SSx(b) delay a (8706.27) + SSx(x) jerk time[2] t_3 (8706.28)

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Calculation factor	Calculation specification response time
SSM	$T_{\_InputProcessing\_F\text{-}PA} + T_{\_Sys}$
SSR:	
• Via F-PA	$T_{\_InputProcessing\_F\text{-}PA} + T_{\_Sys}$ + monitoring delay t_2 (8706.53)
• Via F-DI	$T_{\_InputProcessing\_F\text{-}DI} + T_{\_Sys}$ + monitoring delay t_2 (8706.53)
SDI:	
• Via F-PA	$T_{\_InputProcessing\_F\text{-}PA} + T_{\_Sys}$
• Via F-DI	$T_{\_InputProcessing\_F\text{-}DI} + T_{\_Sys}$
SLI:	
• Via F-PA	$T_{\_InputProcessing\_F\text{-}PA} + T_{\_Sys}$
• Via F-DI	$T_{\_InputProcessing\_F\text{-}DI} + T_{\_Sys}$
SLA:	
• Via F-PA	$T_{\_InputProcessing\_F\text{-}PA} + T_{\_Sys}$
• Via F-DI	$T_{\_InputProcessing\_F\text{-}DI} + T_{\_Sys}$

1) If SBC-release (8706.4) = no, then the brake application time = 0

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11.1.6 Response time in case of limit value violation in independent operation

All response times must be multiplied by the factor 1,002.

Calculation factor	Calculation specification response time
SOS	$T_{\_ENC\_POS} + T_{\_Sys}$
SSx(b)	$T_{\_ENC\_VEL} + T_{\_Sys}$
SLS with parameterized error response:	
• STO	$T_{\_ENC\_VEL} + T_{\_Sys}$
• SS1(c)	$T_{\_ENC\_VEL} + T_{\_Sys}$ + SSx(c) delay t_1 (8706.8) + brake application time [1](8706.15)
• SS2(c)	$T_{\_ENC\_VEL} + T_{\_Sys}$ + SSx(c) delay t_1 (8706.8)
• SS1(b)	$T_{\_ENC\_VEL} + T_{\_Sys}$ + SSx(b) monitoring delay t_2 (8706.9) + brake application time[1] (8706.15) +Actual_speed (8700.79)/SSx(b) delay a (8706.10) + SSx(x) jerk time[2]t_3 (8706.11)
• SS2(b)	$T_{\_ENC\_VEL} + T_{\_Sys}$ + SSx(c) delay t_1 (8706.8) + Actual_speed (8700.79)/SSx(b) delay a (8706.10) + SSx(x) jerk time[2] t_3 (8706.11)
SSM	$T_{\_ENC\_VEL} + T_{\_Sys}$
SSR with parameterized error response:	
• STO	$T_{\_ENC\_VEL} + T_{\_Sys}$
• SS1(c)	$T_{\_ENC\_VEL} + T_{\_Sys}$ + SSx(c) delay t_1 (8706.8) + brake application time[1] (8706.15)
• SS2(c)	$T_{\_ENC\_VEL} + T_{\_Sys}$ + SSx(c) delay t_1 (8706.8)
• SS1(b)	$T_{\_ENC\_VEL} + T_{\_Sys}$ + SSx(b) monitoring delay t_2 (8706.9) + brake application time[1] (8706.15) +Actual_speed (8700.79)/SSx(b) delay a (8706.10) + SSx(x) jerk time[2] t_3 (8706.11)
• SS2(b)	$T_{\_ENC\_VEL} + T_{\_Sys}$ + SSx(c) delay t_1 (8706.8) + Actual_speed (8700.79)/SSx(b) delay a (8706.10) + SSx(x) jerk time[2] t_3 (8706.11)
SDI	$T_{\_ENC\_POS} + T_{\_Sys}$
SLI	$T_{\_ENC\_VEL} + T_{\_Sys}$
SLA with parameterized error response:	
• STO	$T_{\_ENC\_ACC} + T_{\_Sys}$
• SS1(c)	$T_{\_ENC\_ACC} + T_{\_Sys}$ + SSx(c) delay t_1 (8706.8) + brake application time[1] (8706.15)
• SS2(c)	$T_{\_ENC\_ACC} + T_{\_Sys}$ + SSx(c) delay t_1 (8706.8)
• SS1(b)	$T_{\_ENC\_ACC} + T_{\_Sys}$ + SSx(b) monitoring delay t_2 (8706.9) + brake application time[1] (8706.15) + Actual_speed (8700.79)/SSx(b) delay a (8706.10) + SSx(x) jerk time[2] t_3 (8706.11)
• SS2(b)	$T_{\_ENC\_ACC} + T_{\_Sys}$ + SSx(c) delay t_1 (8706.8) + Actual_speed (8700.79)/SSx(b) delay a (8706.10) + SSx(x) jerk time[2] t_3 (8706.11)

1) If SBC-release (8706.14) = no, then the brake application time = 0

2) With ramp monitoring = linear, the jerk time = 0

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11.1.7 Response time in case of limit value violation with safe communication

The response times for the safe communication always relate to the safe protocol and not to the external interface of the safety card. All response times must be multiplied by the factor 1,002.

Calculation factor	Calculation specification response time
SOS	$T_{\_ENC\_POS} + 2 \times T_{\_Sys}$
SSx(b)	$T_{\_ENC\_VEL} + 2 \times T_{\_Sys}$
SLS with parameterized error response:	
• STO	$T_{\_ENC\_VEL} + 2 \times T_{\_Sys}$
• SS1(c)	$T_{\_ENC\_VEL} + 2 \times T_{\_Sys}$ + SSx(c) delay t_1 (8706.8) + brake application time[1](8706.15)
• SS2(c)	$T_{\_ENC\_VEL} + T_{\_Sys}$ + SSx(c) delay t_1 (8706.8)
• SS1(b)	$T_{\_ENC\_VEL} + 2 \times T_{\_Sys}$ + SSx(b) monitoring delay t_2 (8706.9) + brake application time[1] (8706.15) +Actual_speed (8700.79)/SSx(b) delay a (8706.10) + SSx(x) jerk time t_3 [2] (8706.11)
• SS2(b)	$T_{\_ENC\_VEL} + T_{\_Sys}$ + SSx(c) delay t_1 (8706.8) + Actual_speed (8700.79)/SSx(b) delay a (8706.10) + SSx(x) jerk time[2] t_3 (8706.11)
SSM	$T_{\_ENC\_VEL} + T_{\_Sys}$
SSR with parameterized error response:	
• STO	$T_{\_ENC\_VEL} + 2 \times T_{\_Sys}$
• SS1(c)	$T_{\_ENC\_VEL} + 2 \times T_{\_Sys}$ + SSx(c) delay t_1 (8706.8) + brake application time[1] (8706.15)
• SS2(c)	$T_{\_ENC\_VEL} + T_{\_Sys}$ + SSx(c) delay t_1 (8706.8)
• SS1(b)	$T_{\_ENC\_VEL} + 2 \times T_{\_Sys}$ + SSx(b) monitoring delay t_2 (8706.9) + brake application time[1] (8706.15) +Actual_speed (8700.79)/SSx(b) delay a (8706.10) + SSx(x) jerk time[2] t_3 (8706.11)
• SS2(b)	$T_{\_ENC\_VEL} + T_{\_Sys}$ + SSx(c) delay t_1 (8706.8) + Actual_speed (8700.79)/SSx(b) delay a (8706.10) + SSx(x) jerk time[2] t_3 (8706.11)
• F-PE	$T_{\_ENC\_VEL} + T_{\_Sys}$
SDI	$T_{\_ENC\_POS} + 2 \times T_{\_Sys}$
SLI	$T_{\_ENC\_VEL} + 2 \times T_{\_Sys}$
SLA with parameterized error response:	
• STO	$T_{\_ENC\_ACC} + 2 \times T_{\_Sys}$
• SS1(c)	$T_{\_ENC\_ACC} + 2 \times T_{\_Sys}$ + SSx(c) delay t_1 (8706.8) + brake application time[1] (8706.15)
• SS2(c)	$T_{\_ENC\_ACC} + T_{\_Sys}$ + SSx(c) delay t_1 (8706.8)
• SS1(b)	$T_{\_ENC\_ACC} + 2 \times T_{\_Sys}$ + SSx(b) monitoring delay t_2 (8706.9) + brake application time[1] (8706.15) + Actual_speed (8700.79)/SSx(b) delay a (8706.10) + SSx(x) jerk time[2] t_3 (8706.11)
• SS2(b)	$T_{\_ENC\_ACC} + T_{\_Sys}$ + SSx(c) delay t_1 (8706.8) + Actual_speed (8700.79)/SSx(b) delay a (8706.10) + SSx(x) jerk time[2] t_3 (8706.11)

Calculation factor	Calculation specification response time
• F-PE	$T_{\_ENC\_ACC} + T_{\_Sys}$

1) If SBC-release (8706.14) = no, then the brake application time = 0
2) With ramp monitoring = linear, the jerk time = 0

11.1.8 Deselection of a drive safety function via a 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

11.1.9 Deselection of a drive safety function via safe communication

The response times for the safe communication always relate to the safe protocol and not to the external interface of the safety card. All response times must be multiplied by the factor 1,002.

Calculation factor (formula symbol)	Calculation specification response time
Response time ($T_{\_InputProcessing\_F\text{-}DI\_Deselection}$)	$T_{\_InputProcessing\_F\text{-}PA}$ + 16 ms

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12 Service

12.1 Modification/changes to the device

- Hardware changes

  Any changes to the CS..A safety card 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 CS..A safety card.
- 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).

12.2 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:

- Aluminum
- Copper
- Electronic parts
- Plastics

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12.3 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 may 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 2 Hz.
- 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. F-RUN LED flashes green, F-ERR LED flashes yellow and vice versa.

12.3.1 "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 drive safety function 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
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.

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12.3.2 "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 error, cannot be acknowledged.
Red, slowly flashing	• Error can be acknowledged • Error outside of the device, cabling system error • 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	Error-free operation.
Off	Device off.

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12.4 Error states of the MOVISAFE® CS..A safety card

⚠ DANGER

The MOVISAFE® CS..A safety card has an error and automatically restarts in the following cases:

- The DC-24-V supply voltage was switched off and back on.
- The safety card was in the 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.

12.4.1 Fault classes

The occurring safety card errors are divided into 5 different error 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 error response is carried out in the case of a message. An entry is made in the fault memory. In addition, the corresponding error 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 card detects an error at a safe digital output, all safe digital outputs are switched to the safe state. In addition, the drive safety function STO is activated and the safety card is set to the safe state. In the FS protocol, the bits of the outputs F-DO0 and F-DO1 are set to "0" and the bits for the drive safety function STO and the error are set to "1".

In addition, the corresponding error code is transferred for the output error that occurred.

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Input fault

If the safety card detects an error at a safe digital input, the affected safe digital inputs is switched to the safe state. If the affected safe digital input is parameterized as dual-channel, both inputs are switched to the safe state. In the FS-protocol, the bits of the affected safe digital inputs are set to "0" and the error bit is set to "1".

In addition, the corresponding error code is transferred for the input error that occurred.

INFORMATION

If a safe digital input is assigned to a drive safety function via the function assignment, then this drive safety function is selected in the event of an input error.

At a safe digital input with detected error, the error must first be resolved and the safe state established before an acknowledgment of the input error. In this way, a drive safety function is not erroneously selected after acknowledgment of an input error.

Encoder fault

If the safety card detects a fault in the encoder system, this leads to a warning in the absence of an activated drive safety function. The safety card continues to remain operationally ready. If at least one drive safety function is active, this leads to an encoder fault. The drive safety functions switch to the corresponding error state. The corresponding fault code is transferred for the encoder fault that occurred.

The acknowledgment of the encoder fault with activated drive safety function leads to a restart of the drive safety function.

INFORMATION

The acknowledgment of a limit value violation leads to a different behavior of the activated drive safety function 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 error, all safe digital inputs and all safe digital outputs are switched to the safe state. In addition, the drive safety function STO is executed without delay and the outputs F-DO0 and F-DO1 are deactivated. The safety card is set to the safe state.

In the FS protocol, the bits of the safe digital outputs F-DO0 and F-DO1 and inputs F-DI00, F-DI01, F-DI02 and F-DI03 are set to "0" and the bits for the drive safety function STO and the error are set to "1".

In addition, the corresponding error code is transferred for the system error that occurred.

INFORMATION

If the safe digital output is assigned to a drive safety function via the function assignment, this drive safety function is selected in the case of a system error.

Critical fault

In case of a critical error, the safety card is set to safe state. All safe digital inputs and all safe digital outputs are switched to safe state. In addition, the drive safety function STO is executed without delay. The sensor supply for the safe digital inputs is also switched to deenergized state. Active safe communication is suspended.

In addition, the corresponding error code is transferred for the critical fault that occurred.

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Error messages

If there is a fault in the safety card, the inverter indicates that the safety card is reporting a fault.

Measures for error resolution and more information on causes can be found via the error status of the safety card.

12.4.2 Starting behavior of the safety card

⚠ DANGER

After a fault, the safety card 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 card is prevented in the cases mentioned above.

In the "Basic settings" of the "Assist CS.." parameterization tool, the starting behavior of the safety card can be defined with the *Fault status after startup* parameter. The following parameter settings are possible.

- "Start inhibit" parameter setting

  The safety card 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 card 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 card starts up. This parameterization is designated for fieldbus operation where the higher-level controller, if necessary, takes over interlocking in case of a fault.

As long as start inhibit in active, the STO drive safety function is active. Outputs assigned to the STO or SBC function are activated depending on the safety function. 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

12.5 "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").

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12.5.1 Safety notes

⚠ DANGER

Due to the "Emergency mode" function, immediate restart of the system is possible.

Severe or fatal injuries.

- Before activation of the "Emergency mode" function, the user must undertake organizational measures for the protection of personnel and machinery.

⚠ DANGER

The keypad is connected to the wrong device. This can cause immediate restart of the system.

Severe or fatal injuries.

- Before activation of 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 at any time during emergency mode.

12.5.2 Approved devices

The "Emergency mode" function is approved for MOVIDRIVE® technology with MOVISAFE® CS..A safety card.

12.5.3 Requirements

- The "Emergency mode" function (index 8702.2) must be enabled.
- To start the "emergency mode" function, an encoder fault or communication error must be pending in the F-protocol.

12.5.4 Starting emergency mode

Proceed as follows:

- 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.

12.5.5 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.

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12.6 Fault diagnostics

The "Latest initial fault" fault status shows the fault that occurred first in the safety card with the corresponding fault code, subfault code and fault description. For internal purposes, additional error codes are displayed.

The current first error is the error that occurs after a restart or since the last acknowledgment as the first error with the highest priority.

12.6.1 Fault messages

If there is an error in the safety card, this error is indicated by the inverter as follows.

Subfault: 46.50 **Description: Warning**		
	Response: Warning with self reset	
	Cause	Measure
	- Safety card reports a subcomponent error of the "Warning" type.	See error status "Subcomponent safety card"

Subfault: 46.51 **Description: Fault**		
	Response: Emergency stop and output stage inhibit with self-reset	
	Cause	Measure
	- The safety option signals a subcomponent error of the "Standard error" type.	See error status "Subcomponent safety card"

Subfault: 46.52 **Description: Critical fault**		
	Response: Output stage inhibit with self reset	
	Cause	Measure
	- Safety card reports a subcomponent error of the type "Critical error" type.	See error status "Subcomponent safety card"

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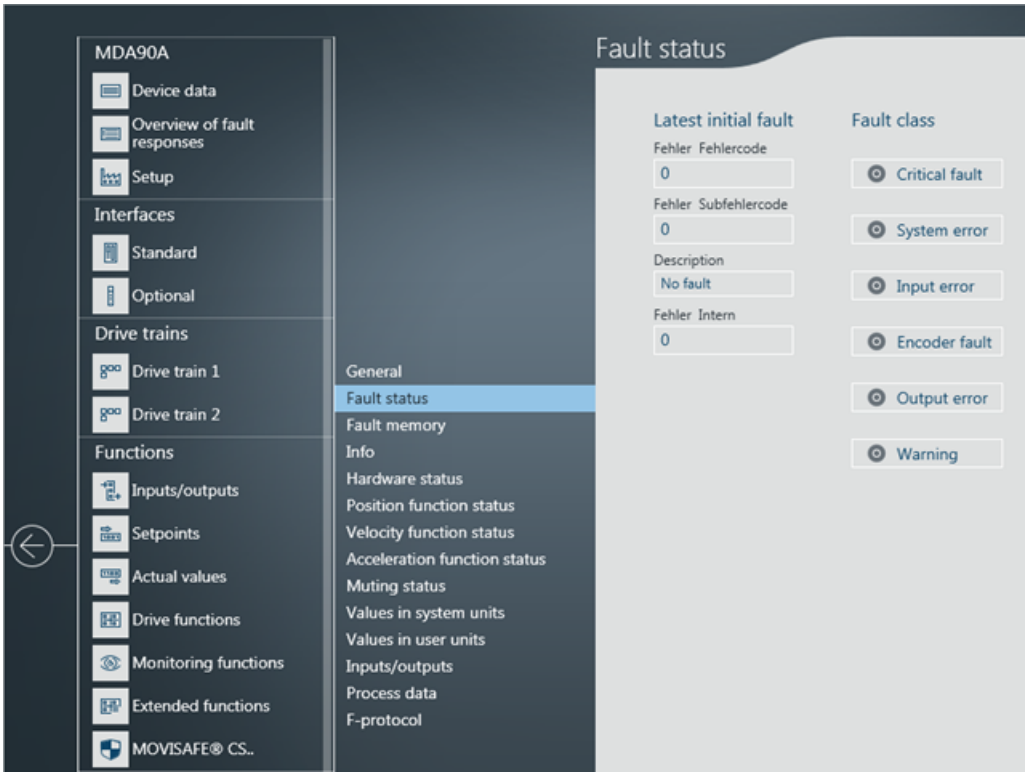
12.6.2 Diagnostics with MOVISUITE® Assist CS..

The current fault of the safety card is displayed with the corresponding fault description in the "Diagnostics" segment in the menu command [MOVISAFE® CS..] > [Fault status].



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12.6.3 Diagnostics with PROFIsafe connection

The CS..A safety card with PROFIsafe connection triggers a diagnostic alarm in the F-PLC in the data exchange between of F-PLC (fieldbus master) and the safety card (fieldbus slave) in case of a fault. Simultaneously, the associated error code is transferred via the communication connection.

The F-host responds the dispatched diagnostic alarm if the *Diagnostic alarm* assembly parameter is enabled for the safety card in the F-PLC per configuration. Depending on the fieldbus used (PROFIBUS or PROFINET), the fault code of the safety card 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 card in the F-PLC).

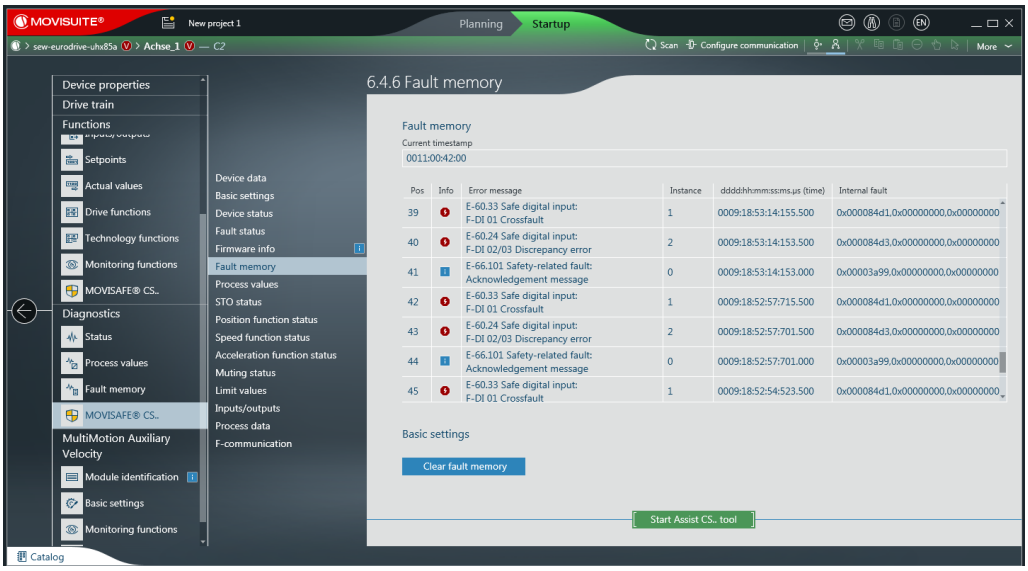
The safety card has PROFIsafe and assembly-specific error codes. All error codes of the CS..A safety card are listed in an error table.

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.

12.6.4 Fault memory

The current initial fault and all other subsequent faults are residually saved in the fault memory with associated timestamp.



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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 an error response of the CS..A safety card. 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 card 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 error is overwritten.

12.7 Device replacement

INFORMATION

Observe the information in chapter "Compatibility".

⚠ WARNING

An incorrect parameterization of the safety card is enabled due to incorrectly inserted pluggable safety key.

Severe or fatal injuries.

- Ensure that the safety key matching the application is inserted at the correct system position.

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12.7.1 Device replacement with MOVI-C® CONTROLLER

The following steps must be performed for the actual device replacement:

The system offers the option to save the application-related data set for the inverter and the data set for the safety card on the controller. This step must be carried out in advance by the user.

1. Switch off the device to be replaced.
2. Pull the pluggable safety key from the safety card.
3. Replace the device (including MOVISAFE® CS..A safety card) or only the MOVISAFE® CS..A safety card.
4. Re-insert the safety key pulled out in step 2.
5. Carry out a functional test. The checking of all parameters is omitted.

The controller detects the device replacement automatically and loads the application-related data set to the MOVISAFE® CS..A safety card. The localized key data set on the safety key ensures that the correct application-related data set has been loaded. The MOVISAFE® CS..A safety card is subsequently in the same state that it was in before the device replacement. This means that the MOVISAFE® CS..A safety card 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 card is still required in the case of automatic device replacement function.

12.7.2 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 with the menu item [Device] > [PC].
2. Switch off the device to be replaced.
3. Pull the pluggable safety key from the safety card.
4. Replace the device (including MOVISAFE® CS..A safety card) or only the MOVISAFE® CS..A safety card.
5. Re-insert the safety key pulled out 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 with 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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13 Technical data

13.1 General technical data

	Value
Ambient temperature for storage of the safety card	≥ -25 °C – ≤ 85 °C
Ambient temperature of MOVIDRIVE® system/ technology, all sizes (For derating, see the "MOVIDRIVE® system" and "MOVIDRIVE® technology" operating instructions)	• 0 °C – 40 °C without derating • 40 °C – 55 °C with derating
Ambient temperature of MOVIDRIVE® modular, all sizes	0 °C – 45 °C without derating
Installation altitude	Maximum 3800 m above sea level

13.2 General electrical data

The safety card is supplied with voltage by the basic device.

13.2.1 Current and power consumption of the safety cards

Safety card	Maximum current consumption	Maximum power consumption
CSB21A	0.74 A	17.7 W
CSS21A	1.1 A	26.4 W
CSB31A	1.6 A	38.4 W
CSS31A	1.6 A	38.4 W

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13.3 Encoder interface

Designation	Value/description	
Features	Encoder interface for HTL encoder interfaces A, $\overline{A}$, B, $\overline{B}$, sin/cos encoder signals	
Permitted safety encoders	EI7C FS, AK0H, AK1H, E.7S, A.7W	
Signal level	0 V – +3 V	Encoder track LOW (logic "0") Encoder track HIGH (logic "1")
Maximum operating speed EI7C FS, E.7S, A.7W	3600 min^{-1}	
Maximum operating speed AK0H, AK1H	6000 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}	
Error 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 triggered by the safety card.

13.4 Safe digital inputs

F-DI00 – F-DI03	Value/description
Properties	DC 24 V input pursuant to EN 61131-2, type 3
Signal level	• Logic "0" = LOW input: ≤ 5 V or ≤ 1.5 mA • Logic "1" = HIGH input: ≥ 11 V and ≥ 2 mA
Reference ground	GND
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
Input capacitance	< 500 pF

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13.5 Sensor supply

F-SS0, F-SS1	Value/description
Properties	• 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

13.6 Safe digital outputs

F-DO00_P/M, F-DO01_P/M	Value/description
Features	• 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 < 1 minute • 0.5 Hz during operation > 1 minute
Overload protection	210 mA
Minimum current for wire break monitoring	15 mA
Permitted cable length	30 m
Load capacitance (max. test pulse duration)	≤ 300 nF
Load capacitance (1 ms test pulse duration)	50 nF
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, F-DO01_P/M	Value/description
Load inductance with freewheeling diode	≤ 40 H
Minimum load resistance	> 130 Ω

13.7 Characteristic safety values

13.7.1 Drive safety functions without encoder evaluation

	Characteristic values pursuant to	
	EN 62061/IEC 61800-5-2	EN ISO 13849-1
Tested safety class/underlying standards	SIL 3	PL e
Probability of dangerous failure per hour (PFH_D value)	4.5×10^{-9} 1/h	
Mission Time/service life	20 years, after which the component must be replaced with a new one.	
Proof test interval	20 years	-
Safe state	Value "0" for all safe F-DO process values (output disabled).	
Drive safety function	• STO, SS1(c), SBC • Safe digital inputs/outputs • Safe communication	

INFORMATION

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

13.7.2 Drive safety functions with encoder evaluation

	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)	4.5×10^{-9} 1/h	
Mission Time/service life	20 years, after which the component must be replaced with a new one.	
Proof test interval	20 years	-
Safe state	Value "0" for all safe F-DO process values (output disabled).	
Drive safety function	SS1, SS2, SOS, SLS, SSM, SSR, SDI, SLI, SLA	

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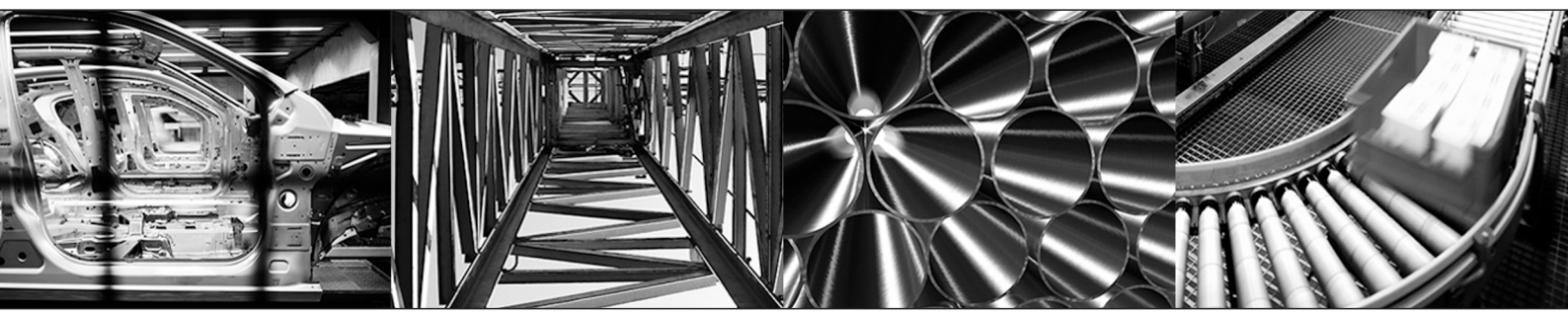

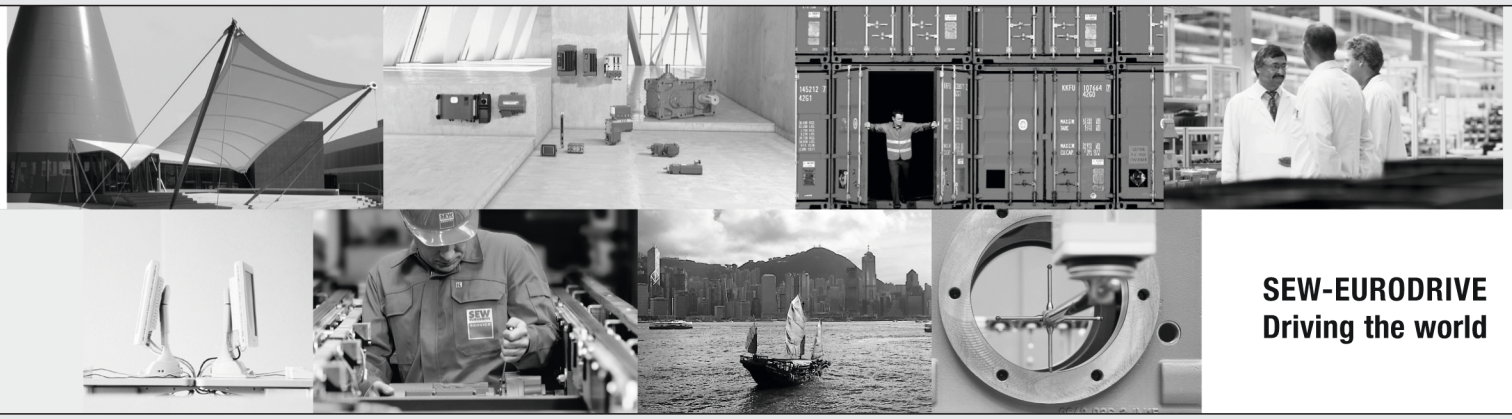

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