Operating instructions for

AX5805 / AX5806

TwinSAFE drive option cards for the AX5000 servo drive

Version: 1.8.0
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BECKHOFF

Table of contents

1 Foreword

1.1 Notes on the manual

1.1.1 Intendent audience

This description is aimed specifically at trained qualified persons with a control and automation technology background, who are familiar with the current national and international standards and guidelines.
The following instructions and explanations must be followed during installation and commissioning of the components.

The qualified personnel must ensure that the application of the described products meets all safety requirements, including all applicable laws, specifications, regulations and standards.

1.1.2 Origin of the document

These operating instructions were originally written in German. All other languages are derived from the German original.

1.1.3 Actuality

Please check whether you have the latest and valid version of this document. On the Beckhoff homepage under the link http://www.beckhoff.de/english/download/twinsafe.htm you may find the latest version for download. If in doubt, please contact the technical support (see chapter 5.1 Beckhoff Support and Service).

1.1.4 Product properties

Valid are only the product properties that are specified in the respectively current user documentation. Other information, which is given on the product pages of the Beckhoff homepage, in emails or other publications is not relevant.

1.1.5 Disclaimer

The documentation has been prepared with care. The products described are, however, constantly under development. For that reason the documentation is not in every case checked for consistency with performance data, standards or other characteristics.
If it should contain technical or editorial errors, we reserve the right to make changes at any time and without notice.
No claims for the modification of products that have already been supplied may be made on the basis of the data, diagrams and descriptions in this documentation.

1.1.6 Trademarks

Beckhoff®, TwinCAT®, EtherCAT®, Safety over EtherCAT®, TwinSAFE® and XFC® are registered trademarks of and licensed by Beckhoff Automation GmbH.
Other designations used in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owners.

1.1.7 Patent Pending

The EtherCAT technology is patent protected, in particular by the following applications and patents: EP1590927, EP1789857, DE102004044764, DE102007017835 with the corresponding applications and registrations in various other countries.

The TwinCAT technology is patent protected, in particular by the following applications and patents: EP0851348, US6167425 with corresponding applications or registrations in various other countries.

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

1.1.8 Copyright

1.1.9 Delivery conditions

In addition, the general delivery conditions of the company Beckhoff Automation GmbH & Co. KG apply.

1.2 Safety instructions

1.2.1 Delivery state

All the components are supplied in particular hardware and software configurations appropriate for the application. Modifications to hardware or software configurations other than those described in the documentation are not permitted, and nullify the liability of Beckhoff Automation GmbH & Co. KG.

1.2.2 Operator's obligation to exercise diligence

The operator must ensure that

- the TwinSAFE products are only used as intended (see chapter Product description);
- the TwinSAFE products are only operated in sound condition and in working order (see chapter Cleaning).
- the TwinSAFE products are operated only by suitably qualified and authorized personnel.
- the personnel is instructed regularly about relevant occupational safety and environmental protection aspects, and is familiar with the operating instructions and in particular the safety instructions contained herein.
- the operating instructions are in good condition and complete, and always available for reference at the location where the TwinSAFE products are used.
- none of the safety and warning notes attached to the TwinSAFE products are removed, and all notes remain legible.

1.2.3 Description of safety symbols

The following safety symbols are used in these operating instructions. They are intended to alert the reader to the associated safety instructions.

 **DANGER**	**Serious risk of injury!** **Failure** to follow the safety instructions associated with this symbol directly endangers the life and health of persons.
 **WARNING**	**Caution - Risk of injury!** **Failure** to follow the safety instructions associated with this symbol endangers the life and health of persons.
 **CAUTION**	**Personal injuries!** **Failure** to follow the safety instructions associated with this symbol can lead to injuries to persons.
 **Attention**	**Damage to the environment or devices** **Failure** to follow the instructions associated with this symbol can lead to damage to the environment or equipment.
 **Note**	**Tip or pointer** This symbol indicates information that contributes to better understanding.

1.2.4 Documentation issue status

Version	Comment
1.8.0	• Note *Restrictions in STO mode* extended • Updating the foreword • Certificate updated • Note to EN 61800-5-2:2017 added • Note to diagnosis data 0xFA10 added
1.7.0	• Extension: notes to SLS, SSM, SSR, SMS, Speed_Compare_Window
1.6.1	• Reliability document updated • Foreword overworked
1.6.0	• Extension: safety-parameter 0x2x20 / 0x2x21 / 0x2x22 • Extension: setting the mode of operation • Extension: intended use • Extension: description of the SOS function • Diagram of SLP state adapted • Note on SOS function added
1.5.4	• Certificate updated
1.5.3	• EN 62061:2005 + A1:2013 mentioned
1.5.2	• Reliability document added for AX5805 and AX5806 • Note about permissible motors revised
1.5.1	• Certificate updated
1.5.0	• Documentation versions added • Company address amended
1.4.0	• Extension for AX5806 added
1.3.1	• Document origin added
1.3.0	• Note on parameter switching for AX5000 added • Note on switching the AX5805 to EtherCAT state BOOT • Extensions for AX5805 software version 05 • Parameter description s_LL_SLI modified
1.2.4	• Note on Speed_Compare_Window added
1.2.2	• Description of the motor string entry expanded
1.2.0	• Description of SDIn corrected in the default mapping control word • Description of the parameters for the function SCA expanded • Notes on error reaction SS1 added
1.1.1	• Tables with axis 1 and 2 information expanded • SOS and SLI parameters changed to increments • Table with reason for shutdown added
1.1.0	• Processing order of the safety functions amended • Velocity calculation examples expanded

1.0.0	• First released version

2 System description

With the integration of safety technology in the drive technology, Beckhoff consistently developed the TwinSAFE system philosophy further. TwinSAFE enables integrated automation, ranging from digital inputs and logic systems to drives or digital outputs. Simple handling, diagnostic and support functions help the user to implement the required application quickly and safely.

Significant hazards to persons arise from the dynamic movements of the electrical drive equipment of machines. The controlling of these hazards whilst achieving a smooth production flow is a big challenge.

The Beckhoff servo drives from the AX5xxx series become fully-fledged safety drives with the AX5805/AX5806 TwinSAFE drive option card.

The option card is able to switch the motor torque-free or to monitor speed, position and direction of rotation (in accordance with EN ISO 13849-1:2006 to PLe). No further circuits are necessary for this, such as circuit breakers or contactors in the supply lines or special external encoder systems.

This enables a very lean installation and helps to lower costs and control cabinet space. No special encoder system is required for implementing the functions SDI (Safe Direction) or SLS (Safely-Limited Speed). All Beckhoff motors listed in the documents "AX5805 list of permitted motors" and "AX5806 list of permitted motors" can be used for these functions without additional measures and without additional encoder systems. Even safe position monitoring or position range monitoring is simple to implement with the aid of the AX5805/AX5806 module.

This does not result in any additional wiring, since EtherCAT communication is used in the AX5xxx basic controllers. The AX5805/AX5806 TwinSAFE drive option card is a self-contained EtherCAT Slave and communicates directly via the AX controller with a TwinSAFE logic terminal existing in the network.

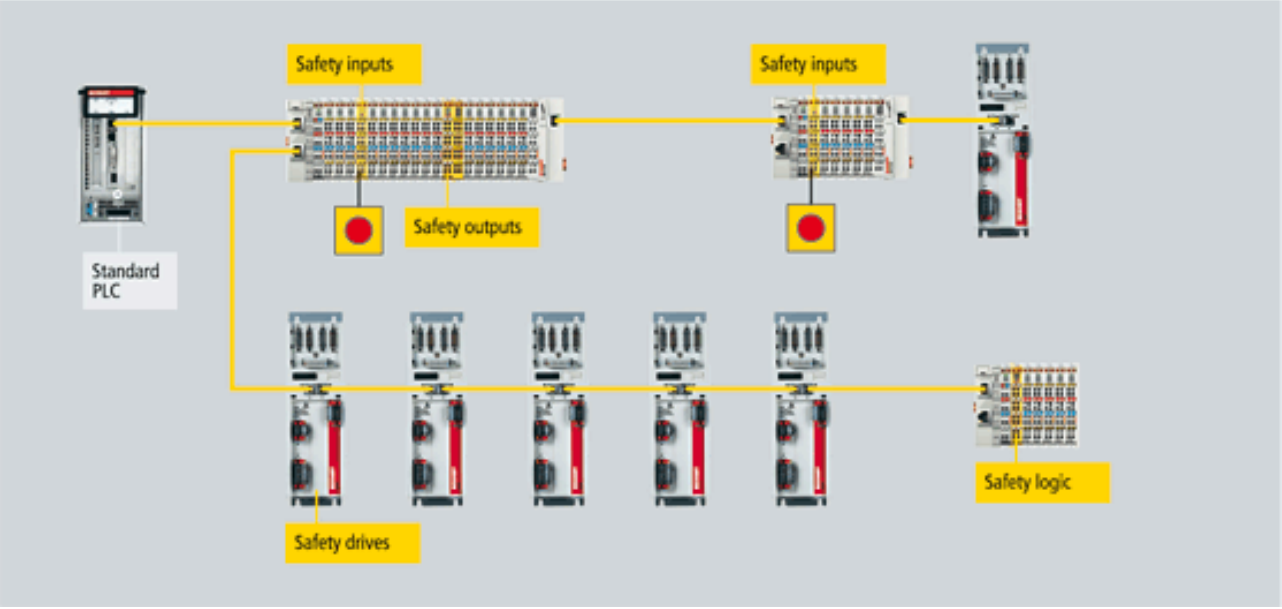


Fig. 1: TwinSAFE system overview

3 Product description

3.1 General description

AX5805/AX5806 – TwinSAFE drive option card for drive controllers from the AX5000 series

The AX5805/AX5806 TwinSAFE drive option card is an optional extension of the Beckhoff AX5000 servo drive series. The following safety functions can be implemented by the installation of the AX5805/AX5806 in the AX5000:

- Stop functions (STO, SOS, SS1, SS2)
- Speed functions (SLS, SSM, SSR, SMS)
- Position functions (SLP, SCA, SLI)
- Acceleration functions (SAR, SMA)
- Direction of rotation functions (SDIp, SDIn)

Like the programming or configuration of the safety application, the entire parameterization of the AX5805/AX5806 option card is performed from the TwinCAT software. All system-specific settings are stored together with the application in the TwinSAFE logic terminal or in the AX5805/AX5806 startup parameters. Therefore an exchange of the AX5805/AX5806 is possible at any time without changing the software. The AX5805/AX5806 receives all necessary parameters at the next switch on or boot-up.

The AX5805/AX5806 fulfils the requirements of IEC 61508:2010 SIL 3, EN 62061:2005 + A1:2013 SILCL3 and DIN EN ISO 13849-1:2006 (Cat 4, PL e).

The AX5805/AX5806 is intended for use in the safety option slot of a servo drive from the AX5000 series.

Attention	**Compatibility of AX5000 and AX5805/AX5806** The AX5805/AX5806 can be used only in servo drives of the new generation (AX5xxx-0000-x2xx). An attempt to install the AX5805/AX5806 into AX5000 servo drives of an older generation can lead to irreparable damage to the AX5000.

CAUTION	**Supported AX5000 devices: AX5805** The AX5805 may only be used in servo drives of types AX5101 to AX5140 and AX5201 to AX5206. Other combinations are not permitted.

CAUTION	**Supported AX5000 devices: AX5806** The AX5806 may only be used in servo drives of types AX5160 to AX5172 and AX5190 to AX5193. Other combinations are not permitted.

3.2 Intended use

 WARNING	**Observe the intended use!** Use of the TwinSAFE drive option card other than for the intended purpose as described below is not permitted!

The AX5805/AX5806 TwinSAFE drive option card extends the field of use of the Beckhoff AX5000 servo drive by safety functions that allow it to also be used in the field of machine safety.

The following safety measures and safety instructions must be observed when using the TwinSAFE drive option card:

 DANGER	**Ensure that the power is switched off before installation!** The servo drive must be disconnected from the mains and system voltage before installing the TwinSAFE drive option card. Even when the AX5000 is disconnected from the mains voltage, dangerous voltage continues to be present at the X02 terminals of the DC link for at least 5 minutes. Wait until the DC link capacitors are discharged before touching live terminals. The voltage measured between the DC+ and DC- terminals (X02) must have dropped to below 50 V.

 DANGER	**Parameter set switching in AX5000!** The AX5000 parameter set switching may not be used in conjunction with the AX5805/AX5806.

 WARNING	**Caution - Risk of injury!** Electronic equipment is not fail-safe. The machine manufacturer is responsible for ensuring that the connected motors and the machine are brought into a safe state in the event of a fault in the drive system.

 WARNING	**Check the parameterization of the TwinSAFE drive option card!** The TwinSAFE Drive option card determines errors in the parameterization, but no logical testing of the parameters can take place. Hence, it is only possible to ensure that the parameterization is correct for the application by means of a corresponding acceptance test. This test must be performed by the machine manufacturer. In particular the Speed_Compare_Window parameter should be set to the smallest possible value (default: 180 increments). The larger the value for this window, the higher the availability of the drive may be. This parameter has a direct effect on the safety functions (see chapter 3.6.2). In order to set the Speed_Compare_Window as small as possible, the Speed_Compare_Filter can be incremented if necessary (filter steps 1 to 15, default 10).

 **WARNING**	**Provide for external safety measures for the STO function of the TwinSAFE Drive Option card!** If the STO safety function is executed, the connected motors are not braked, but are switched torque-free. This leads to the motors coasting to a halt. The duration of this coasting depends on how much kinetic energy is present in the system. With suspended loads the motors may even be accelerated. In order to prevent this, appropriate external safety mechanisms (e.g. mechanical brakes) must be provided by the user.

 **WARNING**	**Provide for external safety measures for the error reactions of the TwinSAFE drive option card!** The preconfigured error reaction occurs if the TwinSAFE drive option card determines an error. The standard error reaction is STO, but the SS1 error reaction can also be parameterized. The following description applies only to the error reaction, not to the STO and SS1 safety functions. If the STO error reaction is executed, the connected motors are not braked, but are directly switched torque-free. This leads to the motors coasting to a halt. The duration of this coasting depends on how much kinetic energy is present in the system. With suspended loads the motors may even be accelerated. In order to prevent this, appropriate external safety mechanisms (e.g. mechanical brakes) must be provided by the user. If the SS1 error reaction is executed, the AX5805/AX5806 TwinSAFE Drive option card triggers a stop ramp in the AX5000. This is purely functional and is not designed to be a safety feature. Subsequently, the STO safety function (motors are switched torque-free) is activated after the time set by the ESTOP_Ramp_Time parameter. Any motors that are still moving coast to a halt. With suspended loads the motors may even be accelerated. In order to avoid inadvertent movements, external safety mechanisms (e.g. mechanical brakes) must be provided by the user.

 **WARNING**	**Avoid line interruptions!** Line interruptions lead to switch-off. The AX5805/AX5806 switches the motors of the AX5000 servo drive torque-free. Any motors that are still moving coast to a halt. With suspended loads the motors may even be accelerated. In order to avoid inadvertent movements, external safety mechanisms (e.g. mechanical brakes) must be provided by the user.

 **WARNING**	**Avoid faults and interruptions in the EtherCAT communication!** Faults and interruptions in the EtherCAT communication lead to switch-off. The AX5805/AX5806 switches the motors of the AX5000 servo drive torque-free. Any motors that are still moving coast to a halt. With suspended loads the motors may even be accelerated. In order to avoid inadvertent movements, external safety mechanisms (e.g. mechanical brakes) must be provided by the user.

 **WARNING**	**Activation or restart of a project in the TwinCAT System Manager** The activation or restart of a project in the TwinCAT System Manager leads to switch-off. The AX5805/AX5806 switches the motors of the AX5000 servo drive torque-free. Any motors that are still moving coast to a halt. With suspended loads the motors may even be accelerated. In order to avoid inadvertent movements, external safety mechanisms (e.g. mechanical brakes) must be provided by the user.

 **WARNING**	**Downloading the safety project to the EL6900 TwinSAFE-Logic leads to switch-off!** Downloading the safety project to the EL6900 TwinSAFE-Logic leads to switch-off. The AX5805/AX5806 switches the motors of the AX5000 servo drive torque-free. Any motors that are still moving coast to a halt. With suspended loads the motors may even be accelerated. In order to avoid inadvertent movements, external safety mechanisms (e.g. mechanical brakes) must be provided by the user.

 **WARNING**	**Avoid incorrect parameterization of the servo drive!** Incorrect parameterization of the servo drive (e.g. current controller oscillates or is too lethargic) leads to switch-off. The AX5805/AX5806 switches the motors of the AX5000 servo drive torque-free. Any motors that are still moving coast to a halt. With suspended loads the motors may even be accelerated. In order to avoid inadvertent movements, external safety mechanisms (e.g. mechanical brakes) must be provided by the user.

 **WARNING**	**Avoid incorrect dimensioning of the servo drive!** Loads that cannot be braked by the AX5000 servo drive (e.g. if the AX5000 servo drive is under-dimensioned) lead to switch-off. The AX5805/AX5806 switches the motors of the AX5000 servo drive torque-free. Any motors that are still moving coast to a halt. With suspended loads the motors may even be accelerated. In order to avoid inadvertent movements, external safety mechanisms (e.g. mechanical brakes) must be provided by the user.

 **WARNING**	**Changing the EtherCAT status** If the AX5805/AX5806 is switched to EtherCAT state BOOT, the stop paths are switched off immediately, and the brake control remains in its current state. This may result in the brake not engaging, even when the axis as at a standstill. In general, the axis should be brought into a safe state before the EtherCAT status is changed. If this is not done, the axis is switched torque-free immediately.

 CAUTION	**Follow the machinery directive!** The TwinSAFE Drive option cards may be used in machines only as defined in the machine directive.

 CAUTION	**Ensure traceability!** The buyer has to ensure the traceability of the device via the serial number.

3.3 Technical data

Product designation	AX5805 / AX5806
Error reaction time	see tables in chapter 3.3.1 and 3.3.2
Safety input process image (dependent on the AX5000)	7 bytes (AX51XX) or 11 bytes (AX52XX)
Safety output process image (dependent on the AX5000)	7 bytes (AX51XX) or 11 bytes (AX52XX)
Standard input process image (dependent on the AX5000)	8 bytes (AX51XX) or 16 bytes (AX52XX)
Standard output process image (dependent on the AX5000)	8 bytes (AX51XX) or 16 bytes (AX52XX)
Supply voltage of the AX5805	Supplied by the AX5000 servo drive
Dimensions (W x H x D) including cover plate	26 mm x 100 mm x 54 mm
Weight	approx. 75 g
Permissible ambient temperature (operation)	0°C to +50°C
Permissible ambient temperature (transport/storage)	-25°C to +70°C
Permissible air humidity	5% to 95%, non-condensing
Permissible air pressure (operation/storage/transport)	750 hPa to 1100 hPa (this corresponds to a height of approx. -690 m to 2450 m over sea level assuming an international standard atmosphere)
Permissible level of contamination	Contamination level 2 according to EN 61800-5-1 (see also chapter Cleaning)
Impermissible operating conditions	TwinSAFE products must not be used under the following operating conditions: - under the influence of ionizing radiation (that exceeds the level of the natural environmental radiation) - in corrosive environments - in an environment that leads to unacceptable soiling of the component
EMC immunity / emission	conforms to EN 61800-5-1 / EN 61326-3-1
Protection class	IP20
Permitted operating environment	control cabinet or terminal box, with minimum protection class IP54 according to IEC 60529
Permissible installation position	vertical
Approvals	CE, TÜV SÜD

Please ensure that the TwinSAFE option cards are only transported, stored and operated under the specified conditions (see technical data)!

 **WARNING**	**Caution - Risk of injury!** The TwinSAFE drive option cards may not be used under the following operating conditions: • under the influence of ionizing radiation (that exceeds the level of the natural environmental radiation) • in corrosive environments • in an environment that would lead to impermissible contamination of the TwinSAFE Drive option cards

3.3.1 Reaction times in the AX51xx servo drive

The measurement of the reaction times takes place from the input of the request to the AX5805/AX5806 until the switching off of the internal switch-off paths. If the TwinSAFE communication is to be included in the calculation, the watchdog time of the TwinSAFE connection must be added to this. For a worst-case consideration, the maximum time with update of the CoE data must always be used. This information is provided in the following table.

Firmware ≤ 04

Operating mode	Minimum reaction time	Maximum reaction time
STO-MODE	18 ms	36 ms
Default process data	22 ms	44 ms
Extended process data	23 ms	46 ms

Firmware > 04 (Revision number ≥ AX5805-0000-0017)

Operating mode	Minimum reaction time	Maximum reaction time
STO-MODE	15 ms	30 ms
Default process data	34 ms	68 ms
Extended process data	34 ms	68 ms

3.3.2 Reaction times in the AX52xx servo drive

The measurement of the reaction times takes place from the input of the request to the AX5805 until the switching off of the internal switch-off paths. If the TwinSAFE communication is to be included in the calculation, the watchdog time of the TwinSAFE connection must be added to this. For a worst-case consideration, the maximum time with update of the CoE data must always be used. This information is provided in the following table.

Firmware ≤ 04

Operating mode	Minimum reaction time	Maximum reaction time
STO-MODE	39 ms	78 ms
Default process data	47 ms	94 ms
Extended process data	48 ms	96 ms

Firmware > 04 (Revision number ≥ AX5805-0000-0017)

Operating mode	Minimum reaction time	Maximum reaction time
STO-MODE	15 ms	30 ms
Default process data	34 ms	68 ms
Extended process data	34 ms	68 ms

Note	**STO mode times** The STO mode times are only applicable, if both axes are operated in STO mode.

3.4 Installation

3.4.1 Safety instructions

Before installing and commissioning the TwinSAFE drive option cards, please also read the safety instructions in the foreword of this documentation.

3.4.2 Transport / storage

For storage and transport of the digital TwinSAFE Drive option cards, use the original packaging in which they were delivered.

 **CAUTION**	**Note the specified environmental conditions** Please ensure that the digital TwinSAFE option cards are only transported and stored under the specified environmental conditions (see technical data).

3.4.3 Installation of the AX5805/AX5806

 **DANGER**	**Ensure that the power is switched off before installation!** Before installing the Safety-Card disconnect the servo drive from the mains and system voltage. Even when the AX5000 is disconnected from the mains voltage, dangerous voltage continues to be present at the X02 terminals of the DC link for at least 5 minutes. Wait until the DC link capacitors are discharged before touching live terminals. The voltage measured between the DC+ and DC- terminals (X02) must have dropped to below 50 V.

3.4.3.1 Condition for the installation

The AX5805 can be used only in servo drives of the new generation (AX5xxx-0000-x2xx).

 **Attention**	**Compatibility of AX5000 and AX5805/AX5806** An attempt to install the AX5805/AX5806 into AX5000 servo drives of an older generation can lead to irreparable damage to the AX5000.

3.4.3.2 Setting the TwinSAFE address of the AX5805/AX5806

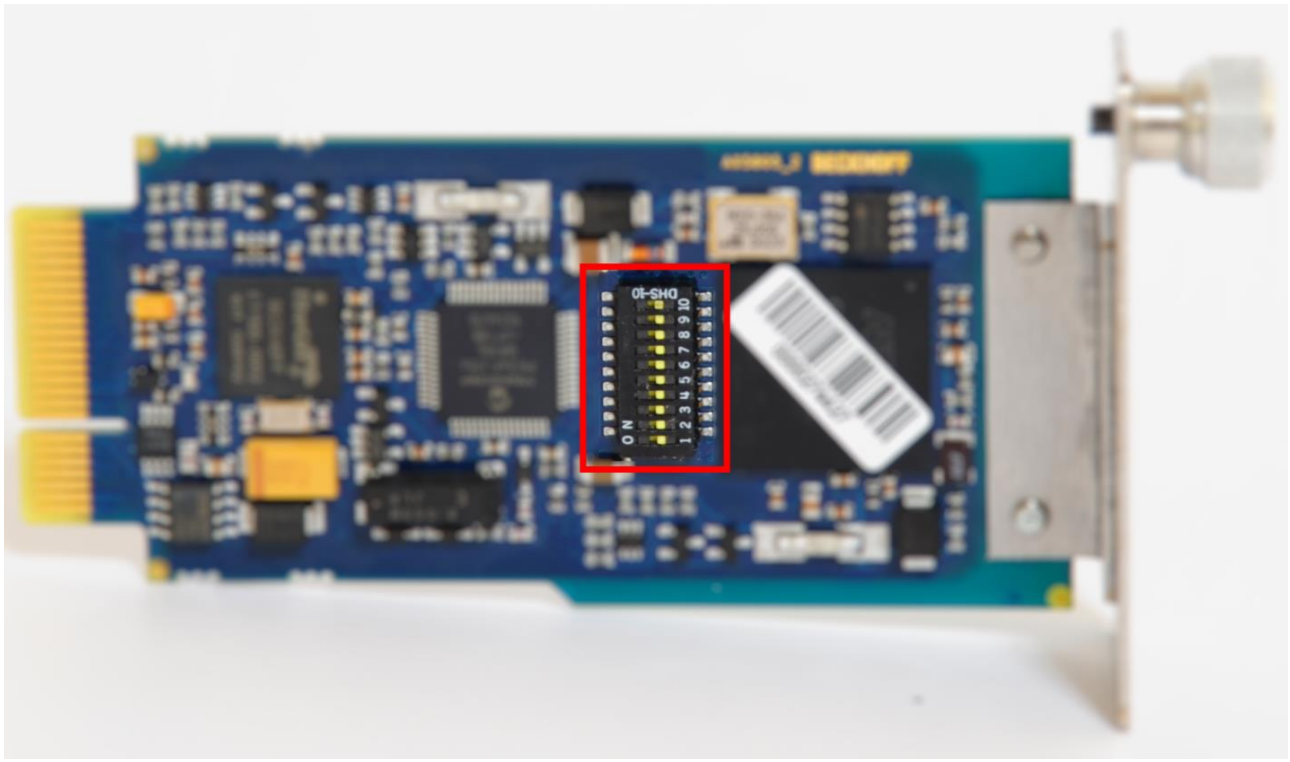


Fig. 2: DIP switch for setting the TwinSAFE address

You must set a unique TwinSAFE address using the 10-way DIP switch on the AX5805/AX5806 TwinSAFE drive option card. TwinSAFE addresses between 1 and 1023 are available. Address 0 is not permitted.

DIP switch										Address
1	2	3	4	5	6	7	8	9	10	
ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	1
OFF	**ON**	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	2
ON	**ON**	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	3
OFF	OFF	**ON**	OFF	OFF	OFF	OFF	OFF	OFF	OFF	4
ON	OFF	**ON**	OFF	OFF	OFF	OFF	OFF	OFF	OFF	5
OFF	**ON**	**ON**	OFF	OFF	OFF	OFF	OFF	OFF	OFF	6
ON	**ON**	**ON**	OFF	OFF	OFF	OFF	OFF	OFF	OFF	7
...	...	...	...	...	...	...	...	...	...	...
ON	**ON**	**ON**	**ON**	**ON**	**ON**	**ON**	**ON**	**ON**	**ON**	1023

WARNING

Assign unique TwinSAFE addresses!

Each TwinSAFE address may only be used once within a network!
The address 0 is not a valid TwinSAFE address!

3.4.3.3 Mounting the AX5805/AX5806

Fig. 3: Safety slot in the AX5000

The AX5805/AX5806 is inserted from above into card slot marked “Safety” in the AX5000 servo drive (see Fig. 3: Safety slot in the AX5000) and fixed by the screw.

Attention	**Care when installing** Insert carefully! Do not use force!

3.4.3.4 Dismounting the AX5805/AX5806

Undo the screw of the AX5805 and carefully pull on the screw.

3.4.4 Permissible motors

CAUTION	**Restrictions in terms of permissible motors** • The certificate for the AX5805/5806 covers only the motors that are listed in the document "List of permissible motors". • No modifications may be made to the permitted motors • The certificate for the AX5805/5806 does not cover any motors or linear drives that are not listed in the document "List of permissible motors". • The customer must provide proof of the safety level attained for applications with third-party motors.

Further details and the motor types can be found in the document “AX5805 – List of permissible motors” or “AX5806 – List of permissible motors”. The associated PFH values for a safety-related calculation can also be found in this document.

3.4.5 Firmware

Different safe parameter settings are possible, depending on the firmware installed on the AX5805.

Firmware AX5805	Revision number	Firmware AX5000	Safe Parameter MotorDefaultData (0x2x40)
≤ 04	AX5805-0000-0016	variable	according to document AX5805_DefaultMotorValues_de.pdf
≥ 05	AX5805-0000-0017	≥ 2.04	0x0000

3.5 Configuration of the AX5805 in the TwinCAT System Manager

3.5.1 Configuration requirements

Version 2.11 build 2041 or higher of the TwinCAT automation software is required for configuring the AX5805. The respective current version can be downloaded from the Beckhoff website at www.beckhoff.de. The AX5806 is configured in the same way.

3.5.2 Inserting an AX5805

The AX5805 TwinSAFE Drive option card must be inserted in the System Manager configuration underneath the AX5000 servo drive.

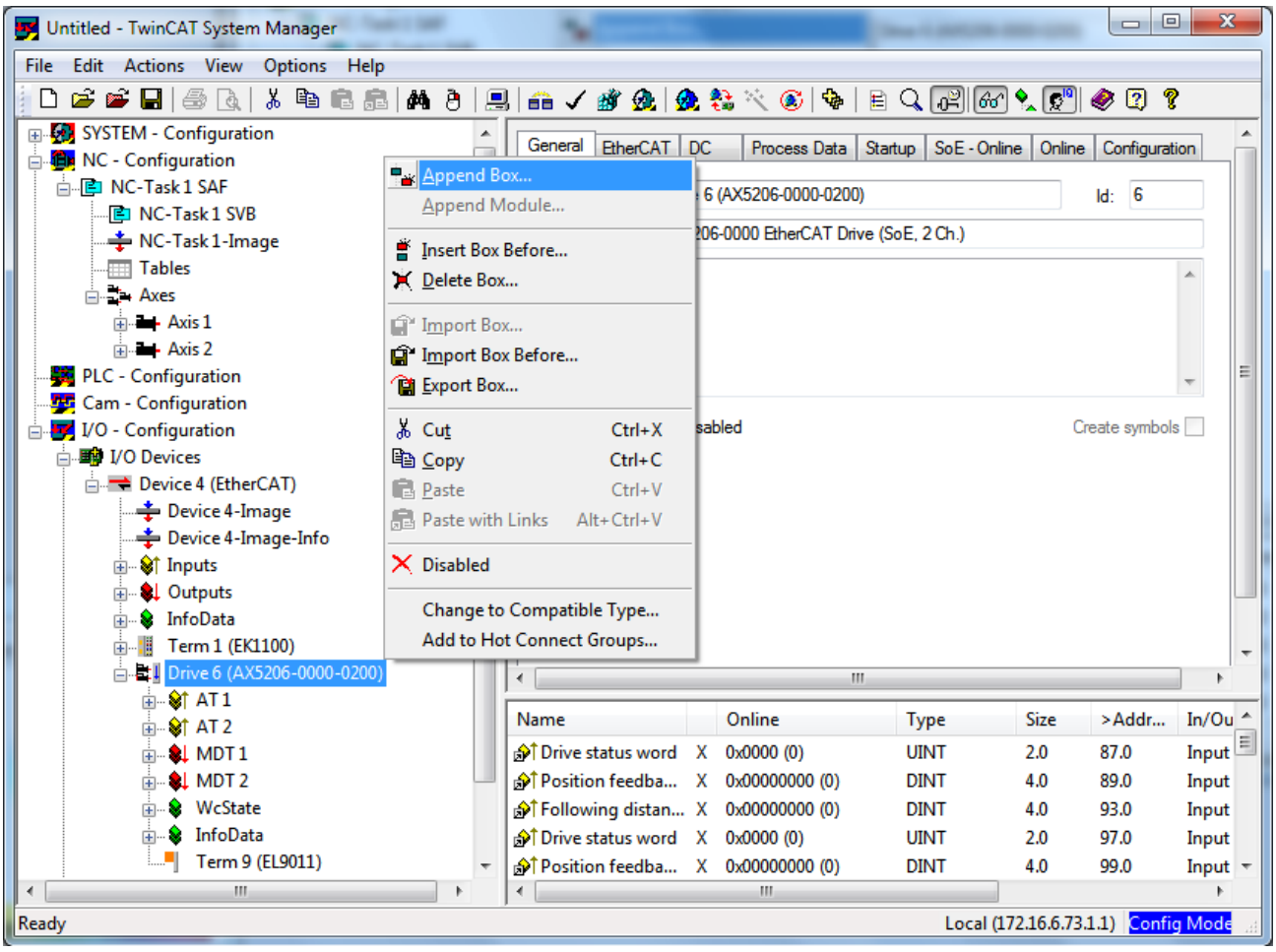


Fig. 4: Addition of an AX5805

Since the software of the AX5805 supports single-channel and two-channel servo drives (AX5000), the AX5805 (Safety Drive Option) must be selected as the basis.

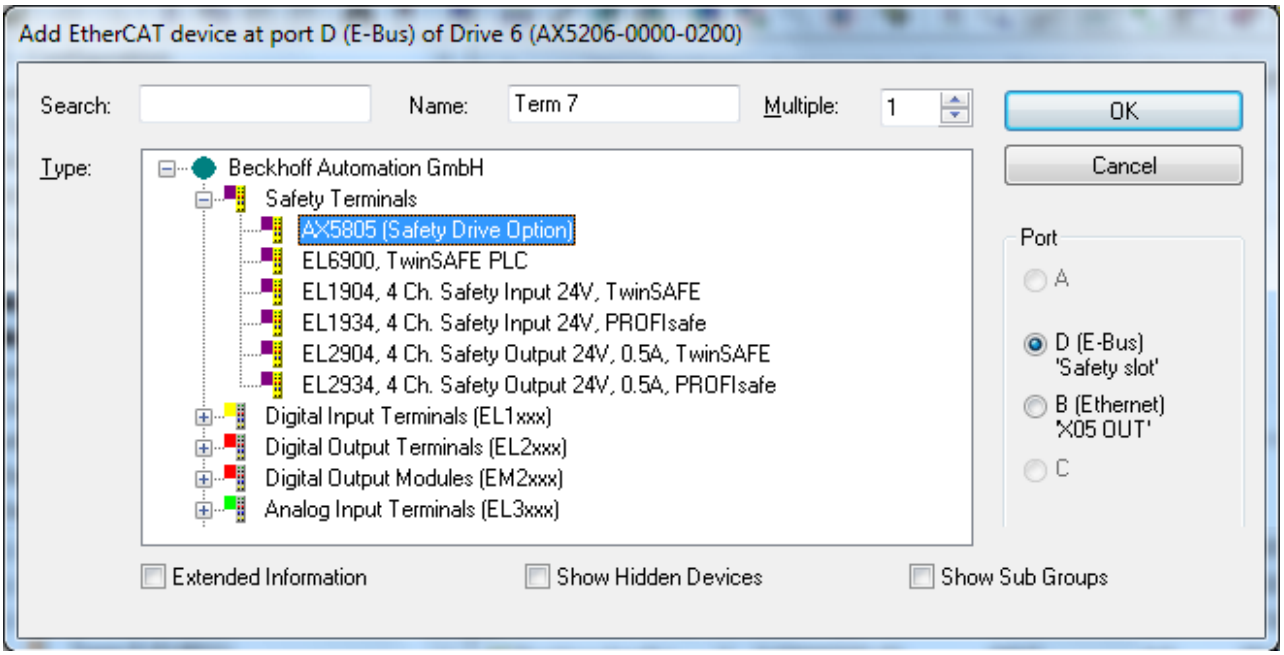


Fig. 5: Selecting the AX5805 as the basis

Depending on the servo drive used (AX5000 single-channel or two-channel), the corresponding modules (single-channel or two channel) must then be inserted. In doing so, care must be taken to insert a safety module and a standard module.

At start-up the AX5805 check whether the modules that have been set match the servo drive.

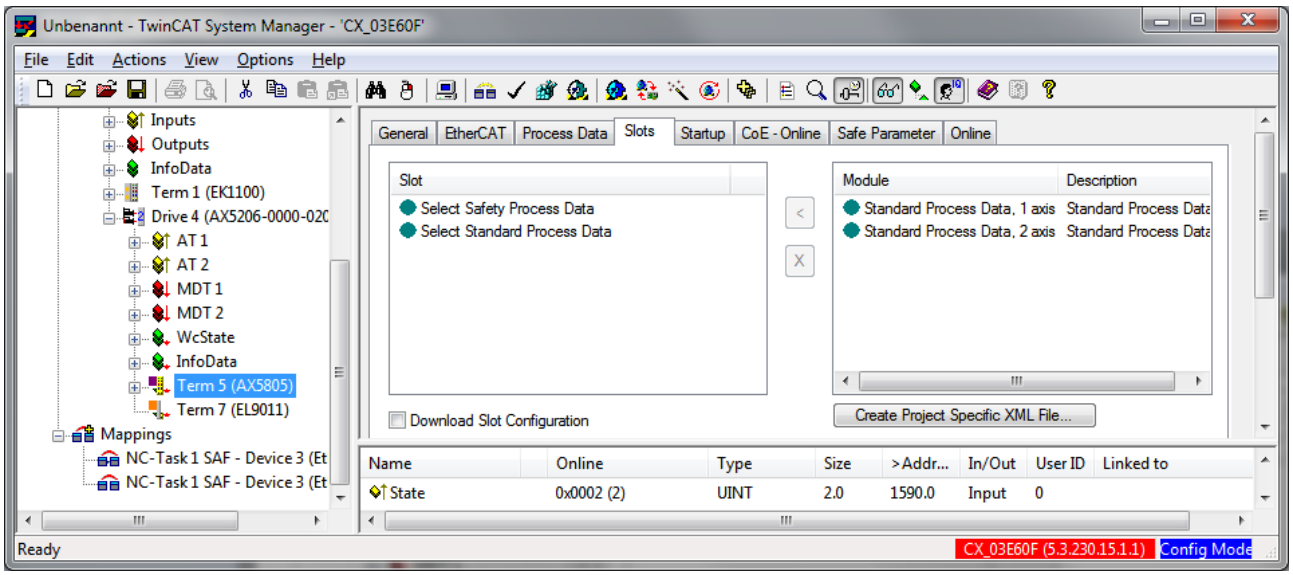


Fig. 6: Inserting the safety module into the AX5805

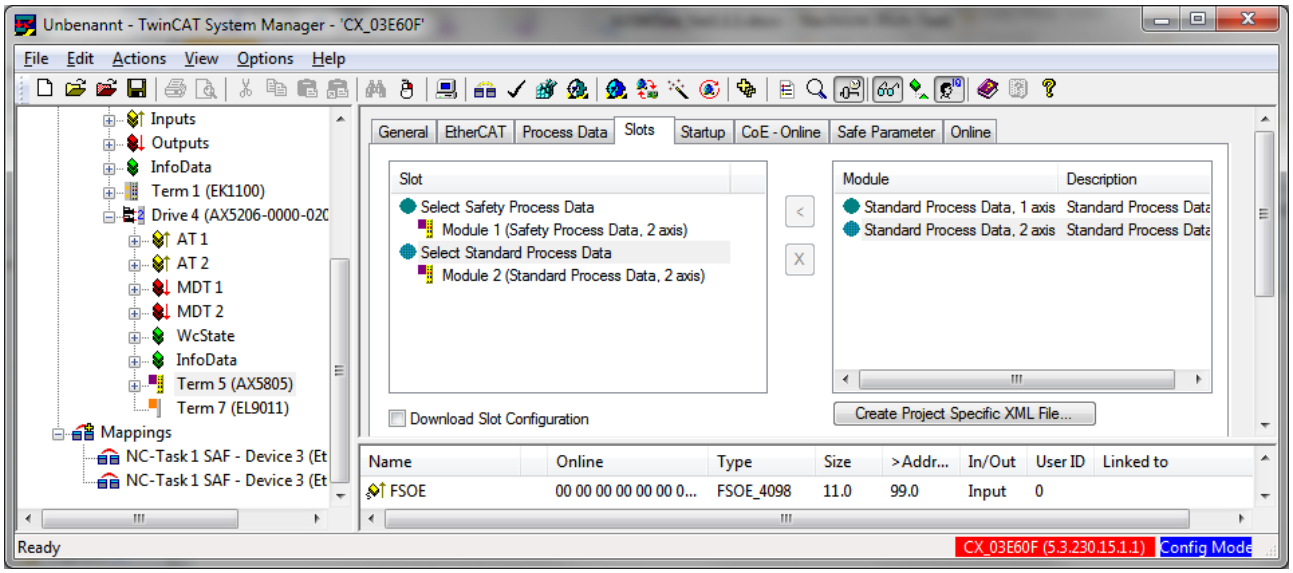


Fig. 7: Inserting the standard module into the AX5805

3.5.3 Registering the TwinSAFE address in the TwinCAT System Manager

The TwinSAFE address set using the DIP switch on the AX5805 TwinSAFE drive option card must also be set on the *Safe Parameter* tab (*FSoE Address* entry).

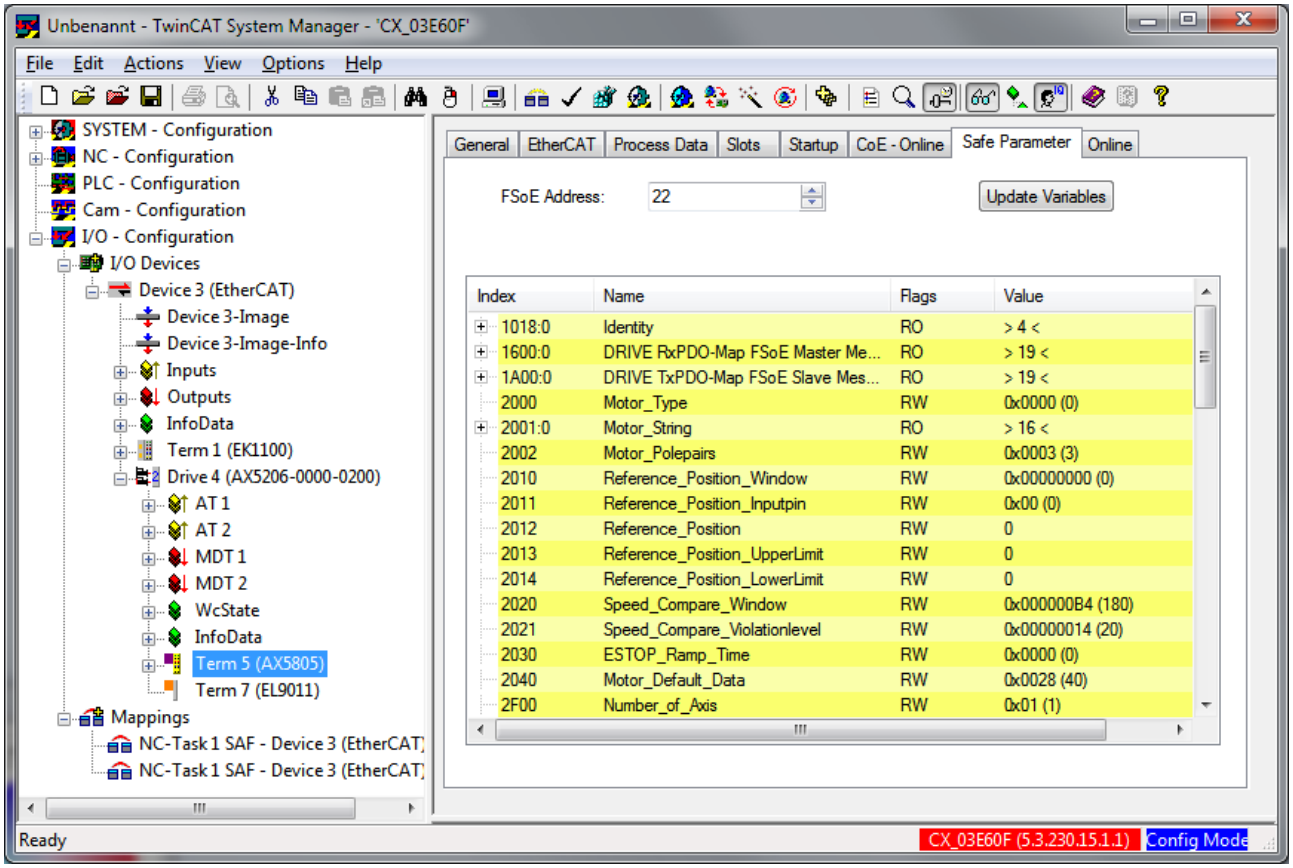


Fig. 8: Registering the TwinSAFE address in the TwinCAT System Manager

3.6 Parameterization of the AX5805/AX5806 in the TwinCAT System Manager

3.6.1 Units and calculations

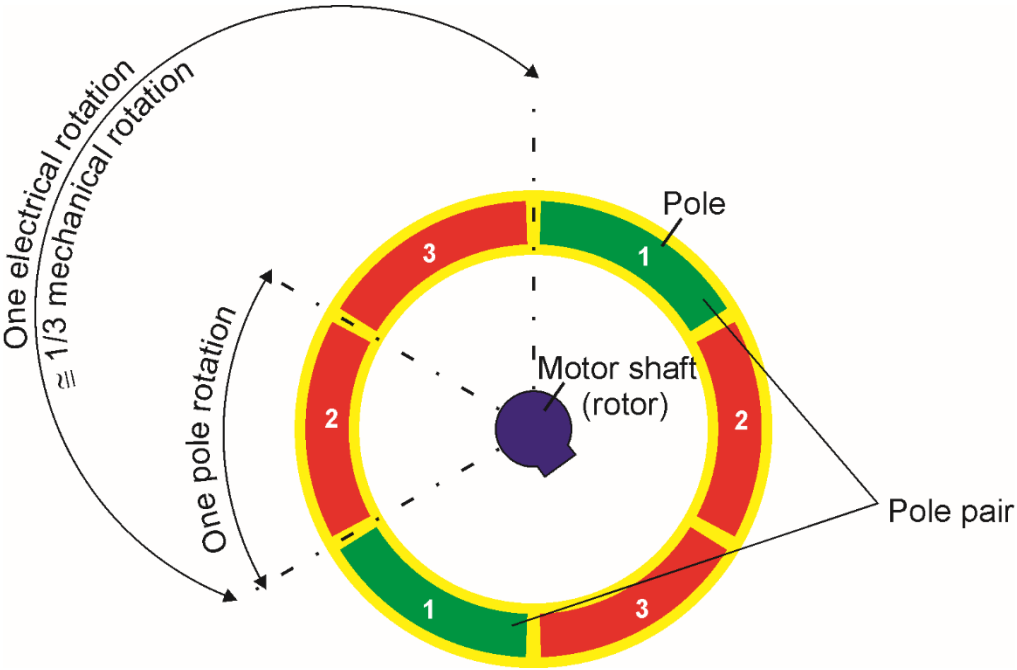


Fig. 9: Units and calculations

Relationship of electrical angle to 1 mechanical motor revolution:

$$\mathbf{1°}\ \boldsymbol{electrical\ angle} = \frac{\mathbf{1°}\ \boldsymbol{mechanical\ angle}}{\boldsymbol{pole\ pairs}}$$

Position - increments relationship in mechanical angles:

$$\boldsymbol{increment} = \frac{\boldsymbol{pole\ pairs} * \mathbf{65536}}{\mathbf{360°}} * \boldsymbol{mechanical\ angle}\ (\boldsymbol{in}\ °)$$

Example position calculation SOS (AM302x - 3 pole pairs; traversing range - 10 turns):

$$\boldsymbol{increments} = \frac{\mathbf{3} * \mathbf{65536}}{\mathbf{360°}} * \mathbf{3600°} = \mathbf{1,966,080}\ \boldsymbol{increments}$$

Position window (e.g. for SLP) (pole revolution)

$$\boldsymbol{pole\ revolution} = \frac{\boldsymbol{number\ of\ mechanical\ revolutions}}{\boldsymbol{pole\ pairs} * \mathbf{2}}\ (\boldsymbol{Unit}: \boldsymbol{mech.revolutions})$$

Speed - calculation in increments/ms:

$$\boldsymbol{increments\ per\ ms} = \mathbf{2} * \mathbf{65536} * \boldsymbol{pole\ pair} * \boldsymbol{revelutions\ per\ ms}$$

Example speed calculation SSR (window between 500 and 250 rpm, AM302x - 3 pole pairs):

$$\mathbf{500}\frac{\boldsymbol{R}}{\boldsymbol{min}} = \mathbf{8.33}\frac{\boldsymbol{R}}{\boldsymbol{s}} = \mathbf{0.00833}\frac{\boldsymbol{R}}{\boldsymbol{ms}}$$

$$\mathbf{250}\frac{\boldsymbol{R}}{\boldsymbol{min}} = \mathbf{4.166}\frac{\boldsymbol{R}}{\boldsymbol{s}} = \mathbf{0.004166}\frac{\boldsymbol{R}}{\boldsymbol{ms}}$$

$$\boldsymbol{increments\ per\ ms}\left(\mathbf{500}\frac{\boldsymbol{R}}{\boldsymbol{min}}\right) = \mathbf{2} * \mathbf{65536} * \mathbf{3}\frac{\boldsymbol{incr}}{\boldsymbol{R}} * \mathbf{0.00833}\frac{\boldsymbol{R}}{\boldsymbol{ms}} = \mathbf{3275}\frac{\boldsymbol{incr}}{\boldsymbol{ms}}$$

$$\boldsymbol{increments\ per\ ms}\left(\mathbf{250}\frac{\boldsymbol{U}}{\boldsymbol{min}}\right) = \mathbf{2} * \mathbf{65536} * \mathbf{3}\frac{\boldsymbol{incr}}{\boldsymbol{R}} * \mathbf{0.004166}\frac{\boldsymbol{R}}{\boldsymbol{ms}} = \mathbf{1638}\frac{\boldsymbol{incr}}{\boldsymbol{ms}}$$

Acceleration - calculation in increments/ms²:

$$\boldsymbol{Increments\ per\ ms^2} = \mathbf{2} * \mathbf{65536} * \boldsymbol{pole\ pair} * \boldsymbol{revelutions\ per\ ms^2}$$

Example acceleration calculation SAR (AM302x - 3 pole pairs, 100 R / ms²):

$$\boldsymbol{Increments\ per\ ms^2} = \mathbf{2} * \mathbf{65536} * \mathbf{3}\frac{\boldsymbol{incr}}{\boldsymbol{R}} * \mathbf{100}\frac{\boldsymbol{R}}{\boldsymbol{s^2}} = \mathbf{39,321,600}\frac{\boldsymbol{incr}}{\boldsymbol{s^2}} = \mathbf{39.32}\frac{\boldsymbol{incr}}{\boldsymbol{ms^2}}$$

Calculation - number of pole revolutions corresponding to mechanical revolutions (for SLP)

In this example, the window for SLP should correspond to two mechanical revolutions with a number of 3 pole pairs.

$$\boldsymbol{pole\ revolution}\ (\boldsymbol{SLP}) = \boldsymbol{mech.revolutions} * \boldsymbol{pole\ pairs} * \mathbf{2} = \mathbf{2} * \mathbf{3} * \mathbf{2}$$
$$= \mathbf{12}\ (\boldsymbol{Unit}\colon \boldsymbol{pole\ revolutions})$$

3.6.2 Parameterization of the Speed_Compare_Window (0x2020 und 0x2820)

 **WARNING**	**Parameters 0x2020, 0x2021 and 0x2022 (0x2820, 0x2821 and 0x2822)** Together with the parameters 0x2021/22 and 0x2821/22, the parameters 0x2020 and 0x2820 have a direct influence on the error detection options of the AX5805/AX5806 safety option card. In the default setting, the safe state is adopted for 20 cycles (of 125 µs each) after 180 increments per cycle are exceeded. This state is also reported accordingly in the CoE object 0xFA10. If the axis is optimally adjusted, the number of increments per cycle can be reduced accordingly, as can the number of cycles. A setting of the filter step 0x2022, or 0x2822 respectively, can be helpful here. The value can be set from 1 to 15. The machine manufacturer, or the user respectively, is solely responsible for the correct setting of the values to suit the application, which concerns both the number of increments (0x2x20) and the number of cycles (0x2x21) as well as the filter step (0x2x22). He must ensure that the detection of errors in his application is guaranteed.

 **WARNING**	**Speed-dependent safety functions** Speed limits for safety functions, such as SLS, SSM, SSR and SMS, which are below the speed resulting from the Speed_Compare_Window, can not be used. • The user has to ensure and check this. • The user must also ensure that the parameterized speed limits are re-evaluated if the Speed_Compare_Window is changed.

 **WARNING**	**Value range for parameters 0x2021 and 0x2821** The parameters 0x2021 and 0x2821 have a value range of 1 to 254 cycles. If the parameter is set to 255, the check function is deactivated.

The Speed_Compare_Window parameter is specified in increments per 125 µs. These increments are converted to revolutions per minute in the following example. A deviation of the speed within these limits will not be reported as an error. If this value is exceeded, a cut-off takes place after the number of 125-µs cycles specified in parameter 0x2021 or 0x2821 respectively.

Calculation with default values

$$SpeedCompareWindow = \frac{0x2020}{65535 * PolePairs} * 8 * 1000 * 60 = \frac{180}{65535 * 5} * 8 * 1000 * 60 = 264\ U/min$$

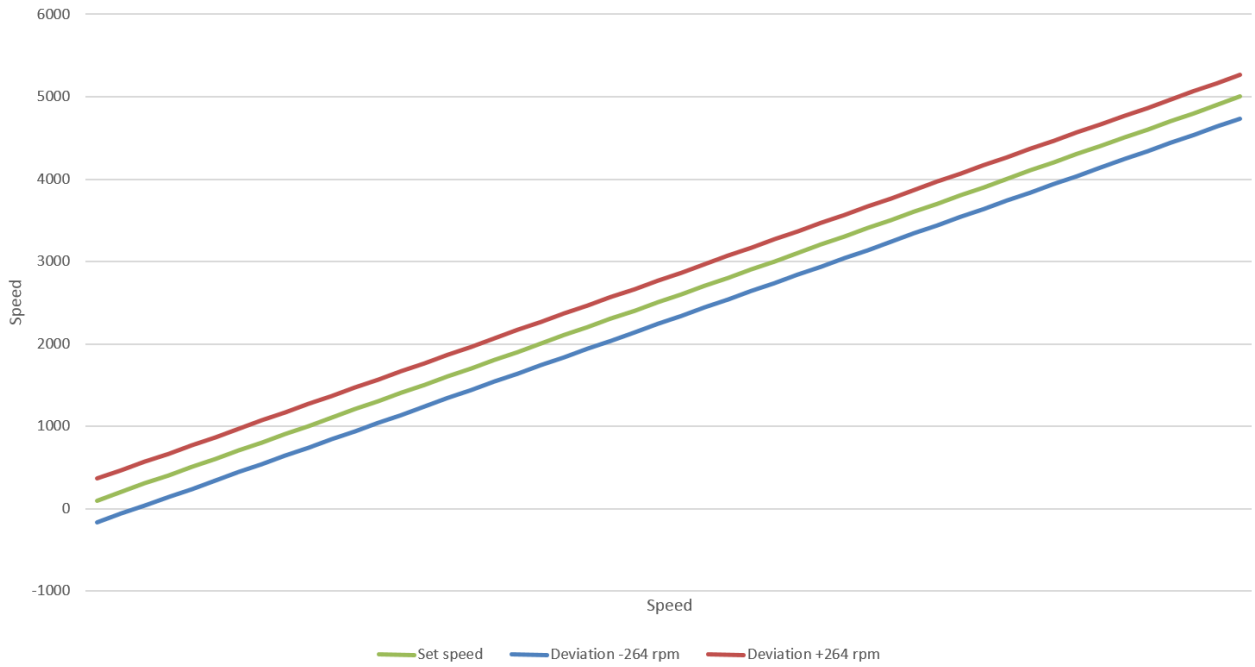


Figure 10: Speed detection and maximum deviation ±264 rpm

Calculation with 0x2020 of 50 increments per 125 µs

$$SpeedCompareWindow = \frac{0x2020}{65535 * PolePairs} * 8 * 1000 * 60 = \frac{50}{65535 * 5} * 8 * 1000 * 60 = 74\ U/min$$

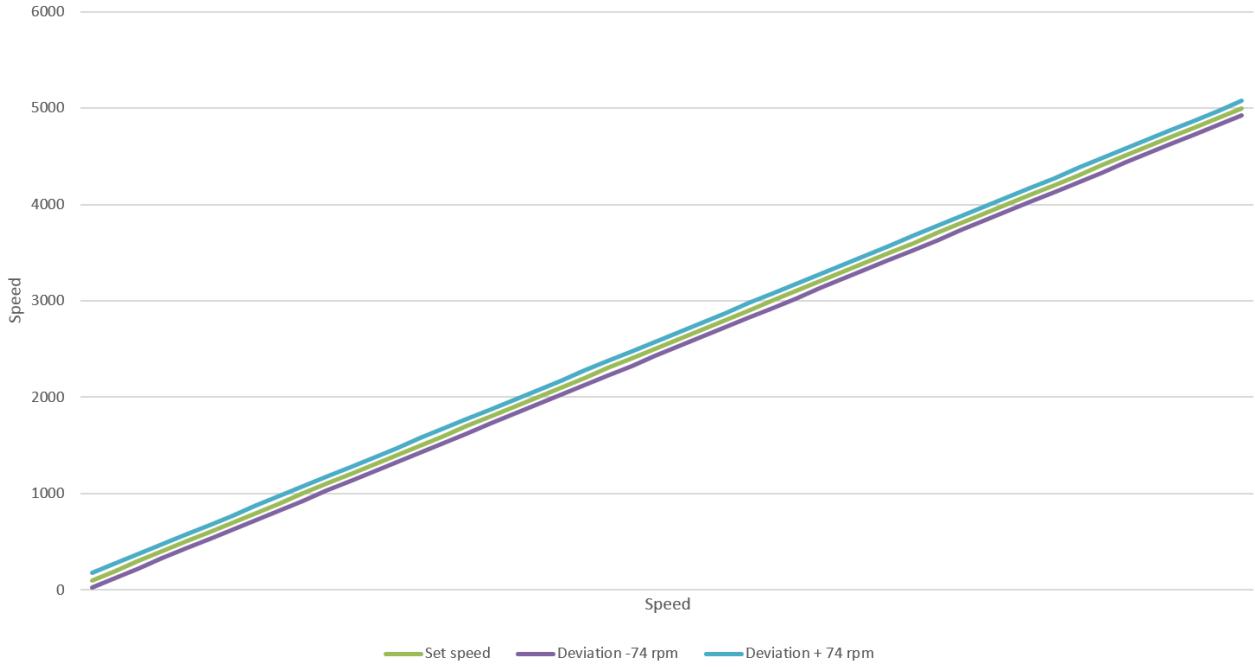


Figure 11: Speed detection and maximum deviation ±74 rpm

Calculation with 0x2020 of 5 increments per 125 µs with SOS at standstill function activated.

With the SOS function activated, a movement of the axis within the set Speed_Compare_Window does not lead to a cut-off as long as the axis is within the position window s_Zero_SOS set for SOS. If the axis moves outside the range s_Zero_SOS, this leads to a cut-off.

If the position value should freeze due to an error of the encoder, a movement will only be detected if a change of position occurs outside the Speed_Compare_Window. The user can calculate the maximum speed using the following equation and evaluate it for his application.

$$Max\ Drehwinkel\ in\ °\ pro\ s = \frac{0x2020}{65535 * PolePairs} * 8 * 1000 * 360° = \frac{5}{65535 * 5} * 8 * 1000 * 360° = 43{,}9° /s$$

WARNING	**Case of error: encoder signal freezes** If the encoder signal should fail (stuck-at error), there is a maximum undetected speed according to the previous calculation.

3.6.2.1 Parameters 0x2022 and 0x2822 Speed_Compare_Filter

The filter time constant is set in 15 steps via the Speed_Compare_Filter parameter. The sample time is 0.000125 seconds (125 µs).

Filter step	Filter time constant τ in seconds
1	0.000125
2	0.0005
3	0.001125
4	0.002375
5	0.00475
6	0.009625
7	0.0195
8	0.039125
9	0.078375
10 (Default)	0.157
11	0.314125
12	0.628375
13	1.256875
14	2.514
15	5.028

3.6.3 Creation of the process image of the AX5805/AX5806

3.6.3.1 General

The safety functions of the AX5805 are activated or deactivated in the control word and the states of the safety functions are returned in the status word. They each consist of one byte with fixed bit occupancy and one byte with variable bit occupancy.

The mappings for control and status word are set via the objects 0x1600 and 0x1A00 in the *Safe Parameters* of the AX5805/AX5806.
Subsequently, the settings are confirmed by pressing the '*Update Variables*' button.

Note	**Creating and changing the process image** The creation of the process image should take place if possible before the creation of a Safety PLC project. The links to the Safety PLC are deleted after each change of the process image.

Note	**Processing sequence of the safety functions** The order in which the safety functions are processed matches the order in the control word.

Note	**Priorities of the safety functions** The safety function STO has the highest priority. This means that an enabled safety function, e.g. SLS, can be interrupted at any time through the activation of the safety function STO.

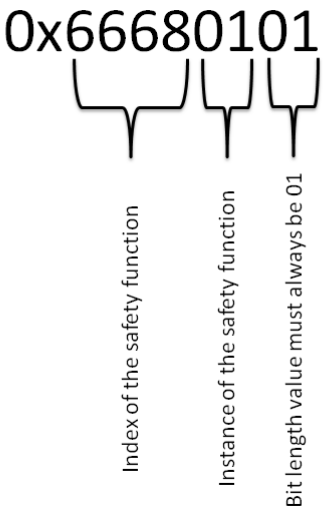


Fig. 12: Example for SOS_1:

Note	**Instance of the safety function** For safety functions that have a maximum of one instance, the value for the instance must be set to 0 when setting the mapping.

3.6.3.2 Control word default mapping for axis 1 (1st byte, fixed occupancy)

Control word default mapping for axis 1 1600:02 – 1600:09

Bit	Assignment	Possible setting	Default value
0	Safe Torque Off (Axis 1 STO)	none	0x66400001
1	Safe Stop 1 (Axis 1 SS1_1)	none	0x66500101
2	Safe Stop 2 (Axis 1 SS2_1)	none	0x66700101
3	Safe Operating Stop (Axis 1 SOS_1)	none	0x66680101
4	Safe Speed Range (Axis 1 SSR_1)	none	0x66800101
5	Safe Direction positive (Axis 1 SDIp)	none	0x66D00001
6	Safe Direction negative (Axis 1 SDIn)	none	0x66D10001
7	Error Acknowledge (Axis 1 ErrAck)	none	0x66320001

Fig. 13: Control word default mapping for axis 1

Control word user mapping for axis 1 (2nd byte, variable occupancy)

Control word user mapping for axis 1 1600:0A - 1600:11
The bits in the variable range of the control word for axis 1 can be occupied by the following functions.

Index	Name	Maximum number of instances
0x6630	Axis 1 Restart_Ack	1
0x6650	Axis 1 Safe Stop 1	8
0x6670	Axis 1 Safe Stop 2	8
0x6668	Axis 1 Safe Operating Stop	8
0x6680	Axis 1 Safe Speed Range	8
0x6690	Axis 1 Safely Limited Speed	8
0x66A0	Axis 1 Safely Limited Position	8
0x66B8	Axis 1 Safely Limited Increment	8
0x66C0	Axis 1 Safe Acceleration Range	8

Fig. 14: Control word user mapping for axis 1

3.6.3.3 Control word default mapping for axis 2 (1st byte, fixed occupancy)

Control word default mapping for axis 2 1600:13 - 1600:1A

Bit	Assignment	Possible setting	Default value
0	Safe Torque Off (Axis 2 STO)	none	0x6E400001
1	Safe Stop 1 (Axis 2 SS1_1)	none	0x6E500101
2	Safe Stop 2 (Axis 2 SS2_1)	none	0x6E700101
3	Safe Operating Stop (Axis 2 SOS_1)	none	0x6E680101
4	Safe Speed Range (Axis 2 SSR_1)	none	0x6E800101
5	Safe Direction positive (Axis 2 SDIp)	none	0x6ED00001
6	Safe Direction negative(Axis 2 SDIn)	none	0x6ED10001
7	Error Acknowledge (Axis 2 ErrAck)	none	0x6E320001

Fig. 15: Control word default mapping for axis 2

3.6.3.4 Control word user mapping for axis 2 (2nd byte, variable occupancy)

Control word user mapping for axis 2 1600:1B - 1600:22
The bits in the variable range of the control word for axis 2 can be occupied by the following functions.

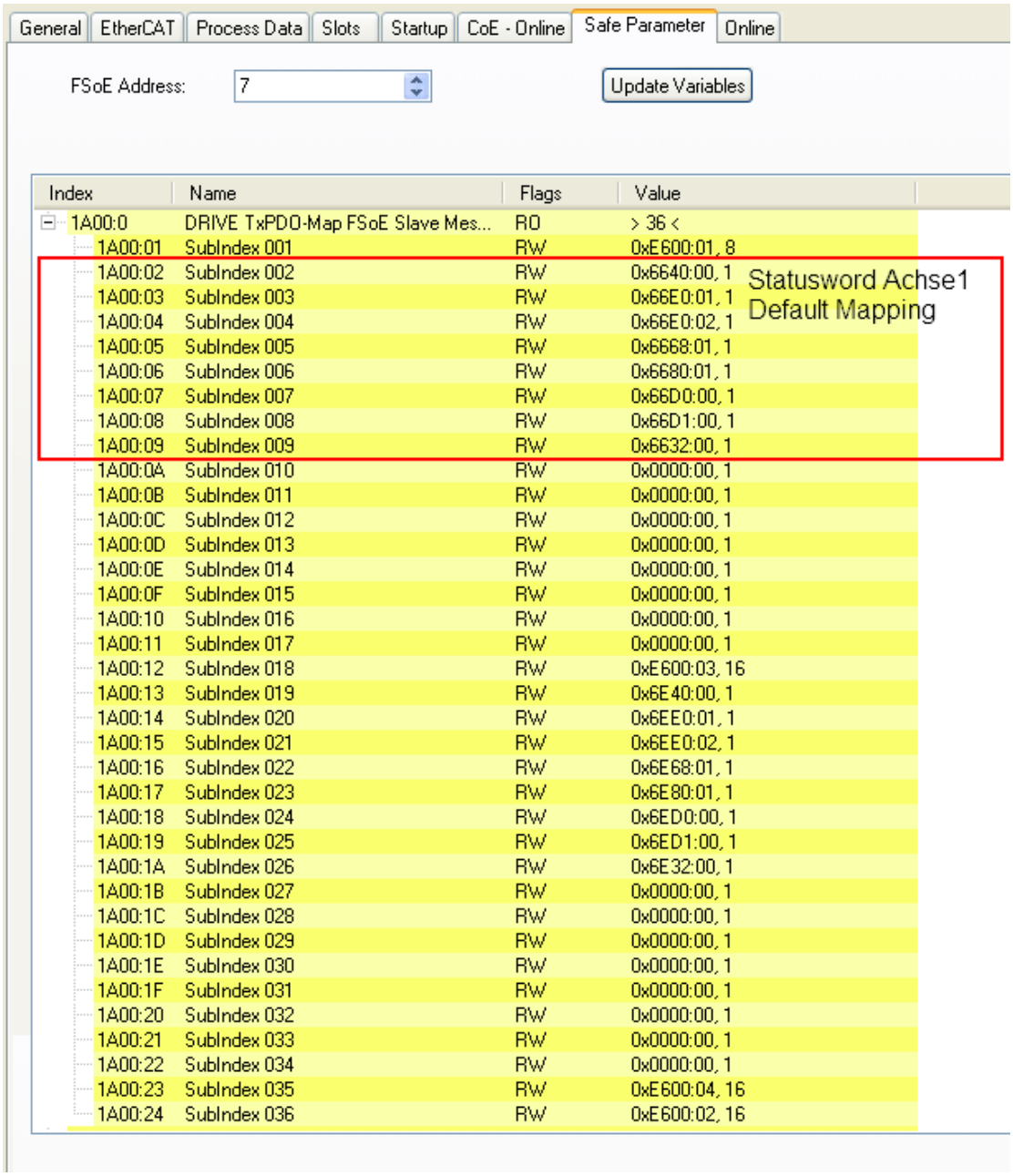
Index	Name	Maximum number of instances
0x6E30	Axis 2 Restart_Acknowledge	1
0x6E50	Axis 2 Safe Stop 1	8
0x6E70	Axis 2 Safe Stop 2	8
0x6E68	Axis 2 Safe Operating Stop	8
0x6E80	Axis 2 Safe Speed Range	8
0x6E90	Axis 2 Safely Limited Speed	8
0x6EA0	Axis 2 Safely Limited Position	8
0x6EB8	Axis 2 Safely Limited Increment	8
0x6EC0	Axis 2 Safe Acceleration Range	8

Fig. 16: Control word user mapping for axis 2

3.6.3.5 Status word default mapping for axis 1 (1st byte, fixed occupancy)

Status word default mapping for axis 1 1A00:02 - 1A00:09

Bit	Assignment	Possible setting	Default value
0	Safe Torque Off (Axis 1 STO)	none	0x66400001
1	Safe Speed Monitor (Axis 1 SSM_1)	none	0x66E00101
2	Safe Speed Monitor (Axis 1 SSM_2)	none	0x66E00201
3	Safe Operating Stop (Axis 1 SOS_1)	none	0x66680101
4	Safe Speed Range (Axis 1 SSR_1)	none	0x66800101
5	Safe Direction positive (Axis 1 SDIp)	none	0x66D00001
6	Safe Direction negative (Axis 1 SDIn)	none	0x66D10001
7	Error Acknowledge (Axis 1 ErrAck)	none	0x66320001



Index	Name	Flags	Value
1A00:0	DRIVE TxPDO-Map FSoE Slave Mes...	RO	> 36 <
1A00:01	SubIndex 001	RW	0xE600:01, 8
1A00:02	SubIndex 002	RW	0x6640:00, 1
1A00:03	SubIndex 003	RW	0x66E0:01, 1
1A00:04	SubIndex 004	RW	0x66E0:02, 1
1A00:05	SubIndex 005	RW	0x6668:01, 1
1A00:06	SubIndex 006	RW	0x6680:01, 1
1A00:07	SubIndex 007	RW	0x66D0:00, 1
1A00:08	SubIndex 008	RW	0x66D1:00, 1
1A00:09	SubIndex 009	RW	0x6632:00, 1
1A00:0A	SubIndex 010	RW	0x0000:00, 1
1A00:0B	SubIndex 011	RW	0x0000:00, 1
1A00:0C	SubIndex 012	RW	0x0000:00, 1
1A00:0D	SubIndex 013	RW	0x0000:00, 1
1A00:0E	SubIndex 014	RW	0x0000:00, 1
1A00:0F	SubIndex 015	RW	0x0000:00, 1
1A00:10	SubIndex 016	RW	0x0000:00, 1
1A00:11	SubIndex 017	RW	0x0000:00, 1
1A00:12	SubIndex 018	RW	0xE600:03, 16
1A00:13	SubIndex 019	RW	0x6E40:00, 1
1A00:14	SubIndex 020	RW	0x6EE0:01, 1
1A00:15	SubIndex 021	RW	0x6EE0:02, 1
1A00:16	SubIndex 022	RW	0x6E68:01, 1
1A00:17	SubIndex 023	RW	0x6E80:01, 1
1A00:18	SubIndex 024	RW	0x6ED0:00, 1
1A00:19	SubIndex 025	RW	0x6ED1:00, 1
1A00:1A	SubIndex 026	RW	0x6E32:00, 1
1A00:1B	SubIndex 027	RW	0x0000:00, 1
1A00:1C	SubIndex 028	RW	0x0000:00, 1
1A00:1D	SubIndex 029	RW	0x0000:00, 1
1A00:1E	SubIndex 030	RW	0x0000:00, 1
1A00:1F	SubIndex 031	RW	0x0000:00, 1
1A00:20	SubIndex 032	RW	0x0000:00, 1
1A00:21	SubIndex 033	RW	0x0000:00, 1
1A00:22	SubIndex 034	RW	0x0000:00, 1
1A00:23	SubIndex 035	RW	0xE600:04, 16
1A00:24	SubIndex 036	RW	0xE600:02, 16

Fig. 17: Status word default mapping for axis 1

3.6.3.6 Status word user mapping for axis 1 (2nd byte, variable occupancy)

Status word user mapping for axis 1 1A00:0A - 1A00:11
The bits in the variable range of the status word for axis 1 can be occupied by the following functions.

Index	Name	Max. number of instances	Comment
0x6630	Axis 1 Restart_Request	1	
0x6668	Axis 1 Safe Operating Stop	8	
0x6680	Axis 1 Safe Speed Range	8	
0x6690	Axis 1 Safely Limited Speed	8	
0x66A0	Axis 1 Safely Limited Position	8	
0x66A8	Axis 1 Safe Maximum Speed	1	Activation by setting the parameters
0x66B8	Axis 1 Safely Limited Increment	8	
0x66C0	Axis 1 Safe Acceleration Range	8	
0x66C8	Axis 1 Safe Maximum Acceleration	1	Activation by setting the parameters
0x66E0	Axis 1 Safe Speed Monitor	8	Activation by setting the parameters
0x66E8	Axis 1 Safe CAM	8	Activation by setting the parameters

Fig. 18: Status word user mapping for axis 1

3.6.3.7 Status word default mapping for axis 2 (1st byte, fixed occupancy)

Status word default mapping for axis 2 1A00:13 - 1A00:1A

Bit	Assignment	Possible setting	Default value
0	Safe Torque Off (Axis 2 STO)	none	0x6E400001
1	Safe Speed Monitor (Axis 2 SSM_1)	none	0x6EE00101
2	Safe Speed Monitor (Axis 2 SSM_2)	none	0x6EE00201
3	Safe Operating Stop Axis 2 (SOS_1)	none	0x6E680101
4	Safe Speed Range (Axis 2 SSR_1)	none	0x6E800101
5	Safe Direction positive (Axis 2 SDIp)	none	0x6ED00001
6	Safe Direction negative (Axis 2 SDIn)	none	0x6ED10001
7	Error Acknowledge (Axis 2 ErrAck)	none	0x6E320001

Fig. 19: Status word default mapping for axis 2

3.6.3.8 Status word user mapping for axis 2 (2nd byte, variable occupancy)

Status word user mapping for axis 2 1A00:1B - 1A00:22
The bits in the variable range of the status word for axis 2 can be occupied by the following functions.

Index	Name	Maximum number of instances	Note
0x6E30	Axis 2 Restart_Request	1	
0x6E68	Axis 2 Safe Operating Stop	8	
0x6E80	Axis 2 Safe Speed Range	8	
0x6E90	Axis 2 Safely Limited Speed	8	
0x6EA0	Axis 2 Safely Limited Position	8	
0x6EA8	Axis 2 Safe Maximum Speed	1	Activation by setting the parameters
0x6EB8	Axis 2 Safely Limited Increment	8	
0x6EC0	Axis 2 Safe Acceleration Range	8	
0x6EC8	Axis 2 Safe Maximum Acceleration	1	Activation by setting the parameters
0x6EE0	Axis 2 Safe Speed Monitor	8	Activation by setting the parameters
0x6EE8	Axis 2 Safe CAM	8	Activation by setting the parameters

Fig. 20: Status word user mapping for axis 2

3.6.4 Setting the mode of operation

3.6.4.1 General

The AX5805/AX5806 has two modes of operation. Firstly, the standard mode with the full range of functions of the AX5805/AX5806 and secondly, the STO mode with a restricted range of functions.

3.6.4.2 Standard mode

In standard mode the AX5805/AX5806 supports all available safety functions. To ensure the correct function, at least the following objects must be parameterized correctly. These are checked when starting up the AX5805/AX5806.
The use of the safety functions is possible only after setting the associated parameters.

Index	Name	Description	Unit	Default value
0x2000	Motor_Type	Motor type for axis 1 0x0000 = rotary synchronous motor with feedback	--	0x0000
0x2001	Motor_String	Name of the motor	--	--
0x2002	Motor_Polepairs	Number of motor pole pairs	--	--
0x2020	Speed_Compare_ Window	The value should be set as small as possible according to the application.	--	0x000000B4
0x2021	Speed_Compare_ Violationlevel	Number of 125 µs cycles in which the axis may be outside the Speed_Compare_Window (value range 0 to 254). The value 255 deactivates the function.	--	0x00000014
0x2022	Speed_Compare_ Filter	Setting of the filter steps for the raw values used for the comparison.	--	0x0000000A
0x2030	ESTOP_Ramp_Time	Error reaction time SS1, after which STO is activated.	ms	0x0000
0x2040	Motor_Default_Data	Motor-specific parameter This value can be found in document: AX5805_Defaultwerte_de.pdf	--	0x0028
0x2043	Current_Compare_ Violationlevel	not used	--	--
0x2800	Motor_Type	Motor type for axis 2 0x0000 = rotary synchronous motor with feedback	--	0x0000
0x2801	Motor_String	Name of the motor	--	--
0x2802	Motor_Polepairs	Number of motor pole pairs	--	--
0x2820	Speed_Compare_ Window	The value should be set as small as possible according to the application.	--	0x000000B4
0x2821	Speed_Compare_ Violationlevel	Number of 125 µs cycles in which the axis may be outside the Speed_Compare_Window (value range 0 to 254). The value 255 deactivates the function.	--	0x00000014
0x2822	Speed_Compare_ Filter	Setting of the filter steps for the raw values used for the comparison.	--	0x0000000A
0x2830	ESTOP_Ramp_Time	Error reaction time SS1, after which STO is activated.	ms	0x0000

Index	Name	Description	Unit	Default value
0x2840	Motor_Default_Data	Motor specific parameter This value can be found in document: AX5805_Defaultwerte_de.pdf	--	0x0028
0x2843	Current_Compare_ Violationlevel	not used	--	--
0x2F00	Number_of_Axis	Number of axes	--	0x0000
0x2F02	Debug_Mode_Active	This value must set to FALSE.	--	FALSE

When parameterizing the motor string, please note that this is entered as ASCII code. More detailed information can be found in document AX5805_MotorDefaultValues_de.pdf.

Example

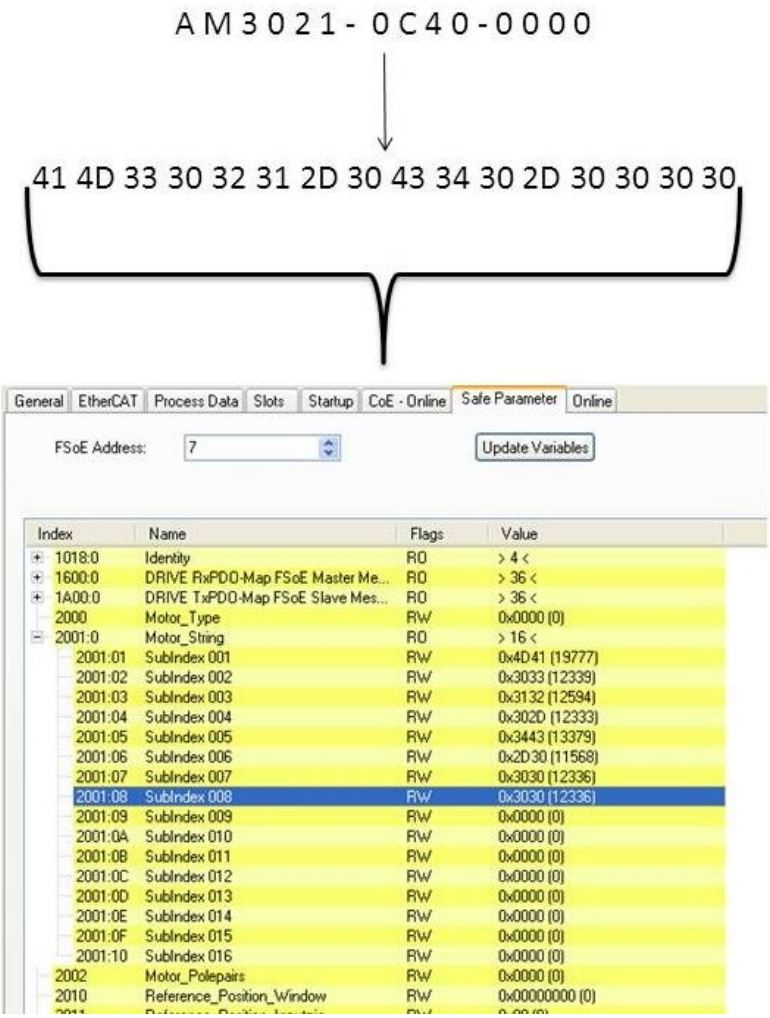


Fig. 21: Input of the motor string

From TwinCAT version 2.11 build 2230, the motor string can also be entered in text form.

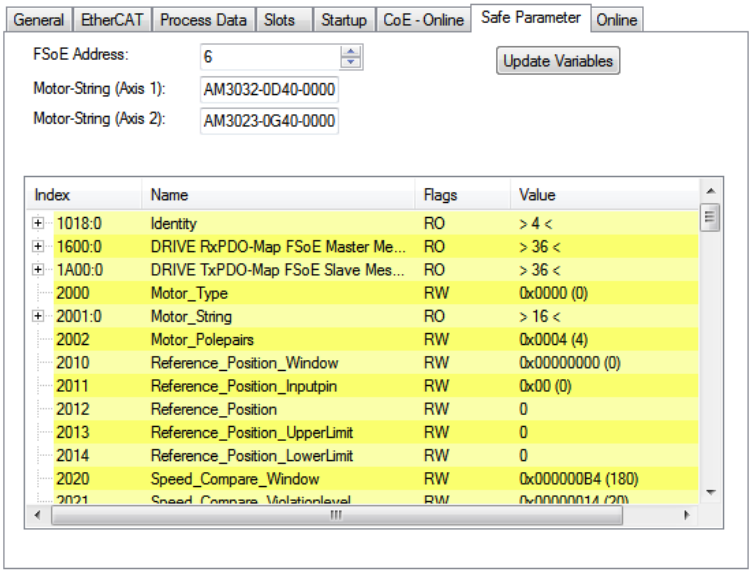


Fig. 22: Entering the text-based motor string

3.6.4.3 STO-mode

The AX5805/AX5806 can also be operated in the so-called STO mode. The AX5805/AX5806 does not evaluate any motor data and safety function parameters. It merely offers the STO function and tests the switch-off paths.

At least the following parameters must be set with this mode of operation (up to firmware 04):

Index	Name	Description	Unit	Default value
0x2F00	Number_of_Axis	Number of axes	--	0x0000
0x2F01	STO_Mode_Active	Activate STO mode	--	TRUE
0x2F02	Debug_Mode_Active	This value must set to FALSE.	--	FALSE

From firmware 05 and revision number AX5805-0000-0017, the following parameters must be set as a minimum in this mode:

Index	Name	Description	Unit	Default value
0x2041	STO_Mode_Active	Activate STO mode axis 1		FALSE
0x2841	STO_Mode_Active	Activate STO mode axis 2		FALSE
0x2F00	Number_of_Axis	Number of axes	--	0x0000
0x2F02	Debug_Mode_Active	This value must set to FALSE.	--	FALSE

Note

Restrictions in STO mode

In STO mode only the function STO is supported. The AX5805/AX5806 does not monitor/evaluate motor data and safety function parameters.
In order to be able to activate the axis / axes, the bits of the safety functions STO and SS1 (including all instances) must be set to 1. The bits of safety function SS1 have no function!

Starting with firmware version 04, it is sufficient to set only the bit of the safety function STO in the control word.

3.6.5 Parameterization and referencing of the safe position

The SLP (Safely Limited Position) and SCA (Safe CAM) safety functions can be used only after the position is referenced.

3.6.5.1 Prerequisites

An external position (e.g. position of the NC) must be linked with the standard process image (Position Actual Value) of the AX5805/AX5806.

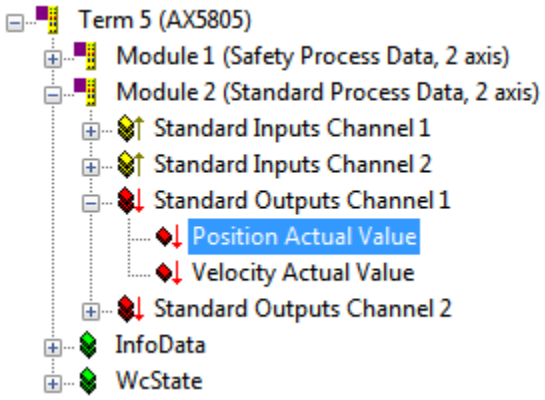


Fig. 23: An external position must be linked with the AX5805

A reference cam (e.g. proximity switch) must be connected to the digital inputs/outputs X06 (device front) of the AX5000. The corresponding number of the digital input (0 to 7) must be entered in the Reference_Position_Inputpin parameter.

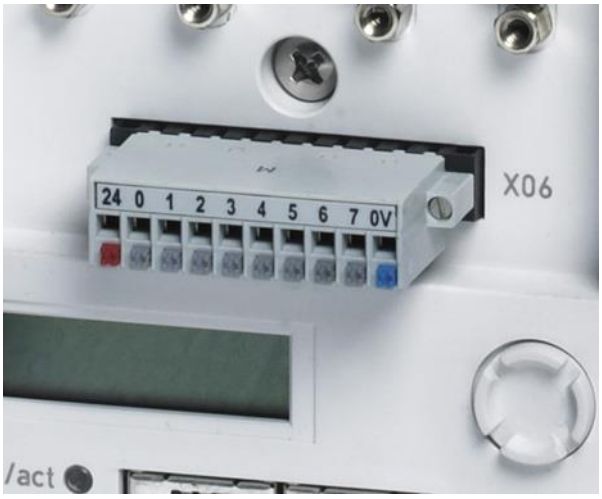


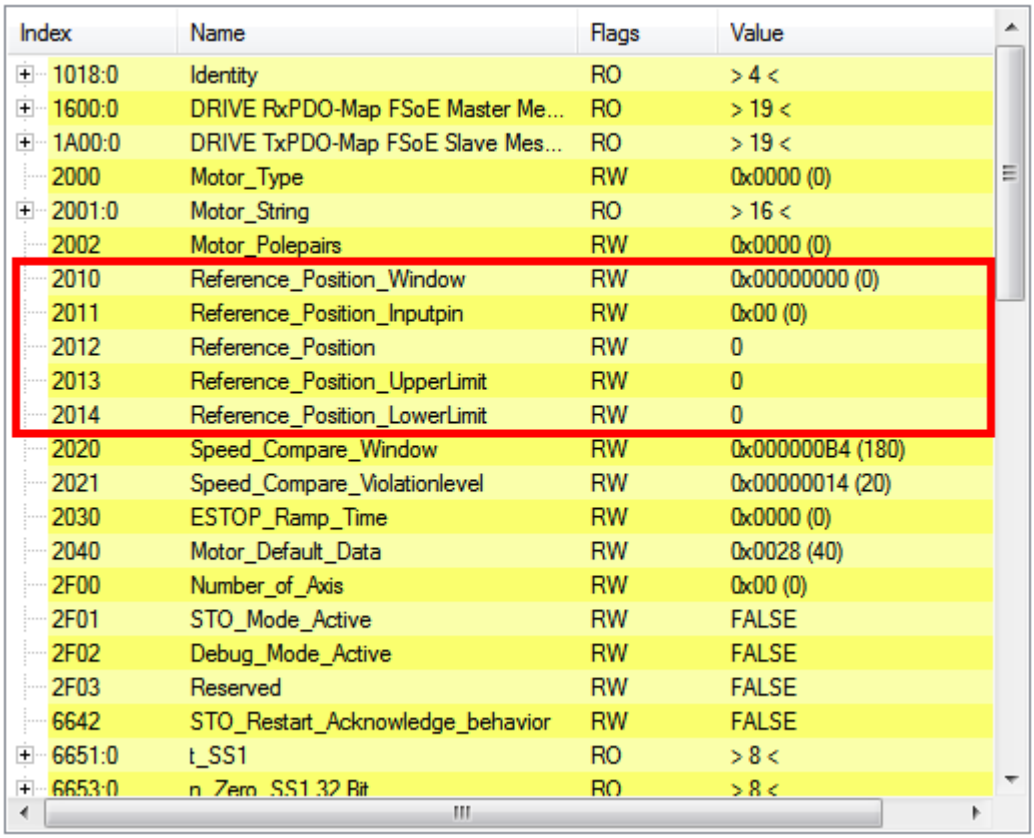
Fig. 24: GPIO (X06) on the AX5000

3.6.5.2 Parameterization

Note	**Monitoring the reference cam** As soon as the parameters for the reference position have been entered and an external position is linked with the standard process image, the AX5805/AX5806 expects the reference cam at the preset position. To deactivate this function, an unused digital input should be assigned in the AX5805/AX5806 parameters.

Note	**Exceeding the maximum range of travel** If the maximum range of travel is exceeded, the AX5805/AX5806 switches the AX5000 servo drive torque-free. There is no direct possibility to re-activate the axes. There are three possibilities to re-activate the axes: • Bring the axis mechanically back within the defined range. • Force the external position accordingly (not recommended) • Parameterize the maximum limits of the range of travel accordingly (not recommended)

Index	Name	Description	Unit	Default value
0x2010	Reference_Position_Window	Window around the reference position at which the AX5805 expects the reference cam (axis 1)	--	0x00000000
0x2011	Reference_Position_Inputpin	Number of the digital input on the AX5000 (0 to 7) to which the reference cam is connected (axis 1)	--	0x00
0x2012	Reference_Position	External position / reference position, central point of the reference cam (axis 1)	--	0x00000000
0x2013	Reference_Position_UpperLimit	Maximum external position (axis 1)	--	0x00000000
0x2014	Reference_Position_LowerLimit	Minimum external position (axis 1)	--	0x00000000
0x2810	Reference_Position_Window	Window around the reference position at which the AX5805 expects the reference cam (axis 2)	--	0x00000000
0x2811	Reference_Position_Inputpin	Number of the digital input on the AX5000 (0 to 7) to which the reference cam is connected (axis 2)	--	0x00
0x2812	Reference_Position	External position / reference position, central point of the reference cam. (axis 2)	--	0x00000000
0x2813	Reference_Position_UpperLimit	Maximum external position (axis 2)	--	0x00000000
0x2814	Reference_Position_LowerLimit	Minimum external position (axis 2)	--	0x00000000



Index	Name	Flags	Value
1018:0	Identity	RO	> 4 <
1600:0	DRIVE RxPDO-Map FSoE Master Me...	RO	> 19 <
1A00:0	DRIVE TxPDO-Map FSoE Slave Mes...	RO	> 19 <
2000	Motor_Type	RW	0x0000 (0)
2001:0	Motor_String	RO	> 16 <
2002	Motor_Polepairs	RW	0x0000 (0)
2010	Reference_Position_Window	RW	0x00000000 (0)
2011	Reference_Position_Inputpin	RW	0x00 (0)
2012	Reference_Position	RW	0
2013	Reference_Position_UpperLimit	RW	0
2014	Reference_Position_LowerLimit	RW	0
2020	Speed_Compare_Window	RW	0x000000B4 (180)
2021	Speed_Compare_Violationlevel	RW	0x00000014 (20)
2030	ESTOP_Ramp_Time	RW	0x0000 (0)
2040	Motor_Default_Data	RW	0x0028 (40)
2F00	Number_of_Axis	RW	0x00 (0)
2F01	STO_Mode_Active	RW	FALSE
2F02	Debug_Mode_Active	RW	FALSE
2F03	Reserved	RW	FALSE
6642	STO_Restart_Acknowledge_behavior	RW	FALSE
6651:0	t_SS1	RO	> 8 <
6653:0	n_Zero_SS1 32 Bit	RO	> 8 <

Fig. 25: Reference position

3.6.5.3 Reference run

As long as the external position has not been referenced, the safe position functions of the TwinSAFE drive option card are deactivated, i.e. the current position output by the AX5805/AX5806 is always 0. The status can also be read out via the CoE object 0x2015.
It is referenced when the external position matches the parameterized position and the reference cam was fully travelled over in positive or negative direction.

If the reference cam is set outside the window around the reference position, the AX5805/AX5806 detects an error and switches the AX5000 servo drive torque-free.

Fig. 26: Structure image for the reference position

Note	**Reference run** During the reference run, the reference cam should be run over as slowly as possible, in order to enable the AX5805/AX5806 to detect the cam limits as accurately as possible.

Note	**Referencing** If the AX5000 is switched to STO, the referencing is cleared and a reference run has to be performed again.

3.6.6 Parameterization of the integrated safety functions of the AX5805/AX5806

3.6.6.1 Description of the Error Acknowledge function

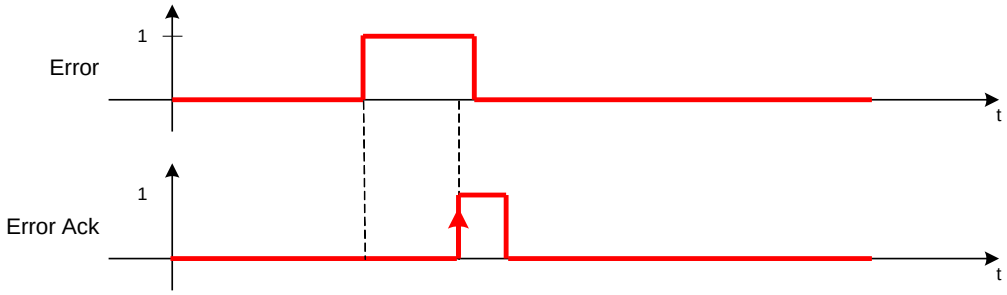


Fig. 27: Description of the Error Acknowledge function

Errors reported by the TwinSAFE Drive option card can be reset via rising edge of the Error Acknowledge signal. The error bit remains set if the reported error continues or occurs again immediately.

3.6.6.2 Description of the STO safety function

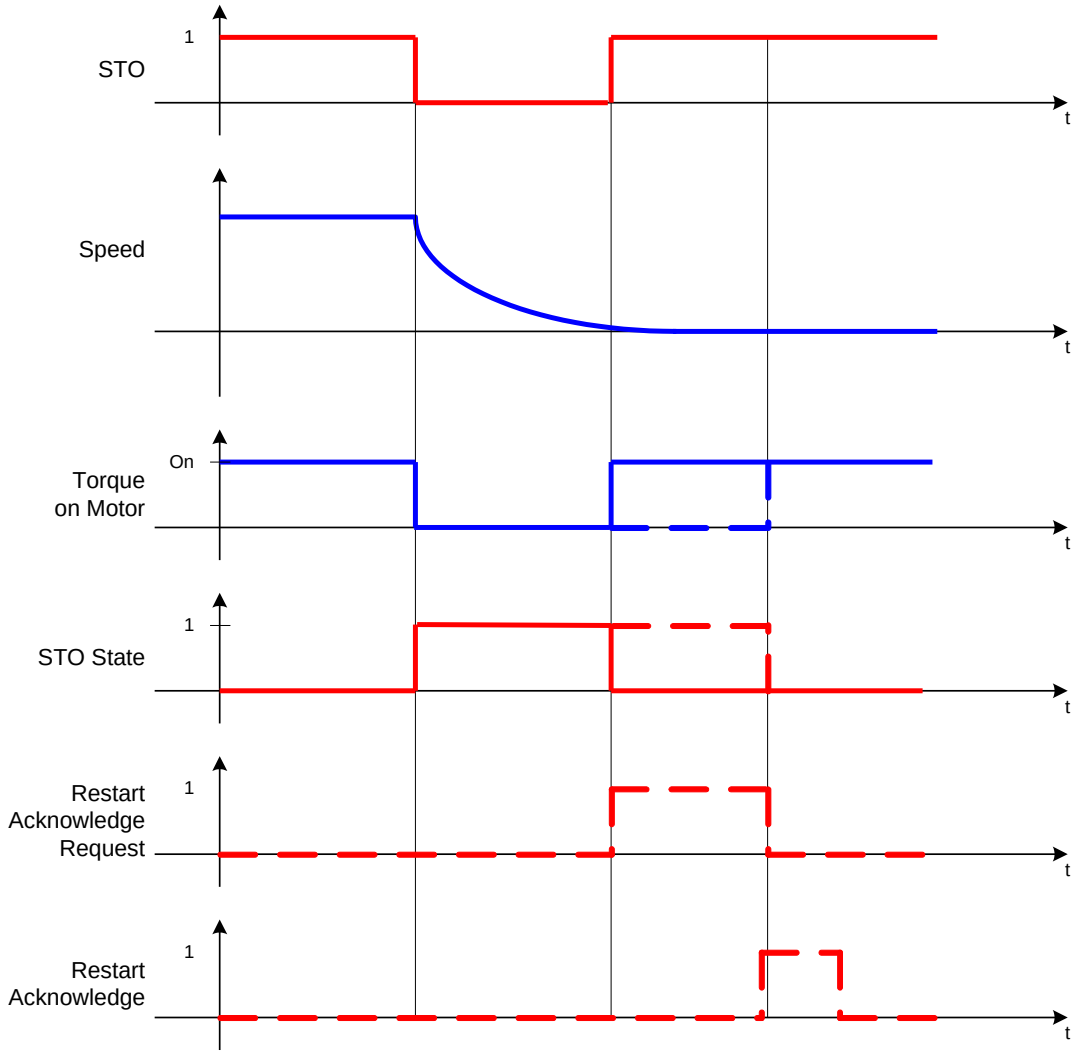


Fig. 28: Description of the Safe Torque Off function (STO)

The respective axis is switched torque-free as soon as the STO function is activated.

If the STO_Restart_Acknowledge_behavior parameter is set to TRUE, then the Restart_Acknowledge control bit must be set in order for the axis to restart.

Note	**ControlBit Restart Acknowledge** The Restart Acknowledge control bit does not belong to the standard mapping of the AX5805/AX5806. It must be additionally mapped into the user range of the control word.

Parameters for axis 1

Index	Name	Description	Sub Index	Unit	Default value
0x6642	STO_Restart_ Acknowledge_behavior	If this parameter is set, the AX5805/AX5806 needs a Restart_Acknowledge_Signal after the STO function is called	--	--	FALSE

Parameters for axis 2

Index	Name	Description	Sub Index	Unit	Default value
0x6E42	STO_Restart_ Acknowledge_behavior	If this parameter is set, the AX5805/AX5806 needs a Restart_Acknowledge_Signal after the STO function is called	--	--	FALSE

3.6.6.3 Description of the SS1 safety function

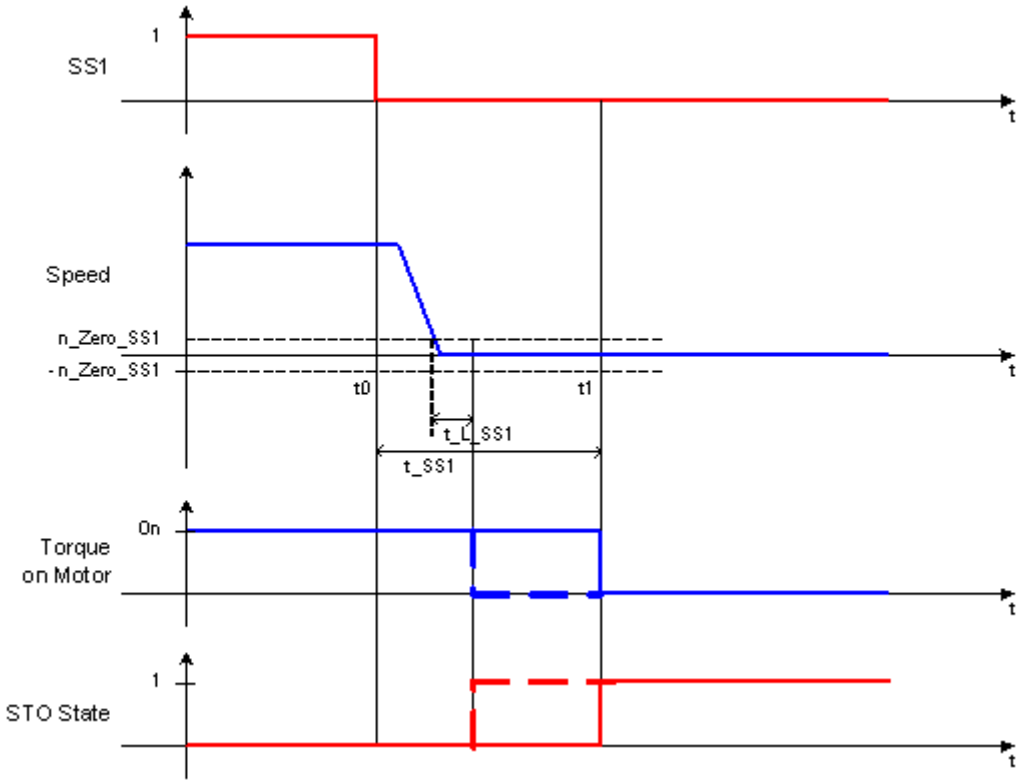


Fig. 29: Description of the Safe Stop 1 function (SS1) with time monitor

The time monitor t_SS1 is started upon activation of the SS1 function. The standard control begins with the deceleration of the axis and the STO function is activated at the latest after t_SS1. Furthermore, a speed window (n_Zero_SS1) is also monitored. The STO function is activated after the time t_L_SS1 as soon as the speed is within the window.

Note	**EN 61800-5-2:2017** EN 61800-5-2:2017 distinguishes 3 types of SS1 functions. Only the safety function SS1-t (en: safe stop 1 time controlled) is supported by the AX5805/AX5806.

Parameters for axis 1

Index	Name	Description	Sub Index	Unit	Default value
0x6651	t_SS1 :001	Maximum time until the activation of the STO safety function	01	10 ms	0x0000
0x6651	t_SS1 :002	Maximum time until the activation of the STO safety function	02	10 ms	0x0000
0x6651	t_SS1 :003	Maximum time until the activation of the STO safety function	03	10 ms	0x0000
0x6651	t_SS1 :004	Maximum time until the activation of the STO safety function	04	10 ms	0x0000
0x6651	t_SS1 :005	Maximum time until the activation of the STO safety function	05	10 ms	0x0000
0x6651	t_SS1 :006	Maximum time until the activation of the STO safety function	06	10 ms	0x0000
0x6651	t_SS1 :007	Maximum time until the activation of the STO safety function	07	10 ms	0x0000
0x6651	t_SS1 :008	Maximum time until the activation of the STO safety function	08	10 ms	0x0000
0x6653	n_Zero_SS1 32 Bit :001	Speed window for SS1_1	01	Increments per 1 ms	0x00000000
0x6653	n_Zero_SS1 32 Bit :002	Speed window for SS1_2	02	Increments per 1 ms	0x00000000
0x6653	n_Zero_SS1 32 Bit :003	Speed window for SS1_3	03	Increments per 1 ms	0x00000000
0x6653	n_Zero_SS1 32 Bit :004	Speed window for SS1_4	04	Increments per 1 ms	0x00000000
0x6653	n_Zero_SS1 32 Bit :005	Speed window for SS1_5	05	Increments per 1 ms	0x00000000
0x6653	n_Zero_SS1 32 Bit :006	Speed window for SS1_6	06	Increments per 1 ms	0x00000000
0x6653	n_Zero_SS1 32 Bit :007	Speed window for SS1_7	07	Increments per 1ms	0x00000000
0x6653	n_Zero_SS1 32 Bit :008	Speed window for SS1_8	08	Increments per 1 ms	0x00000000
0x6654	t_L SS1 :001	Minimum time until the activation of the STO safety function, if the speed is within the window	01	1 ms	0x0000
0x6654	t_L SS1 :002	Minimum time until the activation of the STO safety function, if the speed is within the window	02	1 ms	0x0000
0x6654	t_L SS1 :003	Minimum time until the activation of the STO safety function, if the speed is within the window	03	1 ms	0x0000
0x6654	t_L SS1 :004	Minimum time until the activation of the STO safety function, if the speed is within the window	04	1 ms	0x0000
0x6654	t_L SS1 :005	Minimum time until the activation of the STO safety function, if the speed is within the window	05	1 ms	0x0000
0x6654	t_L SS1 :006	Minimum time until the activation of the STO safety function, if the speed is within the window	06	1 ms	0x0000

Index	Name	Description	Sub Index	Unit	Default value
0x6654	t_L SS1 :007	Minimum time until the activation of the STO safety function, if the speed is within the window	07	1 ms	0x0000
0x6654	t_L SS1 :008	Minimum time until the activation of the STO safety function, if the speed is within the window	08	1 ms	0x0000

Parameters for axis 2

Index	Name	Description	Sub Index	Unit	Default value
0x6E51	t_SS1 :001	Maximum time until the activation of the STO safety function	01	10 ms	0x0000
0x6E51	t_SS1 :002	Maximum time until the activation of the STO safety function	02	10 ms	0x0000
0x6E51	t_SS1 :003	Maximum time until the activation of the STO safety function	03	10 ms	0x0000
0x6E51	t_SS1 :004	Maximum time until the activation of the STO safety function	04	10 ms	0x0000
0x6E51	t_SS1 :005	Maximum time until the activation of the STO safety function	05	10 ms	0x0000
0x6E51	t_SS1 :006	Maximum time until the activation of the STO safety function	06	10 ms	0x0000
0x6E51	t_SS1 :007	Maximum time until the activation of the STO safety function	07	10 ms	0x0000
0x6E51	t_SS1 :008	Maximum time until the activation of the STO safety function	08	10 ms	0x0000
0x6E53	n_Zero_SS1 32 Bit :001	Speed window for SS1_1	01	Increments per 1 ms	0x00000000
0x6E53	n_Zero_SS1 32 Bit :002	Speed window for SS1_2	02	Increments per 1 ms	0x00000000
0x6E53	n_Zero_SS1 32 Bit :003	Speed window for SS1_3	03	Increments per 1 ms	0x00000000
0x6E53	n_Zero_SS1 32 Bit :004	Speed window for SS1_4	04	Increments per 1 ms	0x00000000
0x6E53	n_Zero_SS1 32 Bit :005	Speed window for SS1_5	05	Increments per 1 ms	0x00000000
0x6E53	n_Zero_SS1 32 Bit :006	Speed window for SS1_6	06	Increments per 1 ms	0x00000000
0x6E53	n_Zero_SS1 32 Bit :007	Speed window for SS1_7	07	Increments per 1 ms	0x00000000
0x6E53	n_Zero_SS1 32 Bit :008	Speed window for SS1_8	08	Increments per 1 ms	0x00000000
0x6E54	t_L SS1 :001	Minimum time until the activation of the STO safety function, if the speed is within the window	01	1 ms	0x0000
0x6E54	t_L SS1 :002	Minimum time until the activation of the STO safety function, if the speed is within the window	02	1 ms	0x0000
0x6E54	t_L SS1 :003	Minimum time until the activation of the STO safety function, if the speed is within the window	03	1 ms	0x0000
0x6E54	t_L SS1 :004	Minimum time until the activation of the STO safety function, if the speed is within the window	04	1 ms	0x0000
0x6E54	t_L SS1 :005	Minimum time until the activation of the STO safety function, if the speed is within the window	05	1 ms	0x0000
0x6E54	t_L SS1 :006	Minimum time until the activation of the STO safety function, if the speed is within the window	06	1 ms	0x0000

Index	Name	Description	Sub Index	Unit	Default value
0x6E54	t_L SS1 :007	Minimum time until the activation of the STO safety function, if the speed is within the window	07	1 ms	0x0000
0x6E54	t_L SS1 :008	Minimum time until the activation of the STO safety function, if the speed is within the window	08	1 ms	0x0000

3.6.6.4 Description of the SS2 safety function

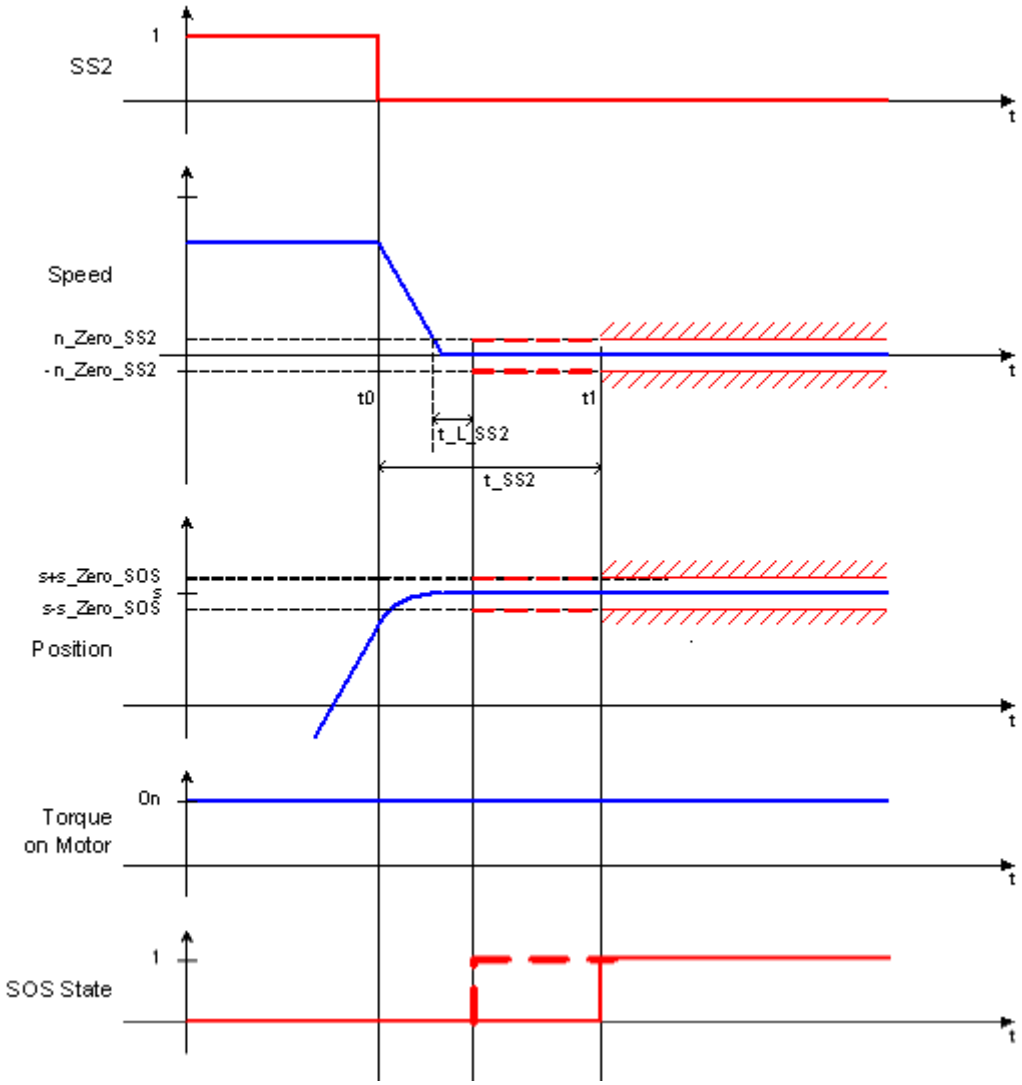


Fig. 30: Description of the Safe Stop 2 function (SS2) with time monitor

The time monitor t_SS2 is started upon activation of the SS2 function. The standard control begins with the deceleration of the axis and the SOS function is activated at the latest after t_SS2. Furthermore, a speed window (n_Zero_SS2) is also monitored. The SOS function is activated after the time t_L_SS2 as soon as the speed is within the window.

Note	**EN 61800-5-2:2017** EN 61800-5-2:2017 distinguishes 3 types of SS2 functions. Only the safety function SS2-t (en: safe stop 2 time controlled) is supported by the AX5805/AX5806.

The corresponding instance of SOS is used for each instance of SS2.

WARNING	**Suspended loads** Please observe the notes of the safety function SOS.

Parameters for axis 1

Index	Name	Description	Sub Index	Unit	Default value
0x6671	t_SS2 :001	Maximum time until the activation of the SOS_1 safety function	01	10 ms	0x0000
0x6671	t_SS2 :002	Maximum time until the activation of the SOS_2 safety function	02	10 ms	0x0000
0x6671	t_SS2 :003	Maximum time until the activation of the SOS_3 safety function	03	10 ms	0x0000
0x6671	t_SS2 :004	Maximum time until the activation of the SOS_4 safety function	04	10 ms	0x0000
0x6671	t_SS2 :005	Maximum time until the activation of the SOS_5 safety function	05	10 ms	0x0000
0x6671	t_SS2 :006	Maximum time until the activation of the SOS_6 safety function	06	10 ms	0x0000
0x6671	t_SS2 :007	Maximum time until the activation of the SOS_7 safety function	07	10 ms	0x0000
0x6671	t_SS2 :008	Maximum time until the activation of the SOS_8 safety function	08	10 ms	0x0000
0x6672	t_L SS2 :001	Minimum time until the activation of the SOS_1 safety function, if the speed is within the window	01	1 ms	0x0000
0x6672	t_L SS2 :002	Minimum time until the activation of the SOS_2 safety function, if the speed is within the window	02	1 ms	0x0000
0x6672	t_L SS2 :003	Minimum time until the activation of the SOS_3 safety function, if the speed is within the window	03	1 ms	0x0000
0x6672	t_L SS2 :004	Minimum time until the activation of the SOS_4 safety function, if the speed is within the window	04	1 ms	0x0000
0x6672	t_L SS2 :005	Minimum time until the activation of the SOS_5 safety function, if the speed is within the window	05	1 ms	0x0000
0x6672	t_L SS2 :006	Minimum time until the activation of the SOS_6 safety function, if the speed is within the window	06	1 ms	0x0000
0x6672	t_L SS2 :007	Minimum time until the activation of the SOS_7 safety function, if the speed is within the window	07	1 ms	0x0000
0x6672	t_L SS2 :008	Minimum time until the activation of the SOS_8 safety function, if the speed is within the window	08	1 ms	0x0000
0x6679	n_Zero_SS2 32 Bit :001	Speed window for SS2_1	01	Increments per 1 ms	0x00000000
0x6679	n_Zero_SS2 32 Bit :002	Speed window for SS2_2	02	Increments per 1 ms	0x00000000
0x6679	n_Zero_SS2 32 Bit :003	Speed window for SS2_3	03	Increments per 1 ms	0x00000000
0x6679	n_Zero_SS2 32 Bit :004	Speed window for SS2_4	04	Increments per 1 ms	0x00000000
0x6679	n_Zero_SS2 32 Bit :005	Speed window for SS2_5	05	Increments per 1 ms	0x00000000

Index	Name	Description	Sub Index	Unit	Default value
0x6679	n_Zero_SS2 32 Bit :006	Speed window for SS2_6	06	Increments per 1 ms	0x00000000
0x6679	n_Zero_SS2 32 Bit :007	Speed window for SS2_7	07	Increments per 1 ms	0x00000000
0x6679	n_Zero_SS2 32 Bit :008	Speed window for SS2_8	08	Increments per 1 ms	0x00000000

Parameters for axis 2

Index	Name	Description	Sub Index	Unit	Default value
0x6E71	t_SS2 :001	Maximum time until the activation of the SOS_1 safety function	01	10 ms	0x0000
0x6E71	t_SS2 :002	Maximum time until the activation of the SOS_2 safety function	02	10 ms	0x0000
0x6E71	t_SS2 :003	Maximum time until the activation of the SOS_3 safety function	03	10 ms	0x0000
0x6E71	t_SS2 :004	Maximum time until the activation of the SOS_4 safety function	04	10 ms	0x0000
0x6E71	t_SS2 :005	Maximum time until the activation of the SOS_5 safety function	05	10 ms	0x0000
0x6E71	t_SS2 :006	Maximum time until the activation of the SOS_6 safety function	06	10 ms	0x0000
0x6E71	t_SS2 :007	Maximum time until the activation of the SOS_7 safety function	07	10 ms	0x0000
0x6E71	t_SS2 :008	Maximum time until the activation of the SOS_8 safety function	08	10 ms	0x0000
0x6E72	t_L SS2 :001	Minimum time until the activation of the SOS_1 safety function, if the speed is within the window	01	1 ms	0x0000
0x6E72	t_L SS2 :002	Minimum time until the activation of the SOS_2 safety function, if the speed is within the window	02	1 ms	0x0000
0x6E72	t_L SS2 :003	Minimum time until the activation of the SOS_3 safety function, if the speed is within the window	03	1 ms	0x0000
0x6E72	t_L SS2 :004	Minimum time until the activation of the SOS_4 safety function, if the speed is within the window	04	1 ms	0x0000
0x6E72	t_L SS2 :005	Minimum time until the activation of the SOS_5 safety function, if the speed is within the window	05	1 ms	0x0000
0x6E72	t_L SS2 :006	Minimum time until the activation of the SOS_6 safety function, if the speed is within the window	06	1 ms	0x0000
0x6E72	t_L SS2 :007	Minimum time until the activation of the SOS_7 safety function, if the speed is within the window	07	1 ms	0x0000
0x6E72	t_L SS2 :008	Minimum time until the activation of the SOS_8 safety function, if the speed is within the window	08	1 ms	0x0000
0x6E79	n_Zero_SS2 32 Bit :001	Speed window for SS2_1	01	Increments per 1 ms	0x00000000
0x6E79	n_Zero_SS2 32 Bit :002	Speed window for SS2_2	02	Increments per 1 ms	0x00000000
0x6E79	n_Zero_SS2 32 Bit :003	Speed window for SS2_3	03	Increments per 1 ms	0x00000000
0x6E79	n_Zero_SS2 32 Bit :004	Speed window for SS2_4	04	Increments per 1 ms	0x00000000
0x6E79	n_Zero_SS2 32 Bit :005	Speed window for SS2_5	05	Increments per 1 ms	0x00000000

Index	Name	Description	Sub Index	Unit	Default value
0x6E79	n_Zero_SS2 32 Bit :006	Speed window for SS2_6	06	Increments per 1 ms	0x00000000
0x6E79	n_Zero_SS2 32 Bit :007	Speed window for SS2_7	07	Increments per 1 ms	0x00000000
0x6E79	n_Zero_SS2 32 Bit :008	Speed window for SS2_8	08	Increments per 1 ms	0x00000000

3.6.6.5 Description of the SOS safety function

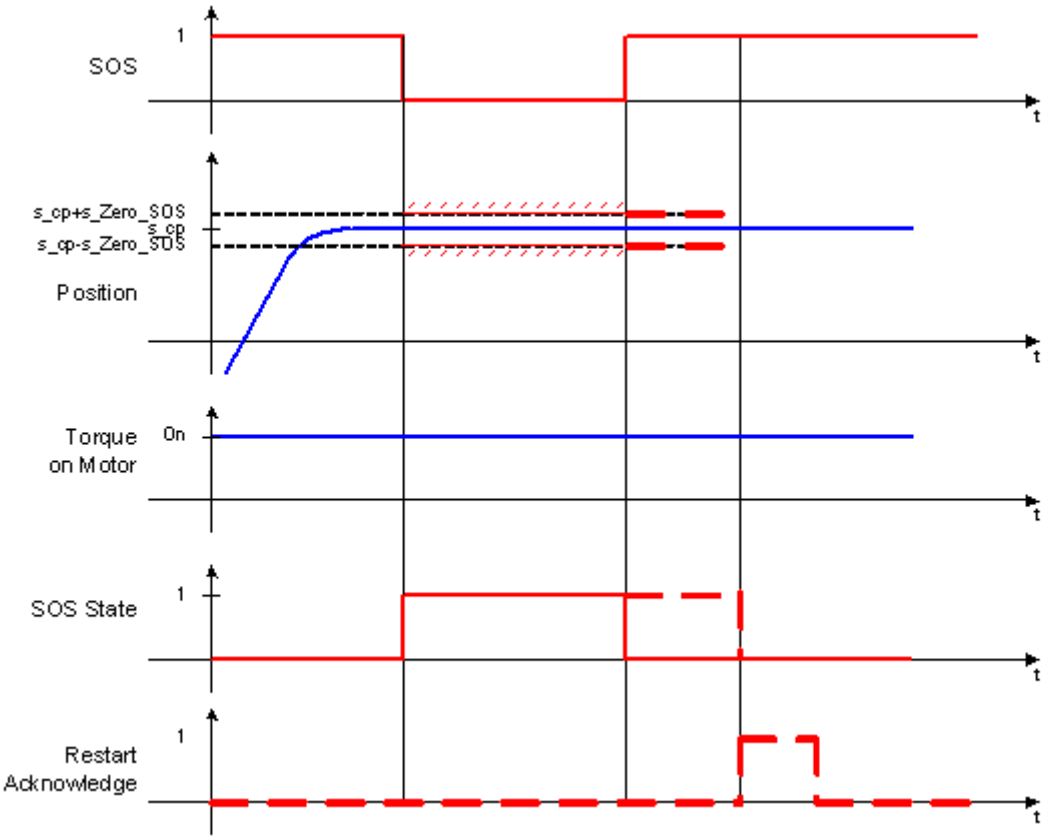


Fig. 31: Description of the Safe Operating Stop function (SOS)

WARNING	**Suspended loads** The SOS function may not be used for suspended loads, since failure of the power supply and/or failure of the encoder signal can result in an undetected movement. This can lead to the endangering of people. In the case of suspended loads please provide for alternative measures to bring the axis safely to a standstill in an error state, such as Scotch derricks, safe service brakes or other measures. These safety measures must be controlled by the user application.

The monitoring of the current position (s_cp) is switched on upon the activation of SOS. The position may not leave the window (s_Zero_SOS), defined around this position. The motor remains activated and under torque.

If one of the limits is violated, the predefined function STO is executed as error reaction. This reaction cannot be parameterized.

If the position value should freeze due to an error of the encoder, a movement will only be detected if a change of position occurs outside the Speed_Compare_Window. The user can calculate the maximum speed using the following equation and evaluate it for his application.

$$Max\ Drehwinkel\ in\ °\ pro\ s = \frac{0x2020}{65535 * PolePairs} * 8 * 1000 * 360° = \frac{5}{65535 * 5} * 8 * 1000 * 360° = 43{,}9° /s$$

WARNING	**Case of error: encoder signal freezes** If the encoder signal should fail (stuck-at error), there is a maximum undetected speed according to the previous calculation.

Parameters for axis 1

Index	Name	Description	Sub Index	Unit	Default value
0x666A	s_Zero_SOS 32 Bit :001	If the SOS_1 function is activated, the axis may move within the position window defined here	01	Increments	0x0000
0x666A	s_Zero_SOS 32 Bit :002	If the SOS_2 function is activated, the axis may move within the position window defined here	02	Increments	0x0000
0x666A	s_Zero_SOS 32 Bit :003	If the SOS_3 function is activated, the axis may move within the position window defined here	03	Increments	0x0000
0x666A	s_Zero_SOS 32 Bit :004	If the SOS_4 function is activated, the axis may move within the position window defined here	04	Increments	0x0000
0x666A	s_Zero_SOS 32 Bit :005	If the SOS_5 function is activated, the axis may move within the position window defined here	05	Increments	0x0000
0x666A	s_Zero_SOS 32 Bit :006	If the SOS_6 function is activated, the axis may move within the position window defined here	06	Increments	0x0000
0x666A	s_Zero_SOS 32 Bit :007	If the SOS_7 function is activated, the axis may move within the position window defined here	07	Increments	0x0000
0x666A	s_Zero_SOS 32 Bit :008	If the SOS_8 function is activated, the axis may move within the position window defined here	08	Increments	0x0000

Parameters for axis 2

Index	Name	Description	Sub Index	Unit	Default value
0x6E6A	s_Zero_SOS 32 Bit :001	If the SOS_1 function is activated, the axis may move within the position window defined here	01	Increments	0x0000
0x6E6A	s_Zero_SOS 32 Bit :002	If the SOS_2 function is activated, the axis may move within the position window defined here	02	Increments	0x0000
0x6E6A	s_Zero_SOS 32 Bit :003	If the SOS_3 function is activated, the axis may move within the position window defined here	03	Increments	0x0000
0x6E6A	s_Zero_SOS 32 Bit :004	If the SOS_4 function is activated, the axis may move within the position window defined here	04	Increments	0x0000
0x6E6A	s_Zero_SOS 32 Bit :005	If the SOS_5 function is activated, the axis may move within the position window defined here	05	Increments	0x0000
0x6E6A	s_Zero_SOS 32 Bit :006	If the SOS_6 function is activated, the axis may move within the position window defined here	06	Increments	0x0000
0x6E6A	s_Zero_SOS 32 Bit :007	If the SOS_7 function is activated, the axis may move within the position window defined here	07	Increments	0x0000
0x6E6A	s_Zero_SOS 32 Bit :008	If the SOS_8 function is activated, the axis may move within the position window defined here	08	Increments	0x0000

3.6.6.6 Description of the SSR safety function

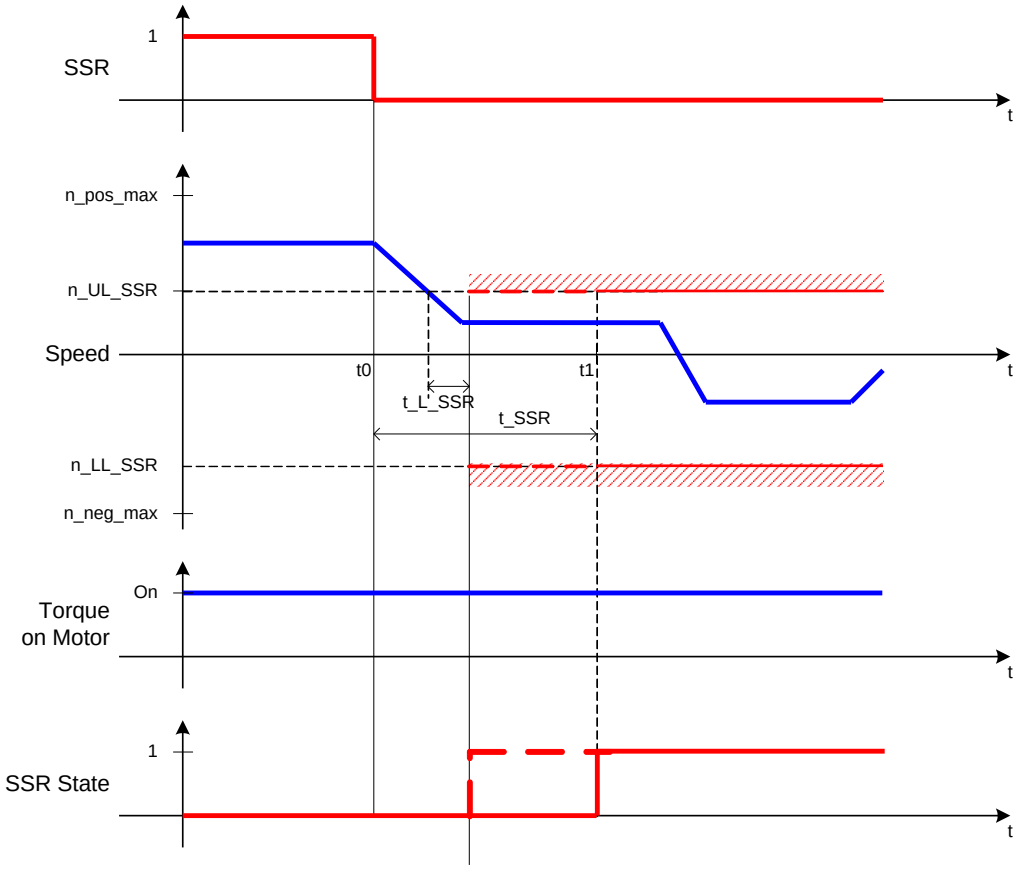


Fig. 32: Description of the Safe Speed Range function (SSR) with time monitor

The time monitor t_SSR is started upon activation of the SSR function. The standard control begins with the deceleration and the maximum speeds n_UL_SSR (UL-upper limit) and n_LL_SSR (LL-lower limit) are monitored at the latest upon the expiry of the time t_SSR.

If the axis is already within the defined speed window, the monitoring is activated after the time t_L_SSR.

If one of the limits is exceeded, the function defined under ErrorReaction_SSR is executed.

WARNING	**Parameter settings** The setting of the speed limits must be above the calculated speed from the Speed_Compare_Window. (See also chapter 3.6.2)

Parameters for axis 1

Index	Name	Description	Sub Index	Unit	Default value
0x6681	t_SSR :001	Maximum time until the activation of the SSR_1 safety function	01	1 ms	0x0000
0x6681	t_SSR :002	Maximum time until the activation of the SSR_2 safety function	02	1 ms	0x0000
0x6681	t_SSR: 003	Maximum time until the activation of the SSR_3 safety function	03	1 ms	0x0000
0x6681	t_SSR :004	Maximum time until the activation of the SSR_4 safety function	04	1 ms	0x0000
0x6681	t_SSR :005	Maximum time until the activation of the SSR_5 safety function	05	1 ms	0x0000
0x6681	t_SSR :006	Maximum time until the activation of the SSR_6 safety function	06	1 ms	0x0000
0x6681	t_SSR :007	Maximum time until the activation of the SSR_7 safety function	07	1 ms	0x0000
0x6681	t_SSR :008	Maximum time until the activation of the SSR_8 safety function	08	1 ms	0x0000
0x6683	n_UL_SSR 32 Bit :001	Upper speed limit when the SSR_1 function is activated	01	Increments per 1 ms	0x00000000
0x6683	n_UL_SSR 32 Bit :002	Upper speed limit when the SSR_2 function is activated	02	Increments per 1 ms	0x00000000
0x6683	n_UL_SSR 32 Bit :003	Upper speed limit when the SSR_3 function is activated	03	Increments per 1 ms	0x00000000
0x6683	n_UL_SSR 32 Bit :004	Upper speed limit when the SSR_4 function is activated	04	Increments per 1 ms	0x00000000
0x6683	n_UL_SSR 32 Bit :005	Upper speed limit when the SSR_5 function is activated	05	Increments per 1 ms	0x00000000
0x6683	n_UL_SSR 32 Bit :006	Upper speed limit when the SSR_6 function is activated	06	Increments per 1 ms	0x00000000
0x6683	n_UL_SSR 32 Bit :007	Upper speed limit when the SSR_7 function is activated	07	Increments per 1 ms	0x00000000
0x6683	n_UL_SSR 32 Bit :008	Upper speed limit when the SSR_8 function is activated	08	Increments per 1 ms	0x00000000
0x6685	n_LL_SSR 32 Bit :001	Lower speed limit when the SSR_1 function is activated	01	Increments per 1 ms	0x00000000
0x6685	n_LL_SSR 32 Bit :002	Lower speed limit when the SSR_2 function is activated	02	Increments per 1 ms	0x00000000
0x6685	n_LL_SSR 32 Bit :003	Lower speed limit when the SSR_3 function is activated	03	Increments per 1 ms	0x00000000
0x6685	n_LL_SSR 32 Bit :004	Lower speed limit when the SSR_4 function is activated	04	Increments per 1 ms	0x00000000
0x6685	n_LL_SSR 32 Bit :005	Lower speed limit when the SSR_5 function is activated	05	Increments per 1 ms	0x00000000
0x6685	n_LL_SSR 32 Bit :006	Lower speed limit when the SSR_6 function is activated	06	Increments per 1 ms	0x00000000
0x6685	n_LL_SSR 32 Bit :007	Lower speed limit when the SSR_7 function is activated	07	Increments per 1 ms	0x00000000
0x6685	n_LL_SSR 32 Bit :008	Lower speed limit when the SSR_8 function is activated	08	Increments per 1 ms	0x00000000

Index	Name	Description	Sub Index	Unit	Default value
0x6686	t_L_SSR :001	Minimum time until the activation of the SSR_1 safety function, if the speed is within the window	01	1 ms	0x0000
0x6686	t_L_SSR :002	Minimum time until the activation of the SSR_2 safety function, if the speed is within the window	02	1 ms	0x0000
0x6686	t_L_SSR :003	Minimum time until the activation of the SSR_3 safety function, if the speed is within the window	03	1 ms	0x0000
0x6686	t_L_SSR :004	Minimum time until the activation of the SSR_4 safety function, if the speed is within the window	04	1 ms	0x0000
0x6686	t_L_SSR :005	Minimum time until the activation of the SSR_5 safety function, if the speed is within the window	05	1 ms	0x0000
0x6686	t_L_SSR :006	Minimum time until the activation of the SSR_6 safety function, if the speed is within the window	06	1 ms	0x0000
0x6686	t_L_SSR :007	Minimum time until the activation of the SSR_7 safety function, if the speed is within the window	07	1 ms	0x0000
0x6686	t_L_SSR :008	Minimum time until the activation of the SSR_8 safety function, if the speed is within the window	08	1 ms	0x0000
0x668A	Error Reaction SSR :001	Error reaction of SSR_1	01	--	0x66400001 (STO)
0x668A	Error Reaction SSR :002	Error reaction of SSR_2	02	--	0x66400001 (STO)
0x668A	Error Reaction SSR :003	Error reaction of SSR_3	03	--	0x66400001 (STO)
0x668A	Error Reaction SSR :004	Error reaction of SSR_4	04	--	0x66400001 (STO)
0x668A	Error Reaction SSR :005	Error reaction of SSR_5	05	--	0x66400001 (STO)
0x668A	Error Reaction SSR :006	Error reaction of SSR_6	06	--	0x66400001 (STO)
0x668A	Error Reaction SSR :007	Error reaction of SSR_7	07	--	0x66400001 (STO)
0x668A	Error Reaction SSR :008	Error reaction of SSR_8	08	--	0x66400001 (STO)

Parameters for axis 2

Index	Name	Description	Sub Index	Unit	Default value
0x6E81	t_SSR :001	Maximum time until the activation of the SSR_1 safety function	01	1 ms	0x0000
0x6E81	t_SSR :002	Maximum time until the activation of the SSR_2 safety function	02	1 ms	0x0000
0x6E81	t_SSR: 003	Maximum time until the activation of the SSR_3 safety function	03	1 ms	0x0000
0x6E81	t_SSR :004	Maximum time until the activation of the SSR_4 safety function	04	1 ms	0x0000
0x6E81	t_SSR :005	Maximum time until the activation of the SSR_5 safety function	05	1 ms	0x0000
0x6E81	t_SSR :006	Maximum time until the activation of the SSR_6 safety function	06	1 ms	0x0000
0x6E81	t_SSR :007	Maximum time until the activation of the SSR_7 safety function	07	1 ms	0x0000
0x6E81	t_SSR :008	Maximum time until the activation of the SSR_8 safety function	08	1 ms	0x0000
0x6E83	n_UL_SSR 32 Bit :001	Upper speed limit when the SSR_1 function is activated	01	Increments per 1 ms	0x00000000
0x6E83	n_UL_SSR 32 Bit :002	Upper speed limit when the SSR_2 function is activated	02	Increments per 1 ms	0x00000000
0x6E83	n_UL_SSR 32 Bit :003	Upper speed limit when the SSR_3 function is activated	03	Increments per 1 ms	0x00000000
0x6E83	n_UL_SSR 32 Bit :004	Upper speed limit when the SSR_4 function is activated	04	Increments per 1 ms	0x00000000
0x6E83	n_UL_SSR 32 Bit :005	Upper speed limit when the SSR_5 function is activated	05	Increments per 1 ms	0x00000000
0x6E83	n_UL_SSR 32 Bit :006	Upper speed limit when the SSR_6 function is activated	06	Increments per 1 ms	0x00000000
0x6E83	n_UL_SSR 32 Bit :007	Upper speed limit when the SSR_7 function is activated	07	Increments per 1 ms	0x00000000
0x6E83	n_UL_SSR 32 Bit :008	Upper speed limit when the SSR_8 function is activated	08	Increments per 1 ms	0x00000000
0x6E85	n_LL_SSR 32 Bit :001	Lower speed limit when the SSR_1 function is activated	01	Increments per 1 ms	0x00000000
0x6E85	n_LL_SSR 32 Bit :002	Lower speed limit when the SSR_2 function is activated	02	Increments per 1 ms	0x00000000
0x6E85	n_LL_SSR 32 Bit :003	Lower speed limit when the SSR_3 function is activated	03	Increments per 1 ms	0x00000000
0x6E85	n_LL_SSR 32 Bit :004	Lower speed limit when the SSR_4 function is activated	04	Increments per 1 ms	0x00000000
0x6E85	n_LL_SSR 32 Bit :005	Lower speed limit when the SSR_5 function is activated	05	Increments per 1 ms	0x00000000

Index	Name	Description	Sub Index	Unit	Default value
0x6E85	n_LL_SSR 32 Bit :006	Lower speed limit when the SSR_6 function is activated	06	Increments per 1 ms	0x00000000
0x6E85	n_LL_SSR 32 Bit :007	Lower speed limit when the SSR_7 function is activated	07	Increments per 1 ms	0x00000000
0x6E85	n_LL_SSR 32 Bit :008	Lower speed limit when the SSR_8 function is activated	08	Increments per 1 ms	0x00000000
0x6E86	t_L_SSR :001	Minimum time until the activation of the SSR_1 safety function, if the speed is within the window	01	1 ms	0x0000
0x6E86	t_L_SSR :002	Minimum time until the activation of the SSR_2 safety function, if the speed is within the window	02	1 ms	0x0000
0x6E86	t_L_SSR :003	Minimum time until the activation of the SSR_3 safety function, if the speed is within the window	03	1 ms	0x0000
0x6E86	t_L_SSR :004	Minimum time until the activation of the SSR_4 safety function, if the speed is within the window	04	1 ms	0x0000
0x6E86	t_L_SSR :005	Minimum time until the activation of the SSR_5 safety function, if the speed is within the window	05	1 ms	0x0000
0x6E86	t_L_SSR :006	Minimum time until the activation of the SSR_6 safety function, if the speed is within the window	06	1 ms	0x0000
0x6E86	t_L_SSR :007	Minimum time until the activation of the SSR_7 safety function, if the speed is within the window	07	1 ms	0x0000
0x6E86	t_L_SSR :008	Minimum time until the activation of the SSR_8 safety function, if the speed is within the window	08	1 ms	0x0000
0x6E8A	Error Reaction SSR :001	Error reaction of SSR_1	01	--	0x66400001 (STO)
0x6E8A	Error Reaction SSR :002	Error reaction of SSR_2	02	--	0x66400001 (STO)
0x6E8A	Error Reaction SSR :003	Error reaction of SSR_3	03	--	0x66400001 (STO)
0x6E8A	Error Reaction SSR :004	Error reaction of SSR_4	04	--	0x66400001 (STO)
0x6E8A	Error Reaction SSR :005	Error reaction of SSR_5	05	--	0x66400001 (STO)
0x6E8A	Error Reaction SSR :006	Error reaction of SSR_6	06	--	0x66400001 (STO)
0x6E8A	Error Reaction SSR :007	Error reaction of SSR_7	07	--	0x66400001 (STO)
0x6E8A	Error Reaction SSR :008	Error reaction of SSR_8	08	--	0x66400001 (STO)

3.6.6.7 Description of the SDIp safety function

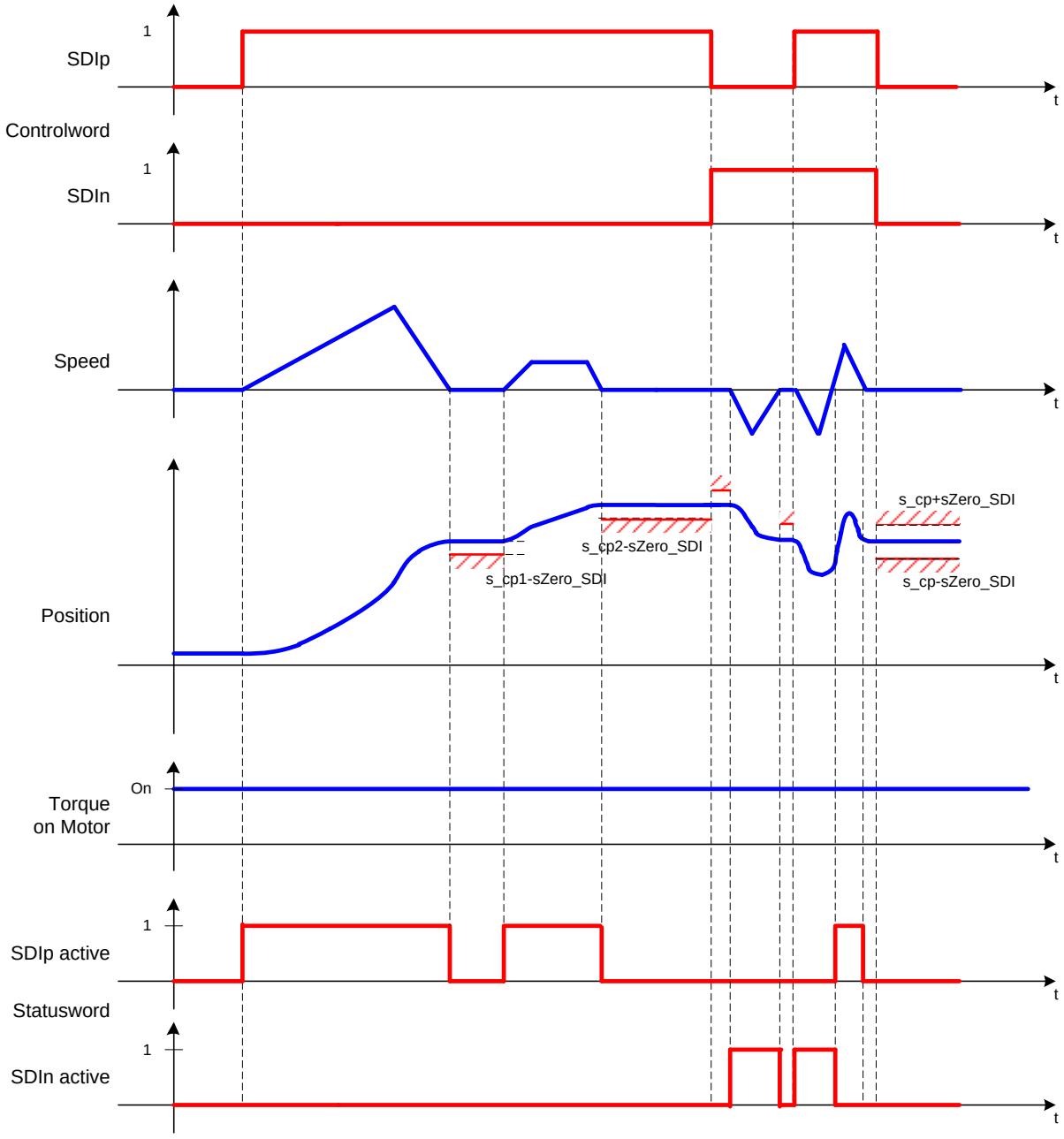


Fig. 33: Description of the Safe Direction positive function (SDIp)

A positive direction of rotation is permitted only if the SDIp bit is set in the control word. The SDIp and SDIn bits in the status word indicate the current direction of rotation. Both status bits are 0 if the axis is stationary. The position may not leave the window (s_Zero_SDI) defined around this position.

Only the negative direction of rotation is permitted if the SDIp function is activated (SDIp = 0).

Parameters for axis 1

Index	Name	Description	Sub Index	Unit	Default value
0x66D3	s_Zero_SDI 32 Bit	Position window for the SDI safety function	--	Increments	0x00000000

Parameters for axis 2

Index	Name	Description	Sub Index	Unit	Default value
0x6ED3	s_Zero_SDI 32 Bit	Position window for the SDI safety function	--	Increments	0x00000000

3.6.6.8 Description of the SDIn safety function

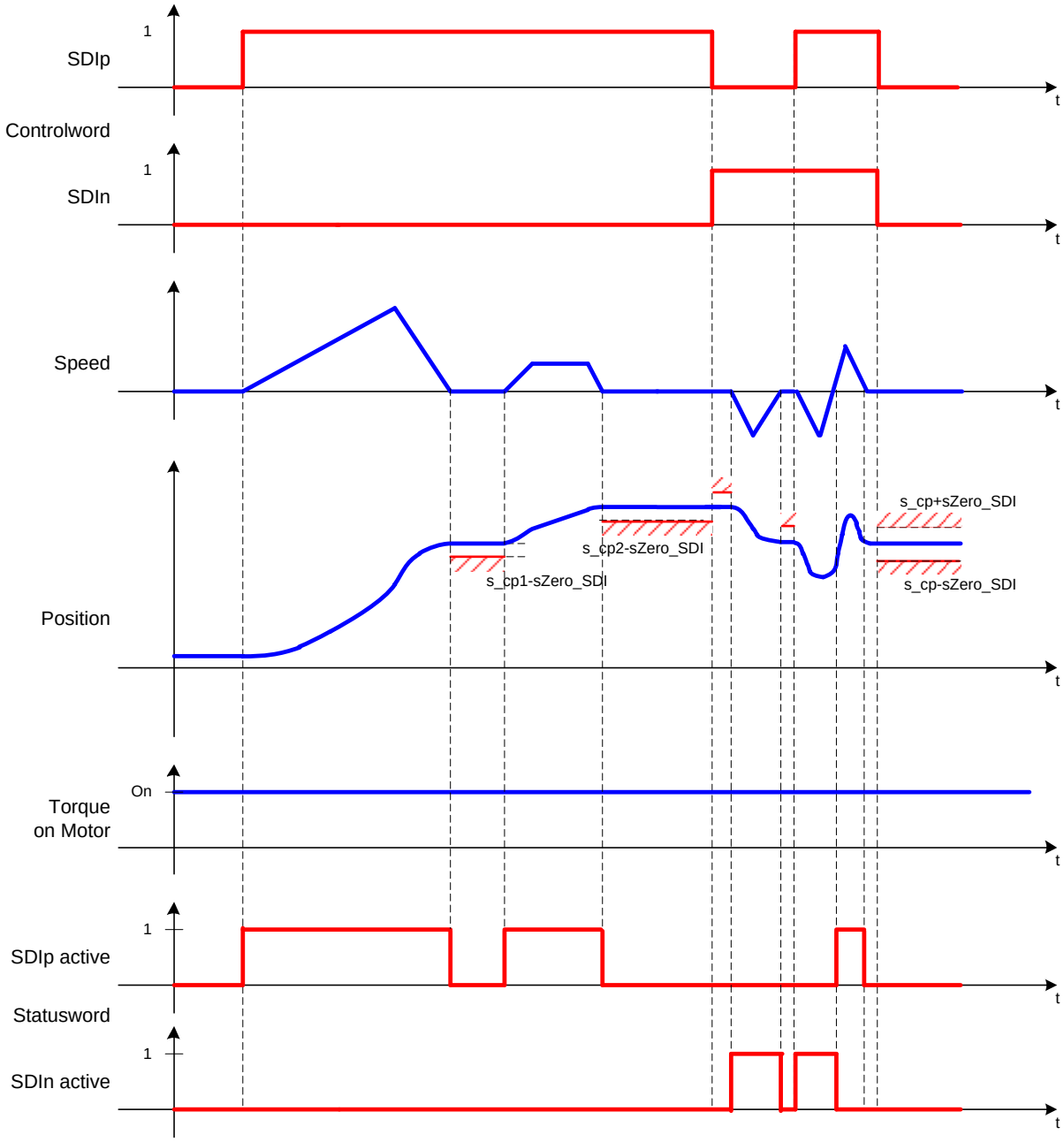


Fig. 34: Description of the Safe Direction negative function (SDIn)

A negative direction of rotation is permitted only if the SDIn bit is set in the control word. The SDIp and SDIn bits in the status word indicate the current direction of rotation. Both status bits are 0 if the axis is stationary. The position may not leave the window (s_Zero_SDI) defined around this position.

Only the positive direction of rotation is permitted if the SDIn function is activated (SDIn = 0).

Parameters for axis 1

Index	Name	Description	Sub Index	Unit	Default value
0x66D3	s_Zero_SDI 32 Bit	Position window for the SDI safety function	--	Increments	0x00000000

Parameters for axis 2

Index	Name	Description	Sub Index	Unit	Default value
0x6ED3	s_Zero_SDI 32 Bit	Position window for the SDI safety function	--	Increments	0x00000000

3.6.6.9 Description of the SSM safety function

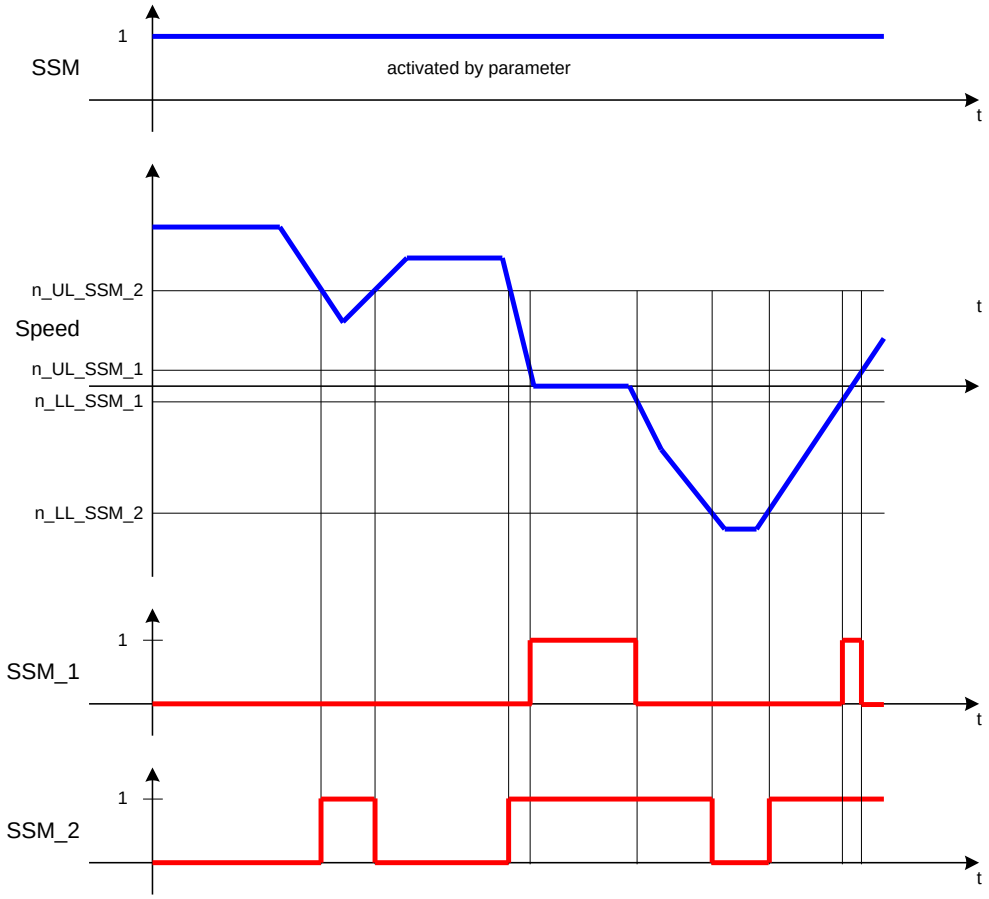


Fig. 35: Description of the Safe Speed Monitor function (SSM0, SSM1)

The SSM function is activated by the parameters (parameter values not equal to 0).

The status is set if the current speed is within the limits n_UL_SSM 32 Bit (UL-Upper limit) and n_LL_SSM 32 Bit (LL-Lower limit).

WARNING	**Parameter settings** The setting of the speed limits must be above the calculated speed from the Speed_Compare_Window. (See also chapter 3.6.2)

Parameters for axis 1

Index	Name	Description	Sub Index	Unit	Default value
0x66E2	n_UL_SSM 32 Bit :001	Upper speed limit of the SSM_1 function	01	Increments per 1 ms	0x00000000
0x66E2	n_UL_SSM 32 Bit :002	Upper speed limit of the SSM_2 function	02	Increments per 1 ms	0x00000000
0x66E2	n_UL_SSM 32 Bit :003	Upper speed limit of the SSM_3 function	03	Increments per 1 ms	0x00000000
0x66E2	n_UL_SSM 32 Bit :004	Upper speed limit of the SSM_4 function	04	Increments per 1 ms	0x00000000
0x66E2	n_UL_SSM 32 Bit :005	Upper speed limit of the SSM_5 function	05	Increments per 1 ms	0x00000000
0x66E2	n_UL_SSM 32 Bit :006	Upper speed limit of the SSM_6 function	06	Increments per 1 ms	0x00000000
0x66E2	n_UL_SSM 32 Bit :007	Upper speed limit of the SSM_7 function	07	Increments per 1 ms	0x00000000
0x66E2	n_UL_SSM 32 Bit :008	Upper speed limit of the SSM_8 function	08	Increments per 1 ms	0x00000000
0x66E4	n_LL_SSM 32 Bit :001	Lower speed limit of the SSM_1 function	01	Increments per 1 ms	0x00000000
0x66E4	n_LL_SSM 32 Bit :002	Lower speed limit of the SSM_2 function	02	Increments per 1 ms	0x00000000
0x66E4	n_LL_SSM 32 Bit :003	Lower speed limit of the SSM_3 function	03	Increments per 1 ms	0x00000000
0x66E4	n_LL_SSM 32 Bit :004	Lower speed limit of the SSM_4 function	04	Increments per 1 ms	0x00000000
0x66E4	n_LL_SSM 32 Bit :005	Lower speed limit of the SSM_5 function	05	Increments per 1 ms	0x00000000
0x66E4	n_LL_SSM 32 Bit :006	Lower speed limit of the SSM_6 function	06	Increments per 1 ms	0x00000000
0x66E4	n_LL_SSM 32 Bit :007	Lower speed limit of the SSM_7 function	07	Increments per 1 ms	0x00000000
0x66E4	n_LL_SSM 32 Bit :008	Lower speed limit of the SSM_8 function	08	Increments per 1 ms	0x00000000

Parameters for axis 2

Index	Name	Description	Sub Index	Unit	Default value
0x6EE2	n_UL_SSM 32 Bit :001	Upper speed limit of the SSM_1 function	01	Increments per 1 ms	0x00000000
0x6EE2	n_UL_SSM 32 Bit :002	Upper speed limit of the SSM_2 function	02	Increments per 1 ms	0x00000000
0x6EE2	n_UL_SSM 32 Bit :003	Upper speed limit of the SSM_3 function	03	Increments per 1 ms	0x00000000
0x6EE2	n_UL_SSM 32 Bit :004	Upper speed limit of the SSM_4 function	04	Increments per 1 ms	0x00000000
0x6EE2	n_UL_SSM 32 Bit :005	Upper speed limit of the SSM_5 function	05	Increments per 1 ms	0x00000000
0x6EE2	n_UL_SSM 32 Bit :006	Upper speed limit of the SSM_6 function	06	Increments per 1 ms	0x00000000
0x6EE2	n_UL_SSM 32 Bit :007	Upper speed limit of the SSM_7 function	07	Increments per 1 ms	0x00000000
0x6EE2	n_UL_SSM 32 Bit :008	Upper speed limit of the SSM_8 function	08	Increments per 1 ms	0x00000000
0x6EE4	n_LL_SSM 32 Bit :001	Lower speed limit of the SSM_1 function	01	Increments per 1 ms	0x00000000
0x6EE4	n_LL_SSM 32 Bit :002	Lower speed limit of the SSM_2 function	02	Increments per 1 ms	0x00000000
0x6EE4	n_LL_SSM 32 Bit :003	Lower speed limit of the SSM_3 function	03	Increments per 1 ms	0x00000000
0x6EE4	n_LL_SSM 32 Bit :004	Lower speed limit of the SSM_4 function	04	Increments per 1 ms	0x00000000
0x6EE4	n_LL_SSM 32 Bit :005	Lower speed limit of the SSM_5 function	05	Increments per 1 ms	0x00000000
0x6EE4	n_LL_SSM 32 Bit :006	Lower speed limit of the SSM_6 function	06	Increments per 1 ms	0x00000000
0x6EE4	n_LL_SSM 32 Bit :007	Lower speed limit of the SSM_7 function	07	Increments per 1 ms	0x00000000
0x6EE4	n_LL_SSM 32 Bit :008	Lower speed limit of the SSM_8 function	08	Increments per 1 ms	0x00000000

3.6.6.10 Description of the SAR safety function

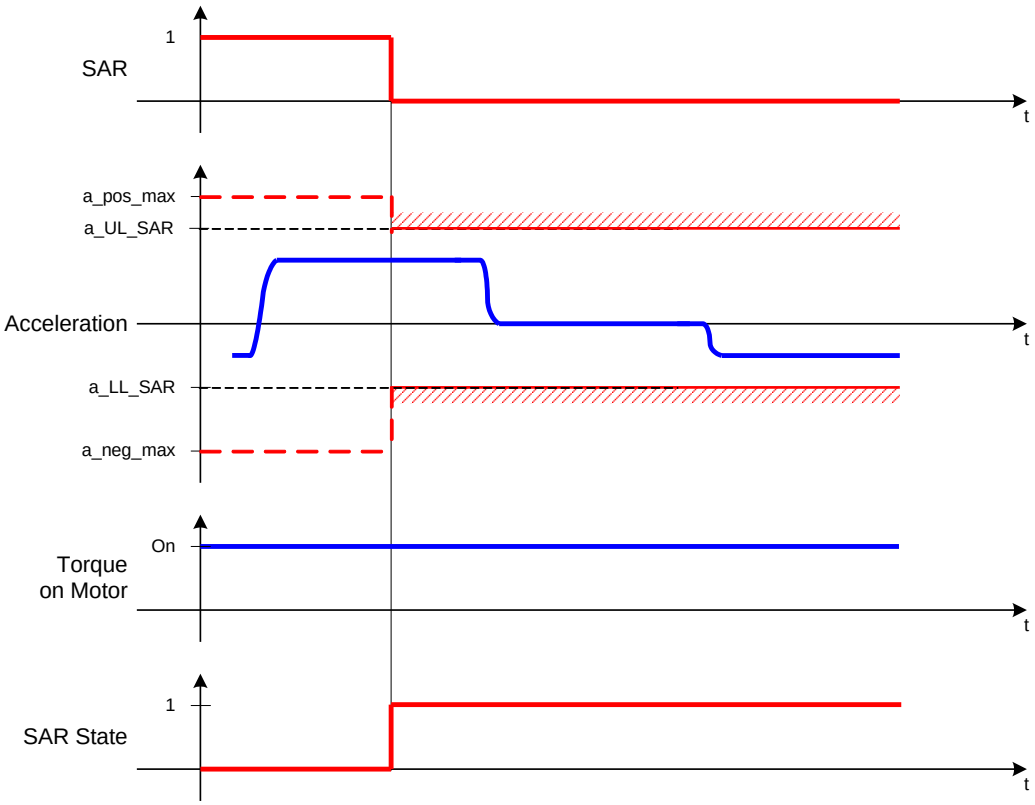


Fig. 36: Description of the Safe Acceleration Range function (SAR)

The monitoring of the acceleration window is started upon the activation of SAR (Safe Acceleration Range).

The acceleration must remain within the limits a_UL_SAR (UL - Upper Limit) and a_LL_SAR (LL - lower limit). If one of the limits is exceeded, the function defined under ErrorReaction_SAR is executed.

Parameters for axis 1

Index	Name	Description	Sub Index	Unit	Default value
0x66C2	a_UL_SAR 32 Bit :001	Upper acceleration limit of the SAR_1 safety function	01	Increments per 1 ms²	0x00000000
0x66C2	a_UL_SAR 32 Bit :002	Upper acceleration limit of the SAR_2 safety function	02	Increments per 1 ms²	0x00000000
0x66C2	a_UL_SAR 32 Bit :003	Upper acceleration limit of the SAR_3 safety function	03	Increments per 1 ms²	0x00000000
0x66C2	a_UL_SAR 32 Bit :004	Upper acceleration limit of the SAR_4 safety function	04	Increments per 1 ms²	0x00000000
0x66C2	a_UL_SAR 32 Bit :005	Upper acceleration limit of the SAR_5 safety function	05	Increments per 1 ms²	0x00000000
0x66C2	a_UL_SAR 32 Bit :006	Upper acceleration limit of the SAR_6 safety function	06	Increments per 1 ms²	0x00000000
0x66C2	a_UL_SAR 32 Bit :007	Upper acceleration limit of the SAR_7 safety function	07	Increments per 1 ms²	0x00000000
0x66C2	a_UL_SAR 32 Bit :008	Upper acceleration limit of the SAR_8 safety function	08	Increments per 1 ms²	0x00000000
0x66C4	a_LL_SAR 32 Bit :001	Lower acceleration limit of the SAR_1 safety function	01	Increments per 1 ms²	0x00000000
0x66C4	a_LL_SAR 32 Bit :002	Lower acceleration limit of the SAR_2 safety function	02	Increments per 1 ms²	0x00000000
0x66C4	a_LL_SAR 32 Bit :003	Lower acceleration limit of the SAR_3 safety function	03	Increments per 1 ms²	0x00000000
0x66C4	a_LL_SAR 32 Bit :004	Lower acceleration limit of the SAR_4 safety function	04	Increments per 1 ms²	0x00000000
0x66C4	a_LL_SAR 32 Bit :005	Lower acceleration limit of the SAR_5 safety function	05	Increments per 1 ms²	0x00000000
0x66C4	a_LL_SAR 32 Bit :006	Lower acceleration limit of the SAR_6 safety function	06	Increments per 1 ms²	0x00000000
0x66C4	a_LL_SAR 32 Bit :007	Lower acceleration limit of the SAR_7 safety function	07	Increments per 1 ms²	0x00000000
0x66C4	a_LL_SAR 32 Bit :008	Lower acceleration limit of the SAR_8 safety function	08	Increments per 1 ms²	0x00000000
0x66C5	Error Reaction SAR :001	Error reaction of SAR_1	01	--	0x66400001 (STO)
0x66C5	Error Reaction SAR :002	Error reaction of SAR_2	02	--	0x66400001 (STO)
0x66C5	Error Reaction SAR :003	Error reaction of SAR_3	03	--	0x66400001 (STO)
0x66C5	Error Reaction SAR :004	Error reaction of SAR_4	04	--	0x66400001 (STO)
0x66C5	Error Reaction SAR :005	Error reaction of SAR_5	05	--	0x66400001 (STO)
0x66C5	Error Reaction SAR :006	Error reaction of SAR_6	06	--	0x66400001 (STO)
0x66C5	Error Reaction SAR :007	Error reaction of SAR_7	07	--	0x66400001 (STO)
0x66C5	Error Reaction SAR :008	Error reaction of SAR_8	08	--	0x66400001 (STO)

Parameters for axis 2

Index	Name	Description	Sub Index	Unit	Default value
0x6EC2	a_UL_SAR 32 Bit :001	Upper acceleration limit of the SAR_1 safety function	01	Increments per 1 ms²	0x00000000
0x6EC2	a_UL_SAR 32 Bit :002	Upper acceleration limit of the SAR_2 safety function	02	Increments per 1 ms²	0x00000000
0x6EC2	a_UL_SAR 32 Bit :003	Upper acceleration limit of the SAR_3 safety function	03	Increments per 1 ms²	0x00000000
0x6EC2	a_UL_SAR 32 Bit :004	Upper acceleration limit of the SAR_4 safety function	04	Increments per 1 ms²	0x00000000
0x6EC2	a_UL_SAR 32 Bit :005	Upper acceleration limit of the SAR_5 safety function	05	Increments per 1 ms²	0x00000000
0x6EC2	a_UL_SAR 32 Bit :006	Upper acceleration limit of the SAR_6 safety function	06	Increments per 1 ms²	0x00000000
0x6EC2	a_UL_SAR 32 Bit :007	Upper acceleration limit of the SAR_7 safety function	07	Increments per 1 ms²	0x00000000
0x6EC2	a_UL_SAR 32 Bit :008	Upper acceleration limit of the SAR_8 safety function	08	Increments per 1 ms²	0x00000000
0x6EC4	a_LL_SAR 32 Bit :001	Lower acceleration limit of the SAR_1 safety function	01	Increments per 1 ms²	0x00000000
0x6EC4	a_LL_SAR 32 Bit :002	Lower acceleration limit of the SAR_2 safety function	02	Increments per 1 ms²	0x00000000
0x6EC4	a_LL_SAR 32 Bit :003	Lower acceleration limit of the SAR_3 safety function	03	Increments per 1 ms²	0x00000000
0x6EC4	a_LL_SAR 32 Bit :004	Lower acceleration limit of the SAR_4 safety function	04	Increments per 1 ms²	0x00000000
0x6EC4	a_LL_SAR 32 Bit :005	Lower acceleration limit of the SAR_5 safety function	05	Increments per 1 ms²	0x00000000
0x6EC4	a_LL_SAR 32 Bit :006	Lower acceleration limit of the SAR_6 safety function	06	Increments per 1 ms²	0x00000000
0x6EC4	a_LL_SAR 32 Bit :007	Lower acceleration limit of the SAR_7 safety function	07	Increments per 1 ms²	0x00000000
0x6EC4	a_LL_SAR 32 Bit :008	Lower acceleration limit of the SAR_8 safety function	08	Increments per 1 ms²	0x00000000
0x6EC5	Error Reaction SAR :001	Error reaction of SAR_1	01	--	0x66400001 (STO)
0x6EC5	Error Reaction SAR :002	Error reaction of SAR_2	02	--	0x66400001 (STO)
0x6EC5	Error Reaction SAR :003	Error reaction of SAR_3	03	--	0x66400001 (STO)
0x6EC5	Error Reaction SAR :004	Error reaction of SAR_4	04	--	0x66400001 (STO)
0x6EC5	Error Reaction SAR :005	Error reaction of SAR_5	05	--	0x66400001 (STO)
0x6EC5	Error Reaction SAR :006	Error reaction of SAR_6	06	--	0x66400001 (STO)
0x6EC5	Error Reaction SAR :007	Error reaction of SAR_7	07	--	0x66400001 (STO)
0x6EC5	Error Reaction SAR :008	Error reaction of SAR_8	08	--	0x66400001 (STO)

3.6.6.11 Description of the SCA safety function

This function is available only if the safe position is referenced.

Note	**STO** If the safety function STO is activated, the referencing is deleted.

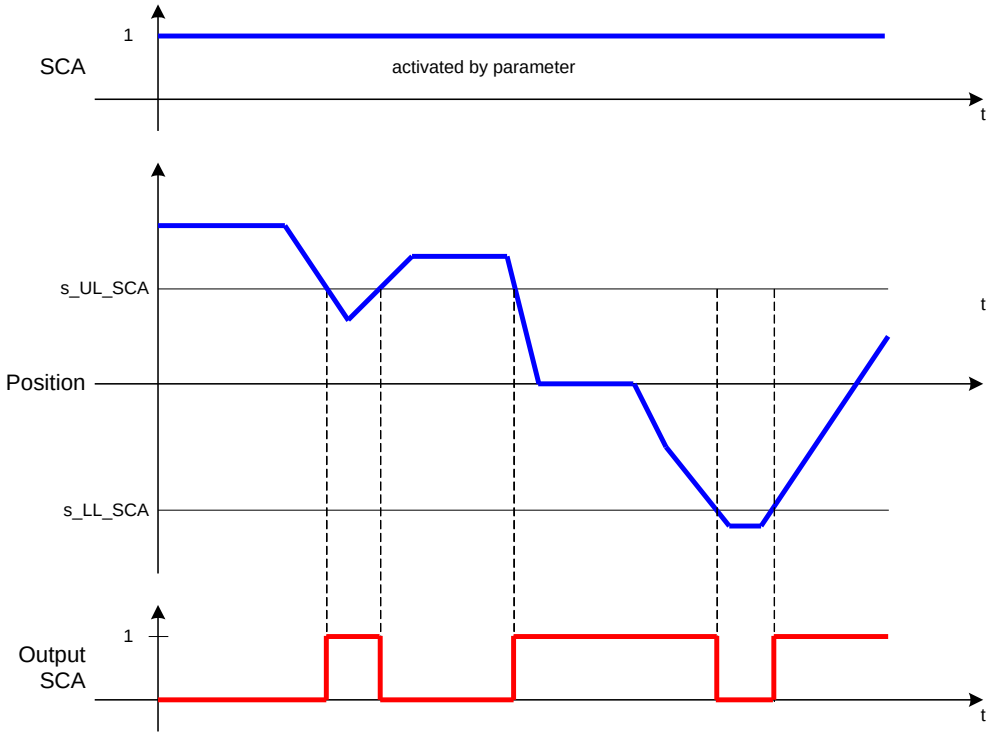


Fig. 37: Description of the Safe CAM function (SCA)

SCA (Safe CAM) can be implemented as a bit in the Safety status word. The SCA output is set to 1 as soon as the current position lies within the window between the upper limit s_UL_SCA (UL - Upper Limit) and the lower limit s_LL_SCA (LL - Lower Limit).

Parameters for axis 1

Index	Name	Description	Sub Index	Unit	Default value
0x66EA	s_UL_SCA 32 Bit :001	Upper position limit of the SCA_1 safety function	01	Pole revolution relative to the reference position	0x00000000
0x66EA	s_UL_SCA 32 Bit :002	Upper position limit of the SCA_2 safety function	02	Pole revolution relative to the reference position	0x00000000
0x66EA	s_UL_SCA 32 Bit :003	Upper position limit of the SCA_3 safety function	03	Pole revolution relative to the reference position	0x00000000
0x66EA	s_UL_SCA 32 Bit :004	Upper position limit of the SCA_4 safety function	04	Pole revolution relative to the reference position	0x00000000
0x66EA	s_UL_SCA 32 Bit :005	Upper position limit of the SCA_5 safety function	05	Pole revolution relative to the reference position	0x00000000
0x66EA	s_UL_SCA 32 Bit :006	Upper position limit of the SCA_6 safety function	06	Pole revolution relative to the reference position	0x00000000
0x66EA	s_UL_SCA 32 Bit :007	Upper position limit of the SCA_7 safety function	07	Pole revolution relative to the reference position	0x00000000
0x66EA	s_UL_SCA 32 Bit :008	Upper position limit of the SCA_8 safety function	08	Pole revolution relative to the reference position	0x00000000
0x66EC	s_LL_SCA 32 Bit :001	Lower position limit of the SCA_1 safety function	01	Pole revolution relative to the reference position	0x00000000
0x66EC	s_LL_SCA 32 Bit :002	Lower position limit of the SCA_2 safety function	02	Pole revolution relative to the reference position	0x00000000
0x66EC	s_LL_SCA 32 Bit :003	Lower position limit of the SCA_3 safety function	03	Pole revolution relative to the reference position	0x00000000
0x66EC	s_LL_SCA 32 Bit :004	Lower position limit of the SCA_4 safety function	04	Pole revolution relative to the reference position	0x00000000
0x66EC	s_LL_SCA 32 Bit :005	Lower position limit of the SCA_5 safety function	05	Pole revolution relative to the reference position	0x00000000
0x66EC	s_LL_SCA 32 Bit :006	Lower position limit of the SCA_6 safety function	06	Pole revolution relative to the reference position	0x00000000
0x66EC	s_LL_SCA 32 Bit :007	Lower position limit of the SCA_7 safety function	07	Pole revolution relative to the reference position	0x00000000
0x66EC	s_LL_SCA 32 Bit :008	Lower position limit of the SCA_8 safety function	08	Pole revolution relative to the reference position	0x00000000

Parameters for axis 2

Index	Name	Description	Sub Index	Unit	Default value
0x6EEA	s_UL_SCA 32 Bit :001	Upper position limit of the SCA_1 safety function	01	Pole revolution relative to the reference position	0x00000000
0x6EEA	s_UL_SCA 32 Bit :002	Upper position limit of the SCA_2 safety function	02	Pole revolution relative to the reference position	0x00000000
0x6EEA	s_UL_SCA 32 Bit :003	Upper position limit of the SCA_3 safety function	03	Pole revolution relative to the reference position	0x00000000
0x6EEA	s_UL_SCA 32 Bit :004	Upper position limit of the SCA_4 safety function	04	Pole revolution relative to the reference position	0x00000000
0x6EEA	s_UL_SCA 32 Bit :005	Upper position limit of the SCA_5 safety function	05	Pole revolution relative to the reference position	0x00000000
0x6EEA	s_UL_SCA 32 Bit :006	Upper position limit of the SCA_6 safety function	06	Pole revolution relative to the reference position	0x00000000
0x6EEA	s_UL_SCA 32 Bit :007	Upper position limit of the SCA_7 safety function	07	Pole revolution relative to the reference position	0x00000000
0x6EEA	s_UL_SCA 32 Bit :008	Upper position limit of the SCA_8 safety function	08	Pole revolution relative to the reference position	0x00000000
0x6EEC	s_LL_SCA 32 Bit :001	Lower position limit of the SCA_1 safety function	01	Pole revolution relative to the reference position	0x00000000
0x6EEC	s_LL_SCA 32 Bit :002	Lower position limit of the SCA_2 safety function	02	Pole revolution relative to the reference position	0x00000000
0x6EEC	s_LL_SCA 32 Bit :003	Lower position limit of the SCA_3 safety function	03	Pole revolution relative to the reference position	0x00000000
0x6EEC	s_LL_SCA 32 Bit :004	Lower position limit of the SCA_4 safety function	04	Pole revolution relative to the reference position	0x00000000
0x6EEC	s_LL_SCA 32 Bit :005	Lower position limit of the SCA_5 safety function	05	Pole revolution relative to the reference position	0x00000000
0x6EEC	s_LL_SCA 32 Bit :006	Lower position limit of the SCA_6 safety function	06	Pole revolution relative to the reference position	0x00000000
0x6EEC	s_LL_SCA 32 Bit :007	Lower position limit of the SCA_7 safety function	07	Pole revolution relative to the reference position	0x00000000
0x6EEC	s_LL_SCA 32 Bit :008	Lower position limit of the SCA_8 safety function	08	Pole revolution relative to the reference position	0x00000000

3.6.6.12 Description of the SLI safety function

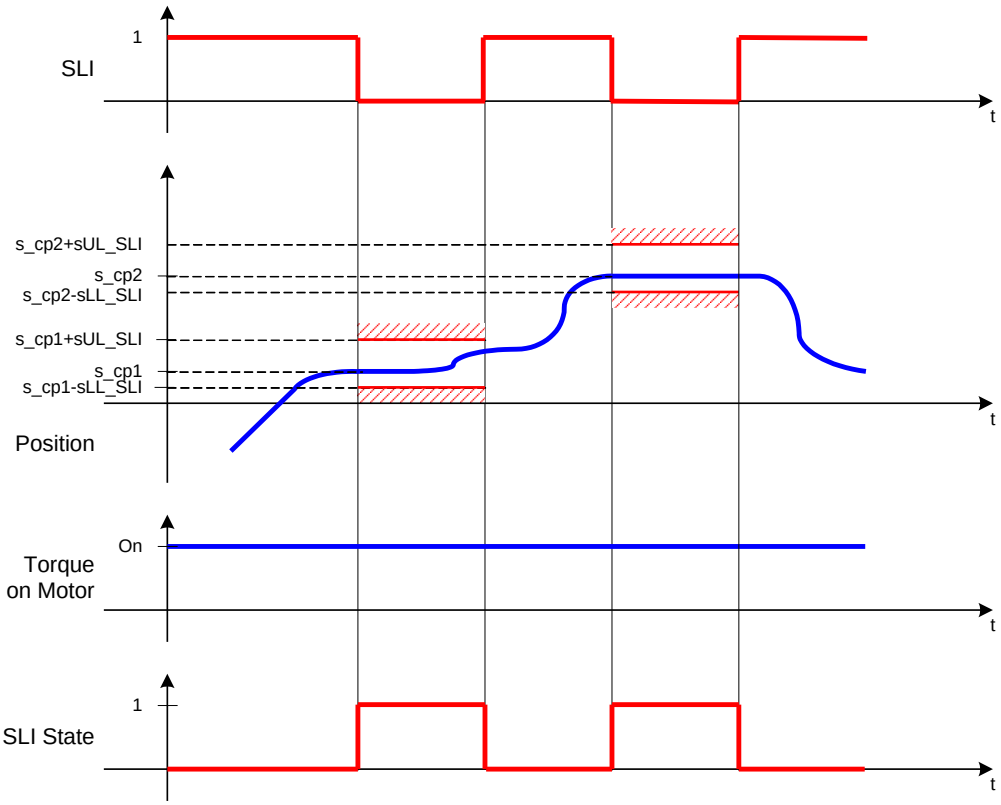


Fig. 38: Description of the Safely Limited Increment function (SLI)

The monitoring of the current position is started when the SLI function is activated (SLI = 0). The position saved upon activation may not leave the window defined between s_UL_SLI (UL-upper limit) and s_LL_SLI (LL-lower limit). If one of the limits is exceeded, the function defined under ErrorReaction_SLI is executed.

Note	**Difference between firmware 04 and firmware 05** Up to firmware version 04, a positive value had to be entered for s_LL_SLI. From firmware version 05, this value has to be negative.

Parameters for axis 1

Index	Name	Description	Sub Index	Unit	Default value
0x66BA	s_UL_SLI 32 Bit :001	Upper position limit of the SLI_1 safety function	01	Increments	0x00000000
0x66BA	s_UL_SLI 32 Bit :002	Upper position limit of the SLI_2 safety function	02	Increments	0x00000000
0x66BA	s_UL_SLI 32 Bit :003	Upper position limit of the SLI_3 safety function	03	Increments	0x00000000
0x66BA	s_UL_SLI 32 Bit :004	Upper position limit of the SLI_4 safety function	04	Increments	0x00000000
0x66BA	s_UL_SLI 32 Bit :005	Upper position limit of the SLI_5 safety function	05	Increments	0x00000000
0x66BA	s_UL_SLI 32 Bit :006	Upper position limit of the SLI_6 safety function	06	Increments	0x00000000
0x66BA	s_UL_SLI 32 Bit :007	Upper position limit of the SLI_7 safety function	07	Increments	0x00000000
0x66BA	s_UL_SLI 32 Bit :008	Upper position limit of the SLI_8 safety function	08	Increments	0x00000000
0x66BC	s_LL_SLI 32 Bit :001	Lower position limit of the SLI_1 safety function	01	Increments	0x00000000
0x66BC	s_LL_SLI 32 Bit :002	Lower position limit of the SLI_2 safety function	02	Increments	0x00000000
0x66BC	s_LL_SLI 32 Bit :003	Lower position limit of the SLI_3 safety function	03	Increments	0x00000000
0x66BC	s_LL_SLI 32 Bit :004	Lower position limit of the SLI_4 safety function	04	Increments	0x00000000
0x66BC	s_LL_SLI 32 Bit :005	Lower position limit of the SLI_5 safety function	05	Increments	0x00000000
0x66BC	s_LL_SLI 32 Bit :006	Lower position limit of the SLI_6 safety function	06	Increments	0x00000000
0x66BC	s_LL_SLI 32 Bit :007	Lower position limit of the SLI_7 safety function	07	Increments	0x00000000
0x66BC	s_LL_SLI 32 Bit :008	Lower position limit of the SLI_8 safety function	08	Increments	0x00000000
0x66BD	Error Reaction SLI :001	Error reaction of SLI_1	01	--	0x66400001 (STO)
0x66BD	Error Reaction SLI :002	Error reaction of SLI_2	02	--	0x66400001 (STO)
0x66BD	Error Reaction SLI :003	Error reaction of SLI_3	03	--	0x66400001 (STO)
0x66BD	Error Reaction SLI :004	Error reaction of SLI_4	04	--	0x66400001 (STO)
0x66BD	Error Reaction SLI :005	Error reaction of SLI_5	05	--	0x66400001 (STO)
0x66BD	Error Reaction SLI :006	Error reaction of SLI_6	06	--	0x66400001 (STO)
0x66BD	Error Reaction SLI :007	Error reaction of SLI_7	07	--	0x66400001 (STO)
0x66BD	Error Reaction SLI :008	Error reaction of SLI_8	08	--	0x66400001 (STO)

Parameters for axis 2

Index	Name	Description	Sub Index	Unit	Default value
0x6EBA	s_UL_SLI 32 Bit :001	Upper position limit of the SLI_1 safety function	01	Increments	0x00000000
0x6EBA	s_UL_SLI 32 Bit :002	Upper position limit of the SLI_2 safety function	02	Increments	0x00000000
0x6EBA	s_UL_SLI 32 Bit :003	Upper position limit of the SLI_3 safety function	03	Increments	0x00000000
0x6EBA	s_UL_SLI 32 Bit :004	Upper position limit of the SLI_4 safety function	04	Increments	0x00000000
0x6EBA	s_UL_SLI 32 Bit :005	Upper position limit of the SLI_5 safety function	05	Increments	0x00000000
0x6EBA	s_UL_SLI 32 Bit :006	Upper position limit of the SLI_6 safety function	06	Increments	0x00000000
0x6EBA	s_UL_SLI 32 Bit :007	Upper position limit of the SLI_7 safety function	07	Increments	0x00000000
0x6EBA	s_UL_SLI 32 Bit :008	Upper position limit of the SLI_8 safety function	08	Increments	0x00000000
0x6EBC	s_LL_SLI 32 Bit :001	Lower position limit of the SLI_1 safety function	01	Increments	0x00000000
0x6EBC	s_LL_SLI 32 Bit :002	Lower position limit of the SLI_2 safety function	02	Increments	0x00000000
0x6EBC	s_LL_SLI 32 Bit :003	Lower position limit of the SLI_3 safety function	03	Increments	0x00000000
0x6EBC	s_LL_SLI 32 Bit :004	Lower position limit of the SLI_4 safety function	04	Increments	0x00000000
0x6EBC	s_LL_SLI 32 Bit :005	Lower position limit of the SLI_5 safety function	05	Increments	0x00000000
0x6EBC	s_LL_SLI 32 Bit :006	Lower position limit of the SLI_6 safety function	06	Increments	0x00000000
0x6EBC	s_LL_SLI 32 Bit :007	Lower position limit of the SLI_7 safety function	07	Increments	0x00000000
0x6EBC	s_LL_SLI 32 Bit :008	Lower position limit of the SLI_8 safety function	08	Increments	0x00000000
0x6EBD	Error Reaction SLI :001	Error reaction of SLI_1	01	--	0x66400001 (STO)
0x6EBD	Error Reaction SLI :002	Error reaction of SLI_2	02	--	0x66400001 (STO)
0x6EBD	Error Reaction SLI :003	Error reaction of SLI_3	03	--	0x66400001 (STO)
0x6EBD	Error Reaction SLI :004	Error reaction of SLI_4	04	--	0x66400001 (STO)
0x6EBD	Error Reaction SLI :005	Error reaction of SLI_5	05	--	0x66400001 (STO)
0x6EBD	Error Reaction SLI :006	Error reaction of SLI_6	06	--	0x66400001 (STO)
0x6EBD	Error Reaction SLI :007	Error reaction of SLI_7	07	--	0x66400001 (STO)
0x6EBD	Error Reaction SLI :008	Error reaction of SLI_8	08	--	0x66400001 (STO)

3.6.6.13 Description of the SLP safety function

This function is available only if the safe position is referenced.

Note	**STO** If the safety function STO is activated, the referencing is deleted.

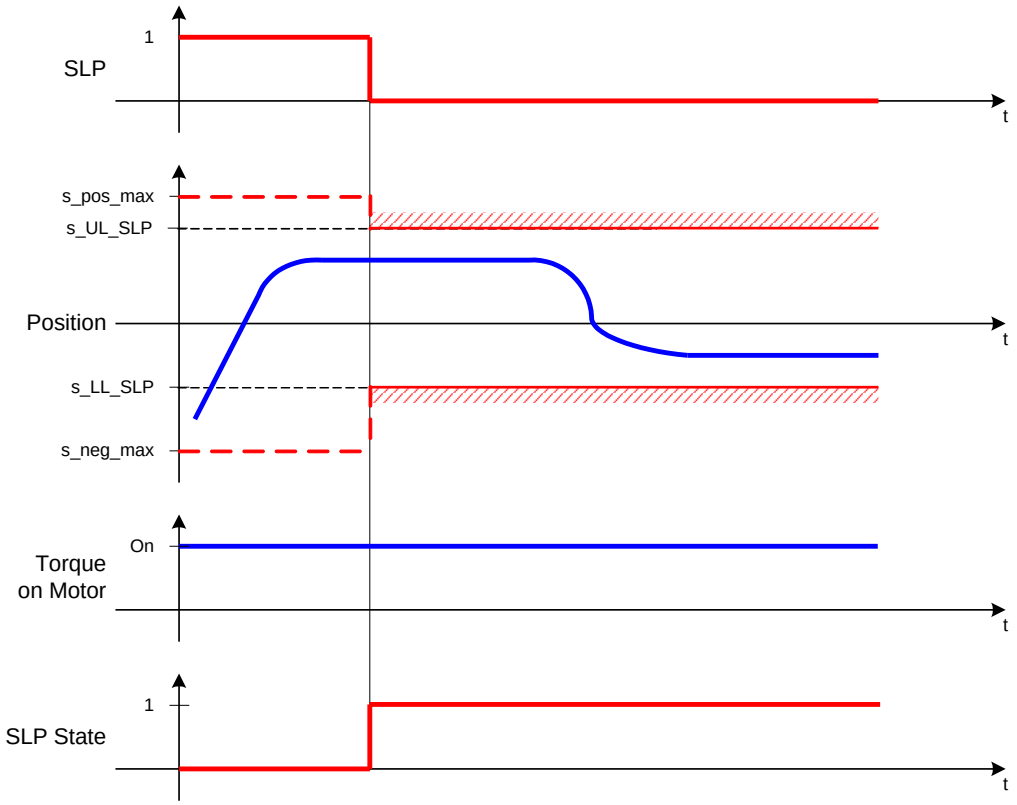


Fig. 39: Description of the Safely Limited Position function (SLP)

The monitoring of the current position is started upon the activation of the SLP function (SLP=0). The position limits are specified in s_UL_SLP (UL-upper limit) and s_LL_SLP (LL-lower limit). If one of the limits is exceeded, the function defined under ErrorReaction_SLP is executed.

Parameters for axis 1

Index	Name	Description	Sub Index	Unit	Default value
0x66A2	s_UL_SLP 32 Bit :001	Upper position limit of the SLP_1 safety function	01	Pole revolution relative to the reference position	0x00000000
0x66A2	s_UL_ SLP 32 Bit :002	Upper position limit of the SLP_2 safety function	02	Pole revolution relative to the reference position	0x00000000
0x66A2	s_UL_SLP 32 Bit :003	Upper position limit of the SLP_3 safety function	03	Pole revolution relative to the reference position	0x00000000
0x66A2	s_UL_SLP 32 Bit :004	Upper position limit of the SLP_4 safety function	04	Pole revolution relative to the reference position	0x00000000
0x66A2	s_UL_SLP 32 Bit :005	Upper position limit of the SLP_5 safety function	05	Pole revolution relative to the reference position	0x00000000
0x66A2	s_UL_SLP 32 Bit :006	Upper position limit of the SLP_6 safety function	06	Pole revolution relative to the reference position	0x00000000
0x66A2	s_UL_SLP 32 Bit :007	Upper position limit of the SLP_7 safety function	07	Pole revolution relative to the reference position	0x00000000
0x66A2	s_UL_SLP 32 Bit :008	Upper position limit of the SLP_8 safety function	08	Pole revolution relative to the reference position	0x00000000
0x66A4	s_LL_SLP 32 Bit :001	Lower position limit of the SLP_1 safety function	01	Pole revolution relative to the reference position	0x00000000
0x66A4	s_LL_SLP 32 Bit :002	Lower position limit of the SLP_2 safety function	02	Pole revolution relative to the reference position	0x00000000
0x66A4	s_LL_SLP 32 Bit :003	Lower position limit of the SLP_3 safety function	03	Pole revolution relative to the reference position	0x00000000
0x66A4	s_LL_SLP 32 Bit :004	Lower position limit of the SLP_4 safety function	04	Pole revolution relative to the reference position	0x00000000
0x66A4	s_LL_SLP 32 Bit :005	Lower position limit of the SLP_5 safety function	05	Pole revolution relative to the reference position	0x00000000
0x66A4	s_LL_SLP 32 Bit :006	Lower position limit of the SLP_6 safety function	06	Pole revolution relative to the reference position	0x00000000
0x66A4	s_LL_SLP 32 Bit :007	Lower position limit of the SLP_7 safety function	07	Pole revolution relative to the reference position	0x00000000
0x66A4	s_LL_SLP 32 Bit :008	Lower position limit of the SLP_8 safety function	08	Pole revolution relative to the reference position	0x00000000
0x66A5	Error Reaction SLP :001	Error reaction of SLP_1	01	--	0x66400001 (STO)
0x66A5	Error Reaction SLP :002	Error reaction of SLP_2	02	--	0x66400001 (STO)
0x66A5	Error Reaction SLP :003	Error reaction of SLP_3	03	--	0x66400001 (STO)
0x66A5	Error Reaction SLP :004	Error reaction of SLP_4	04	--	0x66400001 (STO)
0x66A5	Error Reaction SLP :005	Error reaction of SLP_5	05	--	0x66400001 (STO)
0x66A5	Error Reaction SLP :006	Error reaction of SLP_6	06	--	0x66400001 (STO)
0x66A5	Error Reaction SLP :007	Error reaction of SLP_7	07	--	0x66400001 (STO)
0x66A5	Error Reaction SLP :008	Error reaction of SLP_8	08	--	0x66400001 (STO)

Parameters for axis 2

Index	Name	Description	Sub Index	Unit	Default value
0x6EA2	s_UL_SLP 32 Bit :001	Upper position limit of the SLP_1 safety function	01	Pole revolution relative to the reference position	0x00000000
0x6EA2	s_UL_ SLP 32 Bit :002	Upper position limit of the SLP_2 safety function	02	Pole revolution relative to the reference position	0x00000000
0x6EA2	s_UL_SLP 32 Bit :003	Upper position limit of the SLP_3 safety function	03	Pole revolution relative to the reference position	0x00000000
0x6EA2	s_UL_SLP 32 Bit :004	Upper position limit of the SLP_4 safety function	04	Pole revolution relative to the reference position	0x00000000
0x6EA2	s_UL_SLP 32 Bit :005	Upper position limit of the SLP_5 safety function	05	Pole revolution relative to the reference position	0x00000000
0x6EA2	s_UL_SLP 32 Bit :006	Upper position limit of the SLP_6 safety function	06	Pole revolution relative to the reference position	0x00000000
0x6EA2	s_UL_SLP 32 Bit :007	Upper position limit of the SLP_7 safety function	07	Pole revolution relative to the reference position	0x00000000
0x6EA2	s_UL_SLP 32 Bit :008	Upper position limit of the SLP_8 safety function	08	Pole revolution relative to the reference position	0x00000000
0x6EA4	s_LL_SLP 32 Bit :001	Lower position limit of the SLP_1 safety function	01	Pole revolution relative to the reference position	0x00000000
0x6EA4	s_LL_SLP 32 Bit :002	Lower position limit of the SLP_2 safety function	02	Pole revolution relative to the reference position	0x00000000
0x6EA4	s_LL_SLP 32 Bit :003	Lower position limit of the SLP_3 safety function	03	Pole revolution relative to the reference position	0x00000000
0x6EA4	s_LL_SLP 32 Bit :004	Lower position limit of the SLP_4 safety function	04	Pole revolution relative to the reference position	0x00000000
0x6EA4	s_LL_SLP 32 Bit :005	Lower position limit of the SLP_5 safety function	05	Pole revolution relative to the reference position	0x00000000
0x6EA4	s_LL_SLP 32 Bit :006	Lower position limit of the SLP_6 safety function	06	Pole revolution relative to the reference position	0x00000000
0x6EA4	s_LL_SLP 32 Bit :007	Lower position limit of the SLP_7 safety function	07	Pole revolution relative to the reference position	0x00000000
0x6EA4	s_LL_SLP 32 Bit :008	Lower position limit of the SLP_8 safety function	08	Pole revolution relative to the reference position	0x00000000
0x6EA5	Error Reaction SLP :001	Error reaction of SLP_1	01	--	0x66400001 (STO)
0x6EA5	Error Reaction SLP :002	Error reaction of SLP_2	02	--	0x66400001 (STO)
0x6EA5	Error Reaction SLP :003	Error reaction of SLP_3	03	--	0x66400001 (STO)
0x6EA5	Error Reaction SLP :004	Error reaction of SLP_4	04	--	0x66400001 (STO)
0x6EA5	Error Reaction SLP :005	Error reaction of SLP_5	05	--	0x66400001 (STO)
0x6EA5	Error Reaction SLP :006	Error reaction of SLP_6	06	--	0x66400001 (STO)
0x6EA5	Error Reaction SLP :007	Error reaction of SLP_7	07	--	0x66400001 (STO)
0x6EA5	Error Reaction SLP :008	Error reaction of SLP_8	08	--	0x66400001 (STO)

3.6.6.14 Description of the SLS safety function

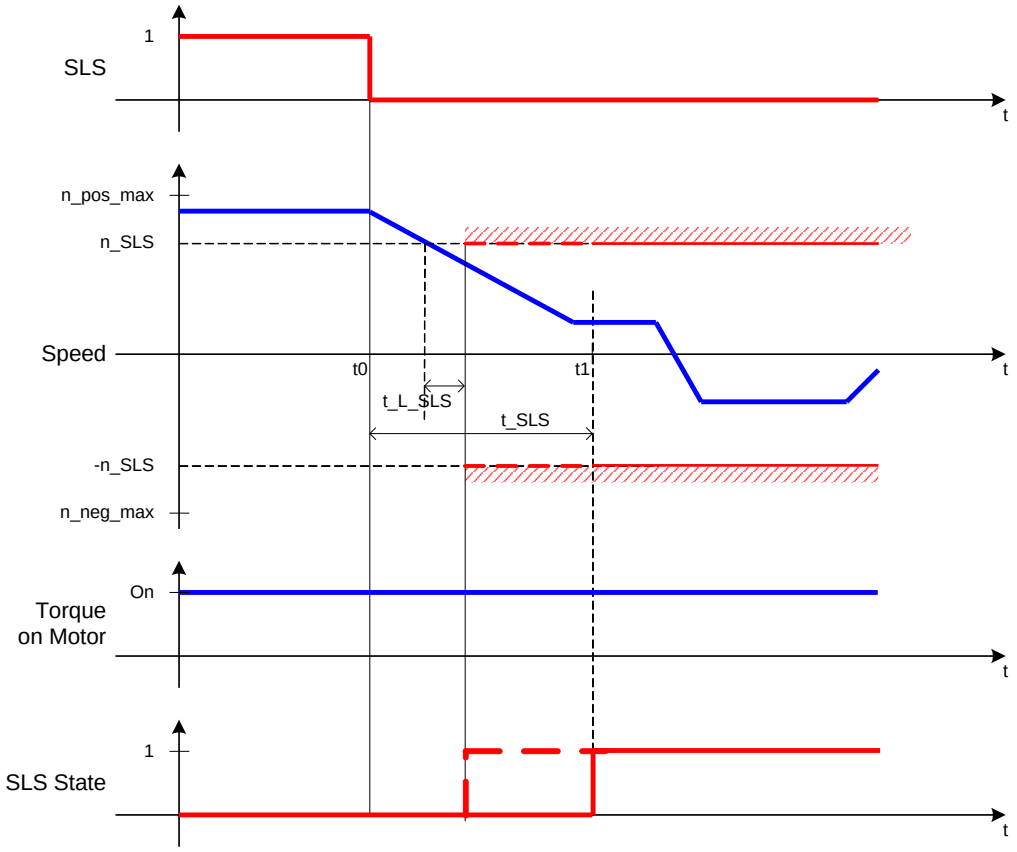


Fig. 40: Description of the Safely Limited Speed function (SLS) with time monitor

The time monitor t_SLS is started upon activation of the SLS function (SLS = 0). The standard control then starts with the deceleration and the speed is monitored with regard to the limits ± n_SLS at the latest on expiry of t_SLS.

Monitoring begins on expiry of the time t_L_SLS if the speed is within the limits. If one of the limits is exceeded, the function defined under ErrorReaction_SLS is executed.

WARNING	**Parameter settings** The setting of the speed limits must be above the calculated speed from the Speed_Compare_Window. (See also chapter 3.6.2)

Parameters for axis 1

Index	Name	Description	Sub Index	Unit	Default value
0x6691	t_SLS :001	Maximum time until the activation of the SLS safety function	01	1 ms	0x0000
0x6691	t_SLS :002	Maximum time until the activation of the SLS safety function	02	1 ms	0x0000
0x6691	t_SLS :003	Maximum time until the activation of the SLS safety function	03	1 ms	0x0000
0x6691	t_SLS :004	Maximum time until the activation of the SLS safety function	04	1 ms	0x0000
0x6691	t_SLS :005	Maximum time until the activation of the SLS safety function	05	1 ms	0x0000
0x6691	t_SLS :006	Maximum time until the activation of the SLS safety function	06	1 ms	0x0000
0x6691	t_SLS :007	Maximum time until the activation of the SLS safety function	07	1 ms	0x0000
0x6691	t_SLS :008	Maximum time until the activation of the SLS safety function	08	1 ms	0x0000
0x6693	n_SLS 32 Bit :001	Speed window for SLS_1	01	Increments per 1 ms	0x00000000
0x6693	n_SLS 32 Bit :002	Speed window for SLS_2	02	Increments per 1 ms	0x00000000
0x6693	n_SLS 32 Bit :003	Speed window for SLS_3	03	Increments per 1 ms	0x00000000
0x6693	n_SLS 32 Bit :004	Speed window for SLS_4	04	Increments per 1 ms	0x00000000
0x6693	n_SLS 32 Bit :005	Speed window for SLS_5	05	Increments per 1 ms	0x00000000
0x6693	n_SLS 32 Bit :006	Speed window for SLS_6	06	Increments per 1 ms	0x00000000
0x6693	n_SLS 32 Bit :007	Speed window for SLS_7	07	Increments per 1 ms	0x00000000
0x6693	n_SLS 32 Bit :008	Speed window for SLS_8	08	Increments per 1 ms	0x00000000
0x6694	t_L SLS :001	Minimum time until the activation of the SLS_1 safety function, if the speed is within the window	01	1 ms	0x0000
0x6694	t_L SLS :002	Minimum time until the activation of the SLS_2 safety function, if the speed is within the window	02	1 ms	0x0000
0x6694	t_L SLS :003	Minimum time until the activation of the SLS_3 safety function, if the speed is within the window	03	1 ms	0x0000

Index	Name	Description	Sub Index	Unit	Default value
0x6694	t_L SLS :004	Minimum time until the activation of the SLS_4 safety function, if the speed is within the window	04	1 ms	0x0000
0x6694	t_L SLS :005	Minimum time until the activation of the SLS_5 safety function, if the speed is within the window	05	1 ms	0x0000
0x6694	t_L SLS :006	Minimum time until the activation of the SLS_6 safety function, if the speed is within the window	06	1 ms	0x0000
0x6694	t_L SLS :007	Minimum time until the activation of the SLS_7 safety function, if the speed is within the window	07	1 ms	0x0000
0x6694	t_L SLS :008	Minimum time until the activation of the SLS_8 safety function, if the speed is within the window	08	1 ms	0x0000
0x6698	Error Reaction SLS :001	Error reaction of SLS_1	01	--	0x66400001 (STO)
0x6698	Error Reaction SLS :002	Error reaction of SLS_2	02	--	0x66400001 (STO)
0x6698	Error Reaction SLS :003	Error reaction of SLS_3	03	--	0x66400001 (STO)
0x6698	Error Reaction SLS :004	Error reaction of SLS_4	04	--	0x66400001 (STO)
0x6698	Error Reaction SLS :005	Error reaction of SLS_5	05	--	0x66400001 (STO)
0x6698	Error Reaction SLS :006	Error reaction of SLS_6	06	--	0x66400001 (STO)
0x6698	Error Reaction SLS :007	Error reaction of SLS_7	07	--	0x66400001 (STO)
0x6698	Error Reaction SLS :008	Error reaction of SLS_8	08	--	0x66400001 (STO)

Parameters for axis 2

Index	Name	Description	Sub Index	Unit	Default value
0x6E91	t_SLS :001	Maximum time until the activation of the SLS safety function	01	1 ms	0x0000
0x6E91	t_SLS :002	Maximum time until the activation of the SLS safety function	02	1 ms	0x0000
0x6E91	t_SLS :003	Maximum time until the activation of the SLS safety function	03	1 ms	0x0000
0x6E91	t_SLS :004	Maximum time until the activation of the SLS safety function	04	1 ms	0x0000
0x6E91	t_SLS :005	Maximum time until the activation of the SLS safety function	05	1 ms	0x0000
0x6E91	t_SLS :006	Maximum time until the activation of the SLS safety function	06	1 ms	0x0000
0x6E91	t_SLS :007	Maximum time until the activation of the SLS safety function	07	1 ms	0x0000
0x6E91	t_SLS :008	Maximum time until the activation of the SLS safety function	08	1 ms	0x0000
0x6E93	n_SLS 32 Bit :001	Speed window for SLS_1	01	Increments per 1 ms	0x00000000
0x6E93	n_SLS 32 Bit :002	Speed window for SLS_2	02	Increments per 1 ms	0x00000000
0x6E93	n_SLS 32 Bit :003	Speed window for SLS_3	03	Increments per 1 ms	0x00000000
0x6E93	n_SLS 32 Bit :004	Speed window for SLS_4	04	Increments per 1 ms	0x00000000
0x6E93	n_SLS 32 Bit :005	Speed window for SLS_5	05	Increments per 1 ms	0x00000000
0x6E93	n_SLS 32 Bit :006	Speed window for SLS_6	06	Increments per 1 ms	0x00000000
0x6E93	n_SLS 32 Bit :007	Speed window for SLS_7	07	Increments per 1 ms	0x00000000
0x6E93	n_SLS 32 Bit :008	Speed window for SLS_8	08	Increments per 1 ms	0x00000000
0x6E94	t_L SLS :001	Minimum time until the activation of the SLS_1 safety function, if the speed is within the window	01	1 ms	0x0000
0x6E94	t_L SLS :002	Minimum time until the activation of the SLS_2 safety function, if the speed is within the window	02	1 ms	0x0000
0x6E94	t_L SLS :003	Minimum time until the activation of the SLS_3 safety function, if the speed is within the window	03	1 ms	0x0000
0x6E94	t_L SLS :004	Minimum time until the activation of the SLS_4 safety function, if the speed is within the window	04	1 ms	0x0000
0x6E94	t_L SLS :005	Minimum time until the activation of the SLS_5 safety function, if the speed is within the window	05	1 ms	0x0000
0x6E94	t_L SLS :006	Minimum time until the activation of the SLS_6 safety function, if the speed is within the window	06	1 ms	0x0000

Index	Name	Description	Sub Index	Unit	Default value
0x6E94	t_L SLS :007	Minimum time until the activation of the SLS_7 safety function, if the speed is within the window	07	1 ms	0x0000
0x6E94	t_L SLS :008	Minimum time until the activation of the SLS_8 safety function, if the speed is within the window	08	1 ms	0x0000
0x6E98	Error Reaction SLS :001	Error reaction of SLS_1	01	--	0x66400001 (STO)
0x6E98	Error Reaction SLS :002	Error reaction of SLS_2	02	--	0x66400001 (STO)
0x6E98	Error Reaction SLS :003	Error reaction of SLS_3	03	--	0x66400001 (STO)
0x6E98	Error Reaction SLS :004	Error reaction of SLS_4	04	--	0x66400001 (STO)
0x6E98	Error Reaction SLS :005	Error reaction of SLS_5	05	--	0x66400001 (STO)
0x6E98	Error Reaction SLS :006	Error reaction of SLS_6	06	--	0x66400001 (STO)
0x6E98	Error Reaction SLS :007	Error reaction of SLS_7	07	--	0x66400001 (STO)
0x6E98	Error Reaction SLS :008	Error reaction of SLS_8	08	--	0x66400001 (STO)

3.6.6.15 Description of the SMA safety function

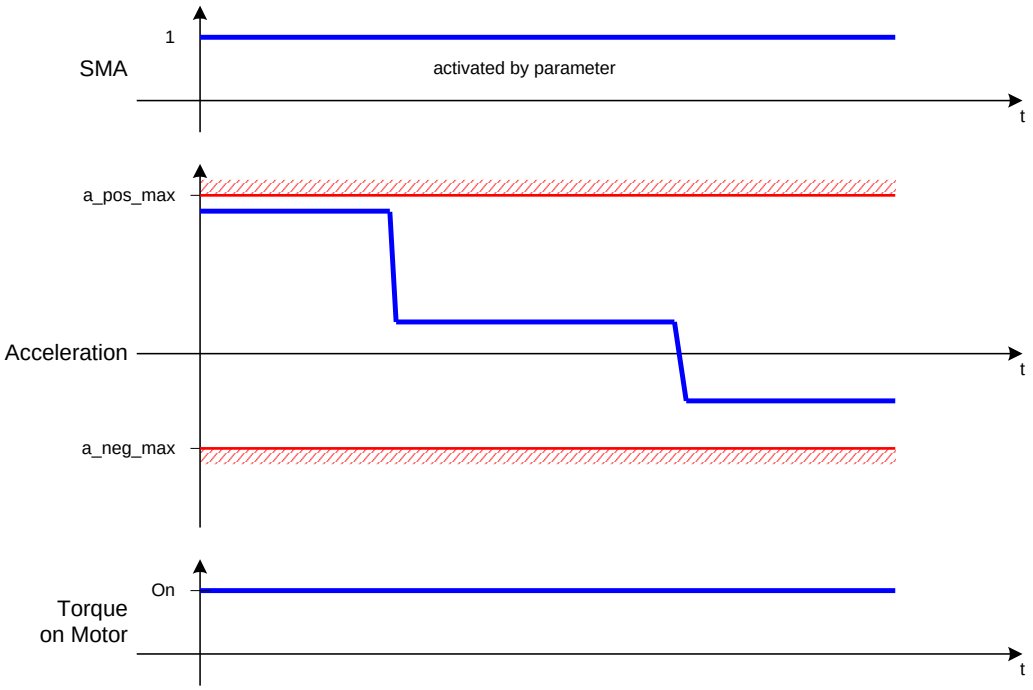


Fig. 41: Description of the Safe Maximum Acceleration function (SMA)

The SMA function is activated via the a_pos_max and a_neg_max parameters and monitors the maximum acceleration. The function is executed if one of the parameters is not equal to 0. If one of the limits is exceeded, the function defined under ErrorReaction_SMA is executed.

Parameters for axis 1

Index	Name	Description	Unit	Default value
0x66CA	a_pos_max_SMA 32Bit	Maximum positive acceleration	Increments per 1 ms²	0x0000
0x66CC	a_neg_max_SMA 32Bit	Maximum negative acceleration	Increments per 1 ms²	0x0000
0x66CD	Error Reaction SMA	Error reaction of SMA	--	0x66400001 (STO)

Parameters for axis 2

Index	Name	Description	Unit	Default value
0x6ECA	a_pos_max_SMA 32Bit	Maximum positive acceleration	Increments per 1 ms²	0x0000
0x6ECC	a_neg_max_SMA 32Bit	Maximum negative acceleration	Increments per 1 ms²	0x0000
0x6ECD	Error Reaction SMA	Error reaction of SMA	--	0x66400001 (STO)

3.6.6.16 Description of the SMS safety function

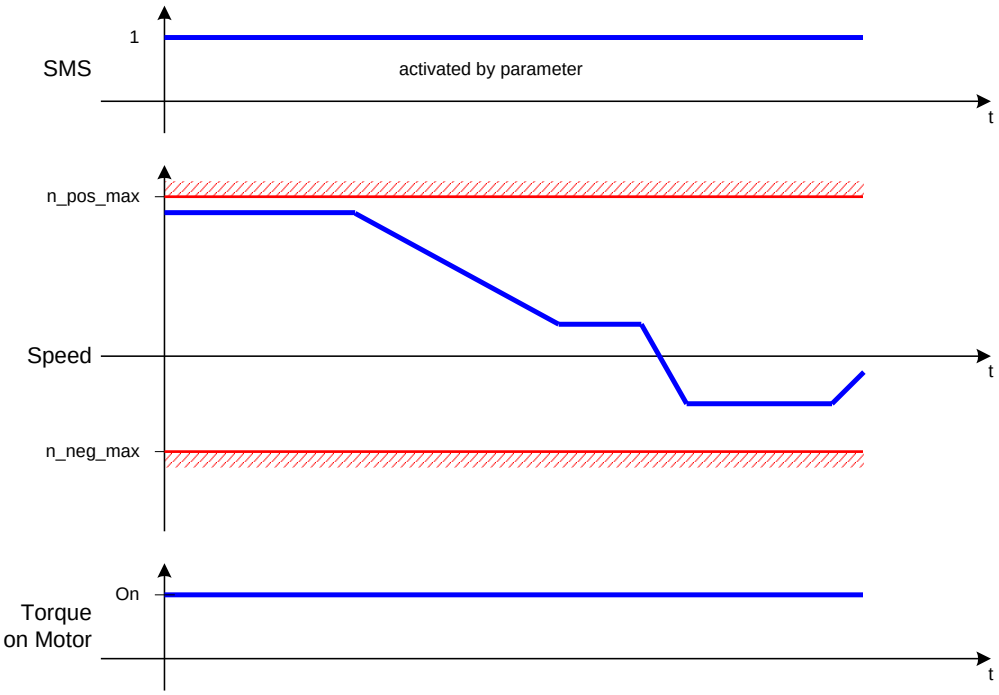


Fig. 42: Description of the Safe Maximum Speed function (SMS)

The SMS function is activated via the n_pos_max and n_neg_max parameters and monitors the maximum speed. The function is executed if one of the parameters is not equal to 0. If one of the limits is exceeded, the function defined under ErrorReaction_SMS is executed.

Parameters for axis 1

Index	Name	Description	Unit	Default value
0x66AA	n_pos_max_SMS 32Bit	Maximum positive speed	Increments per 1 ms	0x0000
0x66AC	n_neg_max_SMS 32Bit	Maximum negative speed	Increments per 1 ms	0x0000
0x66AD	Error Reaction SMS	Error reaction of SMS	--	0x66400001 (STO)

Parameters for axis 2

Index	Name	Description	Unit	Default value
0x6EAA	n_pos_max_SMS 32Bit	Maximum positive speed	Increments per 1 ms	0x0000
0x6EAC	n_neg_max_SMS 32Bit	Maximum negative speed	Increments per 1 ms	0x0000
0x6EAD	Error Reaction SMS	Error reaction of SMS	--	0x66400001 (STO)

WARNING	**Parameter settings** The setting of the speed limits must be above the calculated speed from the Speed_Compare_Window. (See also chapter 3.6.2)

3.6.7 Setting the error reaction

In the AX5805/AX5806 the error reaction can be parameterized for some of the safety functions.

A distinction is made between two reactions, which are explained in more detail below:

3.6.7.1 Error reaction Safe Torque Off (STO 0x66400001)

If this reaction was parameterized, the AX5805/AX5806 switches the AX5000 torque-free immediately after an error is detected.

 **WARNING**	**Provide for external safety measures for the STO function of the TwinSAFE Drive Option card!** If the STO safety function is executed, the connected motors are not braked, but are switched torque-free. This leads to the motors coasting to a halt. The duration of this coasting depends on how much kinetic energy is present in the system. With suspended loads the motors may even be accelerated. In order to prevent this, appropriate external safety mechanisms (e.g. mechanical brakes) must be provided by the user.

3.6.7.2 Error reaction Safe Stop 1 (SS1 0x66500001)

If this reaction was parameterized, the AX5805/AX5806 functionally instructs the AX5000 to run its emergency stop ramp.

 **Note**	**Error reaction SS1** This function is NOT a safety function, but is implemented purely functionally.

Once the time set in the parameters 0x2030 and 0x2830 has elapsed, the AX5805/AX5806 switches the AX5000 to state STO (torque-free).

If the drive does not execute this function, the motors may continue to turn or even accelerate for the set period. The time should therefore always be set such any danger at the machine is avoided, even of the drive accelerates during the set time. The time should be set long enough to enable the drive to be stopped during the set time.

 **DANGER**	**Error reaction SS1!** The time for the error reaction SS1 should be set such that an unsafe system state is avoided, even if the emergency stop ramp fails to be executed or the AX5000 continued to turn or even accelerate the motors during this time. Once the time has elapsed, the drive is switched to STO. If the STO safety function is executed, the connected motors are not braked, but are switched torque-free. This leads to the motors coasting to a halt. The duration of this coasting depends on how much kinetic energy is present in the system. With suspended loads the motors may even be accelerated. In order to prevent this, appropriate external safety mechanisms (e.g. mechanical brakes) must be provided by the user.

3.7 First Steps AX5805

In the following example the SDIn safety function (axis may only rotate in a positive direction) is parameterized and activated.

Hardware used:

- AX5103-0000-0200 servo drive
- TwinSAFE Drive option card AX5805
- TwinSAFE-Logic EL6900
- 3 x EL1904 TwinSAFE input terminals

3.7.1 Step 1: parameterize the AX5103 servo drive

The parameter P-0-2000 in the parameters of the servo amplifier AX5103 must be set to AX5805. Further parameters will probably also have to be set according to the motors in use. See AX5000 operating instructions.

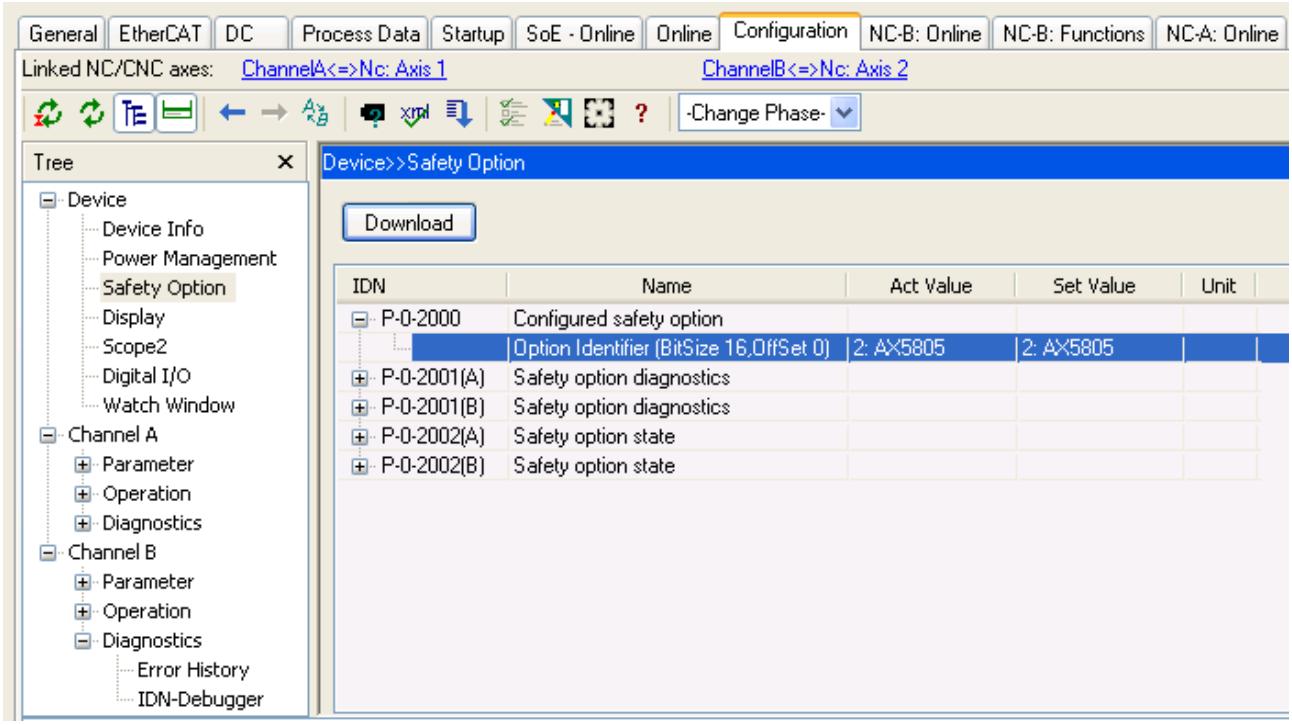


Fig. 43: P-0-2000 Configured Safety Option => AX5805

3.7.2 Step 2: parameterize the AX5805

The following parameters must be set in the safe parameters of the AX5805.

- Motor_String (Index 0x2001)
  The motor in use is called AM3021-0C40-0000 =>
  enter ASCII code 41 4D 33 30 32 31 2D 30 43 34 30 2D 30 30 30 30 or enter as text
- Motor_Polepairs (Index 0x2002)
  The motor in use has 3 pairs of poles. => enter 3
- Number_of_Axis (Index 0x2F00)
  The AX5103 servo drive in use is a single-channel device => enter 1
- s_Zero_SDI 32Bit (Index 0x66D3)
  The window in which the direction of rotation is not monitored => enter e.g. 10 increments

FSoE Address: 22 Update Variables

Index	Name	Flags	Value
1018:0	Identity	RO	> 4 <
1600:0	DRIVE RxPDO-Map FSoE Master Me...	RO	> 19 <
1A00:0	DRIVE TxPDO-Map FSoE Slave Mes...	RO	> 19 <
2000	Motor_Type	RW	0x0000 (0)
2001:0	Motor_String	RO	> 16 <
2001:01	SubIndex 001	RW	0x4D41 (19777)
2001:02	SubIndex 002	RW	0x3033 (12339)
2001:03	SubIndex 003	RW	0x3132 (12594)
2001:04	SubIndex 004	RW	0x302D (12333)
2001:05	SubIndex 005	RW	0x3443 (13379)
2001:06	SubIndex 006	RW	0x2D30 (11568)
2001:07	SubIndex 007	RW	0x3030 (12336)
2001:08	SubIndex 008	RW	0x3030 (12336)
2001:09	SubIndex 009	RW	0x0000 (0)
2001:0A	SubIndex 010	RW	0x0000 (0)
2001:0B	SubIndex 011	RW	0x0000 (0)
2001:0C	SubIndex 012	RW	0x0000 (0)
2001:0D	SubIndex 013	RW	0x0000 (0)
2001:0E	SubIndex 014	RW	0x0000 (0)
2001:0F	SubIndex 015	RW	0x0000 (0)
2001:10	SubIndex 016	RW	0x0000 (0)
2002	Motor_Polepairs	RW	0x0003 (3)
2010	Reference_Position_Window	RW	0x00000000 (0)
2011	Reference_Position_Inputpin	RW	0x00 (0)
2012	Reference_Position	RW	0
2013	Reference_Position_UpperLimit	RW	0
2014	Reference_Position_LowerLimit	RW	0
2020	Speed_Compare_Window	RW	0x000000B4 (180)
2021	Speed_Compare_Violationlevel	RW	0x00000014 (20)
2030	ESTOP_Ramp_Time	RW	0x0000 (0)
2040	Motor_Default_Data	RW	0x0028 (40)
2F00	Number_of_Axis	RW	0x01 (1)
2F01	STO_Mode_Active	RW	FALSE
2F02	Debug_Mode_Active	RW	FALSE
2F03	Reserved	RW	FALSE
6642	STO_Restart_Acknowledge_behavior	RW	FALSE
6651:0	t_SS1	RO	> 8 <
6653:0	n_Zero_SS1 32 Bit	RO	> 8 <
6654:0	t_L SS1	RO	> 8 <
666A:0	s_Zero_SOS 32 Bit	RO	> 8 <
6671:0	t_SS2	RO	> 8 <
6672:0	t_L_SS2	RO	> 8 <
6676:0	Reserved	RO	> 8 <
6679:0	n_Zero_SS2 32 Bit	RO	> 8 <
6681:0	t_SSR	RO	> 8 <
6683:0	n_UL_SSR 32 Bit	RO	> 8 <
6685:0	n_LL_SSR 32 Bit	RO	> 8 <
6686:0	t_L_SSR	RO	> 8 <
668A:0	Error Reaction SSR	RO	> 8 <
6691:0	t_SLS	RO	> 8 <
6693:0	n_SLS 32 Bit	RO	> 8 <
6694:0	t_L_SLS	RO	> 8 <
6698:0	Error Reaction SLS	RO	> 8 <
66A2:0	s_UL_SLP 32 Bit	RO	> 8 <
66A4:0	s_LL_SLP 32 Bit	RO	> 8 <
66A5:0	Error Reaction SLP	RO	> 8 <
66AA	n_pos_max_SMS 32 Bit	RW	0x00000000 (0)
66AC	n_neg_max_SMS 32 Bit	RW	0x00000000 (0)
66AD	Error Reaction SMS	RW	0x66400001 (1715470337)
66BA:0	s_UL_SLI 32 Bit	RO	> 8 <
66BC:0	s_LL_SLI 32 Bit	RO	> 8 <
66BD:0	Error Reaction SLI	RO	> 8 <
66C2:0	a_UL_SAR 32 Bit	RO	> 8 <
66C4:0	a_LL_SAR 32 Bit	RO	> 8 <
66C5:0	Error Reaction SAR	RO	> 8 <
66CA	a_pos_max_SMA 32 Bit	RW	0
66CC	a_neg_max_SMA 32 Bit	RW	0
66CD	Error Reaction SMA	RW	0x66400001 (1715470337)
66D3	s_Zero_SDI 32 Bit	RW	0x0000000A (10)
66E2:0	n_UL_SSM 32 Bit	RO	> 8 <
66E4:0	n_LL_SSM 32 Bit	RO	> 8 <
66EA:0	s_UL_SCA 32 Bit	RO	> 8 <
66EC:0	s_LL_SCA 32 Bit	RO	> 8 <
F050:0	Detected modules	RO	> 2 <

Fig. 44: Setting the parameters

3.7.3 Step 3: link Error_Acknowledge in Safe PLC

In order to be able to acknowledge errors (e.g. axes move in the negative direction despite activated SDIn safety function), a safe input (in this case channel 1 of the first EL1904) is linked with the Error_Acknowledge bit in the control word of the AX5805.

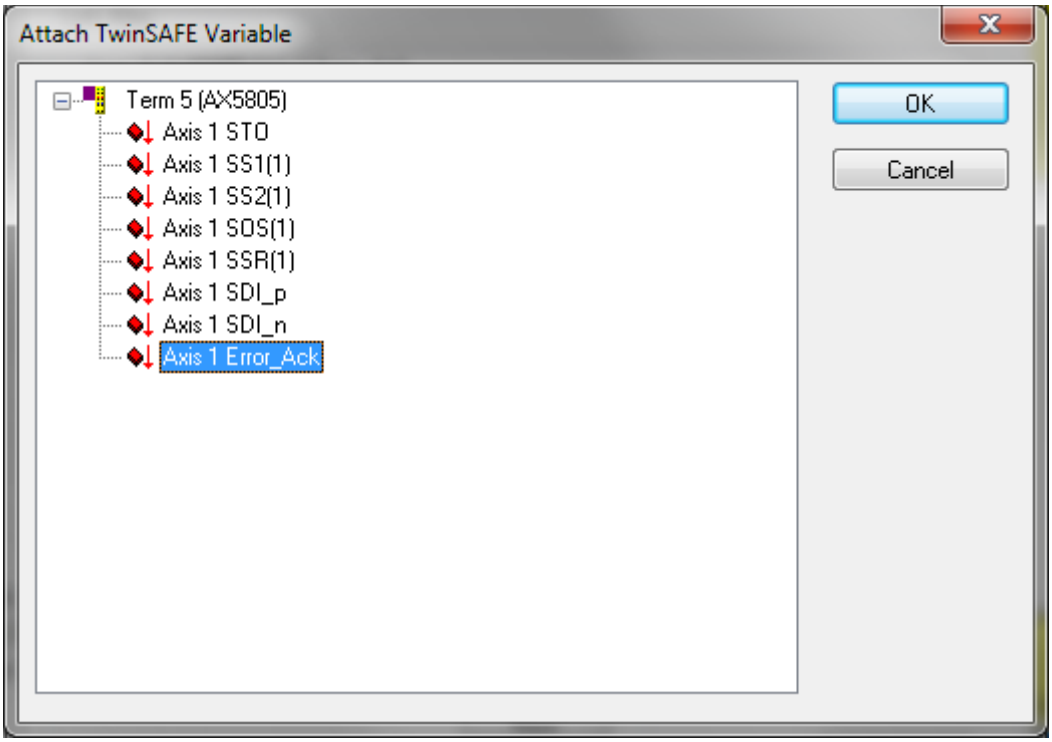


Fig. 45: AX5805 Error_Ack link

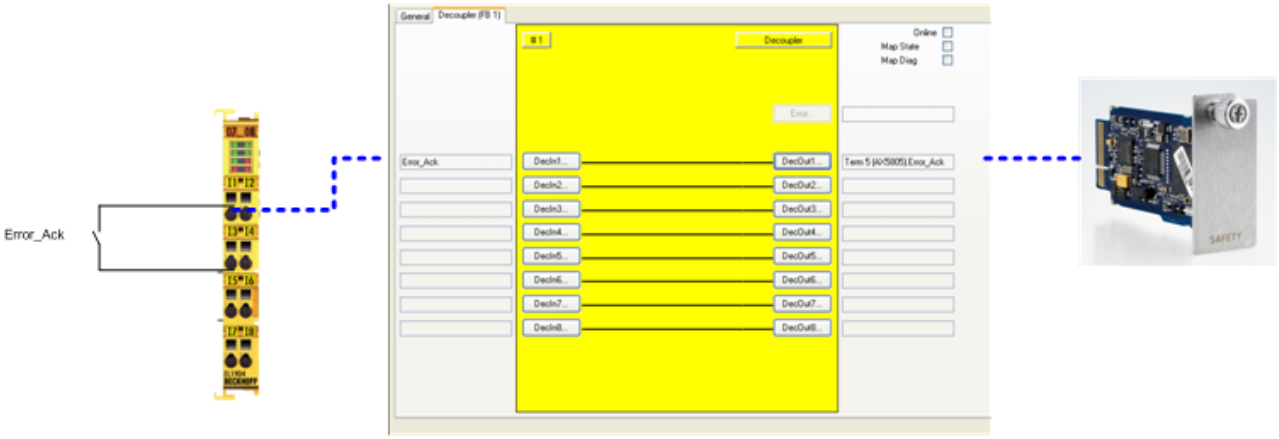


Fig. 46: Error_Acknowledge button on the AX5805

3.7.4 Step 4: Link the SDIn safety function in the Safe PLC

In this example we will activate the SDIn safety function by means of a light curtain, which is connected to the second safe EL1904 input terminal.

The safety function SDIn is activated if the light curtain is interrupted. The axis may only move in the positive direction of rotation. If it is nevertheless moved in a negative direction and the window limit is exceeded, the AX5805 switches the axis torque-free.

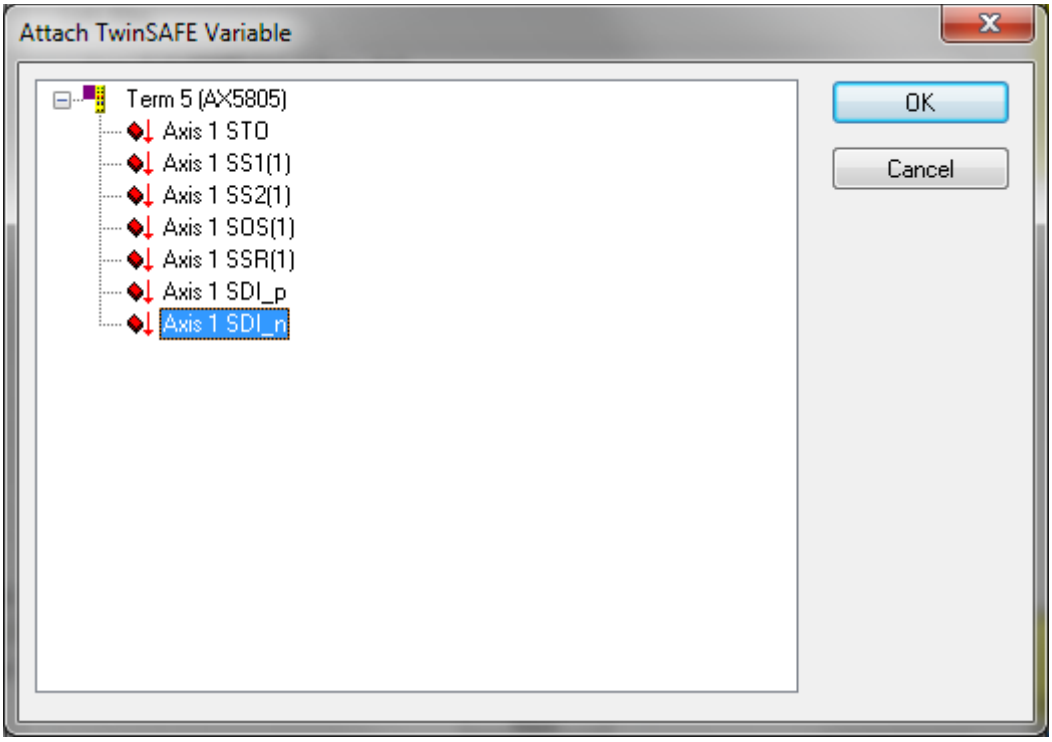


Fig. 47: AX5805 SDI_n link

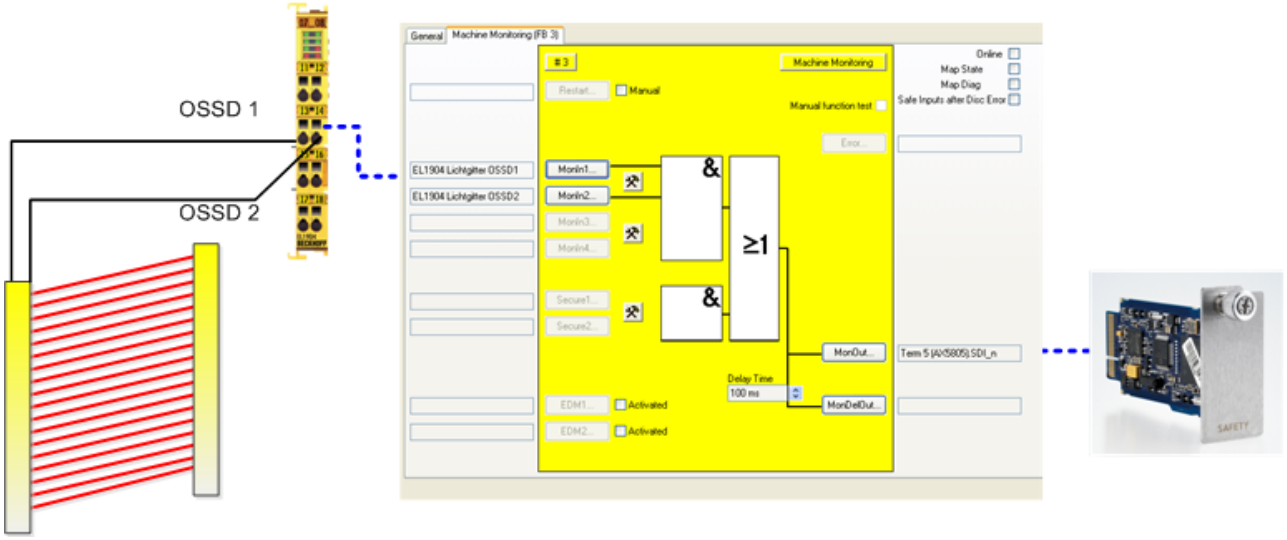


Fig. 48: Light curtain for SDIn of the AX5805

3.7.5 Step 5: Implementation of an EMERGENCY STOP button

The emergency stop function can be implemented as follows:
If the emergency stop button is pressed, the release of the servo drive, for example via a standard PLC, is cancelled. The servo drive then activates a non-safety-orientated STOP ramp (which must naturally be parameterized for this). After a preconfigured time, the STO safety function is activated and the motors are switched torque-free.

All undesired functions are also linked with the delayed output. This has no influence on the top-priority STO safety function, but the undesired functions are deactivated in normal operating mode as a result.

WARNING	**STOP ramp of the AX5000 servo drive** The STOP ramp of the AX5000 servo drive is purely functional and is not designed to be a safety feature. In the event of a malfunction, the motors may coast to a halt or may even be accelerated. In order to avoid these dangerous situations and movements, external safety mechanisms are to be provided by the user.

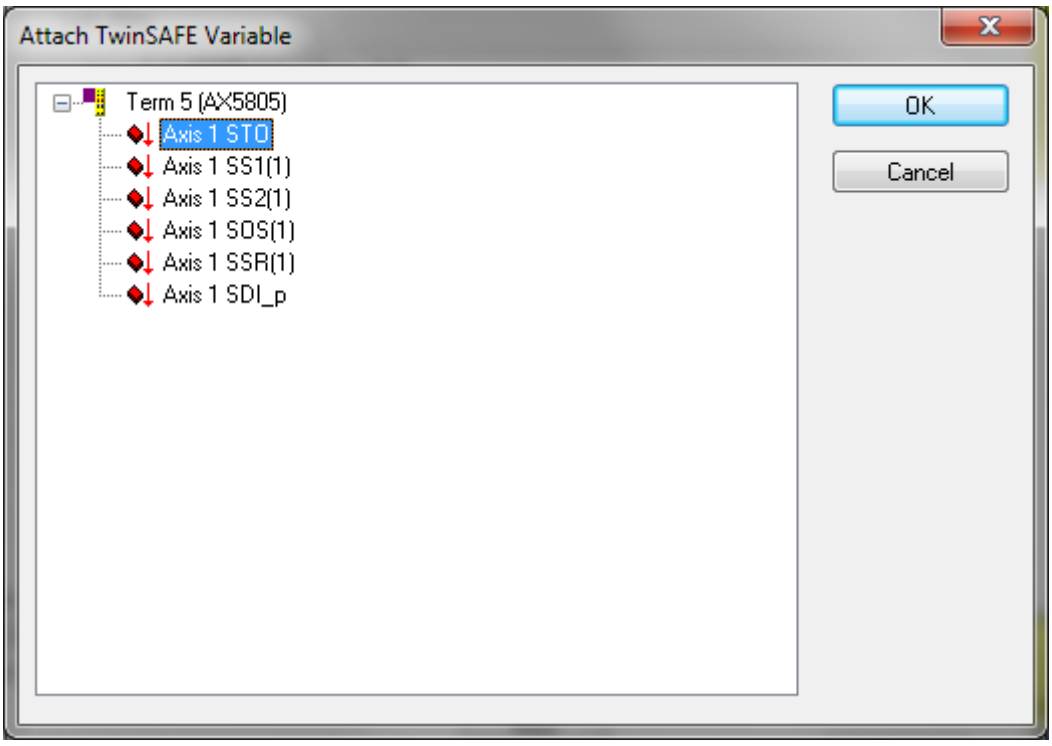


Fig. 49: AX5805 STO link

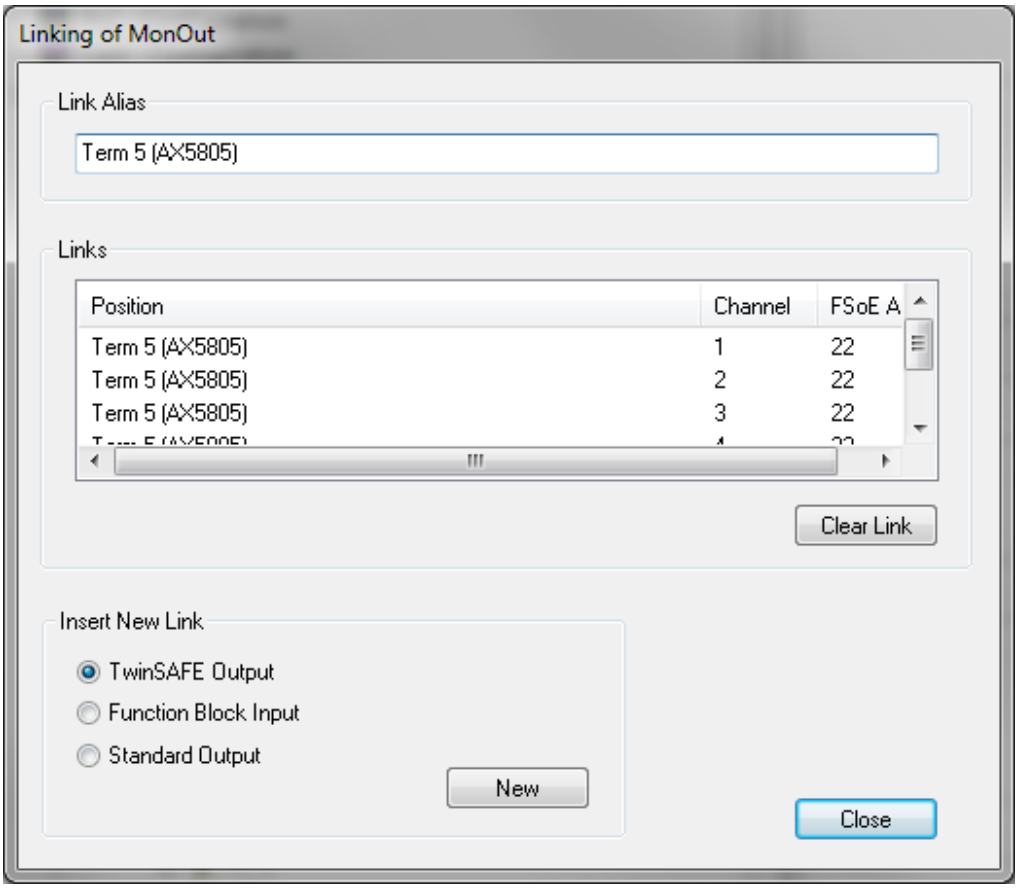


Fig. 50: Linking of the unused AX5805 functions

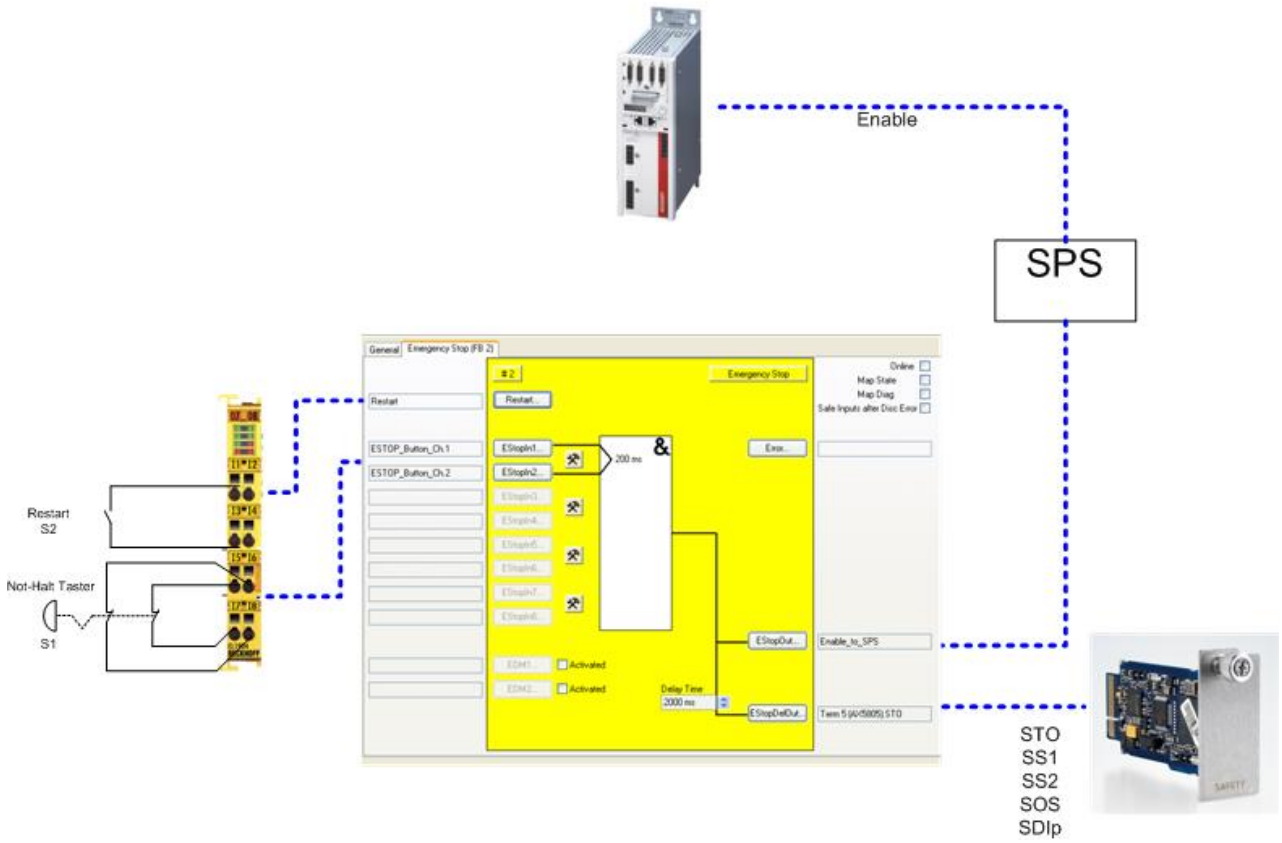


Fig. 51: Emergency stop button for STO of the AX5805

4 Error and diagnosis

The STO error reaction is executed for all errors detected by the AX5805/AX5806. This means that the connected motors are directly switched torque-free and can coast to a halt. The duration of this coasting depends on how much kinetic energy is present in the system. With suspended loads the motors may even be accelerated. In order to prevent this, appropriate external safety mechanisms (e.g. mechanical brakes) must be provided by the user.

The reason for switching off can be read from the diagnostic data (CoE object 0xFA82). The data within this object is divided into diagnosis and error.

Error indices that are smaller than 0x1000 or larger than 0x4FFF can be reset by the EtherCAT state transition from PREOP to SAFEOP. These include communication errors, parameter errors and environment errors.

All other errors are internal errors that can only be reset by a hardware reset or by switching the AX5805/AX5806 to the EtherCAT state BOOT.

4.1 Error indices in CoE object 0xFA82

Error index in 0xFA82	Error name	Description	Typical error reaction time
0x0001	FAULT_MAXT_C1	The temperature has exceeded the maximum permissible temperature (µC1).	
0x0002	FAULT_MAXT_C2	The temperature has exceeded the maximum permissible temperature (µC2).	
0x0003	FAULT_MINT_C1	The temperature has fallen below the minimum permissible temperature (µC1).	
0x0004	FAULT_MINT_C2	The temperature has fallen below the minimum permissible temperature (µC2).	
0x0101	HW_ERR_MAX_VCC_C1	The maximum supply voltage was exceeded (3.3 V).	
0x0102	HW_ERR_MAX_VCC_C2	The maximum supply voltage was exceeded (3.3 V).	
0x0103	HW_ERR_MIN_VCC_C1	The supply voltage fell below the minimum value (3.3 V)	
0x0104	HW_ERR_MIN_VCC_C2	The supply voltage fell below the minimum value (3.3 V)	
0x0201	FAULT_MCTC1_TO	The MCTests of µC1 were not carried out completely within the specified time	
0x0202	FAULT_MCTC2_TO	The MCTests of µC2 were not carried out completely within the specified time	
0x0203	FAULT_TIMER_C1	The global timer was not updated in time.	
0x0204	FAULT_TIMER_C2	The global timer was not updated in time.	
0x020C	FAULT_TS_WDG_TO_C1	The TwinSAFE module was not called within the watchdog time.	
0x020D	FAULT_TS_WDG_TO_C2	The TwinSAFE module was not called within the watchdog time.	
0x020E	FAULT_RESET_MC1	A reset has occurred in the operation of the controller for µC1. µC2 was not reset thereby.	

Error index in 0xFA82	Error name	Description	Typical error reaction time
0x0300	FAULT_SERCOMC2	an error occurred in the SerComP24C2 module during data transmission	
0x0401-0x040B	FAULT_SERCOM	an error occurred in the SerComP24C1 module during data transmission	
0x0501-0x0507	FAULT_TEMPSENSOR	Error in the communication with one of the temperature sensors	
0x0601	FAULT_OUTPUTCOMPARE	The values output by µC1 and µC2 differ.	
0x0602	FAULT_OUTPUTCOMPAREC2	The values output by µC1 and µC2 differ.	
0x0700	HW_ERR_MIN_VCC_FPGA	The FPGA supply voltage fell below the minimum value (5 V).	
0x0701	HW_ERR_MAX_VCC_FPGA	The FPGA supply voltage exceeded the maximum value (5 V).	
0x0710	FAULT_FEEDBACK_C1	An error was detected in the feedback channels of µC1.	
0x0711	FAULT_FEEDBACK_C2	An error was detected in the feedback channels of µC2.	
0x0720	FAULT_Parameter_C1	General parameter error µC1	
0x0721	FAULT_Parameter_C2	General parameter error µC2	
0x0722	FAULT_Parameter_C1_DRIVE_PROFILE	Parameter: unknown parameter index µC1 drive profile	
0x0723	FAULT_Parameter_C1_VENDOR_SPECIFIC	Parameter: unknown parameter index µC1 vendor-specific.	
0x0724	FAULT_Parameter_C2_DRIVE_PROFILE	Parameter: unknown parameter index µC2 drive profile.	
0x0725	FAULT_Parameter_C2_VENDOR_SPECIFIC	Parameter: unknown parameter index µC2 vendor-specific.	
0x0726	FAULT_PDO_MAPPING_FSOE_COMMAND	PDO mapping axis 1/2: FSOE COMMAND error.	
0x0727	FAULT_PDO_MAPPING_LENGTH	PDO mapping axis 1: Length_Error	
0x0728	FAULT_PDO_MAPPING_STO_K1	PDO mapping axis 1: STO error	
0x0729	FAULT_PDO_MAPPING_SS1_1_K1	PDO mapping axis 1: Error SS1_1	
0x072A	FAULT_PDO_MAPPING_SS2_1_K1	PDO mapping axis 1: Error SS2_1	
0x072B	FAULT_PDO_MAPPING_SOS_1_K1	PDO mapping axis 1: SS2_1 error	
0x072C	FAULT_PDO_MAPPING_SSR_1_K1	PDO mapping axis 1: SSR_1 error	
0x072D	FAULT_PDO_MAPPING_SDIp_K1	PDO mapping axis 1: SDIp error	
0x072E	FAULT_PDO_MAPPING_SDIn_K1	PDO mapping axis 1: SDIn error	
0x072F	FAULT_PDO_MAPPING_Error_ACK_K1	PDO mapping axis 1: Error_ACK error	
0x0730	FAULT_PDO_MAPPING_Error_CRC0	PDO mapping axis 1/2: FSOE CRC0 error	
0x0731	FAULT_PDO_MAPPING_STO_K2	PDO mapping axis 2: STO error	
0x0732	FAULT_PDO_MAPPING_SS1_1_K2	PDO mapping axis 2: Error SS1_1	
0x0733	FAULT_PDO_MAPPING_SS2_1_K2	PDO mapping axis 2: Error SS2_1	
0x0734	FAULT_PDO_MAPPING_SOS_1_K2	PDO mapping axis 2: SS2_1 error	
0x0735	FAULT_PDO_MAPPING_SSR_1_K2	PDO mapping axis 2: SSR_1 error	
0x0736	FAULT_PDO_MAPPING_SDIp_K2	PDO mapping axis 2: SDIp error	
0x0737	FAULT_PDO_MAPPING_SDIn_K2	PDO mapping axis 2: SDIn error	

Error index in 0xFA82	Error name	Description	Typical error reaction time
0x0738	FAULT_PDO_MAPPING_Error_ACK_K2	PDO mapping axis 2: Error_ACK error	
0x0739	FAULT_PDO_MAPPING_Error_CRC1	PDO mapping axis 2: FSOE CRC1 error	
0x073A	FAULT_PDO_MAPPING_Error_ConnID	PDO mapping axis 1/2: FSOE ConnID error	
0x073B	FAULT_PDO_MAPPING_SSM_1_K1	PDO mapping axis 1: SSM_1_K1 error	
0x073C	FAULT_PDO_MAPPING_SSM_1_K2	PDO mapping axis 2: SSM_1_K2 error	
0x073D	FAULT_PDO_MAPPING_SSM_2_K1	PDO mapping axis 1: SSM_2_K1 error	
0x073E	FAULT_PDO_MAPPING_SSM_2_K2	PDO mapping axis 2: SSM_2_K2 error	
0x0740	FAULT_WRONG_MOTORCONSTRUCTIONTYPE_K1	Register communication: parameterized motor type for axis 1 does not correspond to the connected motor.	
0x0741	FAULT_UNKNOWN_MOTOR_TYPE_K1	Register communication: parameterized motor type for axis 1 is unknown	
0x0742	FAULT_WRONG_MOTORCONSTRUCTIONTYPE_K2	Register communication: parameterized motor type for axis 2 does not correspond to the connected motor.	
0x0743	FAULT_UNKNOWN_MOTOR_TYPE_K2	Register communication: parameterized motor type for axis 2 is unknown.	
0x0744	FAULT_NUM_OF_POLEPAIRS_K1	Register communication: parameterized number of pole pairs for axis 1 does not correspond to the connected motor.	
0x0745	FAULT_NUM_OF_POLEPAIRS_K2	Register communication: parameterized number of pole pairs for axis 2 does not correspond to the connected motor.	
0x0746	FAULT_WRONG_MOTOR_CONFIGURED_K1	Register communication: parameterized motor type for axis 1 does not correspond to the connected motor.	
0x0747	FAULT_WRONG_MOTOR_CONFIGURED_K2	Register communication: parameterized motor type for axis 2 does not correspond to the connected motor	
0x0748	FAULT_RXPDO_LENGTH	PDO mapping: RXPDO length is wrong.	
0x0749	FAULT_TXPDO_LENGTH	PDO mapping: TXPDO length is wrong.	
0x074A	FAULT_UNKNOWN_RXPDO_INDEX	PDO mapping: RXPDO index is unknown	
0x074B	FAULT_UNKNOWN_TXPDO_INDEX	PDO mapping: TXPDO index is unknown	
0x074C	FAULT_WRONG_NUMBER_OF_AXLE	The parameterized number of axes does not correspond to the number detected.	
0x1001	FAULT_CRC_INIT_C1	An incorrect checksum at µC1 was determined during PowerOn reset.	
0x1002	FAULT_CRC_INIT_C2	An incorrect checksum at µC2 was determined during PowerOn reset.	
0x1003	FAULT_CRC_C1	An incorrect checksum was determined for µC1 during operation.	
0x1004	FAULT_CRC_C2	An incorrect checksum was determined for µC2 during operation.	
0x1011	FAULT_RAM_C1	An error occurred during the RAM test of µC1.	125 µs
0x1012	FAULT_RAM_C2	An error occurred during the RAM test of µC2.	125 µs

Error index in 0xFA82	Error name	Description	Typical error reaction time
0x1013	FAULT_RAM_CHECKERBOARD_C1	An error occurred during the RAM test of µC1.	
0x1014	FAULT_RAM_CHECKERBOARD_C2	An error occurred during the RAM test of µC2.	
0x1021	FAULT_GLBL_TMR	The global timer is not working correctly.	125 µs
0x1031	FAULT_SPLIM1	Stack overruns are no longer being intercepted correctly.	
0x1032	FAULT_SPLIM2	Stack overruns are no longer being intercepted correctly.	
0x1100	FAULT_OPCT_GRP_C1	The opcode test for µC1 has failed.	
0x1300	FAULT_OPCT_GRP_C2	The opcode test for µC2 has failed.	
0x1801	FAULT_ESS_CRC_C1	Different check sums were determined in the TwinSAFE telegrams.	
0x1802	FAULT_ESS_CRC_C2	Different check sums were determined in the TwinSAFE telegrams.	
0x1803	FAULT_SW_MAIN1_C1	The default case of the main loop of µC1 was called.	
0x1804	FAULT_SW_MAIN1_C2	The default case of the main loop of µC2 was called.	
0x1805	FAULT_ESLCONID_PRJCRCRD	The Connection ID is not zero when reading the project CRC.	
0x1806	FAULT_ESLCONID_PRJCRCWR	The Connection ID is not zero when writing the project CRC.	
0x1807	FAULT_SIZE_EEVONDOR_EXID	An address was accessed that lies outside the vendor range in the EEPROM.	
0x5100	FAULT_COM_C1C2	Communication between µC1 and µC2 is disturbed.	
0x5101	FAULT_ISR_SNT_FEEDBACK	High priority ISR: communication interrupted: switched mode power supply feedback	125 µs
0x5102	FAULT_ISR_ANGLE_K1	High priority ISR: communication interrupted: axis 1 angle	125 µs
0x5103	FAULT_ISR_ANGLE_K2	High priority ISR: communication interrupted: axis 2 angle	125 µs
0x5104	FAULT_ISR_DELTA_K1	High priority ISR: communication interrupted: axis 1 distance travelled	125 µs
0x5105	FAULT_ISR_DELTA_K2	High priority ISR: communication interrupted: axis 2 distance travelled	125 µs
0x5106	FAULT_ISR_VELO_K1	High priority ISR: communication interrupted: axis 1 velocity	125 µs
0x5107	FAULT_ISR_VELO_K2	High priority ISR: communication interrupted: axis 2 velocity	125 µs
0x5108	FAULT_ISR_TEST_FEEDBACK	High priority ISR: communication interrupted: feedback from switch-off channels	125 µs
0x5109	FAULT_TIMEOUT_REG_AX5000_CONTROL	Register communication: AX5000 does not answer in time: Controlword	
0x510A	FAULT_TIMEOUT_REG_AX5000_STATUS	Register communication: AX5000 does not answer in time: Statusword	

Error index in 0xFA82	Error name	Description	Typical error reaction time
0x510B	FAULT_TIMEOUT_REG_AX5000_REGADR	Register communication: AX5000 does not answer in time: Register address	
0x510C	FAULT_TIMEOUT_REG_AX5000_REGDATA	Register communication: AX5000 does not answer in time: Register data	
0x510D	FAULT_TIMEOUT_REG_AX5000_CRC	Register communication: AX5000 does not answer in time: CRC	
0x510E	FAULT_UNKNOWN_AX5000_INTERFACE	Register communication: unknown interface to the AX5000	
0x510F	FAULT_COMERROR_AX5000_INTERFACE	Register communication: the interface to the AX5000 has a communication error	
0x5110-0x5113	FAULT_WRITE_HW_VERSION_AX5805	Values could not be written to the register in the AX5000	
0x5114	FAULT_EXT_ADC_ADDRESS	High priority ISR: External ADC: an impermissible address was read	
0x5115	FAULT_REGISTER_AX5000_CRC_ERROR	Register communication with the AX5000: telegram has a CRC error.	
0x5116	FAULT_CYCLIC_AX5000_CRC_ERROR	High priority ISR: cyclic communication with the AX5000: telegram has a CRC error.	125 µs
0x5117	FAULT_UNKNOWN_REGISTER_ADDRESS	Register communication: Addressed register is unknown.	
0x5118	FAULT_AX5000_NOT_READY	High priority ISR: cyclic communication with the AX5000: AX5000 signals a communication error.	125 µs
0x5119	FAULT_C1C2_SYNC_LOST	High priority ISR: cyclic communication between µC1 and µC2: Communication error	125 µs
0x5C00	FAULT_SET_MAPPED_STATE	Mapped safety functions: error while setting the state.	
0x5C01	FAULT_RESET_MAPPED_STATE	Mapped safety functions: error while resetting the state.	
0x5C02	FAULT_MAPPED_FUNCTION	Mapped safety functions: invalid mapping, function does not exist.	
0x5C03	FAULT_MAPPED_INSTANCE	Mapped safety functions: invalid mapping, instance does not exist.	
0x5E02	FAULT_STO_MODE	The requested STO mode is invalid.	
0x5E04	FAULT_UNDEFINED_ERRORREACTION	Error reaction: invalid error reaction, error reaction does not exist.	
0x5E03	FAULT_SDI_MODE	The requested SDI mode is invalid.	
0x5F00	FAULT_CRC_COMPARE_C1	Incorrect checksum detected during comparison by µC1.	
0x5F01	FAULT_CRC_COMPARE_C2	Incorrect checksum detected during comparison by µC2.	
0x5F02	FAULT_TMR2_INTERRUPT_C1	MC_Test: Timer2 has triggered an interrupt on µC1. HighPrioISR was not called in time.	
0x5F03	FAULT_TMR2_INTERRUPT_C2	MC_Test: Timer2 has triggered an interrupt on µC2. HighPrioISR was not called in time.	
0x5F04	FAULT_SWITCHOFF_TEST	MC_Test: the test of the switch-off channels has failed.	
0x5F05	FAULT_NO_SYNC	No SYNC signal	
0x5F06	FAULT_UNKNOWN_AXLE	The requested axis is unknown.	

Error index in 0xFA82	Error name	Description	Typical error reaction time
0x5F07	FAULT_FPGA_C2	The status of the FPGA is incorrect.	
0x5F08	FAULT_ANGLE_FORMAT_C1	The angles of µC1 read-in have the wrong format.	125 µs
0x5F09	FAULT_ANGLE_FORMAT_C2	The angles of µC2 read-in have the wrong format.	125 µs
0x5F0A	FAULT_SAFE_MAIN_STATE	Unknown state requested	
0x5F0B	FAULT_STARTUP_FAILED	Error during start-up.	
0x5F0C	FAULT_MOTION_DETECTION	Motion detection error	125 µs
0x5F0E	FAULT_AX580x_NOT_SUITABLE_FOR_AX5000	Incorrect option card or AX5000 software installed	
0x6000	FAULT_PARAMETER_ FSOE_VENDOR_ID	Incorrect vendor ID transmitted	
0x6001	FAULT_PARAMETER_ FSOE_MODULE_IDENT	Incorrect module ID transmitted	
0x6002	FAULT_PARAMETER_FSOE_CRC	CRC of the AX5805 parameters does not match the transmitted CRC (please check parameters; if necessary, activate System Manager configuration and reload safety project into the EL69xx).	

4.2 Reason for shutdown of CoE objects 0xFA10:07 and 0xFA10:08

To read the shutdown reason, CoE object 0xFA10 subindex 01 must be set to 0.

Value in 0xFA10:07 shutdown reason axis 1 0xFA10:08 shutdown reason axis 2	Description
0xXX00	Error reaction: no error reaction
0xXX40	Error reaction: STO (Safe Torque Off)
0xXX50	Error reaction: SS1 (Safe Stop 1)
0x01XX	Shutdown reason: The status word was calculated incorrectly.
0x02XX	Shutdown reason: The parameters are wrong or not yet loaded
0x03XX	Shutdown reason: FSOE protocol not in state DATA
0x04XX	Shutdown reason: Internal comparison failed. Please check the motor/drive dimensioning/parameterization
0x05XX	Reason for shutdown position detection: external cam detected unexpectedly
0x06XX	Reason for shutdown position detection: external cam detected to the right of the cam window
0x07XX	Reason for shutdown position detection: external cam detected to the left of the cam window
0x08XX	Reason for shutdown position detection: the maximum traversing range was exceeded.
0x50XX	Reason for shutdown safety function: The safety function SS1 has switched off.
0x68XX	Reason for shutdown safety function: The safety function SOS has switched off.
0x80XX	Reason for shutdown safety function: The safety function SSR has switched off.
0x90XX	Reason for shutdown safety function: The safety function SLS has switched off.
0xA0XX	Reason for shutdown safety function: The safety function SLP has switched off.
0xA8XX	Reason for shutdown safety function: The safety function SMS has switched off.
0xB8XX	Reason for shutdown safety function: The safety function SLI has switched off.
0xC0XX	Reason for shutdown safety function: The safety function SAR has switched off.
0xC8XX	Reason for shutdown safety function: The safety function SMA has switched off.
0xD0xx	Reason for shutdown safety function: The safety function SDIp has switched off.
0xD1xx	Reason for shutdown safety function: The safety function SDIn has switched off.

4.3 Diagnostics CoE object 0xFA10

The CoE object 0xFA10 provides additional diagnostic data for the user. Subindex 01 is used to display various data (accordingly to the following tables) in subindices 02 to 08.

The error and diagnostic values match the information described in chapter 4.1.

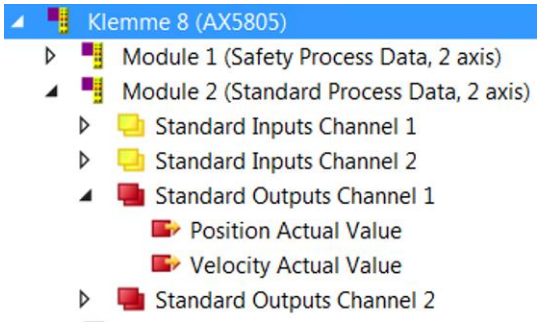
4.3.1 0xFA10:01 = 0

Index in 0xFA10	Name	Description
0xFA10:02	-	-
0xFA10:03	Internal data	-
0xFA10:04	Internal data	-
0xFA10:05	Software CRC C1	-
0xFA10:06	Software CRC C2	-
0xFA10:07	Reason for shutdown axis 1	see chapter 4.2
0xFA10:08	Reason for shutdown axis 2	see chapter 4.2

4.3.2 0xFA10:01 = 1

Index in 0xFA10	Name	Description
0xFA10:02	Error 1 on C1	see chapter 4.1
0xFA10:03	Error 2 on C1	
0xFA10:04	Error 3 on C1	
0xFA10:05	Error 4 on C1	
0xFA10:06	Error 5 on C1	
0xFA10:07	Error 6 on C1	
0xFA10:08	Error 7 on C1	

Note	**Internal speeds** In this setting the current internal speeds are also applied to the process image of the AX5805/AX5806. The parameter Speed_Compare_Window defines the maximum permitted difference between these speeds. The values displayed in the process image are typically read with a cycle time that is greater than the internal cycle time of 125µs.



Variable	Description	Data type	Unit
Standard Outputs Channel 1 Position Actual Value	Internal velocity calculated from the encoder signal for axis 1	INT16	Increments / 125µs
Standard Outputs Channel 1 Velocity Actual Value	Internal velocity calculated from the motor model for axis 1	INT16	Increments / 125µs
Standard Outputs Channel 2 Position Actual Value	Internal velocity calculated from the encoder signal for axis 2	INT16	Increments / 125µs
Standard Outputs Channel 2 Velocity Actual Value	Internal velocity calculated from the motor model for axis 2	INT16	Increments / 125µs

4.3.3 0xFA10:01 = 2

Index in 0xFA10	Name	Description
0xFA10:02	Error 8 on C1	see chapter 4.1
0xFA10:03	Error 9 on C1	
0xFA10:04	Error 10 on C1	
0xFA10:05	Error 11 on C1	
0xFA10:06	Error 12 on C1	
0xFA10:07	Error 13 on C1	
0xFA10:08	Error 14 on C1	

4.3.4 0xFA10:01 = 3

Index in 0xFA10	Name	Description
0xFA10:02	Error 1 on C2	see chapter 4.1
0xFA10:03	Error 2 on C2	
0xFA10:04	Error 3 on C2	
0xFA10:05	Error 4 on C2	
0xFA10:06	Error 5 on C2	
0xFA10:07	Error 6 on C2	
0xFA10:08	Error 7 on C2	

4.3.5 0xFA10:01 = 4

Index in 0xFA10	Name	Description
0xFA10:02	Error 8 on C2	see chapter 4.1
0xFA10:03	Error 9 on C2	
0xFA10:04	Error 10 on C2	
0xFA10:05	Error 11 on C2	
0xFA10:06	Error 12 on C2	
0xFA10:07	Error 13 on C2	
0xFA10:08	Error 14 on C2	

4.3.6 0xFA10:01 = 5

Index in 0xFA10	Name	Description
0xFA10:02	Diagnostic value 1 on C1	see chapter 4.1
0xFA10:03	Diagnostic value 2 on C1	
0xFA10:04	Diagnostic value 3 on C1	
0xFA10:05	Diagnostic value 4 on C1	
0xFA10:06	Diagnostic value 5 on C1	
0xFA10:07	Diagnostic value 6 on C1	
0xFA10:08	Diagnostic value 7 on C1	

4.3.7 0xFA10:01 = 6

Index in 0xFA10	Name	Description
0xFA10:02	Diagnostic value 8 on C1	see chapter 4.1
0xFA10:03	Diagnostic value 9 on C1	
0xFA10:04	Diagnostic value 10 on C1	
0xFA10:05	Diagnostic value 11 on C1	
0xFA10:06	Diagnostic value 12 on C1	
0xFA10:07	Diagnostic value 13 on C1	
0xFA10:08	Diagnostic value 14 on C1	

4.3.8 0xFA10:01 = 7

Index in 0xFA10	Name	Description
0xFA10:02	Diagnostic value 1 on C2	see chapter 4.1
0xFA10:03	Diagnostic value 2 on C2	
0xFA10:04	Diagnostic value 3 on C2	
0xFA10:05	Diagnostic value 4 on C2	
0xFA10:06	Diagnostic value 5 on C2	
0xFA10:07	Diagnostic value 6 on C2	
0xFA10:08	Diagnostic value 7 on C2	

4.3.9 0xFA10:01 = 8

Index in 0xFA10	Name	Description
0xFA10:02	Diagnostic value 8 on C2	see chapter 4.1
0xFA10:03	Diagnostic value 9 on C2	
0xFA10:04	Diagnostic value 10 on C2	
0xFA10:05	Diagnostic value 11 on C2	
0xFA10:06	Diagnostic value 12 on C2	
0xFA10:07	Diagnostic value 13 on C2	

Index in 0xFA10	Name	Description
0xFA10:08	Diagnostic value 14 on C2	

4.4 Maintenance

The TwinSAFE Drive option cards are maintenance-free!

 WARNING	**Observe the specified environmental conditions!** Please ensure that the TwinSAFE option cards are only stored and operated under the specified conditions (see technical data).

If the terminal is operated outside the permitted temperature range it will switch to *Global Fault* state.

4.4.1 Cleaning

Protect the TwinSAFE Drive option cards against impermissible contamination during operation and storage!

The TwinSAFE Drive option cards may not be used any further if they have been exposed to impermissible contamination!

 WARNING	**Have contaminated TwinSAFE Drive option cards checked!** Cleaning of the TwinSAFE Drive option cards by the user is not permitted! Send contaminated TwinSAFE Drive option cards to the manufacturer for checking and cleaning!

4.4.2 Service life

The TwinSAFE Drive option cards have a service life of 20 years.

Due to the high diagnostic coverage within the lifecycle no special proof tests are required.

4.5 Decommissioning

 DANGER	**Ensure that the power is switched off before de-installation!** Place the AX5000 into a safe, de-energized state before commencing with the de-installation of the TwinSAFE Drive option cards!

4.5.1 Disposal

In order to dispose of the device, it must be removed and fully dismantled. Metal parts can be sent for metal recycling. Electronic parts such as disk drives and circuit boards must be disposed of in accordance with national electronics scrap regulations.

5 Appendix

5.1 Beckhoff Support and Service

Beckhoff and their partners around the world offer comprehensive support and service, making available fast and competent assistance with all questions related to Beckhoff products and system solutions.

5.1.1 Beckhoff branches and partner companies Beckhoff Support

Please contact your Beckhoff branch office or partner company for local support and service on Beckhoff products!
The contact addresses for your country can be found in the list of Beckhoff branches and partner companies: www.beckhoff.com. You will also find further documentation for Beckhoff components there.

5.1.2 Beckhoff company headquarters

Beckhoff Automation GmbH & Co.KG
Huelshorstweg 20
33415 Verl
Germany

Phone: + 49 (0) 5246/963-0
Fax: + 49 (0) 5246/963-198
E-mail: info@beckhoff.com
Web: www.beckhoff.com

Beckhoff Support
Support offers you comprehensive technical assistance, helping you not only with the application of individual Beckhoff products, but also with other, wide-ranging services:

- world-wide support
- design, programming and commissioning of complex automation systems
- and extensive training program for Beckhoff system components

Hotline: + 49 (0) 5246/963-157
Fax: + 49 (0) 5246/963-9157
E-mail: support@beckhoff.com

Beckhoff Service
The Beckhoff Service Center supports you in all matters of after-sales service:

- on-site service
- repair service
- spare parts service
- hotline service

Hotline: + 49 (0) 5246/963-460
Fax: + 49 (0) 5246/963-479
E-mail: service@beckhoff.com

5.2 Certificate

Reliability of AX5805

Test and Certification body

TÜV SÜD Rail GmbH
Rail Automation - IQSE
Barthstraße 16
D-80339 Munich

Manufacturer

Beckhoff Automation GmbH & Co. KG
Huelshorstweg 20
D-33415 Verl

Safety parameters AX5805

Key figures	AX5805
Lifetime [a]	20
Prooftest Intervall [a]	not required [1)]
PFH_D	see document "AX5805 List of permitted motors"
%SIL3	see document "AX5805 List of permitted motors"
$MTTF_d$	High
$B10_d$ (cycles)	-
DC	High
Performance level	PL e
Category	4
HFT	1
Element classification*	Type B

*) Classification according to IEC 61508-2:2010 (see chapters 7.4.4.1.2 and 7.4.4.1.3)

The AX5805 drive option card can be used for safety-related applications within the meaning of IEC 61508:2010 up to SIL3 and EN ISO 13849-1 up to PL e (Cat4).

1) Special proof tests for the product are not required during the lifetime of the AX5805 drive option card as a result of the high diagnostic coverage of the system.

Munich, 2016-03-07

Günter Greil

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Datum: 2016.03.07 17:52:49 +01'00'

Reliability of AX5806

Test and Certification body

TÜV SÜD Rail GmbH
Rail Automation - IQSE
Barthstraße 16
D-80339 Munich

Manufacturer

Beckhoff Automation GmbH & Co. KG
Huelshorstweg 20
D-33415 Verl

Safety parameters AX5806

Key figures	AX5806
Lifetime [a]	20
Prooftest Intervall [a]	not required [1)]
PFH_D	see document “AX5806 List of permitted motors”
%SIL3	see document “AX5806 List of permitted motors”
$MTTF_d$	High
$B10_d$ (cycles)	-
DC	High
Performance level	PL e
Category	4
HFT	1
Element classification*	Type B

*) Classification according to IEC 61508-2:2010 (see chapters 7.4.4.1.2 and 7.4.4.1.3)

The AX5806 drive option card can be used for safety-related applications within the meaning of IEC 61508:2010 up to SIL3 and EN ISO 13849-1 up to PL e (Cat4).

[1)] Special proof tests for the product are not required during the lifetime of the AX5806 drive option card as a result of the high diagnostic coverage of the system.

Munich, 2016-03-07

Günter Greil

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DN: c=DE, o=TUEV SUED Rail GmbH, ou=Rail & Automation, cn=Guenter Greil, email=guenter.greil@tuev-sued.de
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ZERTIFIKAT ◆ CERTIFICATE ◆ 認證書 ◆ СЕРТИФИКАТ ◆ CERTIFICADO ◆ CERTIFICAT

Product Service

CERTIFICATE

No. Z10 18 03 62386 050

Holder of Certificate: **Beckhoff Automation GmbH & Co. KG**
Hülshorstweg 20
33415 Verl
GERMANY

Factory(ies): 62386

Certification Mark:

Product: **Safety components**

Model(s): **AX5805/5806 for use in AX5000-0000-0200-Series**

Parameters:
Safety Functions:
STO, SS1, SS2, SOS,
SLS, SSM, SSR, SMS,
SLP, SCA, SLI, SAR,
SMA, SDI
PL e, CAT 4 (EN ISO 13849)
SIL 3 (EN 61508)
SILCL 3 (EN 62061)

Tested according to:
2006/42/EC
EN ISO 13849-1:2015 (Cat.4, PL e)
EN 61508-1:2010 (SIL 3)
EN 61508-2:2010 (SIL 3)
EN 61508-3:2010 (SIL 3)
EN 61508-4:2010 (SIL 3)
EN 62061:2005/A2:2015 (SILCL 3)
EN 61800-5-2:2017

The product was tested on a voluntary basis and complies with the essential requirements. The certification mark shown above can be affixed on the product. It is not permitted to alter the certification mark in any way. In addition the certification holder must not transfer the certificate to third parties. See also notes overleaf.

Test report no.: BV83877T

Valid until: 2023-03-26

Date, 2018-03-27 (Guido Neumann)

Page 1 of 1

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