Instruction Manual

AX5805

TwinSAFE drive option card for the AX5000 servo drive

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BECKHOFF

Table of contents

1 Foreword 3
1.1 Notes on the manual 3
1.1.1 Disclaimer 3
1.1.2 Brands 3
1.1.3 Patents 3
1.1.4 Copyright 3
1.1.5 Delivery conditions 3
1.2 Safety instructions 4
1.2.1 Delivery state 4
1.2.2 Operator's obligation to exercise diligence 4
1.2.3 Safety symbols used in this manual 5
2 System description 6
3 Product description 7
3.1 General description 7
3.2 Intended use 8
3.3 Technical data 12
3.3.1 Reaction times for the AX51xx 13
3.3.2 Reaction times for the AX52xx 13
3.4 Installation 14
3.4.1 Safety instructions 14
3.4.2 Transport and storage 14
3.4.3 Installation of the AX5805 14
3.4.4 Permitted motors 17
3.4.5 Firmware 17
3.5 Configuration of the AX5805 in the TwinCAT System Manager 18
3.5.1 Configuration requirements 18
3.5.2 Inserting an AX5805 18
3.5.3 Registering the TwinSAFE address in the TwinCAT System Manager 21
3.6 Parameterization of the AX5805 in the TwinCAT System Manager 22
3.6.1 Units and calculations 22
3.6.2 Configuration of the process image of the AX5805 24
3.6.3 Setting the mode of operation 33
3.6.4 Parameterization and referencing of the safe position 36
3.6.5 Parameterization of the integrated safety functions of the AX5805 40
3.6.6 Configuring the error reaction 86

3.7 First Steps – AX5805 87
3.7.1 Step 1: parameterize the AX5103 servo drive 87
3.7.2 Step 2: parameterize the AX5805 87
3.7.3 Step 3: link Error_Acknowledge in Safe PLC 89
3.7.4 Step 4: Link the SDIn safety function in the Safe PLC 90
3.7.5 Step 5: Implementation of an EMERGENCY STOP button 91
4 Error and diagnosis 93
4.1 Error indices in CoE object 0xFA82 93
4.2 Reason for shut-down CoE Objects 0xFA10:07 and 0xFA10:08 99
4.3 Diagnose CoE Object 0xFA10 100
4.3.1 0xFA10:01 = 0 100
4.3.2 0xFA10:01 = 1 100
4.3.3 0xFA10:01 = 2 100
4.3.4 0xFA10:01 = 3 101
4.3.5 0xFA10:01 = 4 101
4.3.6 0xFA10:01 = 5 101
4.3.7 0xFA10:01 = 6 102
4.3.8 0xFA10:01 = 7 102
4.3.9 0xFA10:01 = 8 102
4.4 Maintenance 103
4.4.1 Cleaning the AX5805 103
4.4.2 Lifespan and proof tests 103
4.5 Decommissioning 103
4.5.1 Disposal 103
5 Appendix 104
5.1 Beckhoff Support and Service 104
5.1.1 Beckhoff branches and partner companies Beckhoff Support 104
5.1.2 Beckhoff company headquarters 104
5.2 Certificate 105

1 Foreword

1.1 Notes on the manual

This description is only intended for the use of trained specialists in control and automation technology who are familiar with the applicable national standards. It is essential that the following notes and explanations are followed when installing and commissioning these components.
The responsible staff must ensure that the application or use of the products described satisfy all the safety requirements, including all the relevant laws, regulations, guidelines and standards.

1.1.1 Disclaimer

This documentation has been prepared with care. The products described are, however, constantly under development. For this reason, the documentation may not always have been fully checked for consistency with the performance data, standards or other characteristics described.
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.

1.1.2 Brands

Beckhoff®, TwinCAT®, EtherCAT®, Safety over EtherCAT®, TwinSAFE® and XFC® are registered and licensed brand names of Beckhoff Automation GmbH.
The use by third parties of other brand names or trademarks contained in this documentation may lead to an infringement of the rights of the respective trademark owner.

1.1.3 Patents

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 the corresponding applications and registrations in various other countries.

1.1.4 Copyright

1.1.5 Delivery conditions

In addition, the general delivery conditions of the company Beckhoff Automation GmbH 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.

1.2.2 Operator's obligation to exercise diligence

The operator must ensure that

- the TwinSAFE products are only used as intended (refer to Chapter 3);
- the TwinSAFE products are only operated in sound condition and in working order (refer to Chapter 4.4.1).
- 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 Safety symbols used in this manual

The following safety symbols are used in this manual to bring specific safety instructions to the reader's attention.

 **DANGER**	**Risk of immediate personal injury or death** Failure to follow these instructions may *immediately* lead to personal injury or death.
 **WARNING**	**Risk of personal injury or death** Failure to follow these instructions may lead to personal injury or death.
 **CAUTION**	**Risk of personal injury** Failure to follow these instructions may lead to personal injury.
Attention	**Risk of property damage** Failure to follow these instructions may lead to property damage.
 **Note**	**Important** This symbol identifies information that is critical for applying and understanding this product correctly.

2 System description

By integrating safety technology into its drive technology, Beckhoff has extended the TwinSAFE system philosophy into the drive in a manner consistent with existing TwinSAFE products. TwinSAFE enables integrated safety automation, ranging from digital inputs and logic systems to drives and digital outputs. Simple diagnostics and easy to use functions help the user implement the required application quickly and safely.

Significant hazards to persons arise from the dynamic movements of the electrical drive equipment of machines. Controlling these hazards while achieving smooth production flow can be a significant challenge.

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

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

This enables a lean installation and helps to lower costs and cabinet space. No special encoder system is required in order to implement the SDI (Safe Direction) or SLS (Safely Limited Speed) functions. All of Beckhoff's motors listed in the document 'AX5805 – List of permitted motors' can be used without further expenditure and without additional encoder systems for these functions. Even safe position monitoring or position range monitoring is simple to implement with the aid of the AX5805 safety option card.

Adding the AX5805 does not require any additional wiring, since EtherCAT communication is used in the AX5xxx basic controllers. The AX5805 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.

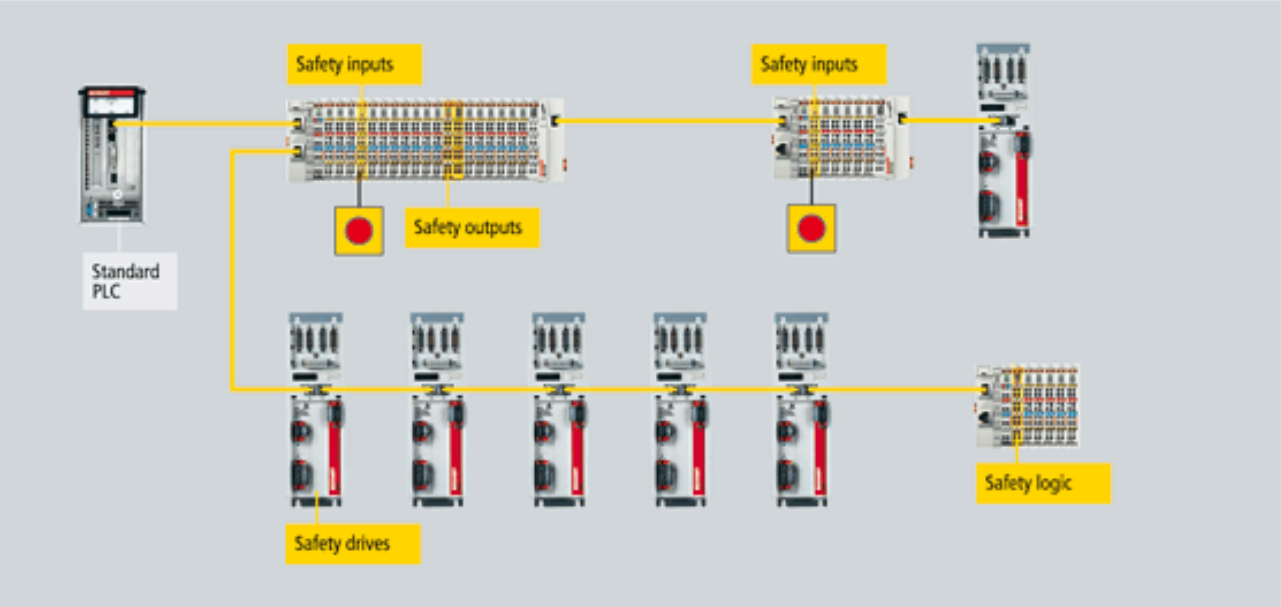


Figure 1: TwinSAFE system overview

3 Product description

3.1 General description

AX5805 – TwinSAFE drive option card AX5000 series drive controllers

The AX5805 TwinSAFE drive option card is an optional extension for Beckhoff's AX5000 servo drive series. The following safety functions can be implemented by installing the AX5805 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)

Similarly to when programming or configuration of the safety application, the entire parameterization of the AX5805 option card is performed in the TwinCAT software. All system-specific settings are stored together with the application in the TwinSAFE logic terminal or in the AX5805 startup parameters. This makes it possible to switch out the AX5805 at any time – without changing the software. The AX5805 receives all necessary parameters at the next switch on or boot-up.

The AX5805 fulfills the requirements of IEC 61508 SIL 3 and DIN EN ISO 13849-1:2006 (Cat 4, PL e).

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

Attention	**Compatibility of the AX5000 and AX5805** The AX5805 can be used only in servo drives AX5xxx-0000-x2xx. Attempting to install the AX5805 into AX5000 servo drives of a previous version can cause irreparable damage to the AX5000.

3.2 Intended use

 WARNING	**Intended use** Using the TwinSAFE drive option card for purposes other than intended, as described below, is not permitted!

The AX5805 TwinSAFE drive option card extends the field of use of the Beckhoff AX5000 servo drive by enabling safety functions that allow the servo drive to 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	**Remove power prior to 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.

 DANGER	**Parameter set change of the AX5000!** The changing of the parameter sets of the AX5000 can not be used together with the AX5805.

 WARNING	**Risk of personal injury or death** 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	**Correctness of the parameters for a specific application** The AX5805 can check if its parameters are set correctly. It cannot check if the parameters are correct for a specific application. This can only be checked in an acceptance test, which the machine manufacturer must perform. Especially the parameter Speed_Compare_Window should be left on the default value. This parameter has a direct influence on the safety functions.

 **WARNING**	**Providing additional external safety measures for STO** When it is activated, STO initiates a coast-to-stop action. No braking is applied to the connected motors; the torque applied to the motor is switched off and the motor coasts to a stop. The time and distance it takes for the motor to stop depends on the mechanics and kinetic energy present in the system. If there are loads suspended from the motor, the motor may even be accelerated. The user must provide external safety mechanisms (e.g. mechanical brakes) to prevent such inadvertent motion.

 **WARNING**	**Providing additional external safety measures for STO and SS1** When it is activated, STO initiates a coast-to-stop action. No braking is applied to the connected motors; the torque applied to the motor is switched off and the motor coasts to a stop. The time and distance it takes for the motor to stop depends on the mechanics and kinetic energy present in the system. If there are loads suspended from the motor, the motor may even be accelerated. The user must provide external safety mechanisms (e.g. mechanical brakes) to prevent such inadvertent motion. When the TwinSAFE drive option card determines that an error has occurred, the preconfigured error reaction is activated. The standard error reaction is STO, but for certain functions (SSR, SAR, SLI, SLP, SLS, SMA, and SMS), the SS1 error reaction can also be parameterized. When the SS1 error reaction is executed, the AX5805 TwinSAFE Drive option card triggers an emergency stop ramp in the AX5000. This is purely functional and is not a safety function. The STO safety function (Safe Torque Off) is activated after the motor reaches SS1 or the time set by the ESTOP Ramp Time parameter has elapsed. Any motors that are still moving after the ESTOP Ramp Time has elapsed will coast to a stop. If there are loads suspended from the motor, the motor may even be accelerated. In order to avoid inadvertent movements, external safety mechanisms (e.g. mechanical brakes) must be provided by the user.

 **WARNING**	**Avoiding power interruptions** Power interruptions activate STO (Safe Torque Off), removing all torque from the motor. Any motors that are moving coast to a stop. If there are loads suspended from the motor, the motor may even be accelerated. The user must provide external safety mechanisms (e.g. mechanical brakes) to prevent such inadvertent motion.

 **WARNING**	**Faults and interruptions in the EtherCAT communication** Faults and interruptions in the EtherCAT communication activate STO (Safe Torque Off), removing all torque from the motor. Any motors that are moving coast to a stop. If there are loads suspended from the motor, the motor may even be accelerated. The user must provide external safety mechanisms (e.g. mechanical brakes) to prevent such inadvertent motion.

 WARNING	**Activating or restarting a project in the TwinCAT System Manager** Activating or restarting a project in the TwinCAT System Manager activates STO (Safe Torque Off), removing all torque from the motor. Any motors that are moving coast to a stop. If there are loads suspended from the motor, the motor may even be accelerated. The user must provide external safety mechanisms (e.g. mechanical brakes) to prevent such inadvertent motion.

 WARNING	**Downloading the safety project to the EL6900 TwinSAFE PLC** Downloading the safety project to the EL6900 TwinSAFE PLC activates STO (Safe Torque Off), removing all torque from the motor. Any motors that are moving coast to a stop. If there are loads suspended from the motor, the motor may even be accelerated. The user must provide external safety mechanisms (e.g. mechanical brakes) to prevent such inadvertent motion.

 WARNING	**The servo drive must be configured correctly** Incorrect parameterization of the servo drive (e.g. current controller oscillates or is too lethargic) activates STO (Safe Torque Off). Any motors that are moving coast to a stop. If there are loads suspended from the motor, the motor may even be accelerated. The user must provide external safety mechanisms (e.g. mechanical brakes) to prevent such inadvertent motion.

 WARNING	**The servo drive must be dimensioned appropriately** Loads that cannot be stopped by the AX5000 servo drive without faulting (e.g. if the AX5000 servo drive is under-dimensioned) activate STO (Safe Torque Off). Any motors that are moving coast to a stop. If there are loads suspended from the motor, the motor may even be accelerated. The user must provide external safety mechanisms (e.g. mechanical brakes) to prevent such inadvertent motion.

 WARNING	**Change of the EtherCAT State** When changing the EtherCAT state of the AX5805 to BOOT, the disconnecting circuits will be switched off immediatelly and the brake stays in its current state. Due to this it can happen that the brake remains opened in case of standstill. In general the axis has to be in a safe state that it is allowed to change the EtherCAT state.

 CAUTION	**For use in machinery per the Machinery Directive** The TwinSAFE Drive option cards may only be used in machines as defined in the Machinery Directive (Directive 2006/42/EC on machinery).

 CAUTION	**Ensuring traceability of serial numbers** The buyer must ensure the traceability of the AX5805 via its serial number.

3.3 Technical data

Product name	AX5805
Fault response time	see tables in chapters 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
Permissible contamination level	Contamination level 2 according to EN 61800-5-1 (see also chapter ‘Cleaning’)
Unacceptable operating conditions	TwinSAFE products must not be used under the following operating conditions: - in the presence of ionizing radiation - in corrosive environments - in an environment that leads to contamination of the safety option card
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

The user must ensure that the TwinSAFE option card is only transported, stored and operated under the conditions specified in technical data (refer to table above).

WARNING

Prohibited operating conditions

The TwinSAFE drive option cards may not be used under the following operating conditions:

- in the presence of ionizing radiation
- in corrosive environments
- in an environment that leads to contamination of the safety option card

3.3.1 Reaction times for the AX51xx

The reaction time is the amount of time from a safety-related event is received (as an input signal to the AX5805) until the internal circuits are switched off. 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.

Firmware ≤ 04

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

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

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

3.3.2 Reaction times for the AX52xx

The reaction time is the amount of time from a safety-related event is received (as an input signal to the AX5805) until the internal circuits are switched off. 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.

Firmware ≤ 04

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

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

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

Note	**STO mode reaction times** The reaction times for the STO mode are only valid, when both axis are configured for the STO mode.

3.4 Installation

3.4.1 Safety instructions

Before installing and commissioning the TwinSAFE drive option cards, refer to the safety instructions in the Foreword of this User Manual (Chapter 1).

3.4.2 Transport and storage

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

 **CAUTION**	**Adhering to the specified environmental conditions** The user must ensure that the TwinSAFE option card is only transported, stored and operated under the conditions specified in technical data.

3.4.3 Installation of the AX5805

 **DANGER**	**Remove power prior to 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

3.4.3.1 Installation requirements

The AX5805 can be used only in servo drives AX5xxx-0000-x2xx.

Attention	**Risk of property damage** Attempting to install the AX5805 into AX5000 servo drives of a previous version can cause irreparable damage to the AX5000.

3.4.3.2 Setting the TwinSAFE address of the AX5805

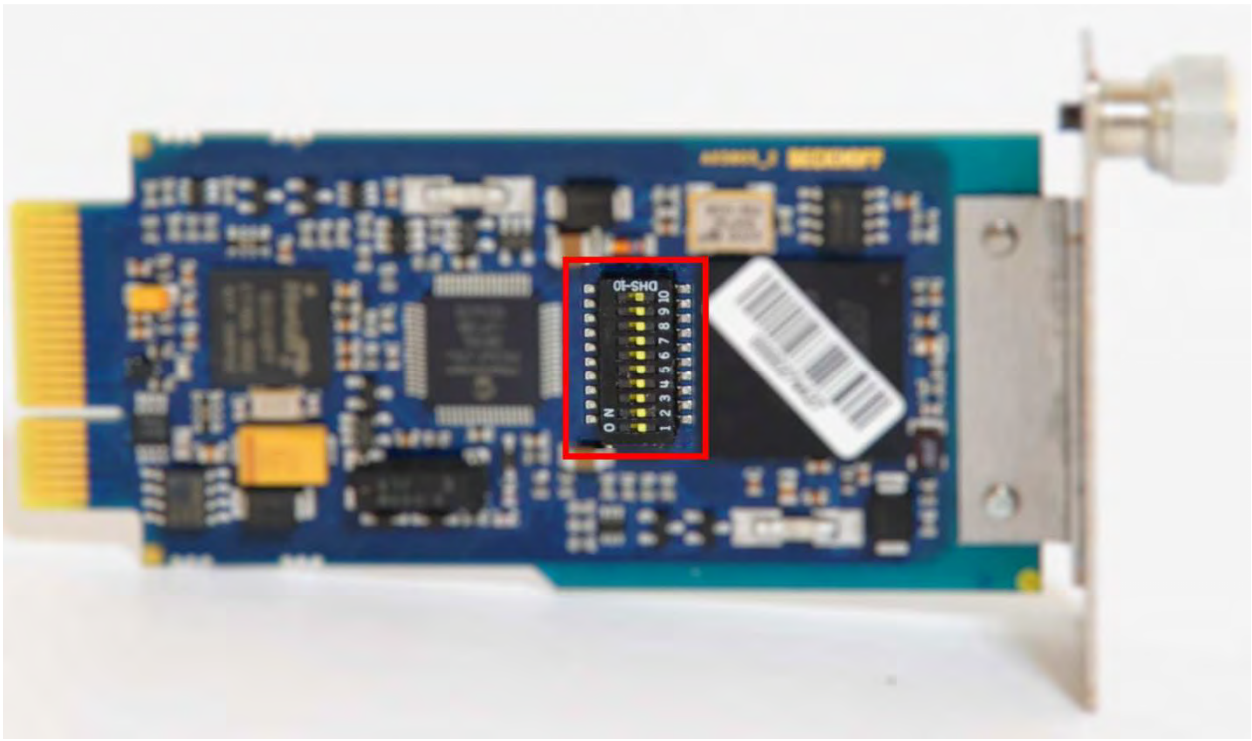


Figure 2: DIP switch for setting the TwinSAFE address

The TwinSAFE address can be set via the 10-way DIP switch seen in Figure 2. The 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	
OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	0
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	**Each TwinSAFE address must be unique** Each TwinSAFE address may only be used once per network.

3.4.3.3 Mounting the AX5805

Figure 3: Safety slot in the AX5000

The AX5805 is inserted from above into the card slot marked ‘Safety’ in the AX5000 servo drive (see Figure 3: Safety slot in the AX5000) and secured by the screw.

Attention	**Install carefully** Insert the AX5805 carefully, without using force.

3.4.3.4 Removing the AX5805

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

3.4.4 Permitted motors

The AX5805 TwinSAFE Drive option card supports only synchronous Beckhoff servo motors with encoders.

 **CAUTION**	**Restrictions for motors** - Only specific Beckhoff rotary synchronous servo motors with position feedback are permitted for use with the AX5805. - Modifying an approved motor is not permitted. - Use of another manufacturer's motor is not permitted. - Use of a linear motor is not permitted.

Further details regarding motor types can be found in the document 'AX5805 – List of permitted motors'. The associated PFH values for a safety-related calculation can also be found in this document.

3.4.5 Firmware

According to the installed firmware on the AX5805 there are different settings in the safe parameters possible.

Firmware AX5805	Revision number	Firmware AX5000	Safe Parameter MotorDefaultData (0x2x40)
≤ 04	AX5805-0000-0016	any	according to the 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

To configure the AX5805, Version 2.11 build 2041 or higher of the TwinCAT automation software is required. The current version can be downloaded from the Beckhoff website at www.beckhoff.com.

3.5.2 Inserting an AX5805

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

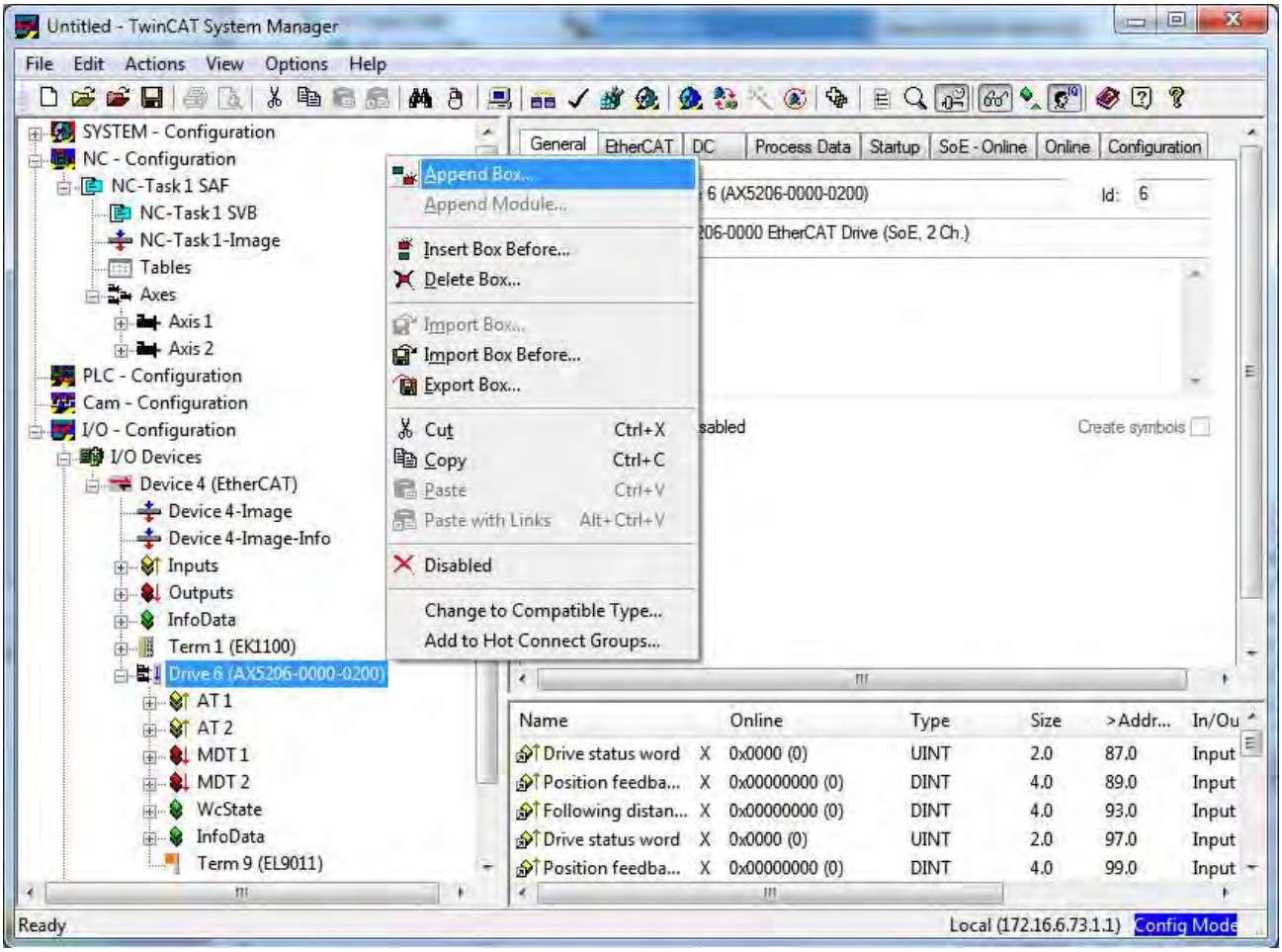


Figure 4: Adding the AX5805 in the TwinCAT System Manager

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

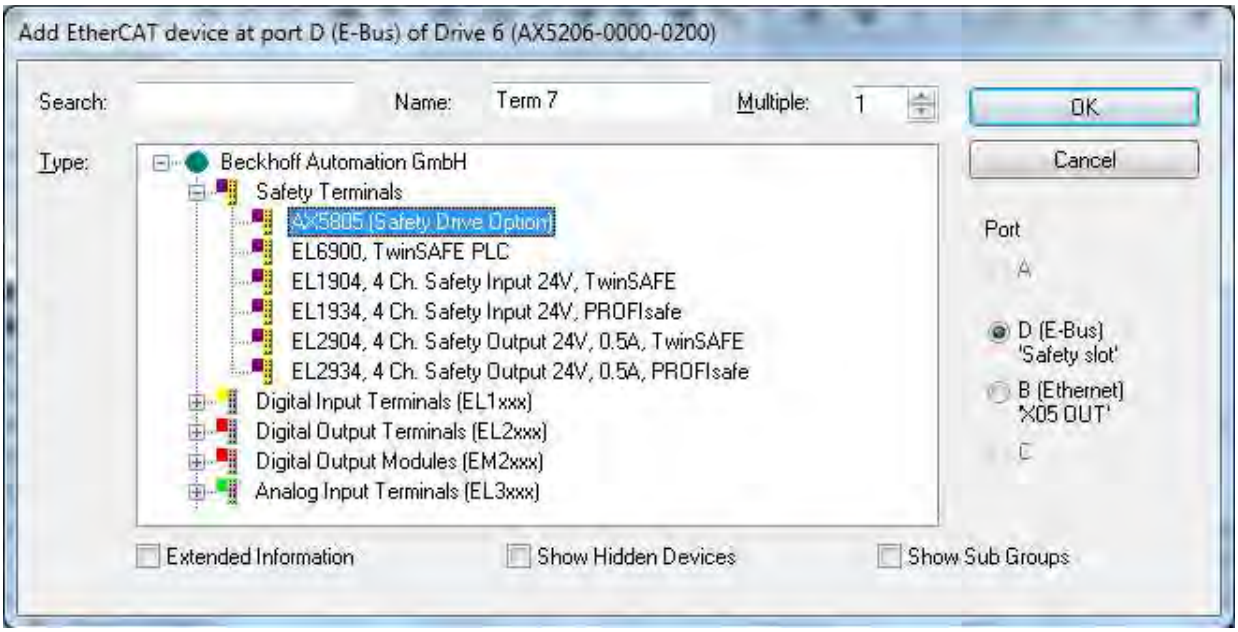


Figure 5: Selecting the AX5805 as the basis

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 checks whether the modules that have been selected match the servo drive.

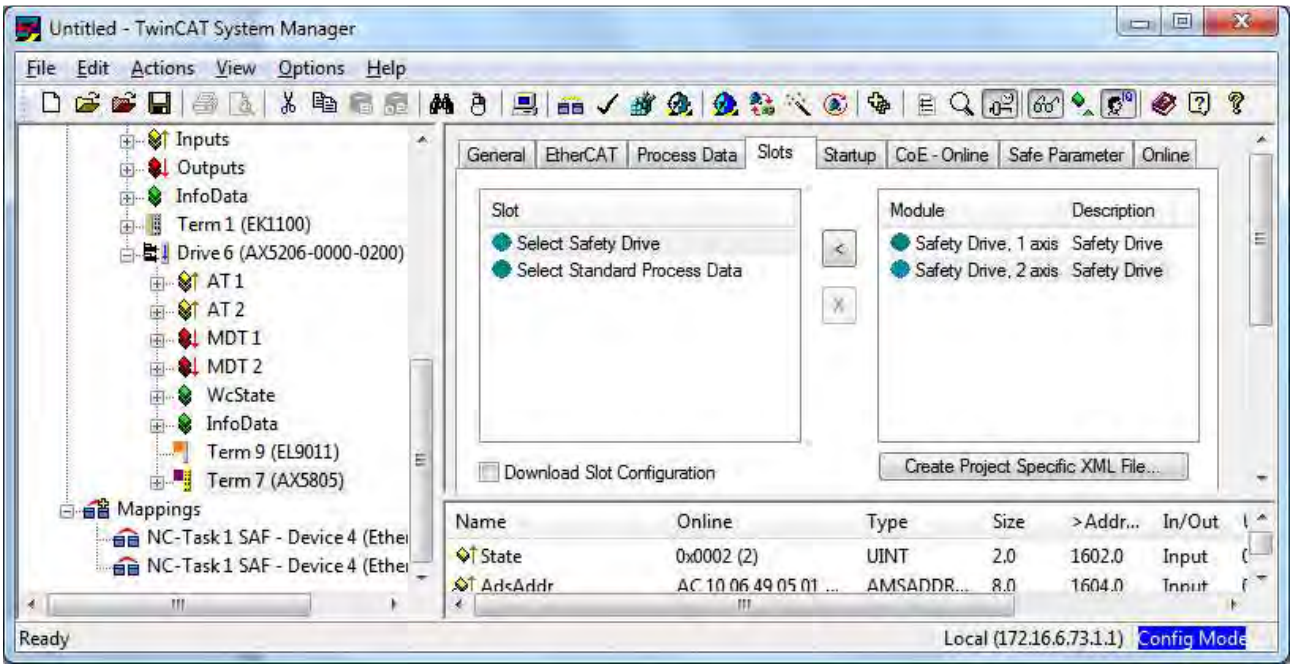


Figure 6: Inserting the safety module in the AX5805

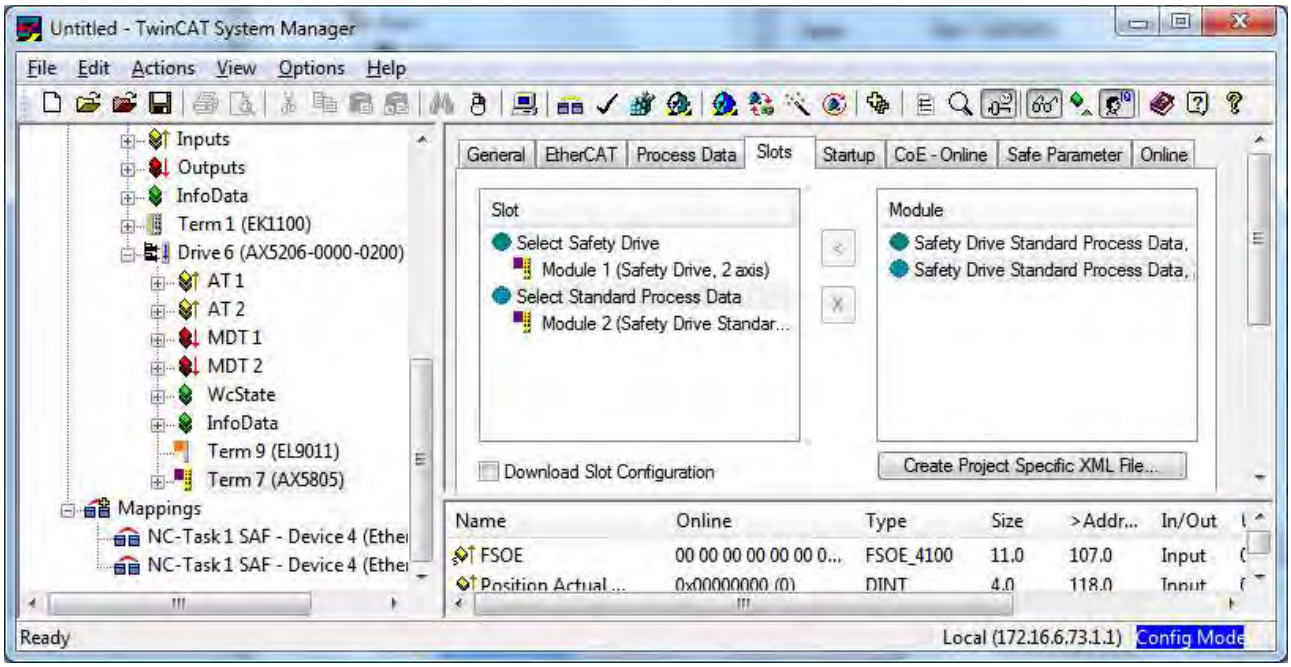


Figure 7: Inserting the standard module in the AX5805

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).

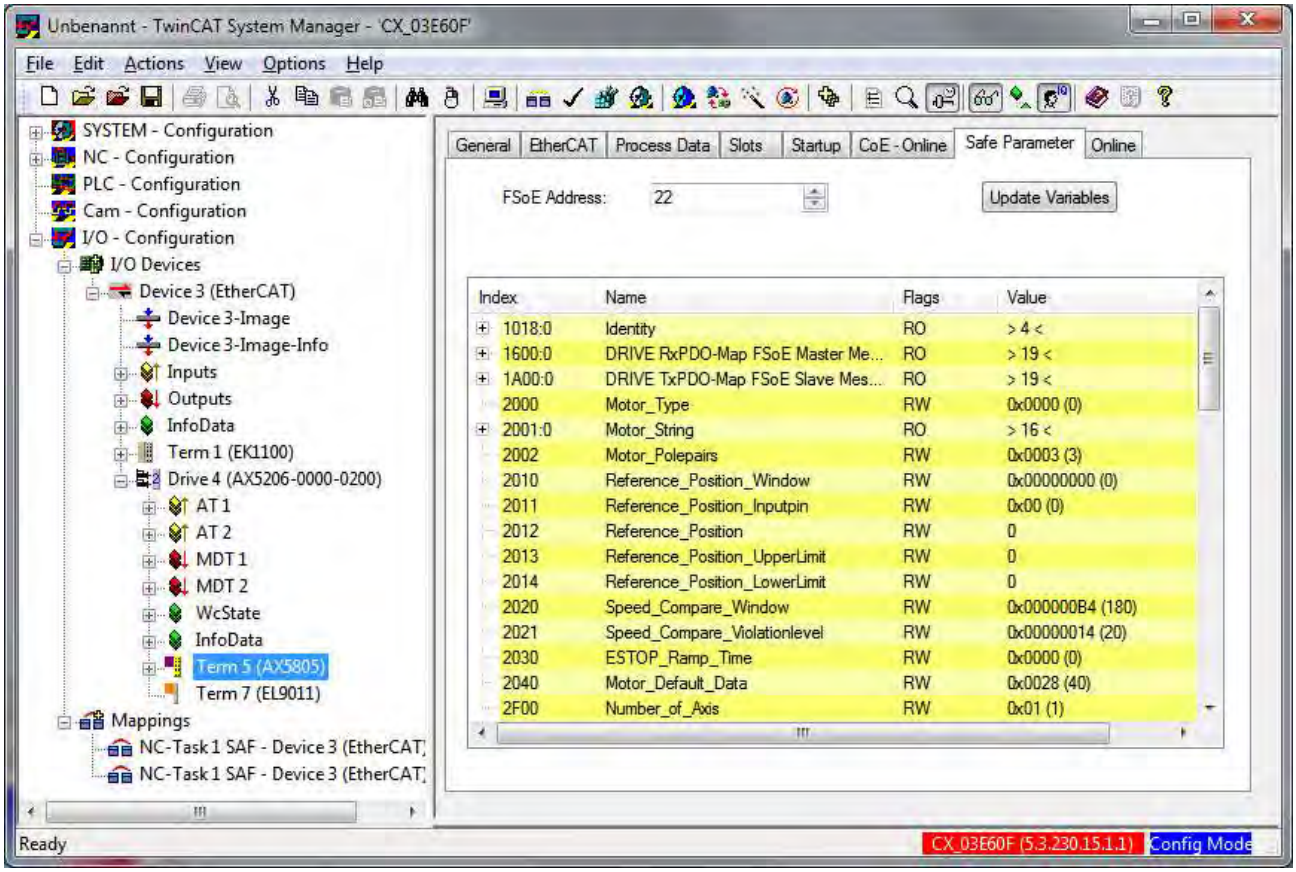
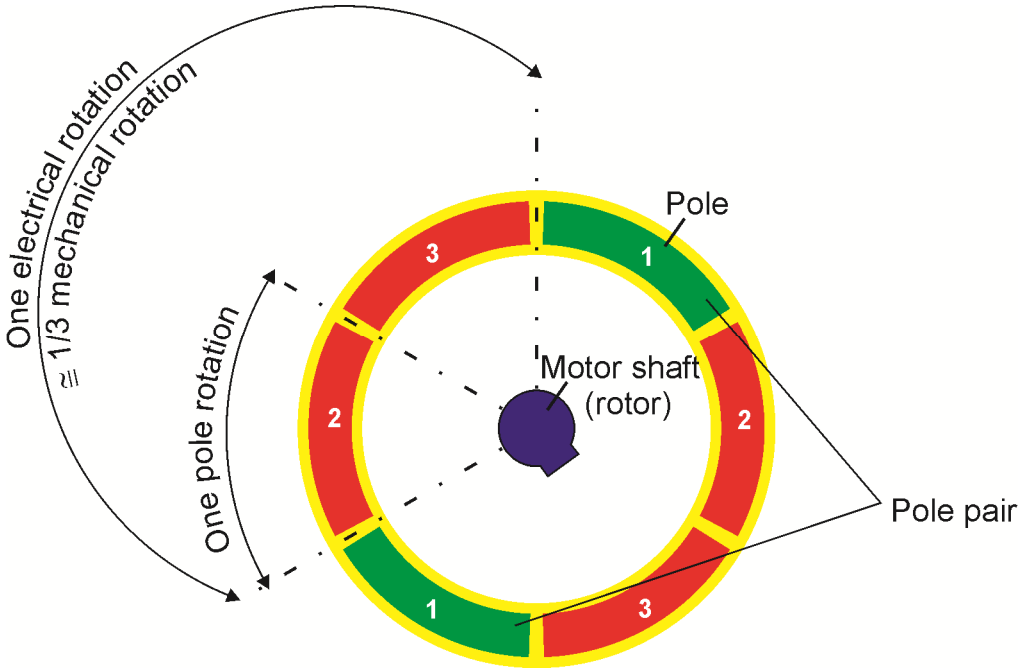


Figure 8: Registering the TwinSAFE address in the TwinCAT System Manager

3.6 Parameterization of the AX5805 in the TwinCAT System Manager

3.6.1 Units and calculations



Relationship of electrical angle to 1 mechanical motor revolution:

$$\mathbf{1°}\ \boldsymbol{electrical\ angle} = \frac{\mathbf{1°}\ \boldsymbol{mechanical\ angle}}{\boldsymbol{pole\ pairs} * \mathbf{2}}$$

Position - relation between increments and mech. angle:

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

Example position - calculation SOS (AM302x - 3 pole pairs; position area - 10 revolutions):

$$\boldsymbol{increments} = \frac{\mathbf{3} * \mathbf{65536}}{\mathbf{360°}} * \mathbf{3600°} = \mathbf{1.966.080}\ \boldsymbol{increments}$$

Unit for position window (e.g. for SLP) (pole revolution)

$$\boldsymbol{pole\ revolution} = \frac{\boldsymbol{mechanical\ revolution}}{\boldsymbol{pole\ pairs} * \mathbf{2}}$$

Speed - calculation in increments/ms:

$$\boldsymbol{increments\ per\ ms} = \mathbf{2} * \mathbf{65536} * \boldsymbol{pole\ pairs} * \boldsymbol{revolution\ per\ ms}$$

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

$$\mathbf{500}\frac{\boldsymbol{R}}{\boldsymbol{min}} = \mathbf{8,33}\frac{\boldsymbol{R}}{\boldsymbol{s}} = \mathbf{0,00833}\frac{\boldsymbol{R}}{\boldsymbol{ms}}$$

$$\mathbf{250}\frac{\boldsymbol{R}}{\boldsymbol{min}} = \mathbf{4,166}\frac{\boldsymbol{R}}{\boldsymbol{s}} = \mathbf{0,004166}\frac{\boldsymbol{R}}{\boldsymbol{ms}}$$

$$\boldsymbol{increments\ per\ ms}\ (\mathbf{500}\frac{\boldsymbol{R}}{\boldsymbol{min}}) = \mathbf{2} * \mathbf{65536} * \mathbf{3}\frac{\boldsymbol{incr}}{\boldsymbol{R}} * \mathbf{0,00833}\frac{\boldsymbol{R}}{\boldsymbol{ms}} = \mathbf{3275}\frac{\boldsymbol{incr}}{\boldsymbol{ms}}$$

$$\boldsymbol{increments\ per\ ms}\ (\mathbf{250}\frac{\boldsymbol{R}}{\boldsymbol{min}}) = \mathbf{2} * \mathbf{65536} * \mathbf{3}\frac{\boldsymbol{incr}}{\boldsymbol{R}} * \mathbf{0,004166}\frac{\boldsymbol{R}}{\boldsymbol{ms}} = \mathbf{1638}\frac{\boldsymbol{incr}}{\boldsymbol{ms}}$$

Acceleration - calculation in increments/ms²:

$$\boldsymbol{increments\ per\ ms^2} = \mathbf{2} * \mathbf{65536} * \boldsymbol{pole\ pairs} * \boldsymbol{revolution\ per\ ms^2}$$

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

$$\boldsymbol{increments\ per\ ms^2} = \mathbf{2} * \mathbf{65536} * \mathbf{3}\frac{\boldsymbol{incr}}{\boldsymbol{U}} * \mathbf{100}\frac{\boldsymbol{U}}{\boldsymbol{s^2}} = \mathbf{39.321.600}\frac{\boldsymbol{incr}}{\boldsymbol{s^2}} = \mathbf{39,32}\frac{\boldsymbol{incr}}{\boldsymbol{ms^2}}$$

3.6.2 Configuration of the process image of the AX5805

3.6.2.1 General

The safety functions of the AX5805 are activated or deactivated in the control word and the current states of the safety functions are returned in the status word. The control words consist of one byte with fixed data and one byte with configurable data.

The mappings for control and status word are set via the objects 0x1600 and 0x1A00 in the *Safe Parameters* of the AX5805. The configuration 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 before the creation of a Safety PLC project. The links to the Safety PLC are deleted after each change of the process image.

Note	**Order of execution of the safety functions** The safety functions are executed in the same order as in the control word.

Note	**Priority of safety functions** The safety function STO (safe torque off) has the highest priority, i.e. any other activated safety function, e.g. SLS (safe limited speed), can be interrupted by activating STO.

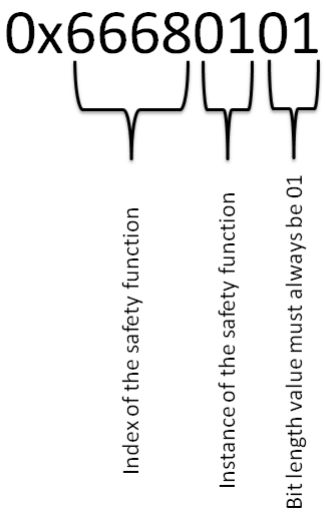


Figure 9: Example for SOS_1:

Note	**Instance of the safety function** Functions are instanced starting at 1. Safety functions that have a maximum of one instance (Restart_Request, Safe Maximum Speed, Safe maximum Acceleration) must be mapped with instance number 0.

3.6.2.2 Control word default mapping for axis 1 (1st byte, fixed feature set)

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

Figure 10: Control word default mapping for axis 1

3.6.2.3 Control word user mapping for axis 1 (2nd byte, configurable feature set)

Control word user mapping for axis 1 1600:0A - 1600:11
The 8 bits in second half of the Control word for axis 1 can be freely configured to contain up to a total of 8 of the following functions. E.g. if 6 safe stop instances are chosen, only 2 other instances can be implemented.

Index	Name	Maximum number of instances
0x6630	Restart_Ack	1
0x6650	Safe Stop 1	8
0x6670	Safe Stop 2	8
0x6668	Safe operating stop	8
0x6680	Safe Speed Range	8
0x6690	Safely Limited Speed	8
0x66A0	Safely Limited Position	8
0x66B0	Safely Limited Increment	8
0x66C0	Safe Acceleration Range	8

Figure 11: Control word user mapping for axis 1

3.6.2.4 Control word default mapping for axis 2 (1st byte, fixed feature set)

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

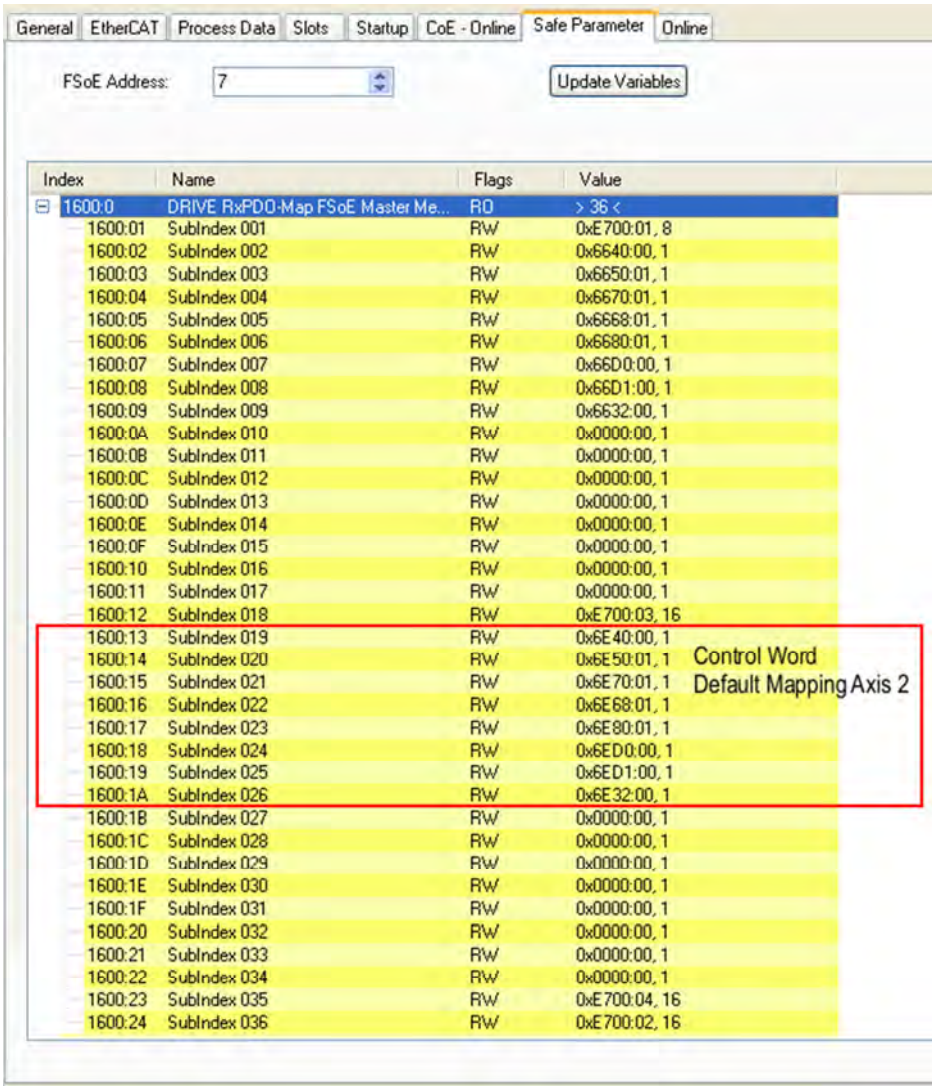


Figure 12: Control word default mapping for axis 2

3.6.2.5 Control word user mapping for axis 2 (2nd byte, configurable feature set)

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	Restart_Acknowledge	1
0x6E50	Safe Stop 1	8
0x6E70	Safe Stop 2	8
0x6E68	Safe operating stop	8
0x6E80	Safe Speed Range	8
0x6E90	Safely Limited Speed	8
0x6EA0	Safely Limited Position	8
0x6EB0	Safely Limited Increment	8
0x6EC0	Safe Acceleration Range	8

Figure 13: Control word user mapping for axis 2

3.6.2.6 Status word default mapping for axis 1 (1st byte, fixed feature set)

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

Figure 14: Status word default mapping for axis 1

3.6.2.7 Status word user mapping for axis 1 (2nd byte, configurable feature set)

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	Maximum 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

Figure 15: Status word user mapping for axis 1

3.6.2.8 Status word default mapping for axis 2 (1st byte, fixed feature set)

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 positive (Axis 2 SDIn)	none	0x6ED10001
7	Error Acknowledge (Axis 2 ErrAck)	none	0x6E320001

Figure 16: Status word default mapping for axis 2

3.6.2.9 Status word user mapping for axis 2 (2nd byte, configurable feature set)

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	Comment
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

Figure 17: Status word user mapping for axis 2

3.6.3 Setting the mode of operation

3.6.3.1 General

The AX5805 has two modes of operation. The standard mode has the full range of the AX5805's functions, while the STO mode has a more restricted range of functions.

3.6.3.2 Standard mode

When operated in standard mode, the AX5805 supports all of its available safety functions. To ensure correct operation, at minimum, the following objects must be parameterized correctly. The parameters are checked when the AX5805 is started up. It is only possible to use a safety function 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	Do not change default value	--	0x000000B4
0x2021	Speed_Compare_Violationlevel	Number of 125 µs cycles in which the speed may be outside the Speed_Compare_Window (value range 0-255)	--	0x00000014
0x2030	ESTOP_Ramp_Time	The amount of time in SS1, after which STO is activated	ms	0x0000
0x2040	Motor_Default_Data	This is a parameter specific to the motor, and can be found in the document "AX5805_Default_Values.pdf"	--	0x0028
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	Do not change default value	--	0x000000B4
0x2821	Speed_Compare_Violationlevel	Number of 125 µs cycles in which the speed may be outside the Speed_Compare_Window (value range 0-255)	--	0x00000014
0x2830	ESTOP_Ramp_Time	The amount of time in SS1, after which STO is activated	ms	0x0000
0x2840	Motor_Default_Data	This is a parameter specific to the motor, and can be found in the document "AX5805_Default_Values.pdf"	--	0x0028
0x2F00	Number_of_Axis	Number of axes	--	0x0000
0x2F01	STO_Mode_Active	Activate STO mode	--	FALSE
0x2F02	Debug_Mode_Active	This parameter must be set to FALSE.	--	FALSE

When parameterizing the motor string, the value must be entered as ASCII code.
Detailed information can be found in the document AX5805_MotorDefaultValues_en.pdf.

Example

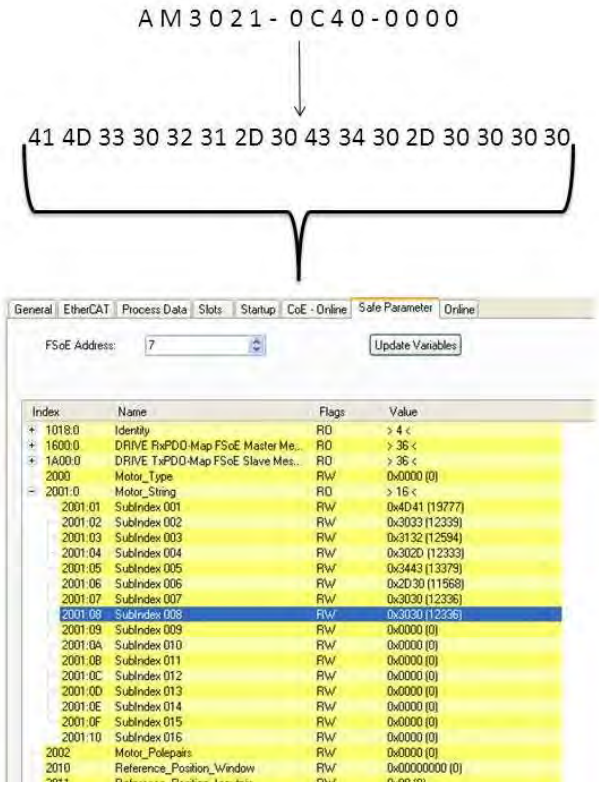


Figure 18: Input of the motor string

Beginning from TwinCAT version 2.11 Build 2230 the motor string can be entered in a textual way.

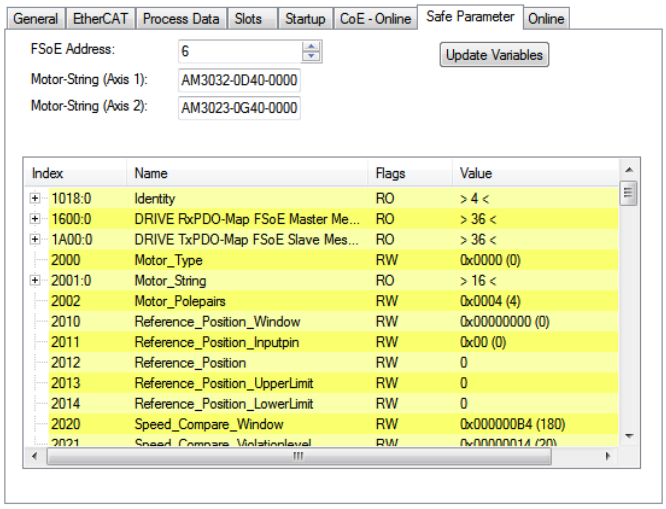


Figure 19: Input of the textual motor string

3.6.3.3 STO-mode

When it is operated in STO-mode, the AX5805 does not evaluate any motor data or the parameters of the safety functions. It is able to execute the STO function, tests the circuitry that is switched off, and can remove all torque from the motor.

The following table contains the minimum parameters that must be set for 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 parameter must be set to FALSE.	--	FALSE

Starting from firmware 05 and revision number AX5805-0000-0017 the following table contains the minimum parameters that must be set for using the STO 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 axis	--	0x0000
0x2F02	Debug_Mode_Active	This parameter must be set to FALSE.	--	FALSE

Note

Restrictions in STO mode

When it is in STO mode, the AX5805 does not evaluate any motor data or the parameters of the safety functions.

In order to enable and move the axis/axes, the bits in the control word for the safety functions STO and SS1 (including all of their instances) must be set to 1.

The bits of the safety function SS1 do not have any functionality.

3.6.4 Parameterization and referencing of the safe position

The SLP (Safely Limited Position) and SCA (Safe CAM) safety functions can be used only after the axis has been homed and the referencing cam has been encountered and the safety position has been referenced.

3.6.4.1 Requirements

An external position (e.g. position of the NC) must be linked with the standard process image (Position Actual Value) of the AX5805. The external position (e.g. NC Position of the axis) must be referenced/homed prior to the AX5805 Reference input being turned on. In the case where an incremental encoder is used, the axis must be homed prior to the referencing input being turned on.

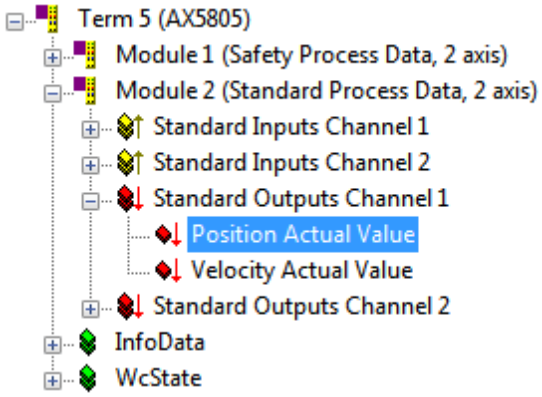


Figure 20: An external position must be linked with the AX5805

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.

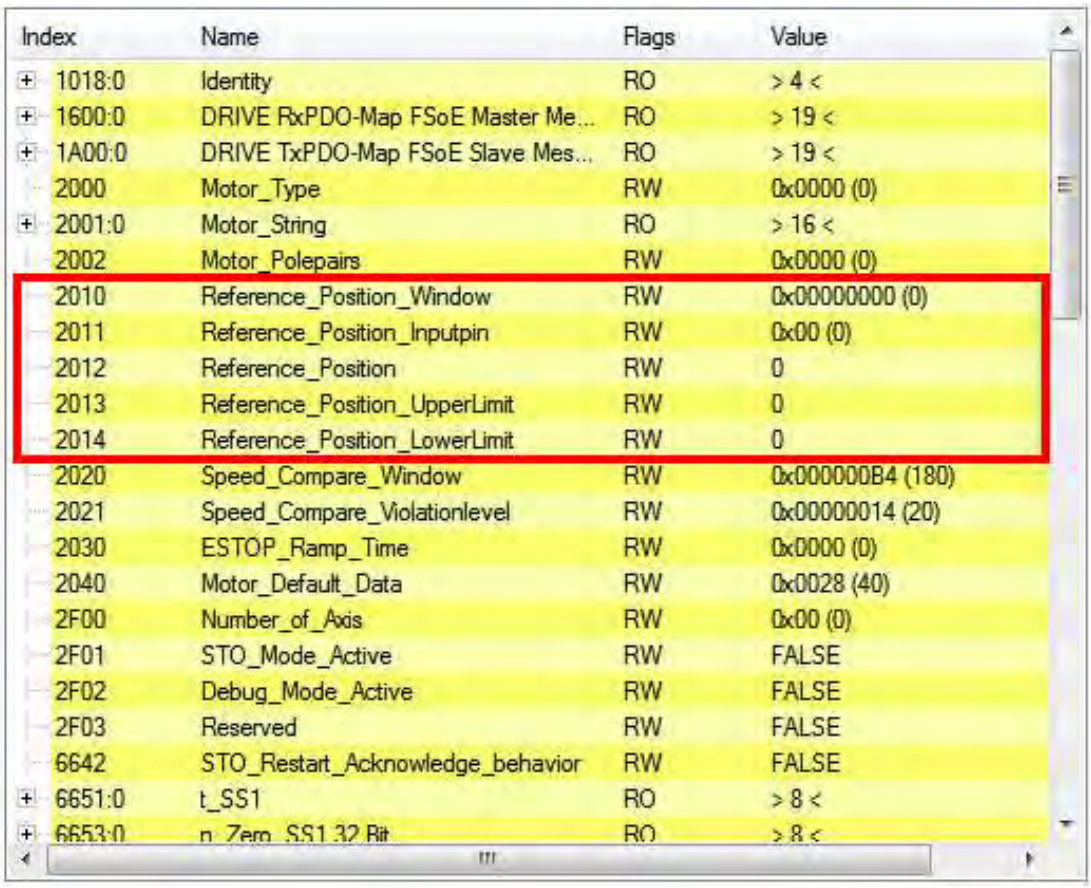
Figure 21: GPIO (X06) on the AX5000

3.6.4.2 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 expects to see that the reference cam input is on every time the reference position is crossed. By default, AX5000 input 0 is configured to be the Reference Cam hardware input. If the SLP and SCA functions are not to be used and a Reference Cam will not be wired to a hardware input on the drive, then Input 0 of the AX5000 must remain unconnected or the AX5805 reference cam hardware input parameter must configured to an unused input of the AX5000.

Note	**Exceeding the maximum range of travel** If the maximum range of travel is exceeded (over travel)the AX5805 activates STO and removes torque from the motor. There is no direct possibility to re-activate the axes. There are three possible methods to re-activate the axes: - Bring the axis mechanically back within the defined range (recommended). - 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 to (0 to 7) 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 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 <

Figure 22: Reference position

3.6.4.3 Initiation of the reference position

As long as the referencing input has *not* been detected, the safe position functions of the AX5805 are deactivated, i.e. its current position output remains at 0. The referencing status can be monitored via the CoE parameter 0x2015. The axis is referenced when the current position corresponds to the parameterized position and simultaneously, the Reference Cam is passed completely in positive or negative direction.

The Reference position is re-verified every time the axis crosses the Reference Position window. If the Reference Cam Input is encountered outside the reference position window, or if the Reference Cam input is not encounter when crossing the reference position window, the AX5805 recognizes that the reference cam is not in the correct location or the controller position system (NC Position) is invalid. Then, the AX5805 activates STO and removes torque from the motor.

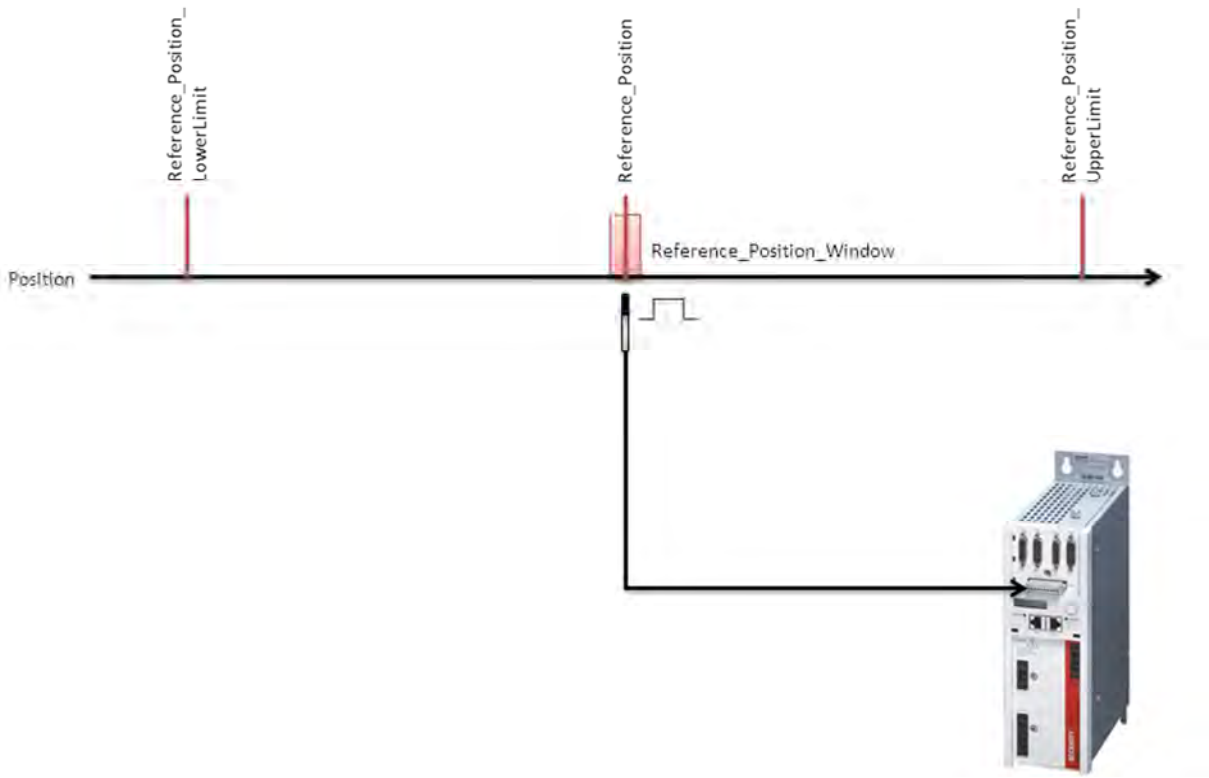


Figure 23: Structure image for the reference position

Note	**Initiation of the reference position** During referencing the reference cam should be passed over with very slow speed. This assures an accurate detection of the cam edges by the AX5805.

3.6.5 Parameterization of the integrated safety functions of the AX5805

3.6.5.1 Description of the Error Acknowledge function

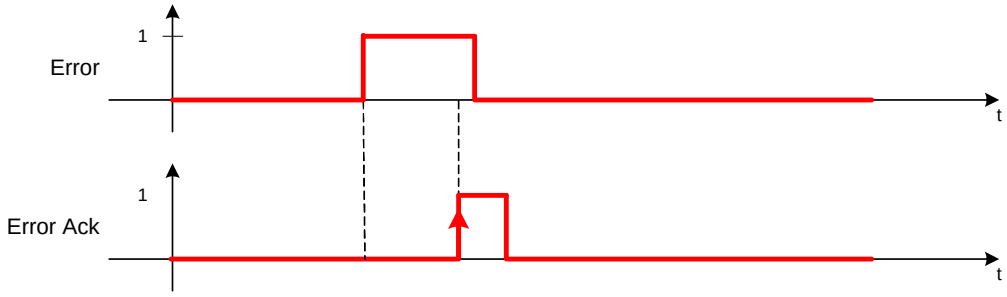


Figure 24: Description of the Error Acknowledge function

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

3.6.5.2 Description of the STO safety function

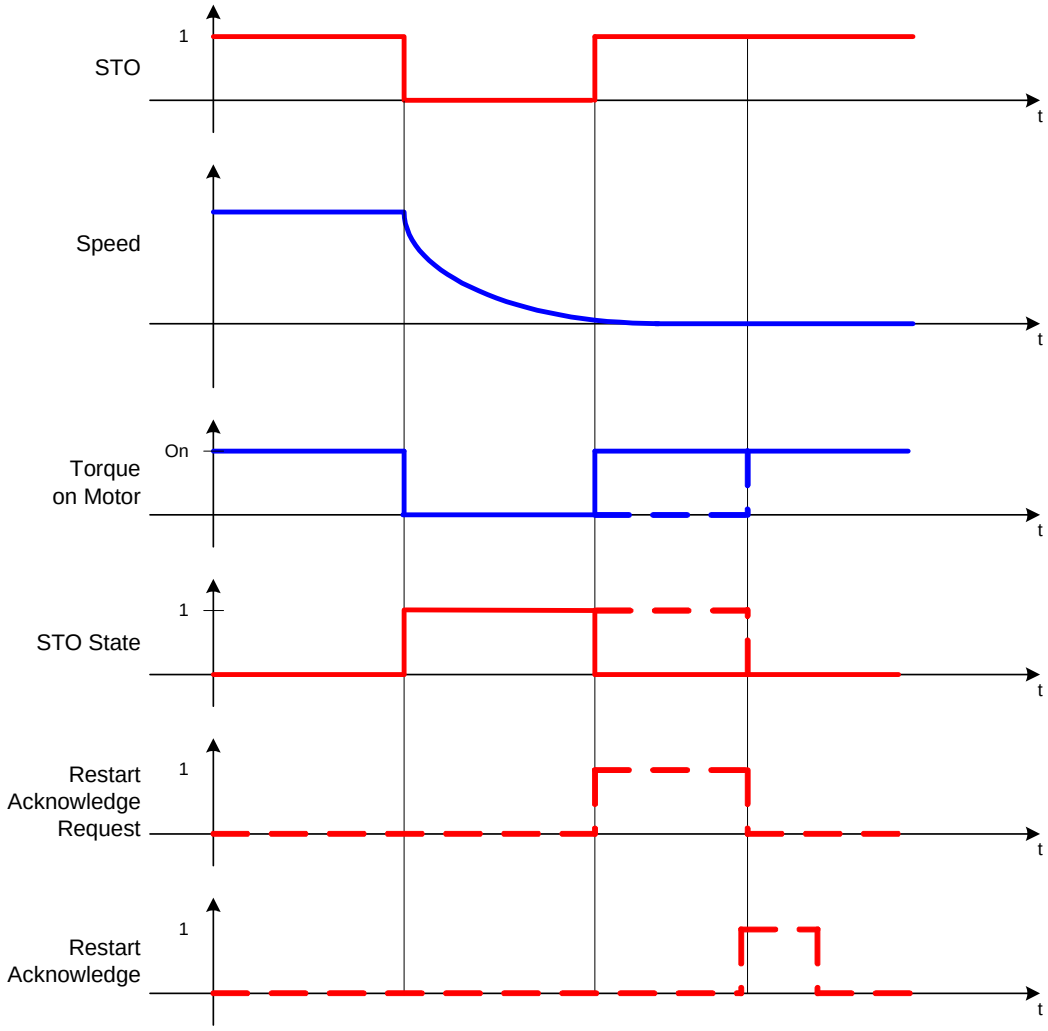


Figure 25: Description of the Safe Torque Off function (STO)

As soon as the safety function STO is activated, all torque is removed from the motor.

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	**Control Bit Restart Acknowledge** The Restart Acknowledge control bit is not included in the standard mapping of the AX5805. It must be additionally mapped into the user configurable 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 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 needs a Restart_Acknowledge_Signal after the STO function is called	--	--	FALSE

3.6.5.3 Description of the SS1 safety function

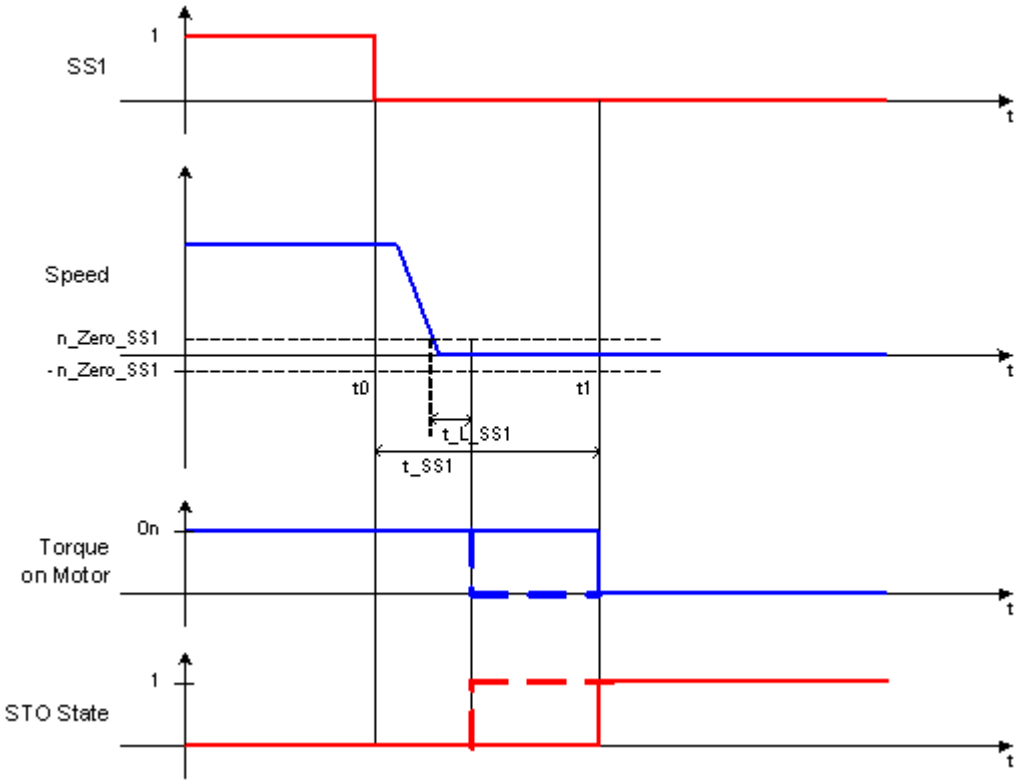


Figure 26: Description of the Safe Stop 1 function (SS1) with time monitor

When the SS1 function is activated, a timer for t_SS1 is started and the speed of the motor is monitored. There are two conditions which activate the STO function (removing torque from the motor):

- Condition 1: The STO function will be activated as soon as the speed of the motor falls within the range of n_Zero_SS1 prior to the t_SS1 timer elapsing.
- Condition 2: If the speed of the motor is not within the range of n_Zero_SS1 when the t_SS1 time elapses, STO function will be activated regardless of the speed of the motor at the point the timer elapses.

Whichever condition occurs first will activate the safety function STO, removing torque from the motor.

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

Index	Name	Description	Sub-index	Unit	Default value
0x6651	t_SS1 :001	Maximum time until the activation of the STO safety function	01	10ms	0x0000
0x6654	t_L SS1 :004	Minimum time until the activation of the STO safety function, if the speed is within the window	04	1ms	0x0000
0x6654	t_L SS1 :005	Minimum time until the activation of the STO safety function, if the speed is within the window	05	1ms	0x0000
0x6654	t_L SS1 :006	Minimum time until the activation of the STO safety function, if the speed is within the window	06	1ms	0x0000
0x6654	t_L SS1 :007	Minimum time until the activation of the STO safety function, if the speed is within the window	07	1ms	0x0000
0x6654	t_L SS1 :008	Minimum time until the activation of the STO safety function, if the speed is within the window	08	1ms	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	10ms	0x0000
0x6E51	t_SS1 :002	Maximum time until the activation of the STO safety function	02	10ms	0x0000
0x6E51	t_SS1 :003	Maximum time until the activation of the STO safety function	03	10ms	0x0000
0x6E51	t_SS1 :004	Maximum time until the activation of the STO safety function	04	10ms	0x0000
0x6E51	t_SS1 :005	Maximum time until the activation of the STO safety function	05	10ms	0x0000
0x6E51	t_SS1 :006	Maximum time until the activation of the STO safety function	06	10ms	0x0000
0x6E51	t_SS1 :007	Maximum time until the activation of the STO safety function	07	10ms	0x0000
0x6E51	t_SS1 :008	Maximum time until the activation of the STO safety function	08	10ms	0x0000
0x6E53	n_Zero_SS1 32 Bit :001	Speed window for SS1_1	01	Increments per ms	0x00000000
0x6E53	n_Zero_SS1 32 Bit :002	Speed window for SS1_2	02	Increments per ms	0x00000000
0x6E53	n_Zero_SS1 32 Bit :003	Speed window for SS1_3	03	Increments per ms	0x00000000
0x6E53	n_Zero_SS1 32 Bit :004	Speed window for SS1_4	04	Increments per ms	0x00000000
0x6E53	n_Zero_SS1 32 Bit :005	Speed window for SS1_5	05	Increments per ms	0x00000000
0x6E53	n_Zero_SS1 32 Bit :006	Speed window for SS1_6	06	Increments per ms	0x00000000
0x6E53	n_Zero_SS1 32 Bit :007	Speed window for SS1_7	07	Increments per ms	0x00000000
0x6E53	n_Zero_SS1 32 Bit :008	Speed window for SS1_8	08	Increments per 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	1ms	0x0000
0x6E54	t_L SS1 :002	Minimum time until the activation of the STO safety function, if the speed is within the window	02	1ms	0x0000
0x6E54	t_L SS1 :003	Minimum time until the activation of the STO safety function, if the speed is within the window	03	1ms	0x0000
0x6E54	t_L SS1 :004	Minimum time until the activation of the STO safety function, if the speed is within the window	04	1ms	0x0000
0x6E54	t_L SS1 :005	Minimum time until the activation of the STO safety function, if the speed is within the window	05	1ms	0x0000
0x6E54	t_L SS1 :006	Minimum time until the activation of the STO safety function, if the speed is within the window	06	1ms	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	1ms	0x0000
0x6E54	t_L SS1 :008	Minimum time until the activation of the STO safety function, if the speed is within the window	08	1ms	0x0000

3.6.5.4 Description of the SS2 safety function

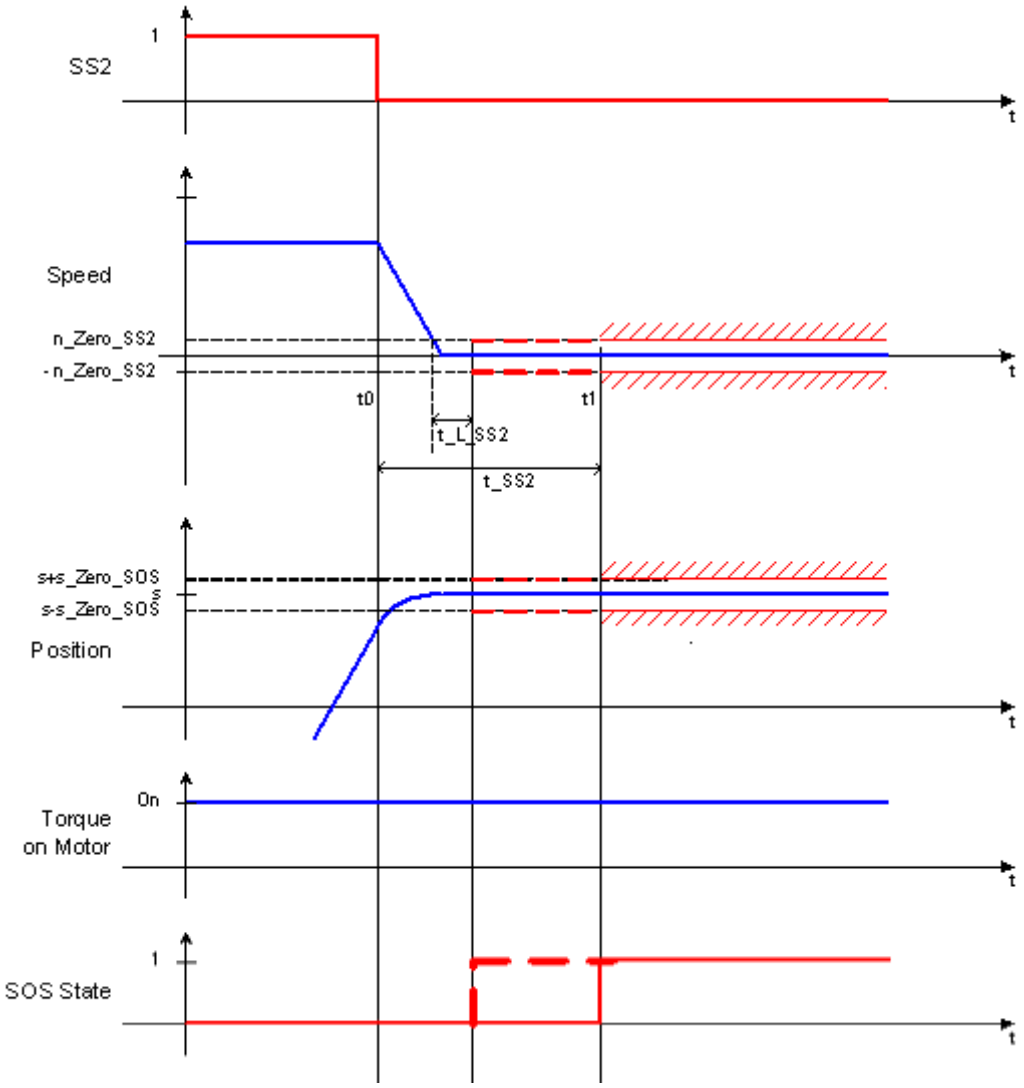


Figure 27: Description of the Safe Stop 2 function (SS2) with time monitor

When the SS2 function is activated, the timer t_SS2 is started and the speed of the motor is monitored. Similarly to the SS1 function, the SS2 function can complete in two ways. Unlike the SS1 function, when the SS2 function completes without error, the drive will be in the SOS state (rather than the STO state).

- Completion Condition 1: If the motor is within the range of n_Zero_SS2 prior to t_SS2 timing out, then the SOS state is activated after t_L_SS2 has elapsed.
- Completion Condition 2: If the t_SS2 timer elapses before the motor reaches the speed set by n_Zero_SS2, then the SOS function is activated regardless of whether the motor is moving or not. Should the parameters of the SOS function be exceeded, the SOS function will activate the STO function, removing torque from the motor.

A corresponding instance of SOS must be used for each instance of SS2.

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	10ms	0x0000
0x6671	t_SS2 :002	Maximum time until the activation of the SOS_2 safety function	02	10ms	0x0000
0x6671	t_SS2 :003	Maximum time until the activation of the SOS_3 safety function	03	10ms	0x0000
0x6671	t_SS2 :004	Maximum time until the activation of the SOS_4 safety function	04	10ms	0x0000
0x6671	t_SS2 :005	Maximum time until the activation of the SOS_5 safety function	05	10ms	0x0000
0x6671	t_SS2 :006	Maximum time until the activation of the SOS_6 safety function	06	10ms	0x0000
0x6671	t_SS2 :007	Maximum time until the activation of the SOS_7 safety function	07	10ms	0x0000
0x6671	t_SS2 :008	Maximum time until the activation of the SOS_8 safety function	08	10ms	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	1ms	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	1ms	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	1ms	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	1ms	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	1ms	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	1ms	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	1ms	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	1ms	0x0000
0x6679	n_Zero_SS2 32 Bit :001	Speed window for SS2_1	01	Increments per ms	0x00000000
0x6679	n_Zero_SS2 32 Bit :002	Speed window for SS2_2	02	Increments per ms	0x00000000
0x6679	n_Zero_SS2 32 Bit :003	Speed window for SS2_3	03	Increments per ms	0x00000000
0x6679	n_Zero_SS2 32 Bit :004	Speed window for SS2_4	04	Increments per ms	0x00000000
0x6679	n_Zero_SS2 32 Bit :005	Speed window for SS2_5	05	Increments per 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 ms	0x00000000
0x6679	n_Zero_SS2 32 Bit :007	Speed window for SS2_7	07	Increments per ms	0x00000000
0x6679	n_Zero_SS2 32 Bit :008	Speed window for SS2_8	08	Increments per 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	10ms	0x0000
0x6E71	t_SS2 :002	Maximum time until the activation of the SOS_2 safety function	02	10ms	0x0000
0x6E71	t_SS2 :003	Maximum time until the activation of the SOS_3 safety function	03	10ms	0x0000
0x6E71	t_SS2 :004	Maximum time until the activation of the SOS_4 safety function	04	10ms	0x0000
0x6E71	t_SS2 :005	Maximum time until the activation of the SOS_5 safety function	05	10ms	0x0000
0x6E71	t_SS2 :006	Maximum time until the activation of the SOS_6 safety function	06	10ms	0x0000
0x6E71	t_SS2 :007	Maximum time until the activation of the SOS_7 safety function	07	10ms	0x0000
0x6E71	t_SS2 :008	Maximum time until the activation of the SOS_8 safety function	08	10ms	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	1ms	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	1ms	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	1ms	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	1ms	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	1ms	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	1ms	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	1ms	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	1ms	0x0000
0x6E79	n_Zero_SS2 32 Bit :001	Speed window for SS2_1	01	Increments per ms	0x00000000
0x6E79	n_Zero_SS2 32 Bit :002	Speed window for SS2_2	02	Increments per ms	0x00000000
0x6E79	n_Zero_SS2 32 Bit :003	Speed window for SS2_3	03	Increments per ms	0x00000000
0x6E79	n_Zero_SS2 32 Bit :004	Speed window for SS2_4	04	Increments per ms	0x00000000
0x6E79	n_Zero_SS2 32 Bit :005	Speed window for SS2_5	05	Increments per 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 ms	0x00000000
0x6E79	n_Zero_SS2 32 Bit :007	Speed window for SS2_7	07	Increments per ms	0x00000000
0x6E79	n_Zero_SS2 32 Bit :008	Speed window for SS2_8	08	Increments per ms	0x00000000

3.6.5.5 Description of the SOS safety function

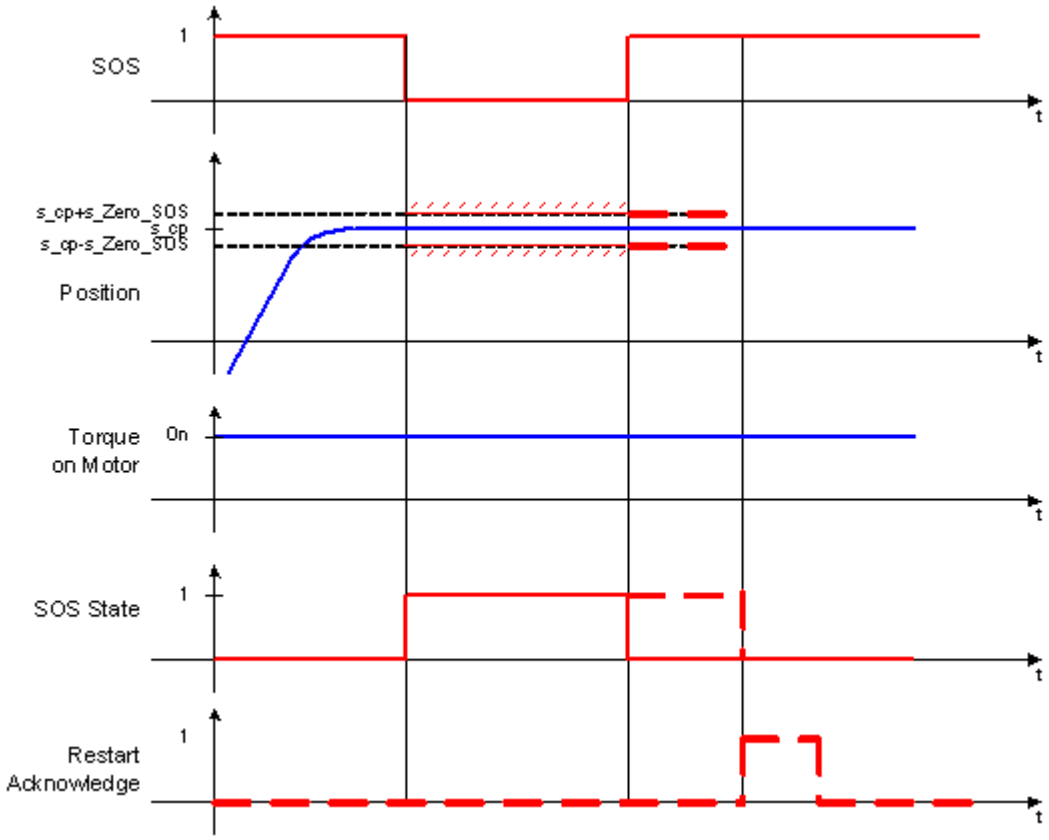


Figure 28: Description of the Safe Operating Stop function (SOS)

When the SOS function is activated, the position of the motor is captured (s_cp), and a position window is defined around this position (s_cp +/- s_Zero_SOS). The current position of the motor is monitored, and as long as the motor remains within this window, the motor remains enabled with torque applied.

If one of the boundaries is crossed, the safety function STO is activated and torque is removed from the motor. This reaction cannot be configured.

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

3.6.5.6 Description of the SSR safety function

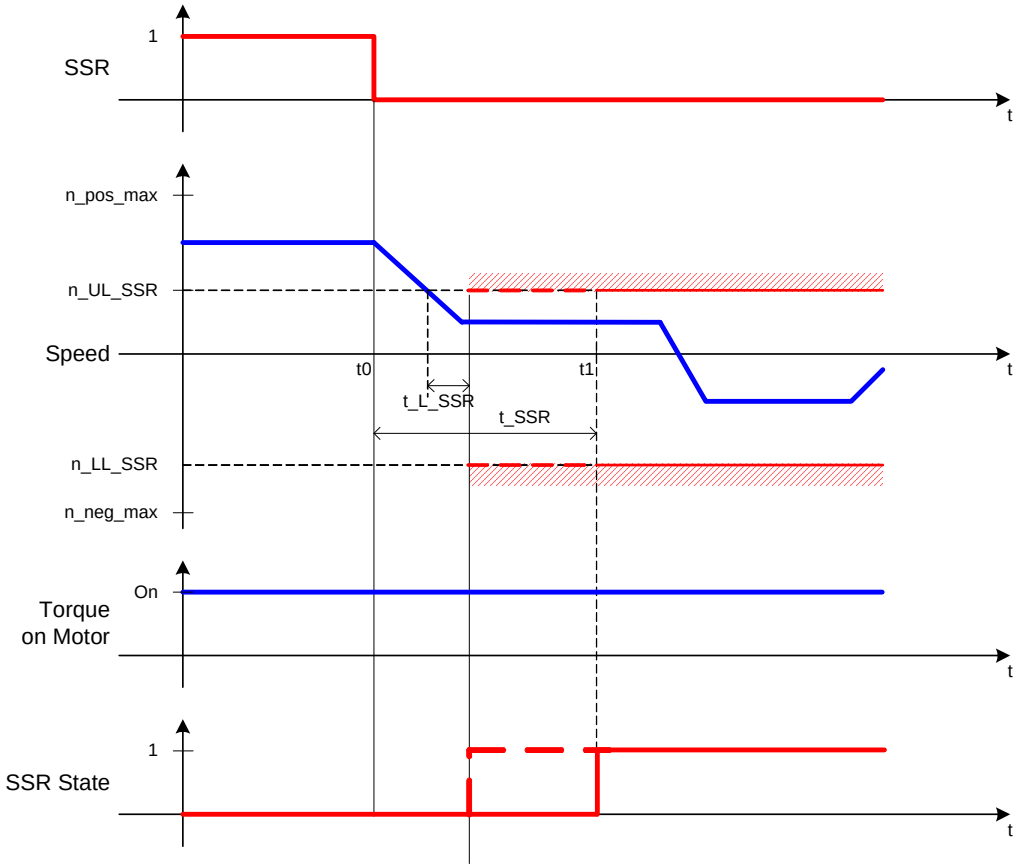


Figure 29: Description of the Safe Speed Range function (SSR) with time monitor

When the SSR function is activated, the velocity of the motor is examined and one of two timers is started.

- If the motor's velocity is *outside* the allowable range defined by n_UL_SSR and n_LL_SSR upon activation, then the timer t_SSR is started and the motor must reach a velocity in the permitted range before the timer elapses. If the t_SSR timer elapses before a permitted velocity is reached, the function defined by ErrorReaction_SSR is activated.
- If the motor's velocity was already *within* the permitted range when the SSR function is activated, then timer t_L_SSR is started and the velocity of the motor will be monitored after the t_L_SSR timer elapses. If the motor exceeds the limits after the t_L_SSR timer has elapsed, then the function ErrorReaction_SSR is activated

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 ms	0x00000000
0x6683	n_UL_SSR 32 Bit :002	Upper speed limit when the SSR_2 function is activated	02	Increments per ms	0x00000000
0x6683	n_UL_SSR 32 Bit :003	Upper speed limit when the SSR_3 function is activated	03	Increments per ms	0x00000000
0x6683	n_UL_SSR 32 Bit :004	Upper speed limit when the SSR_4 function is activated	04	Increments per ms	0x00000000
0x6683	n_UL_SSR 32 Bit :005	Upper speed limit when the SSR_5 function is activated	05	Increments per ms	0x00000000
0x6683	n_UL_SSR 32 Bit :006	Upper speed limit when the SSR_6 function is activated	06	Increments per ms	0x00000000
0x6683	n_UL_SSR 32 Bit :007	Upper speed limit when the SSR_7 function is activated	07	Increments per ms	0x00000000
0x6683	n_UL_SSR 32 Bit :008	Upper speed limit when the SSR_8 function is activated	08	Increments per ms	0x00000000
0x6685	n_LL_SSR 32 Bit :001	Lower speed limit when the SSR_1 function is activated	01	Increments per ms	0x00000000
0x6685	n_LL_SSR 32 Bit :002	Lower speed limit when the SSR_2 function is activated	02	Increments per ms	0x00000000
0x6685	n_LL_SSR 32 Bit :003	Lower speed limit when the SSR_3 function is activated	03	Increments per ms	0x00000000
0x6685	n_LL_SSR 32 Bit :004	Lower speed limit when the SSR_4 function is activated	04	Increments per ms	0x00000000
0x6685	n_LL_SSR 32 Bit :005	Lower speed limit when the SSR_5 function is activated	05	Increments per ms	0x00000000
0x6685	n_LL_SSR 32 Bit :006	Lower speed limit when the SSR_6 function is activated	06	Increments per ms	0x00000000
0x6685	n_LL_SSR 32 Bit :007	Lower speed limit when the SSR_7 function is activated	07	Increments per ms	0x00000000
0x6685	n_LL_SSR 32 Bit :008	Lower speed limit when the SSR_8 function is activated	08	Increments per 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 ms	0x00000000
0x6E83	n_UL_SSR 32 Bit :002	Upper speed limit when the SSR_2 function is activated	02	Increments per ms	0x00000000
0x6E83	n_UL_SSR 32 Bit :003	Upper speed limit when the SSR_3 function is activated	03	Increments per ms	0x00000000
0x6E83	n_UL_SSR 32 Bit :004	Upper speed limit when the SSR_4 function is activated	04	Increments per ms	0x00000000
0x6E83	n_UL_SSR 32 Bit :005	Upper speed limit when the SSR_5 function is activated	05	Increments per ms	0x00000000
0x6E83	n_UL_SSR 32 Bit :006	Upper speed limit when the SSR_6 function is activated	06	Increments per ms	0x00000000
0x6E83	n_UL_SSR 32 Bit :007	Upper speed limit when the SSR_7 function is activated	07	Increments per ms	0x00000000
0x6E83	n_UL_SSR 32 Bit :008	Upper speed limit when the SSR_8 function is activated	08	Increments per ms	0x00000000
0x6E85	n_LL_SSR 32 Bit :001	Lower speed limit when the SSR_1 function is activated	01	Increments per ms	0x00000000
0x6E85	n_LL_SSR 32 Bit :002	Lower speed limit when the SSR_2 function is activated	02	Increments per ms	0x00000000
0x6E85	n_LL_SSR 32 Bit :003	Lower speed limit when the SSR_3 function is activated	03	Increments per ms	0x00000000
0x6E85	n_LL_SSR 32 Bit :004	Lower speed limit when the SSR_4 function is activated	04	Increments per ms	0x00000000
0x6E85	n_LL_SSR 32 Bit :005	Lower speed limit when the SSR_5 function is activated	05	Increments per 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 ms	0x00000000
0x6E85	n_LL_SSR 32 Bit :007	Lower speed limit when the SSR_7 function is activated	07	Increments per ms	0x00000000
0x6E85	n_LL_SSR 32 Bit :008	Lower speed limit when the SSR_8 function is activated	08	Increments per 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)

3.6.5.7 Description of the SDIp safety function

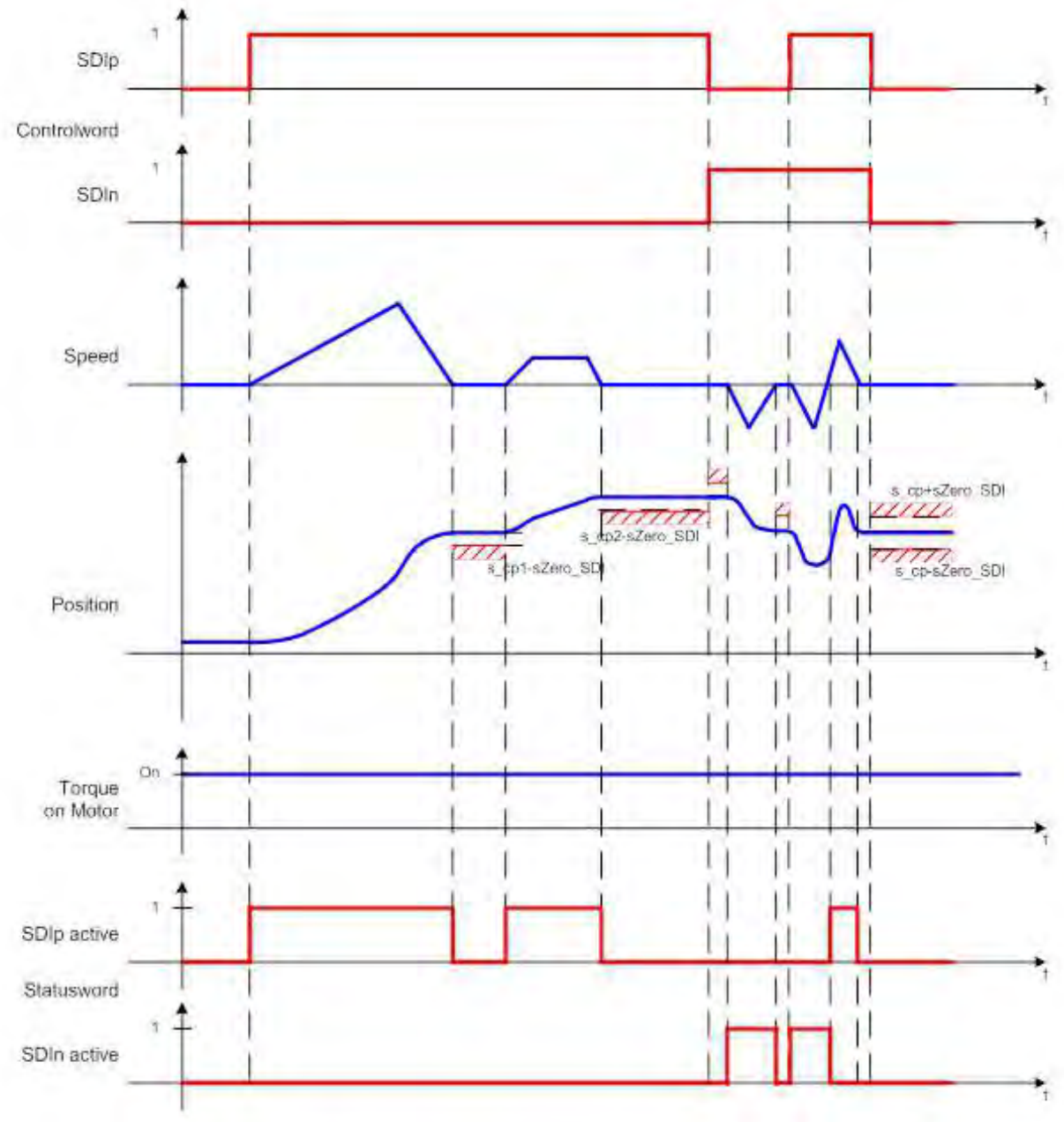


Figure 30: Description of the Safe Direction positive function (SDIp)

The SDIp and SDIn functions are included in the fixed configuration and are separate but related. SDIp permits motion of the motor in a positive direction.

- If the SDIp bit in the control word is set (SDIp=1), positive rotation of the motor is allowed. The status bit SDIp in the status word indicates when the axis is moving in the positive direction (SDIp status=1).
- If the SDIp bit is cleared (SDIp=0), then the SDIp function is activated, the position is captured, and a window is defined (s_cp + s_Zero_SDI). If the axis exceeds this range in the forward direction, the STO function is activated and torque is removed from the motor.

If both SDIp and SDIn are cleared, the motor remains enabled but is not permitted to exceed the position window in either direction.

Parameter 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

Parameter 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

3.6.5.8 Description of the SDIn safety function

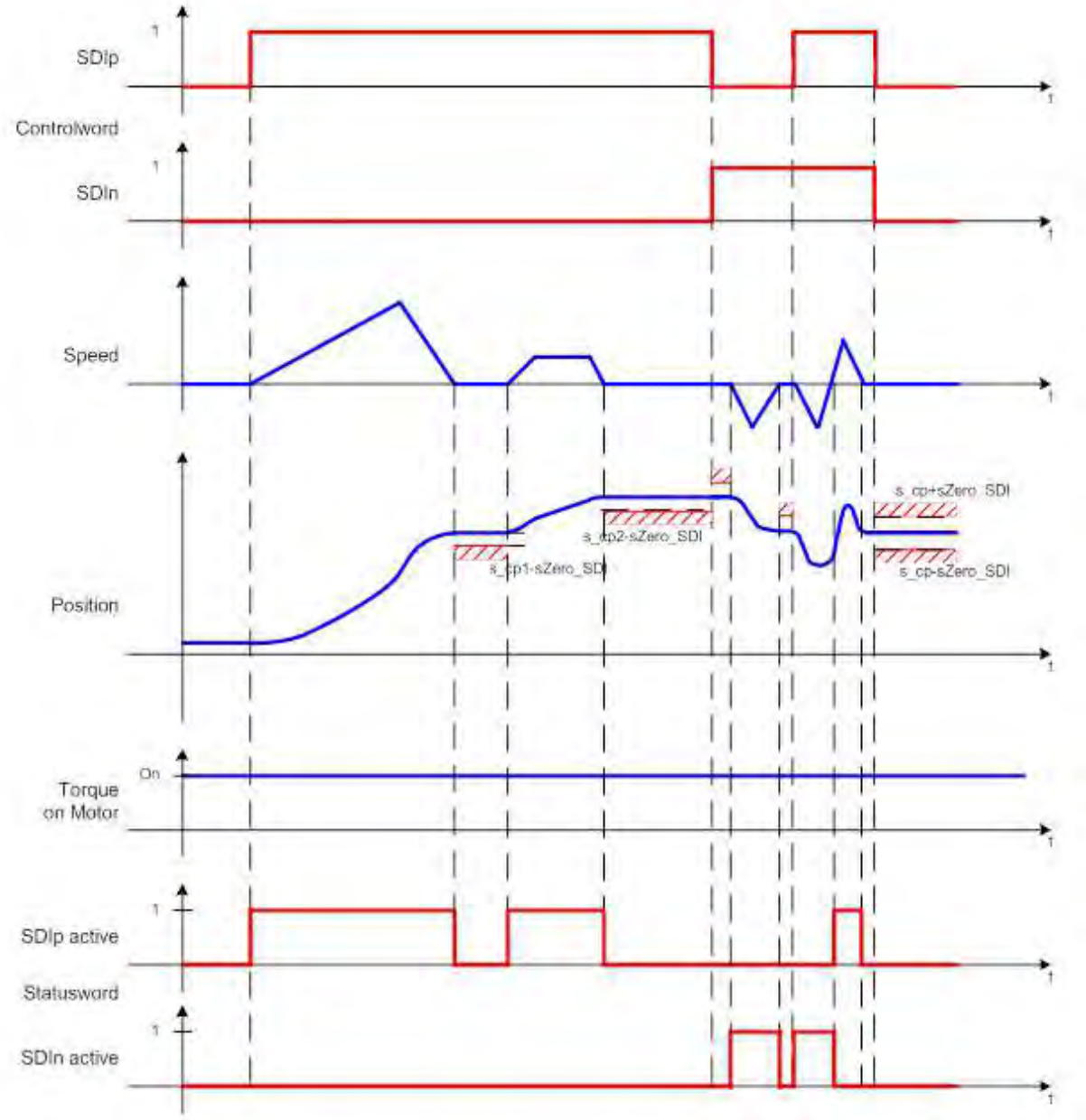


Figure 31: Description of the Safe Direction negative function (SDIn)

The SDIp and SDIn functions are included in the fixed configuration and are separate but related. SDIn permits the motion of the motor in a negative direction.

- If the SDIn bit in the control word is set (SDIn=1), negative rotation of the motor is allowed. The status bit SDIn in the status word indicates when the axis is moving in the negative direction (SDIn status =1).
- If the SDIn bit is cleared (SDIn=0), then the SDIn function is activated, the position is captured, and a window is defined (s_cp - s_Zero_SDI). If the axis exceeds this range in the reverse direction, the STO function is activated and torque is removed from the motor.

If both SDIp and SDIn are cleared, the motor remains enabled but is not permitted to exceed the position window in either direction.

Parameter 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

Parameter 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

3.6.5.9 Description of the SSM safety function

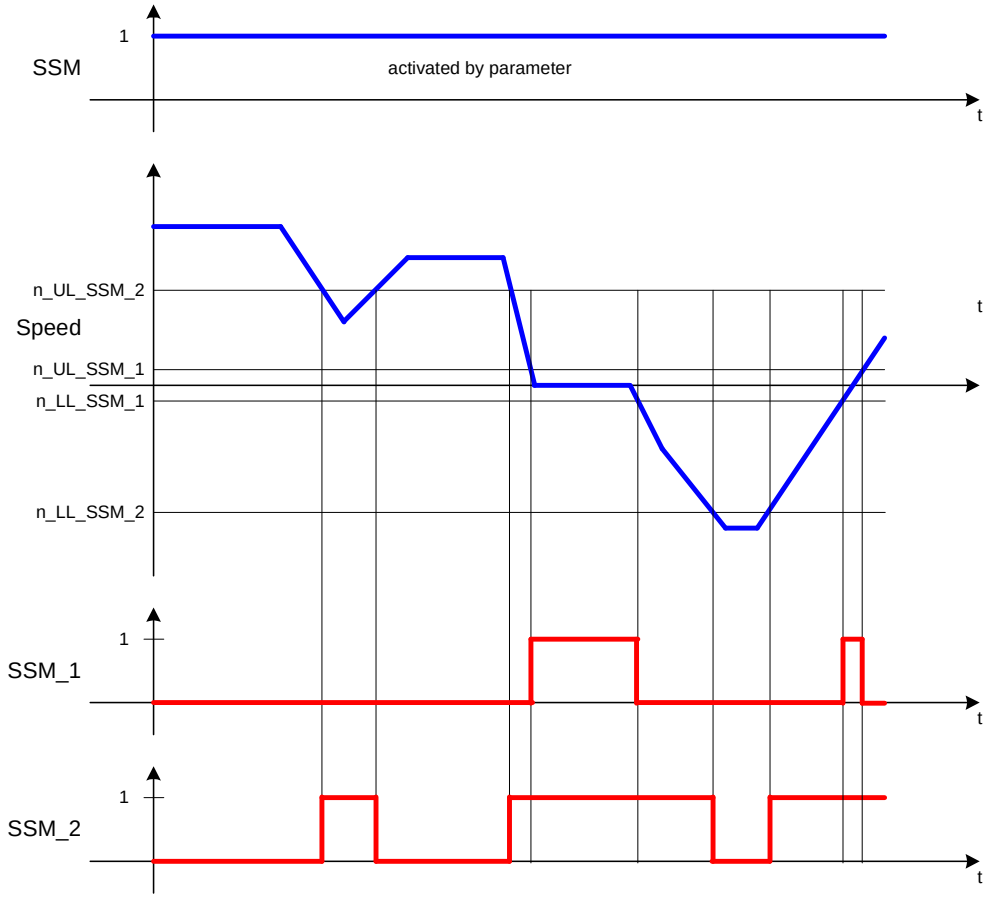


Figure 32: Description of the Safe Speed Monitor function (SSM0, SSM1)

The SSM function only performs monitoring; it indicates when the speed of the axis is within the range specified by the SSM parameters. The SSM monitoring is activated by entering values in the SSM parameters (n_UL_SSM_x or n_LL_SSM_x in Figure 32 unequal 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).

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 ms	0x00000000
0x66E2	n_UL_SSM 32 Bit :002	Upper speed limit of the SSM_2 function	02	Increments per ms	0x00000000
0x66E2	n_UL_SSM 32 Bit :003	Upper speed limit of the SSM_3 function	03	Increments per ms	0x00000000
0x66E2	n_UL_SSM 32 Bit :004	Upper speed limit of the SSM_4 function	04	Increments per ms	0x00000000
0x66E2	n_UL_SSM 32 Bit :005	Upper speed limit of the SSM_5 function	05	Increments per ms	0x00000000
0x66E2	n_UL_SSM 32 Bit :006	Upper speed limit of the SSM_6 function	06	Increments per ms	0x00000000
0x66E2	n_UL_SSM 32 Bit :007	Upper speed limit of the SSM_7 function	07	Increments per ms	0x00000000
0x66E2	n_UL_SSM 32 Bit :008	Upper speed limit of the SSM_8 function	08	Increments per ms	0x00000000
0x66E4	n_LL_SSM 32 Bit :001	Lower speed limit of the SSM_1 function	01	Increments per ms	0x00000000
0x66E4	n_LL_SSM 32 Bit :002	Lower speed limit of the SSM_2 function	02	Increments per ms	0x00000000
0x66E4	n_LL_SSM 32 Bit :003	Lower speed limit of the SSM_3 function	03	Increments per ms	0x00000000
0x66E4	n_LL_SSM 32 Bit :004	Lower speed limit of the SSM_4 function	04	Increments per ms	0x00000000
0x66E4	n_LL_SSM 32 Bit :005	Lower speed limit of the SSM_5 function	05	Increments per ms	0x00000000
0x66E4	n_LL_SSM 32 Bit :006	Lower speed limit of the SSM_6 function	06	Increments per ms	0x00000000
0x66E4	n_LL_SSM 32 Bit :007	Lower speed limit of the SSM_7 function	07	Increments per ms	0x00000000
0x66E4	n_LL_SSM 32 Bit :008	Lower speed limit of the SSM_8 function	08	Increments per 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 ms	0x00000000
0x6EE2	n_UL_SSM 32 Bit :002	Upper speed limit of the SSM_2 function	02	Increments per ms	0x00000000
0x6EE2	n_UL_SSM 32 Bit :003	Upper speed limit of the SSM_3 function	03	Increments per ms	0x00000000
0x6EE2	n_UL_SSM 32 Bit :004	Upper speed limit of the SSM_4 function	04	Increments per ms	0x00000000
0x6EE2	n_UL_SSM 32 Bit :005	Upper speed limit of the SSM_5 function	05	Increments per ms	0x00000000
0x6EE2	n_UL_SSM 32 Bit :006	Upper speed limit of the SSM_6 function	06	Increments per ms	0x00000000
0x6EE2	n_UL_SSM 32 Bit :007	Upper speed limit of the SSM_7 function	07	Increments per ms	0x00000000
0x6EE2	n_UL_SSM 32 Bit :008	Upper speed limit of the SSM_8 function	08	Increments per ms	0x00000000
0x6EE4	n_LL_SSM 32 Bit :001	Lower speed limit of the SSM_1 function	01	Increments per ms	0x00000000
0x6EE4	n_LL_SSM 32 Bit :002	Lower speed limit of the SSM_2 function	02	Increments per ms	0x00000000
0x6EE4	n_LL_SSM 32 Bit :003	Lower speed limit of the SSM_3 function	03	Increments per ms	0x00000000
0x6EE4	n_LL_SSM 32 Bit :004	Lower speed limit of the SSM_4 function	04	Increments per ms	0x00000000
0x6EE4	n_LL_SSM 32 Bit :005	Lower speed limit of the SSM_5 function	05	Increments per ms	0x00000000
0x6EE4	n_LL_SSM 32 Bit :006	Lower speed limit of the SSM_6 function	06	Increments per ms	0x00000000
0x6EE4	n_LL_SSM 32 Bit :007	Lower speed limit of the SSM_7 function	07	Increments per ms	0x00000000
0x6EE4	n_LL_SSM 32 Bit :008	Lower speed limit of the SSM_8 function	08	Increments per ms	0x00000000

3.6.5.10 Description of the SAR safety function

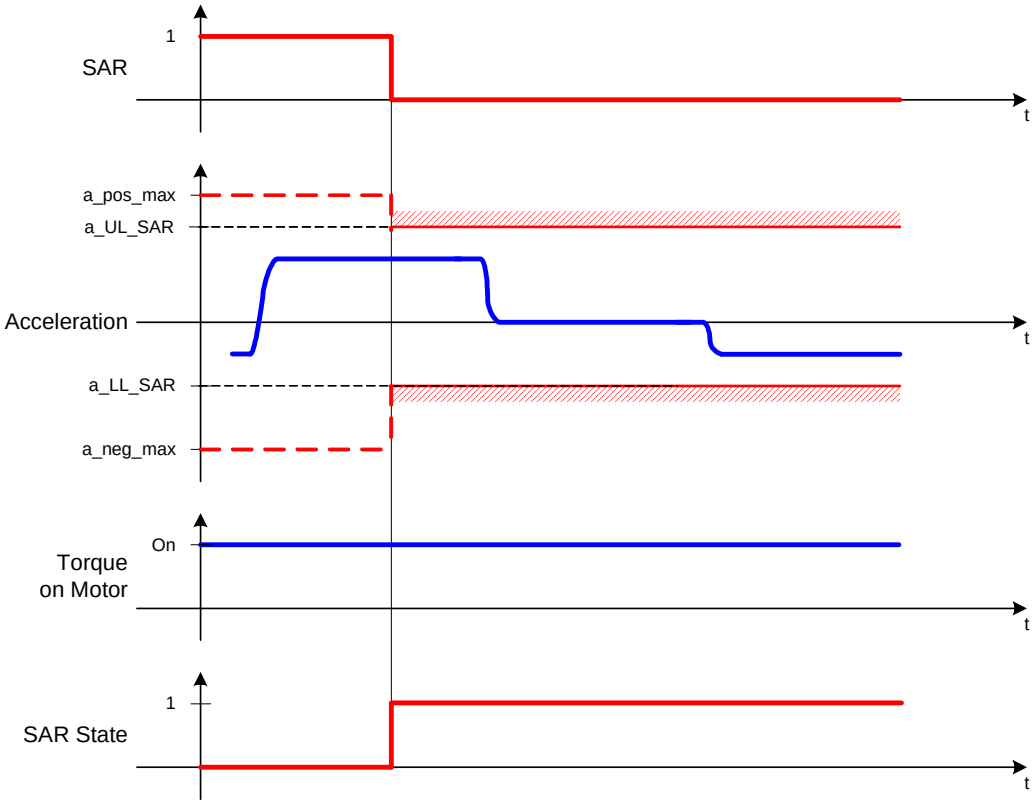


Figure 33: Description of the Safe Acceleration Range function (SAR)

When SAR (Safe Acceleration Range) is activated, monitoring of the acceleration window begins. 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 Error Reaction function SS1 or STO (as defined by 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 ms^2	0x00000000
0x66C2	a_UL_SAR 32 Bit :002	Upper acceleration limit of the SAR_2 safety function	02	Increments per ms^2	0x00000000
0x66C2	a_UL_SAR 32 Bit :003	Upper acceleration limit of the SAR_3 safety function	03	Increments per ms^2	0x00000000
0x66C2	a_UL_SAR 32 Bit :004	Upper acceleration limit of the SAR_4 safety function	04	Increments per ms^2	0x00000000
0x66C2	a_UL_SAR 32 Bit :005	Upper acceleration limit of the SAR_5 safety function	05	Increments per ms^2	0x00000000
0x66C2	a_UL_SAR 32 Bit :006	Upper acceleration limit of the SAR_6 safety function	06	Increments per ms^2	0x00000000
0x66C2	a_UL_SAR 32 Bit :007	Upper acceleration limit of the SAR_7 safety function	07	Increments per ms^2	0x00000000
0x66C2	a_UL_SAR 32 Bit :008	Upper acceleration limit of the SAR_8 safety function	08	Increments per ms^2	0x00000000
0x66C4	a_LL_SAR 32 Bit :001	Lower acceleration limit of the SAR_1 safety function	01	Increments per ms^2	0x00000000
0x66C4	a_LL_SAR 32 Bit :002	Lower acceleration limit of the SAR_2 safety function	02	Increments per ms^2	0x00000000
0x66C4	a_LL_SAR 32 Bit :003	Lower acceleration limit of the SAR_3 safety function	03	Increments per ms^2	0x00000000
0x66C4	a_LL_SAR 32 Bit :004	Lower acceleration limit of the SAR_4 safety function	04	Increments per ms^2	0x00000000
0x66C4	a_LL_SAR 32 Bit :005	Lower acceleration limit of the SAR_5 safety function	05	Increments per ms^2	0x00000000
0x66C4	a_LL_SAR 32 Bit :006	Lower acceleration limit of the SAR_6 safety function	06	Increments per ms^2	0x00000000
0x66C4	a_LL_SAR 32 Bit :007	Lower acceleration limit of the SAR_7 safety function	07	Increments per ms^2	0x00000000
0x66C4	a_LL_SAR 32 Bit :008	Lower acceleration limit of the SAR_8 safety function	08	Increments per ms^2	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 ms^2	0x00000000
0x6EC2	a_UL_SAR 32 Bit :002	Upper acceleration limit of the SAR_2 safety function	02	Increments per ms^2	0x00000000
0x6EC2	a_UL_SAR 32 Bit :003	Upper acceleration limit of the SAR_3 safety function	03	Increments per ms^2	0x00000000
0x6EC2	a_UL_SAR 32 Bit :004	Upper acceleration limit of the SAR_4 safety function	04	Increments per ms^2	0x00000000
0x6EC2	a_UL_SAR 32 Bit :005	Upper acceleration limit of the SAR_5 safety function	05	Increments per ms^2	0x00000000
0x6EC2	a_UL_SAR 32 Bit :006	Upper acceleration limit of the SAR_6 safety function	06	Increments per ms^2	0x00000000
0x6EC2	a_UL_SAR 32 Bit :007	Upper acceleration limit of the SAR_7 safety function	07	Increments per ms^2	0x00000000
0x6EC2	a_UL_SAR 32 Bit :008	Upper acceleration limit of the SAR_8 safety function	08	Increments per ms^2	0x00000000
0x6EC4	a_LL_SAR 32 Bit :001	Lower acceleration limit of the SAR_1 safety function	01	Increments per ms^2	0x00000000
0x6EC4	a_LL_SAR 32 Bit :002	Lower acceleration limit of the SAR_2 safety function	02	Increments per ms^2	0x00000000
0x6EC4	a_LL_SAR 32 Bit :003	Lower acceleration limit of the SAR_3 safety function	03	Increments per ms^2	0x00000000
0x6EC4	a_LL_SAR 32 Bit :004	Lower acceleration limit of the SAR_4 safety function	04	Increments per ms^2	0x00000000
0x6EC4	a_LL_SAR 32 Bit :005	Lower acceleration limit of the SAR_5 safety function	05	Increments per ms^2	0x00000000
0x6EC4	a_LL_SAR 32 Bit :006	Lower acceleration limit of the SAR_6 safety function	06	Increments per ms^2	0x00000000
0x6EC4	a_LL_SAR 32 Bit :007	Lower acceleration limit of the SAR_7 safety function	07	Increments per ms^2	0x00000000
0x6EC4	a_LL_SAR 32 Bit :008	Lower acceleration limit of the SAR_8 safety function	08	Increments per ms^2	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)

3.6.5.11 Description of the SCA safety function

This function is available only if the safe position has been referenced (refer to Chapter 3.6.4.3).

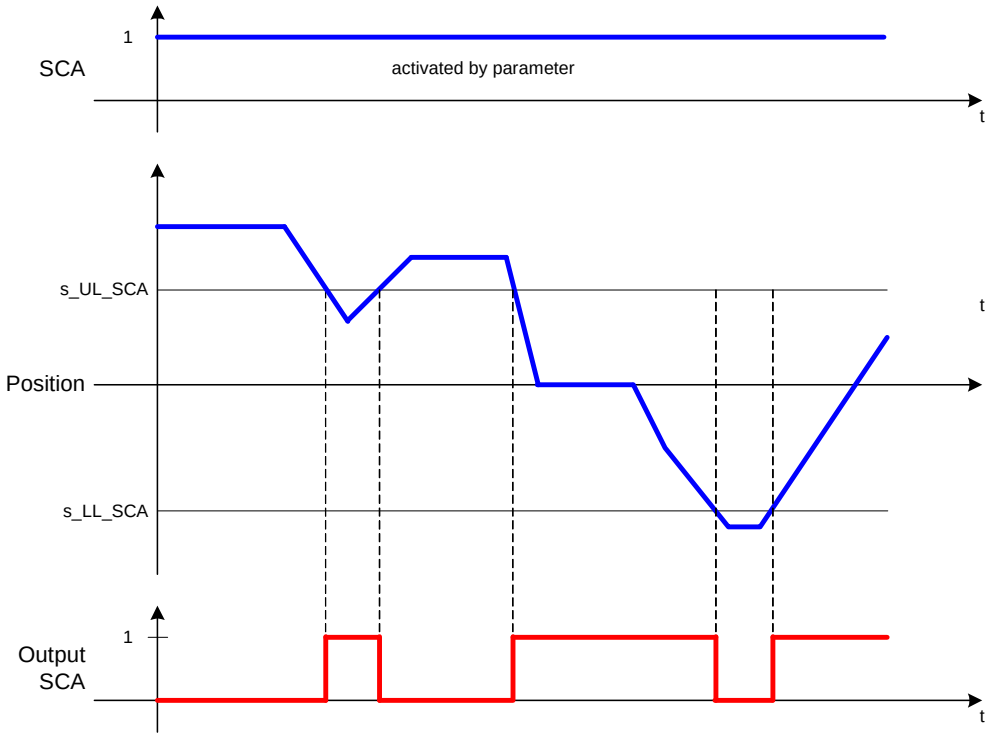


Figure 34: Description of the Safe CAM function (SCA)

SCA (Safe CAM) can be implemented as a bit in the Safety status word. The SCA output is set to 1 when 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 reference position	0x00000000
0x66EA	s_UL_SCA 32 Bit :002	Upper position limit of the SCA_2 safety function	02	pole revolution relative to reference position	0x00000000
0x66EA	s_UL_SCA 32 Bit :003	Upper position limit of the SCA_3 safety function	03	pole revolution relative to reference position	0x00000000
0x66EA	s_UL_SCA 32 Bit :004	Upper position limit of the SCA_4 safety function	04	pole revolution relative to reference position	0x00000000
0x66EA	s_UL_SCA 32 Bit :005	Upper position limit of the SCA_5 safety function	05	pole revolution relative to reference position	0x00000000
0x66EA	s_UL_SCA 32 Bit :006	Upper position limit of the SCA_6 safety function	06	pole revolution relative to reference position	0x00000000
0x66EA	s_UL_SCA 32 Bit :007	Upper position limit of the SCA_7 safety function	07	pole revolution relative to reference position	0x00000000
0x66EA	s_UL_SCA 32 Bit :008	Upper position limit of the SCA_8 safety function	08	pole revolution relative to reference position	0x00000000
0x66EC	s_LL_SCA 32 Bit :001	Lower position limit of the SCA_1 safety function	01	pole revolution relative to reference position	0x00000000
0x66EC	s_LL_SCA 32 Bit :002	Lower position limit of the SCA_2 safety function	02	pole revolution relative to reference position	0x00000000
0x66EC	s_LL_SCA 32 Bit :003	Lower position limit of the SCA_3 safety function	03	pole revolution relative to reference position	0x00000000
0x66EC	s_LL_SCA 32 Bit :004	Lower position limit of the SCA_4 safety function	04	pole revolution relative to reference position	0x00000000
0x66EC	s_LL_SCA 32 Bit :005	Lower position limit of the SCA_5 safety function	05	pole revolution relative to reference position	0x00000000
0x66EC	s_LL_SCA 32 Bit :006	Lower position limit of the SCA_6 safety function	06	pole revolution relative to reference position	0x00000000
0x66EC	s_LL_SCA 32 Bit :007	Lower position limit of the SCA_7 safety function	07	pole revolution relative to reference position	0x00000000
0x66EC	s_LL_SCA 32 Bit :008	Lower position limit of the SCA_8 safety function	08	pole revolution relative to 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 reference position	0x00000000
0x6EEA	s_UL_SCA 32 Bit :002	Upper position limit of the SCA_2 safety function	02	pole revolution relative to reference position	0x00000000
0x6EEA	s_UL_SCA 32 Bit :003	Upper position limit of the SCA_3 safety function	03	pole revolution relative to reference position	0x00000000
0x6EEA	s_UL_SCA 32 Bit :004	Upper position limit of the SCA_4 safety function	04	pole revolution relative to reference position	0x00000000
0x6EEA	s_UL_SCA 32 Bit :005	Upper position limit of the SCA_5 safety function	05	pole revolution relative to reference position	0x00000000
0x6EEA	s_UL_SCA 32 Bit :006	Upper position limit of the SCA_6 safety function	06	pole revolution relative to reference position	0x00000000
0x6EEA	s_UL_SCA 32 Bit :007	Upper position limit of the SCA_7 safety function	07	pole revolution relative to reference position	0x00000000
0x6EEA	s_UL_SCA 32 Bit :008	Upper position limit of the SCA_8 safety function	08	pole revolution relative to reference position	0x00000000
0x6EEC	s_LL_SCA 32 Bit :001	Lower position limit of the SCA_1 safety function	01	pole revolution relative to reference position	0x00000000
0x6EEC	s_LL_SCA 32 Bit :002	Lower position limit of the SCA_2 safety function	02	pole revolution relative to reference position	0x00000000
0x6EEC	s_LL_SCA 32 Bit :003	Lower position limit of the SCA_3 safety function	03	pole revolution relative to reference position	0x00000000
0x6EEC	s_LL_SCA 32 Bit :004	Lower position limit of the SCA_4 safety function	04	pole revolution relative to reference position	0x00000000
0x6EEC	s_LL_SCA 32 Bit :005	Lower position limit of the SCA_5 safety function	05	pole revolution relative to reference position	0x00000000
0x6EEC	s_LL_SCA 32 Bit :006	Lower position limit of the SCA_6 safety function	06	pole revolution relative to reference position	0x00000000
0x6EEC	s_LL_SCA 32 Bit :007	Lower position limit of the SCA_7 safety function	07	pole revolution relative to reference position	0x00000000
0x6EEC	s_LL_SCA 32 Bit :008	Lower position limit of the SCA_8 safety function	08	pole revolution relative to reference position	0x00000000

3.6.5.12 Description of the SLI safety function

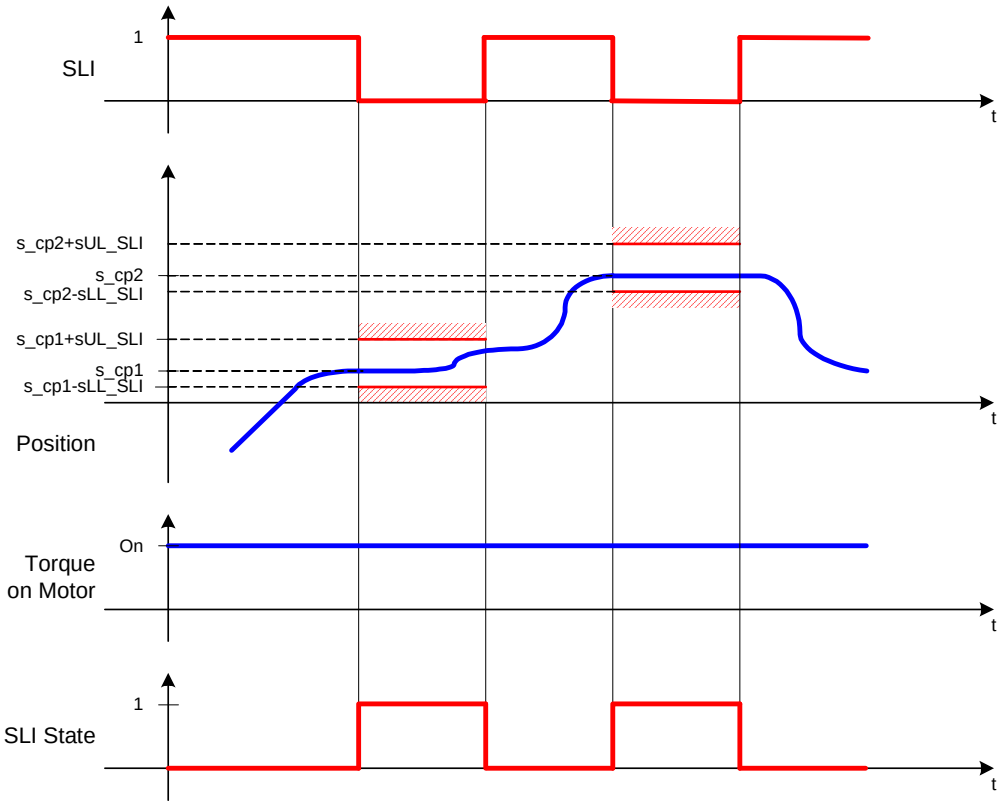


Figure 35: Description of the Safely Limited Increment function (SLI)

When the SLI (Safe Limited Increment) function is activated, the current position is captured under s_cp, and monitoring of the position is activated. The axis may not leave the window defined between s_cp + s_UL_SLI (UL-upper limit) and s_cp - s_LL_SLI (LL-lower limit). If one of the limits is exceeded, the Error Reaction Function SS1 or STO (as defined by ErrorReaction_SLI) is executed.

Note	**Difference between firmware 04 and 05** The value s_LL_SLI has to be entered as a positive value up to firmware version 04. Beginning from firmware version 05 it has to be entered as a negative value.

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)

3.6.5.13 Description of the SLP safety function

This function is available only if the safe position has been referenced (refer to Chapter 3.6.5.3).

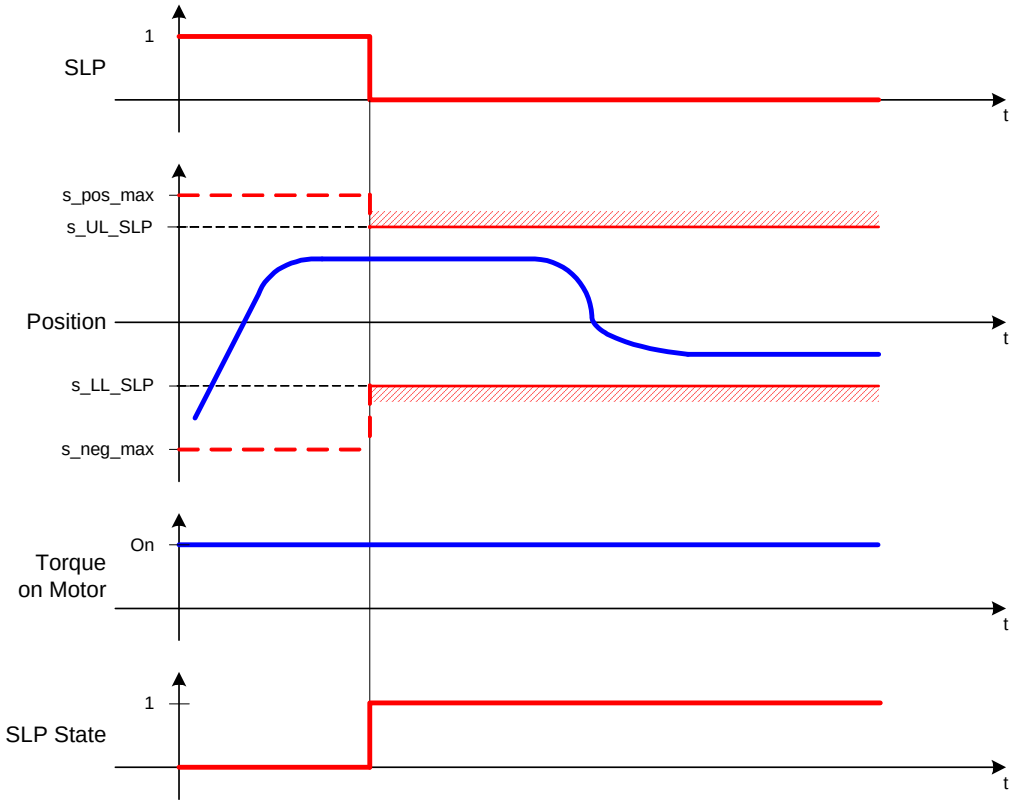


Figure 36: Description of the Safely Limited Position function (SLP)

When the SLP function is activated (SLP = 0), the position of the motor is monitored with regard to the reference position. If the axis is outside the limits specified by parameters s_UL_SLP (upper limit) and s_LL_SLP (lower limit), the Error Reaction function (SS1 or STO) as defined by ErrorReaction_SLP is activated.

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 reference position	0x00000000
0x66A2	s_UL_ SLP 32 Bit :002	Upper position limit of the SLP_2 safety function	02	pole revolution relative to reference position	0x00000000
0x66A2	s_UL_SLP 32 Bit :003	Upper position limit of the SLP_3 safety function	03	pole revolution relative to reference position	0x00000000
0x66A2	s_UL_SLP 32 Bit :004	Upper position limit of the SLP_4 safety function	04	pole revolution relative to reference position	0x00000000
0x66A2	s_UL_SLP 32 Bit :005	Upper position limit of the SLP_5 safety function	05	pole revolution relative to reference position	0x00000000
0x66A2	s_UL_SLP 32 Bit :006	Upper position limit of the SLP_6 safety function	06	pole revolution relative to reference position	0x00000000
0x66A2	s_UL_SLP 32 Bit :007	Upper position limit of the SLP_7 safety function	07	pole revolution relative to reference position	0x00000000
0x66A2	s_UL_SLP 32 Bit :008	Upper position limit of the SLP_8 safety function	08	pole revolution relative to reference position	0x00000000
0x66A4	s_LL_SLP 32 Bit :001	Lower position limit of the SLP_1 safety function	01	pole revolution relative to reference position	0x00000000
0x66A4	s_LL_SLP 32 Bit :002	Lower position limit of the SLP_2 safety function	02	pole revolution relative to reference position	0x00000000
0x66A4	s_LL_SLP 32 Bit :003	Lower position limit of the SLP_3 safety function	03	pole revolution relative to reference position	0x00000000
0x66A4	s_LL_SLP 32 Bit :004	Lower position limit of the SLP_4 safety function	04	pole revolution relative to reference position	0x00000000
0x66A4	s_LL_SLP 32 Bit :005	Lower position limit of the SLP_5 safety function	05	pole revolution relative to reference position	0x00000000
0x66A4	s_LL_SLP 32 Bit :006	Lower position limit of the SLP_6 safety function	06	pole revolution relative to reference position	0x00000000
0x66A4	s_LL_SLP 32 Bit :007	Lower position limit of the SLP_7 safety function	07	pole revolution relative to reference position	0x00000000
0x66A4	s_LL_SLP 32 Bit :008	Lower position limit of the SLP_8 safety function	08	pole revolution relative to reference position	0x00000000
0x66A5	Error Reacti-on SLP :001	Error reaction of SLP_1	01	--	0x66400001 (STO)
0x66A5	Error Reacti-on SLP :002	Error reaction of SLP_2	02	--	0x66400001 (STO)
0x66A5	Error Reacti-on SLP :003	Error reaction of SLP_3	03	--	0x66400001 (STO)
0x66A5	Error Reacti-on SLP :004	Error reaction of SLP_4	04	--	0x66400001 (STO)
0x66A5	Error Reacti-on SLP :005	Error reaction of SLP_5	05	--	0x66400001 (STO)
0x66A5	Error Reacti-on SLP :006	Error reaction of SLP_6	06	--	0x66400001 (STO)
0x66A5	Error Reacti-on SLP :007	Error reaction of SLP_7	07	--	0x66400001 (STO)
0x66A5	Error Reacti-on 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 reference position	0x00000000
0x6EA2	s_UL_ SLP 32 Bit :002	Upper position limit of the SLP_2 safety function	02	pole revolution relative to reference position	0x00000000
0x6EA2	s_UL_SLP 32 Bit :003	Upper position limit of the SLP_3 safety function	03	pole revolution relative to reference position	0x00000000
0x6EA2	s_UL_SLP 32 Bit :004	Upper position limit of the SLP_4 safety function	04	pole revolution relative to reference position	0x00000000
0x6EA2	s_UL_SLP 32 Bit :005	Upper position limit of the SLP_5 safety function	05	pole revolution relative to reference position	0x00000000
0x6EA2	s_UL_SLP 32 Bit :006	Upper position limit of the SLP_6 safety function	06	pole revolution relative to reference position	0x00000000
0x6EA2	s_UL_SLP 32 Bit :007	Upper position limit of the SLP_7 safety function	07	pole revolution relative to reference position	0x00000000
0x6EA2	s_UL_SLP 32 Bit :008	Upper position limit of the SLP_8 safety function	08	pole revolution relative to reference position	0x00000000
0x6EA4	s_LL_SLP 32 Bit :001	Lower position limit of the SLP_1 safety function	01	pole revolution relative to reference position	0x00000000
0x6EA4	s_LL_SLP 32 Bit :002	Lower position limit of the SLP_2 safety function	02	pole revolution relative to reference position	0x00000000
0x6EA4	s_LL_SLP 32 Bit :003	Lower position limit of the SLP_3 safety function	03	pole revolution relative to reference position	0x00000000
0x6EA4	s_LL_SLP 32 Bit :004	Lower position limit of the SLP_4 safety function	04	pole revolution relative to reference position	0x00000000
0x6EA4	s_LL_SLP 32 Bit :005	Lower position limit of the SLP_5 safety function	05	pole revolution relative to reference position	0x00000000
0x6EA4	s_LL_SLP 32 Bit :006	Lower position limit of the SLP_6 safety function	06	pole revolution relative to reference position	0x00000000
0x6EA4	s_LL_SLP 32 Bit :007	Lower position limit of the SLP_7 safety function	07	pole revolution relative to reference position	0x00000000
0x6EA4	s_LL_SLP 32 Bit :008	Lower position limit of the SLP_8 safety function	08	pole revolution relative to reference position	0x00000000
0x6EA5	Error Reacti-on SLP :001	Error reaction of SLP_1	01	--	0x66400001 (STO)
0x6EA5	Error Reacti-on SLP :002	Error reaction of SLP_2	02	--	0x66400001 (STO)
0x6EA5	Error Reacti-on SLP :003	Error reaction of SLP_3	03	--	0x66400001 (STO)
0x6EA5	Error Reacti-on SLP :004	Error reaction of SLP_4	04	--	0x66400001 (STO)
0x6EA5	Error Reacti-on SLP :005	Error reaction of SLP_5	05	--	0x66400001 (STO)
0x6EA5	Error Reacti-on SLP :006	Error reaction of SLP_6	06	--	0x66400001 (STO)
0x6EA5	Error Reacti-on SLP :007	Error reaction of SLP_7	07	--	0x66400001 (STO)
0x6EA5	Error Reacti-on SLP :008	Error reaction of SLP_8	08	--	0x66400001 (STO)

3.6.5.14 Description of the SLS safety function

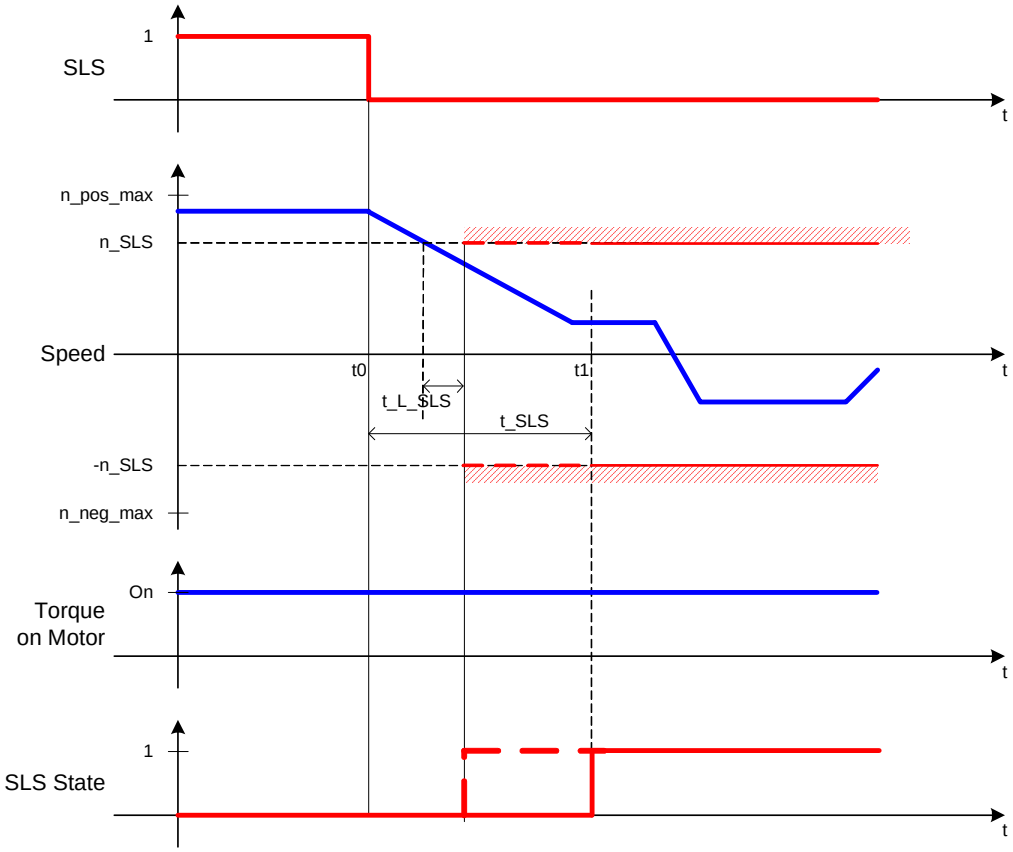


Figure 37: Description of the Safely Limited Speed function (SLS) with time monitor

SLS limits the motor's absolute speed. The single parameter n_SLS is defined, and this limit is the maximum positive and negative speed of the motor.

- If the speed of the motor is *outside* the allowable range defined by +/- n_SLS upon activation (SLS=0), then the timer t_SLS is started and the motor must achieve a speed within the acceptable range before the timer elapses. If the timer elapses before the motor reaches an acceptable speed, the Error Reaction Function SS1 or STO (as defined by ErrorReaction_SLS) is activated.
- If the speed of the motor was already *within* the allowable range upon activation (SLS=0), then timer t_L_SLS is started and the velocity of the motor will be monitored after the t_L_SLS timer elapses. If the motor exceeds the limits after the t_L_SLS timer elapses, then the Error Reaction Function SS1 or STO (as defined by ErrorReaction_SLS) is activated

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 ms	0x00000000
0x6693	n_SLS 32 Bit :002	Speed window for SLS_2	02	Increments per ms	0x00000000
0x6693	n_SLS 32 Bit :003	Speed window for SLS_3	03	Increments per ms	0x00000000
0x6693	n_SLS 32 Bit :004	Speed window for SLS_4	04	Increments per ms	0x00000000
0x6693	n_SLS 32 Bit :005	Speed window for SLS_5	05	Increments per ms	0x00000000
0x6693	n_SLS 32 Bit :006	Speed window for SLS_6	06	Increments per ms	0x00000000
0x6693	n_SLS 32 Bit :007	Speed window for SLS_7	07	Increments per ms	0x00000000
0x6693	n_SLS 32 Bit :008	Speed window for SLS_8	08	Increments per 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
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

Index	Name	Description	Sub-index	Unit	Default value
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 ms	0x00000000
0x6E93	n_SLS 32 Bit :002	Speed window for SLS_2	02	Increments per ms	0x00000000
0x6E93	n_SLS 32 Bit :003	Speed window for SLS_3	03	Increments per ms	0x00000000
0x6E93	n_SLS 32 Bit :004	Speed window for SLS_4	04	Increments per ms	0x00000000
0x6E93	n_SLS 32 Bit :005	Speed window for SLS_5	05	Increments per ms	0x00000000
0x6E93	n_SLS 32 Bit :006	Speed window for SLS_6	06	Increments per ms	0x00000000
0x6E93	n_SLS 32 Bit :007	Speed window for SLS_7	07	Increments per ms	0x00000000
0x6E93	n_SLS 32 Bit :008	Speed window for SLS_8	08	Increments per 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)

3.6.5.15 Description of the SMA safety function

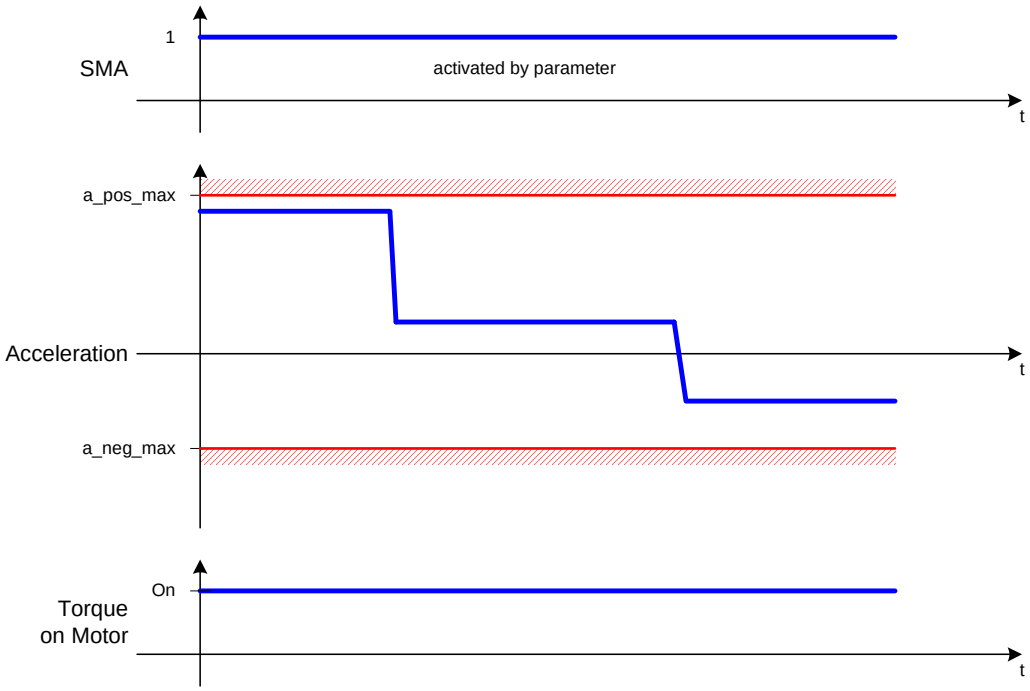


Figure 38: Description of the Safe Maximum Acceleration function (SMA)

The SMA function monitors the maximum acceleration, and is activated by setting the parameters a_pos_max or a_neg_max to a value that is not equal to 0. If at any time either a_pos_max or a_neg_max is not equal to 0 and one of the limits is exceeded, the Error Reaction Function SS1 or STO (as defined by 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 ms^2	0x0000
0x66CC	a_neg_max_SMA 32Bit	Maximum negative acceleration	Increments per ms^2	0x0000
0x66CD	Error Reaction SMA	Maximum time until the activation of the SLS safety function	--	0x66400001 (STO)

Parameters for axis 2:

Index	Name	Description	Unit	Default value
0x6ECA	a_pos_max_SMA 32Bit	Maximum positive acceleration	Increments per ms^2	0x0000
0x6ECC	a_neg_max_SMA 32Bit	Maximum negative acceleration	Increments per ms^2	0x0000
0x6ECD	Error Reaction SMA	Maximum time until the activation of the SMA safety function	--	0x66400001 (STO)

3.6.5.16 Description of the SMS safety function

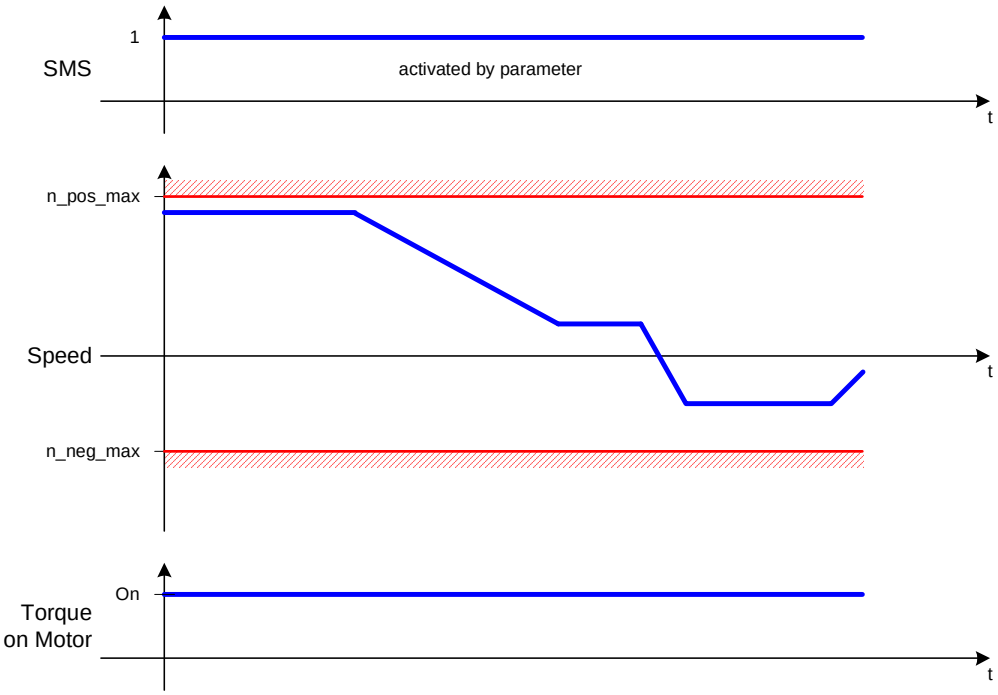


Figure 39: Description of the Safe Maximum Speed function (SMS)

The SMS function monitors the motor's maximum speed and is activated by setting the parameters n_pos_max or n_neg_max to a value not equal to 0. If either n_pos_max or n_neg_max is not equal to 0 and one of the limits is exceeded, the Error Reaction function (STO or SS1) as defined by 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 ms	0x0000
0x66AC	n_neg_max_SMS 32Bit	Maximum negative speed	Increments per ms	0x0000
0x66AD	Error Reaction SMS	Maximum time until the activation of the SMS safety function	--	0x66400001 (STO)

Parameters for axis 2:

Index	Name	Description	Unit	Default value
0x6EAA	n_pos_max_SMS 32Bit	Maximum positive speed	Increments per ms	0x0000
0x6EAC	n_neg_max_SMS 32Bit	Maximum negative speed	Increments per ms	0x0000
0x6EAD	Error Reaction SMS	Maximum time until the activation of the SMS safety function	--	0x66400001 (STO)

3.6.6 Configuring the error reaction

This section describes the AX5805's two error reactions in greater detail. The default error reaction is the STO function. However, for some of the AX5805's safety functions (SSR, SAR, SLI, SLP, SLS, SMA, and SMS), it is possible to configure the error reaction to SS1.

3.6.6.1 Error reaction Safe Torque Off (STO 0x66400001)

This is the default error reaction. If this error reaction is configured, the AX5805 immediately switches all torque off from the motors as soon as an error has been detected.

 **WARNING**	**Providing additional external safety measures for STO** When it is activated, STO initiates a coast-to-stop action. No braking is applied to the connected motors; the torque applied to the motor is switched off and the motor coasts to a stop. The time and distance it takes for the motor to stop depends on the mechanics and kinetic energy present in the system. If there are loads suspended from the motor, the motor may even be accelerated. The user must provide external safety mechanisms (e.g. mechanical brakes) to prevent such inadvertent motion.

3.6.6.2 Error reaction Safe Stop 1 (SS1 0x66500001)

When the error reaction SS1 is activated, the AX5805 notifies the AX5000, that it should activate its emergency stop ramp. The emergency stop ramp is purely functional and is *not* a safety function.

After the timespan set in the parameters 0x2030 and 0x2830 has elapsed, the AX5805 activates the STO function, which removes all torque from the motor.

It is possible that the AX5000 fails to activate the emergency stop ramp. In this case, it is possible that the motors will continue to rotate or even accelerate. Therefore, it is important to configure the timespan so that an inadvertent acceleration during the configured time period does not lead to hazardous situation. On the other hand, it is important to configure a timespan long enough so that the motors can be stopped.

 **DANGER**	**Choosing the timespan for SS1** The timespan for the error reaction SS1 should be configured so that no hazardous situation arises if: - the AX5000 fails to activate the emergency stop ramp, or - if the motors continue to rotate or even accelerate. After the configured timespan has elapsed, STO (Safe Torque Off) is activated. When it is activated, STO initiates a coast-to-stop action. No braking is applied to the connected motors; the torque applied to the motor is switched off and the motor coasts to a stop. The time and distance it takes for the motor to stop depends on the mechanics and kinetic energy present in the system. If there are loads suspended from the motor, the motor may even be accelerated. The user must provide external safety mechanisms (e.g. mechanical brakes) to prevent such inadvertent motion.

3.7 First Steps – AX5805

In the following example, the safety function SDIn (axis may only rotate in a positive direction, refer to Chapter 3.6.5.8) is configured and activated.

This example uses the following hardware:

- AX5103-0000-0200 servo drive
- TwinSAFE Drive option card AX5805
- EL6900 TwinSAFE PLC
- 3x 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 may also have to be set according to the motors in use (refer to the AX5000 user manual).

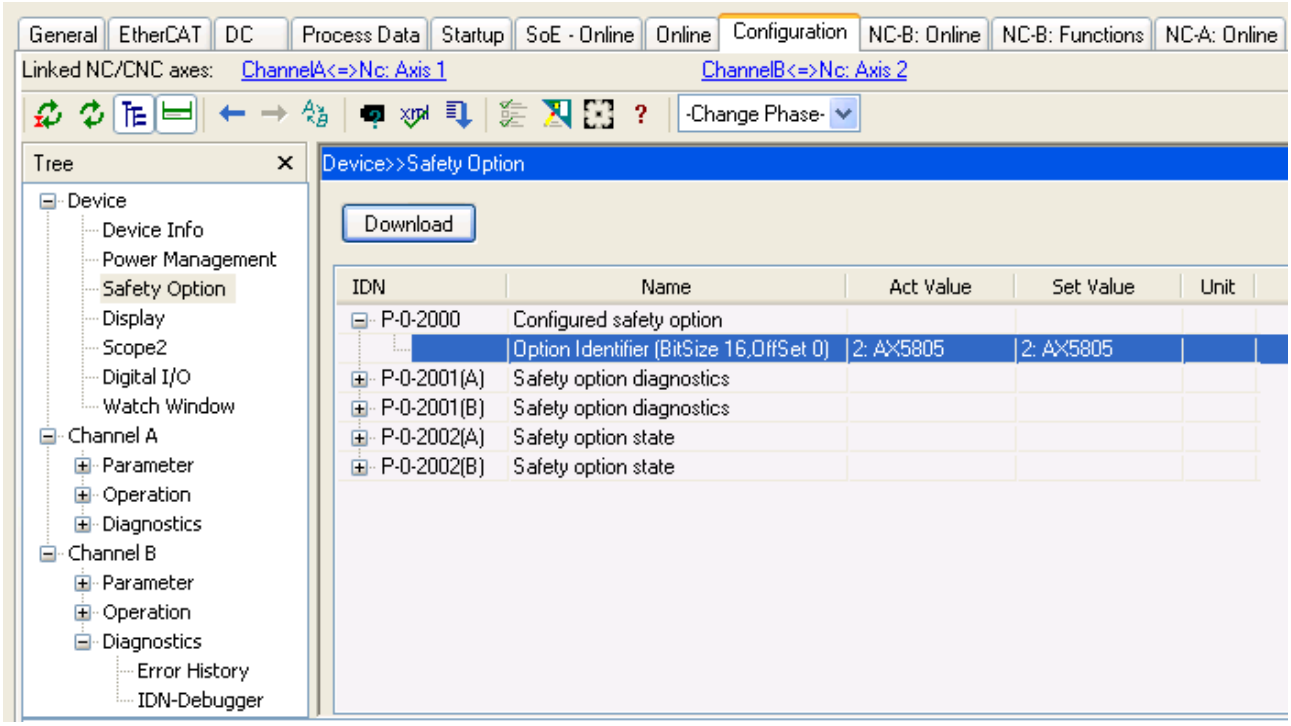


Figure 40: P-0-2000 Configured Safety Option → AX5805

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 this example is named: AM3021-0C40-0000 →
  enter ASCII code 41 4D 33 30 32 31 2D 30 43 34 30 2D 30 30 30 30 or in a textual way
- Motor_Polepairs (Index 0x2002)
  The motor in use has 3 pairs of poles. → enter 3
- Number_of_Axes (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 <

Figure 41: Setting the parameters

3.7.3 Step 3: link Error_Acknowledge in Safe PLC

In order to be able to acknowledge errors (e.g. reset an error after the axis has moved in the negative direction while the SDIn safety function is activated), 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.

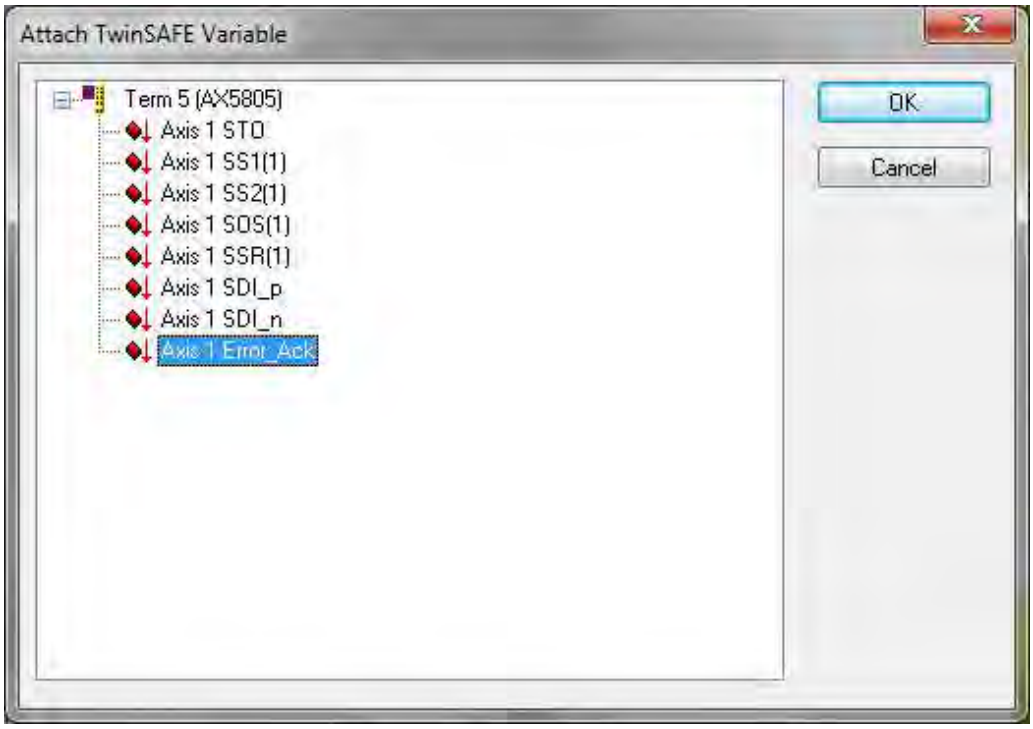


Figure 42: AX5805 Error_Ack link

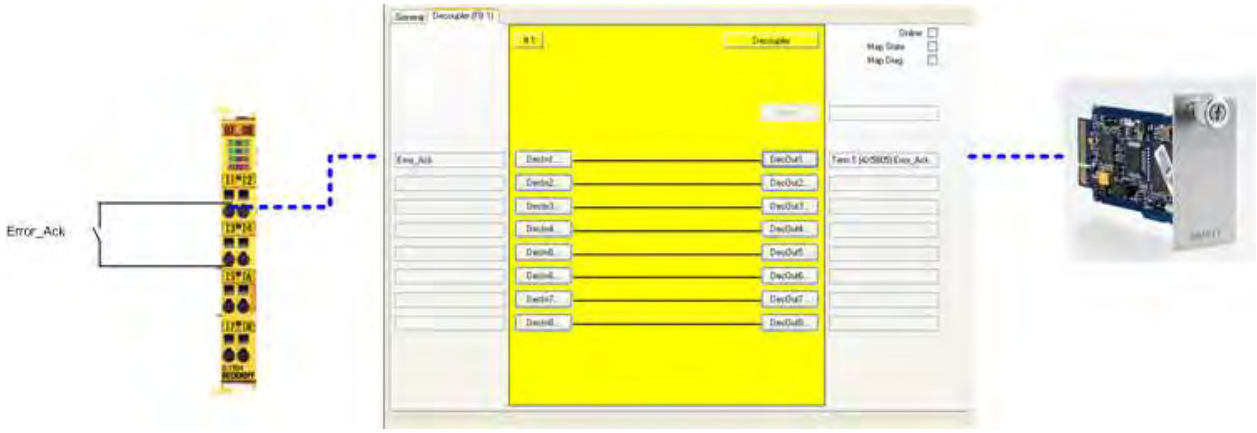


Figure 43: Error_Acknowledge button on the AX5805

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

This example activates the SDIn safety function by using a light curtain, which is connected to the second TwinSAFE 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 nonetheless moves in the negative direction and the window limit is exceeded, the AX5805 activates the STO action and removes torque from the motor.

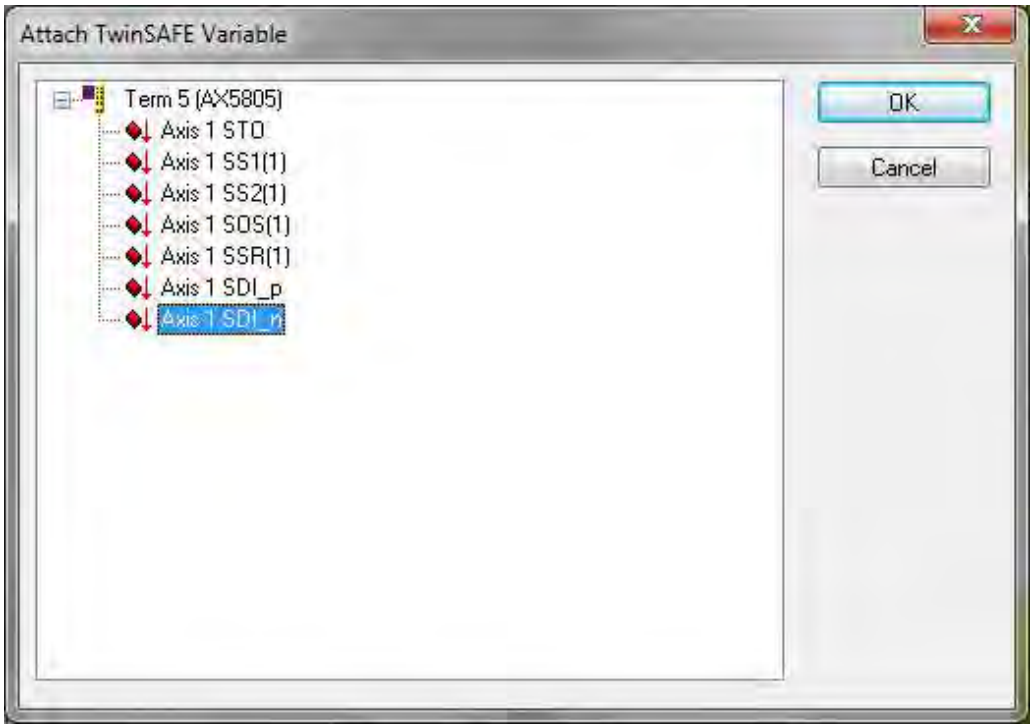


Figure 44: AX5805 SDI_n link

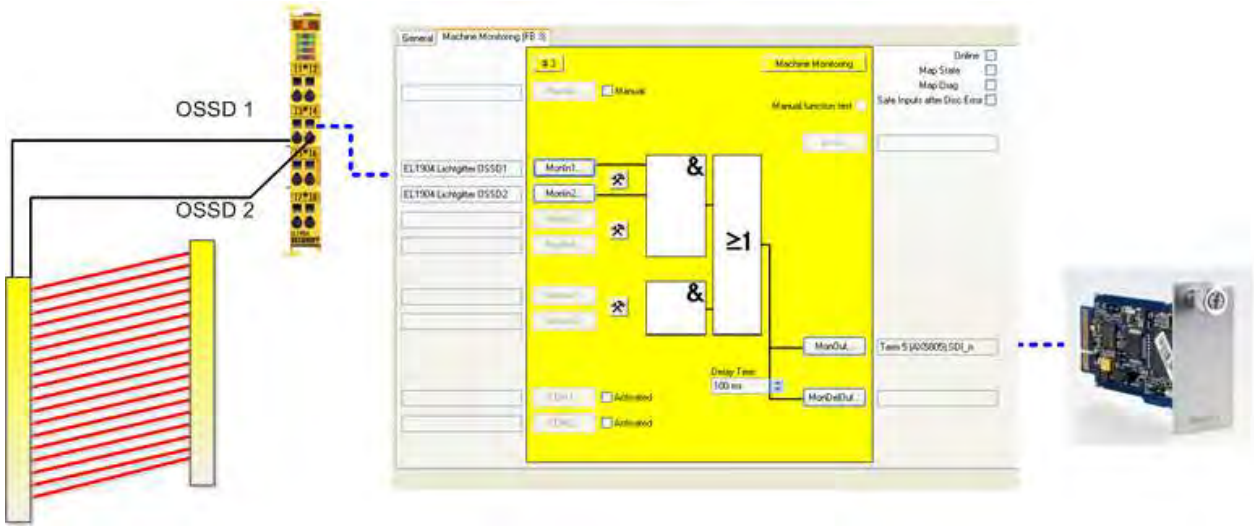


Figure 45: Light curtain for SDIn of the AX5805

3.7.5 Step 5: Implementation of an EMERGENCY STOP button

The emergency stop function could be implemented as follows. When the Emergency Stop is pressed, the drive must be disabled. In this case, the drive stops the motor via the functional (non-safety) STOP ramp. After the preconfigured time (ESTOP delayed output) has elapsed, the STO function is activated and torque is removed from the motor.

The delayed output signal of the ESTOP is linked to all of the functions. Since the STO function has the highest priority, all of the other safety functions are disabled in the normal operating mode, even after the delayed output signal is linked to them.

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 coast to a stop or may even be accelerated. In order to avoid these dangerous situations and movements, external safety mechanisms are to be provided by the user.

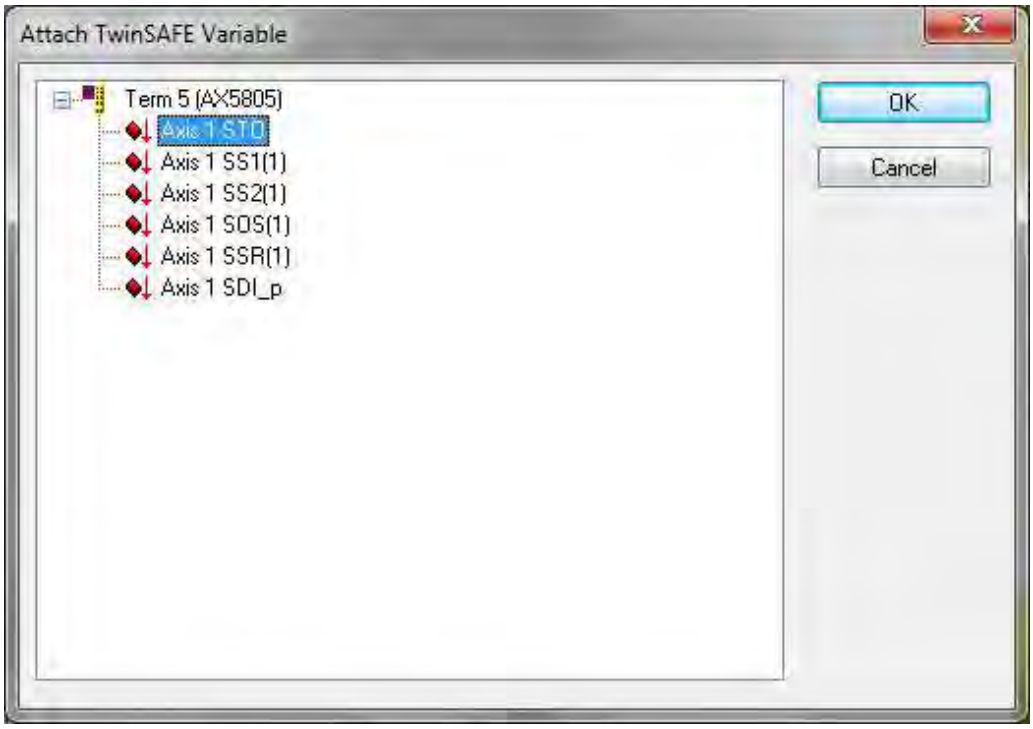


Figure 46: AX5805 STO link

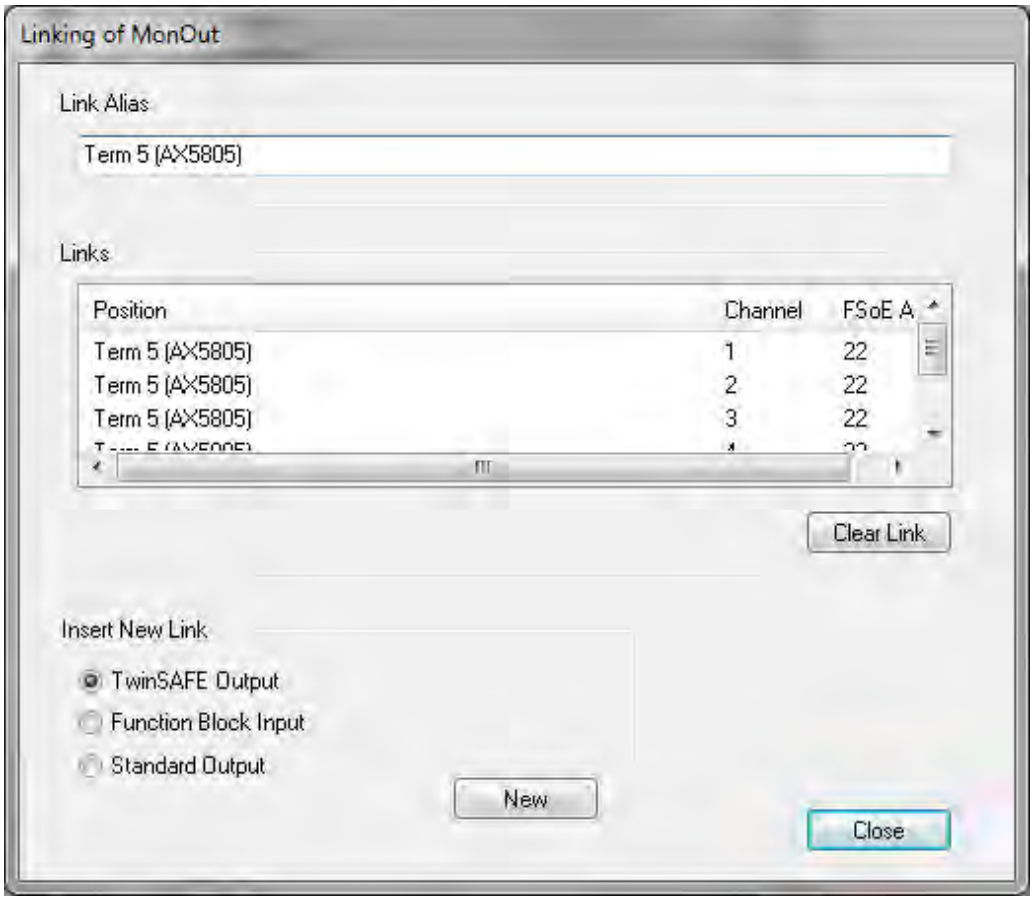


Figure 47: Linking of the unused AX5805 functions

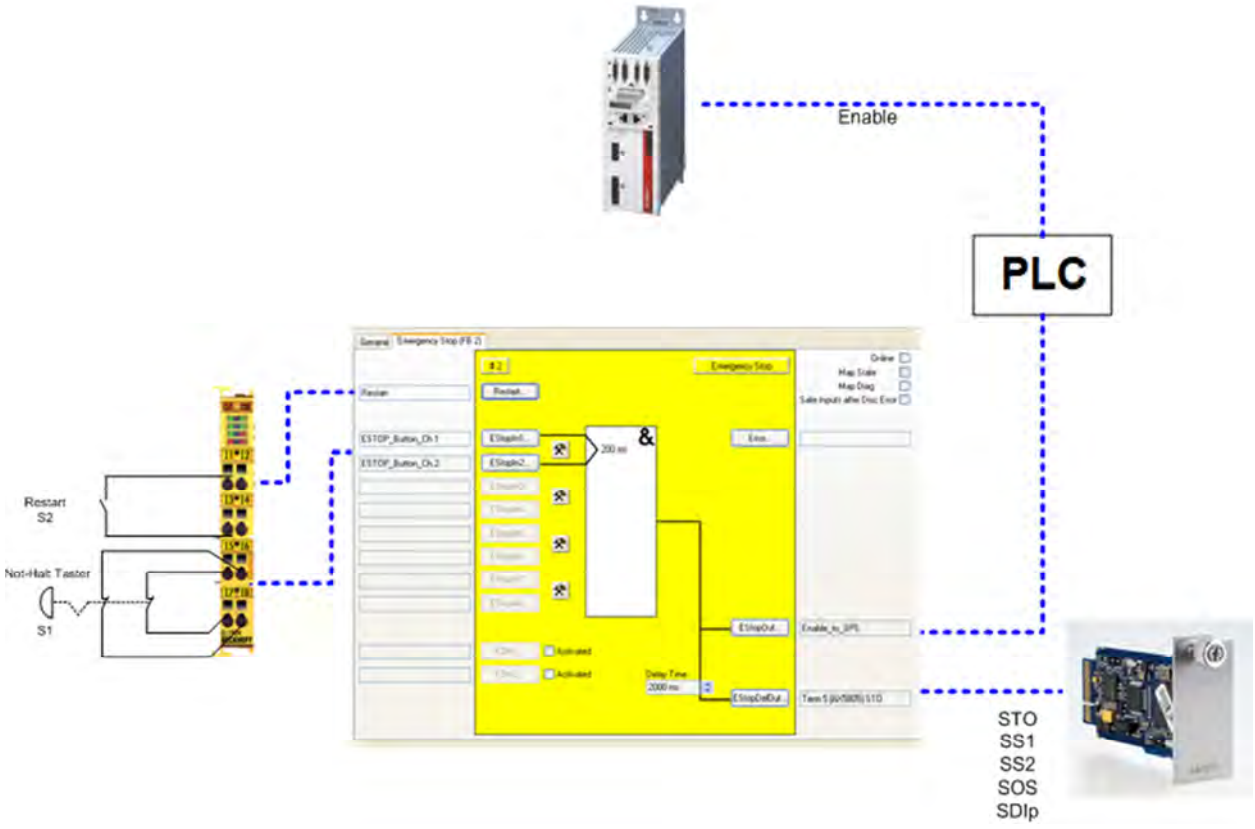


Figure 48: Emergency stop button for STO of the AX5805

4 Error and diagnosis

When it is activated, STO initiates a coast-to-stop action. No braking is applied to the connected motors; the torque applied to the motor is switched off and the motor coasts to a stop. The time and distance it takes for the motor to stop depends on the mechanics and kinetic energy present in the system. If there are loads suspended from the motor, the motor may even be accelerated. The user must provide external safety mechanisms (e.g. mechanical brakes) to prevent such inadvertent motion.

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 smaller than 0x1000 or larger than 0x4FFF are errors that can be reset by the transition of the EtherCAT state 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 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 (MC1).	
0x0002	FAULT_MAXT_C2	The temperature has exceeded the maximum permissible temperature (MC2).	
0x0003	FAULT_MINT_C1	The temperature has fallen below the minimum permissible temperature (MC1).	
0x0004	FAULT_MINT_C2	The temperature has fallen below the minimum permissible temperature (MC2).	
0x0101	HW_ERR_MAX_VCC_C1	The supply voltage has exceeded the maximum permissible voltage.	
0x0102	HW_ERR_MAX_VCC_C2	The supply voltage has exceeded the maximum permissible voltage.	
0x0103	HW_ERR_MIN_VCC_C1	The supply voltage has fallen below the minimum permissible voltage.	
0x0104	HW_ERR_MIN_VCC_C2	The supply voltage has fallen below the minimum permissible voltage.	
0x0201	FAULT_MCTC1_TO	The MCTests of MC1 were not carried out completely within the specified time	
0x0202	FAULT_MCTC2_TO	The MCTests of MC2 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 TS module was not called within the watchdog time.	
0x020D	FAULT_TS_WDG_TO_C2	The TS module was not called within the watchdog time.	

Error index in 0xFA82	Error name	Description	Typical error reaction time
0x020E	FAULT_RESET_MC1	A reset has occurred in the operation of the controller for MC1. MC2 was not reset thereby.	
0x0300	FAULT_SERCOMC2	Error group: an error occurred in the SerComP24C2 module during data transmission	
0x0401-0x040B	FAULT_SERCOM1	Error group: an error occurred in the SerComP24C1 module during data transmission	
0x0501-0x0507	FAULT_TEMPSENSOR	An error occurred during communication with the AD7814.	
0x0601	FAULT_OUTPUTCOMPARE	The values output by MC1 and MC2 differ.	
0x0602	FAULT_OUTPUTCOMPAREC2	The values output by MC1 and MC2 differ.	
0x0700	HW_ERR_MIN_VCC_FPGA	The FPGA supply voltage has fallen below the minimum.	
0x0701	HW_ERR_MAX_VCC_FPGA	The FPGA supply voltage has exceeded the maximum permissible voltage.	
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 – µC2drive profile	
0x0725	FAULT_Parameter_C2_VENDOR_SPECIFIC	Parameter: unknown parameter index – µC2 vendor-specific	
0x0726	FAULT_PDO_MAPPING_FSOE_COMMAND	PDO mapping: FSOE COMMAND error	
0x0727	FAULT_PDO_MAPPING_LENGTH	PDO mapping: Length_Error	
0x0728	FAULT_PDO_MAPPING_STO_K1	PDO mapping: STO error	
0x0729	FAULT_PDO_MAPPING_SS1_1_K1	PDO mapping: Error SS1_1	
0x072A	FAULT_PDO_MAPPING_SS2_1_K1	PDO mapping: Error SS2_1	
0x072B	FAULT_PDO_MAPPING_SOS_1_K1	PDO mapping: SS2_1 error	
0x072C	FAULT_PDO_MAPPING_SSR_1_K1	PDO mapping: SSR_1 error	
0x072D	FAULT_PDO_MAPPING_SDIp_K1	PDO mapping: SDIp error	
0x072E	FAULT_PDO_MAPPING_SDIn_K1	PDO mapping: SDIn error	
0x072F	FAULT_PDO_MAPPING_Error_ACK_K1	PDO mapping: Error_ACK error	
0x0730	FAULT_PDO_MAPPING_Error_CRC0	PDO mapping: FSOE CRC0 error	
0x0731	FAULT_PDO_MAPPING_STO_K2	PDO mapping: STO error	
0x0732	FAULT_PDO_MAPPING_SS1_1_K2	PDO mapping: Error SS1_1	
0x0733	FAULT_PDO_MAPPING_SS2_1_K2	PDO mapping: Error SS2_1	
0x0734	FAULT_PDO_MAPPING_SOS_1_K2	PDO mapping: SS2_1 error	

Error index in 0xFA82	Error name	Description	Typical error reaction time
0x0735	FAULT_PDO_MAPPING_SSR_1_K2	PDO mapping: SSR_1 error	
0x0736	FAULT_PDO_MAPPING_SDIp_K2	PDO mapping: SDIp error	
0x0737	FAULT_PDO_MAPPING_SDIn_K2	PDO mapping: SDIn error	
0x0738	FAULT_PDO_MAPPING_Error_ACK_K2	PDO mapping: Error_ACK error	
0x0739	FAULT_PDO_MAPPING_Error_CRC1	PDO mapping: FSOE CRC1 error	
0x073A	FAULT_PDO_MAPPING_Error_ConnID	PDO mapping: FSOE ConnID error	
0x073B	FAULT_PDO_MAPPING_SSM_1_K1	PDO mapping: SSM_1_K1 error	
0x073C	FAULT_PDO_MAPPING_SSM_1_K2	PDO mapping: SSM_1_K2 error	
0x073D	FAULT_PDO_MAPPING_SSM_2_K1	PDO mapping: SSM_2_K1 error	
0x073E	FAULT_PDO_MAPPING_SSM_2_K2	PDO mapping: 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 2 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 was determined for MC1 during the POR.	
0x1002	FAULT_CRC_INIT_C2	An incorrect checksum was determined for MC2 during the POR.	
0x1003	FAULT_CRC_C1	An incorrect checksum was determined for MC1 during operation.	
0x1004	FAULT_CRC_C2	An incorrect checksum was determined for MC2 during operation.	

Error index in 0xFA82	Error name	Description	Typical error reaction time
0x1011	FAULT_RAM_C1	An error occurred during the GalPat test of MC1.	125 µs
0x1012	FAULT_RAM_C2	An error occurred during the GalPat test of MC2.	125 µs
0x1013	FAULT_RAM_CHECKERBOARD_C1	An error occurred during the checkerboard test of MC1.	
0x1014	FAULT_RAM_CHECKERBOARD_C2	An error occurred during the checkerboard test of MC2.	
0x1021	FAULT_GLBL_TMR	The global timer is not working correctly.	125 µs
0x1031	FAULT_SPLIM1	Stack overruns are no longer being intercepted correctly; SPLIM could not be set.	
0x1032	FAULT_SPLIM2	Stack overruns are no longer being intercepted correctly.	
0x1100	FAULT_OPCT_GRP_C1	The Opcode test has failed, see OpCodeTest.s for error number	
0x1300	FAULT_OPCT_GRP_C2	The Opcode test of MC2 has failed, see OpCodeTest.s for error number	
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 C1 was called.	
0x1804	FAULT_SW_MAIN1_C2	The default case of the main loop of C2 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

Error index in 0xFA82	Error name	Description	Typical error reaction time
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: Control word	
0x510A	FAULT_TIMEOUT_REG_AX5000_STATUS	Register communication: AX5000 does not answer in time: Status word	
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	Register communication: hardware version 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	An incorrect checksum was determined when comparing with C1	
0x5F01	FAULT_CRC_COMPARE_C2	An incorrect checksum was determined when comparing with C2	

Error index in 0xFA82	Error name	Description	Typical error reaction time
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!	
0x5F07	FAULT_FPGA_C2	The status of the FPGA is incorrect	
0x5F08	FAULT_ANGLE_FORMAT_C1	The angles of C1 read-in have the wrong format.	125 µs
0x5F09	FAULT_ANGLE_FORMAT_C2	The angles of C2 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
0x6000	FAULT_PARAMETER_ FSOE_VENDOR_ID	Wrong Vendor ID transmitted	
0x6001	FAULT_PARAMETER_ FSOE_MODULE_IDENT	Wrong Module ID transmitted	
0x6002	FAULT_PARAMETER_FSOE_CRC	CRC of the AX5805 parameters do not fit to the transmitted CRC (Please check parameters and activate system manager configuration and load safety configuration to the EL69xx again)	

4.2 Reason for shut-down CoE Objects 0xFA10:07 and 0xFA10:08

In order to determine the reason for shut-down, the sub-index 01 for the CoE Object 0xFA10 must be set to 0.

Value in 0xFA10:07 Reason for Axis 1 0xFA10:08 Reason for Axis 2	Description
0xXX00	Error reaction: no error reaction
0xXX40	Error reaction: STO (Safe Torque Off)
0xXX50	Error reaction: SS1 (Safe Stop 1)
0x01XX	Reason: the status word was calculated incorrectly
0x02XX	Reason: the parameters are incorrect or haven't been loaded
0x03XX	Reason: the FSOE-Protocol is not in the DATA state
0x04XX	Reason: the internal comparison has failed. Re-check the motor and drive dimensioning and parameterization
0x05XX	Reason: External Position Reference Cam was detected in an unexpected location.
0x06XX	Reason position detection: the External Position Reference Cam was detected at a position greater than the cam window
0x07XX	Reason position detection: the External Position Reference Cam was detected at a position less than the cam window
0x08XX	Reason position detection: the axis has exceeded the defined maximum allowable position range
0x50XX	Reason safety function: the safety function SS1 has been turned off
0x68XX	Reason safety function: the safety function SOS has been turned off.
0x80XX	Reason safety function: the safety function SSR has been turned off.
0x90XX	Reason safety function: the safety function SLS has been turned off.
0xA0XX	Reason safety function: the safety function SLP has been turned off.
0xA8XX	Reason safety function: the safety function SMS has been turned off.
0xB8XX	Reason safety function: the safety function SLI has been turned off.
0xC0XX	Reason safety function: the safety function SAR has been turned off.
0xC8XX	Reason safety function: the safety function SMA has been turned off.
0xD0xx	Reason safety function: the safety function SDIp has been turned off.
0xD1xx	Reason safety function: the safety function SDIn has been turned off.

4.3 Diagnose CoE Object 0xFA10

The CoE Object 0xFA10 supplies the user with additional diagnostic information. When sub-index 01 is set to one of the values in the headings below, sub-indices 02 to 08 show the information in the corresponding table.

The error and diagnostic values correspond to the information described in Chapter 4.2 .

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 shut-down Axis 1	Refer to Chapter 4.2
0xFA10:08	Reason for shut-down Axis 2	Refer to Chapter 4.2

4.3.2 0xFA10:01 = 1

Index in 0xFA10	Name	Description
0xFA10:02	Error 1 in C1	Refer to Chapter 4.2
0xFA10:03	Error 2 in C1	
0xFA10:04	Error 3 in C1	
0xFA10:05	Error 4 in C1	
0xFA10:06	Error 5 in C1	
0xFA10:07	Error 6 in C1	
0xFA10:08	Error 7 in C1	

4.3.3 0xFA10:01 = 2

Index in 0xFA10	Name	Description
0xFA10:02	Error 8 in C1	Refer to Chapter 4.2
0xFA10:03	Error 9 in C1	
0xFA10:04	Error 10 in C1	
0xFA10:05	Error 11 in C1	
0xFA10:06	Error 12 in C1	
0xFA10:07	Error 13 in C1	
0xFA10:08	Error 14 in C1	

4.3.4 0xFA10:01 = 3

Index in 0xFA10	Name	Description
0xFA10:02	Error 1 in C2	Refer to Chapter 4.2
0xFA10:03	Error 2 in C2	
0xFA10:04	Error 3 in C2	
0xFA10:05	Error 4 in C2	
0xFA10:06	Error 5 in C2	
0xFA10:07	Error 6 in C2	
0xFA10:08	Error 7 in C2	

4.3.5 0xFA10:01 = 4

Index in 0xFA10	Name	Description
0xFA10:02	Error 8 in C2	Refer to Chapter 4.2
0xFA10:03	Error 9 in C2	
0xFA10:04	Error 10 in C2	
0xFA10:05	Error 11 in C2	
0xFA10:06	Error 12 in C2	
0xFA10:07	Error 13 in C2	
0xFA10:08	Error 14 in C2	

4.3.6 0xFA10:01 = 5

Index in 0xFA10	Name	Description
0xFA10:02	Diagnostic value 1 in C1	Refer to Chapter 4.2
0xFA10:03	Diagnostic value 2 in C1	
0xFA10:04	Diagnostic value 3 in C1	
0xFA10:05	Diagnostic value 4 in C1	
0xFA10:06	Diagnostic value 5 in C1	
0xFA10:07	Diagnostic value 6 in C1	
0xFA10:08	Diagnostic value 7 in C1	

4.3.7 0xFA10:01 = 6

Index in 0xFA10	Name	Description
0xFA10:02	Diagnostic value 8 in C1	Refer to Chapter 4.2
0xFA10:03	Diagnostic value 9 in C1	
0xFA10:04	Diagnostic value 10 in C1	
0xFA10:05	Diagnostic value 11 in C1	
0xFA10:06	Diagnostic value 12 in C1	
0xFA10:07	Diagnostic value 13 in C1	
0xFA10:08	Diagnostic value 14 in C1	

4.3.8 0xFA10:01 = 7

Index in 0xFA10	Name	Description
0xFA10:02	Diagnostic value 1 in C2	Refer to Chapter 4.2
0xFA10:03	Diagnostic value 2 in C2	
0xFA10:04	Diagnostic value 3 in C2	
0xFA10:05	Diagnostic value 4 in C2	
0xFA10:06	Diagnostic value 5 in C2	
0xFA10:07	Diagnostic value 6 in C2	
0xFA10:08	Diagnostic value 7 in C2	

4.3.9 0xFA10:01 = 8

Index in 0xFA10	Name	Description
0xFA10:02	Diagnostic value 8 in C2	Refer to Chapter 4.2
0xFA10:03	Diagnostic value 9 in C2	
0xFA10:04	Diagnostic value 10 in C2	
0xFA10:05	Diagnostic value 11 in C2	
0xFA10:06	Diagnostic value 12 in C2	
0xFA10:07	Diagnostic value 13 in C2	
0xFA10:08	Diagnostic value 14 in C2	

4.4 Maintenance

The TwinSAFE Drive option cards do not contain serviceable parts.

 WARNING	**The specified environmental conditions must be observed** TwinSAFE option cards must only be stored and operated under the specified conditions (see technical data). There are no user serviceable parts on the AX5805.

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

4.4.1 Cleaning the AX5805

The TwinSAFE Drive option card must be protected from unacceptable contamination during operation and storage. If the option card becomes contaminated, it may not be used any further.

 WARNING	**Having contaminated TwinSAFE Drive option cards checked** Do not attempt to clean the TwinSAFE Drive option card. If the option card becomes contaminated, return it to the manufacturer for decontamination and re-testing.

4.4.2 Lifespan and proof tests

The TwinSAFE Drive option cards have a service lifespan 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 attempting to remove the TwinSAFE Drive option card.

4.5.1 Disposal

Before the TwinSAFE Drive option card can be disposed, it must be removed and destroyed. Metal parts can be recycled as appropriate. Electronic parts such as circuit boards must be disposed of in accordance with local 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
Eiserstr. 5
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

ZERTIFIKAT ◆ CERTIFICATE ◆ 認証書 ◆ СЕРТИФИКАТ ◆ CERTIFICADO ◆ CERTIFICAT

CERTIFICATE

No. Z10 12 01 62386 014

Holder of Certificate:	**BECKHOFF Automation GmbH** Eiserstraße 5 33415 Verl GERMANY
Factory(ies):	62386
Certification Mark:	
Product:	**Safety components**
Model(s):	**AX5805 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 13849-1:2008 (CAT 4, PL e) EN 61508-1:2001 (SIL 3) EN 61508-2:2001 (SIL 3) EN 61508-3:2001 (SIL 3) EN 61508-4:2001 (SIL 3) EN 62061:2005 (SILCL 3) EN 61800-5-2:2007 EN 61326-3-1:2008 IEC 61784-3:2010

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: 2017-02-01

Date, 2012-02-02 (Günter Greil)

472183

Page 1 of 1

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