Setup Guide

Functional Safety

This document describes how to commission *Functional Safety* in the TSD and TSP Drives. The document is intended for safety specialists who commission Triamec drives.

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Document Functional-SafetySetup_EP
Version 003, 2026-01-20
Source Q:\Doc\Software\SWFW\SWFW_Monitor\SafetyMonitor\TsdTsp_Drives\Safety_II\Setu
Destination Q:\Doc\Hardware\HWTSD\HWTSD_SafetyII
Owner ab

www.triamec.com

1 Scope (goal / purpose)

This document describes the necessary steps for commissioning Functional Safety on Triamec Drives.

It applies to a system equipped with Triamec servo drives of the TSD series or TSP700 series with Functional Safety option. These drives are identical in terms of their safety related hardware and software.

2 Terms and abbreviations

SFF	Safe Failure Fraction
DC	Diagnostic Coverage
SIL	Safety Integrity Level
HFT	Hardware Fault Tolerance
PFH	Probability of a dangerous random hardware failure per hour if single-channel: Lambda = $1/MTTF_d$
$MTTF_d$	Mean time to dangerous failure (MTBF)
B_{10d}	Number of cycles until 10% of the components fail dangerously
FIT	Failure in time. Failures per 10^9 h, FIT= (cycles/h)*(0.1/B_{10d})*10^9 .
n_{OP}	Number of operations
Safety Module	Simplified designation for the two safety processors in the drive
SF	Functional Safety Safety function
SP	Safety Processor

3 Applicable standards and company guidelines

Test standard	Title
IEC 61508-1:2010 IEC 61508-2:2010 IEC 61508-3:2010 IEC 61508-4:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems Part 1: General requirements Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems Part 3: Software requirements Part 4: Definitions
IEC 61800-1:2018 IEC 61800-3:2019 IEC 61800-5-1:2017 IEC 61800-5-2:2017	Adjustable speed electrical power drive systems Part 1: General requirements – Rating specifications for low voltage adjustable speed d.c. power drive systems Part 3: EMC requirements and specific test methods Part 5-1: Safety requirements – Electrical, thermal and energy Part 5-2: Safety requirements – Functional
IEC 61326-3-1:2008	Immunity Requirements for safety-related systems
ISO 13849-1:2023 ISO 13849-2:2023	Safety of machinery – Safety-related parts of control systems, Part 1: General principles for design Part 2: Validation

4 System overview

Triamec drives of the TSD and TSP700 family can be equipped with integrated 'Functional Safety'. The integrated functional safety technology provides the prerequisites on the control and drive side for the optimal realisation of protective functions.

The following picture shows a schematic overview of the system. The system under consideration is a servo drive of the TSD family, which can control two axes by means of a main processor (µC/FPGA Drive Logic). Within the servo drive, the safety functionality is integrated with two microcontrollers (µC SP A and SP B). This documentation describes how the safety microcontrollers are configured to fulfill the concrete application-specific functional safety task.

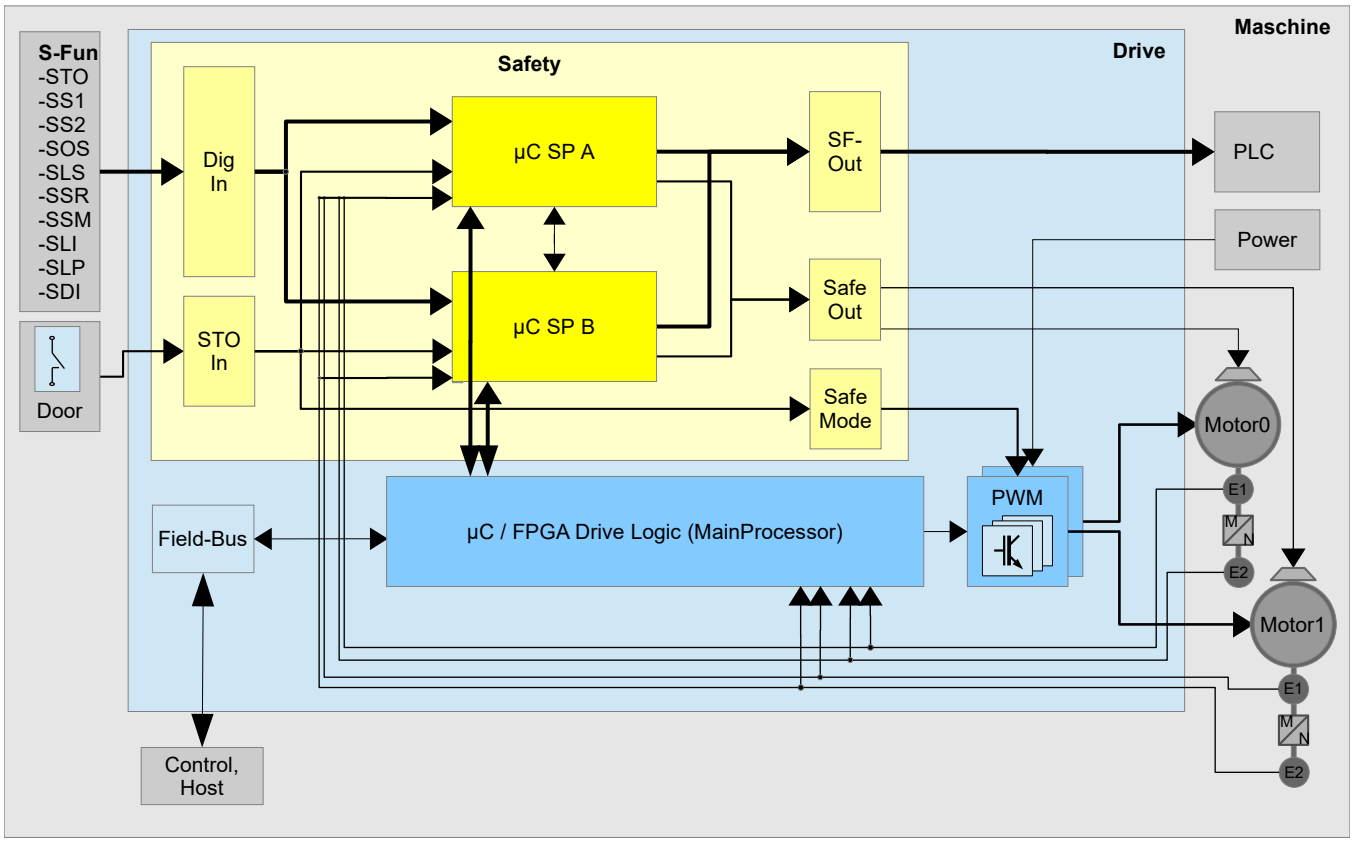


Figure 1: System overview Drive with Functional Safety

5 Safety configuration

Functional Safety is set up in Triamec Drives using a software wizard. It is assumed that the machine with the drives has been commissioned before the safety is set up in the drives.

The following procedure is recommended:

1. Create a safety concept for the machine.
2. Equip the system with the drives and wire it according to the '*Hardware Manual' [3], [4]* and [5].
3. Commission the system with the drives according to the 'Servo Drive Setup Guide'. [2].
4. Perform safety setup, drive by drive, using the ***Safety Setup Wizard*** and check and verify settings using the ***TAM System Explorer*** *and* ***Safety Setup Wizard.***
5. Consolidate safety setup, ensure safety configuration and hash.

It is possible to prepare a safety setup in the office using the offline mode of the ***Safety Setup Wizard***. With this procedure, the points mentioned above must also be carried out! However, with this variant, the time spent on the machine can be shortened at point 4.

6 Setup tool (*Safety Setup Wizard*)

6.1 Introduction

The *Safety Setup Wizard* supports the setup of Functional Safety for the individual drives. The wizard can be used to perform the following basic functions:

- upload safety configurations from the drive's safety module and check settings
- create a safety configuration and load it into the safety module of the drive
- modify an existing safety configuration and load it into the safety module of the drive
- load an authorised safety configuration into the safety module of the drive, if the Config State is Service
- carry out a firmware update of the drive, if the Config State is Service
- delete the persistent safety configuration in the safety module of the drive
- set and delete access passwords of the Safety Module
- support for testing and verification of the safety configuration

6.2 Start the Safety Config Wizard

The ***Safety Setup Wizard*** is integrated in the ***TAM System Explorer*** and can be launched for each drive in the system by right-clicking on the drive to be set up in the tree. When *Configure safety...* is selected in the context menu, the wizard for the selected drive is started.

Note: There is also a *Safety Setup Wizard* version that can be run as a stand-alone application. This is particularly suitable for offline mode.

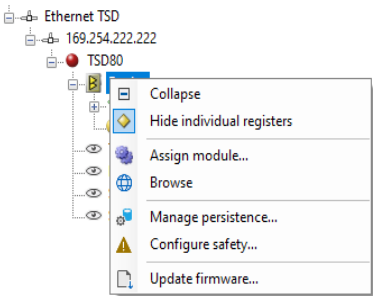


Figure 1: starting the Wizard

6.3 Safety Module Information

The *Safety Setup Wizard* uses the *'Safety Module Information'* form to display the safety-relevant information of the selected drive. This form serves as an introduction to the safety configuration of a drive.

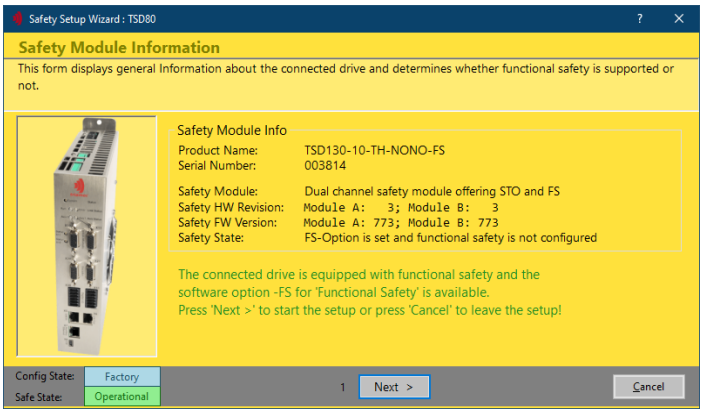


Figure 2: 'Safety Module Information' form in Config State Factory

UI element	Description
Product Name	Name of the connected drive
Serial Number	Serial number of the connected drive
Safety Module	Type of detected safety module in the connected drives
Safety HW Revision	Hardware revision of the two safety modules A and B
Safety FW Version	Firmware version of the two safety modules A and B
Safety State	Plain text display with information about FS option and configuration status
Info text	This field displays information about the currently selected drive, its safety capabilities and information about the possible actions.

Table 1: UI elements of the 'Safety Module Information' form

6.3.1 General UI elements

The following table uses the *'Safety Module Information'* form to describe general UI elements that appear in the other forms of the Safety Wizard.

UI element	Description
Button **Next >**	The wizard navigates forward to the next form. For drives that are equipped with *Functional Safety* hardware and the software option -FS is available or if no drive is connected, the button **Next >** is displayed. In all other situations, e.g. where the drive does not support Functional Safety, the button **Next >** is hidden.
Button **State**	The *'Safety Status Overview'* form with the current state is displayed in addition to the current form if it is not already displayed. The *'Safety Status Overview'* form is hidden if it is already displayed when the **State** button is pressed. The possibility with the display of the state form exists in most forms. (See 6.10 Show Status of Safety Module)
Button **Cancel**	The wizard is closed after a confirmation. This button is available in most forms.
Display **Config State**	This element is used to display the status of the safe parametrisation in the Status Bar of the Wizard at any time. (See 6.3.2 Status of the Safe parametrisation)
Display **Safe State**	With this element, the safety status of the safety module is displayed in the Status Bar of the Wizard at any time. (See 6.3.3 Safe State)

Table 2: General UI elements of the Safety Wizard

Tool tip

For all forms of the ***Safety Setup Wizard,*** a *tool tip* can be displayed by moving the mouse over most of the control elements. This provides information about the function of the corresponding element.

6.3.2 Status of the Safe parametrisation

The current status of the persistent safety configuration is displayed in the **Config State** field in the status line. The display is shown in all other forms of the wizard in order to be informed about the current status of the safe parametrisation at all times.

This is based on the possible states in which the safe parametrisation can be. These are shown graphically in 3.
The following table explains the states and defines the type of representation in the **Config State** field.

The transitions between the individual persistent states are controlled implicitly by means of actions with the wizard.

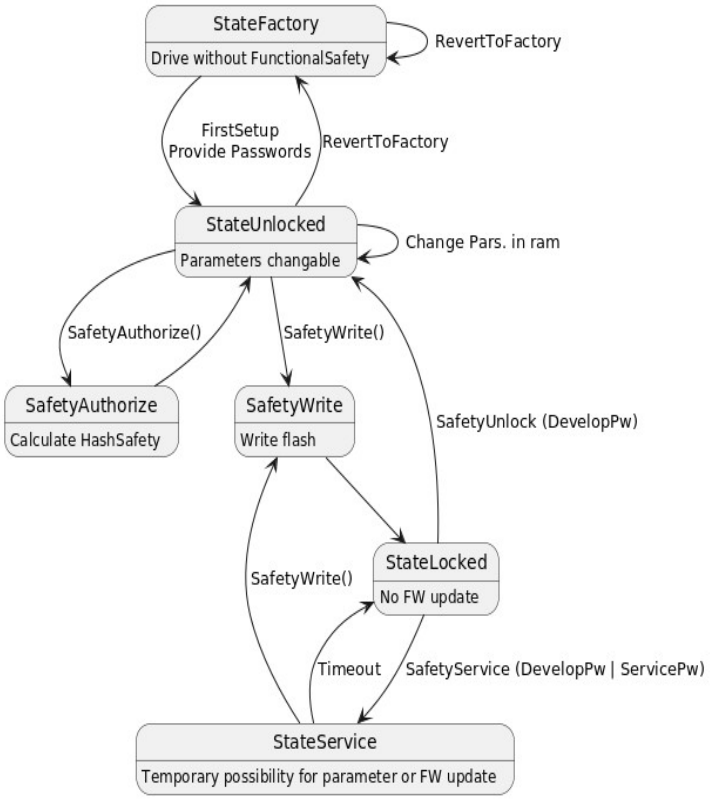


Figure 3: Safety Lifecycle of Safety Module

Config State		
Display	**Colour**	**Meaning**
Factory	Light blue	In the Config State ***Factory***, the Safety module is initial and remains so if *Functional Safety* is not enabled. If the drive allows *Functional Safety*, a trained person can start a Safety configuration by initially entering two passwords: One for *Developer* and one for *Service*. When these passwords are saved, the safety processors enter the Config State ***Unlocked***. (See 6.4.1 Set and delete passwords)
Offline	Silver	No drive connected, *Functional Safety* configuration is only possible *offline*. (See 6.12 Offline configuration)
Locked	Light green	In the Config State ***Locked,*** the parameters are read from the flash and cannot be modified (Safety configuration is activated). Firmware update is not possible either. This Config State can only be exited with password-protected commands.
Password	Light green	Temporary state for password verification when transitioning to ***Unlocked*** or ***Service*** State.
Unlocked	Orange	Functional Safety open for parametrisation. In the Config State ***Unlocked,*** all safety functions are available, but not persistent, and can be changed and tested. Firmware updates are also possible here.
Authorise	Orange	Temporary state during authorisation of the parameters.
Write	Orange	Temporary state while writing the parameters into the persistence of the safety module.
Service	Orange	The Config State ***Service*** can only be accessed with password-protected commands. The Config State ***Service*** is a temporary state and allows loading an authorised configuration. In the Config State ***Service***, the safety processor remains in the 'safe state' and also allows a firmware update. A reboot is carried out afterwards and the safety module then returns to the Config State ***Locked***. The Config State ***Service*** is automatically exited 5 minutes after entry and the safety module returns to the Config State ***Locked***.
Inconsitent	Red	Error: State of the two safety processors is different

Table 3: States of the safe parametrisation

6.3.3 Safe State

The status of the safety module is also displayed in the status line. The field **Safe State** is displayed in all other forms of the wizard in order to be informed about the current status of the safety module at any time.

The following table explains the states and defines the representation in the **Safe State** field.

Safe State		
Display	**Colour**	**Meaning**
Operational	Light green	No error and STO is not active.
STO	Gold	Safety Module is in 'STO Active' state.
Safe	Orange	Safety Module is in 'Safe State'.
Inconsitent	Red	Error: State of the two safety processors is different

Table 4: States of the safety module

6.4 State Factory

The *'Safety Configuration'* form is displayed as the first form after the *'Module Information'* form. As long as no passwords are set, the Config State is **Factory**. In this state, the *'Safety Configuration'* form can only be switched between **Online Configuration** and **Offline Configuration** and, in addition, the passwords can be set and the current configuration can be displayed in online mode.

The initial setting of the passwords is necessary before online safety configuration options are offered. The *'Safety Passwords Setup'* form can be accessed by pressing the button **Set Passwords.**

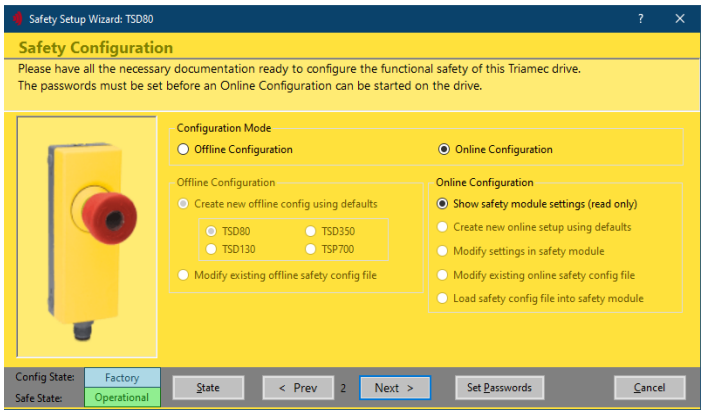


Figure 4: Safety-Configuration in Config State Factory

UI element	Description
RadioButtons in **Configuration Mode**	These two radio buttons are used to select the configuration mode. This is used to decide which type of configuration is to be carried out. • Mode **Offline Configuration** (see 6.12 Offline configuration) • Mode **Online Configuration**: Only the current safety parameters of the safety module can be displayed in the Config State **Factory**.
RadioButtons in ***Online Configuration***	Only **Show safety module settings (read only)** is available in the Config State **Factory.** The other configuration types are not available in this state and are greyed out. With this selection, the current parameters of the safety module can be displayed. Pressing the **Next >** button navigates to the first configuration form. The further steps are described in chapter 6.11 Show configuration.
Button **Set Passwords**	This button is only displayed when **Online Configuration is** selected. When pressed, the wizard changes to the form for entering the passwords. The passwords must be defined before an online configuration can be created or loaded.
Button **< Prev**	The wizard navigates back to the *'Safety Module Information'* form.
Next > *button*	The wizard navigates forward to the *'Safety Configuration Overview'* form.
State Displays **Safe State** and **Config State** *Buttons* **State** and **Cancel**	See Table 2

Table 5: UI elements of the 'Safety Configuration' form in Config State Factory

6.4.1 Set and delete passwords

In order to create a safety configuration in the online configuration mode or to load a safety configuration into the safety module, the access passwords must be defined initially. With regard to authorisation, there are two user roles, which are described below:

- **Developer:** The *Developer* user is authorised:
  - to create a safety configuration and load it into the safety module,
  - to modify an existing safety configuration and load it into the safety module,
  - to change to config State **Service** and to load an authorised safety configuration or to carry out a firmware update in this state,
  - to delete the persistent safety configuration in the safety module and thus set the drive to the Config State **Unlocked,**
  - to set and delete the passwords
- **Service:** The *Service* user is only authorised:
  - to change to config State **Service** and to load an authorised safety configuration or to carry out a firmware update in this state.

In the *'Safety Passwords Setup'* form, a password for the Safety *Developer* and optionally a password for the *Service* user must be defined. The passwords can only be entered in the Config State **Factory**. After correct entry and confirmation of the passwords, the wizard changes the Config State to **Unlocked**.
Once passwords have been assigned, they must be deleted using this form before new passwords can be set. Deleting the passwords also deletes the safety configuration.

Attention The two passwords must be remembered when entering them. If the passwords are forgotten, the safety configuration cannot be changed or deleted and the drive must be returned to Triamec Motion AG.

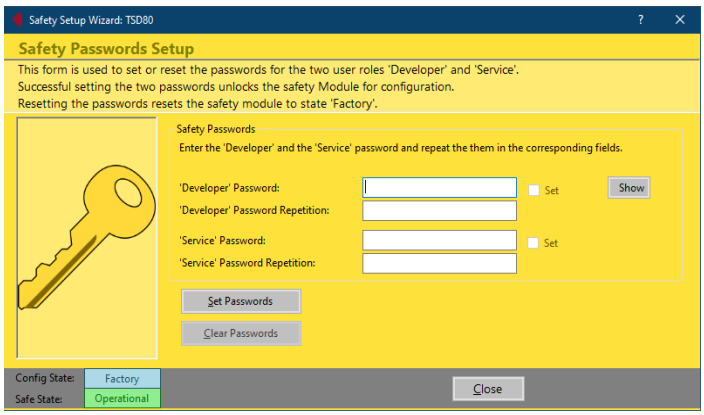
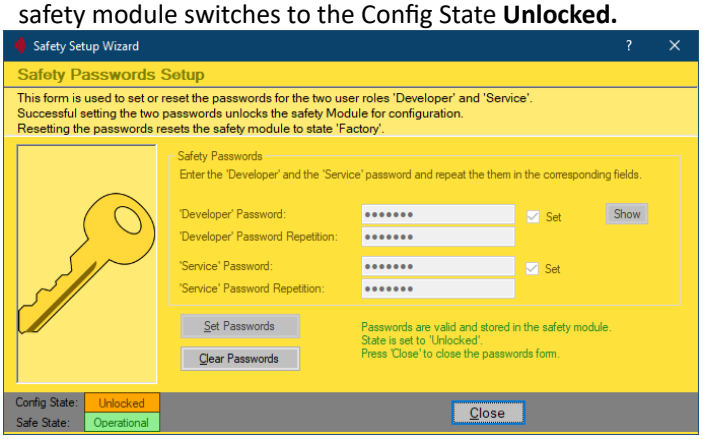
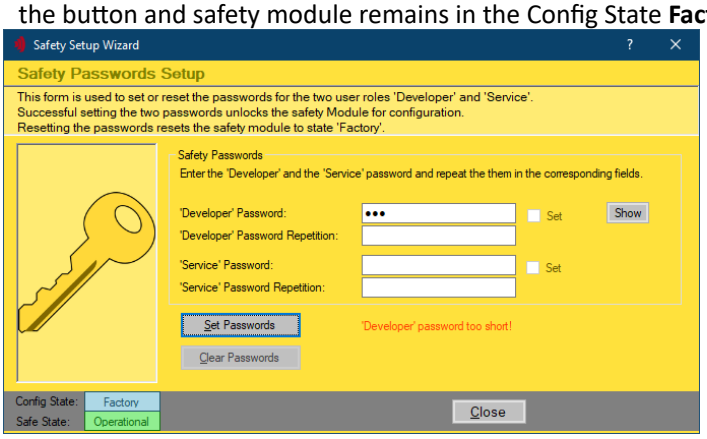


Figure 5: 'Safety Passwords Setup' form in Config State Factory

UI element	Description
Developer' Password	The password for the *Developer* user. The password must contain 4 to 20 characters.
Developer' Password Repetition	The repetition of the password for the user *Developer*. It must match the password for the *Developer* user.
'Service' Password	The password for the *Service* user. The password must not be longer than 20 characters. This password can also be omitted if only the *Developer* user is to be granted access.
'Service' Password Repetition	The repetition of the password for the user *Service*. It must match the password for the user *Service.*
Button **Show**	While pressing this button, the currently entered passwords as well as the password repetitions are displayed in plain text.
CheckBox **Set**	The two check boxes next to the passwords indicate whether the passwords are set or not.
Button **Set Passwords**	This button is only active in the Config State **Factory** (passwords are not set). When pressed, the passwords entered are checked for correctness and, if successful, their hash is persistently stored in the safety module. - If the passwords entered are valid, this is confirmed in the text next to the button and the safety module switches to the Config State **Unlocked.**  *Figure 6: 'Safety Passwords Setup' form after* **Set Passwords** - If the entered passwords are not valid, the detected problem is displayed in the text next to the button and safety module remains in the Config State **Factory.**  *Figure 7: 'Safety Passwords Setup' form after* **Set Passwords**
Button **Clear Passwords**	This button is only active in the Config State **Unlocked** (passwords are set) and is used to delete the passwords, e.g. to define new passwords afterwards. When pressed, the hashes of the passwords and the safety configuration in the safety module are deleted and the state of the safe parametrisation is switched to **Factory**.

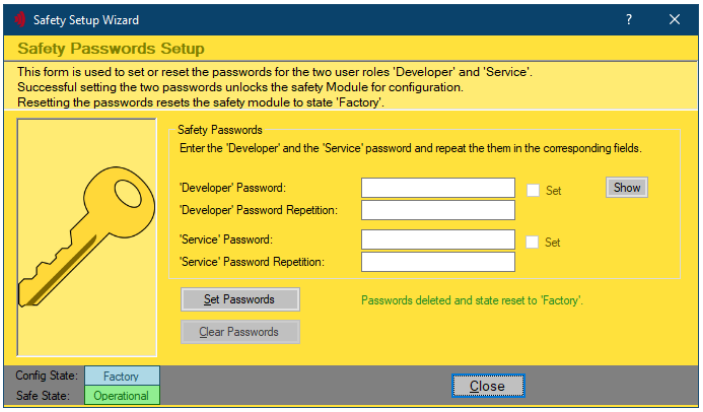
	 *Figure 8: 'Safety Passwords Setup' form after* **Clear Passwords**
Button **Close**	*The 'Safety Passwords Setup'* form is closed. The wizard changes back to the *'Safety Configuration'* form.
State Displays **Safe State** and **Config State**	See Table 2

Table 6: UI elements of the 'Safety Passwords Setup' form

6.5 State Unlocked

The *'Safety Configuration'* form is displayed as the first form after the '*Module information'* form or after deleting the configuration if the passwords are set and the safety configuration is not stored persistently. In this state, an *Online* or *Offline* configuration can be carried out.

6.5.1 Offline configuration

See 6.12 Offline configuration

6.5.2 Online configuration

In this form, one of five configuration types can be selected in the **Online Configuration** mode. These are described below.

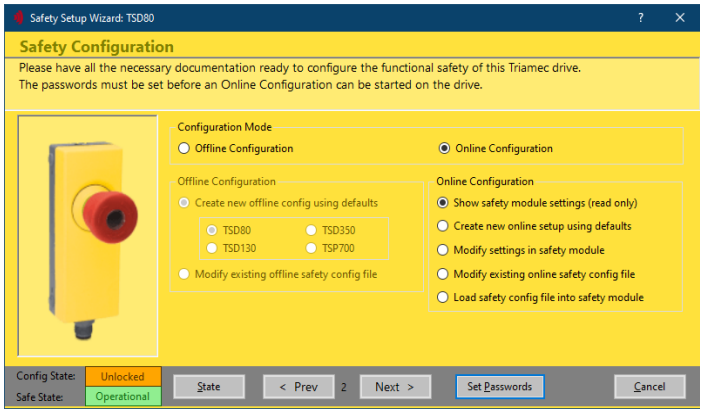


Figure 9: Selecting an Online safety configuration

UI element	Description
RadioButtons in ***Configuration Mode***	These two radio buttons are used to select the configuration mode. This is used to decide which type of configuration is to be carried out. • Mode ***Offline Configuration*** (See 6.12 Offline configuration) • In mode ***Online Configuration***, safety parameters can be displayed or changed in the **Unlocked** Config State. In the Config States **Service** and **Unlocked,** an authorised configuration can be loaded into the safety module. The possibilities are described in more detail below.
RadioButtons in ***Online Configuration***	The five radio buttons are used to select the type of online configuration. • **Show safety module settings (read only)**: (always available) With this selection, the current parameters of the safety module can be displayed but not changed. Pressing the **Next >** button navigates to the first configuration form. The further steps are described in chapter 6.11 Show configuration. • **Create new online setup using defaults**: (only available in Config State **Unlocked**) With this selection, the user *Developer* can create a new configuration with default values. Pressing the **Next >** button prepares a new safety configuration with default parameters of the wizard and navigates to the first form of the configuration. The further steps are described in chapter 6.6 Assemble configuration. • **Modify settings in safety module**: (only available in Config State **Unlocked**) With this selection, the user *Developer* can modify the current safety configuration of the safety module. When the **Next >** button is pressed, a new safety configuration is prepared by loading the current parameters of the safety module. Then the first form of the configuration is navigated to. The further steps are described in chapter 6.6 Assemble configura-

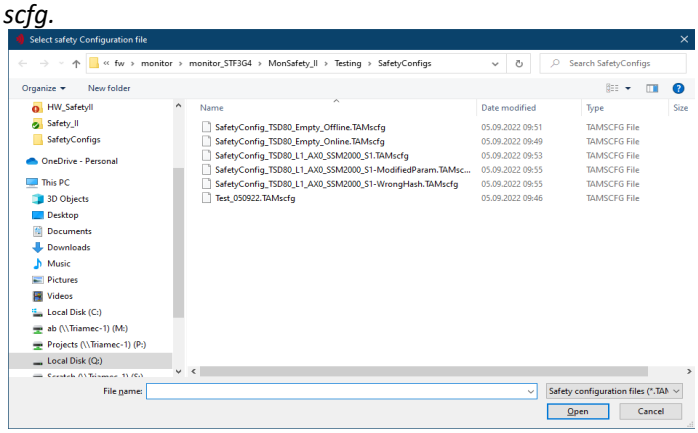
	tion. • **Modify existing online safety config file**: (only available in Config State **Unlocked**) With this selection, the user *Developer* can use and modify a prepared *Online* or *Offline* configuration. After pressing the **Next >** button, a new safety configuration is prepared by loading the parameters from a prepared configuration file. The '*Select safety configuration file*' dialogue prompts the user to select the configuration file with the extension **.TAM-scfg.*  *Figure 10: Selection of a safety configuration* Then the first form of the configuration is navigated to. The further steps are described in chapter 6.6 Assemble configuration. • **Load safety config file into safety module**: (only in Config States **Unlocked** and **Service**) With this selection, the user *Developer* or the user *Service* can load an authorised safety configuration file into the safety module. This type of configuration is described in Chapter 6.7 Load authorised configuration.
Button **< Prev**	The wizard navigates back to the *'Safety Module Information'* form.
Button **Next >**	The wizard navigates forward depending on the selected *online configuration* type, e.g. to the *'Safety Configuration Overview'* form.
State Displays **Safe State** and **Config State** *Button* **State, Set Passwords** and **Cancel**	See Table 5

Table 7: UI elements of the 'Safety Configuration' form in Config State Unlocked

6.6 Assemble configuration

The parametrisation procedure described below is valid for the three online configuration types (**Create new online setup using defaults**, **Modify settings in safety module** and Modify **existing online safety config file**) and for the two offline configuration types (**Create new offline setup using defaults** and **Modify existing offline safety config file**).
If the *Online* configuration type **Show safety module settings (read only)** is selected, the procedure is also valid, but with the difference that all forms are read only and nothing can be parametrised.

In the following chapters, the safety configuration **Create new online setup using defaults** is shown as an example.
After selecting the configuration mode and the desired configuration type and pressing the **Next >** button in the *'Safety Configuration'* form, the *'Safety Configuration Overview'* form appears.

6.6.1 Safety Configuration Overview

This form shows an overview of the safety configuration with the layering of the safe functions. Nothing can be configured in this form, it is purely informative.

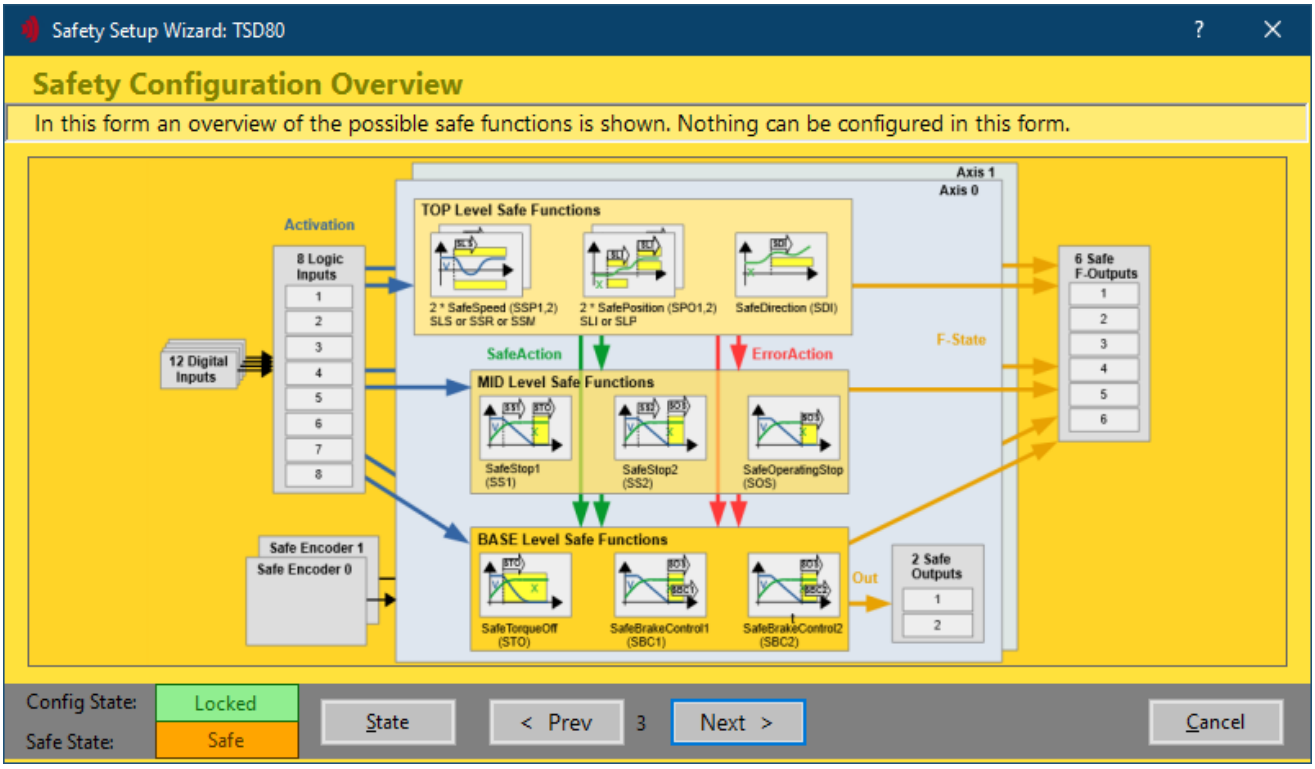


Figure 11: 'Safety Configuration Overview' form

Explanation of the safety configuration with the layering of the safety functions

- The top left shows the drive's 12 digital inputs, which can be combined into 8 single- or dual-channel *Logical Inputs* and are used to activate or deactivate safety functions.
- The 2 *Safe Encoders* are shown below left, which are used by the two axes for the monitoring tasks by the safety functions.
- In the centre, the safety functions are shown in three different layers. There are per axis:
  - *5 TOP-level safety functions:* (activated by logical inputs only)

- *2* SafeSpeed (SSP1,2) -> (SLS | SSR | SSM)*
- *2* SafePosition (SP01,2) -> (SLI | SLP)*
- *1* SafeDirection (SDI)*

- *3 MID-level safety functions:* (activated by logical inputs and top-level SFs)
  - *1* SafeStop1 (SS1)*
  - *1* SafeStop2 (SS2)*
  - *1* SafeOperatingStop (SOS)*
- *3 BASE-level safety functions:* (activated by logical inputs and other SFs)
  - *1* SafeTorqueOff (STO)*
  - *1* SafeTorqueOff with SafeBrakeControl 1 (STO+SBC1)*
  - *1* SafeTorqueOff with SafeBrakeControl 2 (STO+SBC2)*

- The 2 Digital *Safe Outputs* per axis, which can be used by the safety functions SafeBrakeControl1,2 (SBC1,2), are shown below right. *Safe Outputs* are used, for example, for motor brakes.
- At the top right are the 6 digital *Safe F-Outputs* of the drive, which can be used by the safety functions for signalling to the 'outside', e.g. to the PLC.

UI element	Description
Button **< Prev**	The wizard navigates back to the *'Safety Configuration Overview'* form.
Button **Next >**	The wizard navigates forward to the *'Logic Inputs Configuration'* form.
State Displays **Safe State** and **Config State** *Buttons* **State** and **Cancel**	See Table 2

Table 8: UI elements of the 'Safety Configuration Overview' form

6.6.2 Configuration of the logical inputs

The '*Logic Inputs Configuration*' form is used to configure the Logic Inputs. The 8 logic inputs must be defined for the activation of the Safe functions. A Logic Input can be defined as unused or as a single or dual channel input by selecting the available Digital Inputs with the ComboBoxes *Digital Input(s)* and *Axis.* Each digital input can only be used once. This is ensured by removing already selected Digital Inputs from the selection in the *Digital Input(s)* ComboBox.

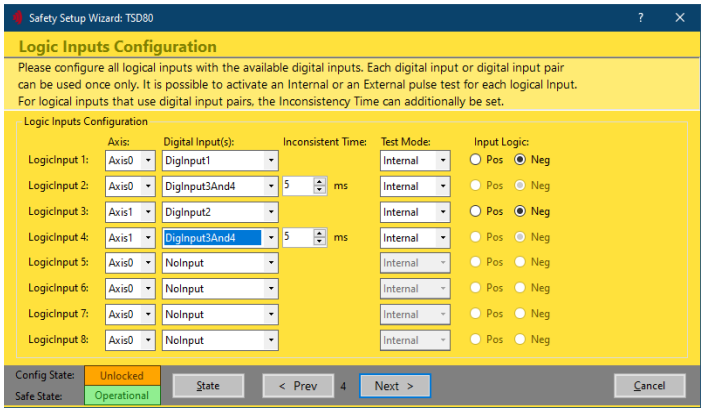


Figure 12: 'Logic Inputs Configuration' form

UI element	Description
ComboBox **Axis**	This selects on which axis the selected Digital Input(s) is(are) used for the Logical Input.
ComboBox **Digital Input(s)**	This selects which Digital Input(s) will be used for the Logical Input.
Inconsistent Time	Tolerated inconsistent time for two-channel inputs. (2ms .. 100ms, default: 5ms). If the two signals differ by more than the set time, an error is triggered and the Safe State is assumed.
ComboBox **Test Mode**	This selects the pulse test mode to be applied. • With the **internal** setting, the Digital Inputs used are tested cyclically by means of an internal circuit at the rate of *safetyPulseTestsPeriodTime* (default 60s). This is the preferred mode for simple external switches. • With the **external** setting, a test pulse is expected cyclically at the used Digital Inputs after a maximum time of *safetyPulseTestsPeriodTime* (60s). This is the preferred mode for external safety units.
Radio Buttons **Input Logic**	This can be used to define the logic for single-channel inputs. Dual-channel inputs always have negative logic. With these inputs, the logic is only displayed, it cannot be selected.
Button **< Prev**	The wizard navigates back to the *'Safety Configuration Overview'* form.
Button **Next >**	The wizard navigates forward to the *'Safety Configuration'* form.
State Displays **Safe State** and **Config State** *Buttons* **State** and **Cancel**	See Table 2

Table 9: UI elements of the 'Logic Inputs Configuration' form

6.6.3 General Safety Configuration

The ‘Safety Configuration’ form is used to configure the STO input, the test pulse period time and the monitoring of the power supply pulses. The STO input is a fixed two-channel Digital Input. The inconsistency time and the test mode can be configured for the STO input.
The *'Safety Pulse Tests Period Time'* parameter is used to set the period time that is used for all pulse tests.

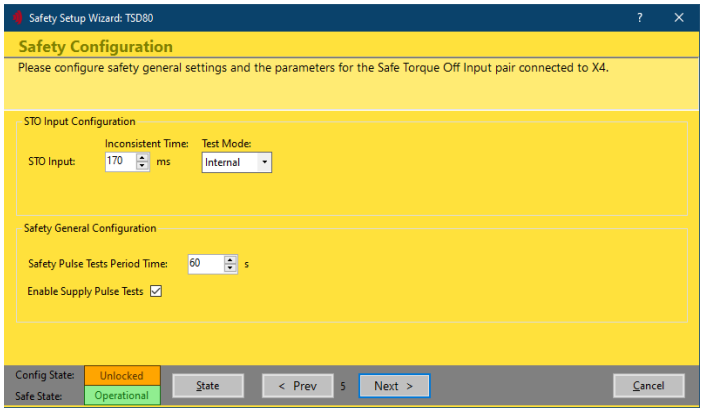


Figure 13: 'Safety Configuration' form

UI element	Description
Inconsistent Time	Tolerated inconsistent time. (160ms ... 220ms, default: 170ms). If the two signals differ by more than the set time, an error is triggered and the Safe State is assumed.
ComboBox **Test Mode**	This selects the STO pulse test mode to be applied. • With the **internal** setting, the STO Digital Inputs are tested cyclically by means of an internal circuit at the rate of *safetyPulseTestsPeriodTime* (default 60s). • When set to **external**, a test pulse is also expected cyclically at the STO Digital Inputs after a maximum of *safetyPulseTestsPeriodTime* (default 60s). This is the preferred mode for external safety units.
Safety Pulse Tests Period Time	Test pulse period time *safetyPulseTestsPeriodTime*, which is used for all test pulses. (1s ... 3600s, default: 60s).
CheckBox **Enable Supply Pulse Tests**	This tells the safety module whether or not to expect and test pulses at internal supply voltages when the they are switched on. • **UnChecked***:* Pulses are not monitored. • **Checked***:* Pulses at the supply voltages are expected and monitored.
Button **< Prev**	The wizard navigates back to the *'Logic Inputs Configuration'* form.
Button **Next >**	The wizard navigates forward to the *'Outputs Configuration'* form.
State Displays **Safe State** and **Config State** *Buttons* **State** and **Cancel**	See Table 2

Table 10: UI elements of 'STO Configuration' form

6.6.4 Configuration of the Outputs

The *'Outputs Configuration'* form is used to configure the *Safe Outputs* and the *Safe F-Outputs*.
The 2 *Safe Outputs* per axis can be used for the Safe Functions SBC1 and SBC2 and must be defined before they are used. A Safe Output can be defined as unused from the safety point of view or as used by selecting the available entries in *Safe Output Mode.*
Note: If a Safe Output is set to *Disabled*, it can be used by the Drive via register.

The 6 Safe F-Outputs can be used to signal the state(s) of a Safe Function(s) and must be defined before they can be used. A Safe F-Output can be defined as unused or as used by selecting the available entries in *Safe F-Output Mode.*

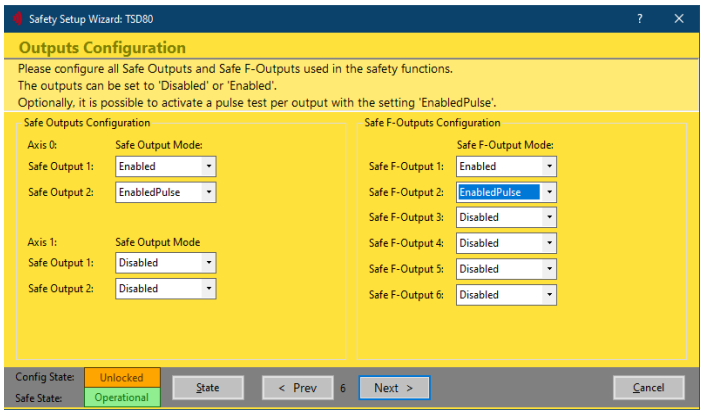


Figure 14: 'Outputs Configuration' form

UI element	Description
ComboBox **Safe Output Mode**	This selects which usage mode is used for the *Safe Output*. • **Disabled**: The Safe Output is not used by Safety. The Drive can use the output as usual and control it via register. • **Enabled**: The Safe Output is used by Safety (SBC1 or SBC2). The Drive can no longer use the output. • **EnabledPulse**: Same as *Enabled.* In addition, a pulse is emitted at the output at cyclical intervals of *safetyPulseTestsPeriodTime* (default 60s) for testing purposes.
ComboBox **Safe F-Output Mode**	This selects which usage mode is used for the Safe F-Out*put*. • **Disabled**: The Safe F-Output is not used by Safety. • **Enabled**: The Safe F-Output can be used by Safe Function(s). • **EnabledPulse**: Same as *Enabled*. In addition, a pulse is emitted at the output at cyclical intervals of *safetyPulseTestsPeriodTime* (default 60s) for testing purposes.
Button **< Prev**	The wizard navigates back to the *'Safety Configuration'* form.
Button **Next >**	The wizard navigates forward to the *'Safe Encoder Configuration'* form.
State Displays **Safe State** and **Config State** *Buttons* **State** and **Cancel**	See Table 2

Table 11: UI elements of the 'Outputs Configuration' form

6.6.5 Configuring the Safe Encoder

6.6.5.1 Introduction

Encoder tests for different encoder configurations are available in the Safety Module. These are described briefly below before the configuration using the *'Safe Encoder Configuration'* form is discussed in detail.

The safety functions are always supplied with the available encoder values, which are captures by the safety module, depending on the possibilities of the specific encoder configuration on two channels.

The encoder checks depend on the set encoder configuration and are described in the following tables. If one of the checks is not passed, an error is triggered and the Safe State is assumed.

Encoder configuration	Description
SingleStandard Encoder	- Only the standard encoder is connected
	- With the two comparators, both safety processors are supplied with the Standard Encoder values and evaluated in both safety processors. In addition, the Analogue Signals are fed to one of the processors for monitoring. With this and the unsafe values from the drive, subsequent tests are possible.
	- The encoder monitoring can perform the following tests in the Safety Module: - Test 1: Both safety processors compare the standard *Pos&Vel* values with the standard 2 values. - Test 2: Both safety processors compare the unsafe *Vel* values from the drive/FPGA with the *Vel* values of the safety processors used for the safety functions. If safe referencing has been performed, the *Pos* values are also compared. - Test 3: Chn1: The safety processor checks whether the amplitudes of the standard analogue encoder signals detected by the other processor are within the specified range. Chn2: The safety processor checks whether the amplitudes of the standard analogue encoder signals are within the specified range.

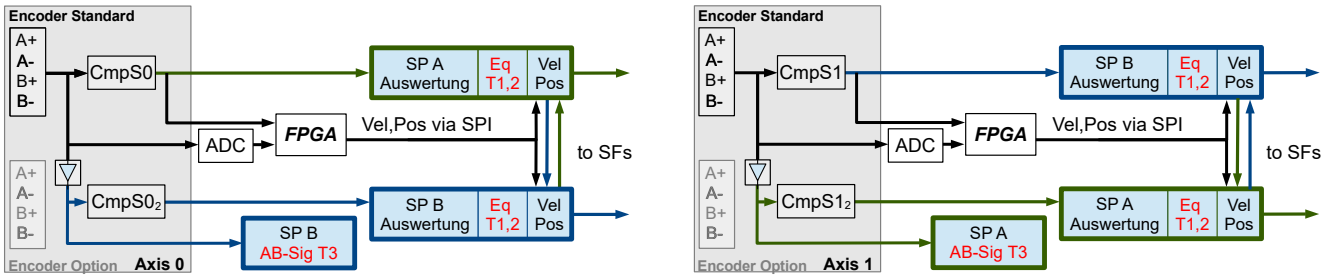


Figure 15: SingleStandard encoder, Axis0 and Axis1

Table 12: Encoder configuration 'SingleStandard Encoder, Axis0 and Axis1'.

Encoder configuration	Description
SingleOptional Encoder	- Only the option encoder is connected.

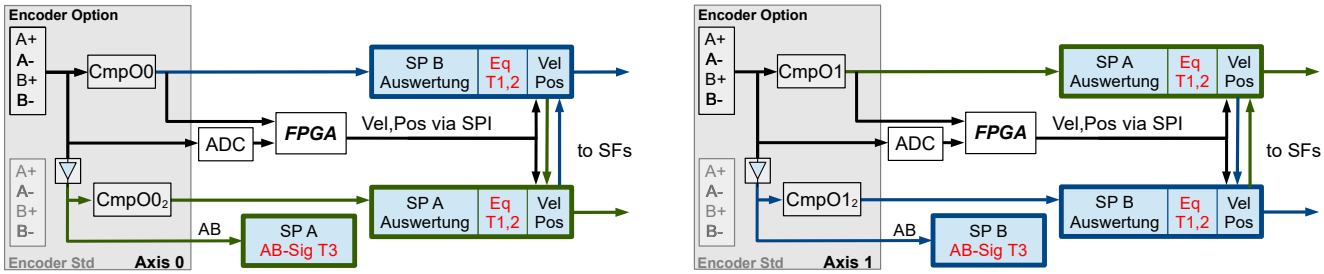


Figure 16: SingleOption encoder, Axis0 and Axis1

	- With the two comparators, both safety processors are supplied with the Option Encoder values and evaluated in both safety processors. In addition, the Analogue Signals are fed to one of the processors for monitoring. With this and the unsafe values from the drive, subsequent tests are possible.
	- The encoder monitoring can perform the following tests in the Safety Module: - Test 1: Both safety processors compare the option *Pos&Vel* values with the option 2 values. - Test 2: Both safety processors compare the unsafe *Vel* values from the drive/FPGA with the *Vel* values of the safety processors used for the safety functions. If safe referencing has been performed, the *Pos* values are also compared. - Test 3: Chn1: The safety processor checks whether the amplitudes of the analogue signals of the option encoder are within the specified range. Chn2: The safety processor checks whether the Amplitudes of the analogue signals of the option encoder detected by the other processor are within the specified range.

Table 13: Encoder configuration 'SingleOption Encoder, Axis0 and Axis1'

Encoder configuration	Description
DualEncoder Std & Opt	- The standard and the option encoder of the same axis are connected.

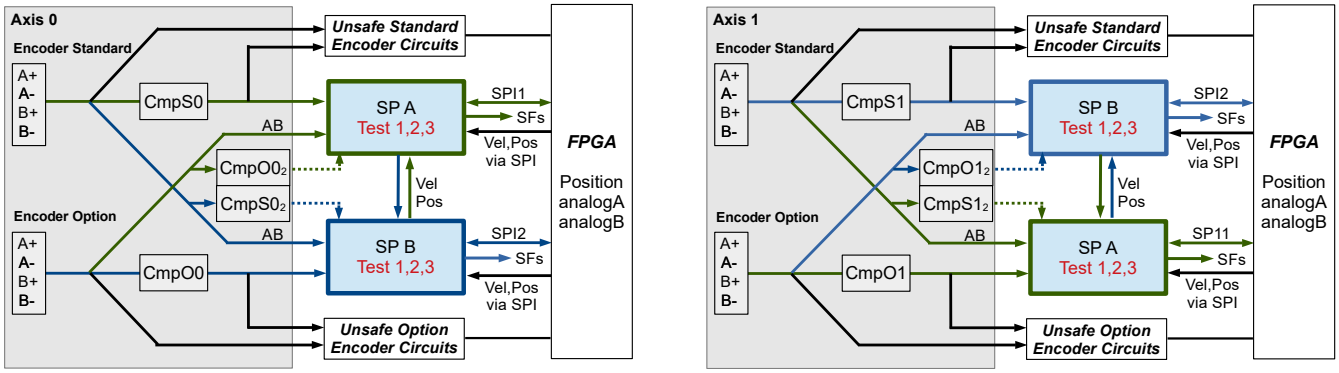


Figure 17: Dual encoder per axis, Axis0 and Axis1

	- With the help of the second encoder and the two comparators, both safety safety processors are supplied with the standard and the option encoder values and evaluated in both safety safety processors. In addition, both safety safety processors are supplied with the analogue signals for monitoring. With this configuration, all tests can be carried out redundantly.
	- The encoder monitoring can perform the following tests in the Safety Module:

Encoder configuration	Description
	- Test 1: Both safety processors compare the standard *Pos&Vel* values with the standard 2 values. They also compare the standard *Vel* values with the option *Vel* values. If safe referencing has been established, both safety processors also compare the standard *Pos* values with the option *Pos* values. - Test 2: Both safety processors compare the unsafe *Vel* values from the drive/FPGA with the *Vel* values of the safety processors used for the safety functions. If safe referencing has been performed, the *Pos* values are also compared. - Test 3: Both safety processors check whether the amplitudes of the analog signals from the standard encoder and the optional encoder are within the specified range.

Table 14: Encoder configuration 'Dual Encoder per Axis, Axis0 and Axis1'

Encoder configuration	Description
DualEncoder Std0 & Std1	- The standard encoders of the two axes are connected.

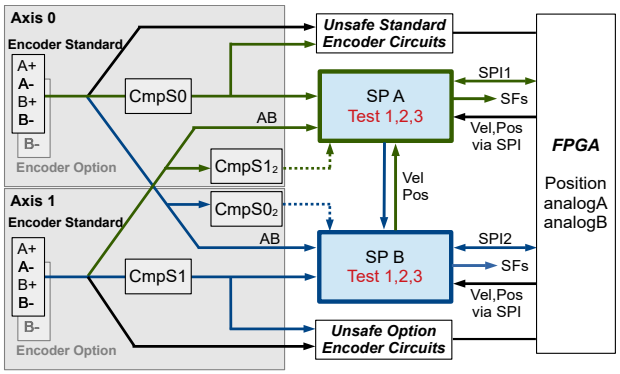



Figure 18: Dual encoder with standard encoder from Axis0 and Axis1	
	- With the help of the two encoders and the two comparators, both safety safety processors are supplied with both standard encoder values and evaluated in both safety safety processors. In addition, both safety safety processors are supplied with the analogue signals for monitoring. With this configuration, all tests are possible redundantly. The option encoders are not used here.
	- The encoder monitoring can perform the following tests in the Safety Module: - Test 1: Both safety processors compare the standard *Pos&Vel* values of both axes with the standard 2 values. They also compare the standard *Vel* values of both axes. If safe referencing has been completed, both safety processors also compare the standard *Pos* values of both axes. - Test 2: Both safety processors compare the unsafe *Vel* values from the drive/FPGA with the *Vel* values of the safety processors used for the safety functions. If safe referencing has been performed, the *Pos* values are also compared. - Test 3: Both safety processors check whether the amplitudes of the analog signals from the two standard encoders are within the specified range.

Table 15: Encoder configuration 'Dual encoder with standard encoder of Axis0 and Axis1'.

6.6.5.2 *Safe Encoder Configuration*

The *'Safe Encoder Configuration'* form is used to configure of the Safe Encoders as well as the Safe Encoder tests described above. The configuration is done separately for the two axes. The parameters for Safe Referencing are also defined in this form.

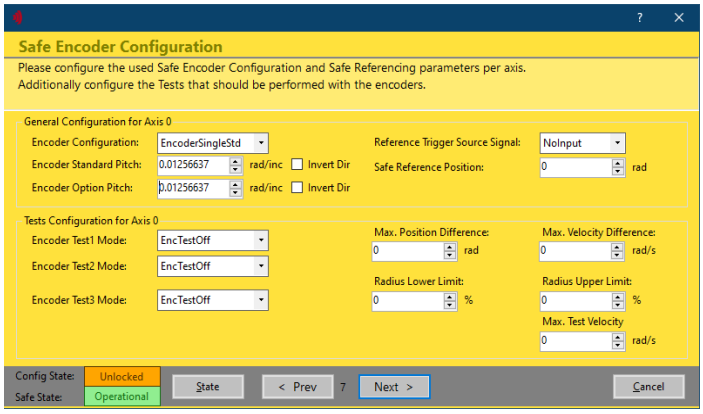


Figure 19: 'Safe Encoder Configuration' form for Axis 0

UI element	Description
ComboBox **Encoder Configuration**	This defines the specific encoder topology for each axis. The possible encoder checks depend on this setting and are shown in the tables Table 12..Table 15. If one of the checks is not passed, an error is triggered and the Safe State is assumed. • **EncoderSingleStd**: Only one encoder is connected to the standard connector. • **EncoderSingleOptStd**: Only one encoder is connected to the option connector. • **EncoderDualStdOpt**: Two encoders, connected to the standard and the option connector. • **EncoderDualStdStd**: Two encoders, connected to the two standard connectors.
Encoder Standard Pitch	The resolution (pitch) of the position measurement of the standard encoder must be entered here. This value must be set to the same value as the pitch of the encoder[0] of the axis in the drive configuration.
CheckBox **Encoder Standard Invert Direction**	This tells the safety module whether or not the standard encoder of the axis in the drive is configured with inverted encoder direction. • **UnChecked***:* Encoder direction is not reversed. • **Checked***:* Encoder direction is reversed.
Encoder Option Pitch	The resolution (pitch) of the position measurement of the option encoder must be entered here. This value must be set to the same value as the pitch of the encoder[1] of the axis in the drive configuration.
CheckBox **Encoder Option Invert Direction**	This tells the safety module whether or not the option encoder of the axis in the drive is configured with inverted encoder direction. • **UnChecked***:* Encoder direction is not reversed. • **Checked***:* Encoder direction is reversed.
ComboBox **Reference Trigger Source**	This determines per axis which trigger signal is to be used for the Safe Referencing functionality. The following settings are possible: • **NoInput**: Trigger signal is undefined. Safe Referencing cannot be performed. • **DigInput1 .. DigInput6**: The selected digital input is used as trigger signal. • **EncIndexStd .. EncIndexOpt**: The selected encoder index is used as the trigger signal in accordance with the set **Encoder Configuration**.
Safe Reference Position	This position tells the safety module which position to set when the trigger changes from low to high during safe referencing. The input is made in the SI unit of the axis position.

ComboBox **Encoder Test1 Mode**	This configures the encoder test 1 as described in Table 12..Table 15. • **EncTestOff***:* Test 1 is not activated. • **EncTestOn**: Test 1 is activated.
ComboBox **Encoder Test2 Mode**	This configures the encoder test 2 as described in Table 12..Table 15. • **EncTestOff***:* Test 2 is not activated. • **EncTestOn**: Test 2 is activated.
Max. Position Difference	This specifies the maximal positional difference between the different sources according to the description in Table 12..Table 15 for Test1 and Test2. The input is made in the SI unit of the axis position.
Max. Velocity Difference	This specifies the maximal velocity difference between the different sources according to the description in Table 12..Table 15 for Test1 and Test2. The input is made in the SI unit of the axis velocity.
ComboBox **Encoder Test3 Mode**	This configures the encoder test 3 as described in Table 12..Table 15. • **EncTestOff***:* Test 3 is not activated. • **EncTestOn**: Test 3 is activated.
Radius Lower Limit	This specifies for the test3, to which percentage the radius of the analogue encoder amplitude may fall without triggering an error. The input is made in % where 100% corresponds to the nominal amplitude of 0.5V (1Vpp).
Radius Upper Limit	This specifies for Test3, to which percentage the radius of the analogue encoder amplitude may increase without triggering an error. The input is made in % where 100% corresponds to the nominal amplitude of 0.5V(1Vpp).
Max. Test Velocity	Maximum velocity up to which the analog encoder amplitudes are monitored in Test3. If set to 0, the maximum velocity is unlimited. (Note: The test may fail above a certain velocity due to the filter effect.)
Button ***< Prev***	The wizard navigates back to the *'Outputs Configuration'* form.
Button ***Next >***	The wizard navigates forward to the *'Top-Level Safe Functions Configuration'* form.
State Displays **Safe State** and **Config State** *Buttons* **State** and **Cancel**	See Table 2

Table 16: UI elements of the 'Safe Encoder Configuration' form

6.6.6 Configuring the Safe functions

6.6.6.1 General settings

- The safety functions are activated by means of a logical input or by a *safe* or *error action of* another safety function (SF).
- The SFs are usually activated and deactivated with an activation input. However, there is also the optional possibility to define a separate deactivation input for deactivation.
- All safety functions offer the option of using one of 6 Safe F-Outputs to signal the status of the SF. In case of multiple use of a Safe F-Output, the output is only signalled when all SFs involved have set the status.
- Some safety functions trigger a *SafeAction* or an *ErrorAction.* For these safety functions, there are fields in the configuration form for selecting these actions.
- In the configuration forms for the safety functions, a schematic timing sequence of the safety function after activation with the parameters to be set is show on the left-hand side of the form. On the right side are the fields with the setting values.
- In this chapter, individual parameters appear repeatedly in the configuration forms of the safety functions. To simplify matters, these parameters are described here once using the form for configuring the safety function *SS1.*

Note For all SF Configuration forms, the parameter fields highlighted in orange must be configured. The button ***Next >*** is also highlighted in orange and inactive as long as the configuration of the form is not complete. By moving the mouse over a ! icon the reason for the refusal can be displayed.

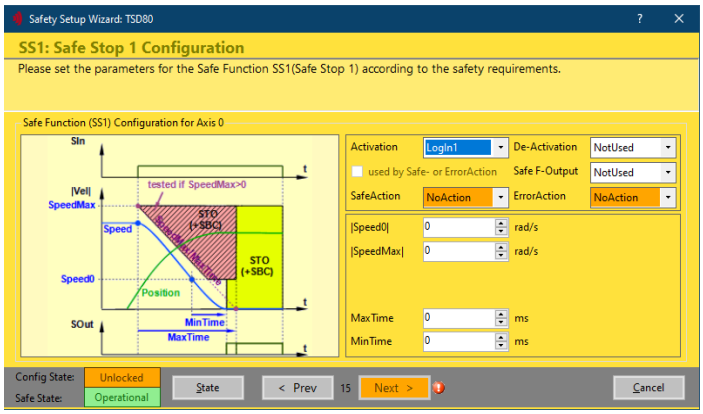


Figure 20: Example form with 'SS1: Safe Stop 1 Configuration' and incomplete configuration

UI element	Description
ComboBox **Activation**	This determines which logical input(s) should be used to activate the SF. The selection of a valid activation input is mandatory if the SF is not used by another SF. The selection is optional if the SF is already used by another SF. This is indicated in individual forms with the *checkBox* **used by Safe- or ErrorAction** • **NotUsed**: No logical input is selected for activation. • **LogIn1** .. **LogIn8**: The SF is activated with the selected logical input. • **LogIn1_2**, **LogIn3_4**, **LogIn5_6**, **LogIn7_8**: The SF is activated when at least one of the two

	logical inputs is active. (e.g. LogIn1_2 = LogIn1 | LogIn2 is active) • **LogIn1_2_3_4, LogIn5_6_7_8**: The SF is activated when at least one of the four logical inputs is active. (e.g. LogIn1_2_3_4 = LogIn1 | LogIn2 | LogIn3 | LogIn4 is active). *Note:* The used *activation input* must be defined in the *'Logic Inputs Configuration'* form 6.6.2.
CheckBox **used by Safe- or ErrorAction**	This indicates whether the SF is already being used by another SF as a *Safe-* or *ErrorAction.* This CheckBox is *read only* and cannot be changed in the displayed form. • **UnChecked***:* The SF is unused. • **Checked***:* The SF is already used by another SF.
ComboBox **De-Activation**	This determines which logical input should be used to de-activate the SF. The selection of a de-activation input is optional. • **NotUsed**: No logical input is selected for deactivation. *Note:* De-activation takes place after all activation inputs are inactive. • **LogIn1** ... **LogIn8**: The SF is de-activated with the selected logical input. *Note:* For deactivation by means of the de-activation input, the activation input must also be inactive. *Note:* A used *de-activation input* must be defined in the *'Logic Inputs Configuration'* form 6.6.2.
ComboBox **Safe F-Output**	This defines whether and with which of the 6 Safe F-Outputs the state of the SF is to be signalled. The selection of a *Safe F-Output* is optional. • **NotUsed**: No status is signalled. • **SafeFOut1** ... **SafeFOut6**: The SF signals its status with selected Safe F-Output. *Note:* A used Safe F-Output must be set to *enabled* or *enabledPulse* in the *'Outputs Configuration'* form 6.6.4.
ComboBox **SafeAction**	This defines which safety action (safety function) is to be triggered in the event of successful completion. *(Only certain safety functions offer this selection)*
ComboBox **ErrorAction**	This defines which error action (safety function) is to be triggered when a monitored condition is violated. *(Only certain safety functions offer this selection)*
Speed, ***Position***	The input for position parameters is made in the SI unit of the axis position. The input for speed parameters is made in the SI unit of the axis speed.
State Displays **Safe State** and **Config State** *Buttons* **State** and **Cancel**	See Table 2

Table 17: UI elements of the 'SS1: Safe Stop 1 Configuration' form

6.6.6.2 *Top-level safe functions*

The *'Top-Level Safe Functions Configuration'* form is used to determine which of the 5 available top-level safety functions are used. The following safety functions are available per axis:

- *2* SafeSpeed (SSP1,2)*
  ->SafeLimitedSpeed (SLS) | SafeSpeedRange (SSR) | SafeSpeedMonitor (SSM)
- *2* SafePosition (SP01,2)*
  ->SafeLimitedIncrement (SLI) | SafeLimitedPosition (SLP)
- *1* SafeDirection (SDI)*

Depending on the selection in this form, configuration forms for the selected safety function(s) are displayed in the following forms.

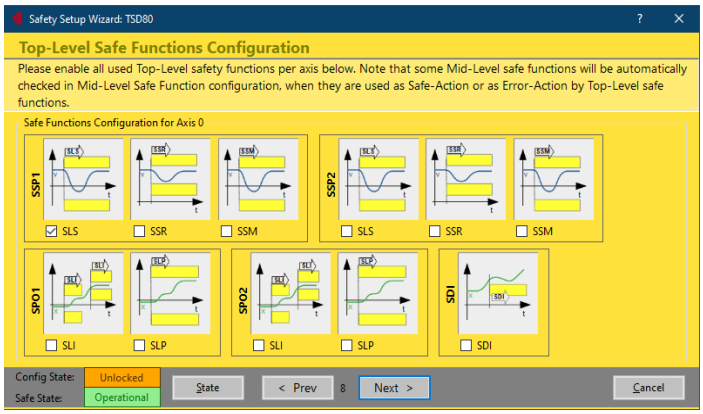


Figure 21: 'Top-Level Safe Functions Configuration' with selection of SLS

UI element	Description
CheckBoxes **SSP1**, **SSP2**	This selects whether and how the two available *SafeSpeed* safety functions *SSP1* and *SSP2* are used. • - : The *SafeSpeed* safety function is not used. • **SLS**: The safety function is used as *SafeLimitedSpeed* safety function. • **SSR**: The safety function is used as *SafeSpeedRange* safety function. • **SSM**: The safety function is used as *SafeSpeedMonitor.*
CheckBoxes **SPO1**, **SPO2**	This selects whether and how the two available *SafePosition* safety functions *SPO1* and *SPO2* are used. • - : The *SafePosition* safety function is not used. • **SLI**: The safety function is used as *SafeLimitedIncrement* safety function. • **SLP**: The safety function is used as *SafeLimitedPosition* safety function.
CheckBox **SDI**	This selects whether the *SafeDirection* safety function *SDI* is used. • - : The *SafeDirection* safety function is not used. • **SDI**: The safety function *SafeDirection* is used.
Button ***< Prev***	The wizard navigates back to the *'Safe Encoder Configuration'* form.
Button ***Next >***	The wizard navigates forward to the first selected Top-Level *Safe Function Configuration* form or to the *'Mid-Level Safe Functions Configuration'* form.
State Displays **Safe State** and **Config State** *Buttons* **State** and **Cancel**	See Table 2

Table 18: UI elements of the 'Top-Level Safe Functions Configuration' form

6.6.6.3 Safe Limited Speed

The 'Safe Limited Speed' (SLS) according to EN 61800-5-2 monitors the axis for compliance with a defined speed limit. If the monitoring function detects a violation of the limit value, the axis is safely stopped or switched off. The type and manner of the error action depends on the application and can be configured in this form.

The *SSL* safety function can only be activated by a logical input.

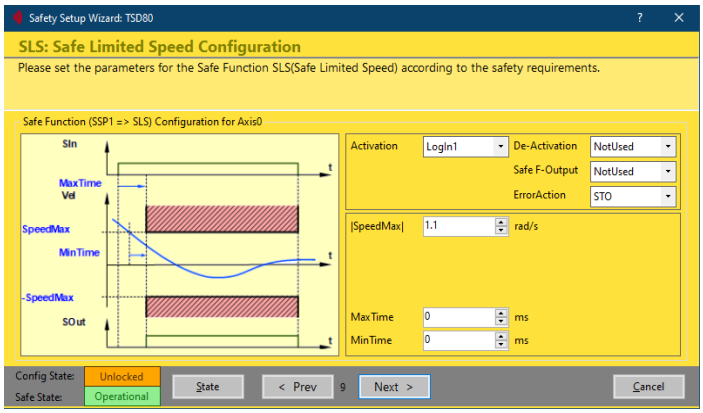


Figure 22: 'SLS: Safe Limited Speed Configuration' form

UI element	Description	
ComboBoxes: **Activation**, **De-Activation**, **Safe F-Output**		(See 6.6.6.1 General settings)
ComboBox **ErrorAction**	This defines which error action (safety function) is to be triggered when a monitoring condition is violated. The selection of an **ErrorAction** is mandatory. • **NoAction**: No **ErrorAction** is triggered. • **STO**, **SS1**, **SS2**: If a monitoring condition is violated, the selected **ErrorAction** is triggered. *Note:* Depending on the selected **ErrorAction,** the corresponding error action is automatically preselected in the *Mid-* or *Base-Level* form that is processed later, and cannot be deselected.	
|SpeedMax|	This specifies the absolute maximum speed permitted after the **MinTime** or **MaxTime** period has elapsed. The input is made in the SI unit of the axis velocity.	
MaxTime, MinTime	These parameters specify when monitoring begins after activation. The check begins after activation at the earliest when the speed is below **|SpeedMax|** during **MinTime**, but latest at **MaxTime** after activation.	
Button **< Prev**	The wizard navigates back to the *'Top-Level Safe Functions Configuration'* form.	
Button **Next >**	The wizard navigates forward to another *Safe Function Configuration* form or to the *'Mid-Level Safe Functions Configuration'* form.	
State Displays **Safe State** and **Config State** *Buttons* **State** and **Cancel**		See Table 2

Table 19: UI elements of the 'SLS: Safe Limited Speed Configuration' form

6.6.6.4 Safe Speed Range

The function 'Safe Speed Range' (SSR) according to EN 61800-5-2 extends the function 'Safely Limited Speed' (SLS) with monitoring to a minimum speed. If the corridor of the monitored speed range is left, the axis is safely stopped or switched off. The type and manner of the error action depends on the application and can be configured in this form.

The safety function *SSR* can only be activated by a logical input.

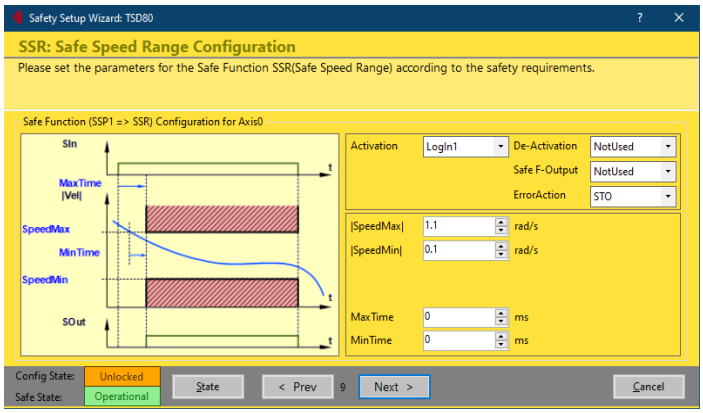


Figure 23: 'SSR: Safe Speed Range Configuration' form

UI element	Description	
ComboBoxes: **Activation**, **De-Activation**, **Safe F-Output**		(See 6.6.6.1 General settings)
ComboBox **ErrorAction**	This defines which error action (safety function) is to be triggered when a monitoring condition is violated. The selection of an **ErrorAction** is mandatory. • **NoAction**: No **ErrorAction** is triggered. • **STO**, **SS1**, **SS2**: If a monitoring condition is violated, the selected **ErrorAction** is triggered. *Note:* Depending on the selected **ErrorAction,** the corresponding error action is automatically preselected in the *Mid-* or *Base-Level* form that is processed later, and cannot be deselected.	
|SpeedMax|	This specifies the absolute maximum speed permitted after the **MinTime** or **MaxTime** period has elapsed. The input is made in the SI unit of the axis velocity.	
|SpeedMin|	This specifies the absolute minimum speed permitted after the **MinTime** or **MaxTime** period has elapsed. The input is made in the SI unit of the axis velocity.	
MaxTime, MinTime	These parameters specify when monitoring begins after activation. The check starts after activation at the earliest when the absolute value of the speed during **MinTime** is in the range **|SpeedMin|**...**|SpeedMax|**, but latest at **MaxTime** after activation.	
Button **< Prev**	The wizard navigates back to the previously configured *Safe Function Configuration* form or to the *'Top-Level Safe Functions Configuration'* form.	
Button **Next >**	The wizard navigates forward to another *Safe Function Configuration* form or to the *'Mid-Level Safe Functions Configuration'* form.	
State Displays **Safe State** and **Config State** *Buttons* **State** and **Cancel**		See Table 2

Table 20: UI elements of the 'SSR: Safe Speed Range Configuration' form

6.6.6.5 Safe Speed Monitor

The function 'Safe Speed Monitor' (SSM) provides a safe output signal according to EN 61800-5-2 to in-

dicate whether the speed is below a defined limit value. In practice, monitoring a defined speed enables for example, the higher-level control system to make a hazardous area accessible only if the speed is below the defined speed.

The safety function *SSM* can only be activated by a logical input.

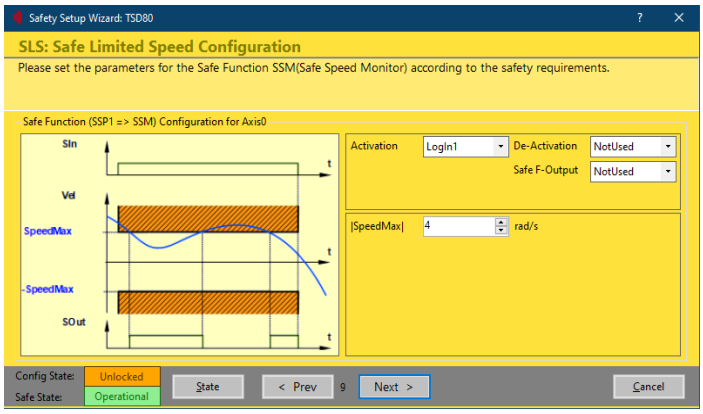


Figure 24: 'SSM: Safe Speed Monitor Configuration' form

UI element	Description	
ComboBoxes: **Activation**, **De-Activation**, **Safe F-Output**		(See 6.6.6.1 General settings)
|SpeedMax|	This indicates the absolute maximum speed permitted. The input is made in the SI unit of the axis velocity.	
Button **< Prev**	The wizard navigates back to the previously configured *Safe Function Configuration* form or to the *'Top-Level Safe Functions Configuration'* form.	
Button **Next >**	The wizard navigates forward to another *Safe Function Configuration* form or to the *'Mid-Level Safe Functions Configuration'* form.	
State Displays **Safe State** and **Config State** *Buttons* **State** and **Cancel**		See Table 2

Table 21: UI elements of the 'SSM: Safe Speed Monitor Configuration' form

6.6.6.6 *Safe Limited Increment*

With the function 'Safely-limited increment' (SLI) according to EN 61800-5-2, the axis may travel a permissible path length after activation. If the limit value is exceeded, the axis is safely stopped or switched off. The type and manner of the error action depends on the application and can be configured in this form.

The SLI safety function can only be activated by a logical input.

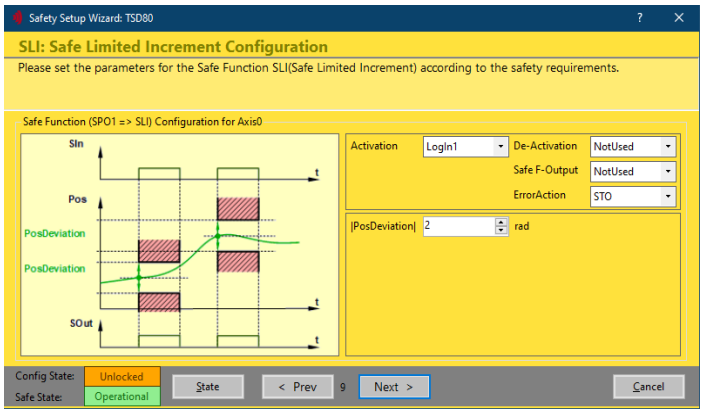


Figure 25: 'SLI: Safe Limited Increment Configuration' form

UI element	Description	
ComboBoxes: **Activation**, **De-Activation**, **Safe F-Output**		(See 6.6.6.1 General settings)
ComboBox **ErrorAction**	This defines which error action (safety function) is to be triggered when a monitoring condition is violated. The selection of an **ErrorAction** is mandatory. • **NoAction**: No **ErrorAction** is triggered. • **STO**, **SS1**, **SS2**: If a monitoring condition is violated, the selected **ErrorAction** is triggered. *Note:* Depending on the selected **ErrorAction,** the corresponding error action is automatically preselected in the *Mid-* or *Base-Level* form that is processed later, and cannot be deselected.	
|PosDeviation|	This specifies in which absolute position window the axis must be after activation. Here relative to the position at which the safety function was activated. The input is made in the SI unit of the axis position.	
Button **< Prev**	The wizard navigates back to the previously configured *Safe Function Configuration* form or to the *'Top-Level Safe Functions Configuration'* form.	
Button **Next >**	The wizard navigates forward to another *Safe Function Configuration* form or to the *'Mid-Level Safe Functions Configuration'* form.	
State Displays **Safe State** and **Config State** *Buttons* **State** and **Cancel**		See Table 2

Table 22: UI elements of the 'SLI: Safe Limited Increment Configuration' form

6.6.6.7 *Safe Limited Position*

With the function 'Safely-limited position' (SLP) according to EN 61800-5-2, a safe position monitoring is realised. This ensures that the axis does not leave a predefined position range. If the limit values are exceeded, the axis is safely stopped or switched off. The type and manner of the error action depends on the application and can be configured in this form.

The safety function *SLP* can only be activated by a logical input.

Note Absolute position detection is required for the *SLP* safety function. This is ensured by means of a safe reference run.

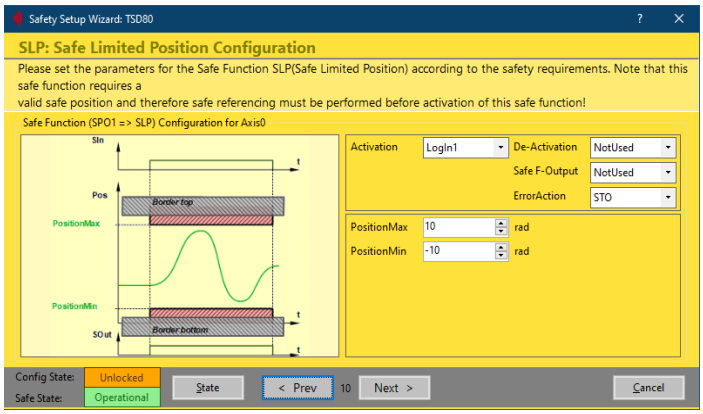


Figure 26: 'SLP: Safe Limited Position Configuration' form

UI element	Description	
ComboBoxes: **Activation, De-Activation, Safe F-Output**		(See 6.6.6.1 General settings)
ComboBox **ErrorAction**	This defines which error action (safety function) is to be triggered when a monitoring condition is violated. The selection of an **ErrorAction** is mandatory. • **NoAction**: No **ErrorAction** is triggered. • **STO, SS1, SS2**: If a monitoring condition is violated, the selected **ErrorAction** is triggered. *Note:* Depending on the selected **ErrorAction,** the corresponding error action is automatically preselected in the *Mid-* or *Base-Level* form that is processed later, and cannot be deselected.	
PositionMax	This specifies the maximum position that may not be exceeded after activation. The input is made in the SI unit of the axis position.	
PositionMin	This specifies which minimum position may not be exceeded of after activation. The input is made in the SI unit of the axis position.	
Button **< Prev**	The wizard navigates back to the previously configured *Safe Function Configuration* form or to the *'Top-Level Safe Functions Configuration'* form.	
Button **Next >**	The wizard navigates forward to another *Safe Function Configuration* form or to the *'Mid-Level Safe Functions Configuration'* form.	
State Displays **Safe State** and **Config State** *Buttons* **State** and **Cancel**		See Table 2

Table 23: UI elements of the 'SLP: Safe Limited Position Configuration' form

6.6.6.8 Safe Direction

Monitoring the 'Safe Direction of Movement' (SDI) according to EN 61800-5-2 prevents an axis from moving in the unintended direction. If a deviation is detected in the direction of movement, the axis is safely stopped or switched off. The type and manner of the error action depends on the application and can be configured in this form. This safety function is designed so that either the positive or the negative direction of movement can be monitored.

The SDI safety function can only be activated by a logical input.

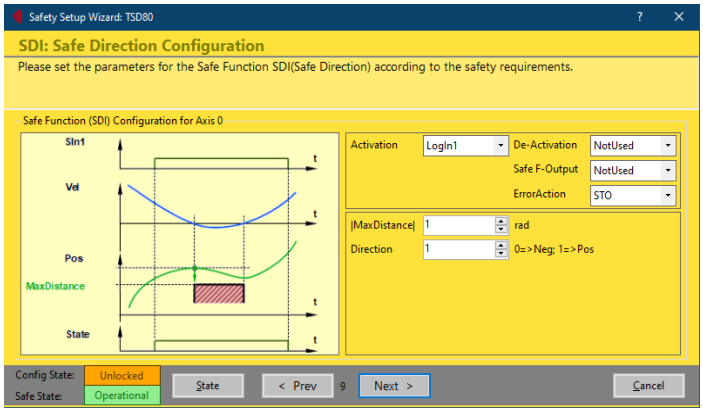


Figure 27: 'SDI: Safe Direction Configuration' form

UI element	Description	
ComboBoxes: **Activation**, **De-Activation**, **Safe F-Output**		(See 6.6.6.1 General settings)
ComboBox **ErrorAction**	This defines which error action (safety function) is to be triggered when a monitoring condition is violated. The selection of an **ErrorAction** is mandatory. • **NoAction**: No **ErrorAction** is triggered. • **STO**, **SS1**, **SS2**: If a monitoring condition is violated, the selected **ErrorAction** is triggered. *Note:* Depending on the selected **ErrorAction,** the corresponding error action is automatically preselected in the *Mid-* or *Base-Level* form that is processed later, and cannot be deselected.	
|MaxDistance|	After activation, the direction of movement is monitored and it is ensured that no further than **MaxDistance** is driven in the blocked direction. The input is made in the SI unit of the axis position.	
Direction	This indicates the permitted direction of movement. • **0***:* The permitted direction of movement is **negative**. • **1***:* The permitted direction of movement is **positive.**	
Button **< Prev**	The wizard navigates back to the previously configured *Safe Function Configuration* form or to the *'Top-Level Safe Functions Configuration'* form.	
Button **Next >**	The wizard navigates forward to the *'Mid-Level Safe Functions Configuration'* form.	
State Displays **Safe State** and **Config State** *Buttons* **State** and **Cancel**		See Table 2

Table 24: UI elements of the 'SDI: Safe Direction' form

6.6.6.9 Mid-Level Safe Functions

In the *'Mid-Level Safe Functions Configuration'* form, it is determined which of the 3 available mid-level safety functions are used or are already implicitly selected by top-level safety functions. The following safety functions are available per axis:

- *1* SafeStop1 (SS1)*
- *1* SafeStop2 (SS2)*
- *1* SafeOperatingStop (SOS)*

Depending on the selection in this form, configuration forms are displayed in the following forms for the selected safety function(s).

Note: Mid-level safety functions already implicitly activated by Top-Level safety functions (SS1 in Figure 28) cannot and must not be deselected in this form.

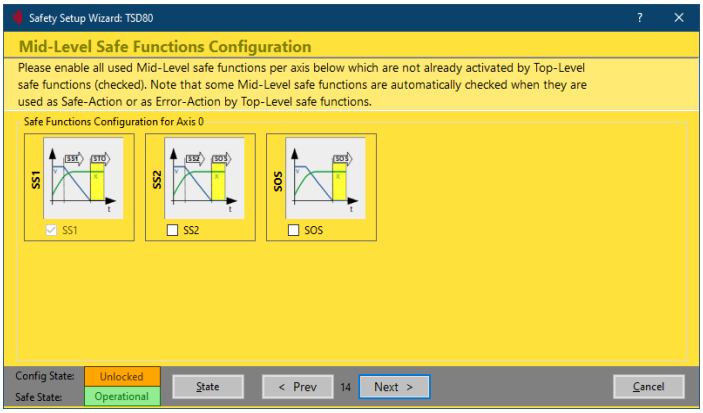


Figure 28: 'Mid-Level Safe Functions Configuration' form with SS1 selected

UI element	Description
CheckBox **SS1**	This selects whether the *SafeStop1* safety functions *SS1* is used. • - : The *SafeStop1* safety function is not used. • **SS1**: The safety function *SafeStop1* is used.
CheckBox **SS2**	This selects whether the *SafeStop2* safety functions *SS2* are used. • - : The *SafeStop2* safety function is not used. • **SS2**: The safety function *SafeStop2* is used. Note: When *SS2 is* activated, *SOS* is implicitly selected because *SS2* uses the SF *SOS* as *SafeAction*.
CheckBox **SOS**	This selects whether the *SafeOperatingStop* safety functions *SOS* is used. • - : The *SafeOperatingStop* safety function is not used. • **SOS**: The *SafeOperatingStop* safety function is used.
Button **< Prev**	The wizard navigates back to the previously configured *Safe Function Configuration* form or to the *'Top-Level Safe Functions Configuration'* form.
Button **Next >**	The wizard navigates forward to the first selected Mid-Level *Safe Function Configuration* form or to the *'Base-Level Safe Functions Configuration'* form.
State Displays **Safe State** and **Config State** *Buttons* **State** and **Cancel**	See Table 2

Table 25: UI elements of the 'Mid-Level Safe Functions Configuration' form

6.6.6.10 Safe Stop 1

With 'Safe Stop 1' (SS1 - Safe Stop 1) according to EN 61800-5-2, the axis is stopped in a defined manner and then switched off. If the axis is in motion when activated, it is actively brought to standstill by controlled stopping and the **STO** safety function is then triggered. If the axis is already standstill at the start, the **STO** safety function is triggered immediately.

The type of shutdown after successful deceleration or in the event of an error depends on the application and can be configured.

The safety function *SS1* can be activated by a logical input or as a *safe* or *error action of* other safety functions.

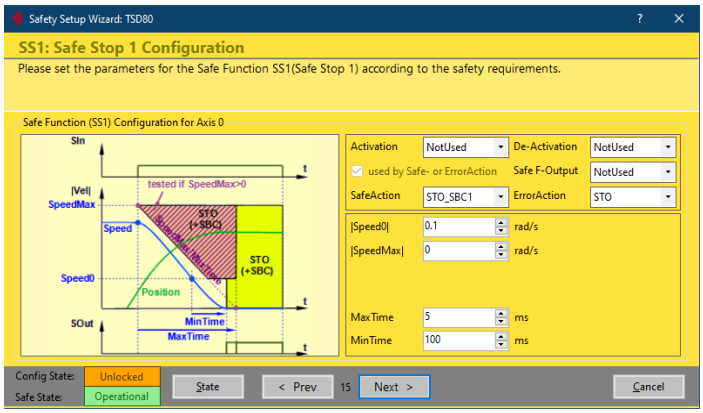


Figure 29: 'SS1: Safe Stop 1 Configuration' form

UI element	Description	
ComboBoxes: **Activation**, **De-Activation**, **Safe F-Output**		(See 6.6.6.1 General settings)
CheckBox **used by Safe- or ErrorAction**		(See 6.6.6.1 General settings)
ComboBox **SafeAction**	This defines which safety action (safety function) is to be triggered after a successful stop. The selection of a **SafeAction** is mandatory. • **NoAction**: No **SafeAction is** triggered. • **STO**, **STO+SBC1**, **STO+SBC2**: After a successful stop, the selected **SafeAction** is triggered. *Note:* Depending on the selected **ErrorAction,** the corresponding error action is automatically preselected in the *Base-Level* form that is processed later, and cannot be deselected.	
ComboBox **ErrorAction**	This defines which error action (safety function) is to be triggered when a deceleration condition is violated. The selection of an **ErrorAction** is mandatory. • **NoAction**: No **ErrorAction** is triggered. • **STO**, **STO+SBC1**, **STO+SBC2**: If a stopping condition is violated, the selected **ErrorAction** is triggered. *Note:* Depending on the selected **ErrorAction,** the selected error action is implicitly selected in the *Base-Level* form and cannot be deselected.	
|Speed0|	This specifies the absolute speed that must be reached during deceleration before **SafeAction** is activated. The input is made in the SI unit of the axis velocity.	
|SpeedMax|	This specifies whether the speed should additionally be monitored for exceeding the deceleration ramp during deceleration. If the parameter **|SpeedMax|** is > 0, this monitoring is activated. If deceleration ramp is exceeded, the **ErrorAction** is activated immediately. The speed limit during deceleration is calculated as follows: $SpeedLimitAbs = max\left(\left\|SpeedMax\right\| - \frac{\left\|SpeedMax\right\|}{MaxTime} * t, \left\|Speed\,0\right\|\right)$	

	The input is made in the SI unit of the axis velocity.
MaxTime, MinTime	These parameters define when the activation of the **SafeAction** starts. The speed is monitored while stopping and after falling below **|Speed0|** the tolerance time **MinTime** is awaited before the **SafeAction** is activated. After the time **MaxTime** has elapsed since activation, the **SafeAction** is activated in any case.
Button **< Prev**	The wizard navigates back to the *Mid-Level Safe Functions Configuration* form.
Button **Next >**	The wizard navigates forward to another *Safe Function Configuration* form or to the *'Base-Level Safe Functions Configuration'* form.
State Displays **Safe State** and **Config State** *Buttons* **State** and **Cancel**	See Table 2

Table 26: UI elements of the 'SS1: Safe Stop 1 Configuration' form

6.6.6.11 Safe Stop 2

With 'Safe Stop 2' (SS2) according to EN 61800-5-2, the axis is stopped in a defined manner and then hold in position. If the axis is in motion, it is actively brought to standstill by controlled stopping and then the **SOS** safety function is triggered. If the axis is already standstill at the beginning, the **SOS** safety function is triggered immediately. In contrast to 'Safe Stop 1' (SS1), the axis is still in controlled operation after execution.

The type of shutdown in the event of an error depends on the application and can be configured.

The safety function *SS2* can be activated by a logical input or as a *safe* or *error action of* other safety functions.

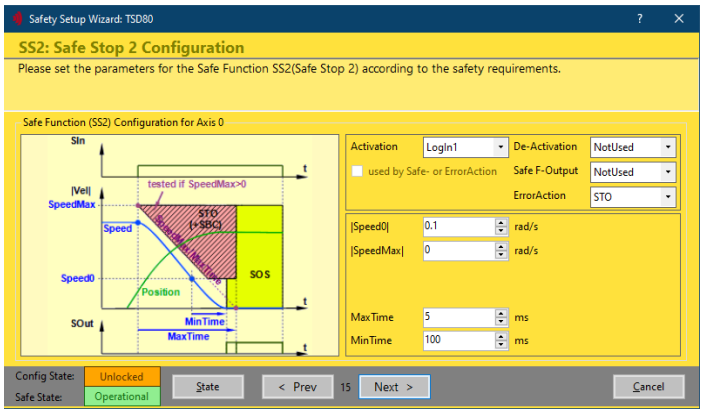


Figure 30: 'SS2: Safe Stop 2 Configuration' form

UI element	Description
ComboBoxes: **Activation, De-Activation, Safe F-Output**	(See 6.6.6.1 General settings)
CheckBox **used by Safe- or ErrorAction**	(See 6.6.6.1 General settings)
ComboBox **ErrorAction**	This defines which error action (safety function) is to be triggered when a deceleration condition is violated. The selection of an **ErrorAktion** is mandatory. • **NoAction**: No **ErrorAktion** is triggered. • **STO**, **STO+SBC1**, **STO+SBC2**: If a braking condition is violated, the selected **ErrorAction** is triggered. *Note:* Depending on the selected **ErrorAction,** the corresponding error action is automatically preselected in the *Base-Level* form that is processed later, and cannot be deselected.
|Speed0|	This indicates the absolute speed that must be reached during deceleration before the *SafeAc-*

	tion ***SOS*** is activated. The input is made in the SI unit of the axis velocity.
|SpeedMax|	This specifies whether the speed should additionally be monitored for exceeding the deceleration ramp during deceleration. If the parameter **|SpeedMax|** is > 0, this monitoring is activated. If deceleration ramp is exceeded, the **ErrorAction** is activated immediately. The speed limit during deceleration is calculated as follows: $SpeedLimitAbs = max\left(\left\|SpeedMax\right\| - \frac{\left\|SpeedMax\right\|}{MaxTime} * t, \left\|Speed\,0\right\|\right)$ The input is made in the SI unit of the axis velocity.
MaxTime, **MinTime**	These parameters define when the activation of the *SafeAction* ***SOS*** starts. The speed is monitored while stopping and after falling below **|Speed0|** the tolerance time **MinTime** is awaited before the **SafeAction** is activated. After the time MaxTime has elapsed since activation, the **SafeAction** is activated in any case.
Button **< Prev**	The wizard navigates back to the previously configured *Safe Function Configuration* form or to the *Mid-Level Safe Functions Configuration* form.
Button **Next >**	The wizard navigates forward to another *Safe Function Configuration* form or to the *'Base-Level Safe Functions Configuration'* form.
State Displays **Safe State** and **Config State** *Buttons* **State** and **Cancel**	See Table 2

Table 27: UI elements of the 'SS2: Safe Stop 2 Configuration' form

6.6.6.12 Safe Operating Stop

The function "Safe operating stop" (SOS) according to EN 61800-5-2 prevents the axis from deviating from the stop position by more than a defined amount. Specifically, this safety function monitors the stop position of an axis and prevents it from leaving the defined position window while maintaining position control. When the monitored position window is left, the axis is safely switched off.

The type of shutdown in the event of an error depends on the application and can be configured.

The safety function *SOS* can be activated by a logical input or as a *safe* or *error action of* other safety functions.

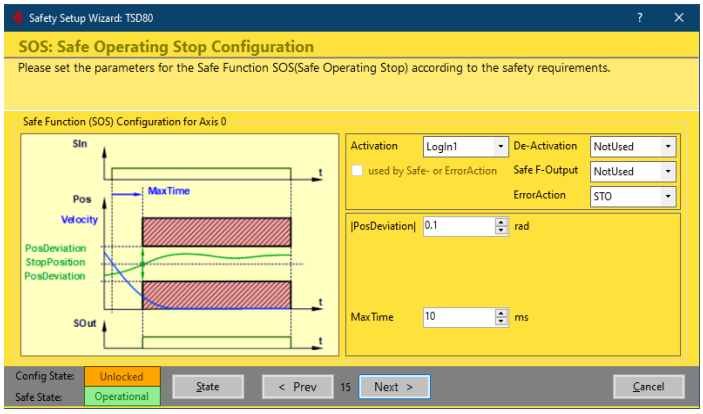


Figure 31: 'SOS: Safe Operating Stop Configuration' form

UI element	Description	
ComboBoxes: **Activation, De-Activation, Safe F-Output**		(See 6.6.6.1 General settings)
CheckBox **used by Safe- or ErrorAction**		(See 6.6.6.1 General settings)
ComboBox	This defines which error action (safety function) is to be triggered when the position deviation	

ErrorAction	is exceeded. The selection of an **ErrorAction** is mandatory. • **NoAction**: No **ErrorAction** is triggered. • **STO**, **STO+SBC1**, **STO+SBC2**: If a condition is violated, the selected **ErrorAction** is triggered. *Note:* Depending on the selected **ErrorAction,** the corresponding error action is automatically preselected in the *Base-Level* form that is processed later, and cannot be deselected.
|PosDeviation|	This specifies the absolute position window in which the axis must remain after the time **MaxTime** has elapsed after activation. The stop position is defined by the position at which the axis is at the time **MaxTime.** The input is made in the SI unit of the axis position.
MaxTime	These parameters specify when monitoring starts after activation.
Button **< Prev**	The wizard navigates back to the previously configured *Safe Function Configuration* form or to the *Mid-Level Safe Functions Configuration* form.
Button **Next >**	The wizard navigates forward to the *'Base-Level Safe Functions Configuration'* form.
State Displays **Safe State** and **Config State** *Buttons* **State** and **Cancel**	See Table 2

Table 28: UI elements of the 'SOS: Safe Operating Stop Configuration' form

6.6.6.13 Base-Level Safe Functions

The *'Base-Level Safe Functions Configuration'* form is used to define which of the 3 available Base-Level safety functions are used or are already implicitly selected by other safety functions. The following safety functions are available per axis:

- *1* SafeTorqueOff (STO)*
- *1* SafeTorqueOff with SafeBrakeControl 1 (STO+SBC1)*
- *1* SafeTorqueOff with SafeBrakeControl 2 (STO+SBC2)*

Depending on the selection in this form, configuration forms are displayed in the following forms for the selected safety function(s).

Note: Base-level safety functions already implicitly activated by other safety functions (STO and SBC1 in Figure 32) cannot and must not be deselected in this form.

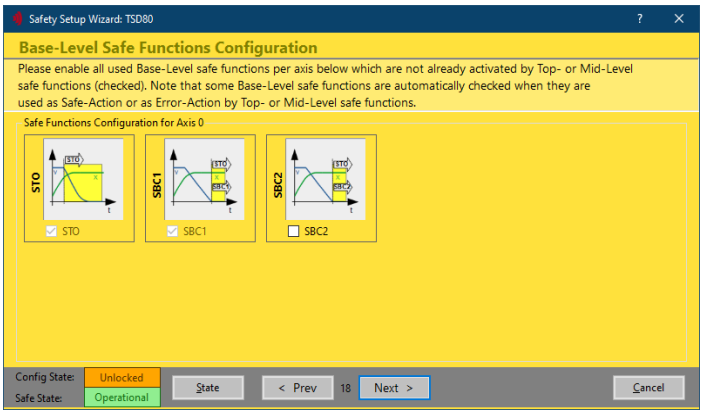


Figure 32: 'Base-Level Safe Functions Configuration' form with selection of STO and SBC1

UI element	Description
CheckBox **STO**	This selects whether the SafeTorqueOff safety function *STO* is used. • - : The *SafeTorqueOff* safety function is not used. • **STO**: The safety function *SafeTorqueOff* is used.
CheckBox **SBC1**	This selects whether the *SafeBrakeControl1* safety function *SBC1* is used. • - : The *SafeBrakeControl1* safety function is not used. • **SBC1**: The safety function SafeBrakeControl1 is used.
CheckBox **SBC2**	This selects whether the SafeBrakeControl2 safety function *SBC2* is used. • - : The *SafeBrakeControl2* safety function is not used. • **SBC2**: The safety function SafeBrakeControl2 is used.
Button **< Prev**	The wizard navigates back to the previously configured *Safe Function Configuration* form or to the *Mid-Level Safe Functions Configuration* form.
Button **Next >**	The wizard navigates forward to the first selected Base-Level *Safe Function Configuration* form or to the *'Safe Encoder Configuration'* form of the 2nd axis or to the *'*Safety *Setup Consolidation'* form.
State Displays **Safe State** and **Config State** *Buttons* **State** and **Cancel**	See Table 2

Table 29: UI elements of the 'Base-Level Safe Functions Configuration' form

6.6.6.14 Safe Torque Off

The safety function 'Safe Torque Off' (STO) according to EN 61800-5-2 prevents force-generating energy from being supplied to the motor. The safety function STO corresponds to an uncontrolled stop according to IEC-60204-1, stop category 0.

The safety function *STO* can be activated by a logical input or as a *safe* or *error action* from other safety functions.

In this form, the *STO: Safe Torque Off* safety function is configured according to the safety application.

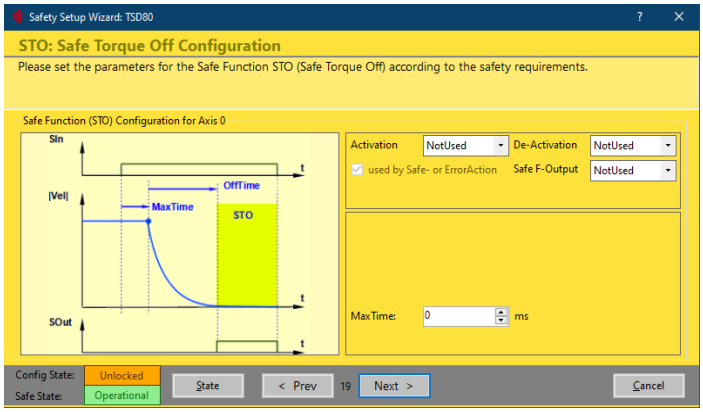


Figure 33: 'STO: Safe Torque Off Configuration' form

UI element	Description	
ComboBoxes: **Activation, De-Activation, Safe F-Output**		(See 6.6.6.1 General settings)
CheckBox **used by Safe- or ErrorAction**		(See 6.6.6.1 General settings)
MaxTime	This parameter defines how long the activation of the ***SafeAction*** *STO* is delayed after the safety function has been activated. This may be necessary, if it is desired that a holding brake is activated before STO. *Note:* After STO has been triggered, the switch-off time of the power bridge driver supplies (170ms) is waited for before STO can be deactivated again.	
Button **< Prev**	The wizard navigates back to the *'Base-Level Safe Functions Configuration'* form.	
Button **Next >**	The wizard navigates forward to another *Safe Function Configuration* form or to the *'Safe Encoder Configuration'* form of the 2nd axis or to the 'Safety *Setup Consolidation'* form.	
State Displays **Safe State** and **Config State** *Buttons* **State** and **Cancel**		See Table 2

Table 30: UI elements of the 'STO: Safe Torque Off Configuration' form

6.6.6.15 Safe Brake Control

The safety function 'Safe Brake Control' (SBC) according to EN 61800-5-2 ensures that an external brake is controlled by means of a safe output signal. SBC is usually used together with STO.

There are two *SBC* safety functions (*SBC1* and *SBC2*) per axis, which are implicitly assigned to the two available safe outputs per axis. The safety functions *SBC1 and SBC2* can be activated by a logical input or as a *safe* or *error action of* other safety functions.

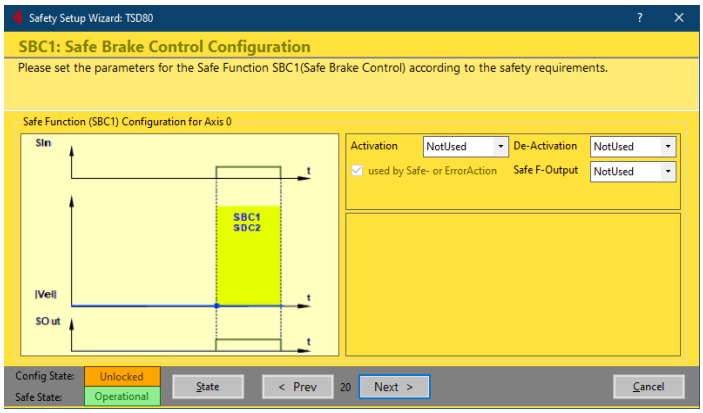


Figure 34: 'SBC1: Safe Brake Control 1 Configuration' form

UI element	**Description**	
ComboBoxes: **Activation, De-Activation, Safe F-Output**		(See 6.6.6.1 General settings)
CheckBox **used by Safe- or ErrorAction**		(See 6.6.6.1 General settings)
Button **< Prev**	The wizard navigates back to the last selected Base-Level *Safe Function Configuration* or to the *'Base Level Safe Functions Configuration'* form.	
Button **Next >**	The wizard navigates forward to another *Safe Function Configuration* form or to the *'Safe Encoder Configuration'* form of the 2nd axis or to the *'Safety Setup Consolidation'* form.	
State Displays **Safe State** and **Config State** *Buttons* **State** and **Cancel**		See Table 2

Table 31: UI elements of the 'SBC: Safe Brake Control Configuration' form

6.6.7 Consolidation

This chapter describes the final consolidation step required for configuration types in which parameters are changed.

After being guided through the *Safe Function Configuration* forms by the wizard, the *'Safety Setup Consolidation'* form is displayed. This form displays safety-relevant information as well as information regarding the existing options in this form.
The following procedure differs between *online* and *offline* configuration.

6.6.7.1 Online consolidation

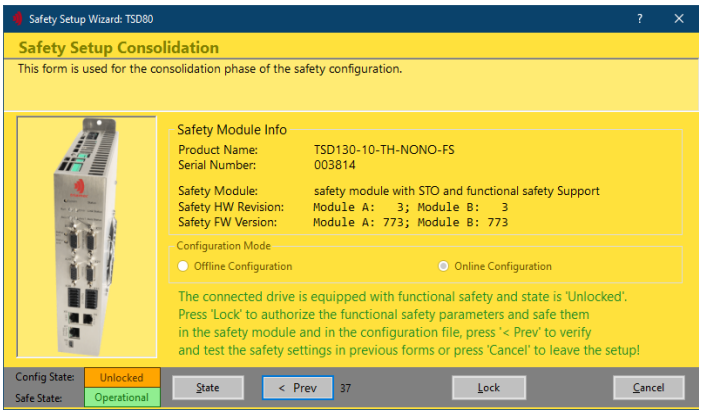


Figure 35: 'Safety Setup Consolidation' form for Online Configuration in Config State Unlocked

UI element	Description
Safety Module Info	Information on the connected drive and its safety module (See Table 1)
RadioButtons in ***Configuration Mode***	These two radio buttons indicate the currently selected configuration mode.
Info Text	This field displays information about the currently selected drive, its safety capabilities and information about the possible actions.
Button **< Prev**	The wizard navigates back to the last *Safe Function Configuration* form. This makes it possible to return to the configuration forms before the actual consolidation step in order to carry out modifications and tests of the safety configuration.
Button **Lock**	Causes the prepared configuration to be persistently saved in a configuration file and in the safety module. For this purpose, the ***SafetyConfigHash*** is calculated from all parameters to be saved, the current FW version, the hash of the *developer* password and the identification of the drive. This hash is saved together with the other values in a configuration file and in the safety module. After pressing the **Lock** button, the *Save safety configuration file* dialogue prompts you to give the new configuration file a name.

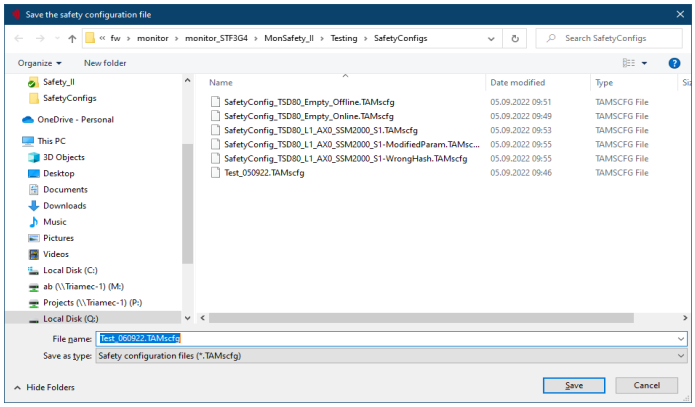
	 *Figure 36: Saving the new safety configuration file* After correctly entering the name and pressing the **Save** button, the new file is created and the configuration is persistently saved in the file and in the safety module. The wizard then navigates to the Safety *Setup Consolidation State* form. **Attention** The configuration file can be used later as an authorised configuration and loaded into the safety module. This file should therefore be kept in a safe place together with the safety project data!
State Displays **Safe State** and **Config State** *Buttons* **State** and **Cancel**	See Table 2

Table 32: UI elements of the 'Safety Setup Consolidation' form in Config State Unlocked

After successful authorisation and saving in the safety module, the safety module performs a reset and then reloads the parameters from the persistence. The configuration is then activated and the safety module changes to the Config State **Locked.**
The wizard uses the *'Safety Consolidation State'* form to display information about the consolidation step that has taken place.

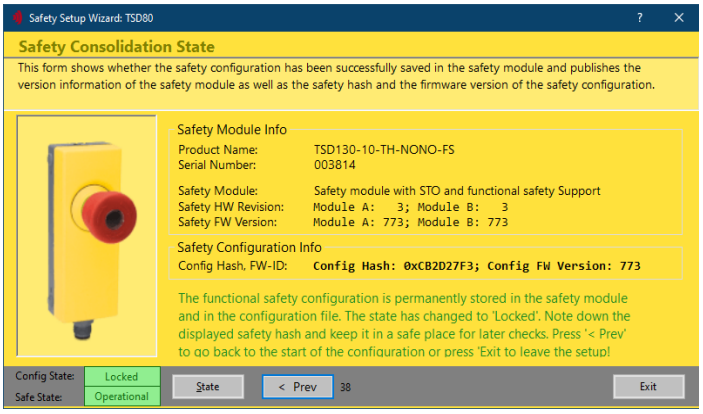


Figure 37: 'Safety Consolidation State' form after successful consolidation

UI element	Description
Safety Module Info	Information on the connected drive and its safety module (See Table 1)
Safety Configuration Info	The ***SafetyConfigHash*** and the ***firmware version*** with which the configuration is authorised are displayed in this area. **Attention** This information must be noted together with the Safety project data and kept in a safe place!
Info Text	This field displays information about the consolidation that has currently taken place as well as

	information about the possible further actions.
Button **< Prev**	The wizard navigates back to the *'Safety Configuration'* form.
Button **Exit**	When pressed, the wizard is terminated without further confirmation.
State Displays **Safe State** and **Config State** *Button* **State**	See Table 2

Table 33: UI elements of the 'Safety Consolidation State' form after successful consolidation

If the authorisation or the storage in the Safety Module is not successful, the Config State remains unchanged **Unlocked** and it is possible to repeat the consolidation.

The wizard displays information about the unsuccessful consolidation step using the *'Safety Consolidation State'* form. In addition, the **< Prev** button is available to navigate back and repeat the consolidation.

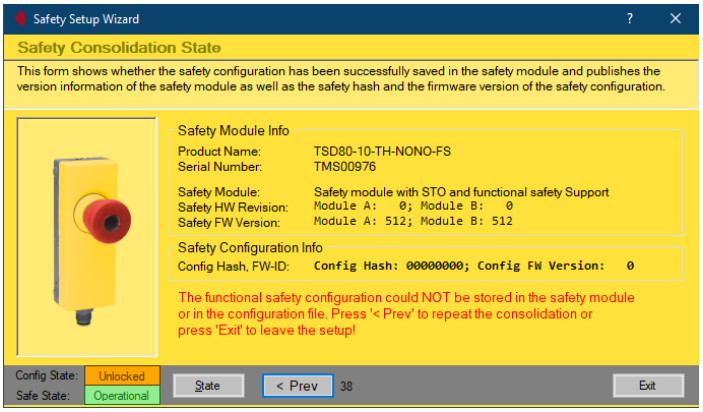


Figure 38: 'Safety Consolidation State' form after unsuccessful consolidation

UI element	**Description**
Safety Module Info	Information on the connected drive and its safety module (See Table 1)
Safety Configuration Info	The ***SafetyConfigHash*** and the ***firmware version*** with which the configuration is authorised are displayed in this area. In the event of an error, 0 is displayed for both entries.
Info Text	This field displays information about the failed consolidation as well as information about the possible further actions.
Button **< Prev**	The wizard navigates back to the *'Safety Setup Consolidation'* form so that the consolidation can be repeated.
Button **Exit**	When pressed, the wizard is terminated without further confirmation.
State Displays **Safe State** and **Config State** *Button* **State**	See Table 2

Table 34: UI elements of the 'Safety Consolidation State' form after unsuccessful consolidation

6.6.7.2 Offline consolidation

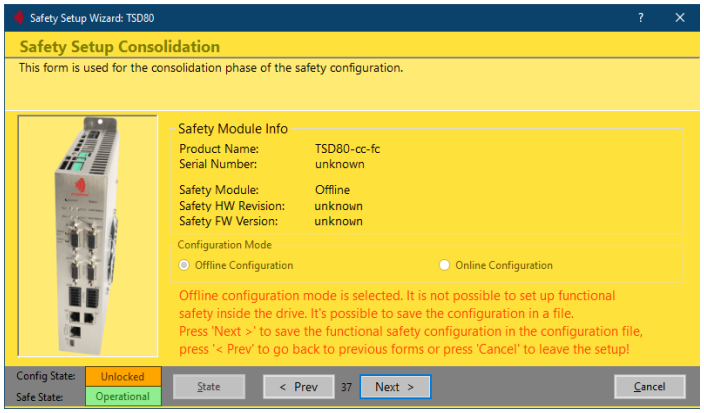


Figure 39: 'Safety Setup Consolidation' form for Offline Configuration

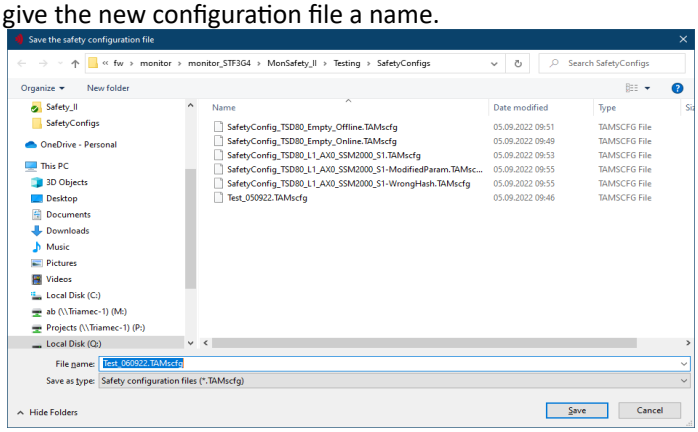
UI element	Description
Safety Module Info	Information on the virtual drive (See Table 1)
RadioButtons in ***Configuration Mode***	These two radio buttons indicate the currently selected configuration mode.
Info Text	This field displays information about the currently selected configuration type as well as information about the possible actions.
Button **< Prev**	The wizard navigates back to the last *Safe Function Configuration* form. This makes it possible to return to the configuration forms before saving in order to make modifications to the safety configuration.
Button **Next >**	Causes the prepared configuration to be saved in a configuration file. After pressing the **Next >** button, the *Save safety configuration file* dialogue prompts you to give the new configuration file a name.  *Figure 40: Saving the new safety configuration file* After correctly entering the name and pressing the **Save** button, the new file is created and the configuration is saved in the file. **Attention** This configuration file can be used for a new *online* or *offline* configuration. It cannot be used as an authorised configuration!
State Displays **Safe State** and **Config State** *Buttons* **State** and **Cancel**	See Table 2

Table 35: UI elements of the 'Safety Setup Consolidation' form

After successful saving, the wizard uses the *'Safety Consolidation State'* form to display information about the consolidation step that has taken place.

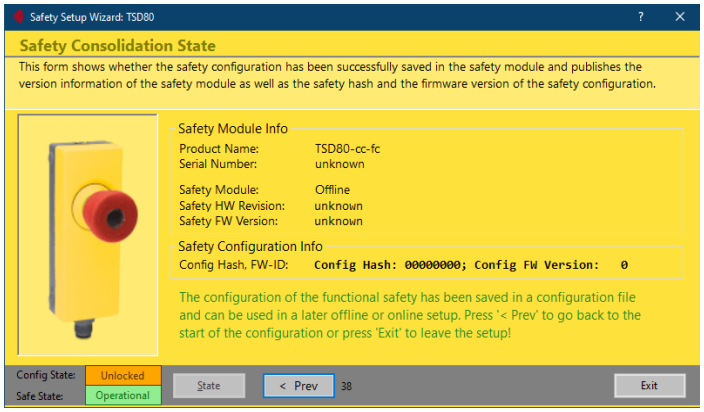


Figure 41: 'Safety Consolidation State' form after successful consolidation

UI element	**Description**
Safety Module Info	Information on the virtual drive (See Table 1)
Safety Configuration Info	The ***SafetyConfigHash*** and the ***firmware version*** with which the configuration is authorised are displayed in this area. In offline mode, 0 is displayed for both entries.
Info Text	This field displays information about the currently performed saving as well as information about the possible further actions.
Button **< Prev**	The wizard navigates back to the *'Safety Configuration'* form.
Button **Exit**	When pressed, the wizard is terminated without further confirmation.
State Displays **Safe State** and **Config State** *Button* **State**	See Table 2

Table 36: UI elements of the 'Safety Consolidation State' form after successful consolidation

6.7 Load authorised configuration

This chapter describes the possibility of loading a configuration authorised by a safety *developer* into the safety module. This option is only available in the Config State **Unlocked** and in the Config State **Service.** In the *'Safety Configuration'* form, the configuration type **Load safety config file into safety module** can be selected in the **online configuration** mode in both of these states. This type of configuration is described below.

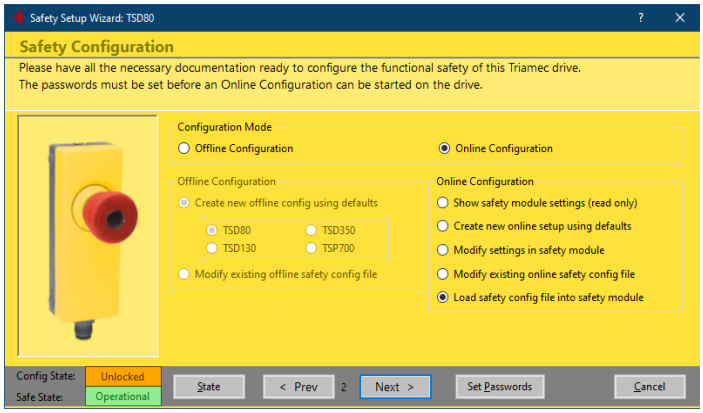
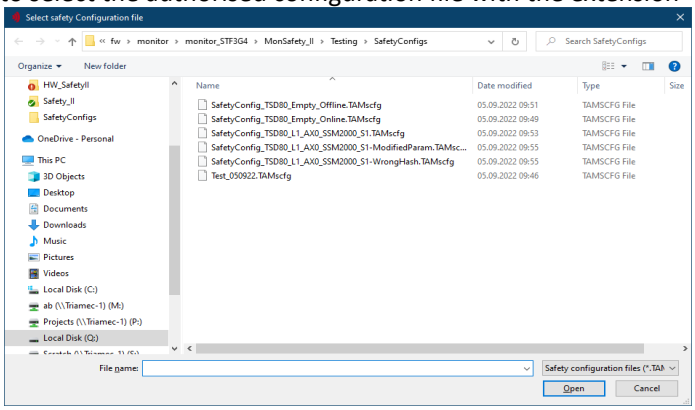


*Figure 42: Selecting **Load safety config file into safety module** in **Unlocked** state*

UI element	Description
RadioButtons in ***Configuration Mode***	These two radio buttons are used to select the configuration mode. • ***Offline Configuration*** mode (See 6.12 Offline configuration) • ***Online Configuration*** mode (See 6.5 State Unlocked)
RadioButtons in ***Online Configuration***	The five radio buttons are used to select the type of online configuration. • **Show safety module settings, Create new online setup using defaults** **Modify settings in safety module, Modify existing online safety config file**: These configuration types are already described in chapter 6.5 State Unlocked. • **Load safety config file into safety module**: (only in Config State **Unlocked** and **Service**) With this selection, the user *Developer* or the user *Service* can load an authorised safety configuration file into the safety module. **Important** The parametrisation cannot be adjusted with this type of configuration!
Button **< Prev**	The wizard navigates back to the *'Safety Module Information'* form.
Button **Next >**	After pressing the **Next >** button, the *Select safety configuration file* dialogue prompts the user to select the authorised configuration file with the extension **.TAMscfg.*  *Figure 43: Selecting an authorized safety configuration* The selected file is opened, checked and, if successful, navigated directly to the *'Safety Setup*

	Consolidation' form.	
State Displays **Safe State** and **Config State** *Button* **State**, **Set Passwords** and **Cancel**		See Table 5

Table 37: UI elements of the 'Safety Configuration' form in Config State Unlocked

6.7.1 Consolidation

This chapter describes the consolidation step that is necessary to complete the configuration type **Load safety config file into safety module**.

After selecting an authorised configuration, the *'Safety Setup Consolidation'* form is displayed. This form displays safety-relevant information as well as information regarding the existing options in this form.

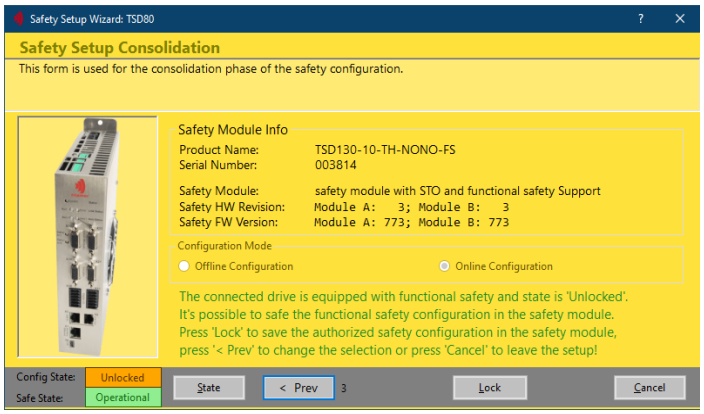


Figure 44: 'Safety Setup Consolidation' form in Config State Unlocked

UI element	Description	
Safety Module Info	Information on the connected drive and its safety module (See Table 1)	
RadioButtons in ***Configuration Mode***	These two radio buttons indicate the currently selected configuration mode.	
Info Text	This field displays information about the currently selected drive, its safety capabilities and information about the possible actions.	
Button **< Prev**	The wizard navigates back to the *Safety Setup Configuration* form. This makes it possible to return to the selection of the configuration file before the actual consolidation step.	
Button **Lock**	This causes the prepared authorised configuration to be persistently saved in the safety module. The ***SafetyConfigHash*** from the authorised configuration is used and checked and saved together with the other values in the safety module. The wizard then navigates to the Safety *Setup Consolidation State* form.	
State Displays **Safe State** and **Config State** *Buttons* **State** and **Cancel**		See Table 2

Table 38: UI elements of the 'Safety Setup Consolidation' form in Config State Unlocked

- After successful authorisation and saving in the safety module, the safety module performs a reset and then reloads the parameters from the persistence. The configuration is then activated and the safety module changes to the Config State **Locked.**
The wizard uses the *'Safety Consolidation State'* form to display information about the consolidation step that has taken place.

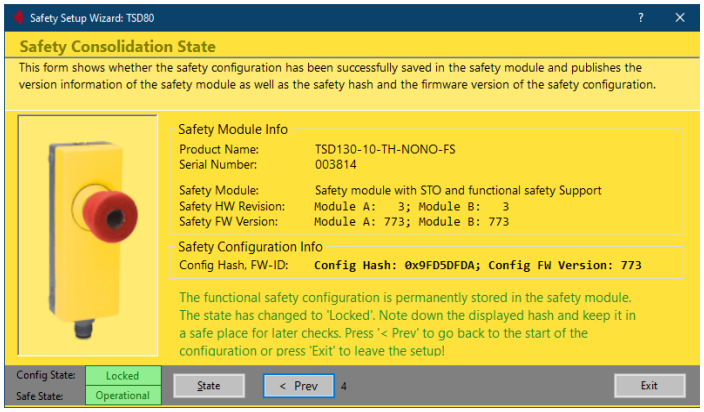


Figure 45: 'Safety Consolidation State' form after successful consolidation

UI element	Description	
Safety Module Info	Information on the connected drive and its safety module (See Table 1)	
Safety Configuration Info	The ***SafetyConfigHash*** and the ***firmware version*** with which the configuration is authorised are displayed in this area. **Attention** This information must be noted together with the Safety project data and kept in a safe place!	
Info Text	This field displays information about the consolidation that has currently taken place as well as information about the possible further actions.	
Button **< Prev**	The wizard navigates back to the *'Safety Configuration'* form.	
Button **Exit**	When pressed, the wizard is terminated without further confirmation.	
State Displays **Safe State** and **Config State** *Button* **State**		See Table 2

Table 39: UI elements of the 'Safety Consolidation State' form after successful consolidation

- If the authorisation or the storage in the Safety Module is not successful, the Config State remains unchanged (**Unlocked** or **Service,** depending on the type of current configuration) and it is possible to repeat the consolidation.

The wizard displays information about the unsuccessful consolidation step using the *'Safety Consolidation State'* form. In addition, the **< Prev** button is available to navigate back and repeat the consolidation.

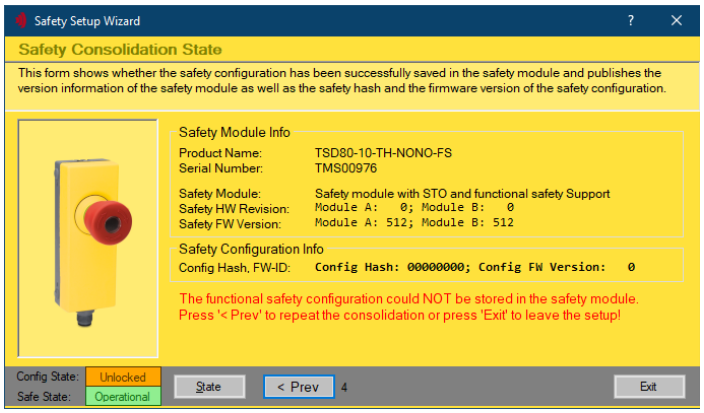


Figure 46: 'Safety Consolidation State' form after unsuccessful consolidation

UI element	Description
Safety Module Info	Information on the connected drive and its safety module (See Table 1)
Safety Configuration Info	The ***SafetyConfigHash*** and the ***firmware version*** with which the configuration is authorised are displayed in this area. In the event of an error, 0 is displayed for both entries.
Info Text	This field displays information about the failed consolidation as well as information about the possible further actions.
Button **< Prev**	The wizard navigates back to the *'Safety Setup Consolidation'* form so that the consolidation can be repeated.
Button **Exit**	When pressed, the wizard is terminated without further confirmation.
State Displays **Safe State** and **Config State** *Button* **State**	See Table 2

Table 40: UI elements of the 'Safety Consolidation State' form after unsuccessful consolidation

6.8 State Locked

The *'Safety Configuration'* form is displayed as the first form after the *Module Information* form.
If a safety configuration is persistently stored in the safety module, the safety module is in the Config State **Locked**. In this state, the safety module reads the parameters from the persistence, the parameters cannot be modified. FW update is prohibited too. The state can be exited with password-protected commands described in this chapter.

In the *'Safety Configuration'* form, you can switch between **Online Configuration** and **Offline Configuration** and also display the current configuration in *Online* mode. It is also possible to 'unlock' the safety configuration in the safety module using the **Unlock** button or to switch the safety module to the temporary **Service** state using the **Service** button.

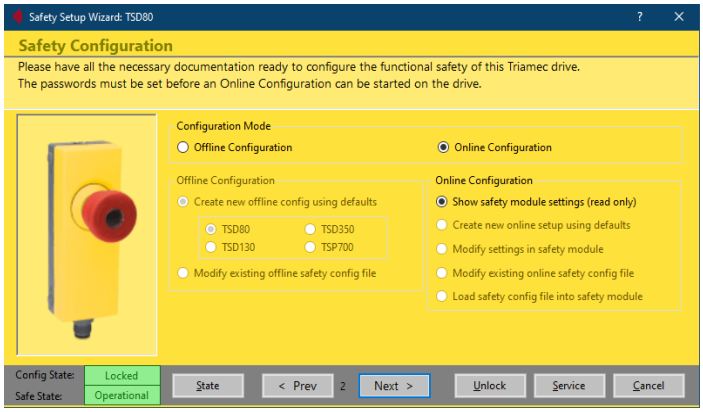
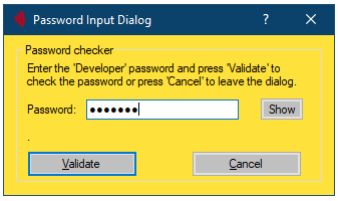


Figure 47: 'Safety Configuration' form in Config State Locked

UI element	Description
RadioButtons in **Configuration Mode**	These two radio buttons are used to select the configuration mode. • **Offline Configuration** mode (See 6.12 Offline configuration) • In **Online Configuration** mode, only the current safety parameters of the safety module can be displayed**.**
RadioButtons in ***Online Configuration***	Only **Show safety module settings (read only)** is available in the Config State **Locked.** The other configuration types are not available in this state and are greyed out. With this selection, the current parameters of the safety module can be displayed. Pressing the **Next >** button navigates to the first configuration form. The further steps are described in chapter 6.11 Show configuration.
Button **Unlock**	This button is only displayed when **Online Configuration** is selected and is used to delete a persistent safety configuration in the safety module. When pressed, the wizard prompts you to enter the *Developer password* via a *password dialogue* in order to deactivate the configuration in the safety module and switch to the Config State **Unlocked.**  *Figure 48: Password Input Dialog* • If the password is entered incorrectly, the error is indicated in the dialogue after **Validate** is pressed. • When **Cancel** is pressed, the dialogue is closed and no further action is taken.

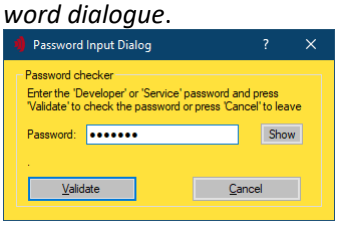
	• If the *Developer* password is entered correctly, the password is validated in the safety module after **Validate** is pressed and the dialogue is closed. The persistent safety configuration in the safety module is deleted and the Config State is changed to **Unlocked.** The *'Safety Configuration'* form is updated and shows the new Config State **Unlocked** and releases all configuration types. A new configuration can then be started (see 6.5 State Unlocked; 6.12 Offline configuration; 6.7 Load authorised configuration)
Button **Service**	This button is only displayed when **Online Configuration** is selected and is used to switch the safety module to the temporary Config State **Service** in order to load an authorised configuration or to perform a Firmware update. When pressed, the wizard prompts you to enter the *Developer* or *Service* password via a *password dialogue*.  *Figure 49: Password Input Dialog* • If the password is entered incorrectly, the error is indicated in the dialogue after **Validate** is pressed. • When **Cancel** is pressed, the dialogue is closed and no further action is taken. • If the *Developer* or *Service* password is entered correctly, the password is validated in the Safety Module after **Validate** is pressed and the dialogue is closed. The Config State is changed to **Service.** The *'Safety Configuration'* form is updated and shows the new Config State **Service** and releases the configuration type **Load safety config file into safety module**. (See 6.9 State Service)
Button **< Prev**	The wizard navigates back to the *'Safety Module Information'* form.
Button **Next >**	The wizard navigates forward to the *'Safety Configuration Overview'* form.
State Displays **Safe State** and **Config State** *Buttons* **State** and **Cancel**	See Table 2

Table 41: UI elements of 'Safety Configuration' form in Config State Factory

6.9 State Service

The *'Safety Configuration'* form is displayed in the Config State **Service** after the change to the **Service** state.

The Config State **Service** is a temporary state and allows the loading of an authorised configuration. In this state, the safety module remains in the 'safe state' and allows a firmware update too. In case of an error or after a reboot or after a timeout of 300s, the **Service** state is exited to the Config State **Locked**.

In this form, two of five configuration types can be selected in the **online** configuration mode. These are described below.

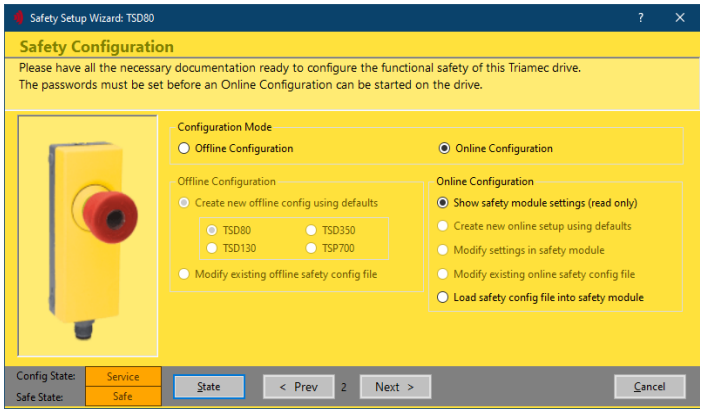


Figure 50: Selecting an online safety configuration in State Service

UI element	Description
RadioButtons in ***Configuration Mode***	These two radio buttons are used to select the configuration mode. • ***Offline Configuration*** mode (See 6.12 Offline configuration) • In the ***Online Configuration*** mode, safety parameters can be displayed and an authorised configuration can be loaded into the safety module. The possibilities are described in more detail below in the description of the ***Online Configuration*** *radio button*.
RadioButtons in ***Online Configuration***	The five radio buttons are used to select the type of online configuration. • **Show safety module settings (read only)**: (always available) With this selection, the current parameters of the safety module can be displayed. Pressing the **Next >** button navigates to the first configuration form. The further steps are described in chapter 6.11 Show configuration. • **Create new online setup using defaults, Modify settings in safety module, Modify existing online safety config file**: These configuration types are not available in the Config State **Service**. • **Load safety config file into safety module**: This selection allows the user to load an authorised safety configuration file into the safety module. This type of configuration is described in chapter 6.7 Load authorised configuration.
Button **< Prev**	The wizard navigates back to the *'Safety Module Information'* form.
Button **Next >**	The wizard navigates forward depending on the selected *online configuration* type, e.g. to the *'Safety Configuration Overview'* form.
State Displays **Safe State** and **Config State** *Buttons* **State** and **Cancel**	See Table 2

Table 42: UI elements of the 'Safety Configuration' form in the Config State Service

6.10 Show Status of Safety Module

When the **State** button in the Status Bar of a the current form is pressed, the *'Safety Status Overview'* form with the current internal status is displayed in addition to the current form, if it is not already displayed. The *'Safety Status Overview'* form is hidden if it is already displayed when the **State** button is pressed.

The possibility with the display of the *Safety Status* form exists in most forms.

With the help of this form, the status of the components in the safety module can be viewed. This includes the status of the logical inputs, the safety outputs, the Safe F-Outputs, the safe encoder and the status of the safety functions.

By means of small indicators, which are equipped with varying colours and labels, the status of the individual elements is displayed.

The logic input indicators also operate as buttons. If a logic input is configured, pressing the indicator simulates activation or deactivation. This option is useful during the testing phase to check the set functions.

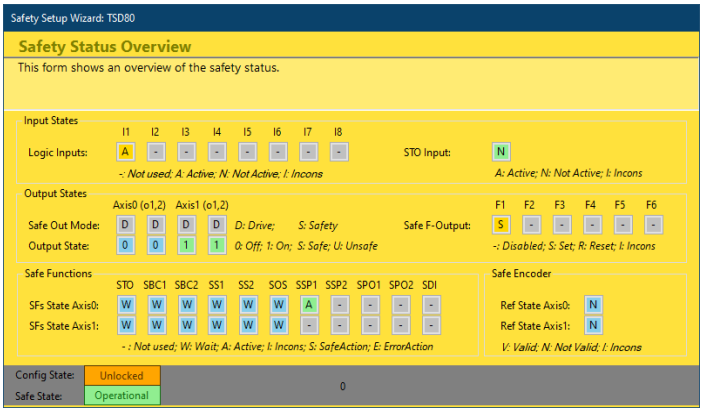


Figure 51: 'Safety Status Overview' form

In the example opposite, the logical input Li1, the Safe F-Output F1 and the safety function SSP1(SSM) is configured with logic input Li1.
The logical input Li1 is activated and with it the safety function SSP1(SSM). By means of status F1, the SF signals that the speed is in the valid range.

UI element	Description
Logic Inputs	These indicators show the current status of the eight logical inputs. • [--] : Logical input is unused • [N] : Logical input is configured and **N**ot Active • [A] : Logical input is configured and **A**ctive • [I] : Logical dual input is configured and state is **I**nconsistent • [E] : **E**rror: Logical input is configured incorrectly
STO Input	This indicator shows the current status of the two-channel STO input. • [N] : STO **N**ot Active • [A] : STO **A**ctive • [I] : STO inputs are not identical (**I**nconsistent) • [E] : **E**rror: Monitors show different STO state
Safe Out Mode	These indicators show the mode of use of the two digital outputs per axis. • [D] : The output is not used by the safety (used by the **D**rive). • [S] : The output is used by the **S**afety
Output State	These indicators show the current status of the two digital outputs per axis. • [U] : Output is used by Safety and indicates **U**nsafe status (On). • [S] : Output is used by Safety and indicates **S**afe state (Off). • [0] : Output is controlled by the Drive and switched off (**0 = Off**).

	• [1] : Output is controlled by the Drive and switched on (**1 = On**).
Safe F-Outputs	These indicators show the current status of the six Safe F-Outputs. • [-]- : Safe F-Output is unused • [R] : Safe F-Output is configured and not set (**R**eset) • [S] : Safe F-Output is configured and set (**S**et) • [I] : Status on the two monitors is not identical (**I**nconsistent) • [E] : **E**rror: Safe F-Output is configured incorrectly
Safe Functions	These indicators show the current status of the safety functions per axis. • [--] : Safety function is unused • [w] : Safety function is used and **W**aits for activation • [A] : Safety function is used and is **A**ctive • [S] : Safety function is used, is active and has its ***S**afeAction* activated. • [E] : Safety function is used, is active and has its ***E**rrorAction* activated. • [I] : Safety function is configured and state is **I**nconsistent • [E] : **E**rror: Safety function is configured incorrectly
Safe Encoder State	These indicators show the current status of the safe encoders per axis. • [V] : Safe Referencing is performed and is **V**alid • [N] : Safe Referencing is not performed and is **N**ot valid • [I] : The state of the safe Referencing is **I**nconsistent
State Displays **Safe State** and **Config State**	See Table 2

Table 43: UI elements of 'Safety Status Overview' form

6.11 Show configuration

In display mode, the parameters are loaded from the safety module and displayed read-only in the configuration forms of the wizard.

After selecting the configuration mode **Online Configuration** and the configuration type **Show safety module settings (read only)** in the *'Safety Configuration'* form and pressing the **Next >** button, the *'Safety Configuration Overview'* form appears. Then you can proceed in the same way as described in chapter 6.6 Assemble configuration. You can navigate through all *Safety Configuration* forms. The parameters in all forms are read-only and cannot be changed.

Once you have navigated through all the *safety configuration* forms, you will reach the *'Safety Setup Consolidation'* form. This is described below.

6.11.1 Consolidation

This form displays safety-relevant information as well as information regarding the existing options in this form.

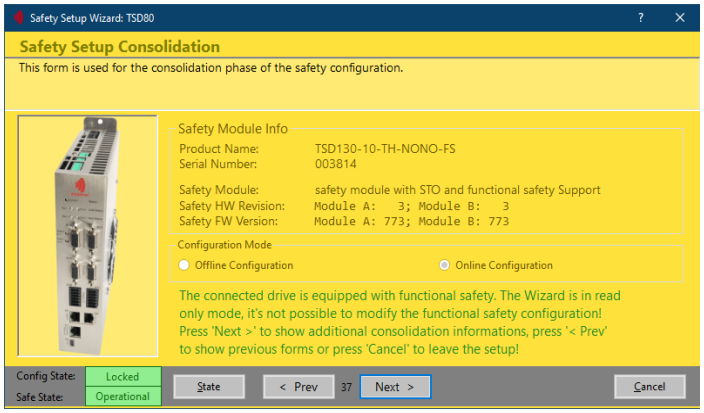


Figure 52: 'Safety Setup Consolidation' form

UI element	Description
Safety Module Info	Information on the connected drive and its safety module (See Table 1)
RadioButtons in ***Configuration Mode***	These two radio buttons indicate the currently selected configuration mode.
Info Text	This field displays information about the currently selected drive, its safety capabilities and information about the possible actions.
Button **< Prev**	The wizard navigates back to the last *Safe Function Configuration* form.
Button **Next >**	The wizard navigates to the *Safety 'Setup Consolidation State'* form.
State Displays **Safe State** and **Config State** *Buttons* **State** and **Cancel**	See Table 2

Table 44: UI elements of the 'Safety Setup Consolidation' form in Config State Unlocked

The wizard uses the *'Safety Consolidation State'* form to display information about the current safety configuration in the safety module.

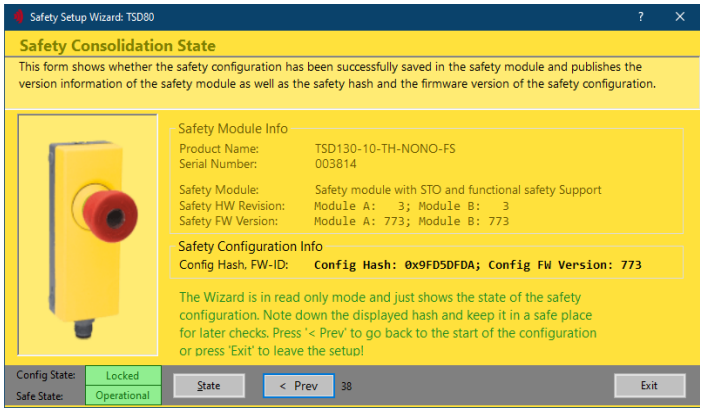


Figure 53: 'Safety Consolidation State' form

UI element	Description
Safety Module Info	Information on the connected drive and its safety module (See Table 1)
Safety Configuration Info	*The **SafetyConfigHash*** and the ***firmware version*** *with* which the configuration is authorised are displayed in this area. **Attention** This information must be noted together with the Safety project data and kept in a safe place!
Info Text	This field displays information about the current status as well as information about possible further actions.
Button **< Prev**	The wizard navigates back to the *'Safety Configuration'* form.
Button **Exit**	When pressed, the wizard is terminated without further confirmation.
State Displays **Safe State** and **Config State** *Button* **State**	See Table 2

Table 45: UI elements of the 'Safety Consolidation State' form

6.12 Offline configuration

The offline configuration can be carried out with or without a drive connected and independently of the Config Status of the safety module. Passwords do not have to be set either.

The *'Safety Configuration'* form is shown below as an example in the Config State **Factory.** In this form, one of two configuration types can be selected in **Offline Configuration** mode. These are described below.

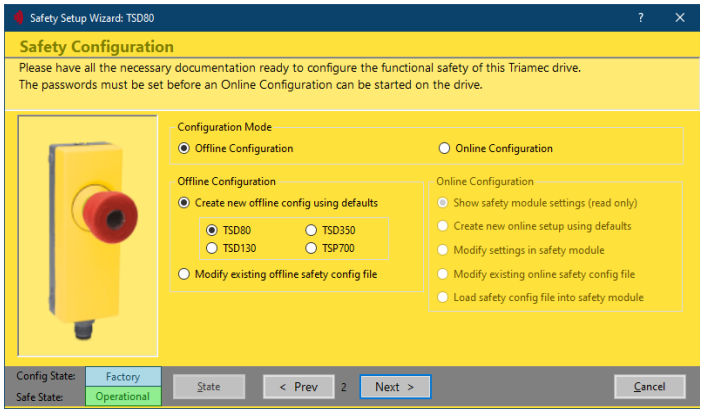


Figure 54: Selecting an offline safety configuration

UI element	Description
RadioButtons in ***Configuration Mode***	These two radio buttons are used to select the configuration mode. • In ***Offline Configuration*** mode, which is also available without a drive connected, it is possible to prepare a safety configuration for a specific drive type, save it in a file and use it later in **Offline Configuration** mode or in **Online Configuration** mode. The possibilities are listed below in the description of the ***Offline Configuration*** *radio button.* • ***Online Configuration*** mode (See 6.5 State Unlocked or 6.4 State Factory)
RadioButtons in ***Offline Configuration***	The two radio buttons are used to select the type of offline configuration. • **Create new offline setup using defaults**: With this selection, the user can create a new configuration with default values. When the **Next >** button is pressed, a new safety configuration with default parameters of the wizard is prepared for the selected drive type and the first form of the configuration is navigated to. The further steps are described in chapter 6.6 Assemble configuration. • **Modify existing offline safety config file**: With this selection, the user can use and modify a prepared *offline* configuration. After pressing the **Next >** button, a new safety configuration is prepared by loading the parameters from a prepared configuration file. The *Select safety configuration file* dialogue prompts the user to select the configuration file with the extension **.TAMscfg.*

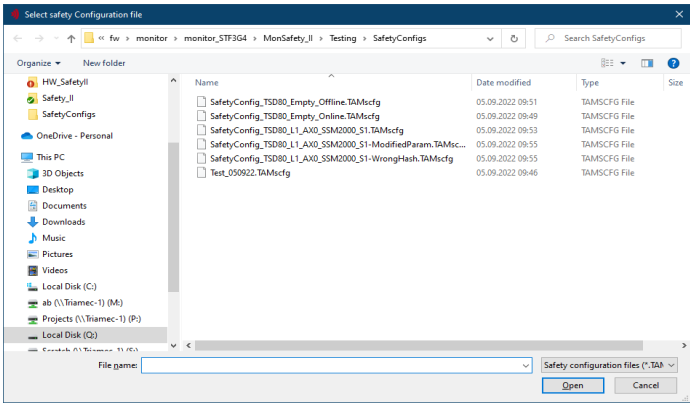
	 *Figure 55: Selecting a safety configuration* Then the first form of the configuration is navigated to. The further steps are described in chapter 6.6 Assemble configuration.
Button **< Prev**	The wizard navigates back to the *'Safety Module Information'* form.
Button **Next >**	The wizard navigates forward depending on the type of *online configuration* selected, e.g. to the *'Safety Configuration Overview'* form.
State Displays **Safe State** and **Config State** *Buttons* **State** and **Cancel**	See Table 2

Table 46: UI elements of the 'Safety Configuration' form in Config State Factory

7 Setup aids in TAM System Explorer

The *TAM System Explorer* supports the setup of Functional Safety in the individual drives. The following functions can be performed with the *TAM System Explorer*:

- Start the Safety Setup Wizard for the individual drives in the system. (see 6.2 Start the Safety Config Wizard)
- Display safety-relevant signals of the safety processors in the register tree.
- Record safety-relevant signals using the scope.

7.1 Show safety signals

Individual, important signals of the Safety Module (Safety Processors A and B) are integrated in the register tree of the ***TAM System Explorer*** and can be displayed in the register tree for each drive that supports Functional Safety. The signals can be found in the register of the selected drive under */General/Signals/FunctionalSafetyA* and */General/Signals/FunctionalSafetyB*.

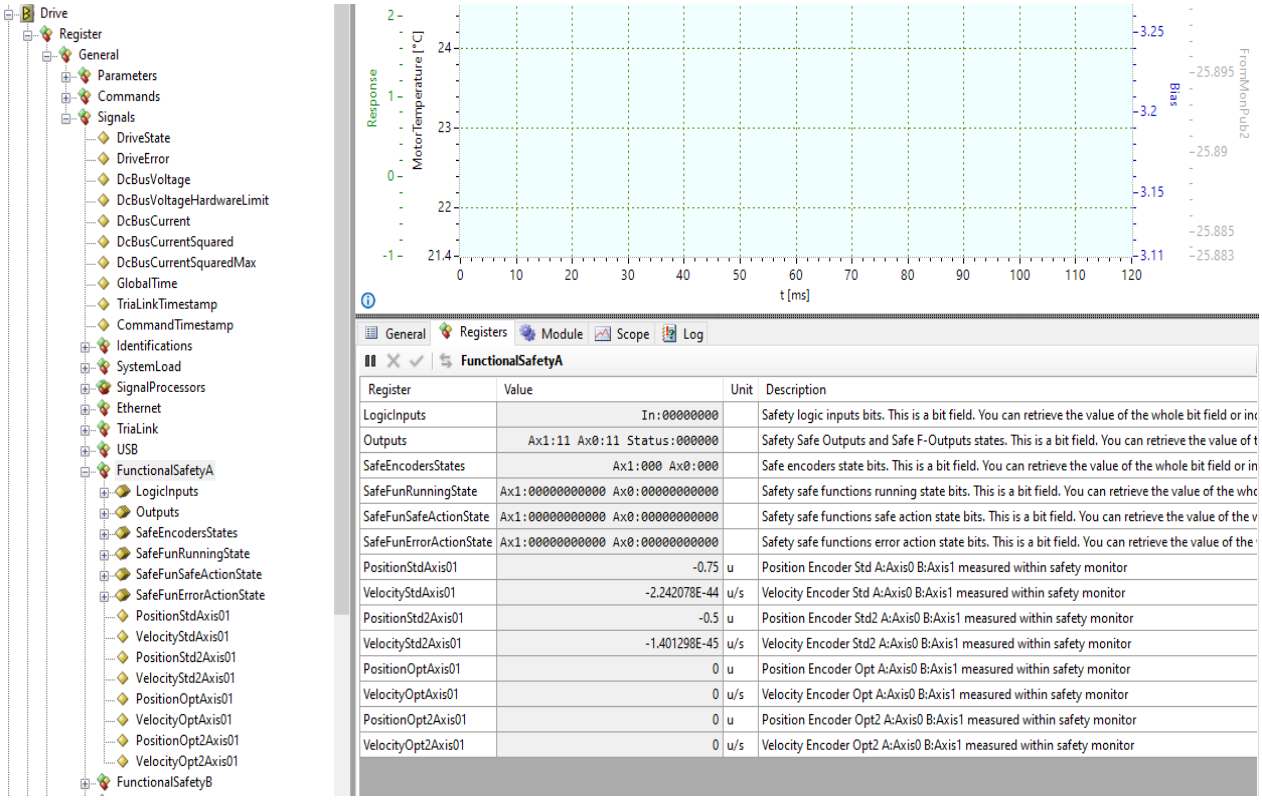


Figure 56: Signals of the safety module in the register tree

The following signals are updated every 1 ms and can be displayed for both safety processors and recorded in the scope. The first signals can be 'expanded' further in the tree to see the status of the individual bits.

Signal	Unit	Description
LogicInputs-States	-	State of the 8 logical inputs (LogIn1..LogIn8)
Outputs	-	State of the 6 Safe F-Outputs and the 2*2 safe outputs
SafeFunRunningState	-	Operating state of all safety functions of both axes

Signal	Unit	Description
		• False: Safety function is unused or in use and waiting for activation • True: Safety function is used and is active
SafeFunSafeActionState	-	*SafeAction* activation state of all safety functions of both axes • False: Safety function is unused or being used and waiting for *SafeAction* to be activated. • True: Safety function is used, is active and has activated its *SafeAction*.
SafeFunErrorActionState	-	*ErrorAction* activation state of all safety functions of both axes. • False: Safety function is unused or is being used and is waiting for its *ErrorAction* to be activated. • True: Safety function is used, is active and has activated its *ErrorAction*.
PositionStdAxis0/1	u	Position of the standard encoder of axis 0 or axis 1 determined by the safety processor [SI unit of the position of the drive axis]
VelocityStdAxis0/1	u/s	Speed of the standard encoder of axis 0 or axis 1 determined by the safety processor [SI unit of the speed of the drive axis]
PositionStd2Axis0/1	u	Position of the standard2 encoder of axis 0 or axis 1 determined by the safety processor [SI unit of the position of the drive axis]
VelocityStd2Axis0/1	u/s	Speed of the standard2 encoder of axis 0 or axis 1 determined by the safety processor [SI unit of the speed of the drive axis]
PositionOptAxis0/1	u	Position of the option encoder of axis 0 or axis 1 determined by the safety processor [SI unit of the position of the drive axis]
VelocityOptAxis0/1	u/s	Speed of the option encoder of axis 0 or axis 1 determined by the safety processor [SI unit of the speed of the drive axis]
PositionOpt2Axis0/1	u	Position of the option2 encoder of axis 0 or axis 1 determined by the safety processor [SI unit of the position of the drive axis]
VelocityOpt2Axis0/1	u/s	Speed of the option2 encoder of axis 0 or axis 1 determined by the safety processor [SI unit of the speed of the drive axis]

Table 47: Signals from the safety processors

7.2 Recording safety signals

Signals of the safety module can be recorded with the scope of the *TAM System Explorer*, like other signals of the drive. The signals of the safety module can be found in the register tree of the selected drive under */General/Signals/FunctionalSafetyA* or */General/Signals/FunctionalSafetyB*.

There are plot templates for the most important signals in relation to safety. These can be set up for the desired axis in the plot area using context menu **Scope > Load for 'Drive' Axis x > Safety Analysis**. These templates contain the position, speed and status information of the axis. They also contain status signals of the safety module.

8 Validate safety functions

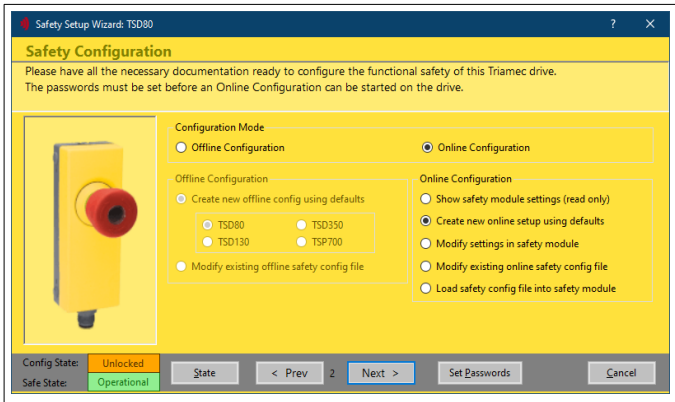
This chapter shows an example of how to configure a safety function with the *Safety Setup Wizard* and then how to check the safety function that has been set up. The *'Safety Status Overview'* form of the *Safety Setup Wizard* as well as the Scope of the *TAM System Explorer* can be used for the check.

Important The test must be carried out on the system on which Safety is set up. For verification, the behaviour must be checked using external measuring equipment. The test options shown here can be used to support the setup.

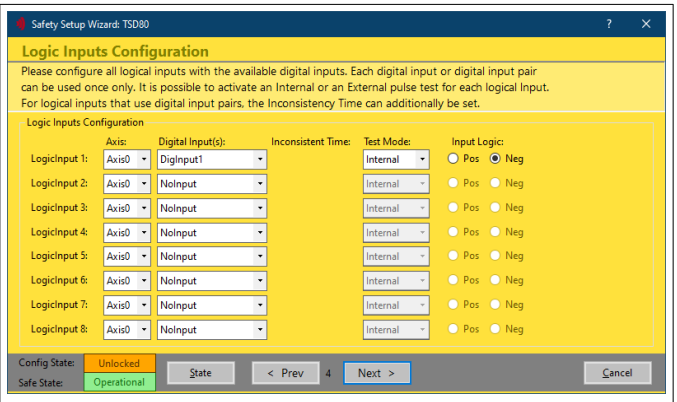
8.1 Configuration

It is assumed that the safety module is in the **Unlocked** state, the passwords are set up correctly. The configuration of the example is done according to chapter 6.5.2 Online configuration with the configuration type **Create new online setup using defaults**.

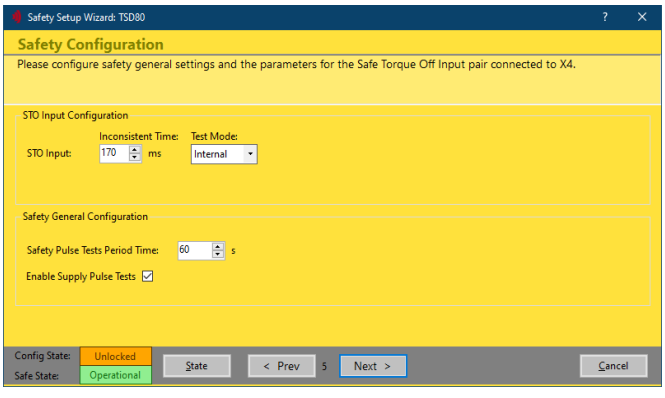
As an example, a safety function *SLS* with *SS2* as *ErrorAction* is set up. The logical input *LogIn1 is* used to activate *SLS*, the Safe *F-Output1* is used for signalling.



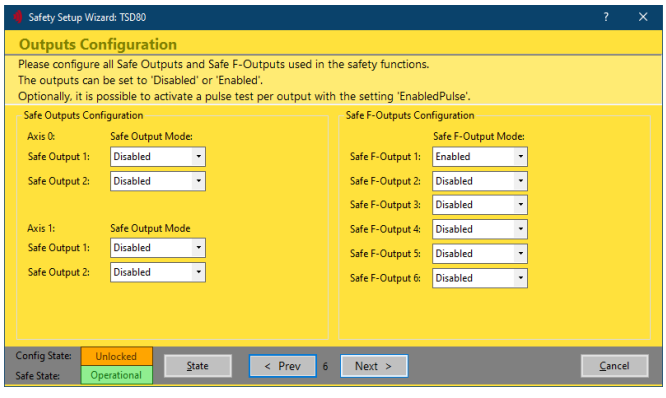
Selection of the **Online Configuration** type:
Create new online setup using defaults.



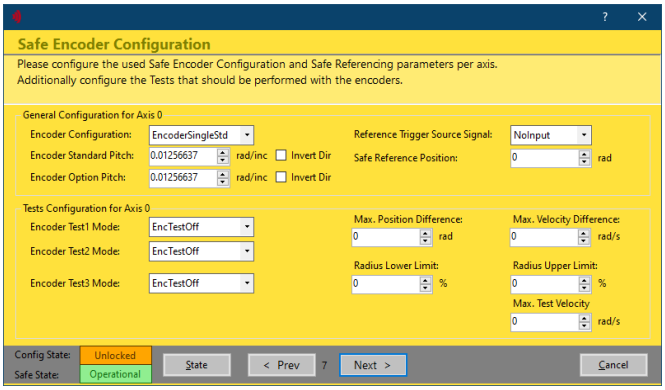
Configure Logic Inputs:
Define **Logic Input 1** on DigInput1



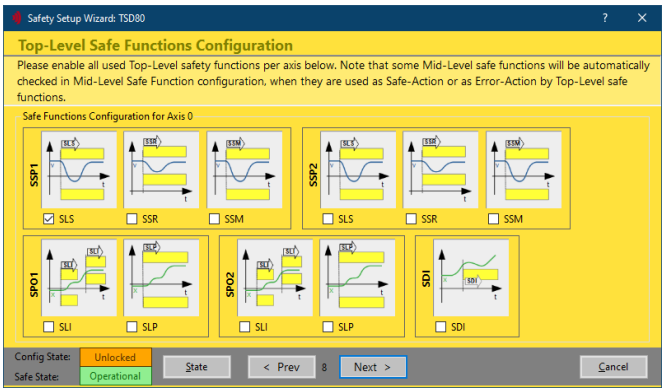
Configure STO Input:
Leave STO with default value



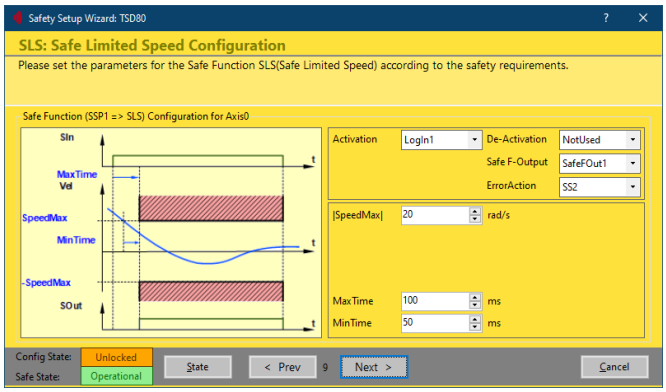
Configure outputs:
Set **Safe F-Output 1** to enabled



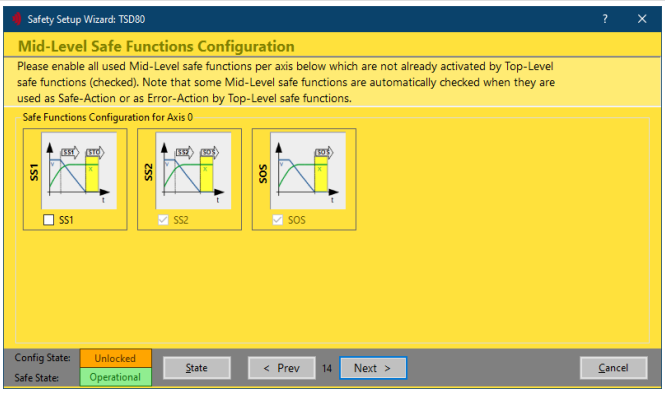
Configure the safe encoder: Enter the pitch and leave the rest of the encoder configuration at the default settings.



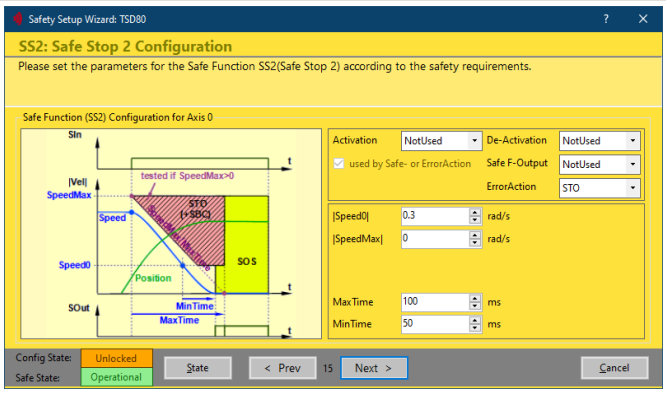
Configure top-level SF:
Select **SLS**



Configure SF *SLS*:
Activation = LogIn1,
Safe F-Output = SafeFOut1,
ErrorAction = SS2,
|SpeedMax| = 20Rad/s),
MaxTime = 100ms and **MinTime** = 50ms



Configure Mid-Level SF:
SS2 and **SOS** are implicitly selected



Configure SF *SS2*:
ErrorAction = STO,
|Speed0| = 0.3Rad/s,
MaxTime = 100ms and **MinTime** = 50ms

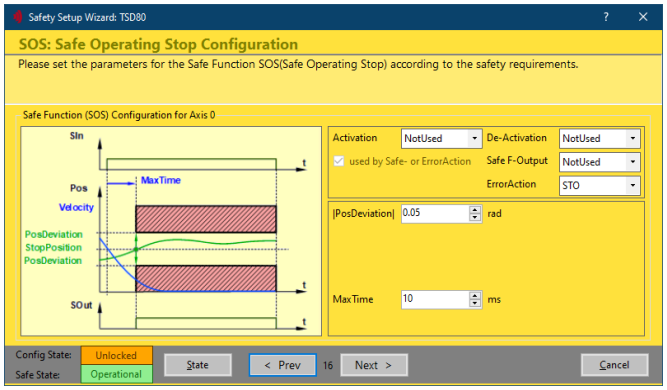
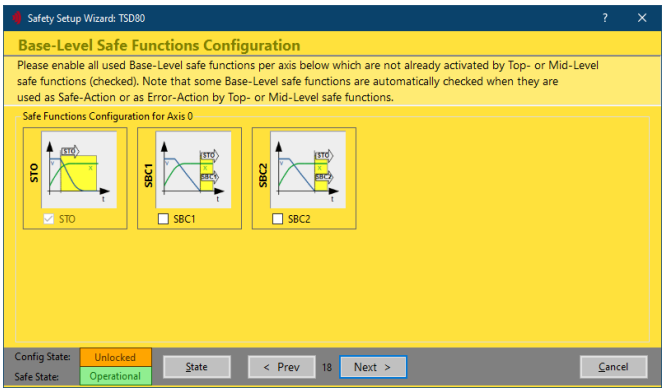
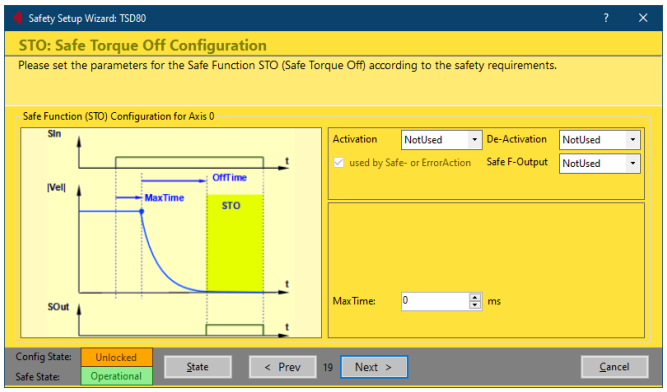
	 Configure SF *SOS*: **ErrorAction** = STO, **|PosDeviation|** = 50 inc (0.05 Rad) **MaxTime** = 0ms
 Configure base level SF: **STO** is implicitly selected	 Configure SF *STO*: Leave STO configuration at default

Table 48: example configuration SLS with SS2

8.2 Testing

In the following step, the check is carried out with the help of the *TAM System Explorer* and the *'Safety Status Overview'* form. The consolidation is not carried out at this point so that you can navigate back and change parameters if necessary. The *'Safety Status Overview'* form is activated with the **State** button (See 6.10 Show Status of Safety Module)

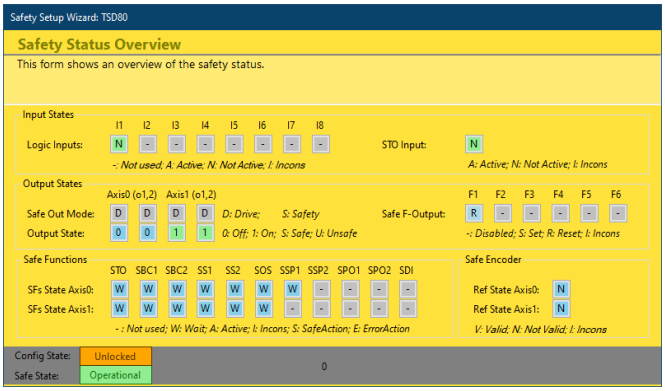
	*Safety Status Overview'* before the SF is activated: - Logic Input **I1** is configured and *Not Active* - STO Input: is *Not Active* - Safe outputs not configured for safety - Safe F-Output **F1** is configured and *reset* - SF **SSP1 (SLS)** and all Base- and Mid-layer SFs are *Wait* - Config State: *Unlocked* - Safe State: *Operational*

Table 49: Status before SF is activated

In the *TAM System Explorer*, the scope is first set up for the current axis 0 using the context menu **Scope > Load for 'Drive' Axis 0 > Safety Analysis**. (see 7.2 Recording safety signals)

The scope is started with the TAM System Explorer, then at approx. 1500ms the safety function SLS is activated with the configured digital input and at 2500ms a move with a speed lower than **speedMax** is started.
The SLS monitoring is active from approx. 1500ms and shows this with the rising edge of signal *LogicInputs.* The signal *Status1* signal shows that the *speed* is OK and that the move is executed without stopping. Further signals of the safety module and the drive are available in the scope and can be used for further analyses.

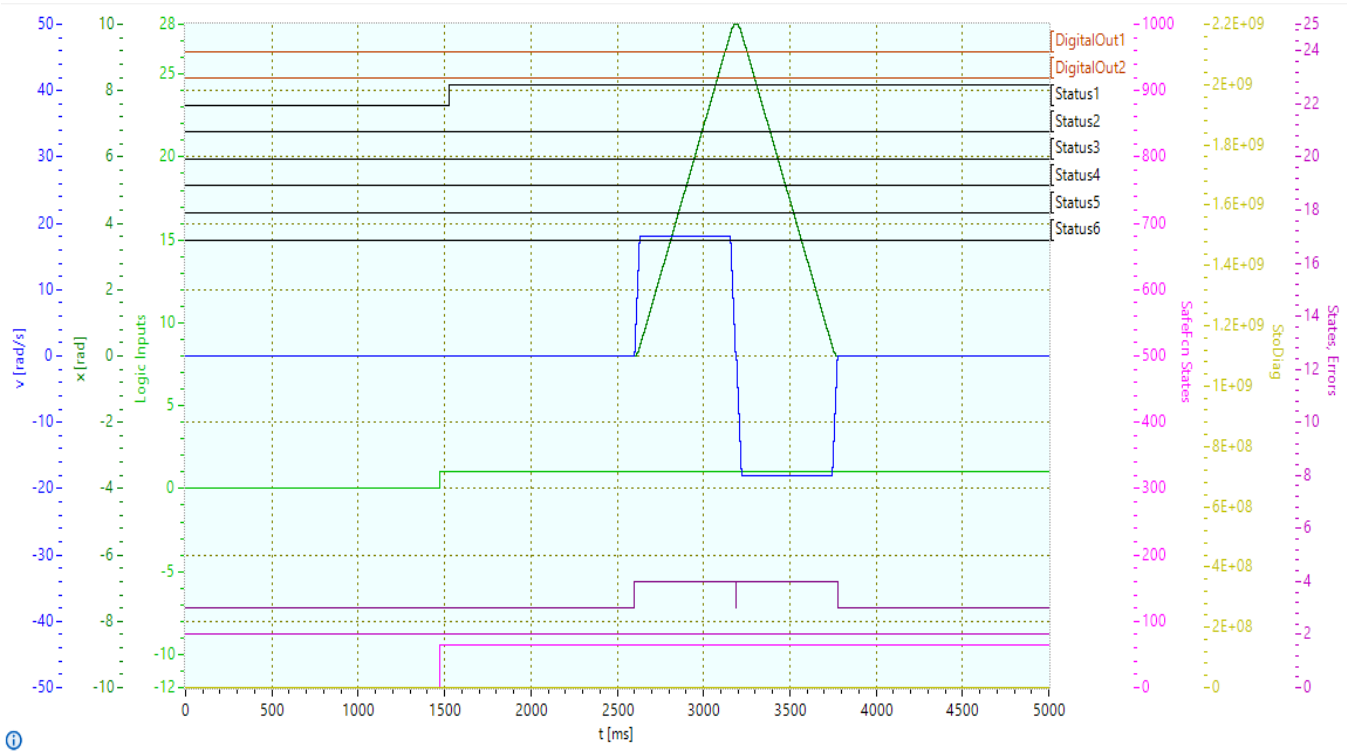


Figure 57: Scope during move with a speed lower than SpeedMax

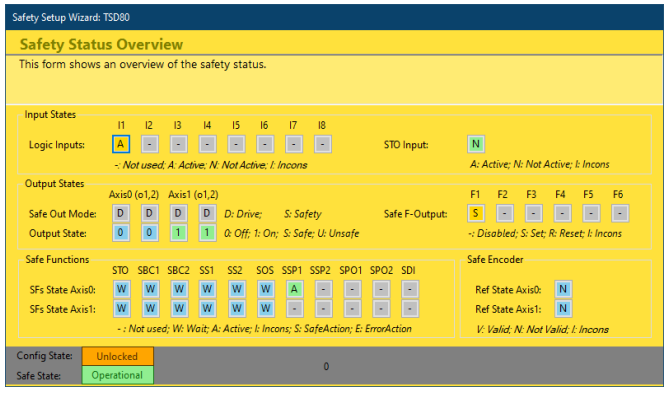
	*Safety Status Overview'* after the SF is activated and the axis is moving slower than **speedMax**: - Logic Input **I1** is *Active* - STO is *Not Active* - Safe outputs not configured for safety - Safe F-Output **F1** is *Set* -> SLS Speed OK - SF **SSP1 (SLS)** is *active* -> SF SLS is running - All Base- and Mid-layer SFs are *Wait* - Config State: *Unlocked* - Safe State: *Operational*

Table 50: Status after SF is activated, SLS active and watching for error condition

After the last recording, SLS is deactivated again before the next test takes place.

With the TAM System Explorer, the scope is started again, then at approx. 1600ms the SLS safety function is activated with the configured digital input and at 2800ms a move with a speed greater than **speedMax** is started.

The SLS monitoring is active from 1600ms and shows this again with the signal *LogicInputs*. The move is stopped when the *speed* is exceeded by means of SS2. The axis is still controlled after the SS2 stop (SOS).

The Status1 signal is set after activation of SLS and shows that the *speed* is still OK. After exceeding the speed limit and the stop, status1 is reset.
Other signals of the safety module and the drive are available in the scope and can be used for further analyses.

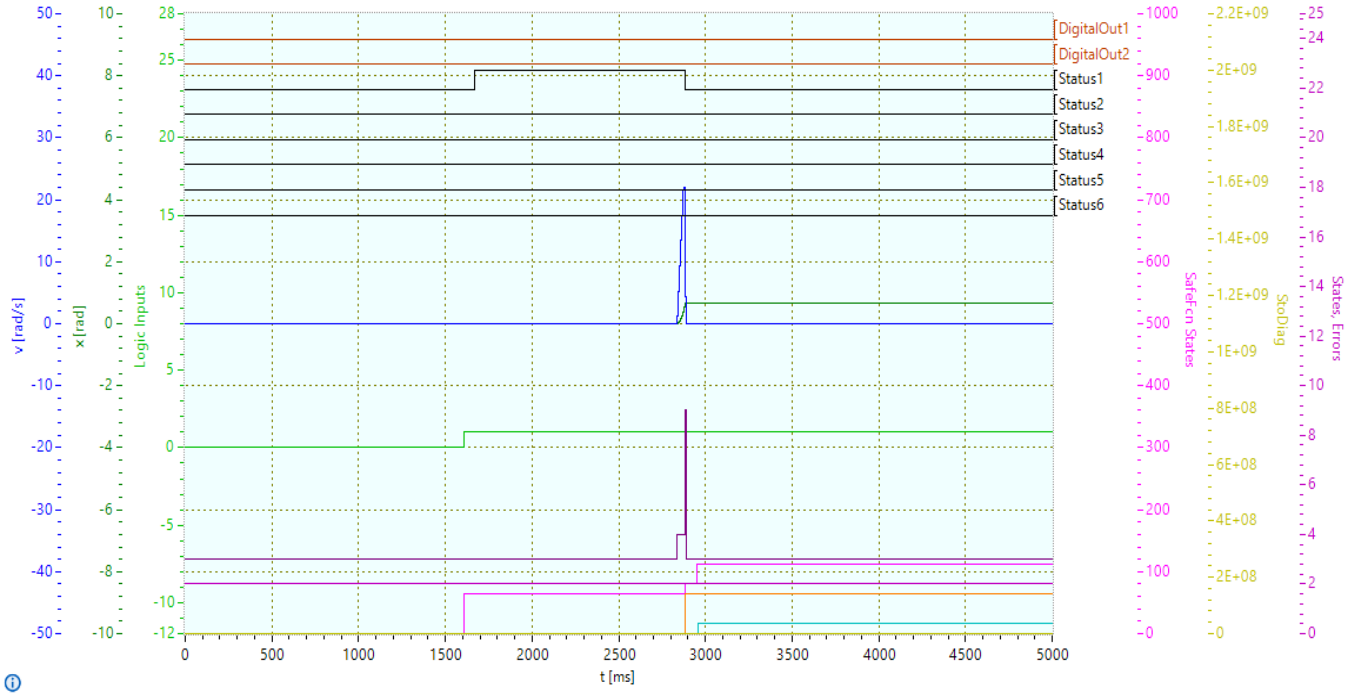
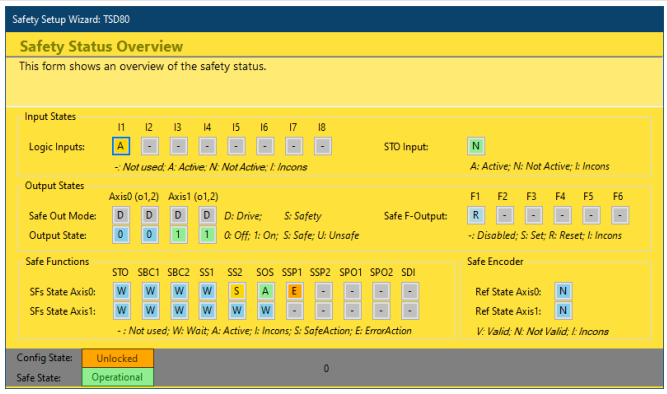


*Figure 58: Scope during move with speed greater than **SpeedMax***



Safety Status Overview' after the SF is activated and the axis has moved faster than **speedMax**:
- Logic Input **I1** is *Active*
- STO is *Not Active*
- Safe outputs not configured for safety
- Safe F-Output **F1** is ***Reset*** -> SLS Speed not OK
- SF **SSP1 (SLS)** is active and has activated **ErrorAction *SS2***
- SF **SS2** is Active and has activated **SaveAction SOS**
- SF **SOS** is **Active**
- The remaining Base and Mid-layer SFs are *Wait*

- Config State: *Unlocked*
- Safe State: *Operational*

Table 51: Status after SF is activated and SLS has activated the SaveAction SOS

8.3 Validation

The possibilities shown above with the *TAM System Explorer* and the *'Safety Status Overview'* form can be used to adjust the settings of the safety application according to the requirements. After all settings have been checked and found to be correct, the consolidation step (6.6.7 Consolidation) must be carried out with the wizard. After successful consolidation, the safety parameters are persistently saved in the safety module.

Attention The check of the safety settings must be verified again on the system after the consolidation step.

References

[1] “Triamec TwinCAT”, SWTC_TwinCAT-UserGuide_EP027.pdf, Triamec Motion AG, 2021.

[2] “Servo Drive Setup Guide, TSD and TSP Series”, ServoDrive-SetupGuide_EP030.pdf, Triamec Motion AG, 2025.

[3] “Hardware Manual, TSD80/TSD130 Rev 6”, HWTSD80-TSD130_6_HardwareManual_EP001.pdf, Triamec Motion AG, 2025.

[4] “Hardware Manual, TSD350 Rev 3”, HWTSD350_3_HardwareManual_EP001.pdf, Triamec Motion AG, 2025.

[5] “Hardware Manual, TSP700 Rev4”, HWTSP700_4_HardwareManual_EP001.pdf, Triamec Motion AG, 2025.

Revision History

Version	Date	Editor	Comment
001	2022-09-30	ab	Initial edit
002	2023-10-24	ab	Added configuration of supply pulses to STO configuration form. Renamed Monitor with SafetyProcessor
003	2025-07-17	ab	Complete rework after conversion to SI units and release of TSD80/130 Rev6
	2025-09-30	ab	Revision after review by FM

Approval / Signature

We hereby approve this document (Version 003):

Zug, 29.09.2025	Filippo Marinho	(Reviewer)
Zug, 24.07.2025	Arnold Bischof	(Owner)

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