Application to support the acceptance test of the Safety Integrated Functions of SINAMICS G120

SINAMICS G120

Safety Integrated – acceptance test support

Application description • December 2015

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SINAMICS
Safety Integrated
Acceptance test support

SINAMICS G120

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1 Task

Introduction

The application supports you when generating the acceptance test documentation of the Safety Integrated Extended Functions of the G120 according to Appendix A2 and A3, Safety Function Module G120 04/2015.

The application provides support regarding the following points:

- Documentation of all safety-relevant parameters
- Documentation of the checksums
- Conducting and documenting/logging test cases

As an additional feature, screen forms guide you through the individual steps of the acceptance test according to Appendix A2 FHS G120.

Overview of the automation task

This application deals with the following key points:

- Creating understandable documentation.
- Documenting the safety parameters and checksums according to Appendix A3 of the Safety Function Manual G120 04/2015.
- Accompanying the acceptance test and documenting/logging the results according to Appendix A2 FHS G120.

Description of the automation task

This application is intended for commissioning engineers and service personnel. It is assumed that the reader is knowledgeable regarding configuring/engineering SINAMICS G120 drives, especially Safety Integrated functions.

This application addresses machines that are equipped with SINAMICS G120 in which Safety Integrated functions are used (Basic and/or Extended).

2 Solution

2.1 Overview of the overall solution

Schematic

The application consists of a script that is executed in STARTER/SCOUT.
The script supports you when documenting and performing the acceptance test –
and saves the results in an Excel table, which represents the acceptance report.

Structure

This application cannot run on its own. It must be integrated into an existing project
(imported).

Differentiation

The following points must be observed in this application:

The application is not able to validate the compliance with the applicable
regulations and standards. This remains the task of the machine manufacturer
(OEM).

Operating personnel must carefully monitor the acceptance test, the application is
not able to automatically identify every malfunction of the machine. However, the
application informs the operator as to which points he needs to pay attention to.

This documentation does not contain any information on how to commission drive
systems. This documentation also does not address commissioning the Safety
Integrated functions. In these cases, the manuals of the particular products must be
referred to.

Note	The application provides support for the acceptance test of Safety Integrated Functions of SINAMICS. These are only part of the safety functions of the machine. All other safety-relevant functions or components (F-PLC, sensors, additional actuators) should be checked separately.

Knowledge required

It is assumed that readers have basic knowledge about the safety functions of the
SINAMICS G120. Further, the user must be knowledgeable about applying the
relevant standards relating to machine safety.

2.2 Hardware and software components used

The application was created and tested with the following components:

Hardware components

Table 2-1

Component	Qty.	Order number	Note
G120 demonstration case	1		
CU250S-2 PN	1	6SL3246-0BA22-1FA0	
CU240E-2 DP-F	1	6SL3244-0BB13-1PA1	
CU250D-2 PN-F	1	6SL3546-0FB21-1FA0	
G120C DP	1	6SL3210-1KE21-7UP1	
1FT6 motor	1	1FT6062-1AF71-3AH1	To test the SBC function

Standard software components

Table 2-2

Component
Starter V4.3.1 – V4.4.1
SINAMICS firmware V4.3.2, V4.4, V4.5, V4.6, V4.7 and V4.7SP3
Microsoft Excel 2003 and 2010
Internet Explorer 6, 10 and 11

Sample files and projects

The list below contains all the files and projects used in this example.

Table 2-3

Component	Note
SI_AcceptanceTest_G120_V11.zip	This zipped file contains the script in the form of an XML file. This can then be imported into an existing project. In addition, the following Excel file is included in the zip file.
SI_AcceptanceTest_G120_V11.xls	The Excel table that documents the acceptance test.
"Trace templates" folder	Here you can find trace templates, which are used to test the safety functions.
SI_AcceptanceTest_G120_V11.pdf	This document.

3 Functional mechanisms of this application

An Excel table is provided with this application. In addition to the individual acceptance tests of the safety functions, this table includes general data on the machine, the safety parameters and the checksums.
In some instances, the application asks for the necessary data and this is automatically entered into the Excel document. Other parts (e.g. the overview diagram of the machine, traces recorded during the tests, etc.) must be subsequently entered manually into the Excel table.

Note	Users cannot make any entries as long as the Excel table of the application is open and being processed/edited. You must first close the application and then open the acceptance report (Excel file). You can now make the appropriate changes. The Microsoft Excel and Internet Explorer software programs are required for the correct functioning of this application.

The Excel table represents the acceptance report of the safety functions. All of the necessary information is included in the spreadsheets. The following section provides an overview of the individual spreadsheets. These can be selected from a tab at the lower edge. The structure is oriented to the report structure from the G120 Safety Function Manual, Appendix A3.
After the acceptance test has been completed, this report must be printed and signed. We recommend that when the machine is accepted the end user also signs this document. The document must then be archived by the machine manufacturer (OEM). We also recommend that the Excel file is also saved. The report can be (but does not have to be) handed over to the end customer.

Note	Because the active acceptance-test application does not permit access to other functions (e.g. trace) of the STARTER/SCOUT, the engineering system must be opened a second time. The trace recordings must be produced there. The application provides the user with information as to which variables should be recorded and how the trigger condition should be configured. The application is oriented to the tables in Appendix A2 of the G120 FHS. Information is provided there as to how the traces should be evaluated. The application also provides support in this area.

3.1 The Excel file - the acceptance report

The Excel file "SI_AcceptanceTest_G120_V11.xls" is included in the "SI_AcceptanceTest_G120_V11.zip" file. This can be used, unchanged as report file. You can, however, give this file a different name and move it to any directory. In order to always have the original file available for multiple use, it is recommended to use a copy of the file for logging rather than the original file. It is not permissible to use an Excel file that you created yourself.

3.1.1 "Overview" spreadsheet

This spreadsheet contains an overview of the safety functions used on the individual axes and their test status.

Fig. 3-1 - "Overview" spreadsheet

- Successfully tested functions are designated with OK and fields with a green background.
- Safety functions with yellow background are either not yet tested or, in the case of SLS and SDI, are not fully tested.
- An error occurred during the test for functions designated with "Fault" and a red background.

This means that you have a compact overview of the status of the acceptance test. In this example, a drive is used where the STO Basic Function is used via PROFIsafe, as well as the SLS and SDI Extended Functions. F-DI0 and F-DI1 are transferred via PROFIsafe.
The table below shows the parameterized SLS levels with their stop responses.
The same is true for the SDI directions. The "Behavior during pulse suppression" column shows the behavior of the SDI safety function when the pulses are suppressed.
The response when the pulses are suppressed can also be displayed for the SSM safety function.
In the example, the first two SLS levels are parameterized with STOP A or STOP B. For SDI, the positive direction with STOP A and active monitoring for pulse suppression are parameterized.

3.1.2 "System description" spreadsheet

This spreadsheet contains general machine data.

Fig. 3-2 - "System overview" Part 1 spreadsheet

Acceptance report

Plant description - Documentation part 1

Table: Machine description and overview diagram

Designation	Machine
Type	ABC123
Serial number	abc-123-cba
Manufacturer	SIEMENS
End customer	Customer
Electrical drives	2
Other drives	2

Overview diagram of machine

The script queries the system data, and automatically enters these into the report (Excel file). It goes without saying that you can subsequently insert an overview diagram of the machine.
Information about the firmware versions used and the safety cycles is saved in the second part. Here, the application reads out the relevant data and enters this into the report.

Fig. 3-3 - "System overview" Part 2 spreadsheet

Table: Values of relevant parameters

Versions of the firmware			
	Name		
Basic Functions	Control Unit firmware version	r18 =	4503002
	SI version drive-integrated safety function	r9770 =	4503000
Extended Functions	Control Unit firmware version	r18 =	4503002
	SI Motion version safety motion monitoring	r9590 =	4502400
	SI version drive-integrated safety function	r9770 =	4503000

Table: Monitoring clock cycle

Monitoring clock cycles of Safety Integrated			
	Name		
Basic Functions & Extended Functions	SI monitoring clock cycle	r9780 =	2 ms

3.1.3 "Description of functions" spreadsheet

In addition, the user must fill out what is known as the function description. The application cannot do this as this is dependent on the specific machine.
This spreadsheet corresponds to Table A-3 from Appendix 2 of the FHS G120 04/2015.

Fig. 3-4 - "Description of functions" spreadsheet

Description of safety functions - Documentation Part 2

Introduction

This description of a system is for illustration purposes only. In each case,
the actual settings for the system concerned will need to be modified as required.

Function table

Table: Example table: Active monitoring functions depending on the operating mode
and safety equipment

Operating mode	Safety equipment	Drive	Selected safety function	Checked
Example:				
Production	Protective door closed	Conveyor belt		
	Protective door open	Conveyor belt	SS1 (braking in 2 seconds)	Yes
	Emergency Stop button active	Conveyor belt	STO	Yes
Setting up	Protective door closed	Conveyor belt		
	Protective door open	Conveyor belt	SLS limit 1 (300 rpm)	No
	Emergency Stop button active	Conveyor belt	STO	No
...	...	...	...	...

3.1.4 "Drive data" spreadsheet

All of the drive safety parameters are entered into this spreadsheet. The application reads the values from the project and inserts them into the report.
Here, a distinction is made between Basic and Extended functions, this is the reason that the number of safety parameters vary. When using the CU250S-2 Control Unit or the SINAMICS G120D, the safety parameters for the fail-safe digital output (F-DO) are also documented.
If a parameter does not exist (e.g. when using an older FW Version), the corresponding field has a gray background.
A section of the logged data is shown in the following diagram.

Fig. 3-5 - "Drive data" spreadsheet

Drive-specific data

Basic Functions

Name	Parameternumber	Value
SI enable, functions integrated in the drive	p9601	D Hex
SI enable safe brake control	p9602	
SI PROFIsafe address	p9610	C6 Hex
SI F-DI changeover, tolerance time	p9650	2000 ms
SI STO debounce time	p9651	1 ms
SI Safe Stop 1 delay time	p9652	
SI forced dormant error detection timer	p9659	8 h

Extended Functions

Name	Parameternumber	Value
SI motion, enable safety-related functions	p9501	20001 Hex
SI Motion function specification	p9506	1
SI Motion function configuration	p9507	3 Hex
SI Motion response during pulse suppression	p9509	1FF Hex

3.1 The Excel file - the acceptance report

3.1.5 "Control Unit" spreadsheet

The structure of this spreadsheet depends on which safety functions are being used. The tables Appendix A2 of the FHS G120 04/2015 are inserted.
The application guides you through the individual test steps and logs them. For Extended Safety functions that require a trace, you must subsequently insert the graphic representation of this trace.

Fig. 3-6 - "Control Unit" spreadsheet

Acceptance test for Safe Stop 1 without encoder - Extended Function

Table: Function "Safe Stop 1" (SS1)

No.	Description	Status
1.	Initial state	
	• The inverter is ready (p10 = 0).	OK
	• The inverter signals neither faults nor alarms of the safety functions (r0945[0…7], r2122[0…7]).	OK
	• SS1 is not active (r9722.1 = 0).	OK
	Go online with the STARTER and configure the following trace:	
	• Trigger on variable - bit pattern (r9720.1 = 0)	OK
	• Record the following values: r9714[0], r9714[1], r9722	
	• Display the bits r9722.0 / r9722.1	
	• Select the time interval and pretrigger so you can recognize the selection of SS1 and the transition into the subsequent STO state.	
	• Start the trace.	
2.	Switch on motor	
	• Enter a speed setpoint ≠ 0.	OK
	• Switch on the motor (ON command).	
	• Check that the correct motor is running.	OK
3.	Select SS1	
	• Select SS1 while the motor is switched on.	OK
	• The inverter signals neither faults nor alarms of the safety functions (r0945[0…7], r2122[0…7]).	OK
	Analyze the trace.	
	• SS1 is active after selecting SS1 (r9722.1 = 1).	OK
	• The motor brakes on the OFF3 ramp.	OK
	• STO becomes active if the speed drops below the shutdown speed p9560 (r9722.0 = 1).	OK
	• The recorded curves of r9714[0] and r9714[1] are approximately parallel.	OK
4.	Deselect SS1	
	• Deselect SS1.	OK
	Check the following:	
	• SS1 is not active (r9722.1 = 0).	OK
	• The inverter signals neither faults nor alarms of the safety functions (r0945[0…7], r2122[0…7]).	OK

Trace:

The test cases of the safety functions used are entered into the "Control Unit" spreadsheet. In this example, you can see the acceptance test of the encoderless Safety Extended function SS1.
If the fields have a green background and are marked with OK, then the corresponding test steps have been successfully executed. If the test has still not been executed, then the fields in the right column have a yellow background.

In the case that a fault occurs, then the field for the corresponding test step has a red background and marked with "Fault". This report provides you with information as to what precisely went wrong with the acceptance test.

Note

The STO and SS1 Basic Functions, with control via terminal and/or PROFIsafe, were combined in one test case. If the control type is configured via terminal <u>and</u> PROFIsafe, then both control types must be tested.
If the control type is only via terminal or only via PROFIsafe, then the test steps that are not relevant have a gray background!

3.1 The Excel file - the acceptance report

3.1.6 "Completion" spreadsheet

The checksums as well as the logbook parameters of the safety functions are saved here. As the name suggests, this is also the final page of the acceptance report.

At this point (after the printout), signatures must be added. You must then subsequently enter the data for these persons in the Excel file, the application does not support this input.

The structure of this spreadsheet is oriented to Appendix A3.3 of the FHS G120 04/2015.

Fig. 3-7 - "Completion" spreadsheet

Completion of certificate

SI parameters

	Specified values checked?	
	Yes	**No**
Processor 1		
Processor 2		

Checksums

Basic Functions & Extended Functions			
Drive name	**Drive number**	**SI setpoint checksum SI**	**SI setpoint checksum SI**
		r9799 =	r9899 =

Only Extended Functions			
Drive name	**Drive number**	**SI setpoint checksum SI parameters (processor 1)**	**SI setpoint checksum SI parameters (processor 2)**
		p9729[0] =	p9399[0] =
		p9729[1] =	p9399[1] =
		p9729[2] =	

Safety logbook

Name	Functional	
SI checksum to track functional changes	r9781[0] =	
SI checksum to track hardware-specific changes	r9781[1] =	
SI time stamp for checksum to track functional changes	r9782[0] =	
SI time stamp for checksum to track hardware-specific changes	r9782[1] =	

Data backup

Data	Storage medium			Storage location
	Type	**Designation**	**Date**	
Parameters				
PLC progrmm				
Circuit diagrams				

Countersignatures

Commissioning engineer
This confirms that the tests and checks have been carried out properly.

Date	Name	Company / dept.	Signature

.

3.2 Functionality of the application – the script

3.2.1 Program details on the script

In addition to the Excel file, which represents the report, the application also includes a script. This guides the user through all of the necessary steps of the acceptance test. When using the STO, SS1 and SBC Basic Functions and the STO and SBC Extended Functions, then this script automatically and fully completes the acceptance report. The acceptance report is also automatically filled out when testing the transfer of F-DIs via PROFIsafe. For all other Extended Functions, traces must be recorded.
The trace recordings are included with the application and can be imported into the trace function of STARTER.
These must then be subsequently inserted into the Excel file.
If you test one of the following Extended Functions: SS1, SLS, SSM or SDI, then it is mandatory that the traces are recorded.
The acceptance test does not have to be performed in one go. It can be interrupted and continued at a later time. If, after a first test, safety-relevant parameter changes are still to be made, then the logging of the associated data as well as testing the modified safety function must be carried out again.

3.2.2 Delivery format

The script is provided as zip file (SI_AcceptanceTest_G120_V11.zip). It is a zipped version of the exported script, the report file in the form of an Excel table and a documentation file. The zip file is not an executable project.
All of the necessary steps required to insert the script in your existing project are described in the following chapter.
Before you can work with the script, the machine or the test setup must have been fully commissioned; this also applies to the safety functions. Further, the connection to the process signals must exist so that the drives can be traversed.
For individual tests, it can be necessary to make special settings on the drive side in order to provoke a limit violation (e.g. when testing SLS).

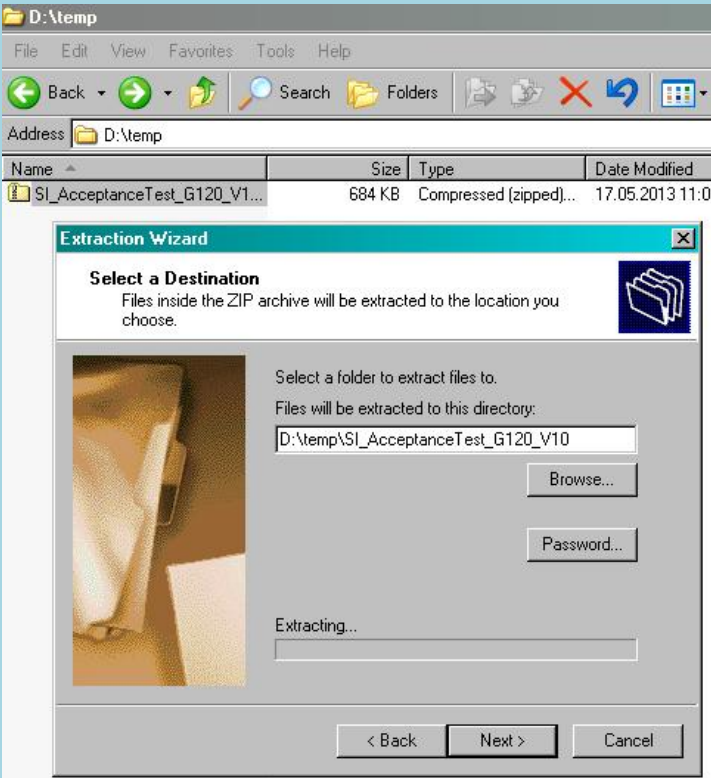| Note	When using the SLS and SDI Safety Integrated Extended Functions, measures must be taken to provoke a limit violation. For the tests of the just mentioned SLS and SDI functions, the acceptance test mode of the SINAMICS is automatically selected, i.e. the setpoint limit of the drive when selecting SLS / SDI is withdrawn. When the automatic setpoint limiting in SINAMICS is not interconnected, then the control, which specifies the setpoint, must ensure that the SLS or SDI limit is violated.

4 Commissioning the application

4.1 Preparation

The machine or the test setup must have been commissioned so that the drives can be traversed. Further, it is assumed that the safety functions being used can be controlled.
The script supports all safety functions up to Firmware V4.7SP3, and their associated control versions. All other G120-2 devices, with the permissible firmware versions for this hardware, can be tested.

4.2 Importing the script

Table 4-1 - Importing the script

No.	Action	Remark
1.	The zip file must first be extracted. A program such as WinZip can be used to do this. Extract the files to a directory of your choice. The "D:\temp" directory was used in this example.	
2.	In the next step, a script folder must be created in your existing encoder. To do this, please open STARTER or SCOUT and the project that you have created. Please remain in the offline mode. The folder must be inserted directly below the drive unit. If the script is inserted at the incorrect position (e.g. under the Control Unit), then the application will not be able to be executed.	
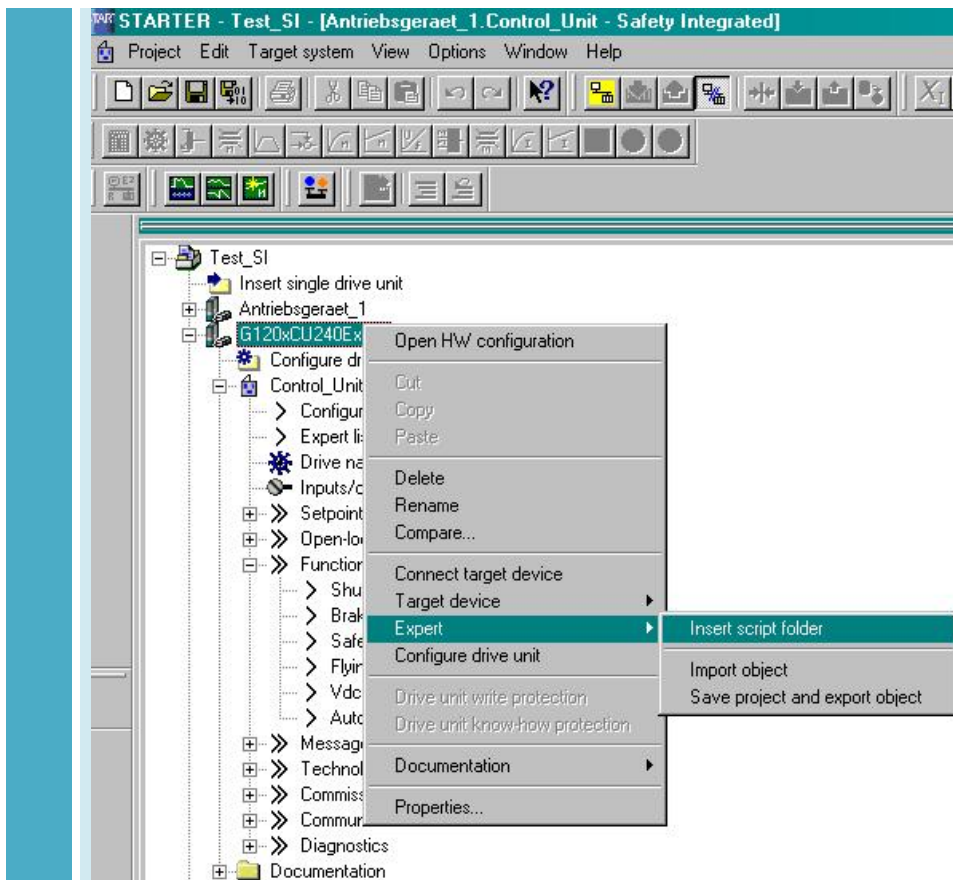
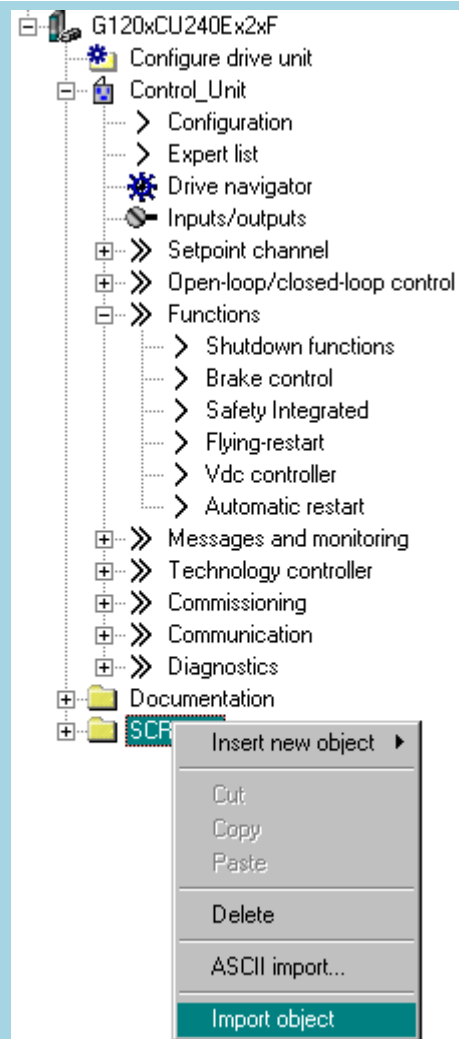To create the folder, right-click the drive unit. Under "Experts", select the "Insert script folder" entry. The folder is now created.

4.2 Importing the script

3.	Then right-click this folder and select the "Import object" entry.	

4.	
	A window opens in which the "SI_AcceptanceTest_V20.xml" file to be imported can be selected. Use "Browse" to select the directory in which the "SI_AcceptanceTest_G120_V11.zip" was extracted previously.
5.	Now select the "SI_AcceptanceTest_G120_V11.xml" xml file and click the "Open" button. The file is now selected and is imported with "OK".

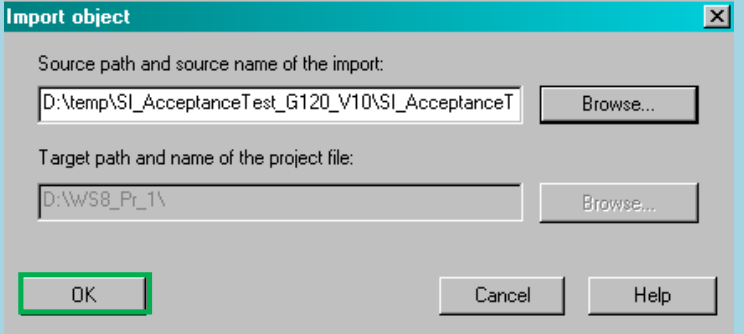|		
6.	If the procedure was completed successfully, the acceptance-test script is now available in the previously inserted script folder. The script is know-how protected and cannot be opened by the user.	Test_SI 　Insert single drive unit 　G120xCU240Ex2xF 　　Configure drive unit 　　Control_Unit 　　　Configuration 　　　Expert list 　　　Drive navigator 　　　Inputs/outputs 　　　Setpoint channel 　　　Open-loop/closed-loop control 　　　Functions 　　　Messages and monitoring 　　　Technology controller 　　　Commissioning 　　　Communication 　　　Diagnostics 　　Documentation 　　SCRIPTS 　　　Insert script 　　　SI_AcceptanceTest_G120_V10

5 Using the application

5.1 Starting the application

Before the script is started it must be ensured that a functioning connection has been established between STARTER or SCOUT and the SINAMICS. It is not assumed that an online connection has already been established when the script is started.
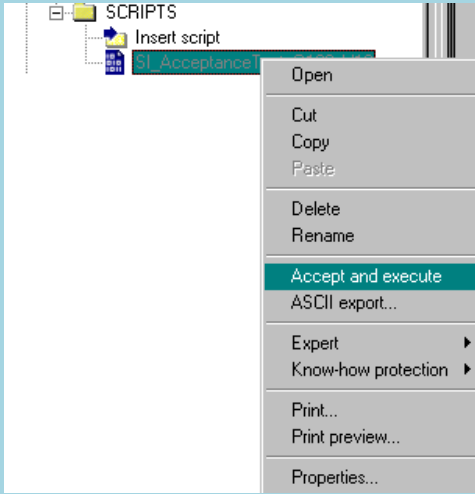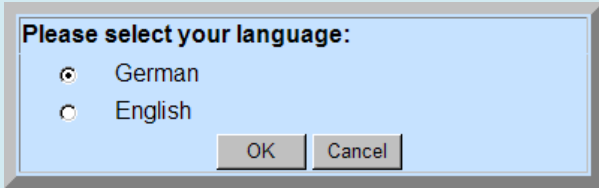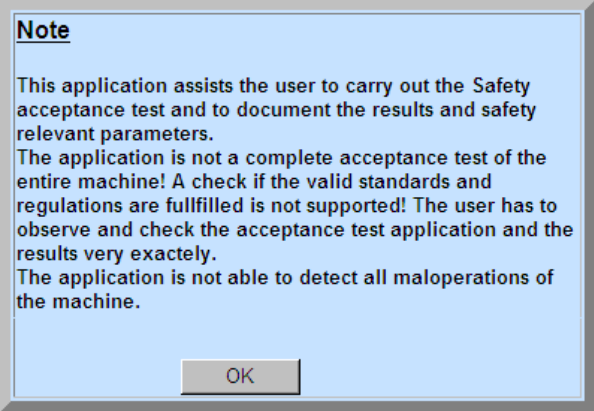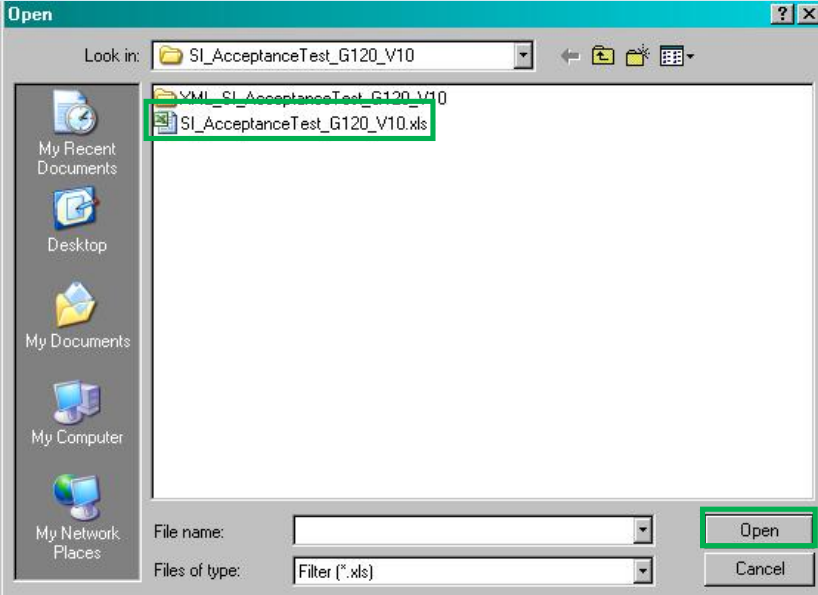
5.1 Starting the application

Table 5-1 - Starting the application

No.	Action	Remark
1.	The script is started by clicking on it with the right mouse button and selecting the menu item "Accept and execute".	SCRIPTS — Insert script — SI_AcceptanceT... Open / Cut / Copy / Paste / Delete / Rename / **Accept and execute** / ASCII export... / Expert ▶ / Know-how protection ▶ / Print... / Print preview... / Properties...
2.	Immediately after the start, a HTML page opens in which the language can be selected. The script supports two languages – German and English.	**Please select your language:** ⦿ German / ○ English / OK / Cancel
3.	**Note** — This application assists the user to carry out the Safety acceptance test and to document the results and safety relevant parameters. The application is not a complete acceptance test of the entire machine! A check if the valid standards and regulations are fullfilled is not supported! The user has to observe and check the acceptance test application and the results very exactly. The application is not able to detect all maloperations of the machine. — OK ——— A window then opens to inform the user that this script is only a support for performing the acceptance test. The operator remains responsible.	

4.
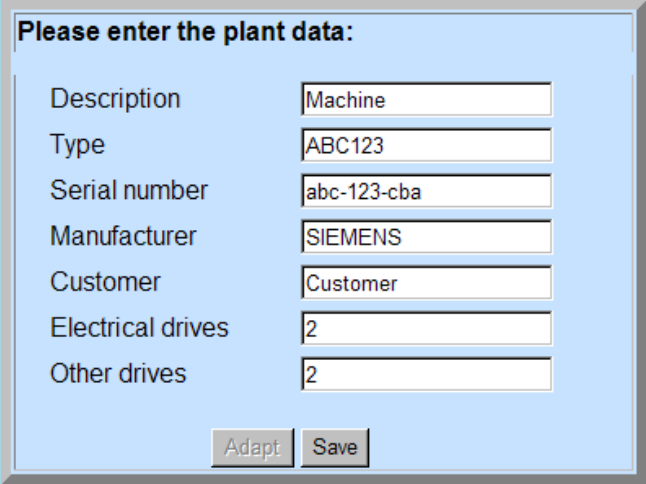
The Excel file used as the report must then be selected.
The script opens a window in which the user selects the Excel file.

This must either be the file supplied or a copy of it.
An Excel table that you created yourself cannot be used. However, the provided file – or a copy of it – can have any name.
An internal check is made as to whether the script version matches the Excel file version. The application can only be executed if this is the case. Otherwise a window opens with an appropriate error message.
If an online connection has not been established, the script establishes it. A message window is opened to give the user time to physically establish a connection. The connection can be established only after clicking "OK".

5.2 Operator inputs

Table 5-2 - Operator inputs

No.	Action	Remark
1.	After the described steps have been performed, the operator is asked to input some data about the machine. **Please enter the plant data:** Description Machine Type ABC123 Serial number abc-123-cba Manufacturer SIEMENS Customer Customer Electrical drives 2 Other drives 2 Adapt Save The input regarding the number of drives is only used for documentation purposes and has no influence on the subsequent test. "Other drives" involve drives that are not electrically driven (e.g. hydraulic axes), which cannot be tested by the application. The inputs mentioned above can be subsequently found in the report (Excel file) in the "System description" spreadsheet. After the acceptance test has been completed, a machine sketch/diagram should be added to these. The inputs are confirmed using the "Save" key; changes can be made at any time by pressing the "Adapt" button.	

The applications now evaluate as to whether safety functions have been configured, and, if yes, how the safety functions are controlled, e.g. via terminal or a PROFIsafe.
When Basic Functions are being used (except for CU250S-2), then the application is in a position to automatically identify the configured functions.
The SS1 Basic Function is available when using a CU250S-2. When it is controlled, STO can also be tested via PROFIsafe. This cannot be identified by the application, therefore it is separately queried in the following window.

Note

You have selected the Safety function SS1 via PROFIsafe.
Do you also want to test the Basic Function STO via PROFIsafe?

| Yes | No |

When controlled via PROFIsafe, the application is not in a position to identify the safety functions used. Therefore, the following list is opened in which the user can select the configured safety functions.

2.

Please select the projected Safety functions:

Extended Safety
- ☐ STO Safe Torque Off
- ☐ SS1 Safe Stop 1
- ☐ SLS Safely-limited Speed
    - ☐ SLS stage 1
    - ☐ SLS stage 2
    - ☐ SLS stage 3
    - ☐ SLS stage 4
- ☐ SDI Safe Direction
    - ☐ SDI positive
    - ☐ SDI negative
- ☐ SSM Safe Speed Monitoring

Save

Here, you must select all used safety functions that should be tested.
When selecting SLS and SDI, the parameterized levels or directions must be selected below.
The input is completed with "Safe" and the window closed.

5.2 Operator inputs

3.	After the functions to be tested have been selected, the following overview window opens.
4.	The overview window is structured as follows: • System data • Test of the safety function • Test progress/status • Final report
5.	The system data were already described in this document, and will not be discussed any further here.
6.	The following window provides an overview of the safety functions selected for the test and the progress of their test. Functions that have been selected but have still not been tested or completely tested, have a yellow background. The field turns green once the test has been successfully completed. If an error occurred during the test, then this is marked red. This screen form corresponds to the "Overview" spreadsheet.
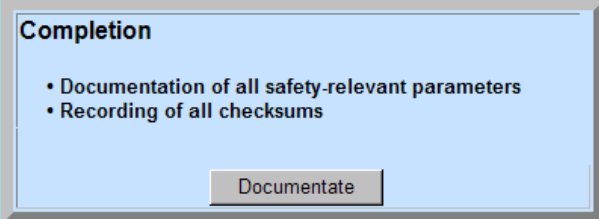
7.	**Completion** • Documentation of all safety-relevant parameters • Recording of all checksums Documentate The documentation also includes the safety parameters, the safety clock cycles, the firmware versions and the checksums. This data is subsequently contained in the report in the spreadsheets "System description", "Drive data" and "Completion". The documentation must be selected once, as otherwise the report is not complete. We recommend that this is done at the end of the test. If parameters change in the course of the test, then these are not lost.

8.	To start a safety function test, initially, the safety function must be selected.
	The test is started with "Start test".
	
	The actual test status can be saved at any time using the "Save" button. This should be realized after each tested function.
	
	Test of the Safety functions:
	Basic Safety
	  ◉ STO Safe Torque Off
	    ◉ via terminal
	Extended Safety
	  ○ SS1 Safe Stop 1
	  ○ SLS Safely-limited Speed
	    ◉ SLS stage 1
	    ○ SLS stage 2
	  ○ SDI Safe Direction
	    ◉ SDI positive
	Start test

|	
Note	After one or several functions have been tested, the acceptance test can be exited with "Quit". If not all of the functions were (successfully) tested, the test can be continued later. This is required, for example, if an error occurred or it was determined that a safety parameter needs to be changed.
Note	Always exit the script with the "Quit" button and never with the STARTER/SCOUT "Cancel" button.

5.3 Continuing an existing acceptance test

The first steps do not differ from those when starting a new test. You open the report file and the application identifies that this file has already been used once. After confirming the liability exclusion clause the following message window is opened.
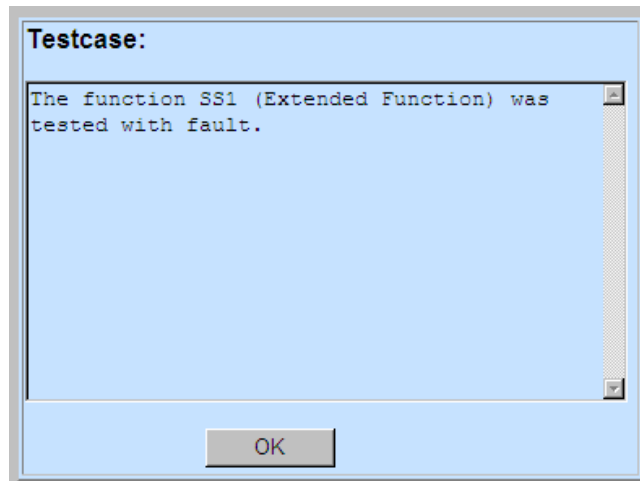
Fig. 5-1 - Continuing the application
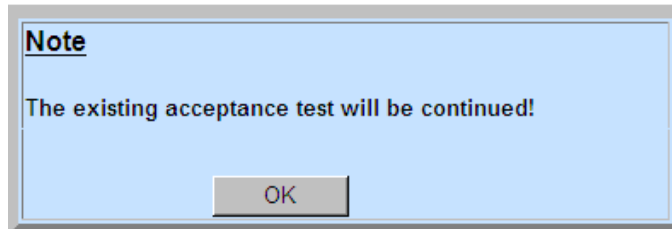
Note	If the test is saved in a certain language, it can only be continued in this language.

5.4   Response in the case of an error

If an error occurs during a test, then the application opens a corresponding message window and cancels the test.

Fig. 5-2 - Error case: View of the user interface

The actual status should be saved and the application exited for improved diagnostics. The report file can now be opened. The test point that resulted in an error can be identified in the "Control Unit" spreadsheet.

Fig. 5-3 - Error case: View of the Excel table

Acceptance test for Safe Stop 1 without encoder - Extended Function

Table: Function "Safe Stop 1" (SS1)

No.	Description	Status
1.	Initial state	
	• The inverter is ready (p10 = 0).	OK
	• The inverter signals neither faults nor alarms of the safety functions (r0945[0...7], r2122[0...7]).	OK
	• SS1 is not active (r9722.1 = 0).	Fault

How you can identify that querying/interrogating SS1 deselection resulted in an error. It can be assumed that SS1 was active when the test was started.
Once the cause has been resolved and the messages acknowledged, the test can be continued.
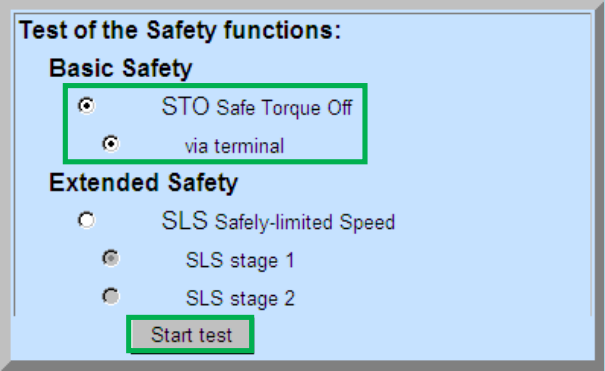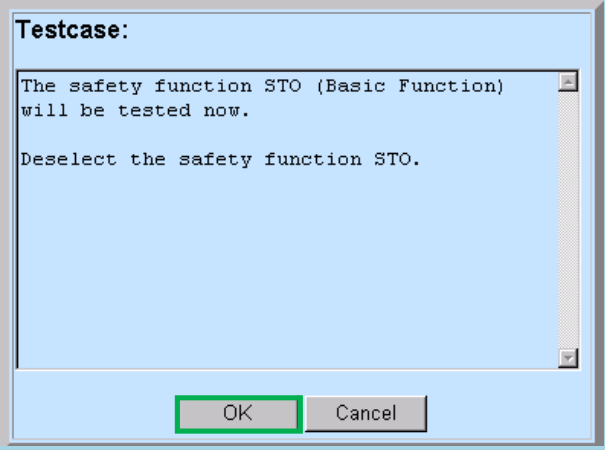
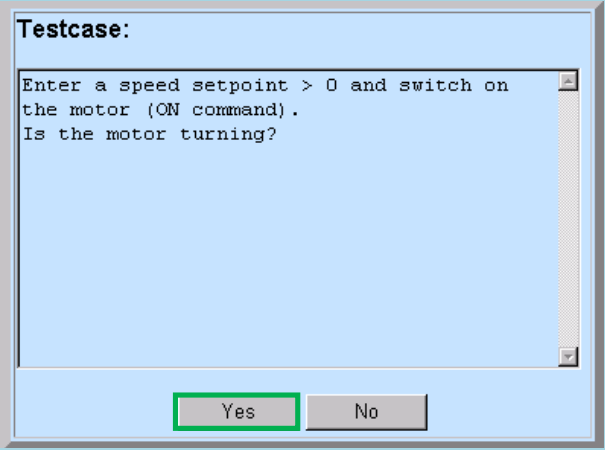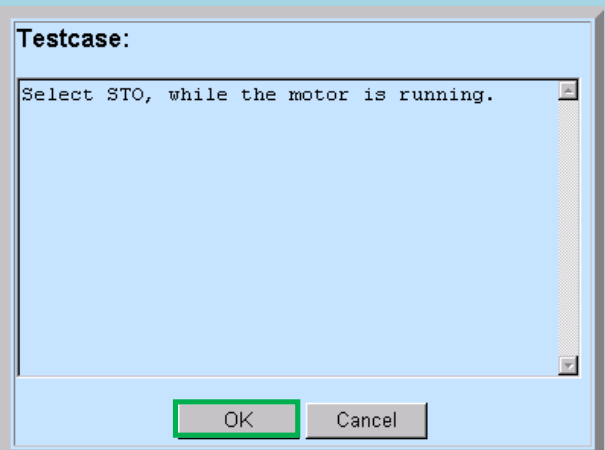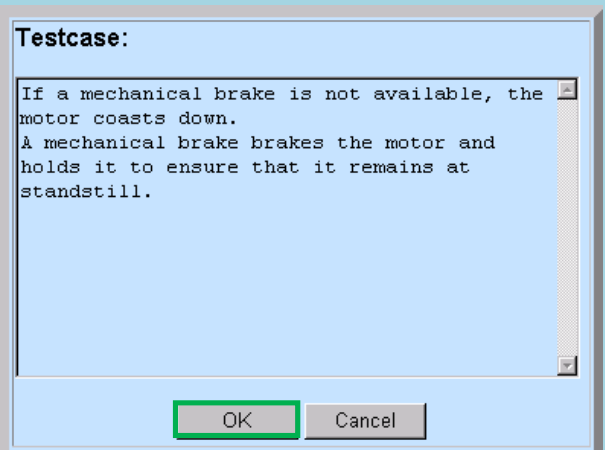| **Note**	It must be ensured that the report file is not opened in Excel, otherwise, executing the script cannot be continued.

6 Performing the tests

6.1 Testing the Safety Integrated Basic Function STO

Performing the test of the Safety Integrated Extended Function "Safety-limited speed" (SLS) is shown in the following tabular overview. Here, the function is controlled via a terminal. All interactions with the operator are described.

Table 6-1 - Performing the test of the Safety Integrated Basic Function STO

No.	Action	Remark
1.	You can test the configured safety functions in the "Test of Safety functions" window. Under "Basic Safety", select the safety function "STO via terminal" and click on "Start test".	**Test of the Safety functions:** **Basic Safety** ○ STO Safe Torque Off ○ via terminal **Extended Safety** ○ SLS Safely-limited Speed ○ SLS stage 1 ○ SLS stage 2 Start test
2.	The "Test case" window now opens. All of the instructions, which are preconditions for a successful acceptance test, are listed in this window. At the beginning of the test, STO (and if necessary, all other Safety functions) must be deselected. "OK" may only be selected once this has been done. If STO or SS1 is still active, this will lead to an error in the test.	**Testcase:** The safety function STO (Basic Function) will be tested now. Deselect the safety function STO. OK Cancel

3.	You are now prompted to traverse the drive. It is also queried as to whether the drive is rotating. The application does not check this. You are responsible for making the correct entry. When selecting "Yes", the test point is evaluated as OK; if "No", then the test is canceled with an error message.	**Testcase:** Enter a speed setpoint > 0 and switch on the motor (ON command). Is the motor turning? [Yes] [No]
4.	You are now prompted to select the STO function. The "OK" button may only be pressed after the function has been selected, otherwise this is canceled with an error message.	**Testcase:** Select STO, while the motor is running. [OK] [Cancel]
5.	Observe the axis as it coasts down, and then decide whether the test has been successfully completed. The application cannot evaluate this. When selecting "OK", the test point is evaluated as OK; for "cancel", the test is canceled with an error message.	**Testcase:** If a mechanical brake is not available, the motor coasts down. A mechanical brake brakes the motor and holds it to ensure that it remains at standstill. [OK] [Cancel]

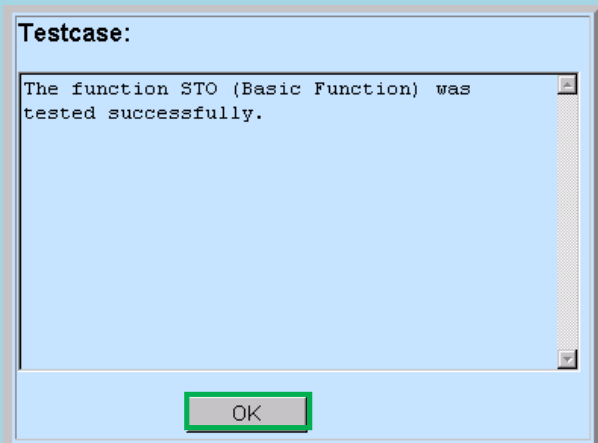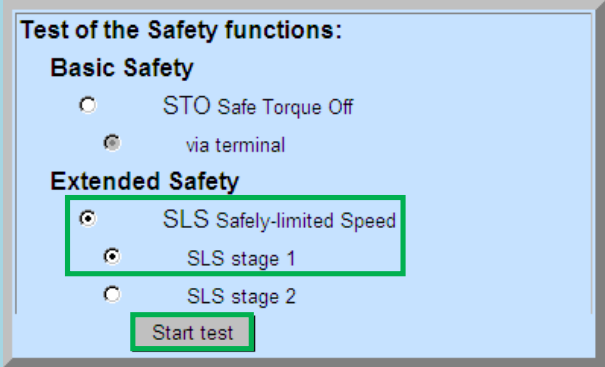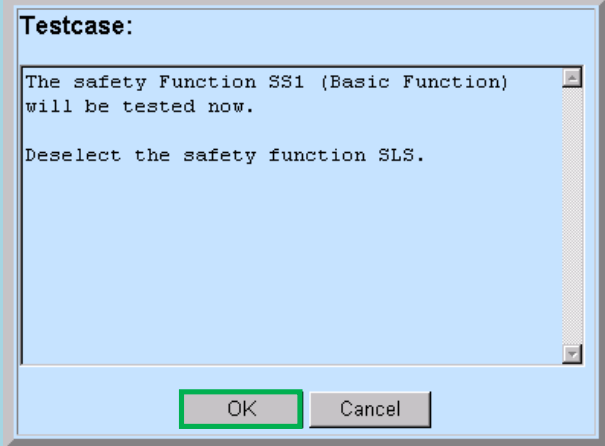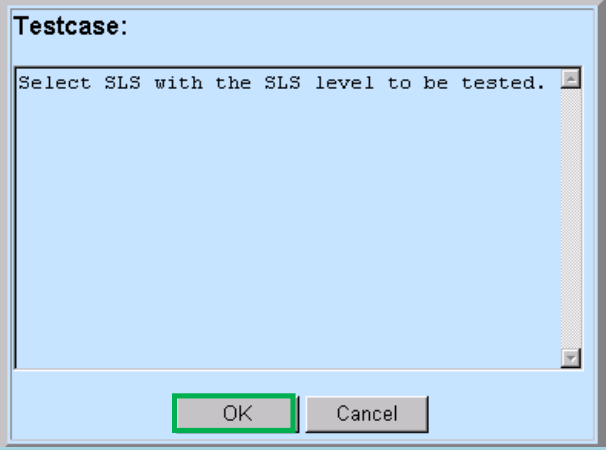|		
6.	You will now be prompted to deselect STO again. Confirmation with "OK" is only permissible after this has been done.	**Testcase:** Deselect STO. OK Cancel
7.	A successfully performed test is displayed with this message. Confirm the message with "OK".	**Testcase:** The function STO (Basic Function) was tested successfully. OK
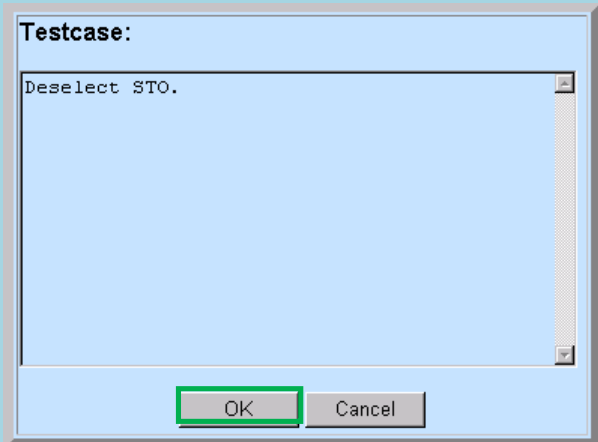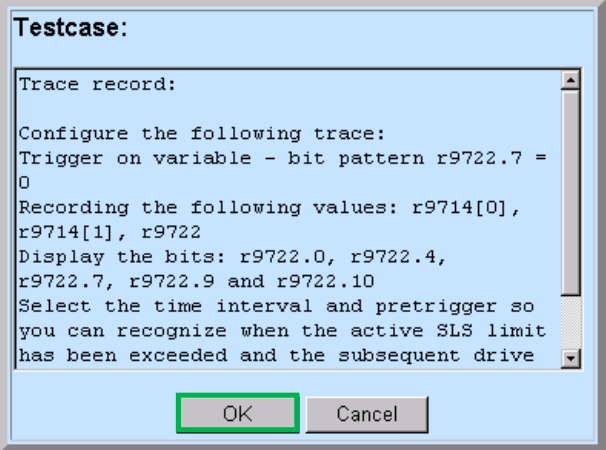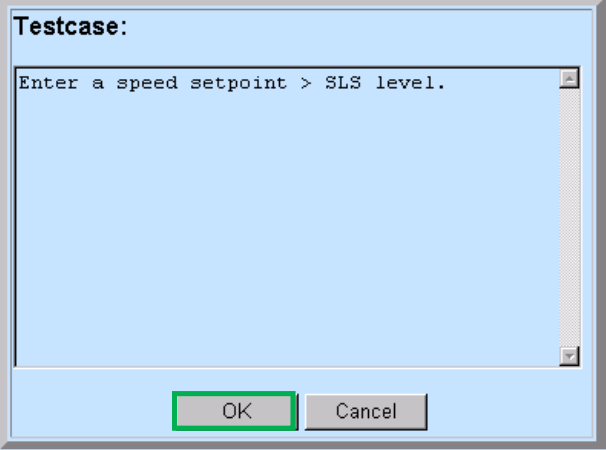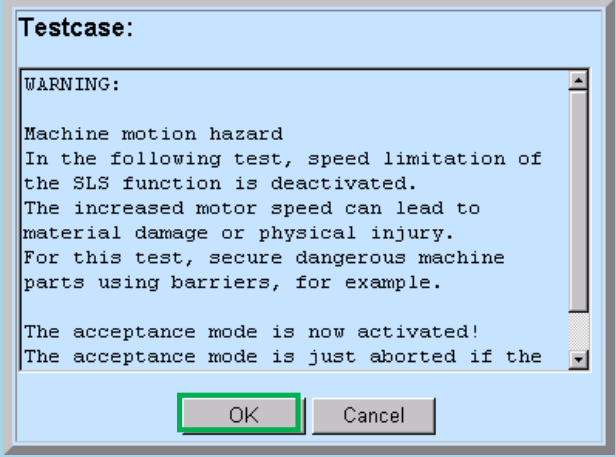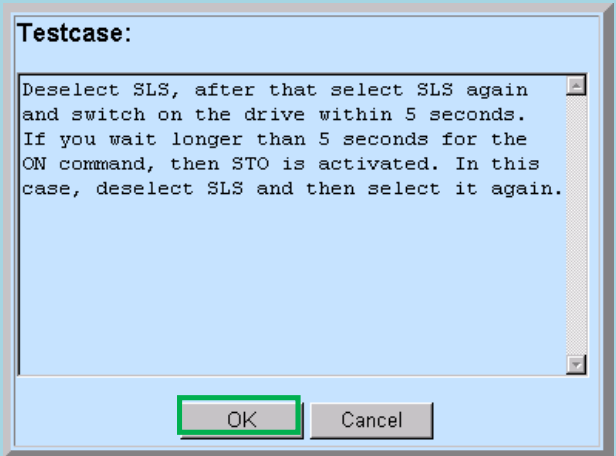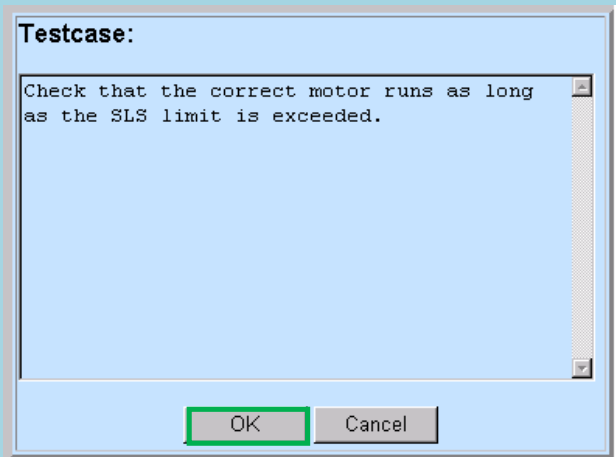
6.2 Testing Safety Integrated Extended function SLS
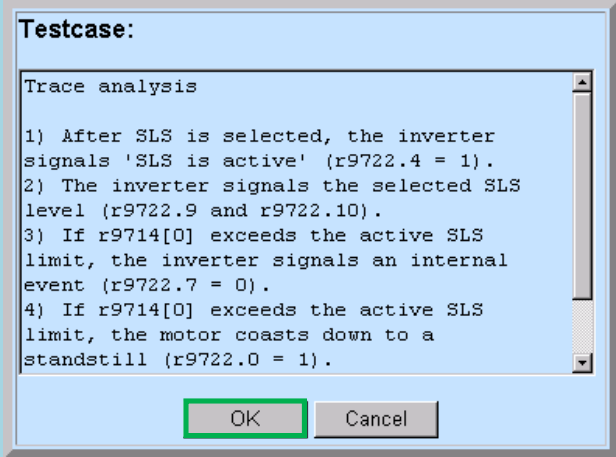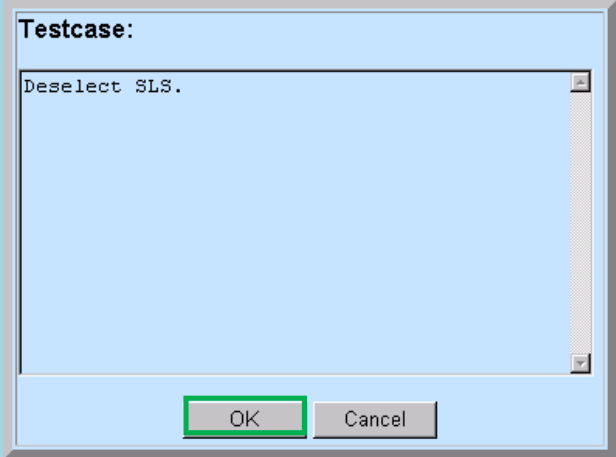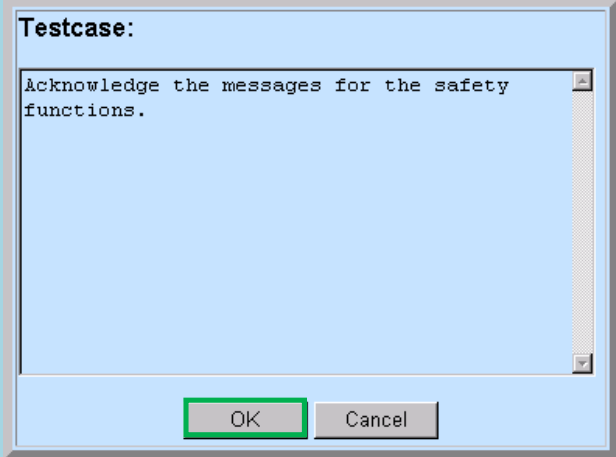
Performing the test of the Safety Integrated Extended Function "Safety-limited speed" (SLS) is shown in the following tabular overview. Here, the function is controlled via PROFIsafe. All operator interactions are described.
The other Extended Functions are tested in a very similar way. This also applies when controlling the functions via onboard terminals. This is the reason why there is no detailed description of the tests for the other Safety Integrated Extended Functions.

Table 6-2 - Performing the test of the Safety Integrated Extended Function SLS

No.	Action	Remark
1.	You can test the configured safety functions in the "Test of Safety functions" window. Under "Extended Safety", select the safety function "SLS stage 1".	**Test of the Safety functions:** **Basic Safety** ○ STO Safe Torque Off ◉ via terminal **Extended Safety** ◉ SLS Safely-limited Speed ◉ SLS stage 1 ○ SLS stage 2 [Start test]
2.	The "Test case" window now opens. All of the instructions, which are preconditions for a successful acceptance test, are listed in this window. SLS must be deselected at the start of the test. "OK" may only be selected once this has been done. If SLS is still active, this will lead to an error in the test.	**Testcase:** The safety Function SS1 (Basic Function) will be tested now. Deselect the safety function SLS. [OK] [Cancel]

3.	You will now be prompted to open STARTER or SCOUT a second time to start a trace recording. As soon as the engineering tool is opened twice, please select the trace functionality and open the trace template („SLS_STOP_A_without_encoder.clg"), which is delivered by the application. Click on "OK" after you have configured the trace.	**Testcase:** Trace record: Configure the following trace: Trigger on variable – bit pattern r9722.7 = 0 Recording the following values: r9714[0], r9714[1], r9722 Display the bits: r9722.0, r9722.4, r9722.7, r9722.9 and r9722.10 Select the time interval and pretrigger so you can recognize when the active SLS limit has been exceeded and the subsequent drive OK Cancel
4.	Now enter a speed setpoint above the SLS limit, without switching on the motor. Confirm the window with "OK".	**Testcase:** Enter a speed setpoint > SLS level. OK Cancel
5.	Select SLS with the limit to be tested, and then confirm with "OK".	**Testcase:** Select SLS with the SLS level to be tested. OK Cancel

6.	The acceptance mode is activated in the next step. When selecting SLS, the script automatically removes the setpoint limiting of the ramp-function generator, i.e. the drive rotates faster than the configured SLS limit. Carefully ensure that nobody is in the danger zone. Confirm the message with "OK".	**Testcase:** WARNING: Machine motion hazard In the following test, speed limitation of the SLS function is deactivated. The increased motor speed can lead to material damage or physical injury. For this test, secure dangerous machine parts using barriers, for example. The acceptance mode is now activated! The acceptance mode is just aborted if the [OK] [Cancel]
7.	If, in the meantime, the drive has gone into the STO state, deselect SLS, select it again and switch on the motor within 5 seconds. Confirm the message with "OK".	**Testcase:** Deselect SLS, after that select SLS again and switch on the drive within 5 seconds. If you wait longer than 5 seconds for the ON command, then STO is activated. In this case, deselect SLS and then select it again. [OK] [Cancel]
8.	The drive now accelerates beyond the SLS limit. Check that the drive rotates until the SLS limit was violated and then confirm with "OK".	**Testcase:** Check that the correct motor runs as long as the SLS limit is exceeded. [OK] [Cancel]

9.	You are now prompted to analyze the trace that was recorded. The application provides some notes in this case. You can take additional notes and information from FHS G120 Appendix A2. Now switch back to the STARTER/SCOUT that is open in parallel on which the trace was recorded. Display the corresponding bits. Save the trace file and copy the trace image into the clipboard so that it can be subsequently added to the Excel table of the application.	**Testcase:** Trace analysis 1) After SLS is selected, the inverter signals 'SLS is active' (r9722.4 = 1). 2) The inverter signals the selected SLS level (r9722.9 and r9722.10). 3) If r9714[0] exceeds the active SLS limit, the inverter signals an internal event (r9722.7 = 0). 4) If r9714[0] exceeds the active SLS limit, the motor coasts down to a standstill (r9722.0 = 1). OK Cancel
10.	Deselect the SLS safety function and press "OK".	**Testcase:** Deselect SLS. OK Cancel
11.	Acknowledge the safety messages.	**Testcase:** Acknowledge the messages for the safety functions. OK Cancel

12.	A successfully performed test is displayed with this message. Confirm the message with "OK".	**Testcase:** The function SLS was tested successfully. OK

6.3   Notes regarding the application

1) At several locations, the application will prompt you to confirm as to whether the drive is rotating or is stationary. Here you are responsible for monitoring the situation. The application does not evaluate as to whether your entry is correct or not.

2) When testing the Basic Function SS1, you will be prompted whether the drive has braked along the OFF3 ramp down to standstill. This should be confirmed with "OK". If you confirm this before the SS1 time has expired, then the test will be evaluated as having had an error, as the expected signal states are only assumed after the SS1 time has expired.

3) The response for a pulse inhibit must also be tested for the test of SDI without encoder. However, this test is only performed in one direction, i.e. if only one direction has been parameterized, then the test is directly conducted after the function test. If both directions are parameterized, the test follows the function test in the positive direction. The test of SDI is only marked in the overview as having been successfully conducted after all of the parameterized directions and the behavior for pulse inhibit have been successfully tested.

6.4   Supplementary conditions when using the application

Some supplementary conditions and restrictions must be observed when using the application. These are described below.

- The application was generated and tested with STARTER/SCOUT V4.3.1 up to V4.4.1. The application cannot be used with an earlier version of STARTER/SCOUT.
- The check of the application, if Safety-relevant warnings are triggered, e.g. A01796, dispensed since version 1.1. The operator has to check, that no Safety-relevant warnings are triggered.

7 References

7.1 References

This list does not claim to be complete and only provides a selection of suitable references.

Table 7-1

	Topic	Title
/1/	G120 Safety Function Manual, edition 04/2015	https://support.industry.siemens.com/cs/document/109477367/safety-integrated-function-manual-for-sinamics-g110m-g120-g120c-g120d-and-simatic-et-200pro-fc-2?dti=0&lc=en-DE

7.2 Internet links

This list does not claim to be complete and only provides a selection of suitable information.

Table 7-2

	Topic	Title
\1\	Reference to the article	http://support.automation.siemens.com/WW/view/de/73102423
\2\	Siemens Industry Online Support	http://support.automation.siemens.com

8 Contact persons

Siemens AG

Industry Sector
I DT MC PMA APC
Frauenauracher Strasse 80
D - 91056 Erlangen, Germany
E-mail: safety.team.motioncontrol.i-dt@siemens.com

9   History

Table 9-1

Version	Date	Change
V1.0	05/2013	First edition
V1.1	12/2015	- Error adjustment - Firmware extension up to V4.7SP3 - Supply of trace templates