YASKAWA

Advanced Safety Module

for Sigma-7 SERVOPACK SGD7S-□□□DA0□8□□F91, 400 V

Application Manual

Model: SGD7S-OSB01A
SGD7S-OSB02A

To properly use the product, read this manual thoroughly and retain for easy reference, inspection, and maintenance. Ensure the end user receives this manual.

Manual No. SIEP YEUOS7S 02A

Table of contents

1 Unpacking and Mounting the Advanced Safety Module

1.1 Contents of the Box

Depending on the type you have ordered, you will receive the SGD7S-OSB01A or the SGD7S-OSB02A.The SGD7S-OSB01A is represented by a single board, while the SGD7S-OSB02A consists of a double board (sandwich).

Never try to disassemble. Otherwise the warranty will be lost.

The box also includes:

- the Instruction Manual
- the Declaration of Conformity (DoC)
- the nameplate sticker, the model designation sticker and the LED identification sticker
- the mounting screws

1.2 Required Accessory for Board Mounting

To attach the module to the SERVOPACK you will need the mounting rail for option cards for Sigma-7 400 V SERVOPACKs (order no. JZSP-P7R2-8-E).

For the SGD7S-OSB02A you additionally need the I/O connector (order no. JUSP-7CN21).

1.3 Attaching the Advanced Safety Module to the SERVOPACK

1. Read the Instruction Manual to find out how to attach the module to the SERVOPACK.
2. Also pay attention to the safety instructions in this manual.
3. Make sure that the power supply (main power supply 400 V AC and control power supply 24 V DC) is switched off and the charge LED of the SERVOPACK is not lit.
4. Then start by opening the cover for the Option Modules on the right-hand side of the SERVOPACK.
5. Attach the mounting rail.
6. Carefully plug the Advanced Safety Module into the SERVOPACK.
7. Fix the module with the mounting screws.
8. Take the plastic module cover out of the box.
9. Depending on your needs, you should break out the openings in the cover for the CN21 connector (SGD7S-OSB02A) and/or for other interface connectors for additional option modules as the second encoder module.
10. Attach the nameplate sticker, the model designation sticker and the LED identification sticker on the designated fields on the cover. For a detailed illustration of the specified positions, see chapter 3.3 of the Instruction Manual.
11. Close the cover.

1.4 Attaching the I/O Connector (SGD7S-OSB02A only)

1. Read the Instruction Manual and make sure that the power is switched off.
2. Plug the field connector JUSP-7CN21 into the CN21 plug of the Advanced Safety Module.

3. Close the both levers of the connector to tighten the connection. This prevents the connection from being loosened by vibrations or shocks.

> *Do not mix up the I/O connection of the SERVOPACK with the I/O connection of the Advanced Safety Module. This could damage the safety module or the SERVOPACK.*

4. Follow the instructions in the Product Manual for I/O wiring. Analogue signals must be shielded. An external 24V SELV/PELV power supply must be connected to drive the digital outputs.

1.5 FSoE Connection

Plug the Ethernet cable (CAT5 or higher such as Yaskawa Part Numbers found below) of the previous FSoE communication device into connector CN6A (input) and the next FSoE device into connector CN6B (output) of the SERVOPACK. However, the FSoE master can also be located anywhere within the network.

Cables with RJ45 Connectors on Both Ends

Cable Length	Item Number
0.2 m	CM3RRM0-00P2-E
0.5 m	CM3RRM0-00P5-E
1 m	JZSP-CM3RRM0-01-E
3 m	JZSP-CM3RRM0-03-E
5 m	JZSP-CM3RRM0-05-E
10 m	JZSP-CM3RRM0-10-E
20 m	JZSP-CM3RR00-20-E
30 m	JZSP-CM3RR00-30-E
40 m	JZSP-CM3RR01-40-E
50 m	JZSP-CM3RR01-50-E

2 Switching On the SERVOPACK

2.1 Switching On the Control Voltage

2.1.1 Preparations

The correct assembly and wiring of the SERVOPACK and the Advanced Safety Module is described in the Instruction Manual and the Product Manual.

Observe the safety regulations for the protection of people and equipment.

You need the *Advanced Safety Module Parameter Editor* tool on your PC (laptop) to configure the Advanced Safety Module.

1. Please download the tool software from the Yaskawa homepage yaskawa.eu.com.
2. Follow the instructions in the Quick Installation Guide to install and activate the tool. (You can also find the Quick Installation Guide as a download on the homepage in the Safety Option Module section).
3. If you have installed the *Advanced Safety Module Parameter Editor* on your PC (laptop), connect the USB online cable JZSP-CVS06-02-E to your USB interface and plug it into the CN7 connector of the SERVOPACK.
4. Start the tool on your PC.

For more detailed information on the Advanced Safety Module Parameter Editor, see Chap. 3 'Creating a Project using the Advanced Safety Module Parameter Editor' page 22.

5. Please note the serial number of the Advanced Safety Module. It will be needed in the next step of the initial start-up.

2.1.2 Initial Start-Up

1. Switch on the control voltage of the SERVOPACK.

> *After the voltage has been switched on, the pairing of the safety module and the SERVOPACK is carried out automatically.*

⇨ ■ The SERVOPACK stores that the safety module is connected.
■ The safety module stores the serial number of the connected SERVOPACK.

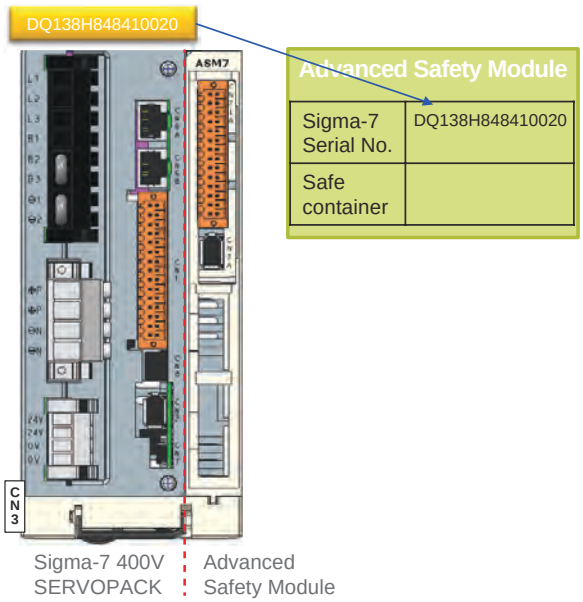


Fig. 1: Pairing of Safety Module and SERVOPACK

2. Observe the devices.

The red LED on the Advanced Safety Module lights up. The error display on the SERVOPACK shows "A.EC1" (Safety-related Servo Parameter Unmatch Alarm) or "A.EC0" (Safety Module Confirmation Alarm).

Alarm cause "A.EC1": There is no valid safe container in the safety module.

Alarm cause "A.EC0": Serial number of the SERVOPACK and serial number of the SERVOPACK stored in the safety module do not match.

If the error "A.EC0" (Safety Module Confirmation Alarm) appears on the SERVOPACK error display, continue with step 2 in chapter ↯ *Chap. 2.1.3.2 'Safety Module already in operation and new SERVOPACK' page 17*.

3. Continue with the parameterisation via the *Advanced Safety Module Parameter Editor*.

The parameterisation is described in detail with an example in chapter ↯ *Chap. 3 'Creating a Project using the Advanced Safety Module Parameter Editor' page 22*.

4. During parameterisation, you must enter the serial number of the Advanced Safety Module when configuring the General Device Parameters. Without this entry, it is not possible to generate a safe parameter container upon completion of the project file.

   The *Advanced Safety Module Serial Number* consists of a total of 15 digits (2 characters and 13 numbers), e.g. D0207A000110004. Locate the serial number of the Advanced Safety Module to be deployed and enter it exactly in the applicable data entry field.

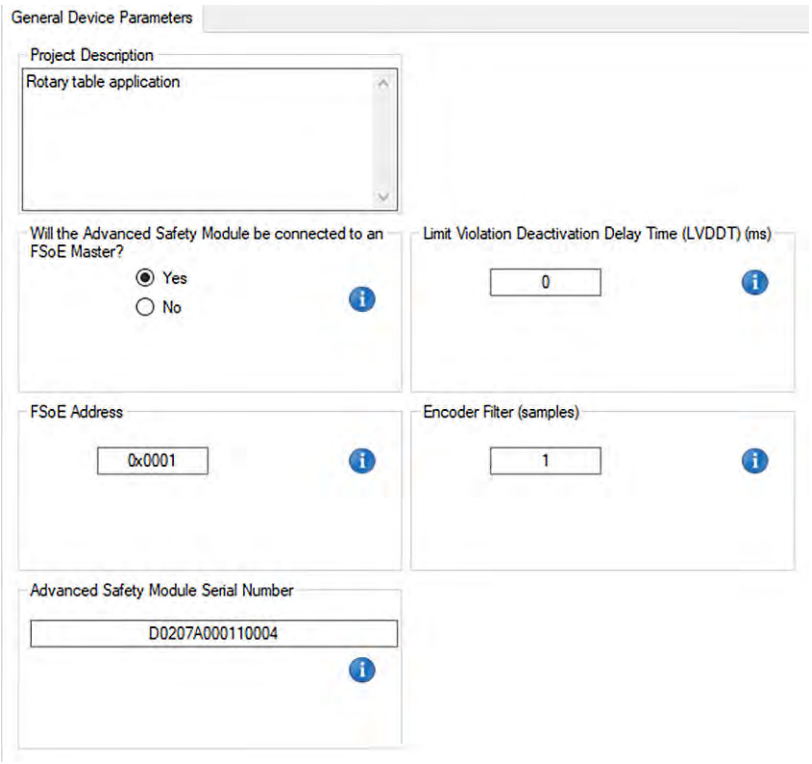


Fig. 2: The General Device Parameters dialog

5. Enter your safety parameters as described in chapter ↬ *Chap. 3 'Creating a Project using the Advanced Safety Module Parameter Editor' page 22*.

6. When all the necessary intermediate steps described in chapter ↳ *Chap. 3 'Creating a Project using the Advanced Safety Module Parameter Editor' page 22* have been carried out, click on *CMIF Container Transfer* in the *Device* menu.

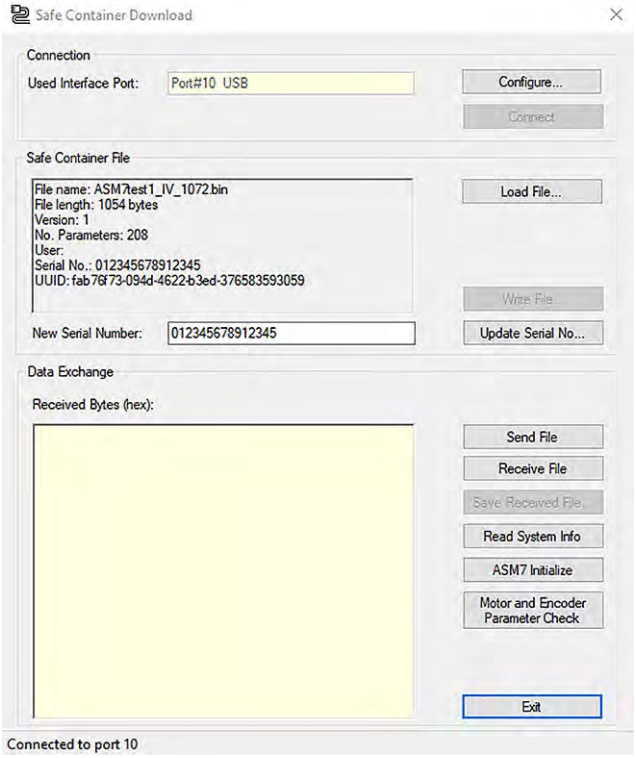


Fig. 3: Safe Container File loaded

7. Click on the *Send File* button to start the download of the safe container file to the Advanced Safety Module.

⇨ When the download is completed successfully, a *Write Success* message will be displayed.

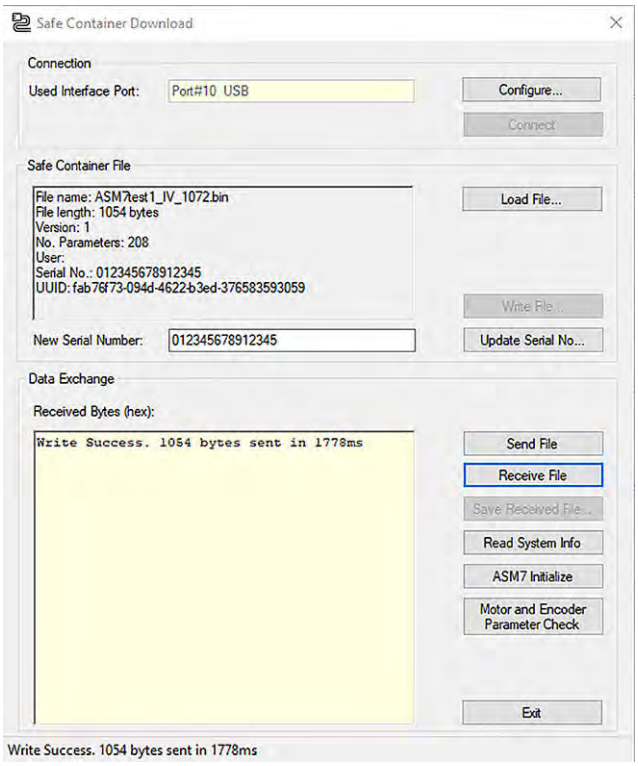


Fig. 4: Safe Container File Sending Completed

As a result, the alarm "A.EB9" may occur to indicate a change of the ASM7 parameter set. This change must be activated by a power cycle to enable the new setting (a software reset with SigmaWin+ can also clear the "A.EB9" alarm).

8. Restart the SERVOPACK.

⇨ The error display on the SERVOPACK shows "HWBB" for 5 seconds. After that, the display goes out and no more errors are displayed. The green LED on the Advanced Safety Module lights up.

2.1.3 Start-Up for other SERVOPACK / Safety Module Constellations

When combining a SERVOPACK or Advanced Safety Module that has been previously used in safety applications, the behaviour differs from the initial start-up.

2.1.3.1 SERVOPACK already in operation and new Safety Module

Use of the identical Safety Module type

In this case, the start-up procedure is identical to the procedure described in chapter ↳ *Chap. 2.1.2 'Initial Start-Up' page 8*.

Use of a different Safety Module type

1. Switch on the control voltage of the SERVOPACK.
   ⇨ The safety module stores the serial number of the connected SERVOPACK.

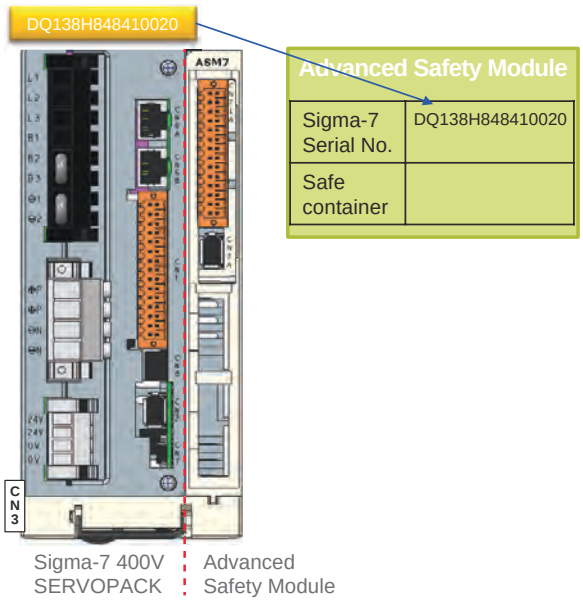


Fig. 5: Pairing of Safety Module and SERVOPACK

2. Observe the devices.

   The red LED on the Advanced Safety Module lights up. The error display on the SERVOPACK shows "A.E81" (Safety Option Module Unmatch Alarm).

   Alarm cause: A safety module of a different type was connected.

3. Execute Fn014 (Reset Option Module Configuration Error) with SigmaWin+ or the Digital operator.

   With the help of this step, the SERVOPACK deletes that a safety module was connected.

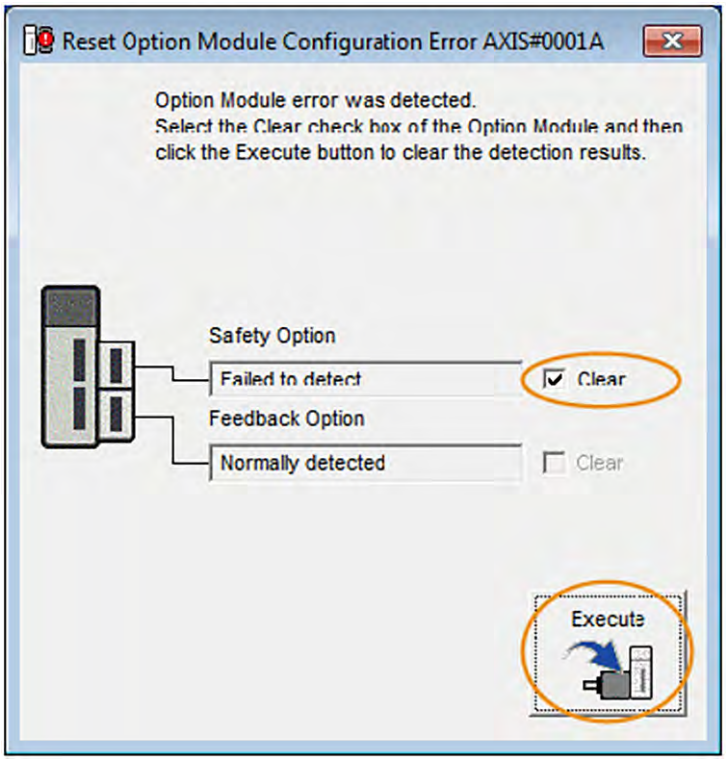


Fig. 6: Reset Option Module Configuration Error

⇨

Please note that the USB port can only be used by one tool at a time. In this case, you should first close the Advanced Safety Module Parameter Editor before opening SigmaWin+.

4. Switch off the control voltage of the SERVOPACK.
5. Switch on the control voltage of the SERVOPACK.
   ⇨ The SERVOPACK stores that the safety module is connected.
6. The Safety-related Servo Parameter Unmatch Alarm (A.EC1) is displayed.

   Alarm cause: There is no valid safe container in the safety module.
7. Continue with the parameterisation via the *Advanced Safety Module Parameter Editor*.

Please note that the USB port can only be used by one tool at a time. In this case, you should first close SigmaWin+ before opening the Advanced Safety Module Parameter Editor.

The parameterisation is described in detail with an example in chapter ↳ *Chap. 3 ‘Creating a Project using the Advanced Safety Module Parameter Editor’ page 22*.

8. During parameterisation, you must enter the serial number of the Advanced Safety Module when configuring the General Device Parameters. Without this entry, it is not possible to generate a safe parameter container upon completion of the project file.

The *Advanced Safety Module Serial Number* consists of a total of 15 digits (2 characters and 13 numbers), e.g. D0207A000110004. Locate the serial number of the Advanced Safety Module to be deployed and enter it exactly in the applicable data entry field.

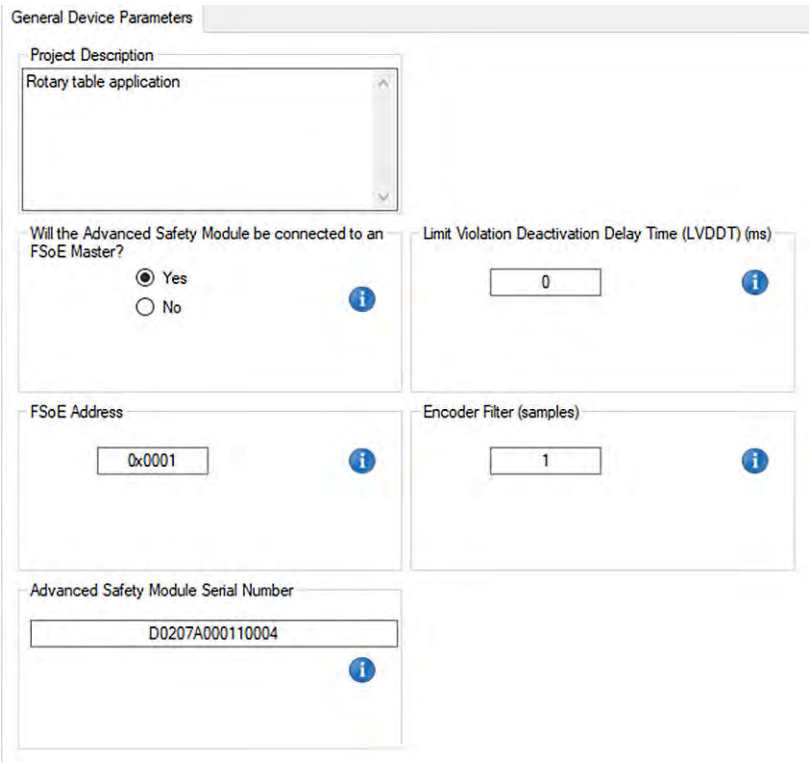


Fig. 7: The General Device Parameters dialog

9. Enter your safety parameters as described in chapter ↬ *Chap. 3 'Creating a Project using the Advanced Safety Module Parameter Editor' page 22*.

10. When all the necessary intermediate steps described in chapter ↳ *Chap. 3 'Creating a Project using the Advanced Safety Module Parameter Editor' page 22* have been carried out, click on *CMIF Container Transfer* in the *Device* menu.

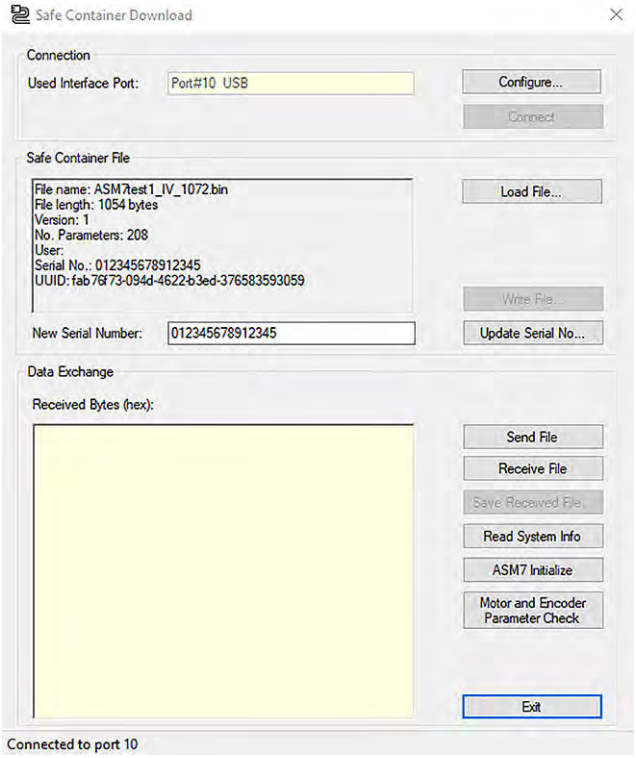


Fig. 8: Safe Container File loaded

11. Click on the *Send File* button to start the download of the safe container file to the Advanced Safety Module.

⇨ When the download is completed successfully, a *Write Success* message will be displayed.

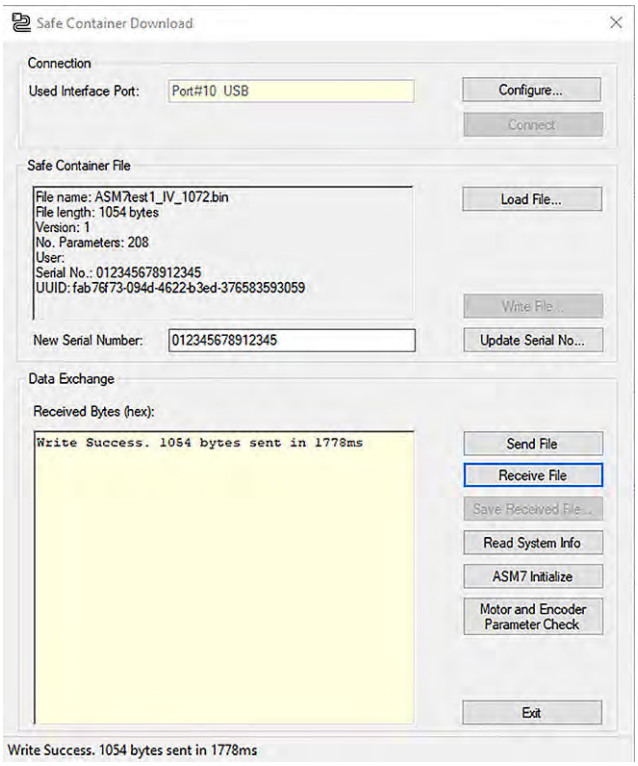


Fig. 9: Safe Container File Sending Completed

As a result, the alarm "A.EB9" may occur to indicate a change of the ASM7 parameter set. This change must be activated by a power cycle to enable the new setting (a software reset with SigmaWin+ can also clear the "A.EB9" alarm).

12. Restart the SERVOPACK.

⇨ The error display on the SERVOPACK shows "HWBB" for 5 seconds. After that, the display goes out and no more errors are displayed. The green LED on the Advanced Safety Module lights up.

2.1.3.2 Safety Module already in operation and new SERVOPACK

1. Switch on the control voltage of the SERVOPACK.
   ⇨ The SERVOPACK stores that the safety module is connected.

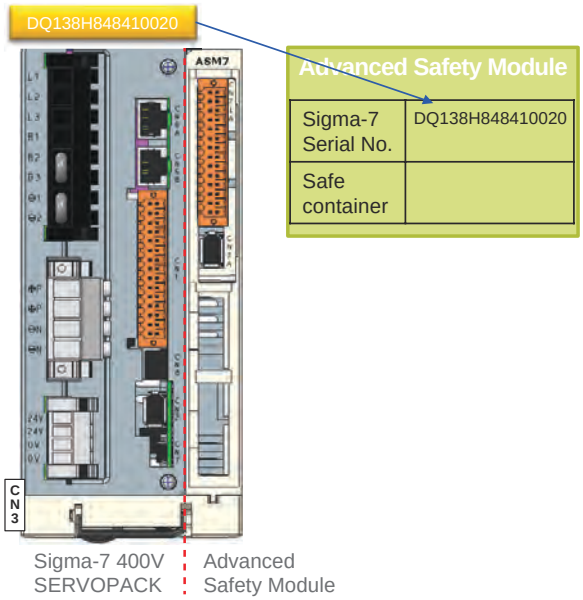


Fig. 10: Pairing of Safety Module and SERVOPACK

2. Observe the devices.

   The red LED on the Advanced Safety Module lights up. The error display on the SERVOPACK shows "A.EC0" (Safety Module Confirmation Alarm).

   Alarm cause: Serial number of the SERVOPACK and serial number of the SERVOPACK stored in the safety module do not match.

3. With the Advanced Safety Module Parameter Editor: Click on button "ASM7 Initialize".

   ⇨ This function deletes the serial number of the SERVOPACK, the homing information and the safe container in the non-volatile memory of the safety module.

> *The serial number specified in the New Serial Number field must be the serial number of the currently connected Advanced Safety Module.*

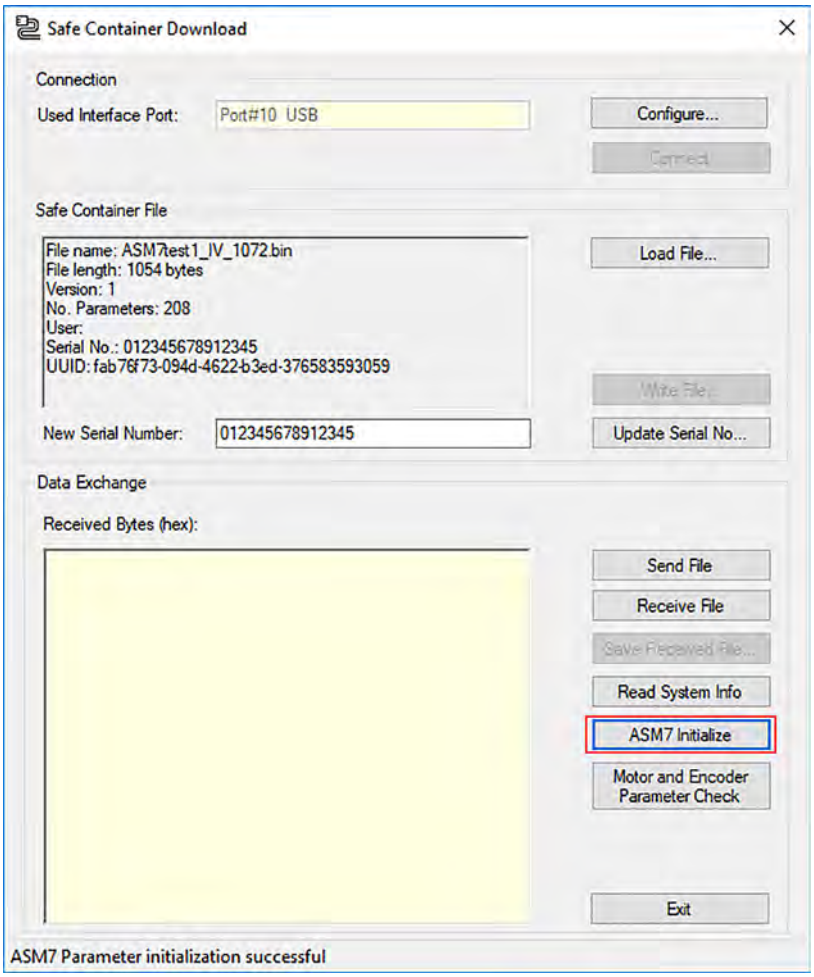


Fig. 11: ASM7 Initialize Button

4. Alternative possibility with the Digital Operator (replaces step 3): Execute Fn040 (Safety Option Module Access Mode Setting).

   To activate this function, the last four characters of the serial number of the safety module (attached to the SERVOPACK) must be entered (range = 0001 to 9999).

   ⇨ This function enables the execution of Fn043.

5. Execute Fn043 (Safety Option Module Initializing Parameter Setting) with the Digital Operator.

   ⇨ This function deletes the serial number of the SERVOPACK, the homing information and the safe container in the non-volatile memory of the safety module.

6. Switch off the control voltage of the SERVOPACK.

7. Switch on the control voltage of the SERVOPACK.

   ⇨ The safety module stores the serial number of the connected SERVOPACK.

8. The Safety-related Servo Parameter Unmatch Alarm (A.EC1) is displayed.

   Alarm cause: There is no valid safe container in the safety module.

9. Continue with the parameterisation via the *Advanced Safety Module Parameter Editor*.

> *Please note that the USB port can only be used by one tool at a time. In this case, you should first close SigmaWin+ before opening the Advanced Safety Module Parameter Editor.*

   The parameterisation is described in detail with an example in chapter *Chap. 3 'Creating a Project using the Advanced Safety Module Parameter Editor' page 22*.

10. During parameterisation, you must enter the serial number of the Advanced Safety Module when configuring the General Device Parameters. Without this entry, it is not possible to generate a safe parameter container upon completion of the project file.

    The *Advanced Safety Module Serial Number* consists of a total of 15 digits (2 characters and 13 numbers), e.g. D0207A000110004. Locate the serial number of the Advanced Safety Module to be deployed and enter it exactly in the applicable data entry field.

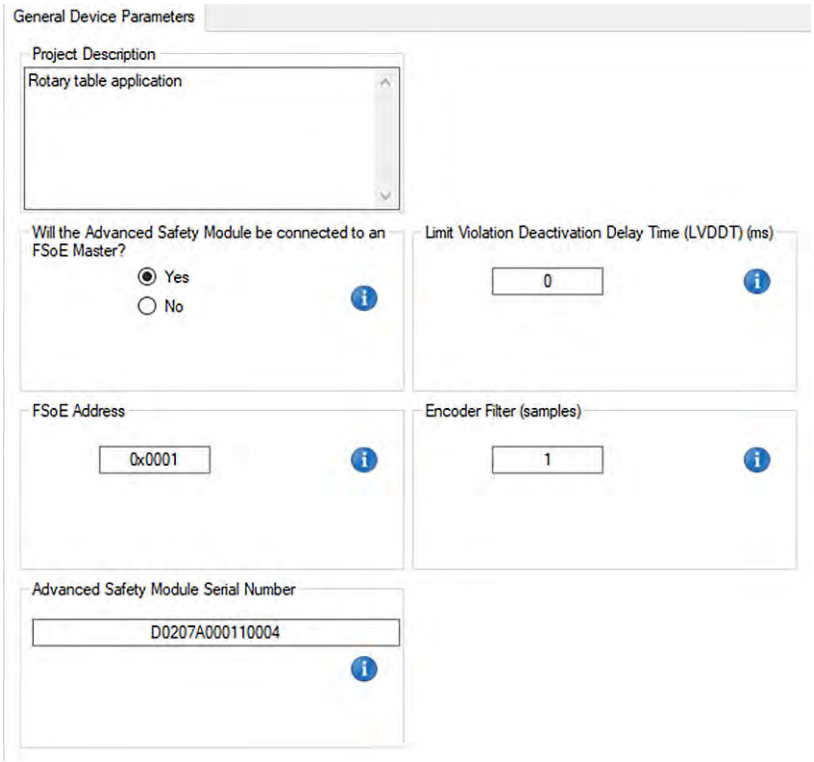


Fig. 12: The General Device Parameters dialog

11. Enter your safety parameters as described in chapter *Chap. 3 'Creating a Project using the Advanced Safety Module Parameter Editor' page 22*.

12. When all the necessary intermediate steps described in chapter ↳ *Chap. 3 'Creating a Project using the Advanced Safety Module Parameter Editor' page 22* have been carried out, click on *CMIF Container Transfer* in the *Device* menu.

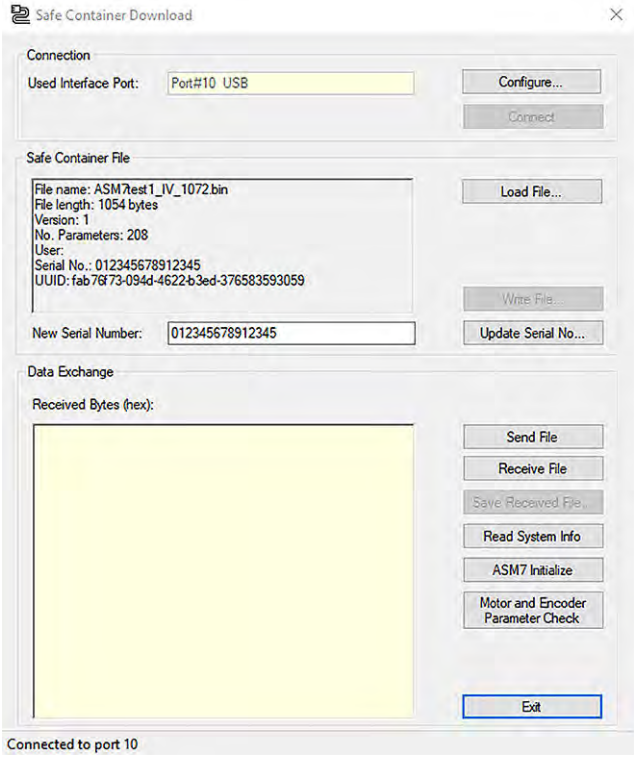


Fig. 13: Safe Container File loaded

13. Click on the *Send File* button to start the download of the safe container file to the Advanced Safety Module.

⇨ When the download is completed successfully, a *Write Success* message will be displayed.

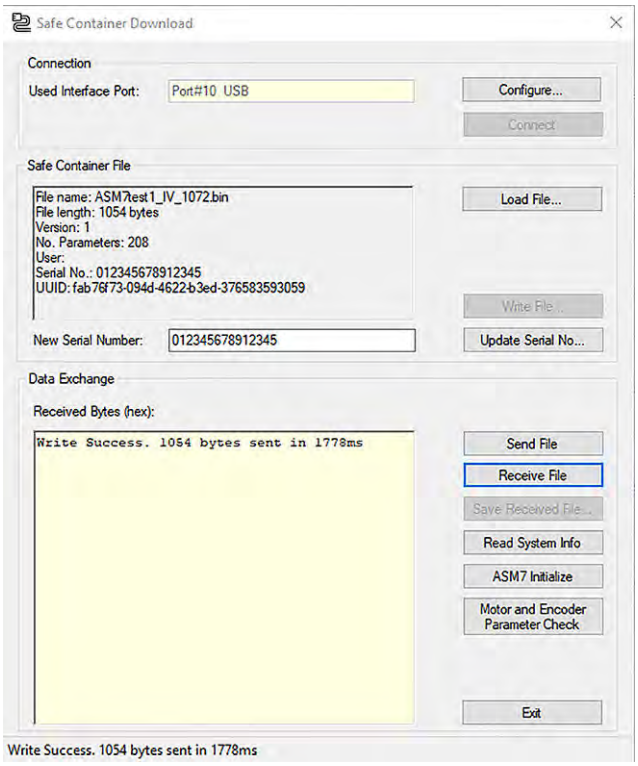


Fig. 14: Safe Container File Sending Completed

As a result, the alarm "A.EB9" may occur to indicate a change of the ASM7 parameter set. This change must be activated by a power cycle to enable the new setting (a software reset with SigmaWin+ can also clear the "A.EB9" alarm).

14. Restart the SERVOPACK.

⇨ The error display on the SERVOPACK shows "HWBB" for 5 seconds. After that, the display goes out and no more errors are displayed. The green LED on the Advanced Safety Module lights up.

3 Creating a Project using the Advanced Safety Module Parameter Editor

3.1 Introduction

The software tool Advanced Safety Module Parameter Editor (henceforth ASM Parameter Editor) is used to create and modify project files (with file extension *.asm7). In addition, the ASM Parameter Editor is used to create safe parameter containers (with file extension *.bin) which can then be downloaded to the Advanced Safety Module (ASM).

3.2 System Requirements

A PC with the Windows 10 operating system is required. In order to download and upload safe parameter containers, the installation of SigmaWin+ Version 7.40 or greater is also required. In addition, the following Visual C++ Redistributable Package is required (if not already installed) for the correct operation of SigmaWin+:

- *Microsoft Visual C++ 2015-2019 Redistributable (x86)*

The user is advised to check whether this entry appears in the list of *Programs and Features* (*Control Panel → Programs and Features*). If the above entry does not appear in the list of *Programs and Features*, download the file *vc_redist.x86.exe* from the following Microsoft website:

- https://www.microsoft.com/en-us/download/details.aspx?id=48145

3.3 Installation

The installation files for the ASM Parameter Editor can be downloaded from Yaskawa's homepage. In order to download the installation files, the user must first register himself/herself at Yaskawa. Upon successful registration, the user will receive an e-mail containing a password. This password is required to be entered when the starting the Parameter Editor for the first time.

After downloading the installation files for the ASM Parameter Editor, simply run the file *setup.exe*. Upon completion of the installation, start the ASM Parameter Editor and enter the password obtained through the registration mentioned above. The user will then be prompted to enter a user-defined password.

3.4 Creating a New Advanced Safety Module Project File

The creation of a new project file using the Parameter Editor is straightforward. The ASM Parameter Editor guides the user while configuring the parameters for the ASM to ensure that a predefined sequence is observed.

When creating a new project, the very first action the user must perform is to select the type of ASM to be deployed in the application – either the SGD7S-OSB01A or the SGD7S-OSB02A module.

The parameters are divided into groups based upon their function are listed below in the sequence (order) they are to be configured:

1. ***General Device Parameters***: These parameters apply to the ASM in general and include the FSoE Address of the ASM, the Limit Violation Deactivation Delay Time (LVDDT) and the Encoder Filter.
2. ***Motor and Encoder Parameters***: These parameters are configured in accordance with the actual electromechanical components deployed in the machine.

3. ***I/O Configuration Parameters***: These parameters are applicable to the SGD7S-OSB02A module (with physical I/O terminals) only and are used to define the configuration of the I/O ports, e.g. *Digital Input* or *Digital Output*, and their associated attributes, e.g. *Filter Time* and *Discrepancy Time* in the case of digital inputs, or *Test Pulse Length* for digital outputs.

4. ***Slot Parameters***: Up to 10 slots can be configured with the available 16 *safety functions*. A *Safe Homing Position* (SHP) function (only one per project) as well as *Mapping* function can also be configured. In addition to the selection of a safety function, the selection of an *Activation Input* and an *Output Signal Type* as well as the associated *Output Signal Behaviour* can be performed in each slot. Additional parameters associated with the selected Safety Function itself are also configured during the configuration of a safety slot.

Important!
*The General Device Parameters, the Motor and Encoder Parameters, and the I/O Configuration parameters strongly influence the selection possibilities in the configuration of the Slot Parameters. It is therefore imperative that the General Device Parameters, the Motor and Encoder Parameters, and the I/O Configuration parameters are configured correctly **before** proceeding with the Slot Parameters.*

Important!
*With respect to the General Device Parameters, once these parameters have been checked, committed and confirmed and this dialog closes, it is no longer possible to modify the selection "Will the Advanced Safety Module be connected to an FSoE Master?" Once slot parameters have been configured, i.e. checked, committed and confirmed, it is afterwards not possible to edit **any** Motor and Encoder Parameters nor is it possible to edit those I/O Configuration parameters for which their I/O's that have been selected in the slot configuration(s).*

The order in which the safety slots themselves are configured is immaterial.

3.5 Example of Creating a New Advanced Safety Module Project File

An example of how to create a new ASM project file is shown below. Before beginning with the creation of the project, consider the following characteristics, features and requirements of a hypothetical machine that will be used in this example:

1. The ASM **SGD7S-OSB02A** will be deployed – a configuration of the I/O ports is therefore necessary

2. The ASM will be connected to an FSoE Master – virtual I/O can therefore be used in the slot configuration

3. **Linear Application** with **Rotary Motor**:
   - Sigma-7 Motor/Encoder: SGM7**G**-1ED7**F**** – 15 kW, 400Vac, 24-bit absolute encoder, rated motor speed 1500 rpm, maximum motor speed 2000 rpm
   - Motor Encoder Usage: Absolute Multi-Turn
   - External linear (2nd) encoder (Heidenhain®) with 20 µm scale pitch – to be used for safety only
   - Sigma-7 Serial Converter Unit with 12-bit interpolation (JZDP-J□□□-□□□-E)
   - Gearbox ratio: 10:1
   - Ball screw pitch: 6 mm (6000 µm)

4. **I/O Configuration**:
   - Port A: Digital Output Test Pulse A
   - Port B: Digital Output
   - Port C: Digital Output EDM
   - Port D: Digital Input
   - Port E: Digital Input Test Pulse A
   - Port F: Analog Input (0-10V)
   - Port G: G1: 4-20mA, G2: PT1000
5. **Safety Slot Configuration**:
   - One slot with safety function SLS (Safely Limited Speed) – a “safe motion” type safety function
   - One slot with safety function SS1-r (Safe Stop 1, deceleration monitored and time controlled) – a “safe standstill” type safety function (aka a *stopping* method – this slot will be “linked” to the above slot via a “Limit Violation”)
   - One slot with safety function SMT (Safe Motor Temperature) – a “safe monitoring” type safety function

3.6 Creating a New Project File

Select the from the *File* menu *New Project* or click the following icon on the toolbar shown inside the red rectangle:

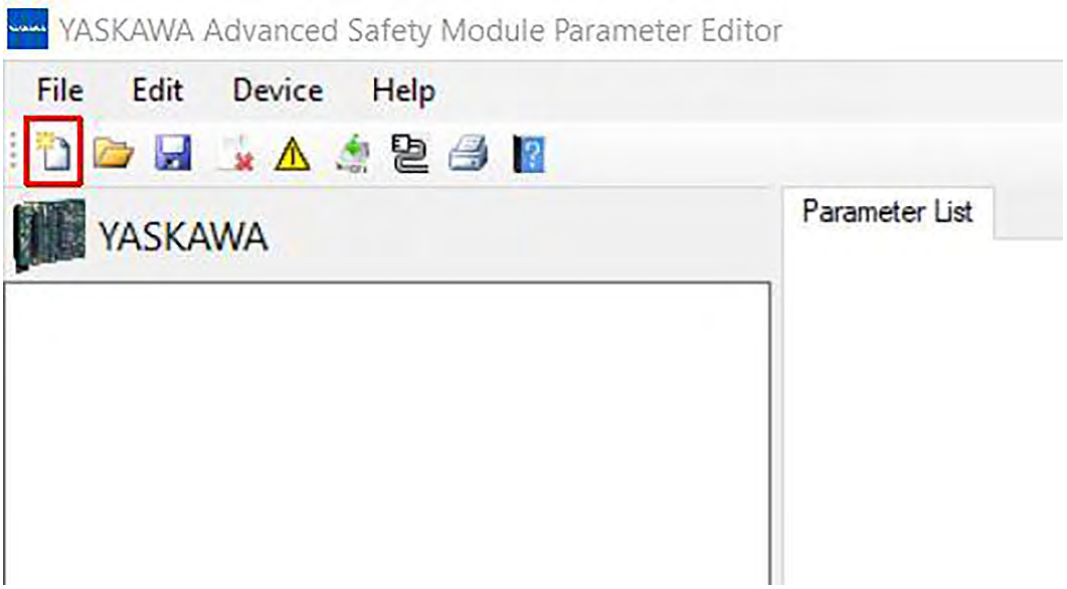


Fig. 15: Start a new project icon on the toolbar

The following *Create New Project* dialog will appear:

Fig. 16: Create New Project dialog

In accordance with the example characteristics and features given above, select *SGD7S-OSB02A* for the *ASM7 Module Type*.

For the project *Description*, up to 260 characters can be entered. This enables the user to enter a meaningful and detailed description of the project. For this example, the following was entered in the *Create New Project* dialog:

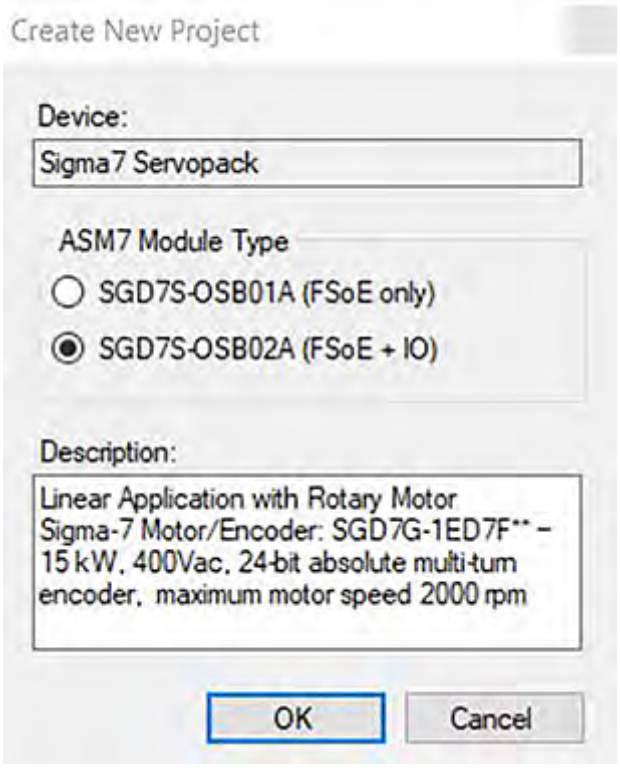


Fig. 17: Completed Create New Project dialog

Click *OK*.

Important!
Once the OK button is clicked and this dialog closes, it no longer possible to modify the ASM7 Module Type!

For carriage return line feed (new line) inside the Description data entry field, use the short-cut key combination CTRL + Enter.

The project Description can also be entered in the General Device Parameters dialog as well as in the Project Details window (lower left grey area of the ASM Parameter Editor). The Project Details window displays the details of the current parameter project and provides a context menu (right mouse click) for changing the project Description and for setting a serial number.

Before proceeding to the configuration of the parameters, save the project by clicking the icon on the toolbar inside the red rectangle:

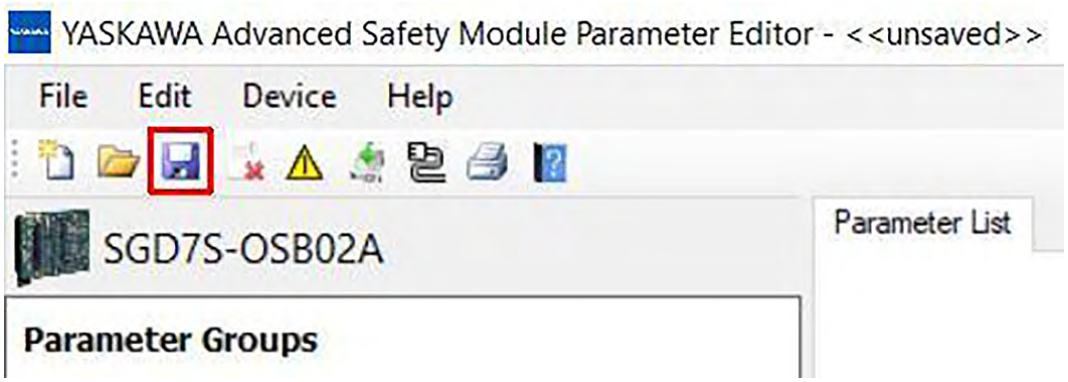


Fig. 18: Save the current project icon on the toolbar

In the *Save Project File* dialog, select the directory, enter a file name and click the button *Save*. Note that project files always have the file extension ***.asm7**.

*For path and file names, use only printable and permissible characters from the standard ASCII character set. Non-permissible standard ASCII characters are the following; > < : " / \ | ? **

The *Project Details* windowpane will now appear as shown below:

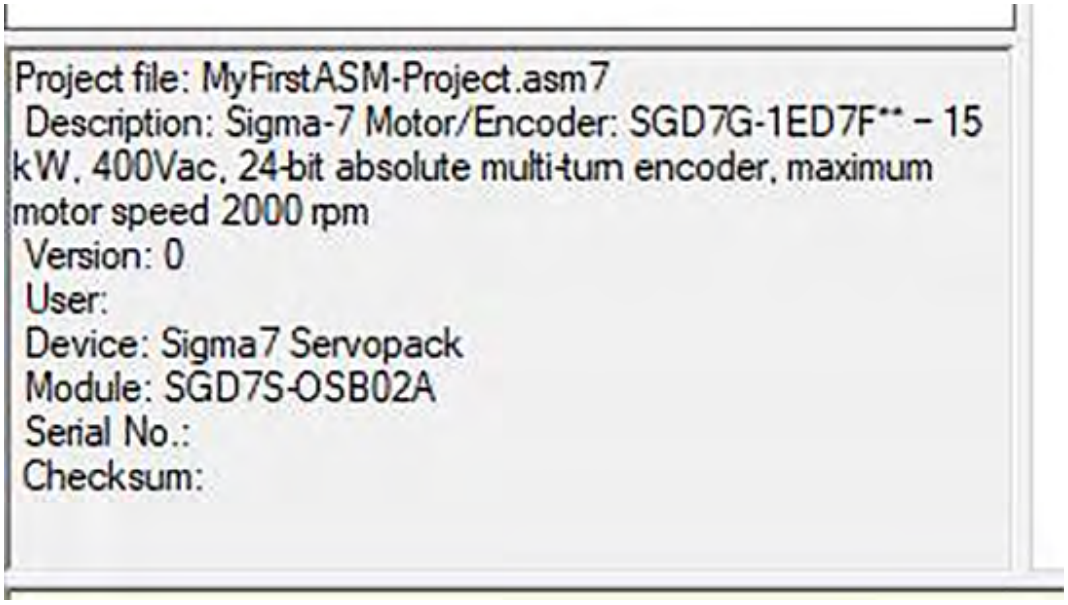


Fig. 19: The Project Details windowpane

3.7 Configuring the General Device Parameters

In the windowpane *Parameter Groups*, click the *General Device Parameters* group. The following dialog will appear as shown below:

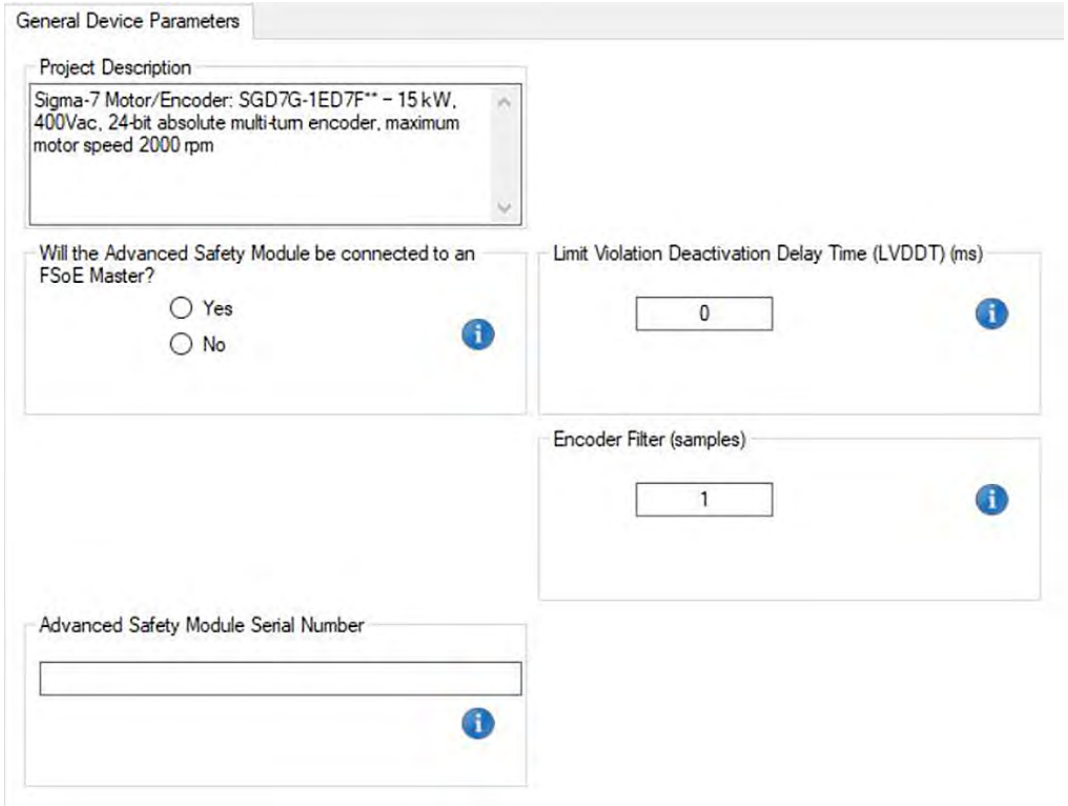


Fig. 20: The General Device Parameters dialog

In accordance with item 2 of the characteristics, features and requirements given above (*Chap. 3.5 'Example of Creating a New Advanced Safety Module Project File' page 23*), select *Yes* in the group box entitled *Will the Advanced Safety Module be connected to an FSoE Master?* and in the data entry field for the *FSoE Address* the hexadecimal value ***0x0007***.

Enter the value ***1000*** in the data entry field for Limit Violation Deactivation Delay Time (LVDDT). The parameter LVDDT is used to prevent output chatter. Click the icon ⓘ inside the group box for LVDDT for more information.

The parameter *Encoder Filter* is applicable only when the safety function SLA (**S**afely **L**imited **A**cceleration) will be used. Since SLA will not be implemented in this example project, leave the default value of 1 as is.

The *Advanced Safety Module Serial Number* consists of a total of 15 digits (2 characters and 13 numbers), e.g. D0207A000110004. Locate the serial number of the *Advanced Safety Module* to be deployed and enter it exactly in the applicable data entry field.

Upon completion of the project file, a safe parameter container can be generated which can then be downloaded to the Advanced Safety Module. The correct serial number is a prerequisite for the error-free download of the binary safe container to the Advanced Safety Module.

The completed dialog for *General Device Parameters* should now appear similar to the following (the *Project Description* and *Serial Number* are examples only):

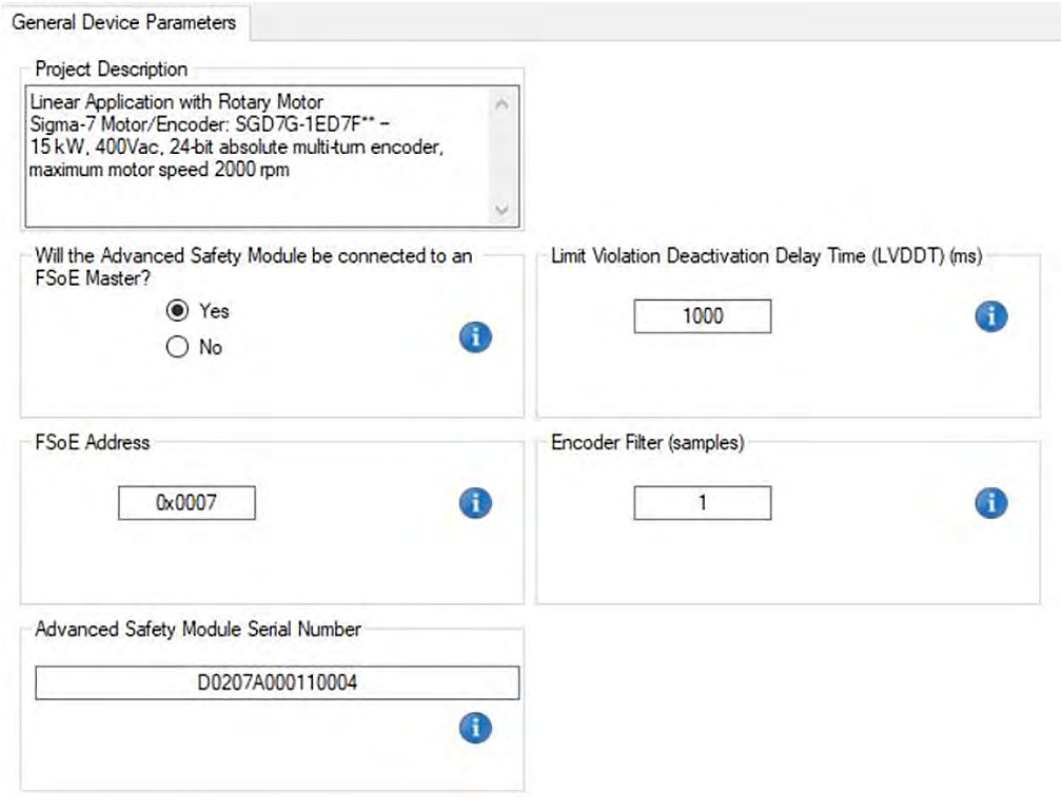


Fig. 21: Completed General Device Parameters dialog

Click the yellow Check and Commit button. The *Compare and Confirm* dialog will appear:

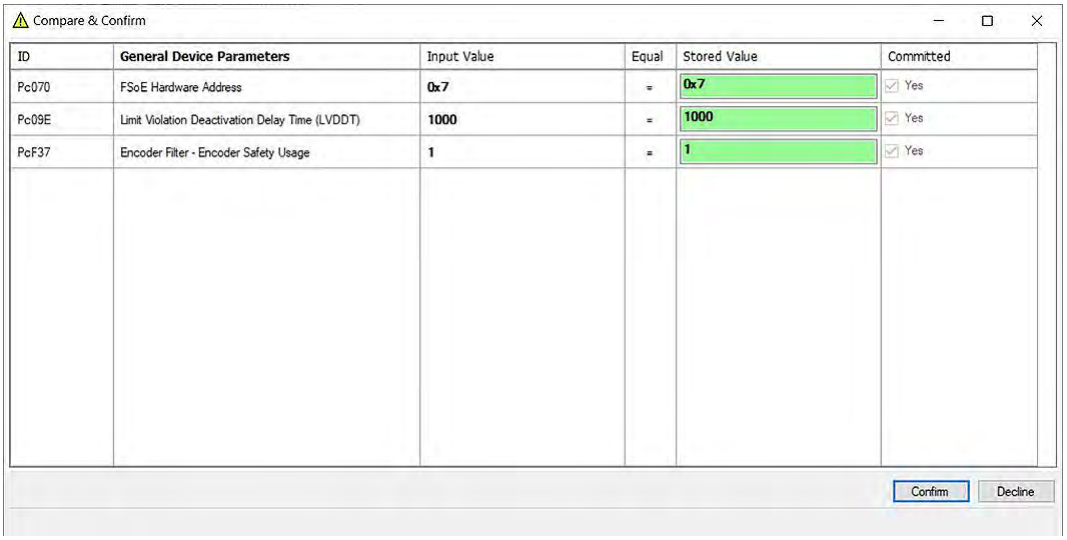


Fig. 22: Compare and Confirm dialog for the General Device Parameters

Since the *Input Values* and the *Stored Values* for the *FSoE Address*, *LVDDT* and *Encoder Filter* are identical, click the Confirm button and the *Compare and Confirm* dialog closes.

Important!
With respect to the General Device Parameters, once the Confirm button is clicked and this dialog closes, it is no longer possible to modify the selection "Will the Advanced Safety Module be connected to an FSoE Master?"

For further details concerning the Compare and Confirm procedure, please refer to the Online Help utility of the ASM Parameter Editor by simply clicking the icon on the toolbar inside the red rectangle:

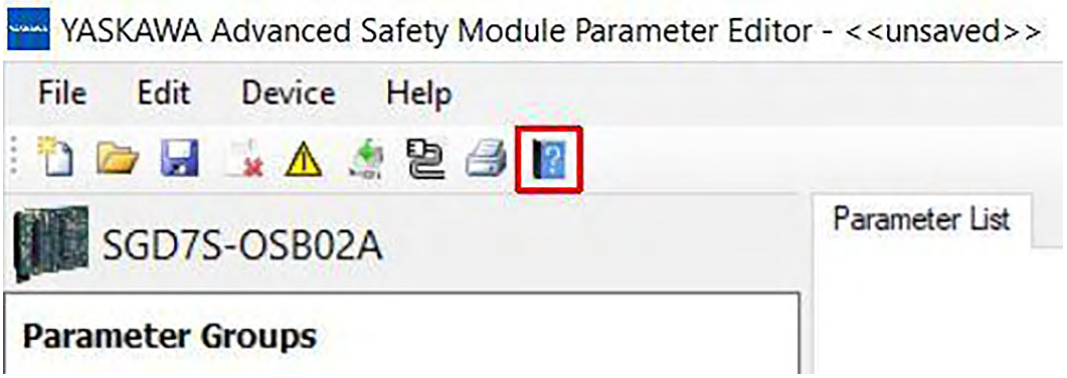


Fig. 23: Help icon on the toolbar

3.8 Configuring the Motor and Encoder Parameters

In the windowpane *Parameter Groups*, click the *Motor and Encoder Parameters* group.

In accordance with item 3 of the characteristics, features and requirements given above (↳ *Chap. 3.5 'Example of Creating a New Advanced Safety Module Project File' page 23*):

1. In the group box *Basic Application*, click **Linear Application**.
2. In the group box *Motor Type*, click **Rotary Motor**.
3. From the pull-down menu in the group box *Motor/Encoder Type*, select **SGM7G-***7***.
4. In the group box *Motor Encoder Usage*, click **Absolute Multi-Turn**. Leave the value of **65535** for *Multi-Turn Limit* as is – do not change.
5. In the group box *Motor Direction*, select **Forward (CCW)**. Note: Set Sigma-7 parameter Pn000.0 to 0.
6. In the group box *Motor Maximum Speed*, enter the value **2000**.
7. In the group box *External Encoder*, click **Used for safety only** and from the pull-down menu for *Serial Converter Type*, select **JZDP-J***-*****.
8. In the group box *External Encoder Direction*, click **Equal to Motor Encoder**. Tip: Click the icon ℹ inside the group box for *External Encoder Direction* for more detailed information on how to make the correct selection. Note: Set Sigma-7 parameter Pn00E.3 to 1.
9. In the group box *External Encoder Scale Pitch*, enter the value **2000**. (20/0.01 µm = 2000)
10. In the group box *Encoder Deviation*, enter the value **1000**.
11. In the group box *Encoder Deviation Window*, enter the value **1000**.
12. Within the displayed graphic are two data entry fields for *Gearbox Input* and *Gearbox Output*. Enter the value **10** in the *Gearbox Input* data entry field and enter the value **1** in the *Gearbox Output* data entry field.
13. In the group box *Linear Feed*, enter the ball screw pitch **6000**.
14. In the group box *User Units Input Mode*, leave the selection **Set the user units with graphical assistance** as is – do not change.

Upon completion of the selections and data entries listed above, the *Motor and Encoder Parameters* dialog will appear as shown below:

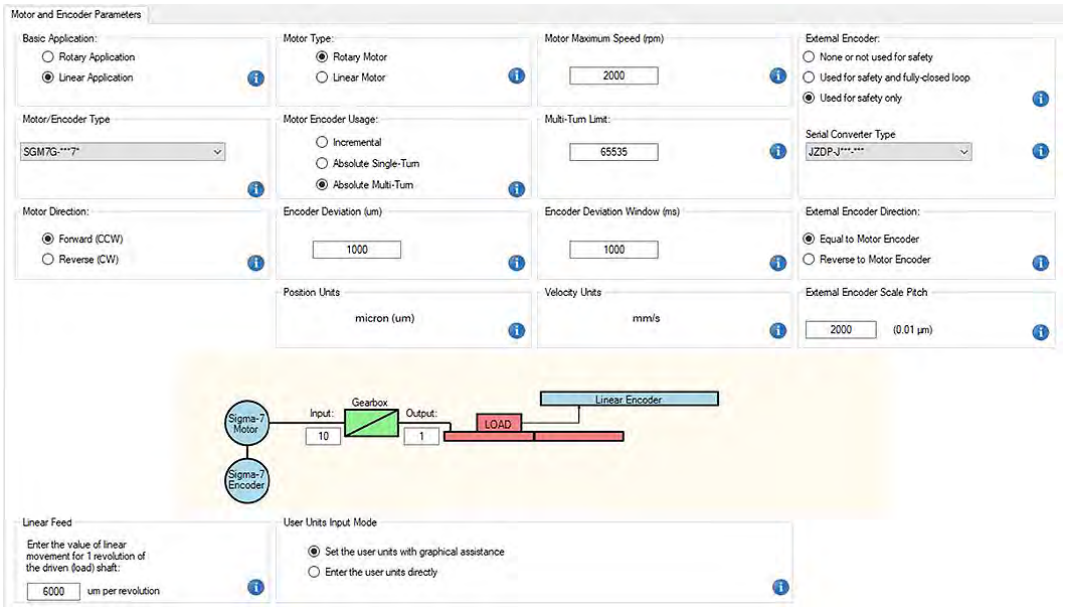


Fig. 24: Motor and Encoder Parameters dialog

Click the yellow **Check and Commit** button. The *Compare and Confirm* dialog will appear:

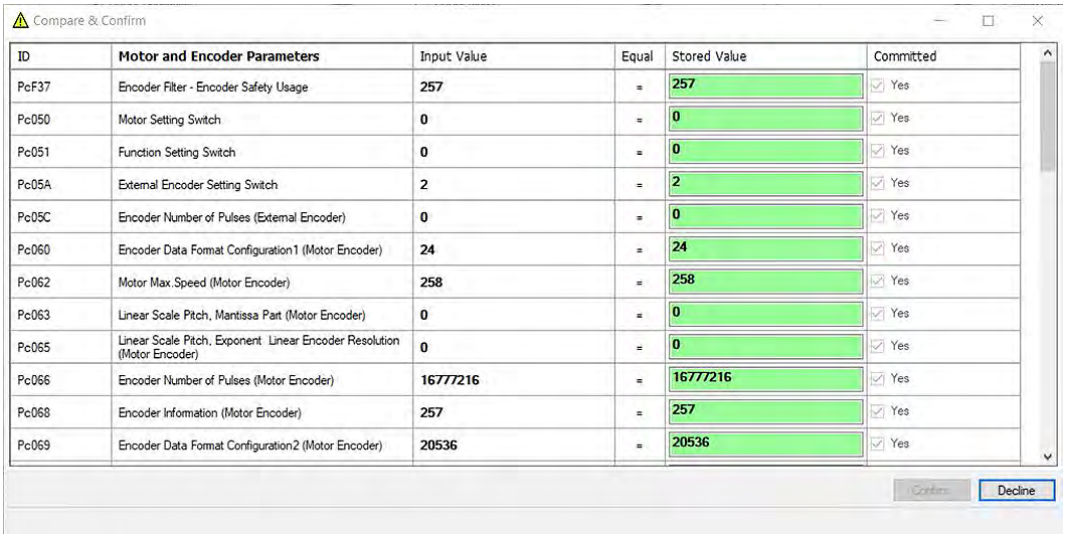


Fig. 25: Compare and Confirm dialog for the Motor and Encoder Parameters

Use the scrollbar at the right of the *Compare and Confirm* dialog and while scrolling down verify that the *Input Values* and the *Stored Values* are identical. It is necessary to scroll to the very bottom of the dialog in order to activate the *Confirm* button. If the *Input Values* and the *Stored Values* for the *Motor and Encoder Parameters* are identical, click the *Confirm* button and the *Compare and Confirm* dialog closes.

Important!
*Once the Confirm button is clicked and this dialog closes, **it is no longer possible to modify**:*

- *The Basic Application (Rotary or Linear Application)*
- *The Motor Type (Rotary or Linear Motor)*

3.9 Configuring the I/O Parameters

In the windowpane *Parameter Groups*, click the *I/O Configuration* parameters group.

Prior to proceeding with the I/O configuration, it is instructive to review the port functions available. In the pull-down menus for ports A to G, the function of the respective port can be selected. The following table shows which assignments are possible for which port.

I/O Port Function Types

Safe	Function Type	A	B	C	D	E	F	G1	G2
2-channel	Digital Input	●	●	●	●	●	●	–	–
2-channel	Digital Input Test Pulse A	–	●	●	●	●	●	–	–
2-channel	Digital Input Test Pulse B	●	–	●	●	●	●	–	–
2-channel	Analog Input (0-10V)	–	–	–	–	–	●	–	–
1-channel	Analog Input (4-20mA)	–	–	–	–	–	–	●	–
1-channel	Analog Input (PT1000)	–	–	–	–	–	–	–	●
2-channel	Digital Output	●	●	●	●	–	–	–	–

Safe	Function Type	A	B	C	D	E	F	G1	G2
no	Digital Output EDM	●	●	●	●	–	–	–	–
2-channel	Digital Output Test Pulse	●	●	–	–	–	–	–	–

● = Available

– = Not available

In addition, additional I/O port parameters are to be configured dependent upon the port function as shown in the following table:

I/O Port Parameter Dependencies

Port Function	Filter Time	Discrep-ancy Time	Test Pulse Length	Channel Tolerance
00: None	-	-	-	-
01: Digital Input	●	●	-	-
02: Digital Input Test Pulse A	●	●	-	-
03: Digital Input Test Pulse B	●	●	-	-
04: Analog Input (0-10V)	-	-	-	●
06: Analog Input (4-20mA and PT1000)	-	-	-	-
07: Digital Output	-	-	●	-
08: Digital Output EDM	-	-	-	-
09: Digital Output Test Pulse	-	-	●	-

In accordance with item 4 of the characteristics, features and requirements given above (↳ *Chap. 3.5 'Example of Creating a New Advanced Safety Module Project File' page 23*), the I/O Configuration will now be carried out:

1. In the group box *Port A Function*, click the pull-down menu and select ***Digital Output Test Pulse A***.
2. In the group box *Port A Test Pulse Length*, enter the value ***100*** in the data entry field.
3. In the group box *Port B Function*, click the pull-down menu and select ***Digital Output***.
4. In the group box *Port B Test Pulse Length*, enter the value ***50*** in the data entry field.
5. In the group box *Port C Function*, click the pull-down menu and select ***Digital Output EDM***.
6. In the group box *Port D Function*, click the pull-down menu and select ***Digital Input***.
7. In the group box *Port D Filter Time*, enter the value ***250*** in the data entry field.
8. In the group box *Port D Discrepancy Time*, enter the value ***150*** in the data entry field.
9. In the group box *Port E Function*, click the pull-down menu and select ***Digital Input Test Pulse A***.
10. In the group box *Port E Filter Time*, enter the value ***200*** in the data entry field.
11. In the group box *Port E Discrepancy Time*, enter the value ***150*** in the data entry field.

12. In the group box *Port F Function*, click the pull-down menu and select ***Analog Input (0-10Vdc)***.
13. In the group box *Port F Channel Tolerance*, enter the value ***5*** in the data entry field.
14. In the group box *Port G Function*, click the pull-down menu and select ***G1: 4-20mA, G2: PT1000***.

Upon completion of the selections and data entries listed above, the *I/O Configuration* parameters dialog will appear as shown below:

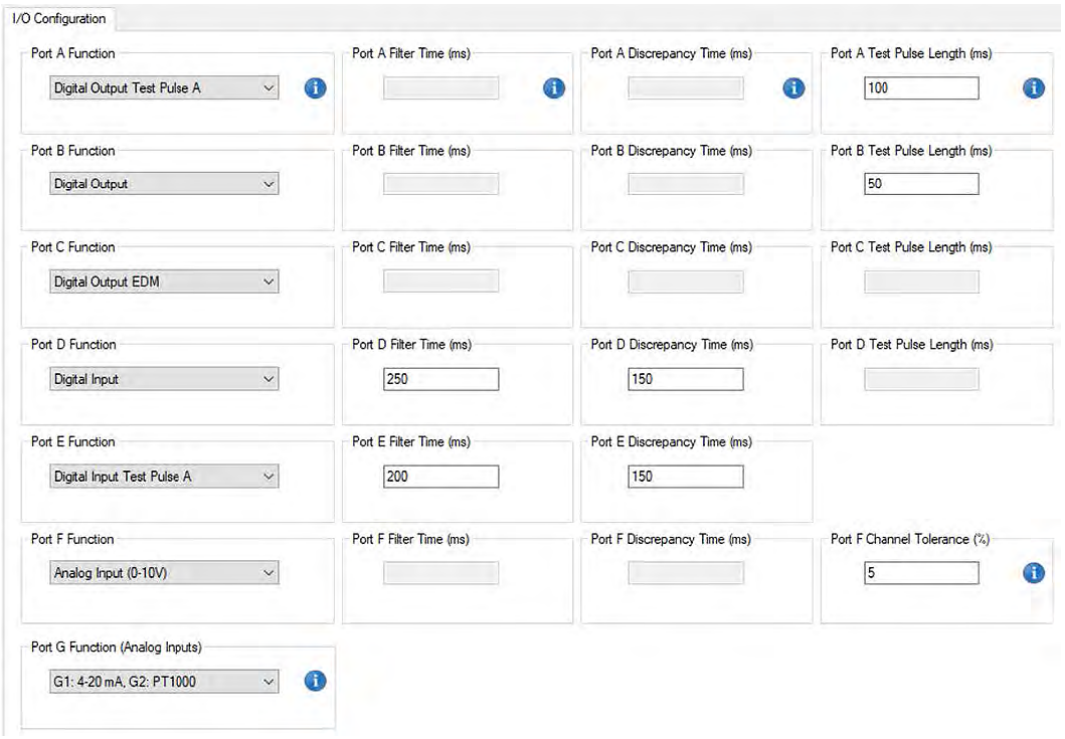


Fig. 26: Completed I/O Configuration parameters dialog

> ***Important!***
> *The Test Pulse Length parameterised for Port A must be shorter than the Filter Time parameterised at the corresponding input (to which the test pulse returns) – in this example Port E. If this is not the case, the signal received at the input is not interpreted as a test pulse, but rather as a signal which activates the safety function parameterised with this particular input.*

Click the yellow Check and Commit button. The *Compare and Confirm* dialog will appear:

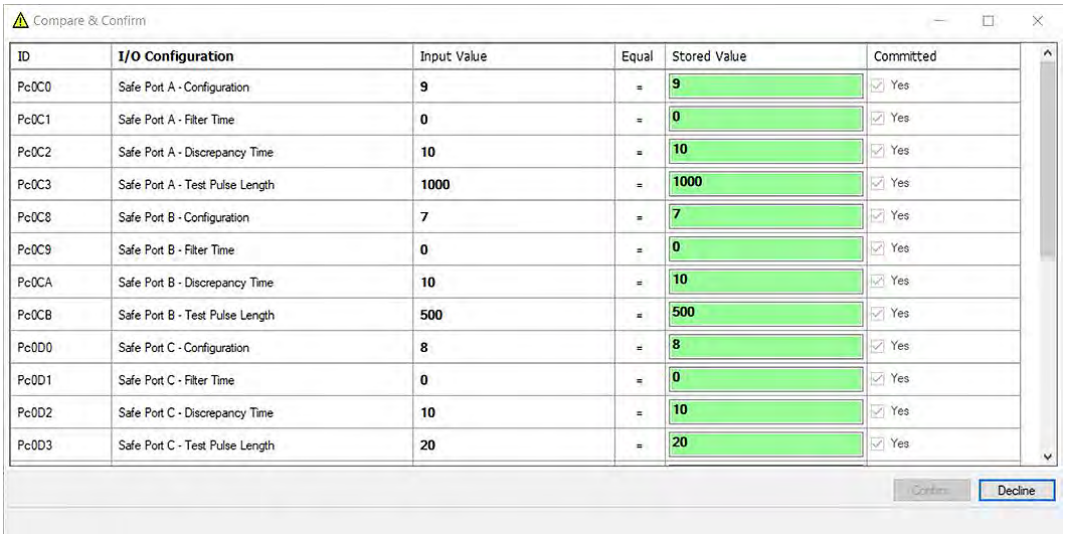


Fig. 27: Compare and Confirm dialog for the I/O Configuration parameters

Use the scrollbar at the right of the *Compare and Confirm* dialog and while scrolling down verify that the *Input Values* and the *Stored Values* are identical. It is necessary to scroll to the very bottom of the dialog in order to activate the *Confirm* button. If the *Input Values* and the *Stored Values* for the *I/O Configuration* parameters are identical, click the *Confirm* button and the *Compare and Confirm* dialog closes.

3.10 Configuring the Slot Parameters

For the sake of convenience, the characteristics, features and requirements for safety slot configuration (item 5, ↬ *Chap. 3.5 'Example of Creating a New Advanced Safety Module Project File' page 23*) are given below:

- One slot with safety function **SLS** (Safely Limited Speed) – a "safe motion" type safety function
- One slot with safety function **SS1-r** (Safe Stop 1, deceleration monitored and time controlled) – a "safe standstill" type safety function (aka a *stopping* method – this slot will be "linked" to the above slot via a "Limit Violation")
- One slot with safety function **SMT** (Safe Motor Temperature) – a "safe monitoring" type safety function

In accordance with the given above requirements, the safety slot configuration will now be undertaken beginning with *Slot 1*:

1. In the windowpane *Parameter Groups*, click the *Slot 1 Parameters* group.
2. In the group box *Safety Function*, click the pull-down menu and select ***SLS***.
3. In the group box *Activation Input*, click the pull-down menu and select ***Virtual Input 0***.
4. In the group box *Output Signal Type*, click the pull-down menu and select ***Safe Port B: Digital Output***.
5. In the group box *Output Signal Behaviour*, click the pull-down menu and select ***LOW during safe state***.
6. In the group box *Waiting Time t1*, enter the value ***1000*** in the data entry field.
7. In the group box *Monitoring Time t2*, enter the value ***3000*** in the data entry field.
8. In the group box *Speed Limit s1*, enter the value ***1000*** in the data entry field.
9. In the group box *Speed Limit s2*, enter the value ***100*** in the data entry field.

Upon completion of the selections and data entries listed above for Slot 1, the Slot 1 Parameters dialog will appear as shown below:

Fig. 28: Completed Slot 1 Parameters dialog

Click the yellow **Check and Commit** button. The *Compare and Confirm* dialog will appear:

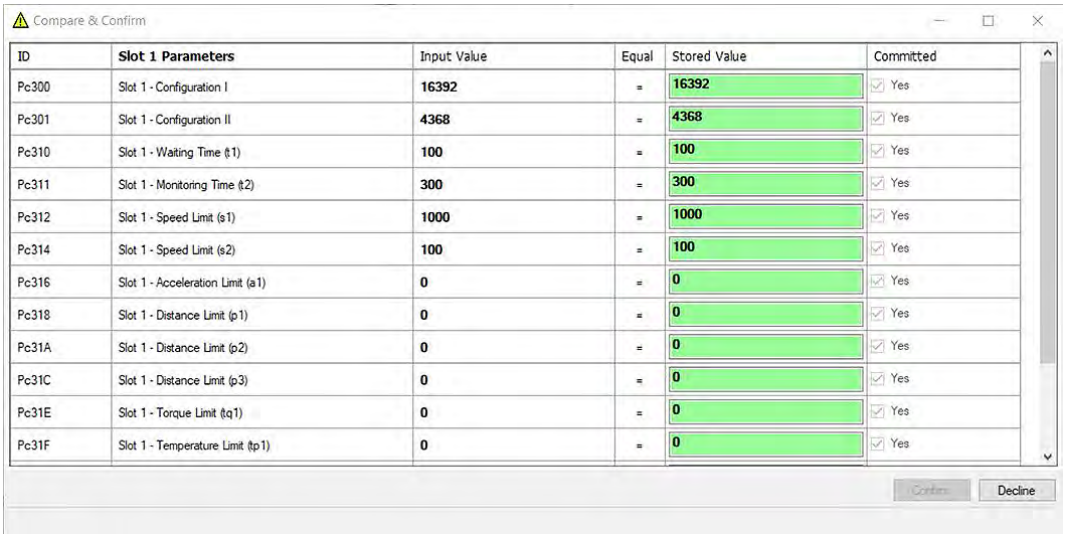


Fig. 29: Compare and Confirm dialog for the Slot 1 Parameters

Use the scrollbar at the right of the *Compare and Confirm* dialog (if necessary) and while scrolling down verify that the *Input Values* and the *Stored Values* are identical. It is necessary to scroll to the very bottom of the dialog in order to activate the *Confirm* button. If the *Input Values* and the *Stored Values* for the *Slot 1 Parameters* are identical, click the *Confirm* button and the *Compare and Confirm* dialog closes.

Continuing with the configuration of the *Slot 2 Parameters*:

1. In the windowpane *Parameter Groups*, click the *Slot 2 Parameters* group.
2. In the group box *Safety Function*, click the pull-down menu and select ***SS1-r***.

3. In the group box *Activation Input*, click the pull-down menu and select ***Limit Violation Slot 1***.
4. In the group box *Output Signal Type*, click the pull-down menu and select ***Virtual Output 0***.
5. In the group box *Output Signal Behaviour*, click the pull-down menu and select ***HIGH during working safety function***.
6. In the group box *Waiting Time t1*, enter the value ***500*** in the data entry field.
7. In the group box *Monitoring Time t2*, enter the value ***1500*** in the data entry field.
8. In the group box *Speed Limit s1*, enter the value ***100*** in the data entry field.
9. In the group box *Speed Limit s2*, enter the value ***10*** in the data entry field.

Upon completion of the selections and data entries listed above for *Slot 2*, the *Slot 2 Parameters* dialog will appear as shown below:

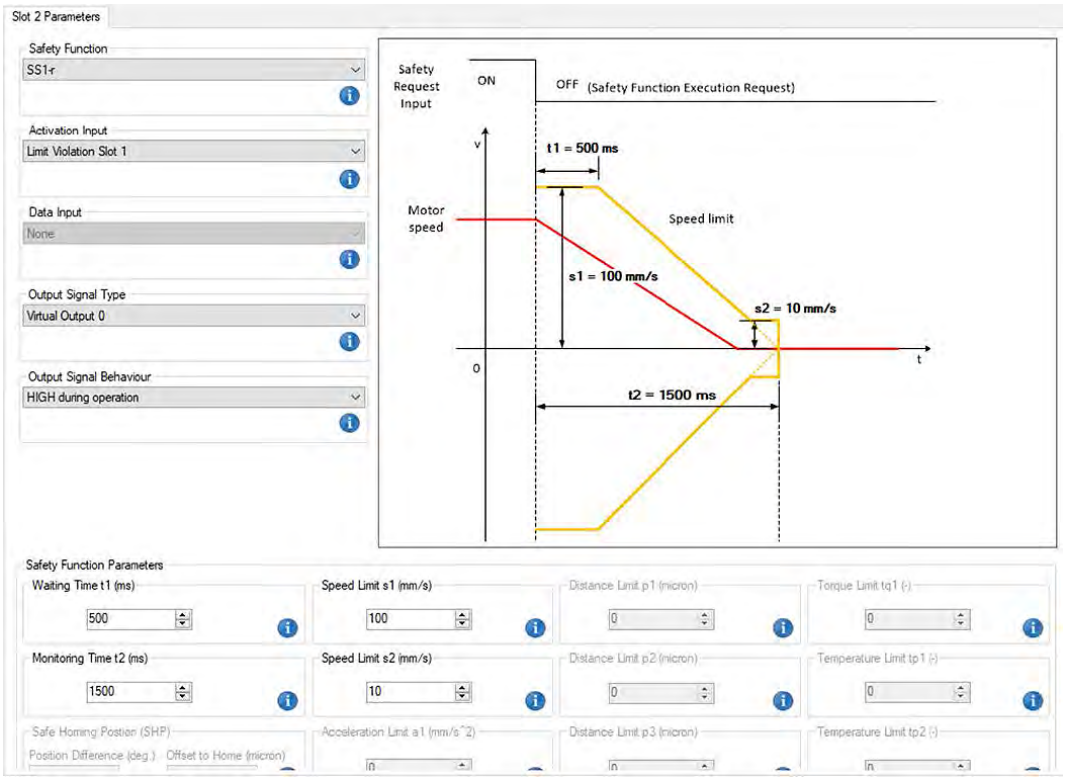


Fig. 30: Completed Slot 2 Parameters dialog

Click the yellow Check and Commit button. The *Compare and Confirm* dialog will appear:

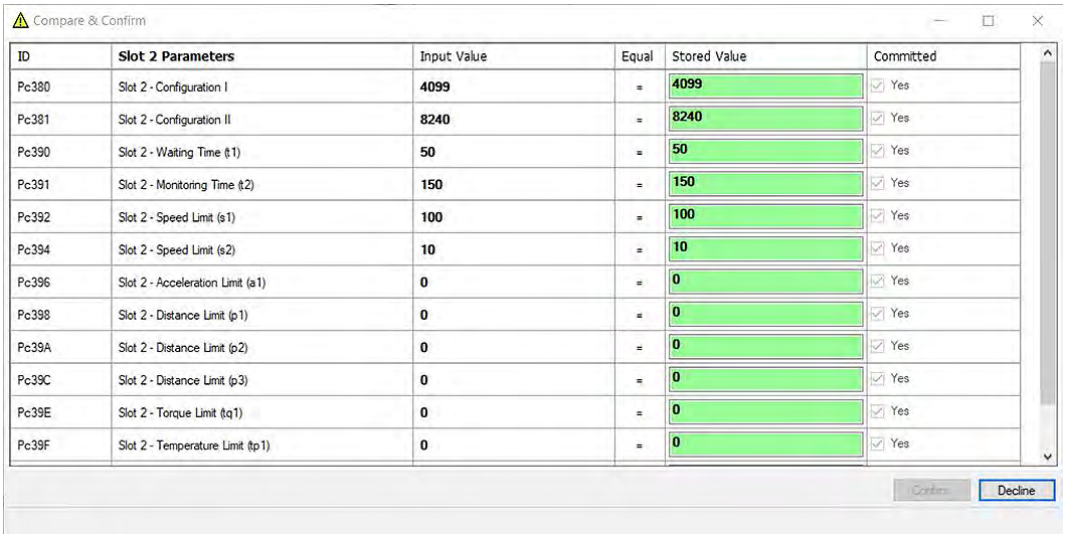


Fig. 31: Compare and Confirm dialog for the Slot 2 Parameters

Use the scrollbar at the right of the *Compare and Confirm* dialog (if necessary) and while scrolling down verify that the *Input Values* and the *Stored Values* are identical. It is necessary to scroll to the very bottom of the dialog in order to activate the *Confirm* button. If the *Input Values* and the *Stored Values* for the *Slot 2 Parameters* are identical, click the *Confirm* button and the *Compare and Confirm* dialog closes.

Continuing with the configuration of the *Slot 3 Parameters*:

1. In the windowpane *Parameter Groups*, click the *Slot 3 Parameters* group.
2. In the group box *Safety Function*, click the pull-down menu and select ***SMT***.
3. In the group box *Activation Input*, click the pull-down menu and select ***Safe Port D: Digital Input***.
4. In the group box *Data Input*, click the pull-down menu and observe the available choices: *Safe Port F: Analog Input (0-10Vdc), Port G1: Analog Input (4-20mA), Port G2: PT1000*. Select ***Port G2: PT1000***.
5. In the group box *Output Signal Type*, click the pull-down menu and select ***Port C2: EDM Output***.
6. In the group box *Output Signal Behaviour*, click the pull-down menu and select ***HIGH after limit violation***.
7. In the group box *Temperature Limit tp1*, enter the value ***150*** in the data entry field.
8. In the group box *Temperature Limit tp2*, enter the value ***100*** in the data entry field.

Upon completion of the selections and data entries listed above for Slot 3, the Slot 3 Parameters dialog will appear as shown below:

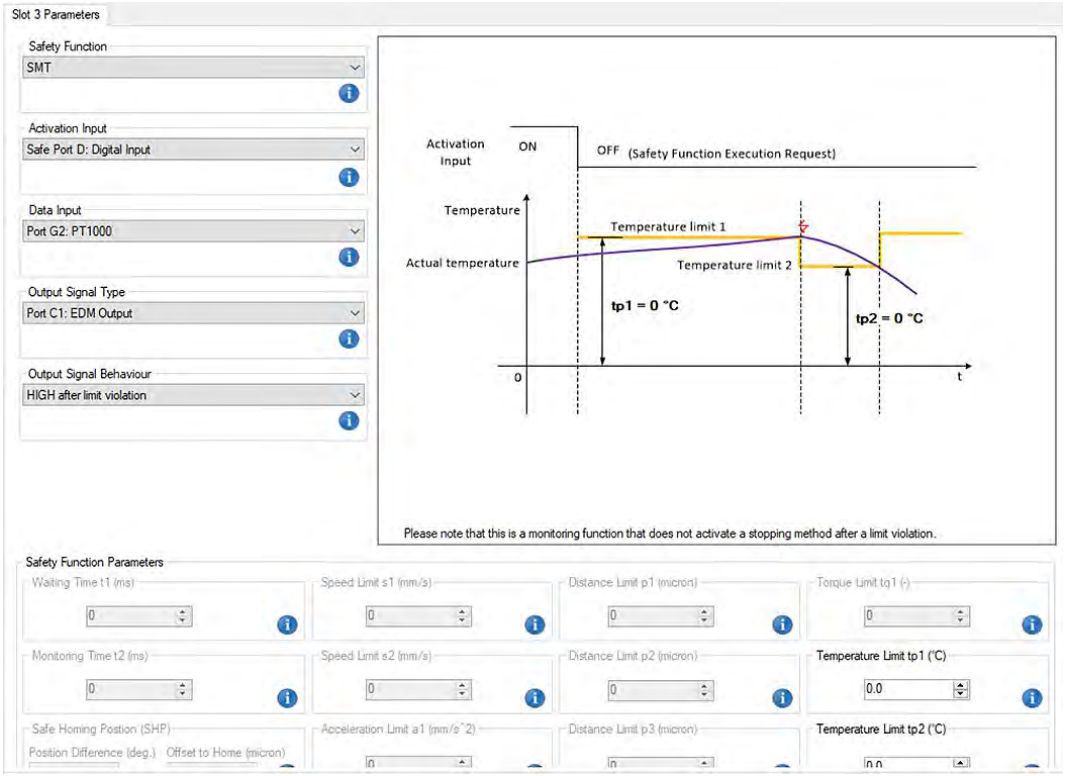


Fig. 32: Completed Slot 3 Parameters dialog

Click the yellow **Check and Commit** button. The *Compare and Confirm* dialog will appear:

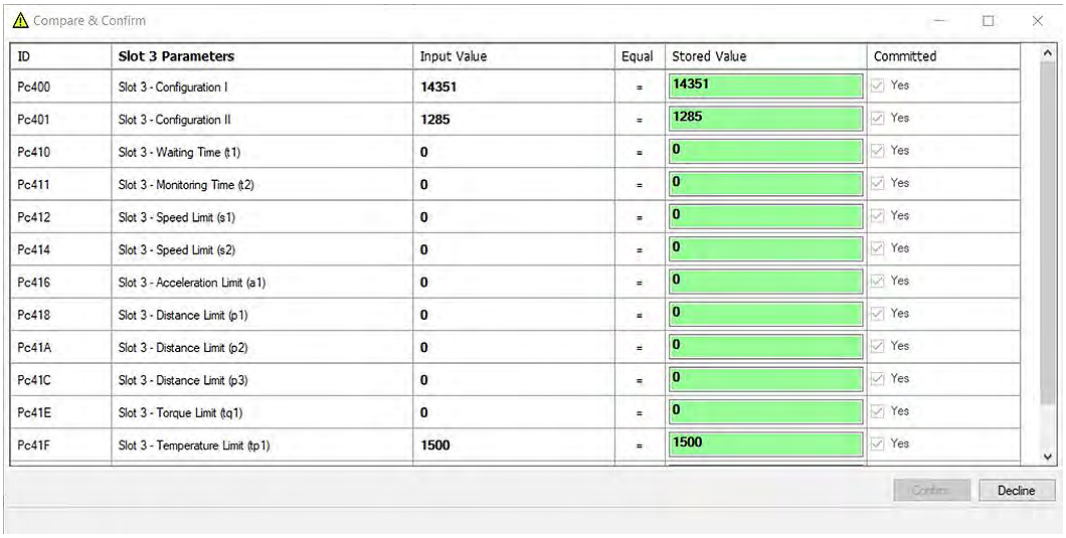


Fig. 33: Compare and Confirm dialog for the Slot 3 Parameters

Use the scrollbar at the right of the *Compare and Confirm* dialog (if necessary) and while scrolling down verify that the *Input Values* and the *Stored Values* are identical. It is necessary to scroll to the very bottom of the dialog in order to activate the *Confirm* button. If the *Input Values* and the *Stored Values* for the *Slot 3 Parameters* are identical, click the *Confirm* button and the *Compare and Confirm* dialog closes.

The configuration and parameterisation of the example project is now complete. Before proceeding with the creation of a safe parameter container, save the project by clicking the icon on the toolbar inside the red rectangle:

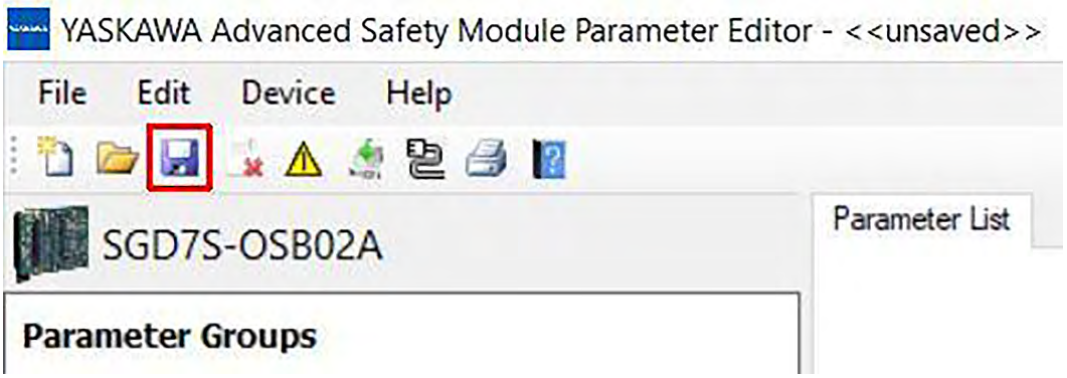


Fig. 34: Save the current project icon on the toolbar

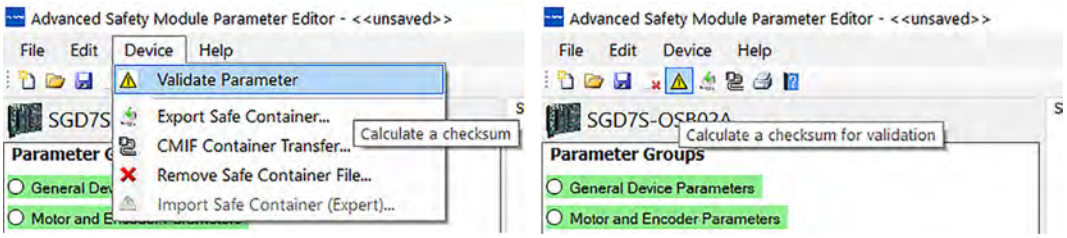
*For path and file names, use only printable and permissible characters from the standard ASCII character set. Non-permissible standard ASCII characters are the following; > < : " / \ | ? **

3.11 Generating Parameter Files

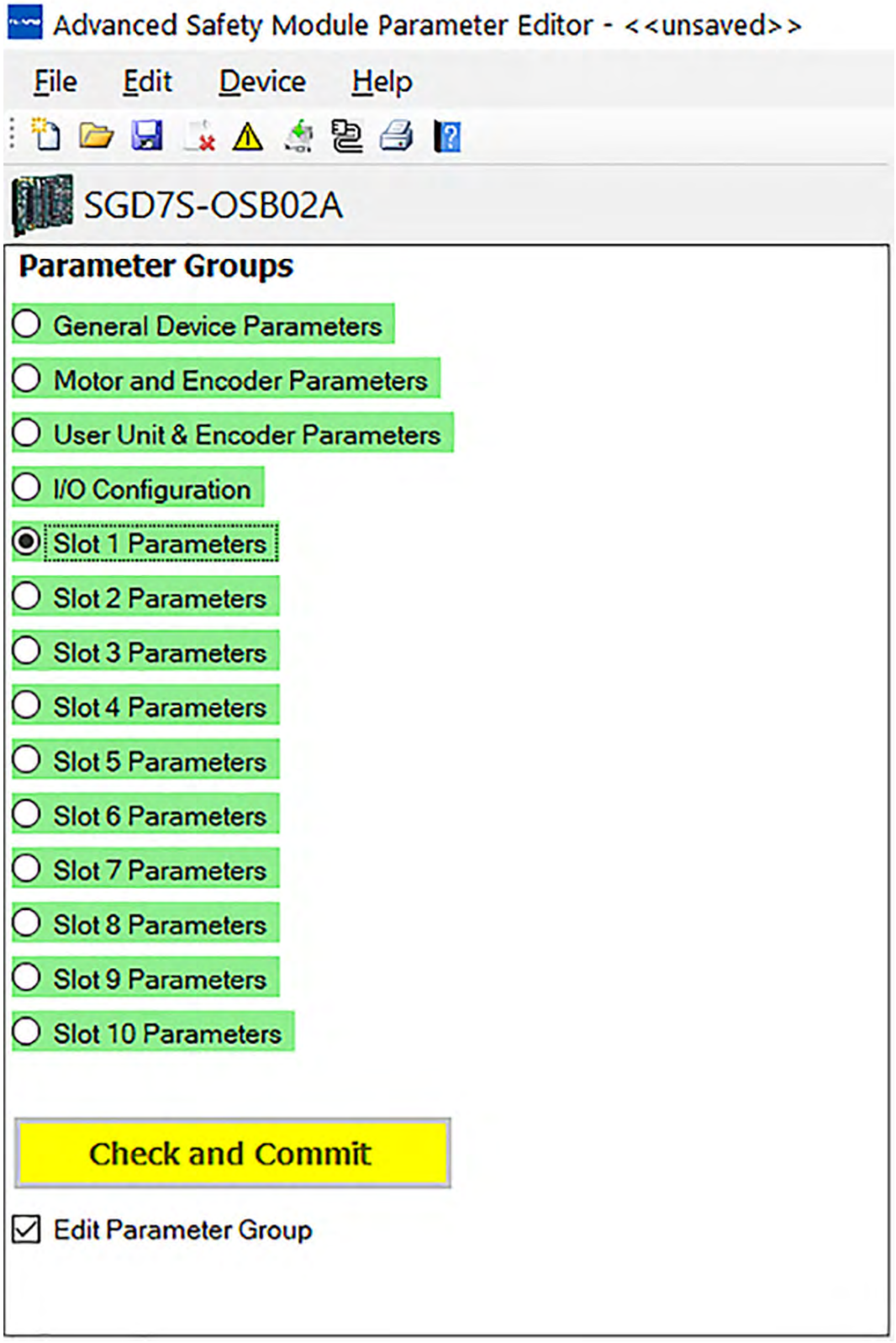
After completion of the parameter configuration and all parameters have been checked and committed, a validation check (which includes a final plausibility check) can be performed. Upon successful validation, a checksum is generated. When subsequently creating the Safe Parameter Container, this checksum is applied to the safe container in order to "protect" its contents. Prior to creation of a safe container, it is essential that a successful validation check is performed.

To do this, press the *Validate Parameter* button in the *Device* menu or the button shown in the following figure in the toolbar.

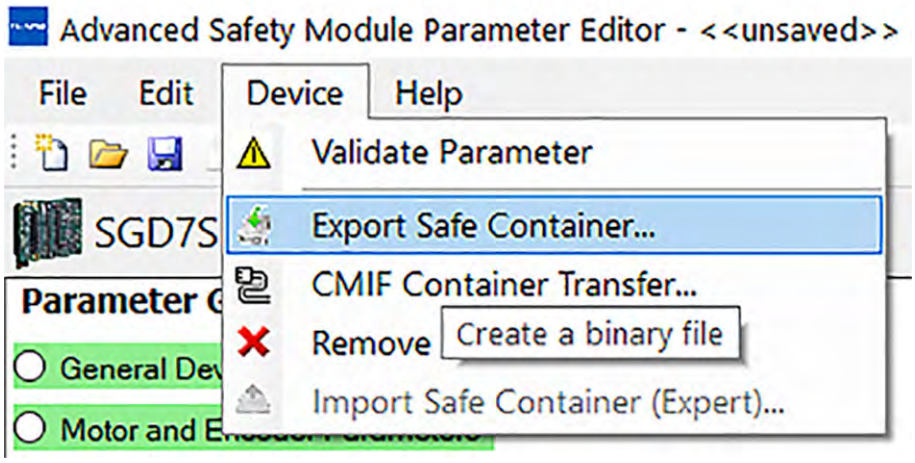
It is not mandatory to first click on the Validate Parameter menu item from the menu bar or directly on the icon with the warning triangle in the toolbar. When clicking on the Export Safe Container item in the menu bar or directly on the corresponding icon in the toolbar, a validation check is first performed automatically. The user can therefore skip the Validate Parameter step and proceed directly to the Export Safe Container step. If the validation fails, no Safe Container will be created.



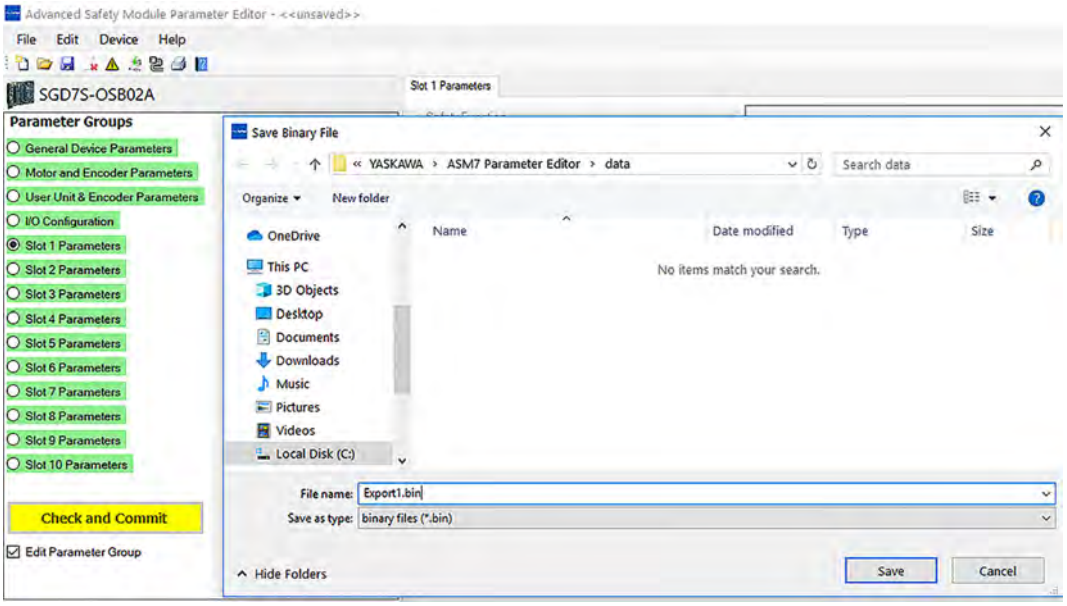
If the validation check was successful, the tool displays the message "CRC calculation successful: ...." with the resulting CRC32 checksum for the safe parameter container in the message log. If the validation fails, an error message is displayed.



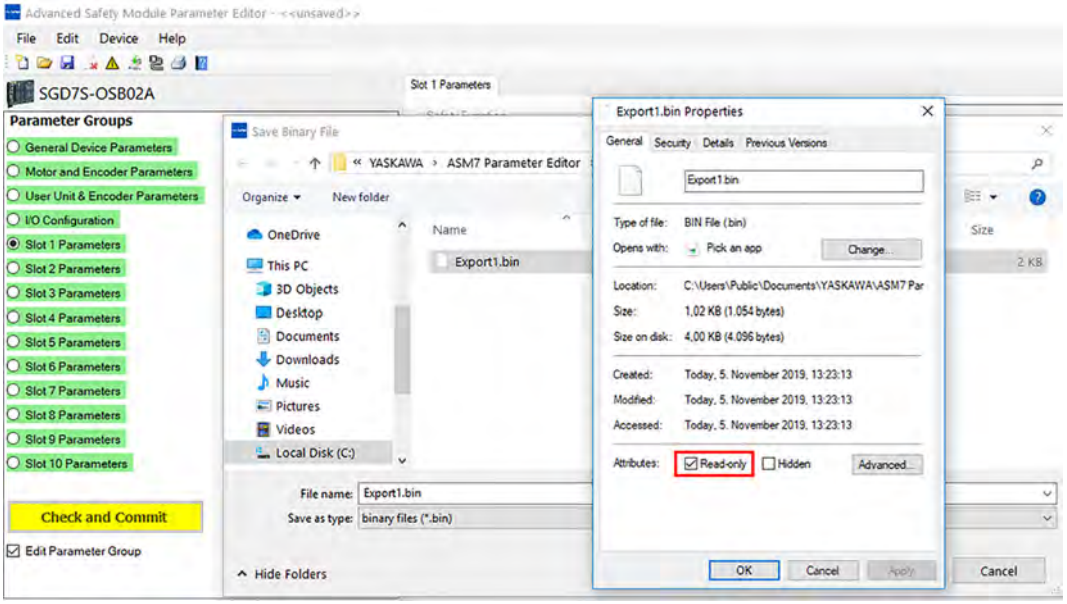
If the parameter validation was successful, a binary safe container file can be generated. This is done by pressing the *Export Safe Container* button.



The tool opens a file save dialogue to enter the desired file name in the current output directory. The default extension for the parameter files is ".bin", which indicates binary content.



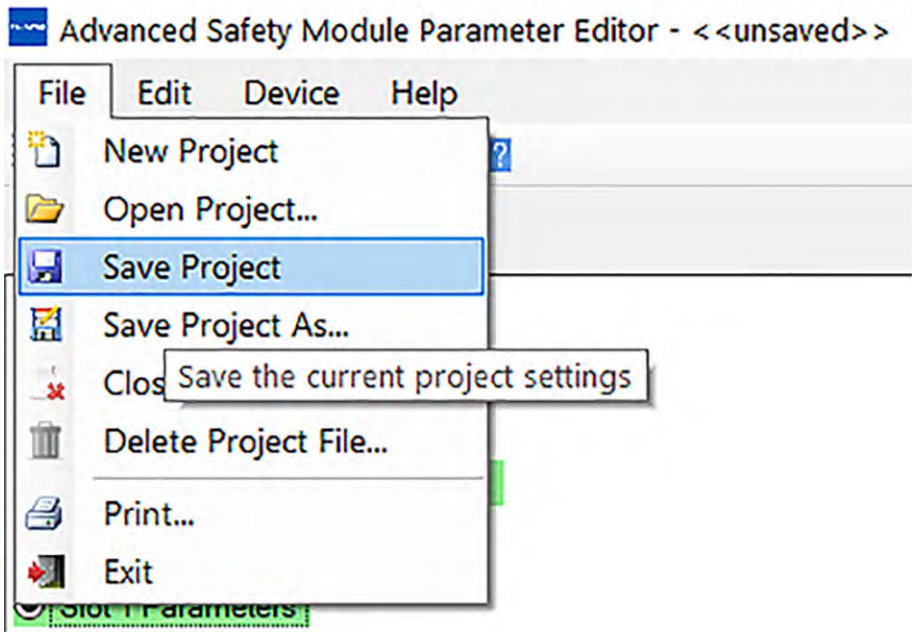
The parameter files are set to read-only after export to prevent accidental deletion. If the same file is to be overwritten, the write protection must be removed. This can be done in the file save dialogue by right-clicking on the existing file and removing the read-only property as shown in the following figure.

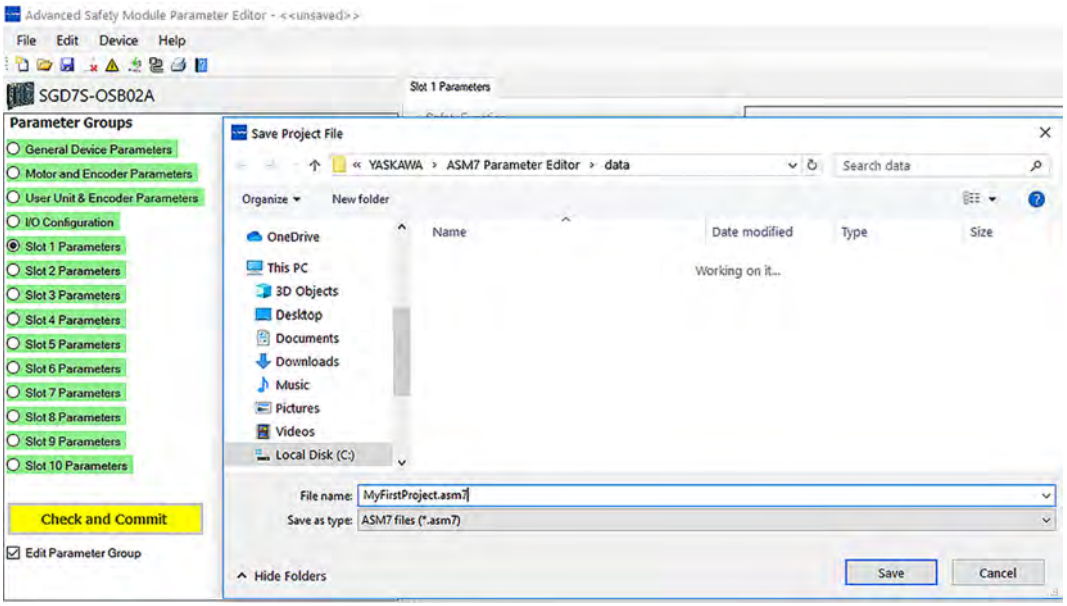


The tool increments an internal version counter and writes this value to **both** the project file and to the binary safe parameter container when the following steps have been executed:

1. A parameter value has been modified.
2. The modified parameter value has been checked and committed.
3. A new binary safe parameter container is generated.
4. The project is saved.

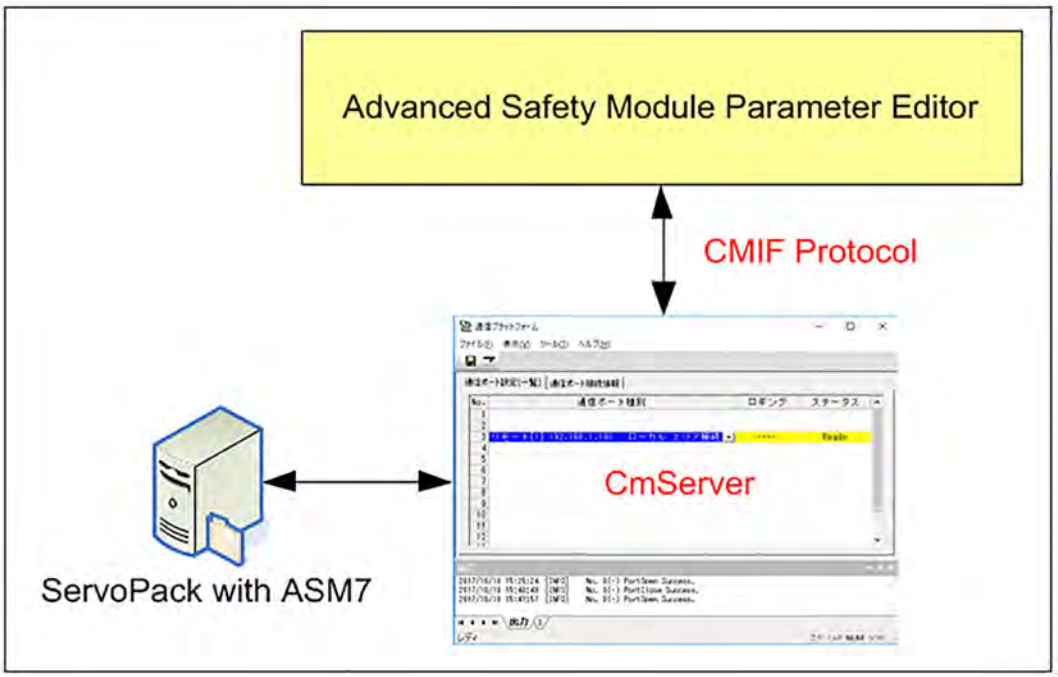
The last step completes the configuration. Save the project before closing the tool.





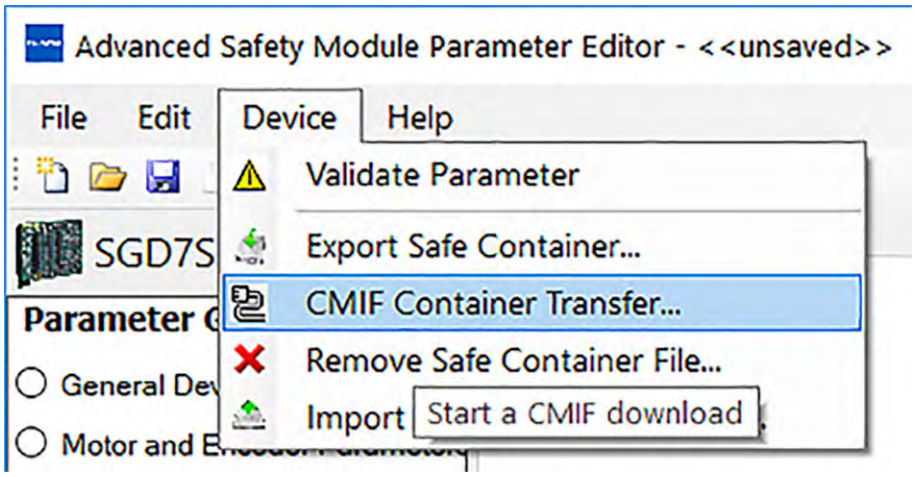
3.12 CMIF Container Transfer

The generated parameter files can be downloaded to the Advanced Safety Module. The Advanced Safety Module Parameter Editor offers a direct download function via the CMIF interface to the SERVOPACK CmServer. Therefore, the PC with the installed tool requires the installation of SigmaWin+ Version 7.40 (or later) including the communication service CmServer.



Communication with the SERVOPACK is only possible when one and only one software program uses the designated interface (typically USB). For example, it is not possible to have an online connection to the SERVOPACK using SigmaWin+ and simultaneously use the Safe Container Download function of the Advanced Safety Module Parameter Editor. Otherwise, communication will fail. Either close SigmaWin+ or close the Safe Container Download window of the Advanced Safety Module Parameter Editor.

By clicking on *CMIF Container Transfer* in the *Device* menu the following download dialogue is displayed.



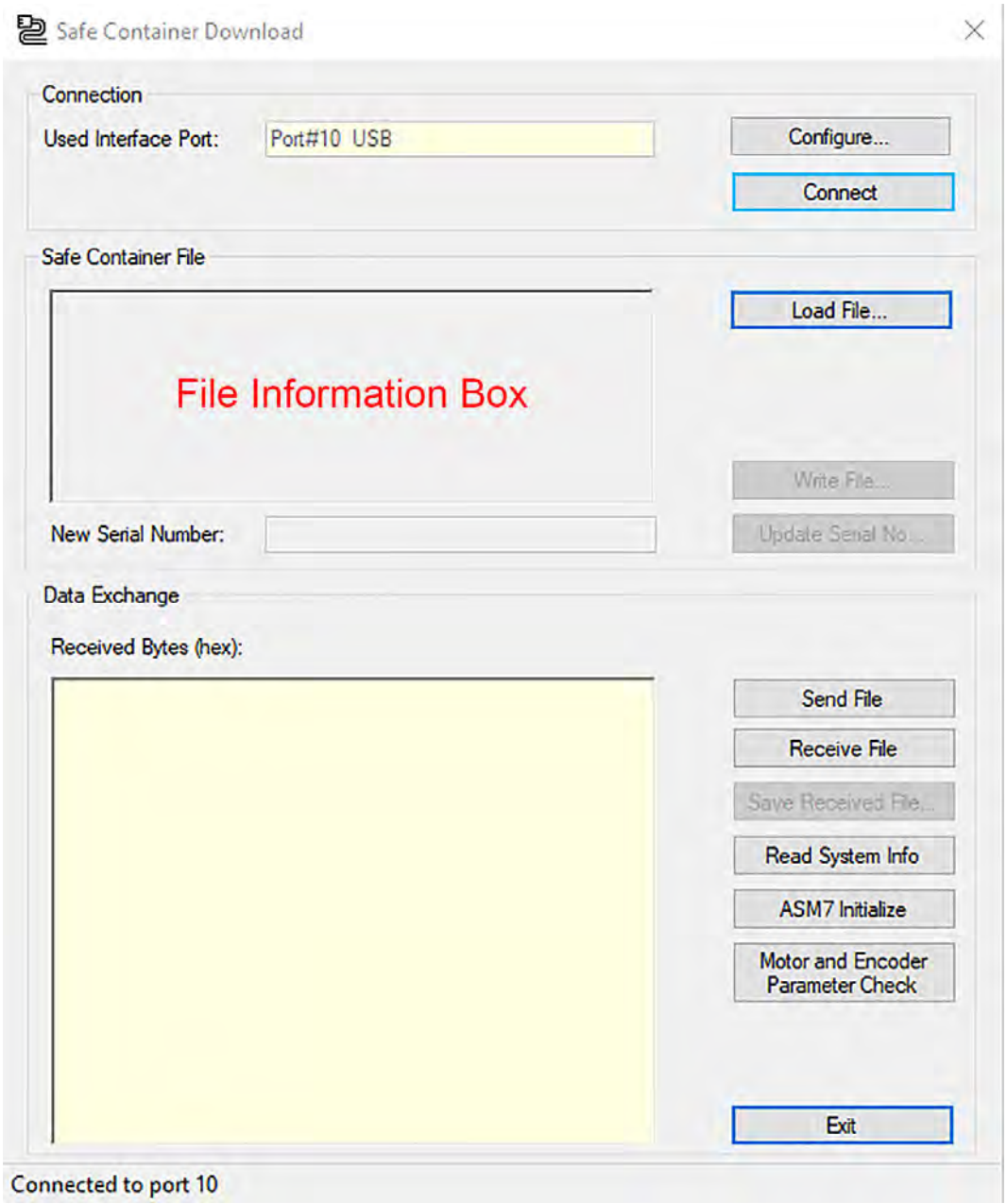
Downloading a safe container file to the Advanced Safety Module

1. Configure the connection to the SERVOPACK.

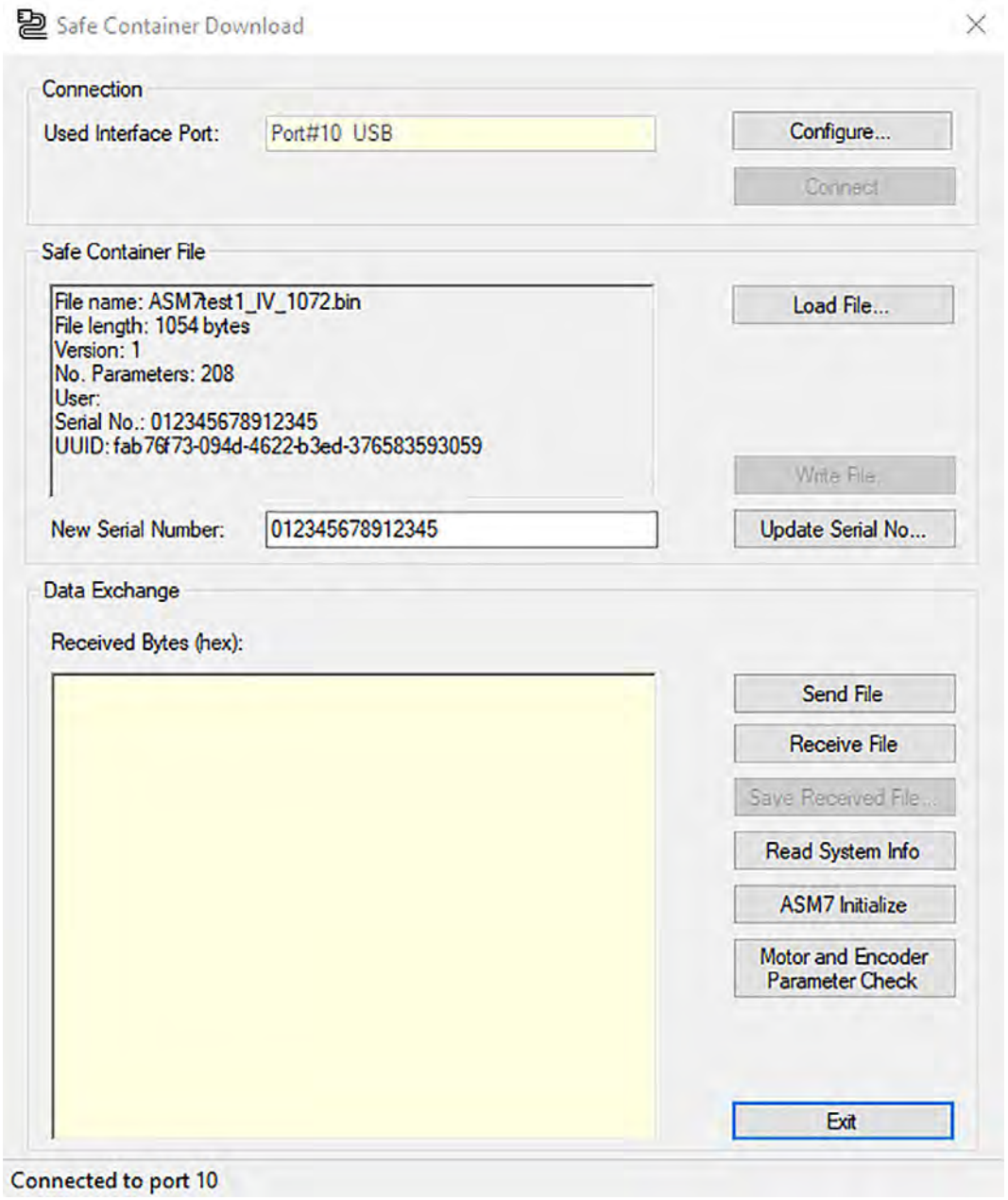
   At present, the port to which the SERVOPACK is connected can be only the USB port (Port#10 USB). Do NOT select an Ethernet connection!

2. Click on the *Connect* button to connect the SERVOPACK.

3. When the connection is established, click on the *Load File...* button at the top right of the dialogue.



4. Select the desired file in the *Load Safe Container File* dialogue. The serial number currently associated with the safe container file is displayed in the file information box and in the *New Serial Number* data entry field.



5. Determine the serial number of the connected Advanced Safety Module. If the serial number of the connected Advanced Safety Module matches the serial number displayed as described step 4, proceed to step 6.

   If the serial number of the connected Advanced Safety Module differs from the serial number displayed as described in step 4, the safe container file must be updated with the serial number of the connected Advanced Safety Module.

   Click the *Update Serial No...* button to apply the new serial number to the safe container file.

   The new serial number will be shown in the file information box (and in the *New Serial Number* data entry field) and will be applied to the safe container file for sending. Writing this serial number to the safe container file is not required. If, however, it is desired to make this serial number persistently associated with the safe container file, click the button *Write File*.

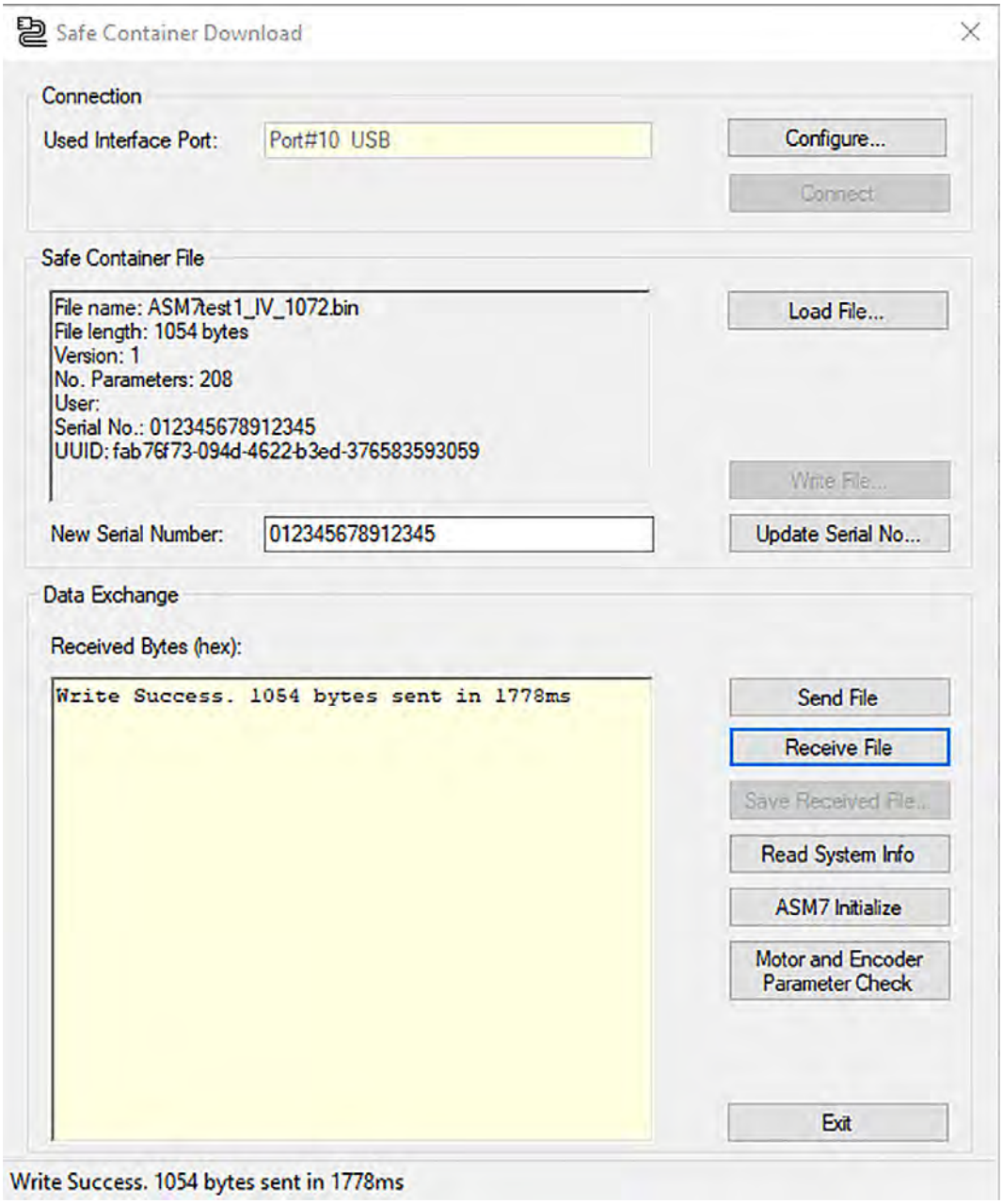
   

   Important information for machine manufacturers engaged in serial production

   It is possible to assign a serial number without having to save the safe container file again and again for each and every machine axis. Use the one applicable safe container file and update the serial number as required for the whole series. If identical machine axes are to be furnished with the same safe container file, the serial number is entered during the download (see step 5 above) without having to save a new safe container file.

6. Click on the *Send File* button to start the download.

7. When the download is completed successfully, a *Write Success* message will be displayed.



Uploading a safe container file from the connected Advanced Safety Module

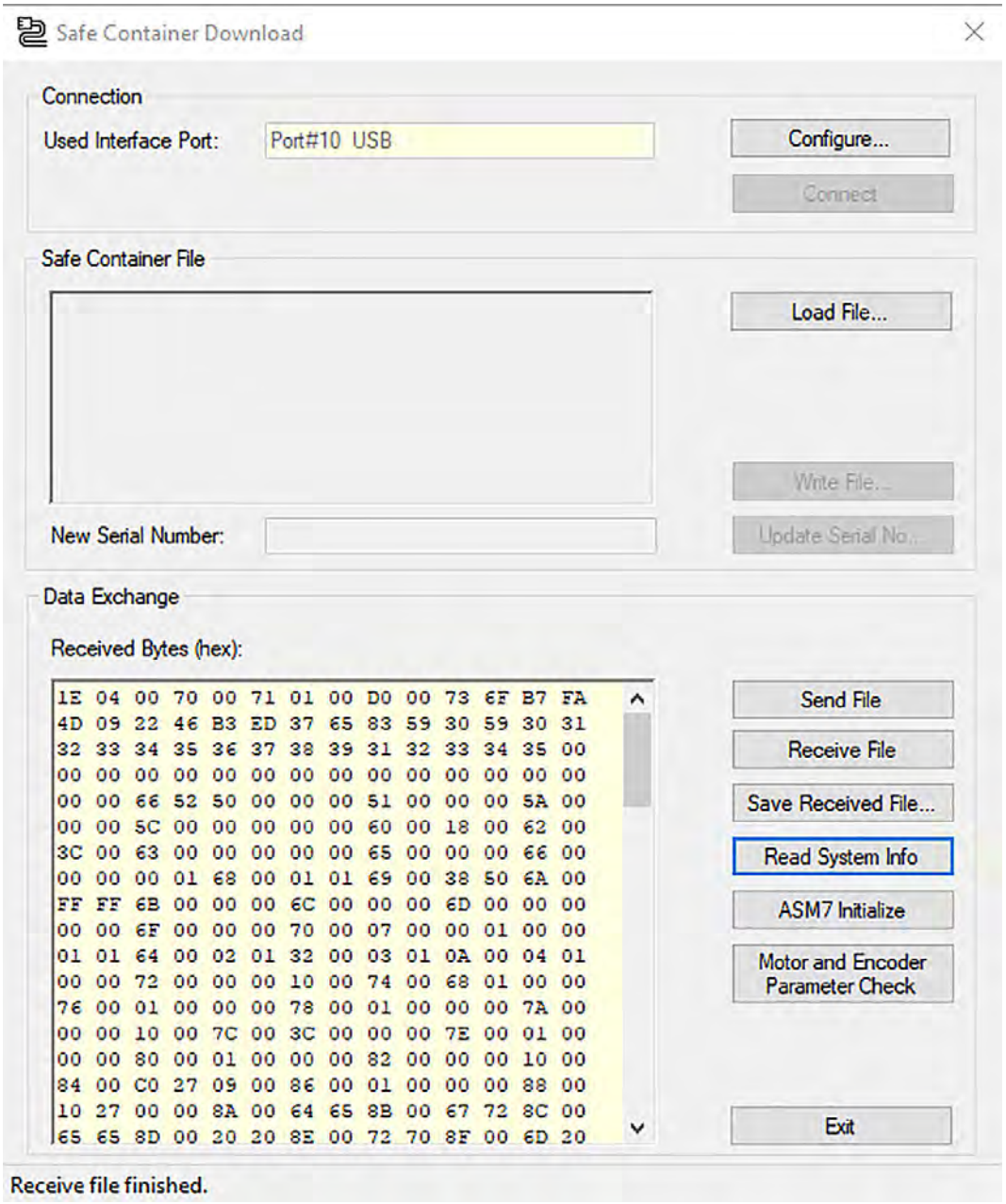
In addition to downloading, it is also possible to upload a parameter file from the connected Advanced Safety Module.

1. Configure the connection to the SERVOPACK.

> *At present, the port to which the SERVOPACK is connected can be only the USB port (Port#10 USB). Do NOT select an Ethernet connection!*

2. Click on the *Connect* button to connect the SERVOPACK.

3. When the connection is established, click on the *Receive File* button to start the upload.
4. If the upload was successful, save the received container file by clicking on the *Save Received File* button.



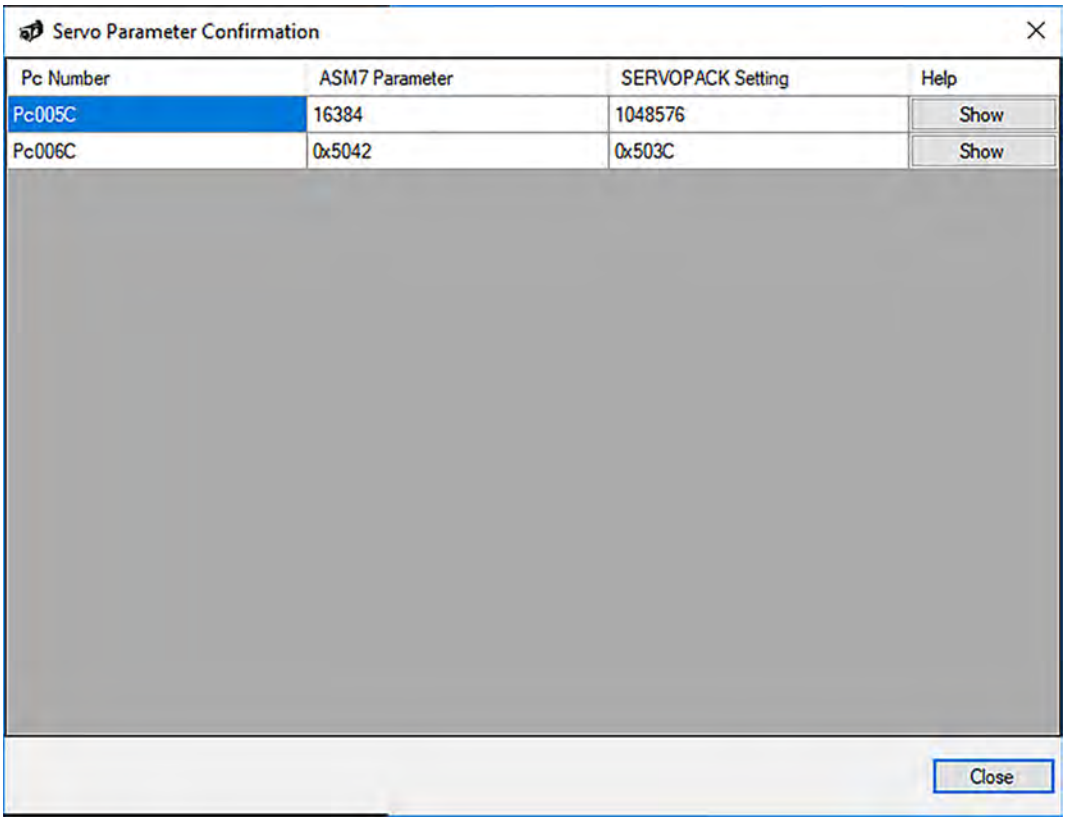
Motor and Encoder Parameter Check button (Servo Parameter Confirmation)

The safety-related servo parameters contain information about the motor and encoder configuration of the SERVOPACK and are managed by the Advanced Safety Module. This information is held in the SERVOPACK, but it is also managed in the Advanced Safety Module with different parameter numbers.

When the unit consisting of SERVOPACK and Advanced Safety Module is switched on, the values of this parameter group stored in the SERVOPACK are compared with the values of the corresponding parameters in the Advanced Safety Module. If the values do not match, alarm A.EC1 (Safety-related Servo Parameter Unmatch Alarm) is displayed.

The safety-related servo parameters that do not match between SERVOPACK and Advanced Safety Module can be displayed by pressing the button *Motor and Encoder Parameter Check*.

Non-matching parameters are displayed in the following dialogue box.



At the same time the following message appears in the Message Log:

```
Safety related servo parameter confirmation failed. Number of
unmatching parameters: 2
```

If all parameters match, the following message is displayed in the Message Log without the *Servo Parameter Confirmation* dialogue box being displayed.

```
Safety related servo parameter confirmation successful
```

When using the Digital Operator, the function described here corresponds to Fn042 (Safety-related Servo Parameter Confirmation).

ASM7 Initialize button

If an Advanced Safety Module that is already in operation is initialized with a new SERVOPACK, the ASM7 Initialize button is helpful.

This Advanced Safety Module has the following features:

- SERVOPACK serial number stored
- Optional: Safe container stored
- Optional: Homing information stored

If an Advanced Safety Module with these properties is connected to a new SERVOPACK, the Safety Module Confirmation Alarm (A.EC0) is displayed.

By clicking on the *ASM7 Initialize* button, the stored serial number of the SERVOPACK, the homing information and the safe container in the non-volatile memory of the Advanced Safety Module are deleted.

- Click on the *ASM7 Initialize* button.
  A message box will appear with the instructions to switch the power supply of the SERVOPACK off and on.

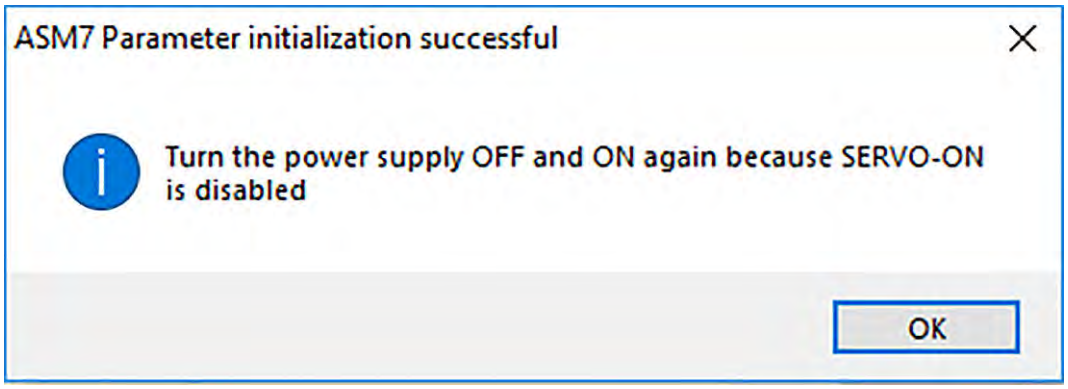
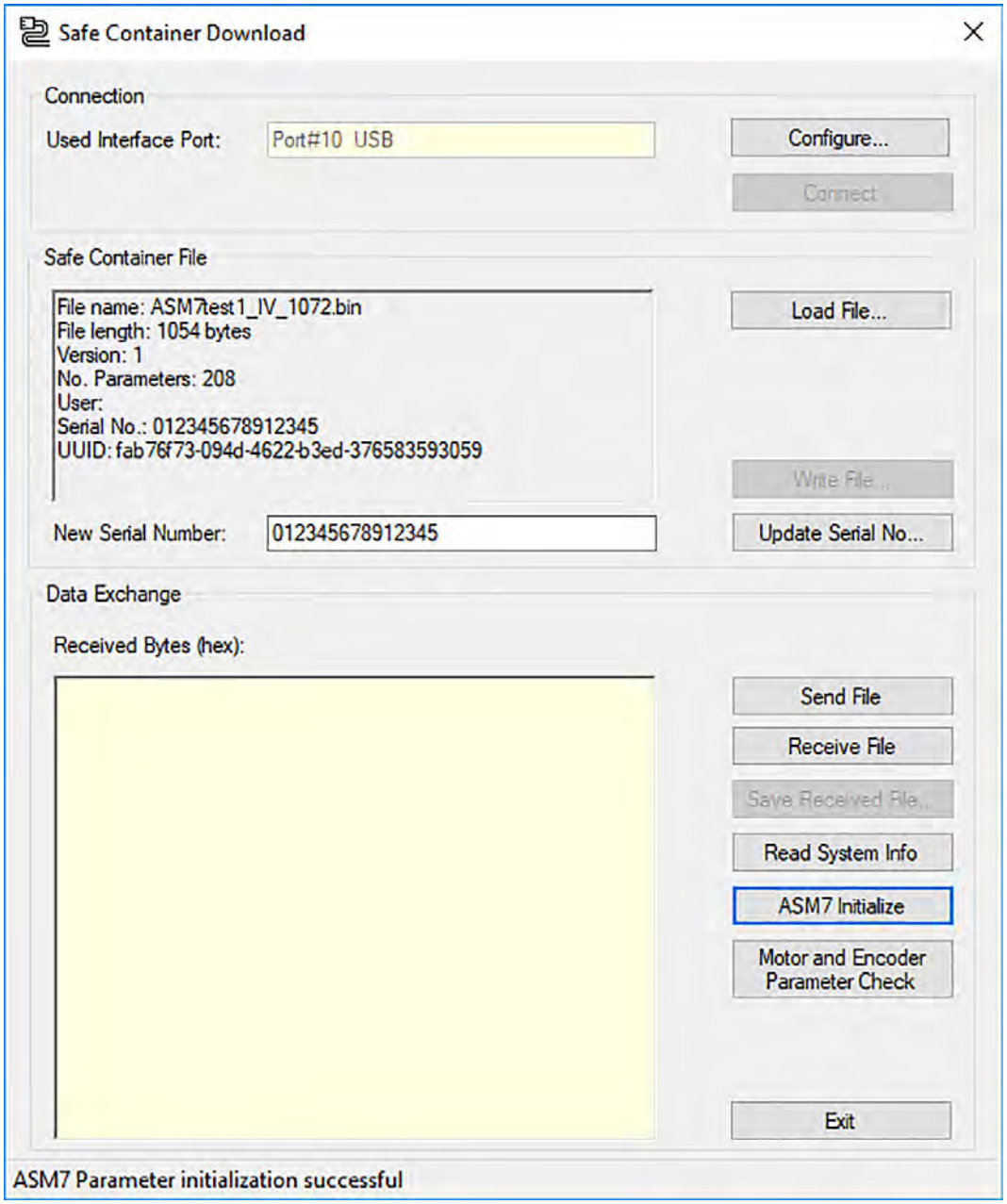


Fig. 35: ASM7 Initialize Cycle Power Dialogue box

After clicking OK in the message box, the message "ASM7 Parameter Initialization successful" will appear.



The initialization of the Advanced Safety Module can then be continued as described in the product manual.

When using the Digital Operator, the function described here corresponds to Fn043 (Safety Option Module Initializing Parameter Setting).

4 Application Example: Rotary Table

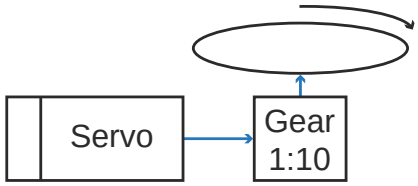


Fig. 36: Rotary table application

This application consisting of a gearbox and a rotary motor is to be realised with the safety requirements described below.

User unit:

- Position unit in degrees
- Speed in deg/s

Safety requirements

A light curtain is hardwired to the Advanced Safety Module and sets the servomotor to STO (Safe Torque Off).

The SLS (Safely Limited Speed) function is activated via FSoE. In the Advanced Safety Module, we realise this via virtual input 0.

The maximum allowable speed is one turn per second.

A safe output is connected to a safety relay which, in the event of STO, activates a warning light and switches off the downstream axes.

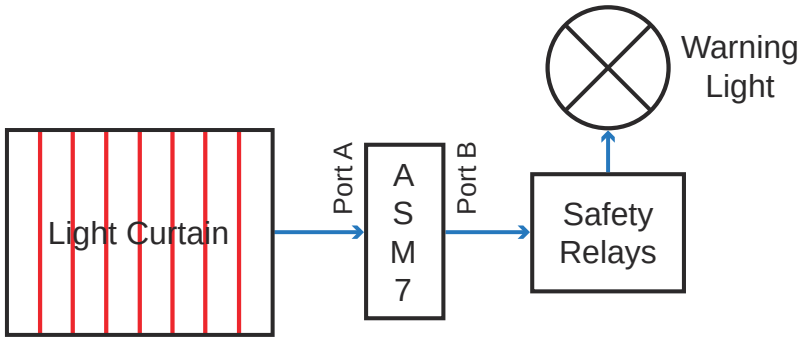


Fig. 37: Rotary table application - Safety requirements

Yaskawa's scope of supply in the above illustration is limited to the Advanced Safety Module (ASM7).

Starting the Advanced Safety Module Parameter Editor and Login

The creation of a project with the Advanced Safety Module Parameter Editor is described in detail in chapter Chap. 3 'Creating a Project using the Advanced Safety Module Parameter Editor' page 22. Only particularly significant points for the example application are described here.

You must enter the password to obtain full parameterisation rights when starting the application.

Fig. 38: Login

The main window is displayed when the application is started. You can now create a new project.

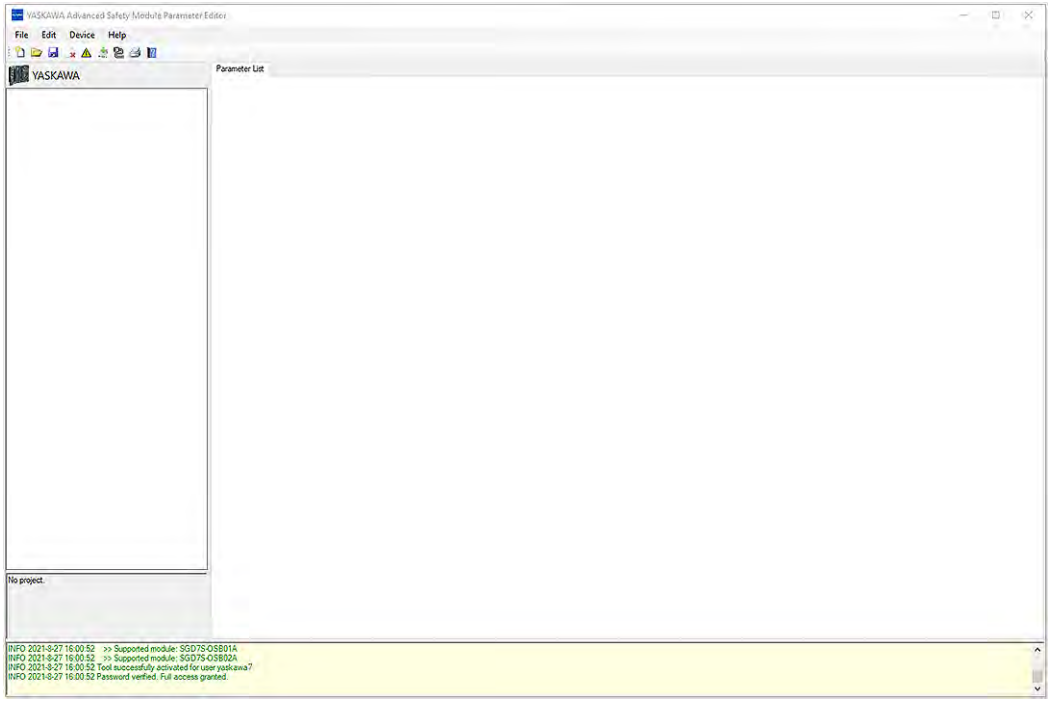


Fig. 39: Successful Start of the Application

Creating a Project

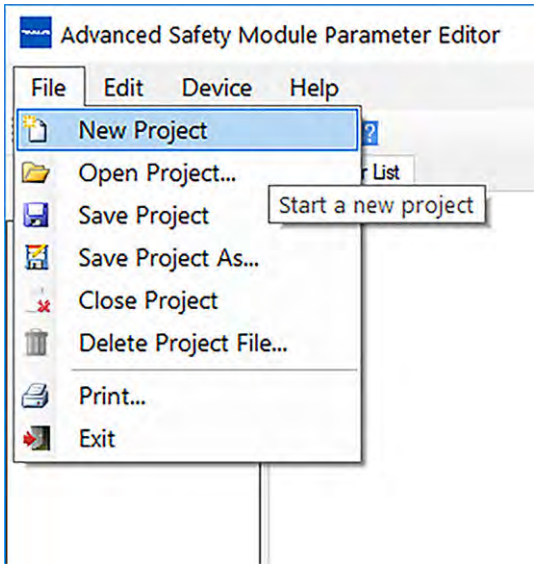


Fig. 40: New Project

Before parameters can be configured, a project must first be created. Click *New Project* in the File menu to create a new project. The *Create New Project* dialogue box appears.

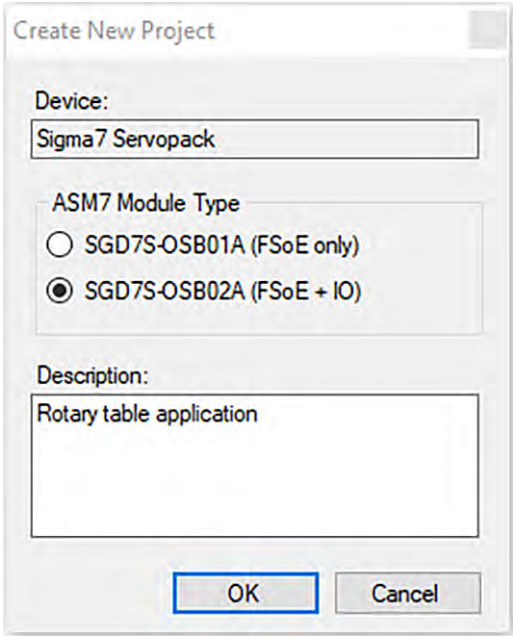


Fig. 41: Create New Project - Rotary table application

Select the ASM7 Module Type:

- SGD7S-OSB01A (FSoE only)
- SGD7S-OSB02A (FSoE + IO)

Important!
Once the OK button is clicked and this dialogue closes, it no longer possible to modify the ASM7 Module Type!

A short description of the application project should always be entered.

After validating the *Create New Project* dialogue, the parameter groups on the left are active and the parameters are available for editing.

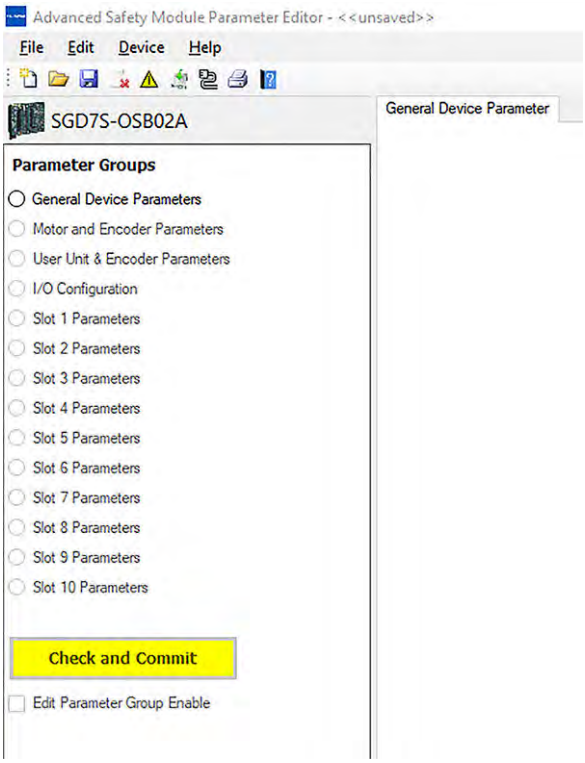


Fig. 42: New Project Ready for Editing

Here you can check whether you have selected the correct *ASM7 Module Type*.

The displayed parameter groups must always be edited starting at the top. When the parameterisation of a parameter group has been completed, the Check and Commit button becomes active. Clicking this button displays the *Compare & Confirm* dialogue box to check and confirm the stored values.

General Device Parameters

Select the parameter group *General Device Parameters*.

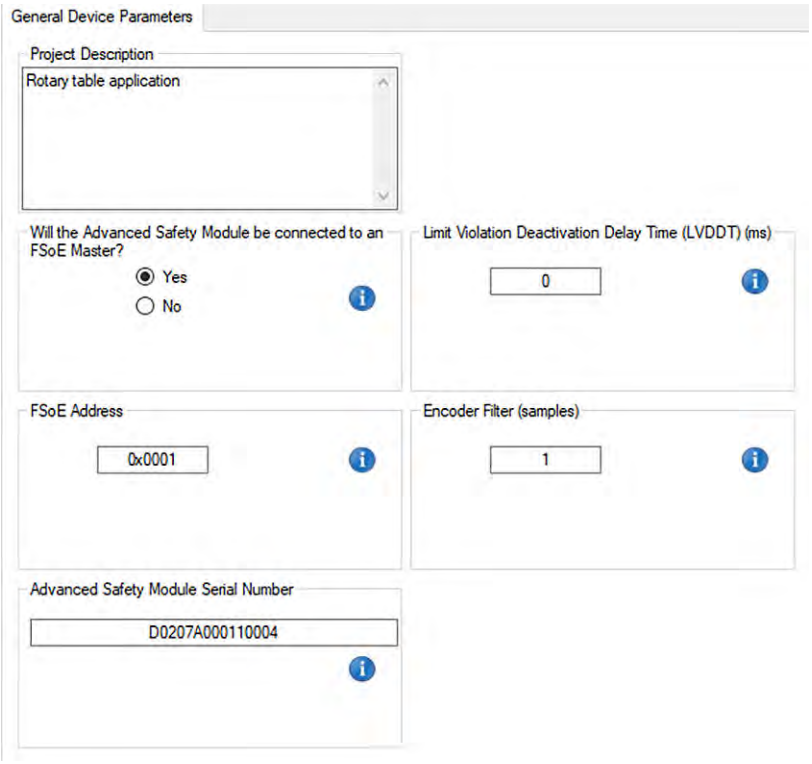


Fig. 43: General Device Parameters group

In the *General Device Parameters* group, indicate whether you are using an FSoE master or not, and if so, enter the FSoE address.

You also enter the serial number of the Advanced Safety Module, which is indicated on the sticker of the board.

Before you install the SERVOPACK (e.g. in a control panel), please ensure that the serial number of the product is recorded. If the SERVOPACK is already installed, the serial number can also be read out with SigmaWin+.

If you are unsure about the meaning of a certain parameter, use the ℹ buttons that display a small help text.

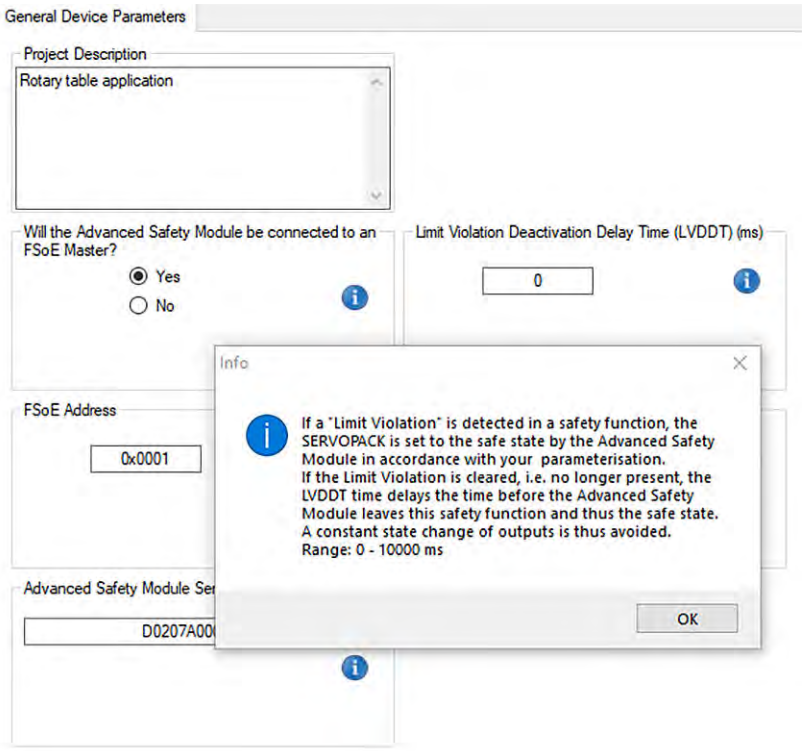


Fig. 44: Limit Violation Deactivation Delay Time Help Text

When you have entered all values and made all selections, click on the Check and Commit button.

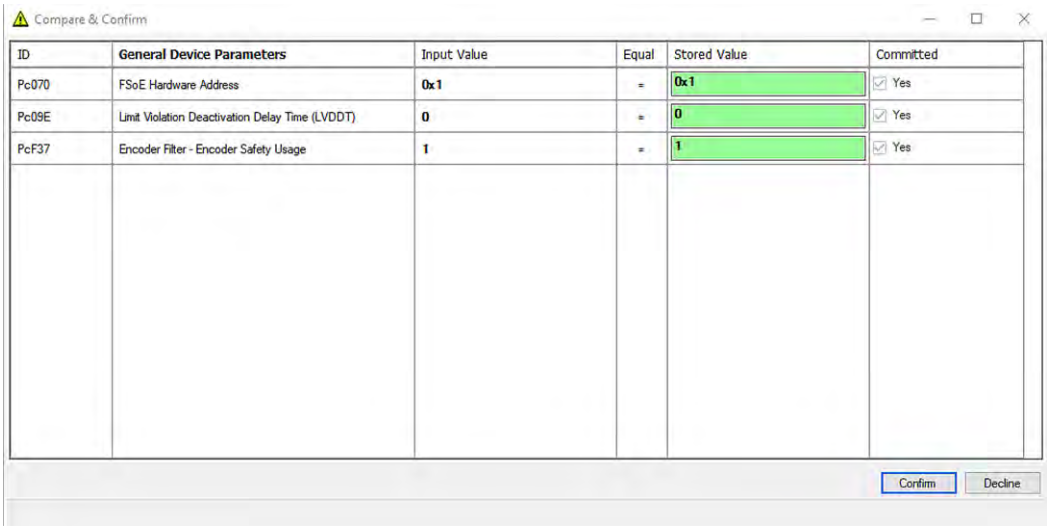


Fig. 45: Compare & Confirm General Device Parameters

In the *Compare & Confirm* dialogue you will now see the previous entries with the corresponding parameter number.

If all input values match the saved values, click on Confirm!

Motor and Encoder Parameters

Now select the next parameter group *Motor and Encoder Parameters*.

Let's assume you have only one motor and no second encoder (with this configuration, SIL 2 is achievable) and want to use the Advanced Safety Module for a rotary table application.

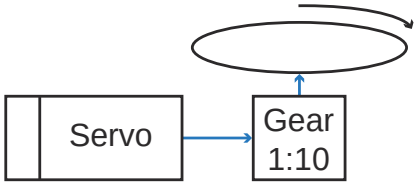


Fig. 46: Rotary table application

Fill in the *Motor and Encoder Parameters* group and click on Check and Commit after completing the entry.

User unit:

- Position unit in degrees
- Speed in deg/s

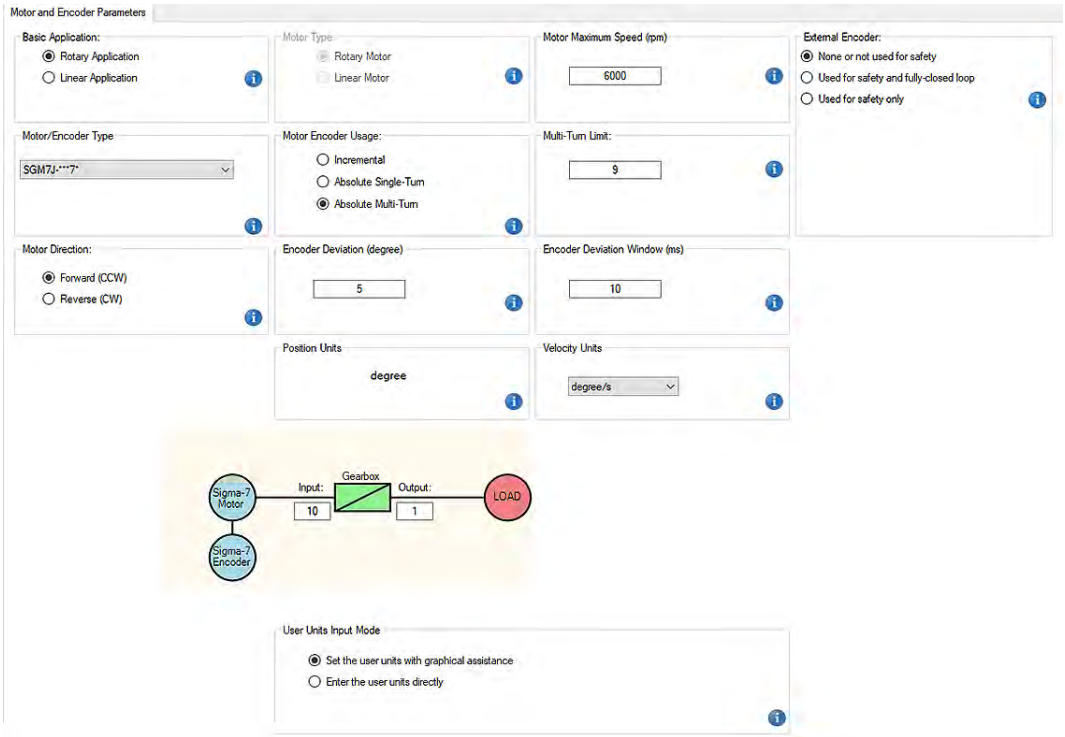


Fig. 47: Motor and Encoder Parameters

Basic Application:	Rotary Application
Motor Maximum Speed (rpm):	6000 The maximum motor speed is determined by the motor used.
External Encoder:	None or used for safety
Motor/Encoder Type:	SGM7J-***7*
Motor Encoder Usage:	Absolute Multi-Turn
Multi-Turn Limit:	9 Since a gearbox with a reduction of 1:10 is used, the value 9 must be selected here if the rotary table is to be set to 360 degrees.
Motor Direction:	Forward (CCW)
Encoder Deviation (degree):	5
Encoder Deviation Window (ms):	10
Position Units:	degree
Velocity Units:	degree/s
Gearbox Input:	10
Gearbox Output:	1

I/O Configuration

Now select the next parameter group *I/O Configuration*.

Fill in the *I/O Configuration* group and click on Check and Commit after completing the entry.

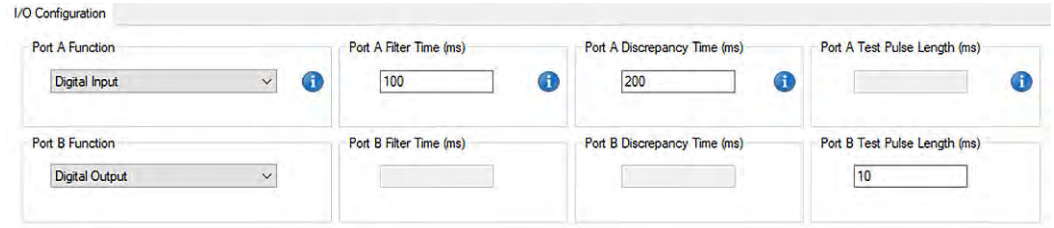


Fig. 48: I/O Configuration

Port A Function:	Digital Input
Port B Function:	Digital Output
Port A Filter Time (ms):	100 If the light curtain output works via relays, note that relays bounce (20 ms). Due to this assumption, the value 100 ms was chosen.
Port A Discrepancy Time (ms):	200 The Discrepancy Time was chosen according to the previous assumption if a delay occurs due to a test pulse. When setting these values, the test pulse lengths given in the light curtain operating instructions must be observed.
Port B Test Pulse Length (ms):	10

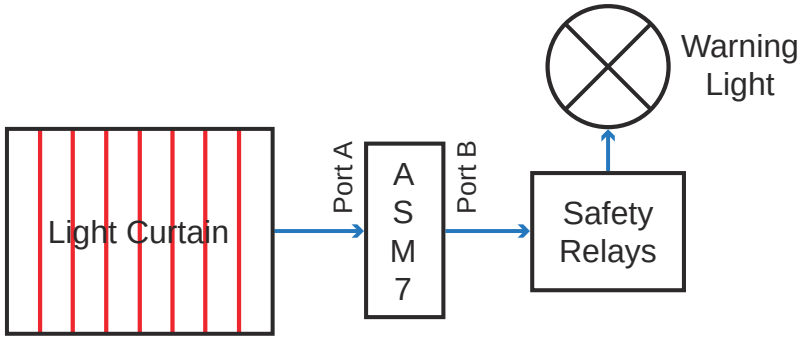


Fig. 49: Rotary table application - Safety requirements

Slot 1 Parameters

Now select the next parameter group *Slot 1 Parameters*.

Each slot can only contain one safety function!

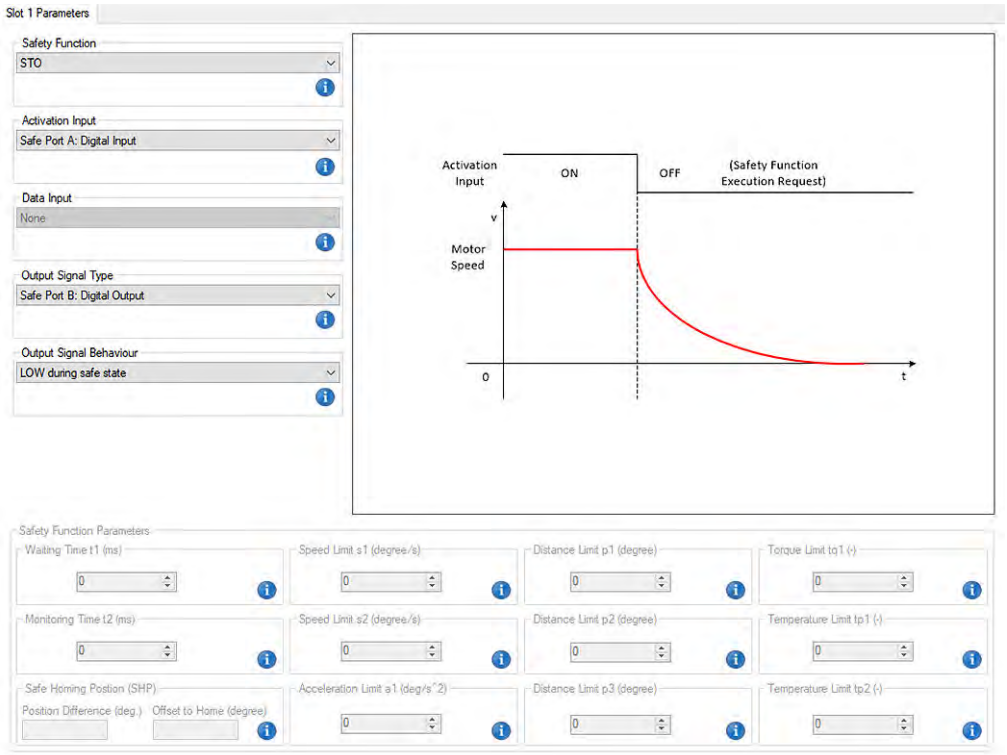


Fig. 50: Slot 1 Parameters

Safety Function:	STO
Activation Input:	Safe Port A: Digital Input
Output Signal Type:	Safe Port B: Digital Output
Output Signal Behaviour:	LOW during safe state

Slot 2 Parameters

Now select the next parameter group *Slot 2 Parameters*.

Each slot can only contain one safety function!

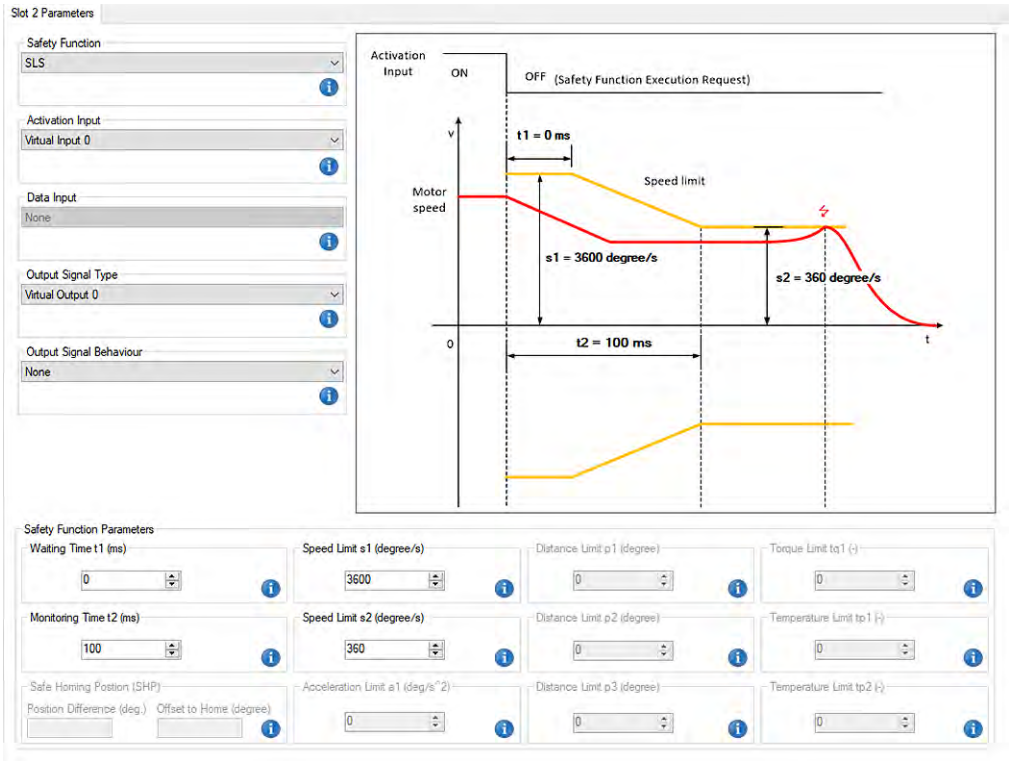


Fig. 51: Slot 2 Parameters

Safety Function:	SLS
Activation Input:	Virtual Input 0 The SLS function is activated via the virtual input 0.
Output Signal Type:	Virtual Output 0
Output Signal Behaviour:	None
Waiting Time t1 (ms):	0
Speed Limit s1 (degree/s):	3600 6000 rpm (Motor Maximum Speed) / 10 (Gear Ratio = 1:10) = 600 rpm 600 rpm = 10 turns/s = 3600°/s
Speed Limit s2 (degree/s):	360 The maximum allowable speed is one turn per second = 360°/s
Monitoring Time t2 (ms):	100

Writing a Save Container File

Save your project file.

Fig. 52: Save Project File

If there are unused slots in your parameter set, the following information appears.

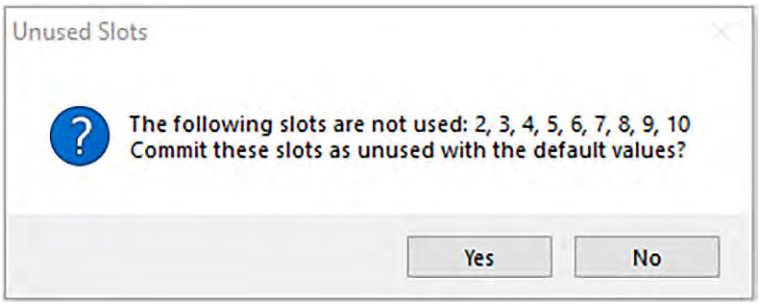


Fig. 53: Unused Slots

Calculate a Checksum for Validation.

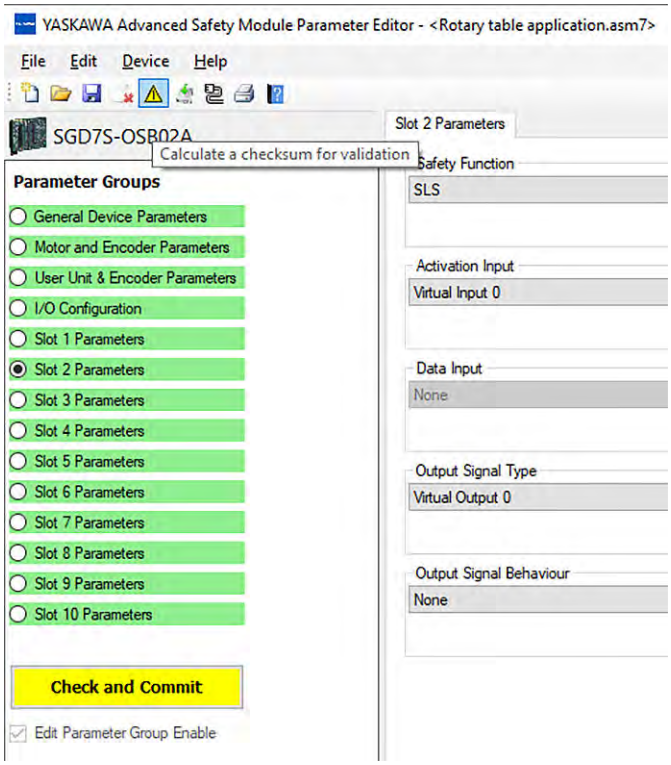


Fig. 54: Calculate a Checksum for Validation

Finally, all parameter groups must be displayed with a green background.

Write a Safe Container File.

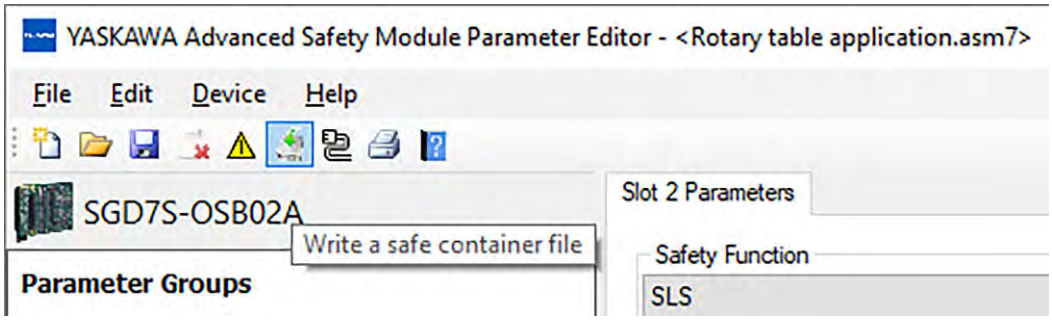


Fig. 55: Write a Safe Container File

Save the Binary File.

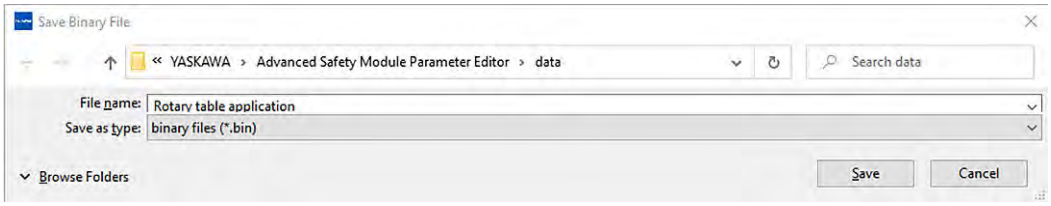


Fig. 56: Save Binary File

Parameter File Transfer

Transfer your Save Container File to the Advanced Safety Module.

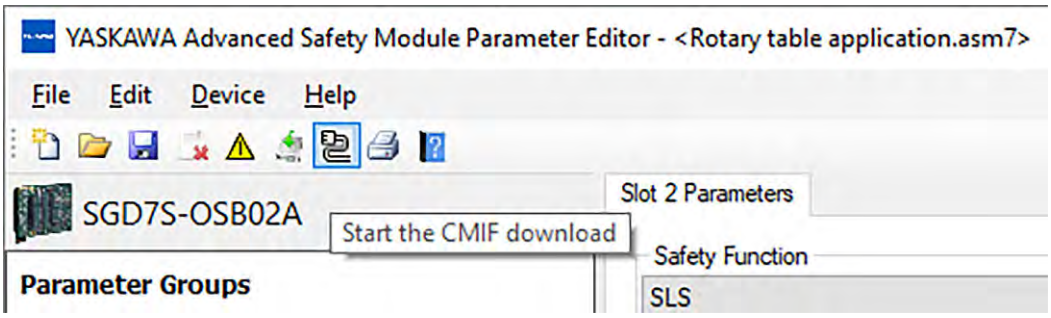


Fig. 57: Start the CMIF Download

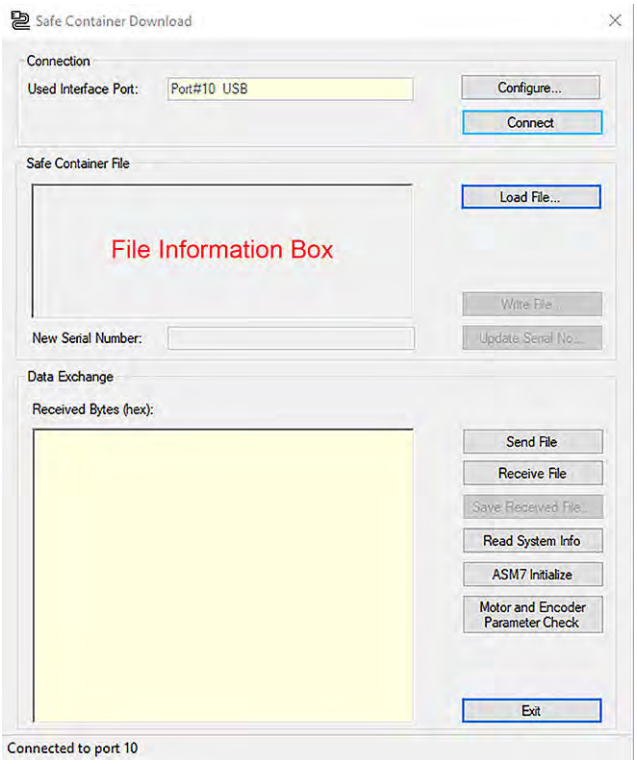


Fig. 58: Safe Container Download

1. Click on the Load File button.
2. Check your file name in the File Information Box.
3. Check the serial number of your Advanced Safety Module in the File Information Box.

4. Click on the *Connect* button and after making sure that the correct file has been selected, click on the *Send File* button to start the download.

At present, the port to which the SERVOPACK is connected can be only the USB port (Port#10 USB). Do NOT select an Ethernet connection!

5. When the download is completed successfully, a *Write Success* message will be displayed.

Starting the execution on the Advanced Safety Module

1. Cycle the power of the SERVOPACK.
   ⇨ After about 5 seconds HWBB should disappear and the servo can be switched on.
2. A.9C0 indicates that slot 1 (STO) is activated, immediately HWBB (STO) is displayed.
3. A.9C1 indicates that Slot 2 (SLS) is activated.
   ⇨ If no safety function is active, only the green LED lights up.

   When a safety function is activated, the red LED starts flashing.

   If the red LED lights up continuously, the Advanced Safety Module has set the SERVOPACK to the safe state (STO).

5 Commissioning of an Advanced Safety Module via TwinCAT 3

5.1 Hardware Setup

5.1.1 C6915-0010 | Fanless Control Cabinet Industrial PC | Intel Atom®

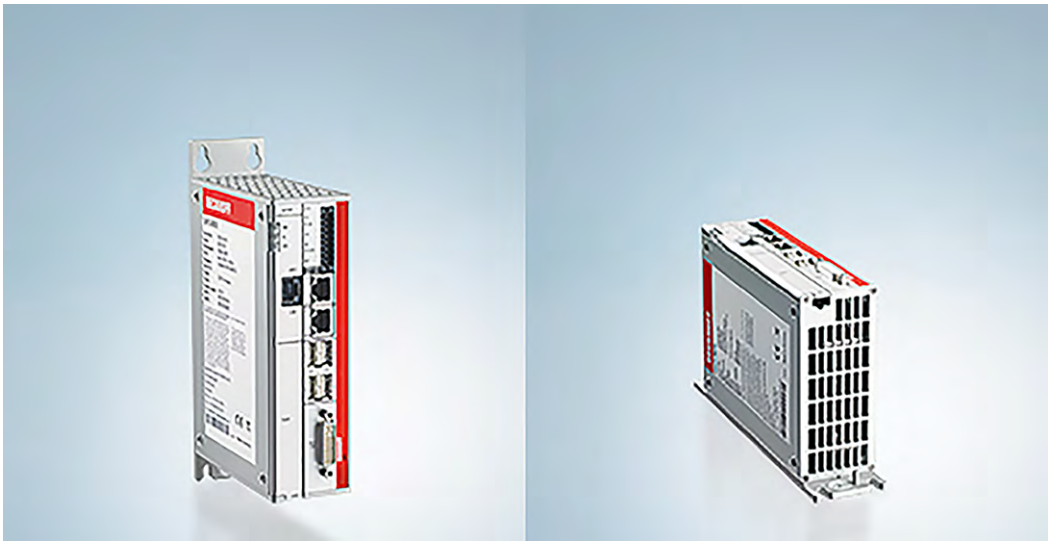


Fig. 59: Beckhoff PLC C6915

The C6915 industrial PC is designed for installation in control cabinets. The compact housing is equipped with a 3½-inch motherboard with Intel Atom® with up to four cores. All connections of the PC are located on the front of the housing. The industrial PC is cooled by internal cooling fins without a fan and allows operation up to 55 °C.

5.1.2 EK1914 | EtherCAT Coupler with Integrated Digital Standard and Safety I/Os

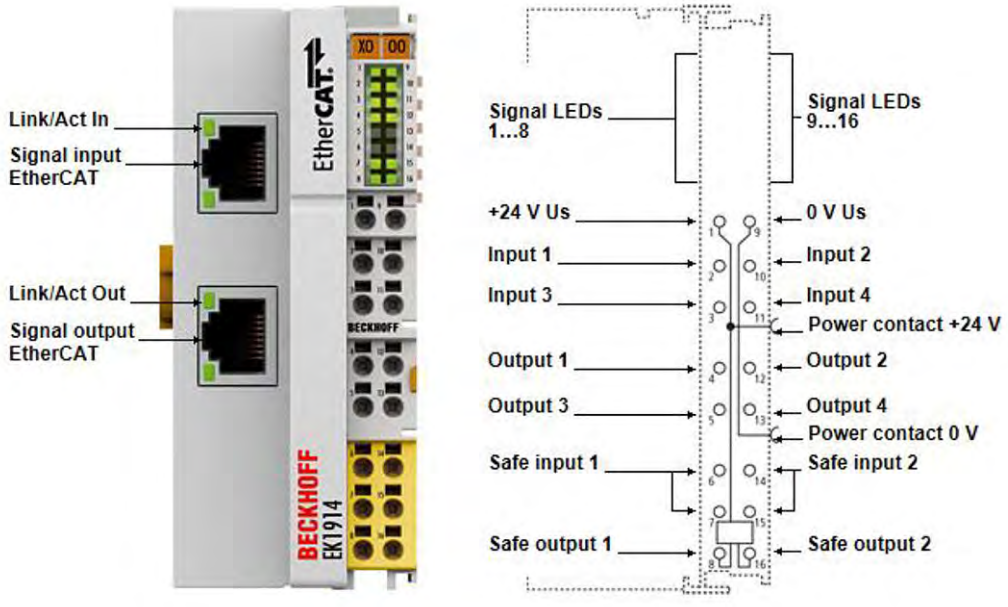


Fig. 60: Beckhoff EtherCAT coupler EK1914

The EK1914 EtherCAT coupler combines the functionalities of the EK1100 EtherCAT coupler with standard and safe digital I/Os. The resulting compact design is particularly suitable for applications with a low number of I/Os. Like the EK1100, the EK1914 can be extended with all EL/ES terminals. The EK1914 has four digital inputs and four digital outputs as well as two fail-safe inputs and two fail-safe outputs.

5.1.3 EL6910 | TwinSAFE Logic

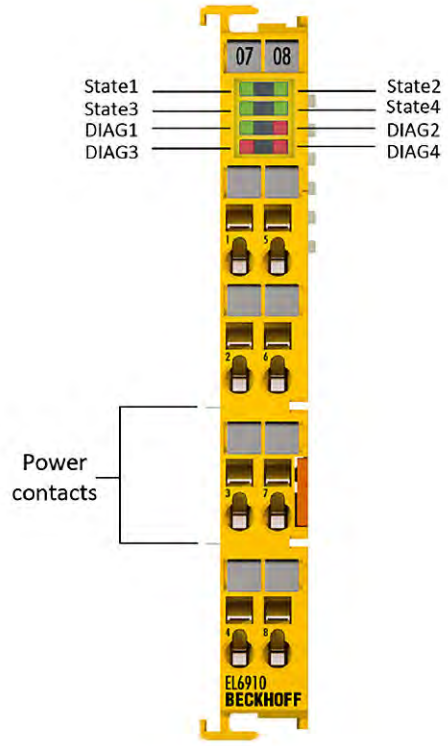


Fig. 61: Beckhoff TwinSAFE Coupler EL 6910

The TwinSAFE Logic EL6910 can establish 212 connections to other TwinSAFE devices. Several EL6910s can be cascaded in a TwinSAFE network with up to 65,535 TwinSAFE devices.

The EL6910 EtherCAT terminal has certified safety function blocks that are configured according to the application. Safety functions such as emergency stop, safety door monitoring, two-hand control, etc. can thus be selected and linked very easily. All function blocks can be interconnected and are supplemented by operators such as AND, OR, etc.

In addition to the Safety over EtherCAT protocol, the EL6910 also supports TwinSAFE SC technology. TwinSAFE SC enables secure data transmission from standard EtherCAT I/Os with the identifier -009x (TwinSAFE SC extension) to the TwinSAFE Logic EL6910. The EL6910 also supports the processing of analogue signals (16/32 bit, signed and unsigned). These signals are sent to the logic from standard, TwinSAFE SC or Safety over EtherCAT I/Os. This allows analogue signals to be analysed within the logic, checked for plausibility and subjected to a "voting". For safety reasons, at least one of the data sources must be a TwinSAFE SC component. The other data can come from other standard I/Os, drive controllers or measuring transducers. The entire calculation and scaling is carried out in the safety-related TwinSAFE Logic EL6910 at the SIL 3/PL e safety level. Certified components such as ADD, SUB, MUL, DIV, but also more complex ones such as Counter, Limit or Compare are available for processing analogue signals.

The required functions are programmed with the TwinCAT Safety Editor under TwinCAT 3.1 and loaded into the TwinSAFE Logic EL6910 via the fieldbus.

5.1.4 EL1904 | 4-Channel Digital Input Terminal, TwinSAFE, 24 V DC

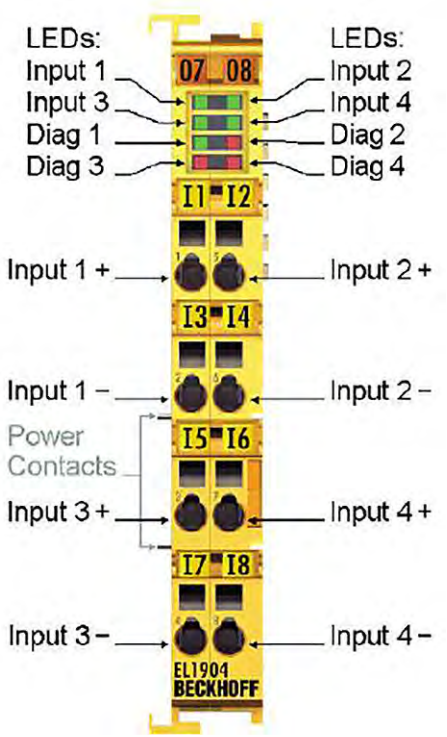


Fig. 62: Beckhoff TwinSAFE input terminal EL1904

The EL1904 Safety EtherCAT terminal is a digital input terminal for sensors with potential-free contacts for 24 V DC. The EtherCAT terminal has four fail-safe inputs.

5.1.5 EL9410 | Power Supply Terminal for E-bus Refresh, with Diagnostics

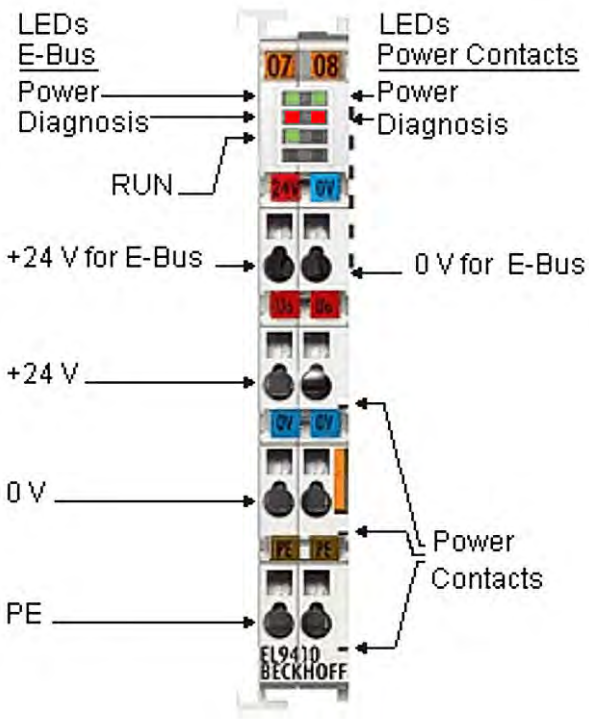


Fig. 63: Beckhoff power supply terminal EL9410

The EL9410 power supply terminal is used to refresh the E-bus, via which the data exchange between EtherCAT coupler and terminals takes place. Each EtherCAT terminal requires a certain current from the E-bus. This current is fed into the E-bus by the power supply unit of the respective EtherCAT coupler. In configurations with a large number of EtherCAT terminals, the EL9410 can be used to increase the power supply of the E-bus by 2 A. The EL9410 has a diagnostic function that is displayed via LED and in the process image.

5.1.6 EL2904 | 4-Channel Digital Output Terminal, TwinSAFE, 24 V DC

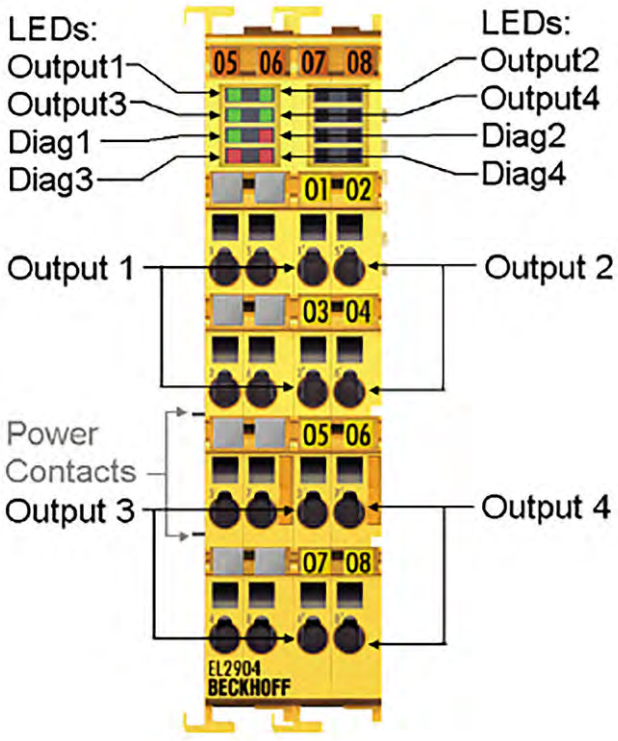


Fig. 64: Beckhoff TwinSAFE output terminal EL2904

The EL2904 Safety EtherCAT terminal is a digital output terminal with four channels. It switches 24 V DC actuators with up to 0.5 A current per channel. If the EtherCAT terminal detects an error, it switches off automatically (fail-stop).

5.2 Prerequisite for the Configuration

- Software: TwinCAT 3 Build 4024.10
  This software version has been updated on the computer and the Beckhoff PLC.
- Firmware versions:
  - SERVOPACK SGD7S: 002F_F910
  - Interface version: 0008-0015
  - Advanced Safety Module: 0007 or higher

5.3 Creating a new TwinCAT Project

5.3.1 Creating a New TwinCAT Project File

1. Select: Menu *File* ⇨ *New* ⇨ *Project...*

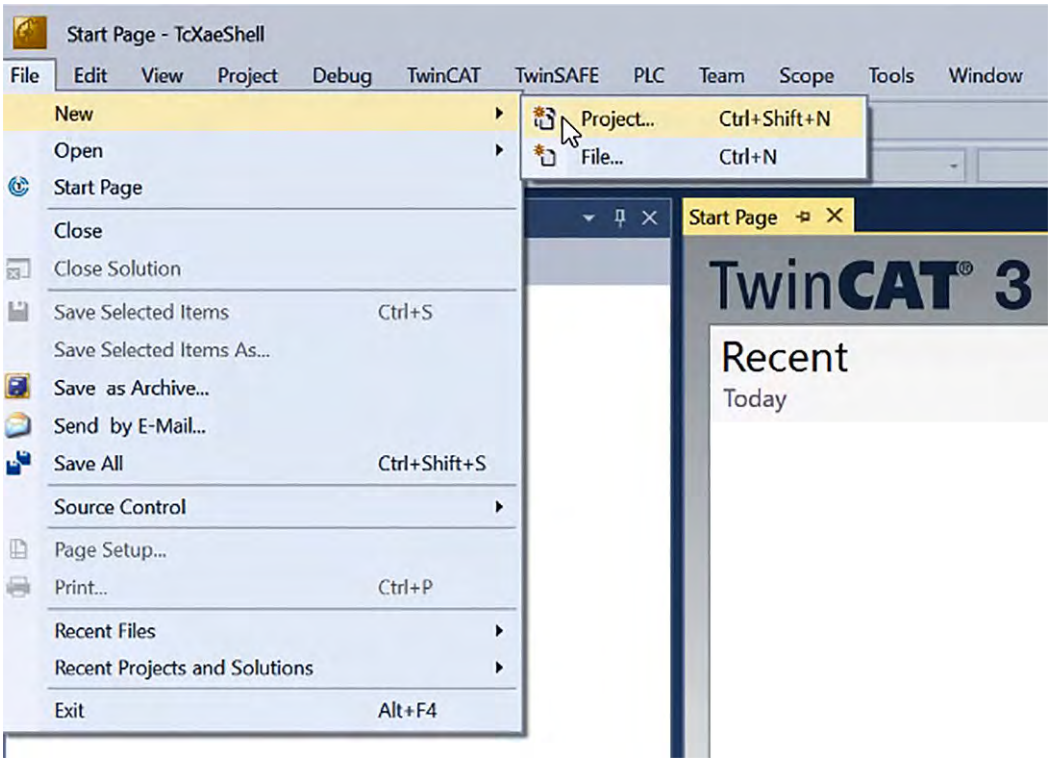


Fig. 65: TwinCAT 3 - Create new project

2. Select the *TwinCAT XAE Project (XML format)* project template in the dialogue box that opens.

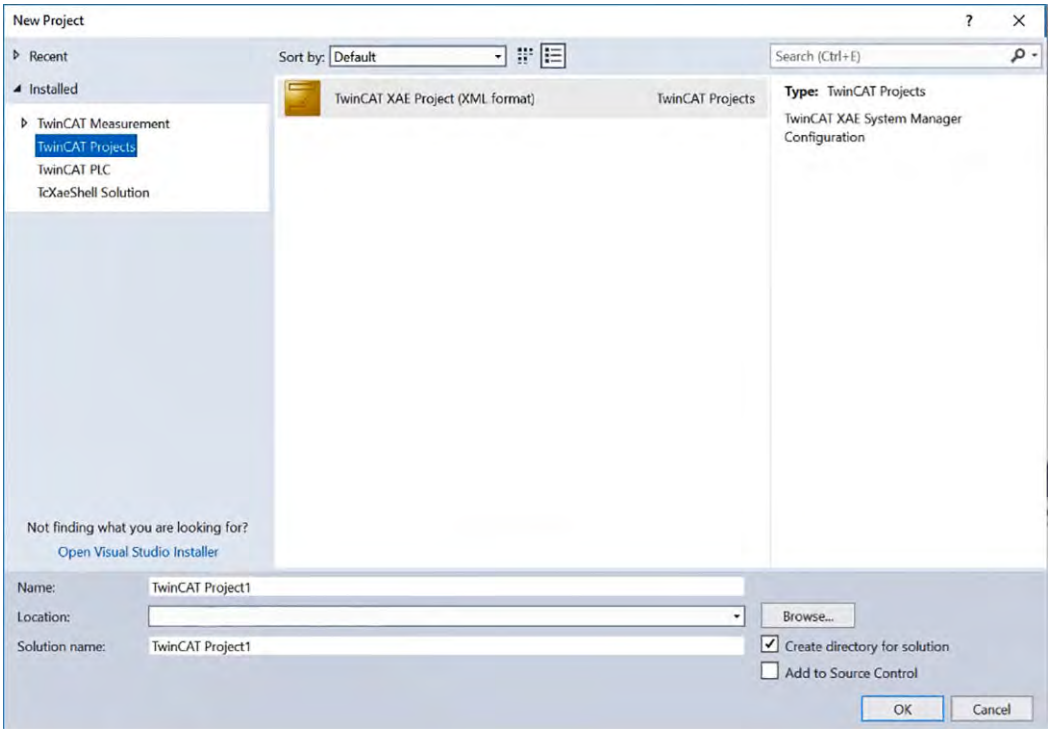


Fig. 66: TwinCAT 3 - Create new project - Select TwinCAT XAE Project

⇨ In the field *Name:* the file name can be changed, taking into account the file path conventions of the operating system. Dots in the name are not allowed.

If the Create directory for solution checkbox is selected, all files created in connection with this application are stored in the same project folder directory.

3. Confirm the creation of the new TwinCAT project file with *OK*.

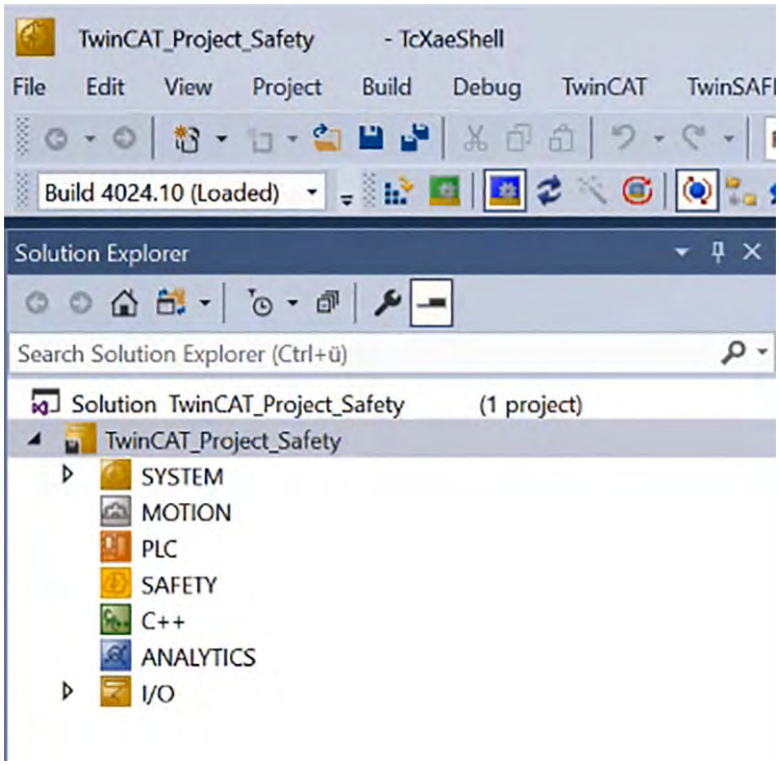


Fig. 67: TwinCAT 3 - New TwinCAT project created

The nodes displayed in the project folder have the following meaning:

- SYSTEM: Routes, Licences, Task, Real-time
- MOTION: NC configuration
- PLC: PLC programming
- SAFETY: Safety programming
- C++: Creation of C++ modules
- ANALYTICS: Analysis
- I/O: Hardware configuration

General notes

The TwinCAT system can only be configured or programmed when it is in configuration mode. Scanning the fieldbus is also only possible in configuration mode. This is indicated by the TwinCAT icon (*Restart TwinCAT (Config Mode)*) with a purple background in the task bar.

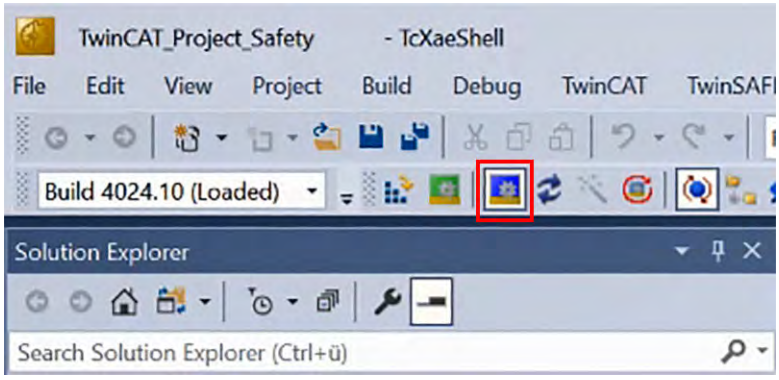


Fig. 68: TwinCAT 3 - Restart TwinCAT (Config Mode)

The nodes PLC and SAFETY are completely separated, communication (in the sense of programming) between these areas usually only takes place by linking variables from the node PLC to the node SAFETY (see Chap. 5.3.5.1 'Combining ErrorAcknowledgement.sds and Run.sds with a Standard Signal' page 90).

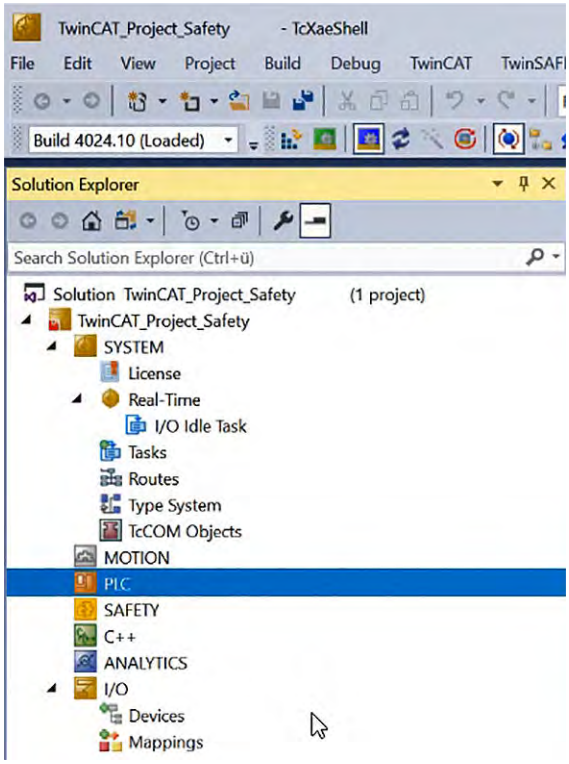


Fig. 69: TwinCAT 3 - PLC and SAFETY are separated items

5.3.2 Scanning the Hardware Configuration

You can find the Sigma-7 ESI file (ESI = EtherCAT slave information) on our homepage www.yaskawa.eu.com ⇨ Service & Training ⇨ Download Center by searching for "Sigma-7 Advanced Safety Module ESI".

Store the ESI file in the following directory before scanning the hardware configuration: This PC ⇨ Windows (C:) ⇨ TwinCAT ⇨ 3.1 ⇨ Config ⇨ Io ⇨ EtherCAT. If the ESI file is in this directory, the SERVOPACK will also be found with the Advanced Safety Module installed.

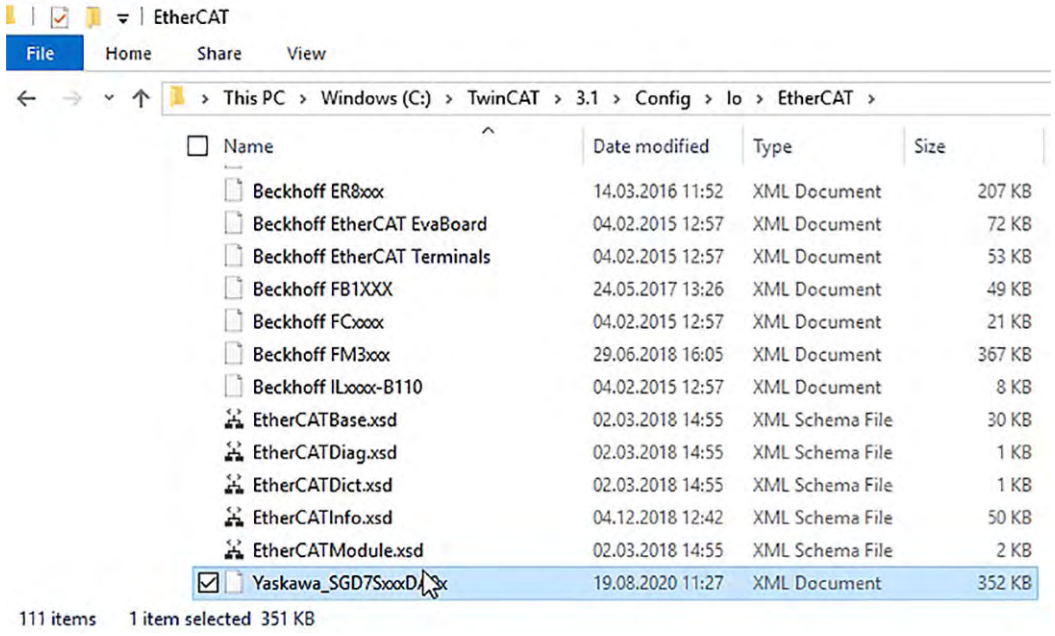


Fig. 70: TwinCAT 3 - Local path for Sigma-7 ESI file

1. Scan the hardware configuration to find the devices present on the fieldbus.

A device is the connection from the PC to the fieldbus.

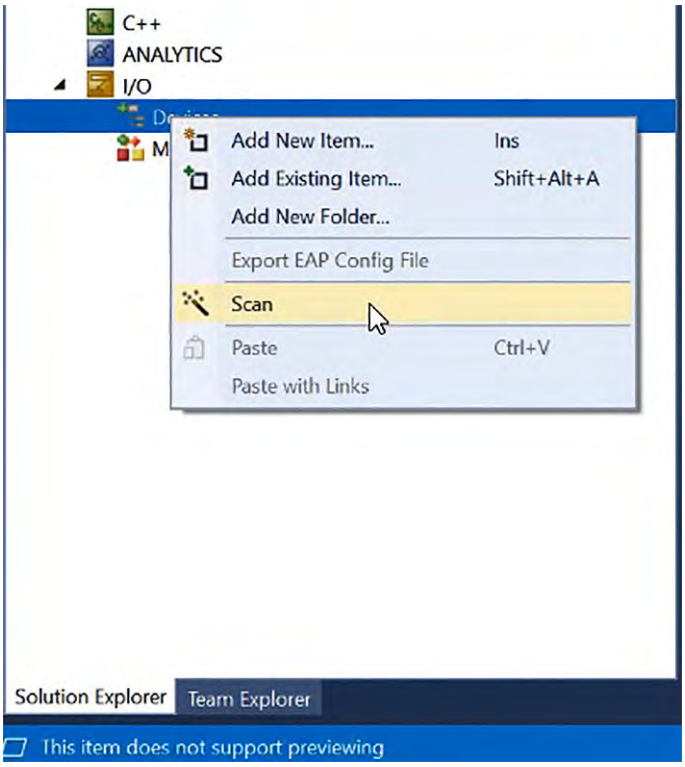


Fig. 71: TwinCAT 3 - Scan Hardware configuration

2. Confirm the note that not all types of devices can be found automatically.

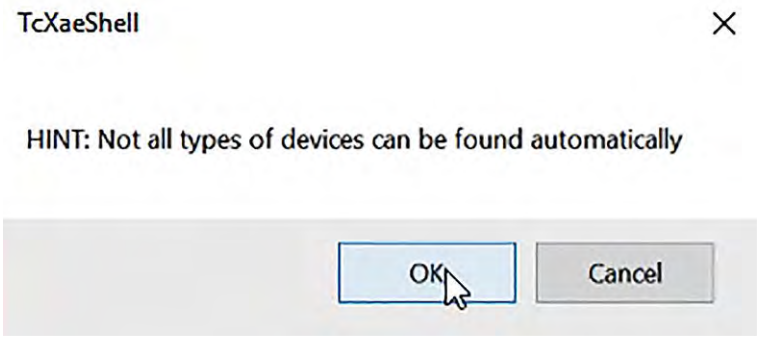


Fig. 72: TwinCAT 3 Hint - Not all types of devices can be found automatically

3. Confirm the newly found device.

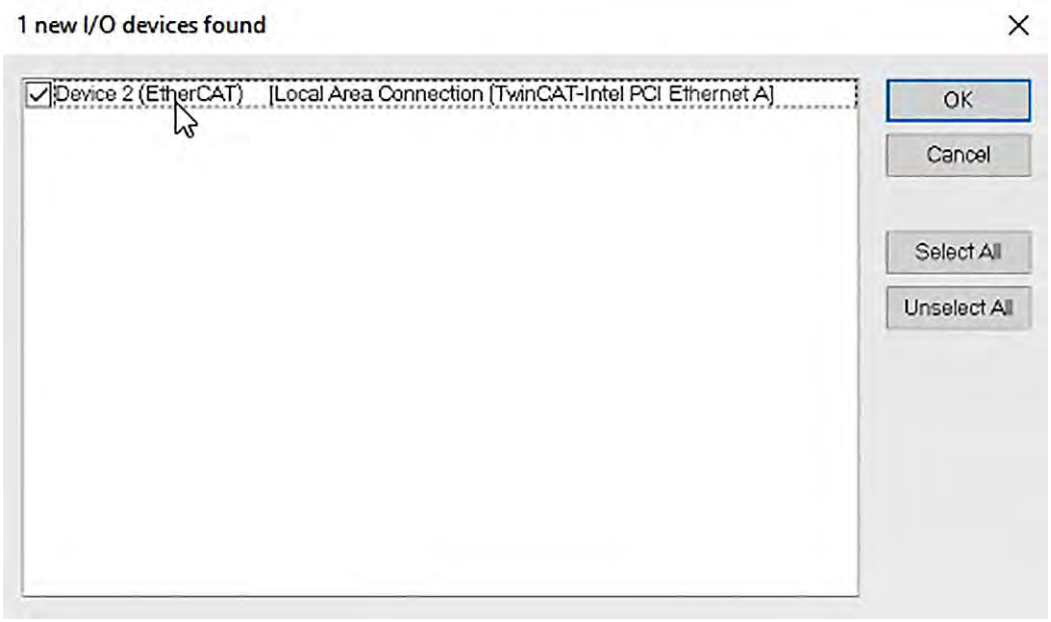


Fig. 73: TwinCAT 3 - New IO devices found

⇨ This device is the EtherCAT master.

If the Sigma-7 ESI file is not placed in the correct directory, the device will only be referred to and found as a box.

4. Click *Yes* in the *Scan for boxes* dialogue box.

Fig. 74: TwinCAT 3 - Scan for boxes

5. The devices found are now displayed under the *Devices* node.

⇨

In the screenshot, 'Term 1 (EK1914)' is expanded. This is not the default view, the term must be expanded by clicking on it!

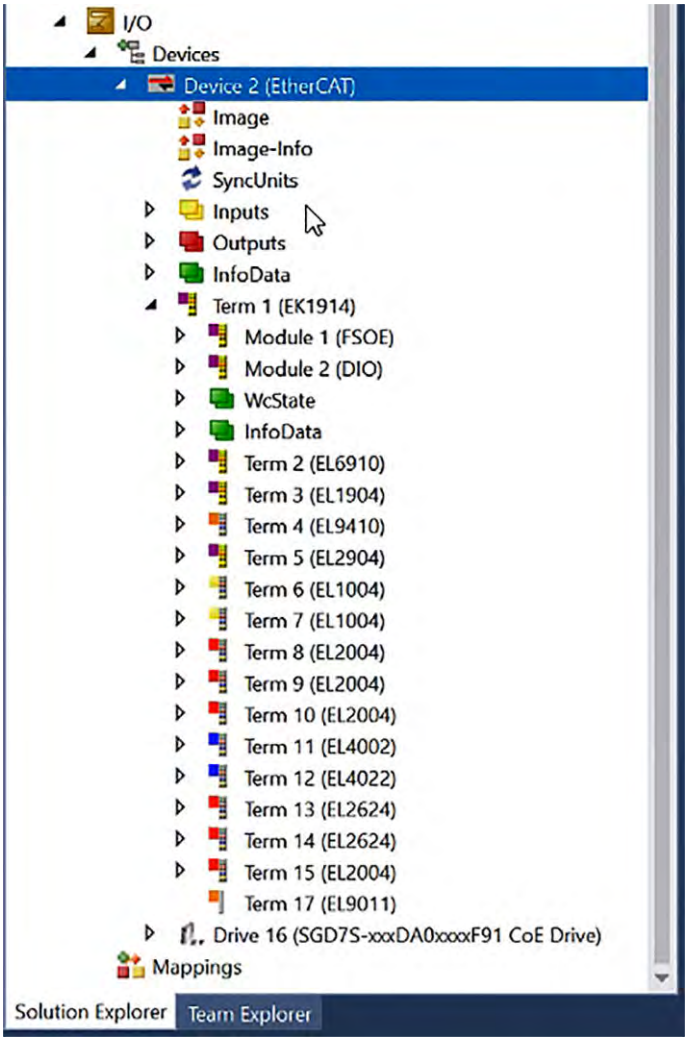


Fig. 75: TwinCAT 3 - Found devices after scanning for boxes

5.3.3 Creating a Safety Project

1. Use the context menu of the *SAFETY* node to create a new safety project via *Add New Item…*.

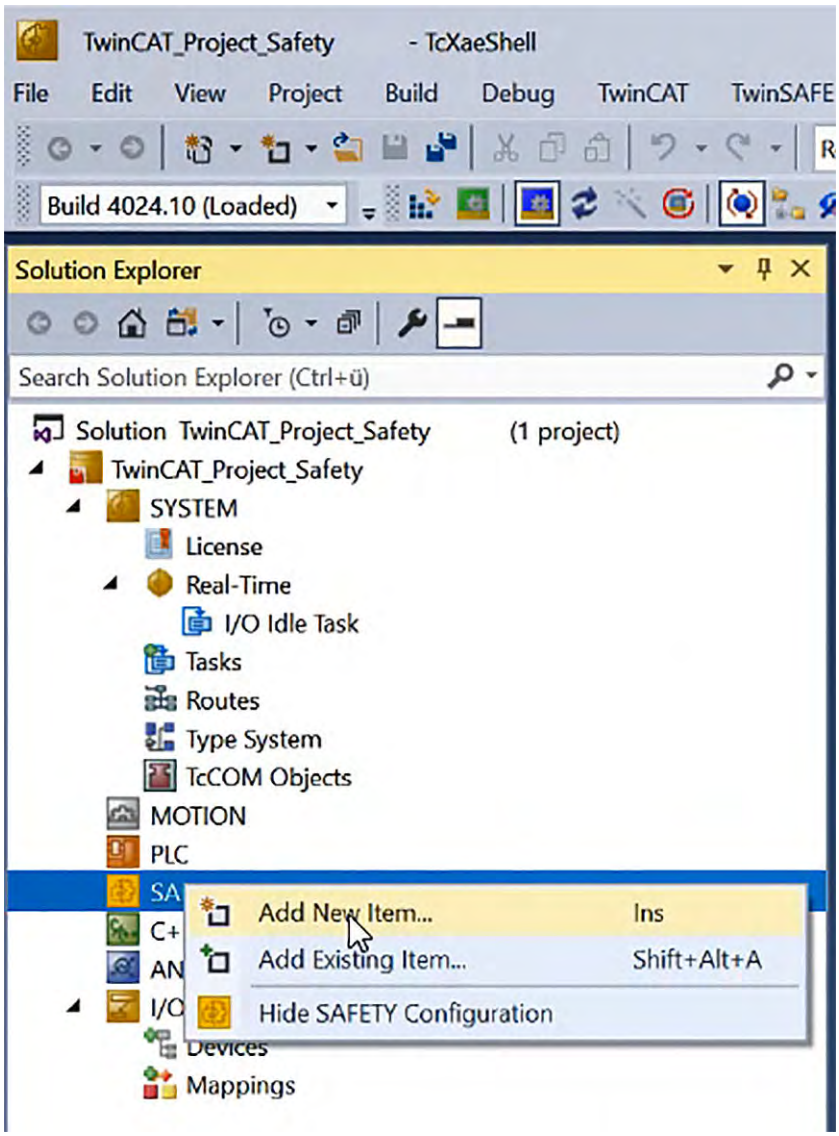


Fig. 76: TwinCAT 3 - SAFETY - Add New Item

2. A dialogue box opens, select *TwinCAT Safety Project Preconfigured Inputs* and assign a name to the project.

In our example, the project was given the name 'Safety_Prog'.

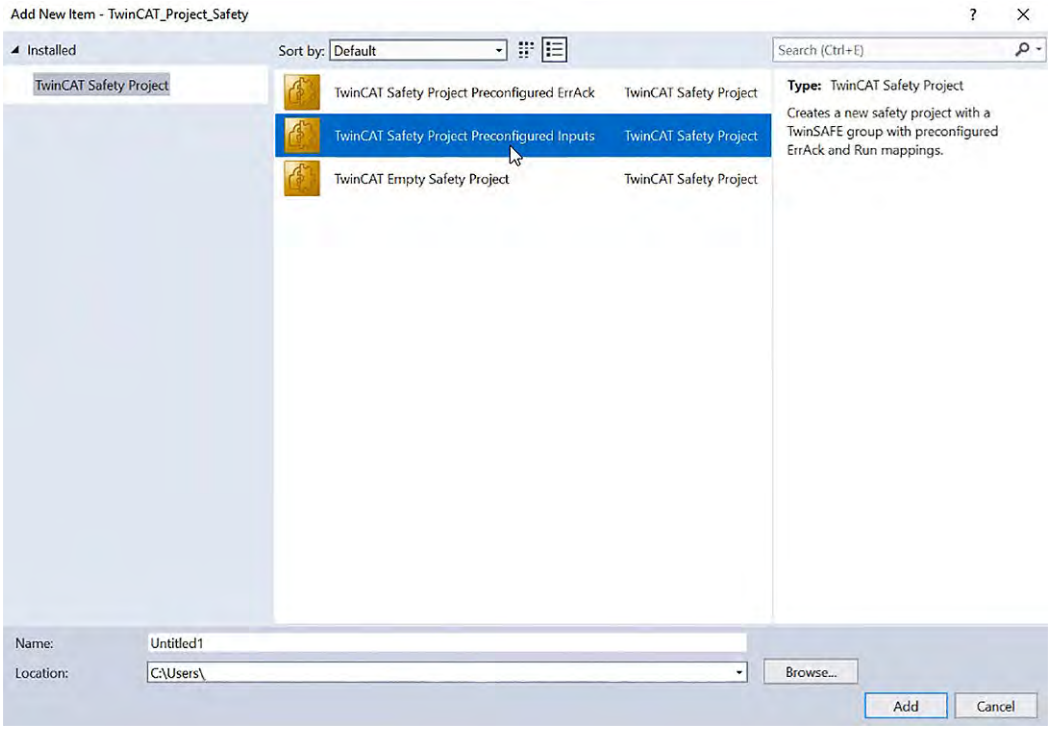


Fig. 77: TwinCAT 3 - SAFETY - Add New Item - Select TwinCAT Safety Project Preconfigured Inputs

3. Use the Add button to create the safety project.

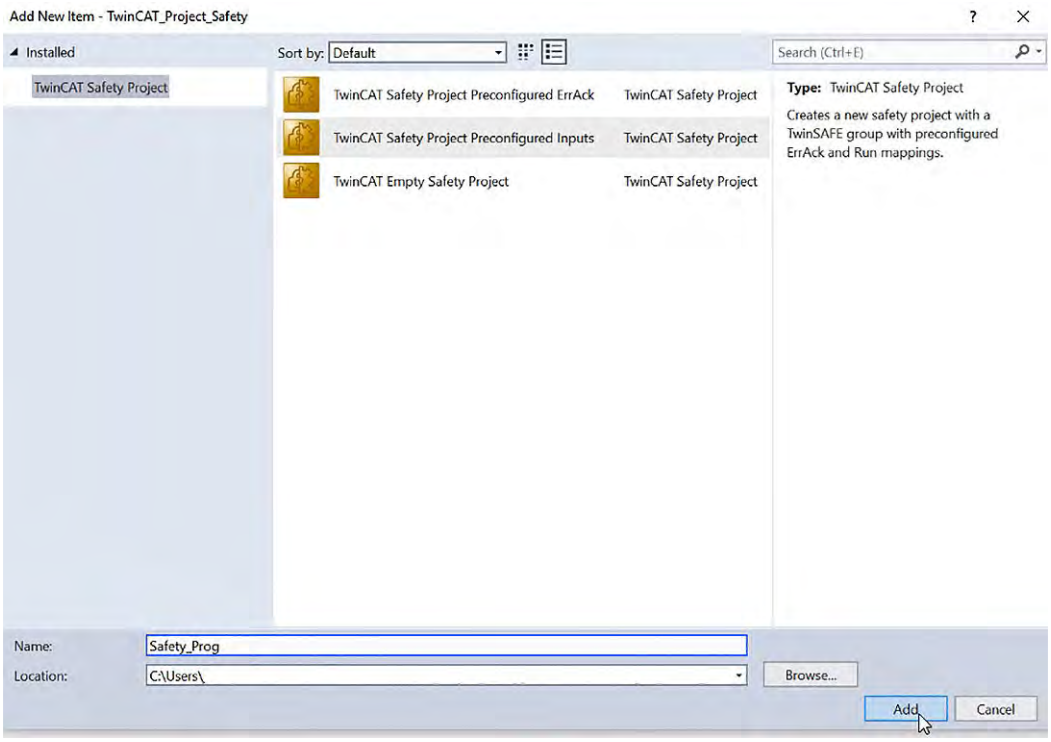


Fig. 78: TwinCAT 3 - SAFETY - Add New Item - Select TwinCAT Safety Project Preconfigured Inputs - Create Safety Project

4. The *TwinCAT Safety Project Wizard* now opens. Select the setting *Hardware Safety PLC* as the target system and the graphical editor as the programming language. Author and internal project name can be freely chosen.

> *We recommend not choosing Safety C as the programming language, because in that case there are no certified function blocks available, these must be programmed yourself (and are also not certified!).*

Make the selection as shown in the figure and then confirm by clicking OK.

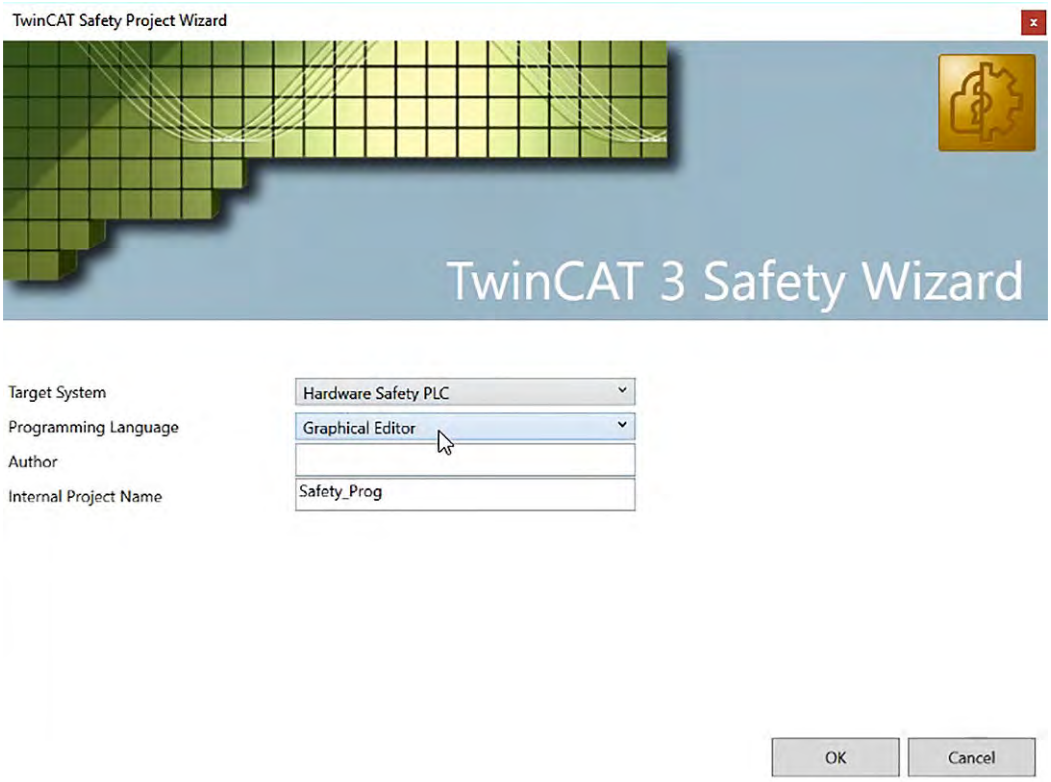


Fig. 79: TwinCAT 3 - TwinCAT Safety Project Wizard

⇨ The created safety project is now created in the *Solution Explorer* under the *SAFETY* node.

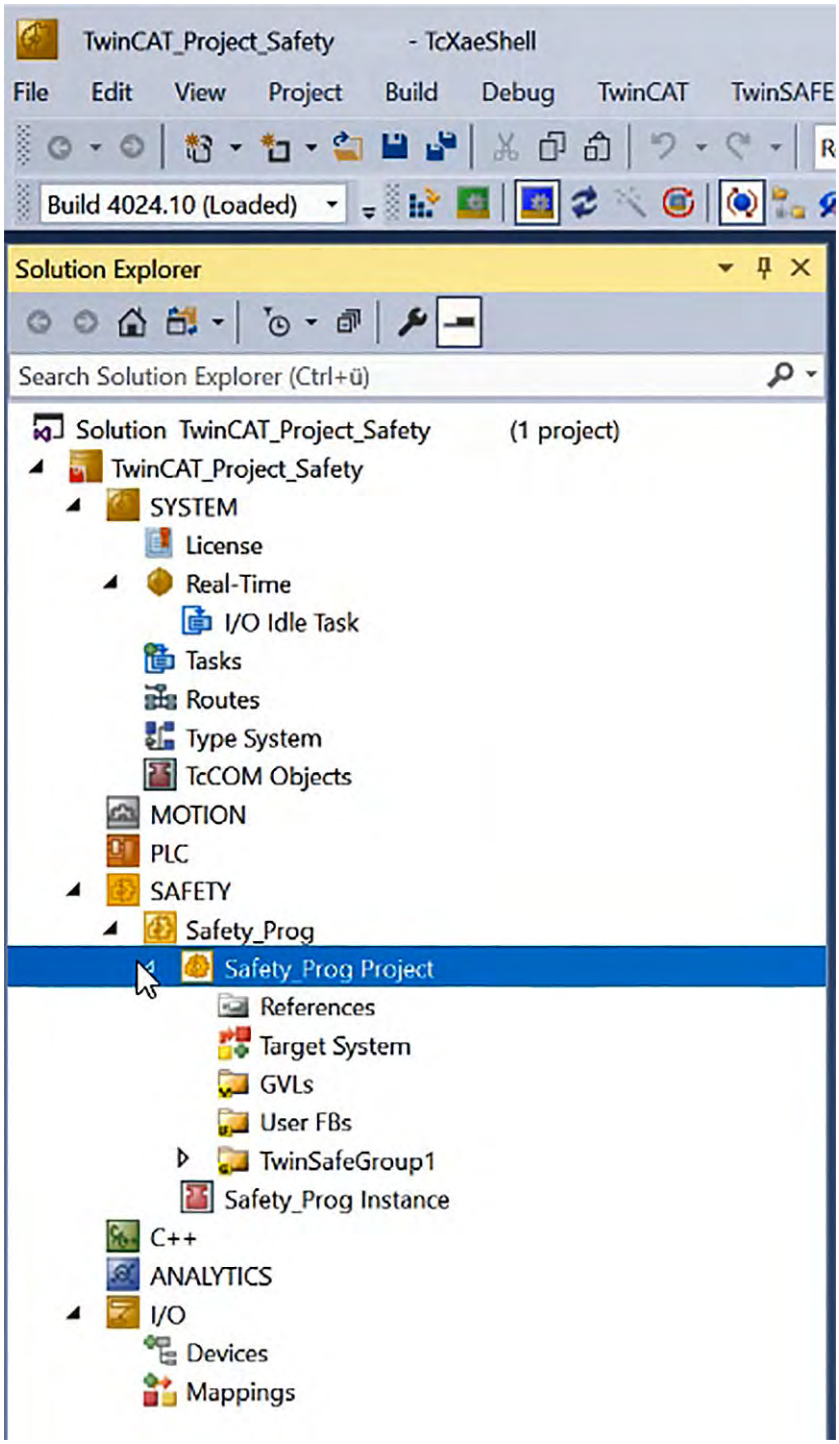


Fig. 80: TwinCAT 3 - Safety Project is created in the Solution Explorer

5.

Before the safety project can be linked with the physical TwinSAFE terminal EL6910, the hardware configuration must be scanned!

By selecting the *Target System* node, the assignment of the safety project to the physical TwinSAFE terminal EL6910 (for example) is carried out.

The *Target System* is selected by double-clicking on the *Target System* node.

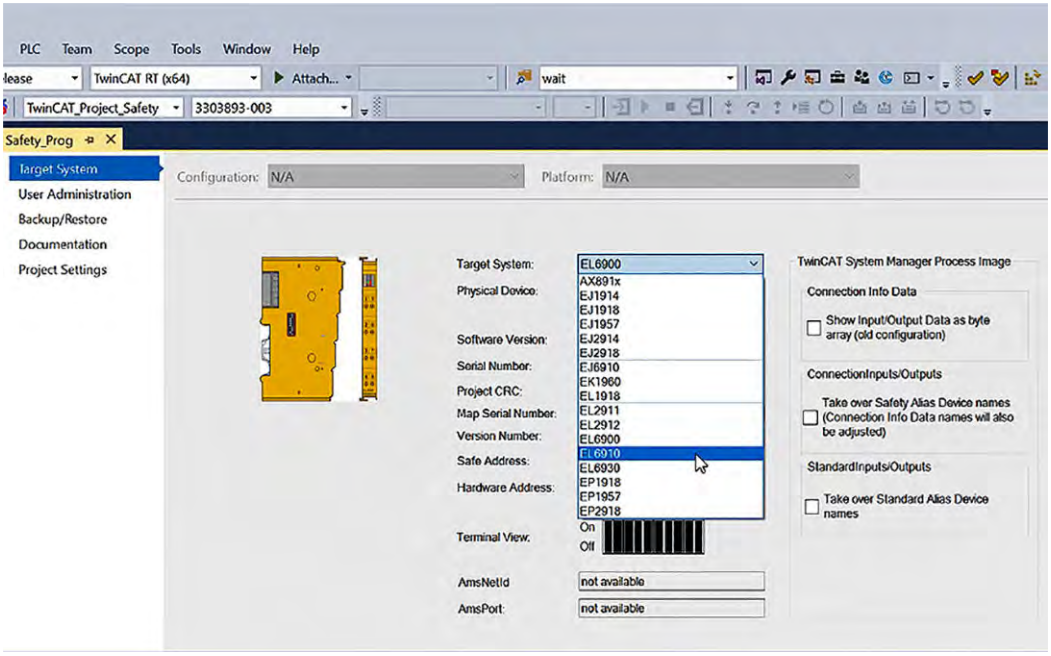


Fig. 81: TwinCAT 3 - Select Target System EL6910 for Safety Project

6. The target system is set to EL6910 via the drop-down list and linked to the EL6910 terminal via the link button next to *Physical Device*.

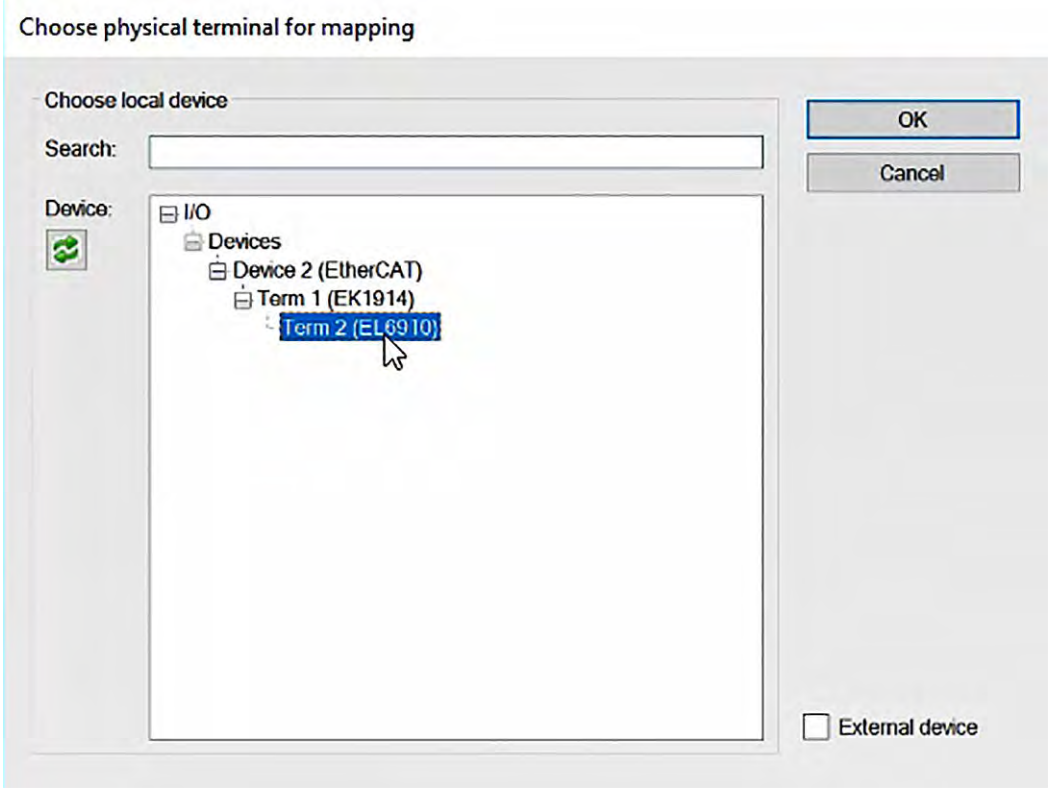


Fig. 82: TwinCAT 3 - Choose physical terminal for mapping

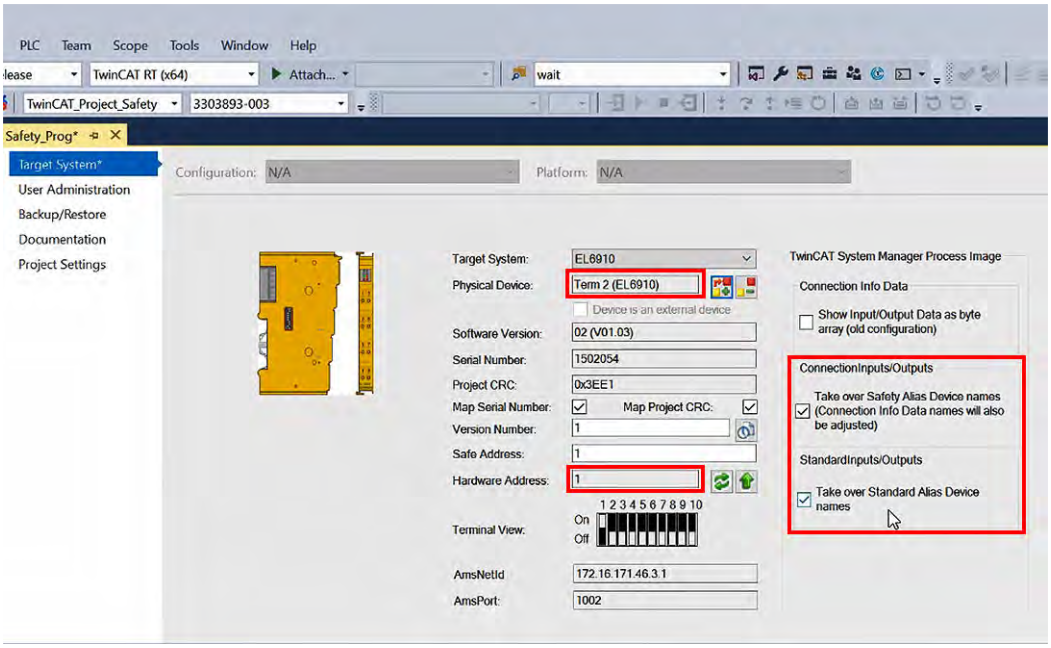


Fig. 83: TwinCAT 3 - Physical device is mapped

⇨ Term 2 (EL6910) is now entered in the field next to *Physical Device*, and the hardware address has also been recognised.

The two checkboxes *Take over Safety Alias Device names (Connection Info Data names will also be adjusted)* and *Take over Standard Alias Device names* should be selected, as this ensures consistent naming (and thus easy recognition) even of alias device names.

TwinSAFE address

- *The TwinSAFE terminal (EL6910) has a 10-position DIP switch on the side via which a hardware address must be assigned.*
- *TwinSAFE addresses from 1 to 1023 are available.*
- *Address 0 is not a valid TwinSAFE address!*
- *The EtherCAT coupler (EK1914) must also have an address different from 0!*
- *Each set TwinSAFE address may only occur once within a network/configuration!*

7. Save the configuration with *Save all*.

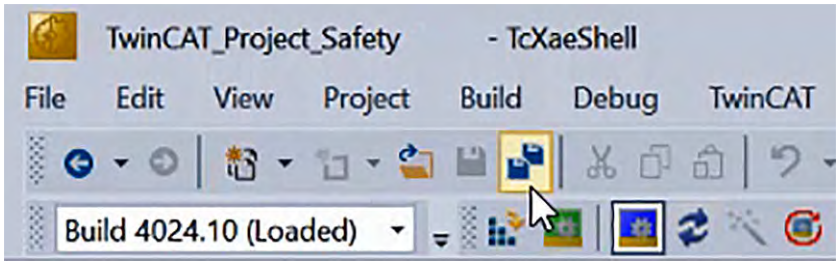


Fig. 84: TwinCAT 3 - Save all

5.3.4 Importing the Alias Devices from the I/O Configuration

The communication between the EL6910 TwinSAFE terminal and the I/O level is realised via an alias level. In this alias level (sub-node *Alias Devices*), corresponding alias devices are created for all safe inputs and outputs, but also for standard signals. This can also be done automatically for the safe inputs and outputs using the I/O configuration. The connection- and device-specific parameters are set via the Alias Devices.

In the TwinSafeGroup1 there are already two alias devices that the *TwinCAT Safety Project Wizard* has created:

- ErrorAcknowledgement.sds
  ErrorAcknowledgement is to be linked to a PLC output or a standard input (such as a push button) and used to acknowledge safety group errors: An error must additionally be acknowledged manually so that it is reset.
  Linking standard variables is always a two-step process: First they must be linked from within the logic to the alias, and then from the alias to the PLC or the physical I/Os.
  ErrorAcknowledgement is already important when going online with the PLC project. In this case, the signals of the safety PLC indicate that there is a communication error (or ComErr). To reset the communication error, a 0 ⇨ 1 ⇨ 0 transition must be seen on the *ErrorAcknowledgement* signal.
- Run.sds
  Run/Stop sets the complete TwinSafeGroup in *Run* mode (activated) or in *Stop* mode (deactivated).
  When working on a safety system (e.g. plugging or unplugging), an error occurs if the TwinSafeGroup concerned is not in Stop mode. In addition, for machines with several safety areas (and thus several TwinSafeGroups), each area can be specifically set to *Run* or *Stop* mode.

⇨ Start the automatic import of the alias devices from the I/O configuration via the context menu of *Alias Devices*.

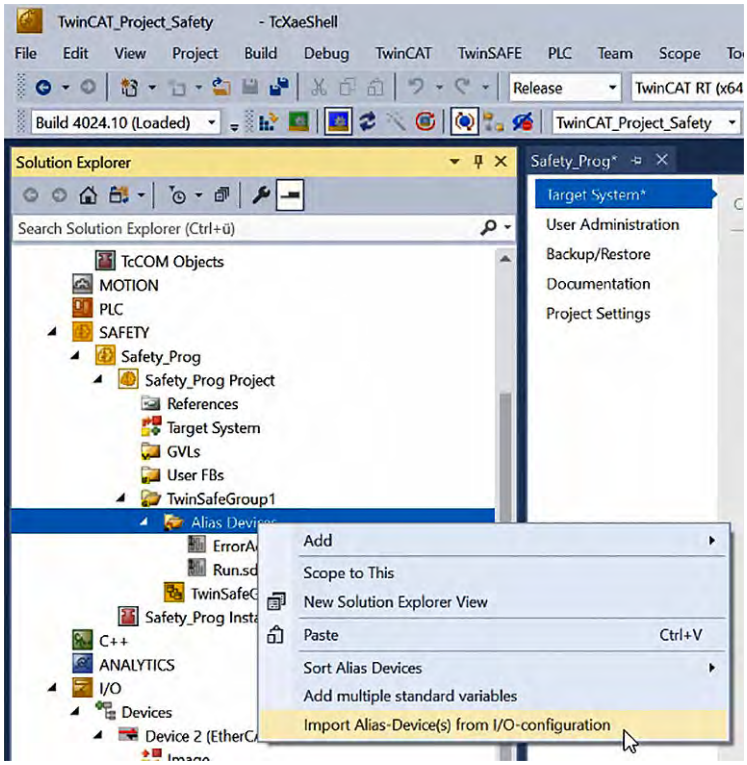


Fig. 85: TwinCAT 3 - Import Alias Device(s) from IO configuration

2. A selection dialogue opens in which the individual terminals to be imported can be selected.

Only select the terminals that are also used in the safety project, as an error is reported if alias devices of terminals not used in the safety project are present!

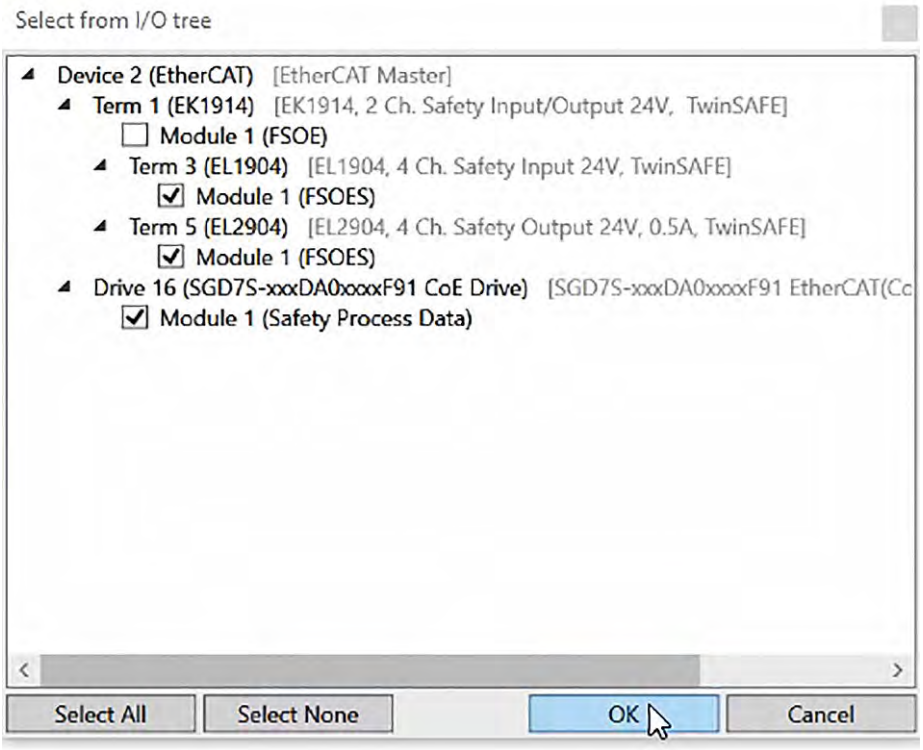


Fig. 86: TwinCAT 3 - Select Alias Devices from IO tree

⇨ After closing the dialogue via OK, the alias devices are created in the safety project.

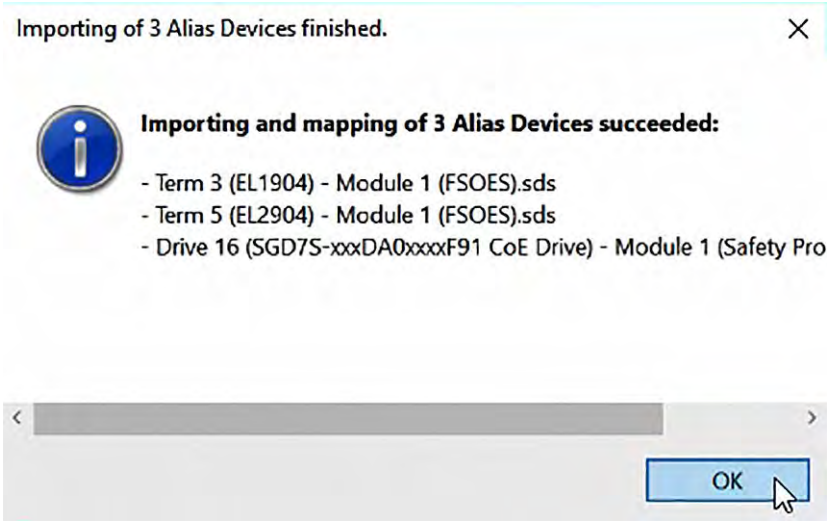


Fig. 87: TwinCAT 3 - Importing and mapping of Alias Devices succeeded

After importing, you can access the inputs and outputs of the safety terminals in the safety project. This would not have been possible before.

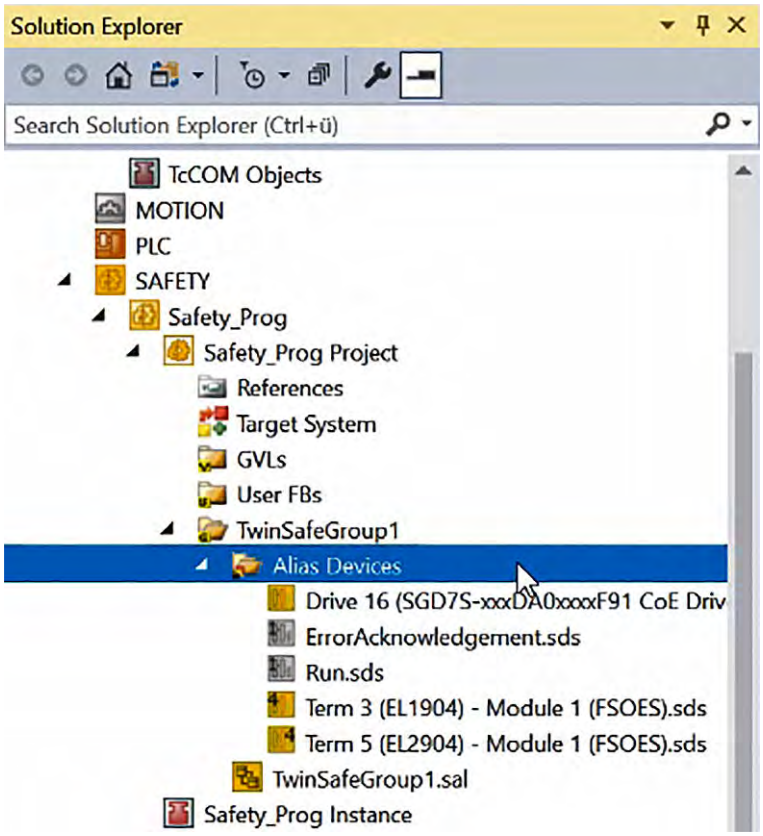


Fig. 88: TwinCAT 3 - Alias Devices in TwinSafeGroup imported

3. Double-click on the alias device in the safety project structure to open the settings. The *Linking* tab contains the FSoE address, the checkbox for setting as *External Device* and the link to the physical I/O device.

Actually, the FSoE address should be transferred automatically from the hardware address (dip switch); if this is not the case, the FSoE address must be written manually into the corresponding field.

To be on the safe side, press the refresh button in advance so that the current status of the configuration is displayed.

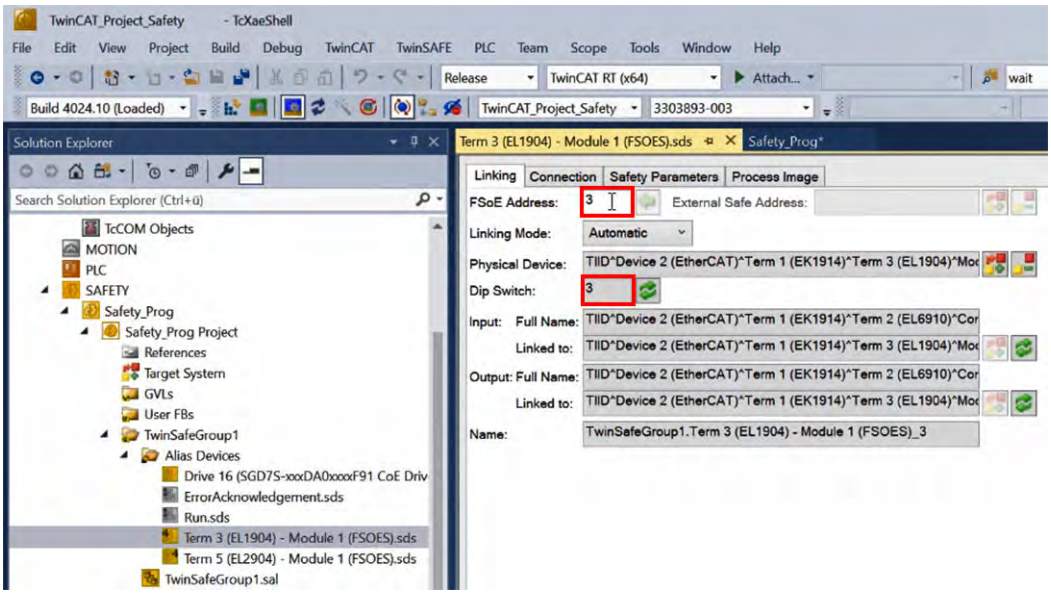


Fig. 89: TwinCAT 3 - Properties of the Safety Project structure

⇨

With the Advanced Safety Module, the FSoE address is transmitted by the Safe Container. Therefore, before importing the alias devices, the container should be in the Advanced Safety Module and the corresponding inputs should also be mapped.

The Safe Container is created using the Advanced Safety Module Parameter Editor.

The Advanced Safety Module does not have a dip switch, the FSoE address is only assigned via the Advanced Safety Module Parameter Editor!

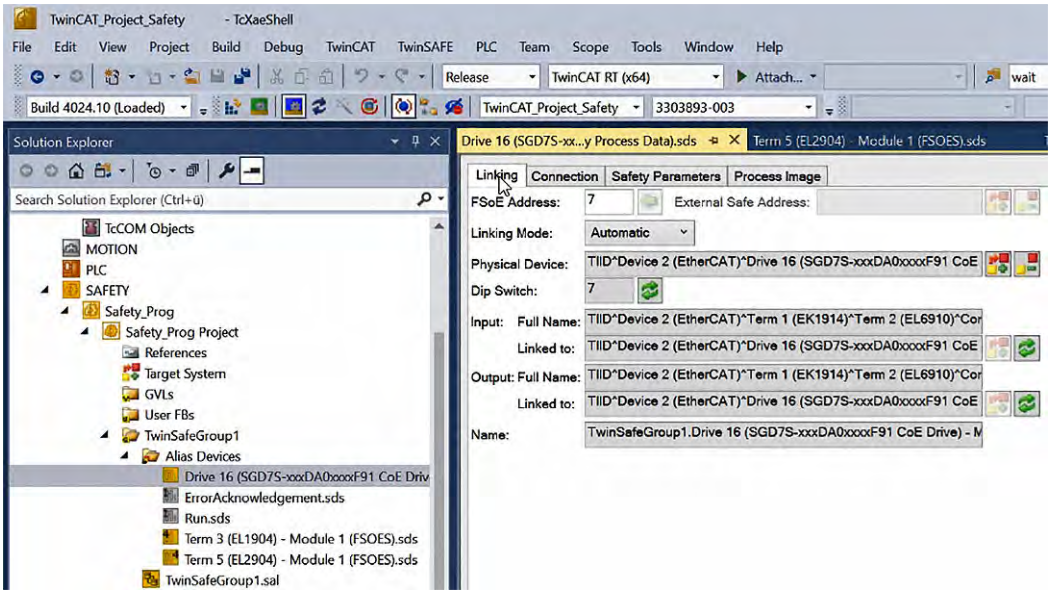


Fig. 90: TwinCAT 3 - Properties of the SGD7S Alias Device

5.3.5 Safety Programming in the TwinSAFE Group

5.3.5.1 Combining ErrorAcknowledgement.sds and Run.sds with a Standard Signal

This step must be carried out before the safety programming of the Twin-SAFE group can be carried out.

1. *ErrorAcknowledgement.sds* and *RUN.sds* must always be linked to a standard signal. Therefore, we now create a PLC programme and declare two Boolean variables (RUN, ERR ACK).

   Right-click in the *PLC* node and select *Add New Item...*.

> ***Run and ErrACK of the TwinSAFE Group***
> *Error acknowledgement is not performed automatically, i.e. the ERR ACK input must always be linked to a standard signal. For the EL6910 and newer logics, the RUN input must also always be linked to a standard signal.*

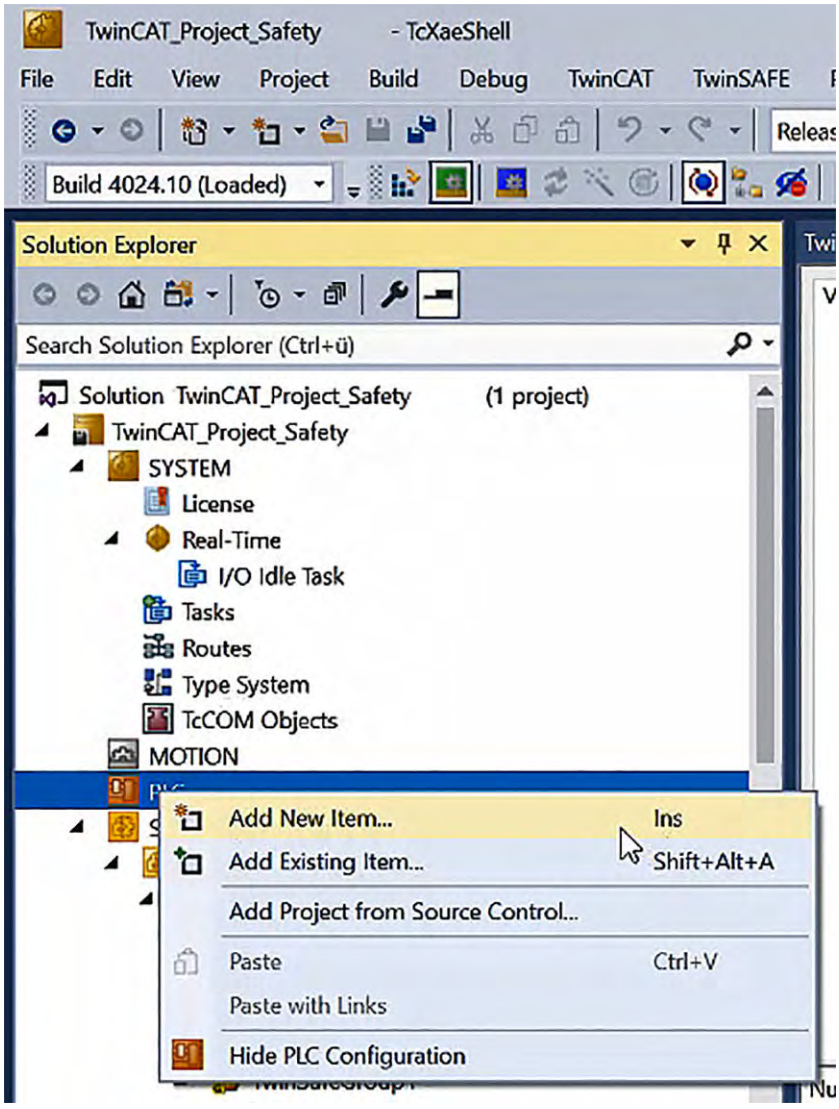


Fig. 91: TwinCAT 3 - Add New Item in PLC

2. In the dialogue box that opens, select *Standard PLC Project*, assign a name to the new project and create the project with *Add*.

> *In our example, the project was given the name "PLC_Safety Project".*

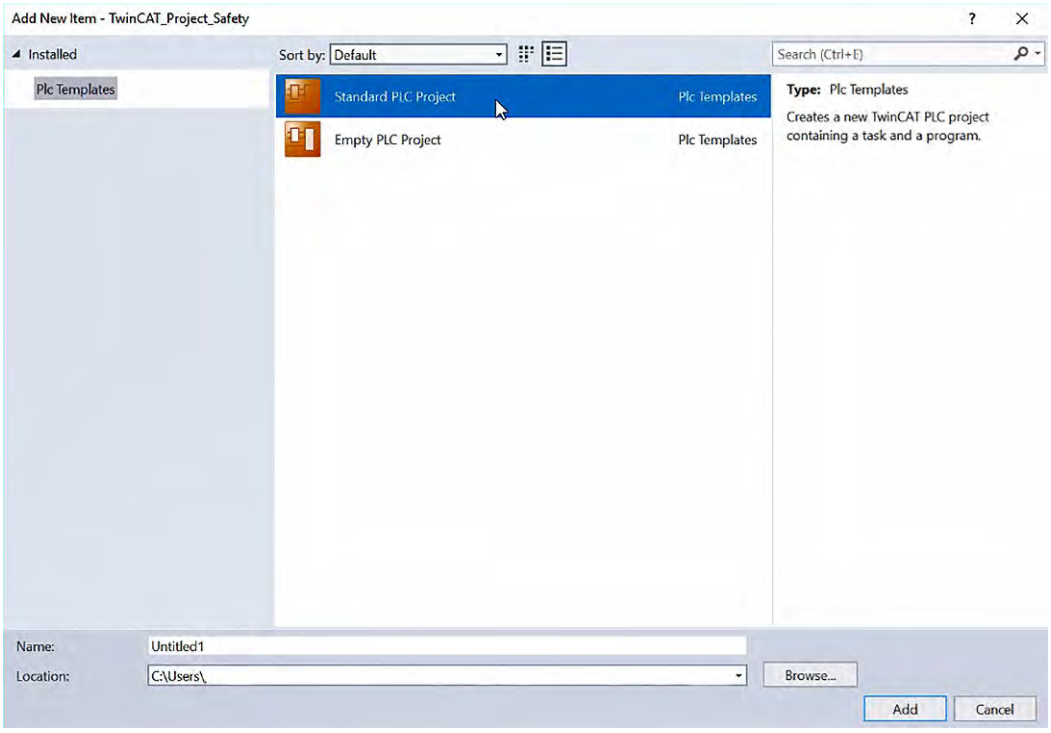


Fig. 92: TwinCAT 3 - Create Standard PLC Project

⇨ The project structure is now created in the *Solution Explorer*.

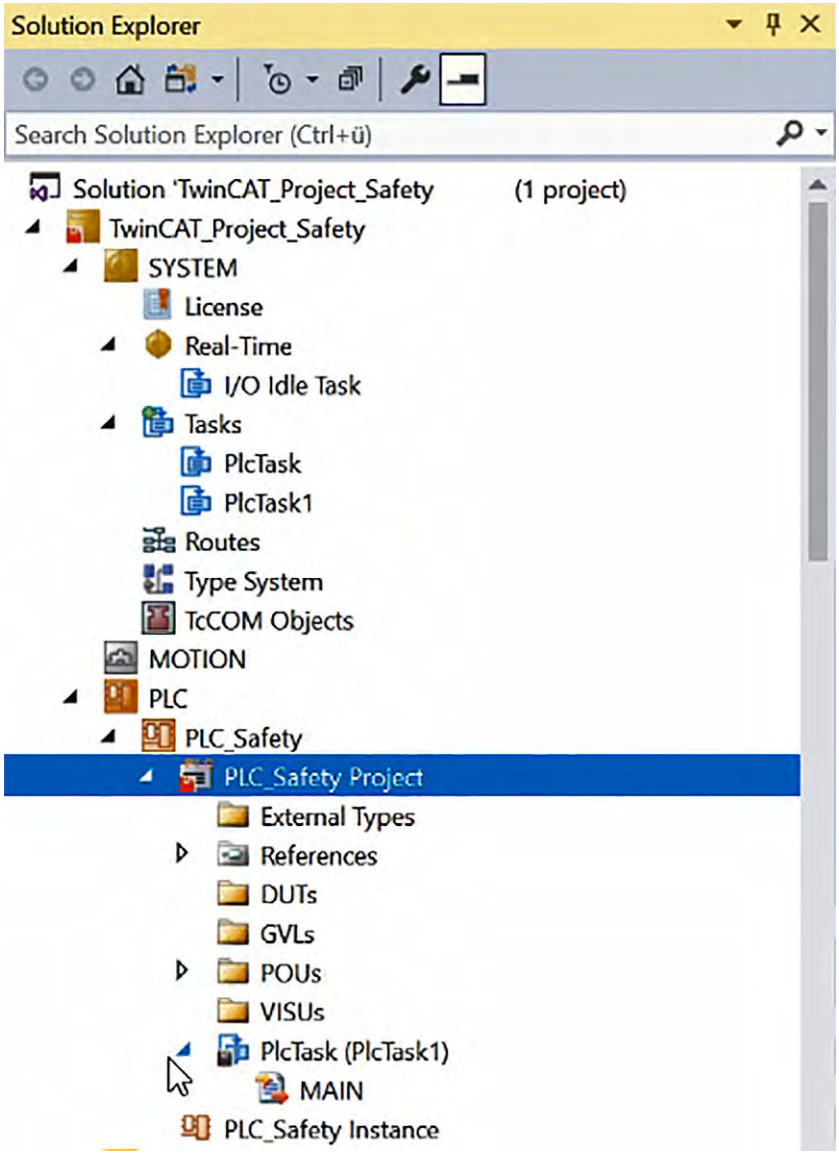


Fig. 93: TwinCAT 3 - Standard PLC Project created

3. Open the *MAIN* PLC programme.

> *The MAIN PLC programme is opened by double-clicking on the MAIN node.*

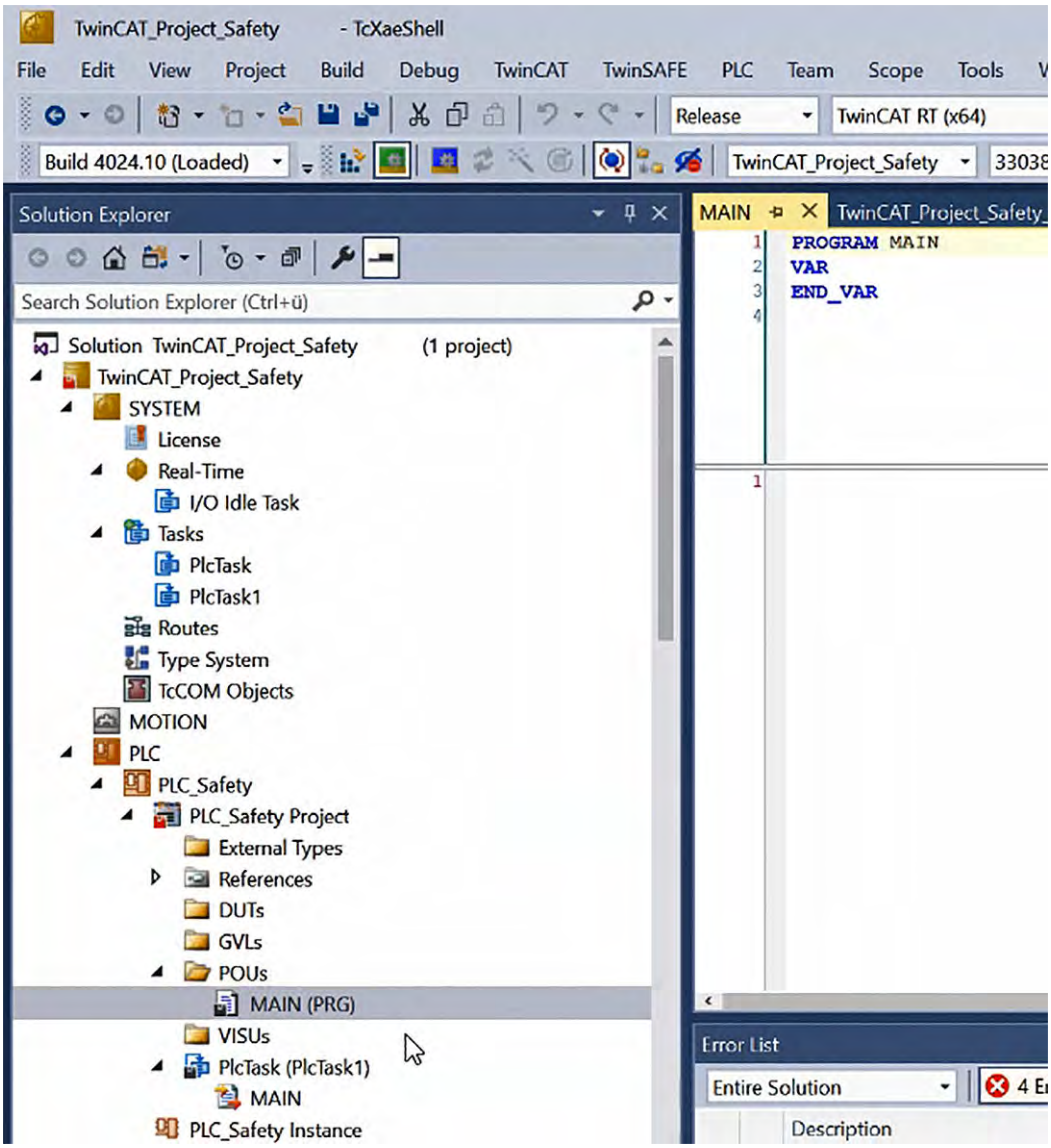


Fig. 94: TwinCAT 3 - Open MAIN PLC program

4. Two Boolean variables are declared in *MAIN*, which we subsequently need for *ErrorAcknowledgement.sds* and *Run.sds*:

- bErrACK AT %Q* : BOOL;
- bStartStop AT %Q* : BOOL;

> *In TwinCAT, the actual addresses of the I/Os are of no interest, and there is no direct access to them. Therefore, one declares a variable with %I* as input and with %Q* as output. Once the programme has been translated, these variables can then be assigned to the physical inputs and outputs.*

The variables must be entered manually.

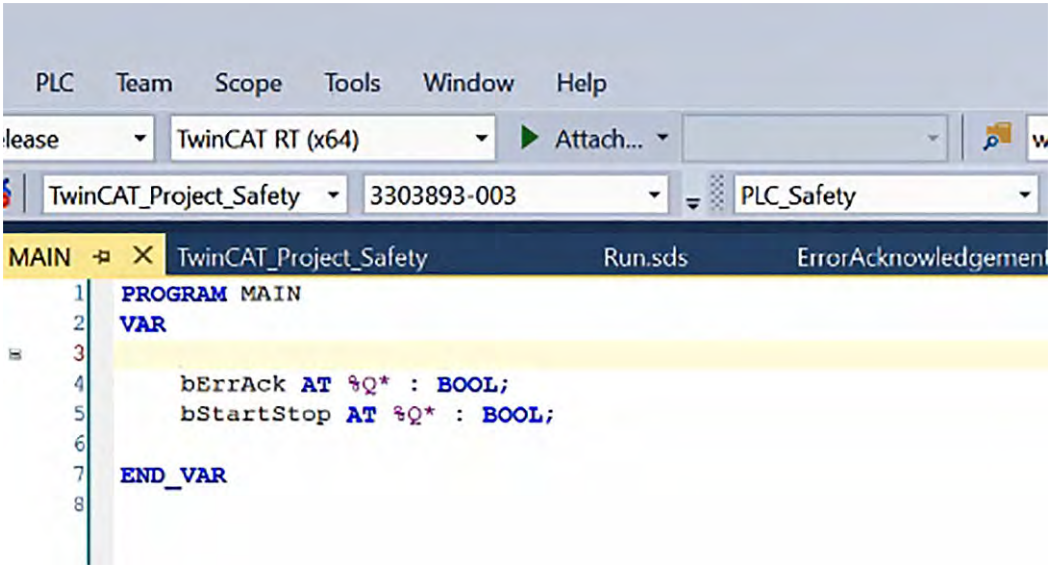


Fig. 95: TwinCAT 3 - Variables in MAIN PLC program

⇨

> *ErrorAcknowledgement.sds is an input in the safety project, therefore the variable must be declared as an output (%Q*) in the standard PLC.*

5. Save the programme.

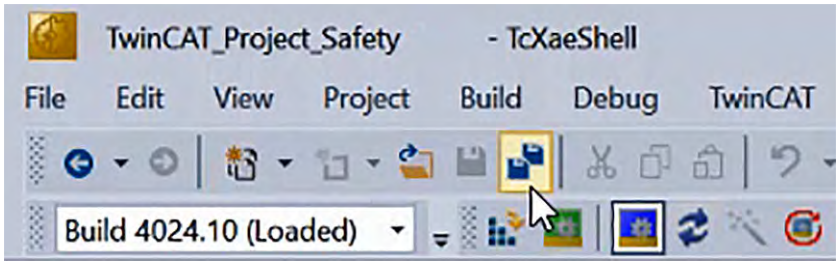


Fig. 96: TwinCAT 3 - Save all

6. Activate the configuration.

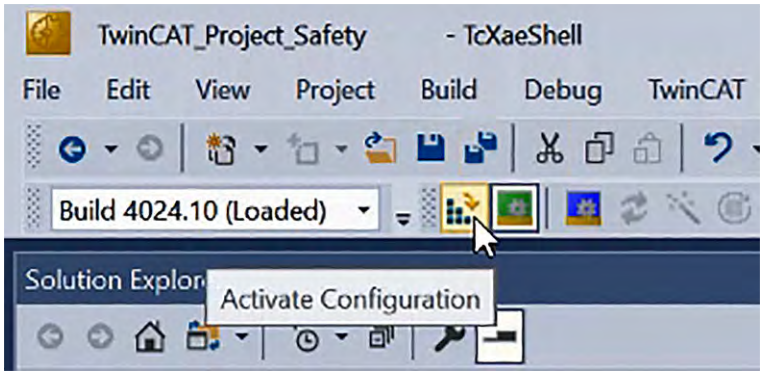


Fig. 97: TwinCAT 3 - Activate Configuration

⇨ Confirm the activation of the configuration.

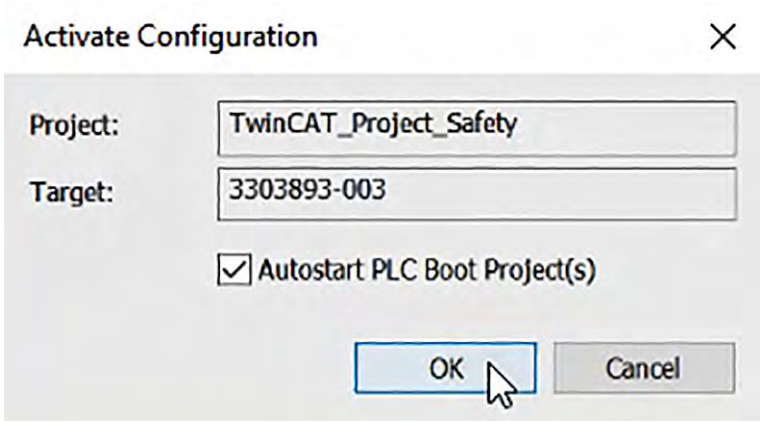


Fig. 98: TwinCAT 3 - Activate Configuration Dialog box

A restart of the TwinCAT system in *Run Mode* is not necessary.

The message that alias devices of terminals are present, which are not included in the safety project, only appears after a restart of the TwinCAT system (see Chap. 5.3.4 'Importing the Alias Devices from the I/O Configuration' page 85).

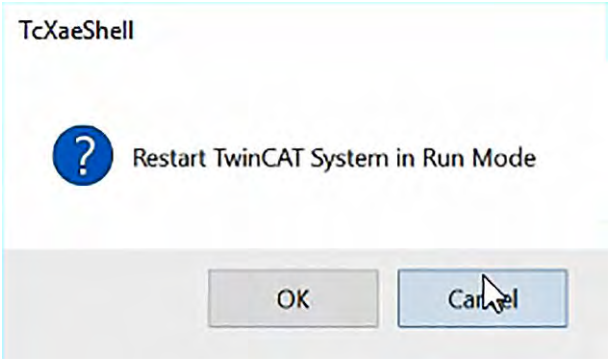


Fig. 99: TwinCAT 3 - Restart TwinCAT System in Run Mode - Cancel

7. Link the variables to the alias devices.

> *By linking the variables to the alias devices, the connection between the standard PLC and the safety project is established.*

Double-click on *ErrorAcknowledgement.sds* in the Solution Explorer to call up the alias device.

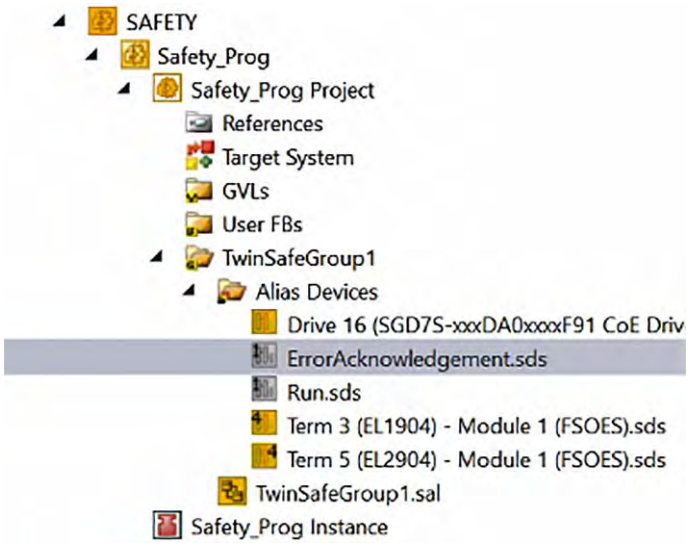


Fig. 100: TwinCAT 3 - ErrorAcknowledgement Alias Device in Solution Explorer

8. In the main window, click on the link button on the right side of the *Linked to:* field.

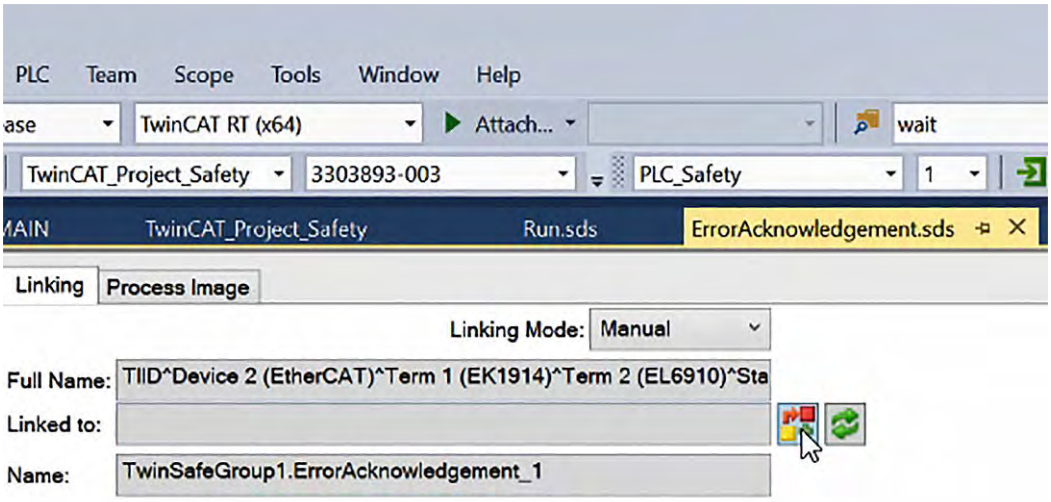


Fig. 101: TwinCAT 3 - ErrorAcknowledgement - Link Button

9. Select the variable bErrAck and confirm the dialogue box with OK.

> *Depending on the number of integrated terminals, you have to scroll down in the dialogue box to see the variables.*

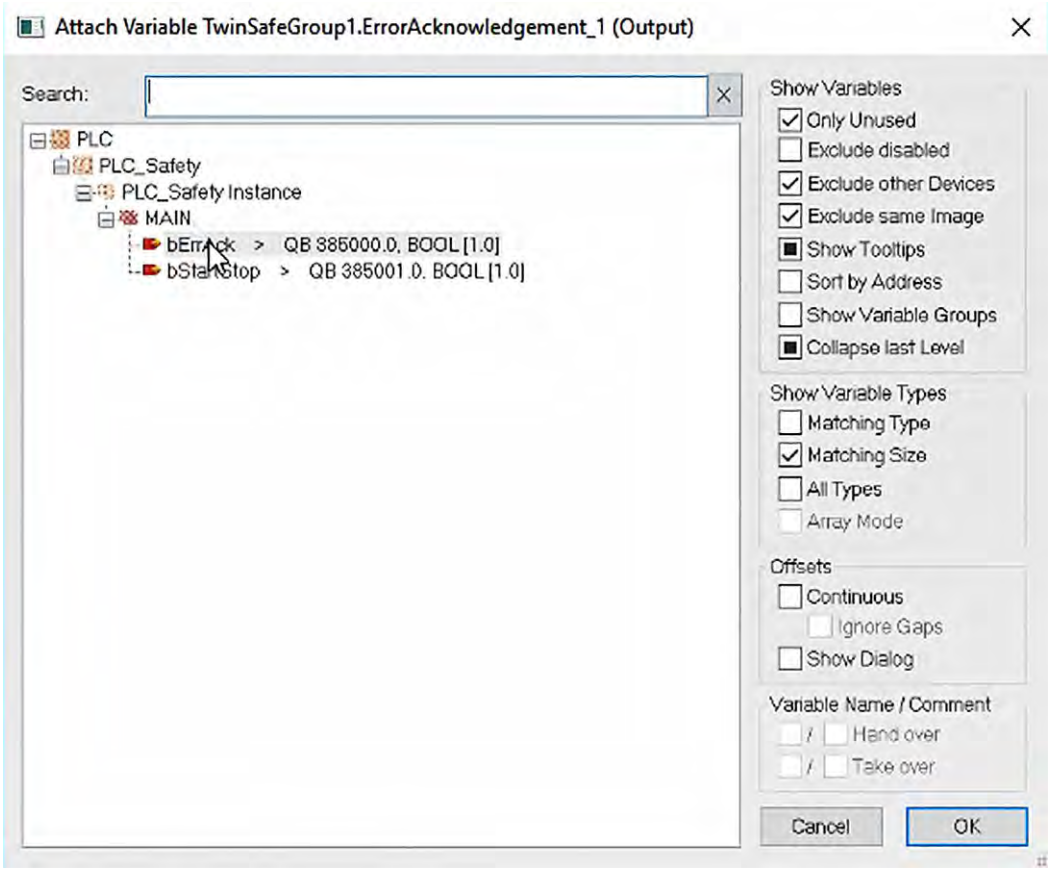


Fig. 102: TwinCAT 3 - Attach Variable bErrAck to ErrorAcknowledgement

⇨ The *Linked to:* field shows that the link has been successfully established.

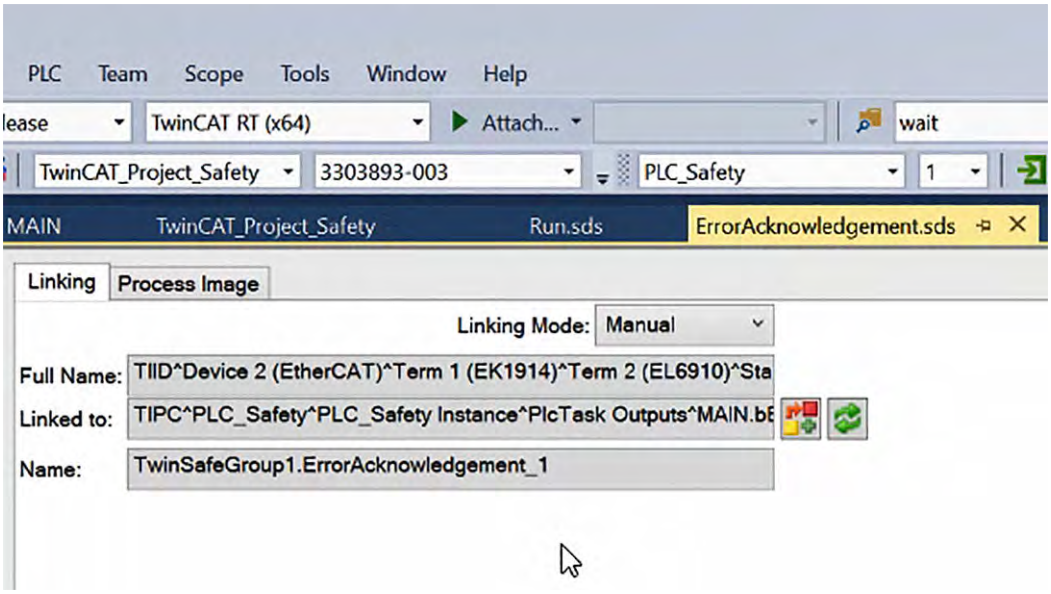


Fig. 103: TwinCAT 3 - Variable bErrAck attached to ErrorAcknowledgement

10. Double-click on *Run.sds* in the Solution Explorer to call up the alias device.

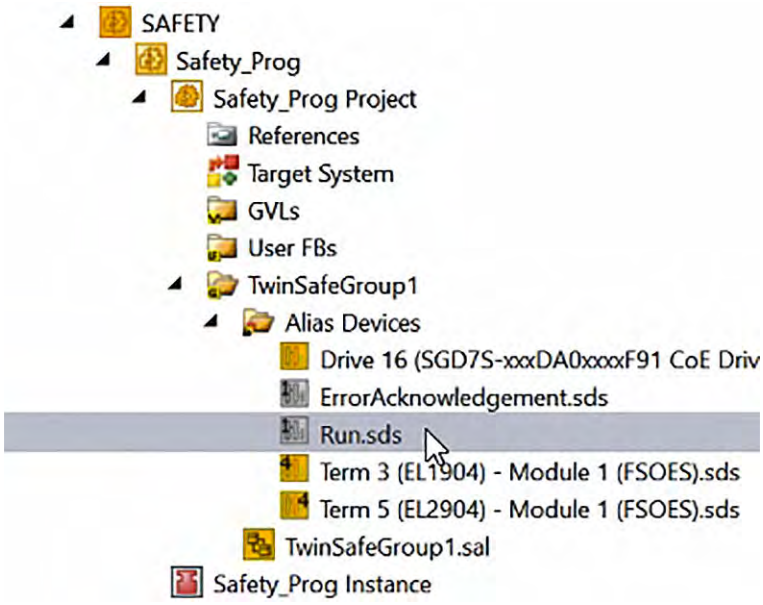


Fig. 104: TwinCAT 3 - Run Alias Device in Solution Explorer

11. In the main window, click on the link button on the right side of the *Linked to:* field.

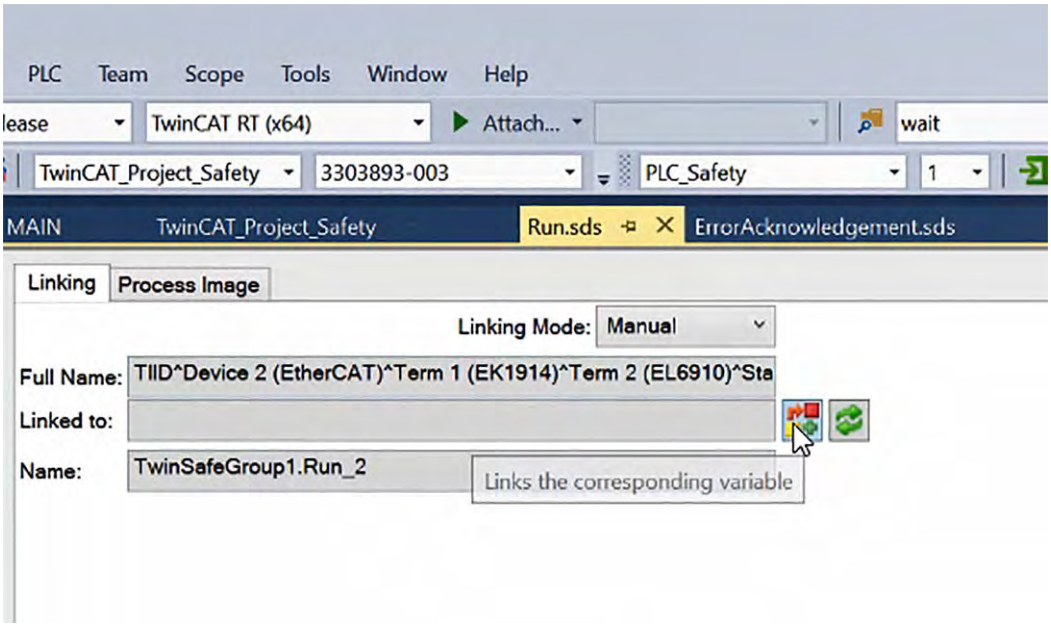


Fig. 105: TwinCAT 3 - Run - Link Button

12. Select the variable bStartStop and confirm the dialogue box with OK.

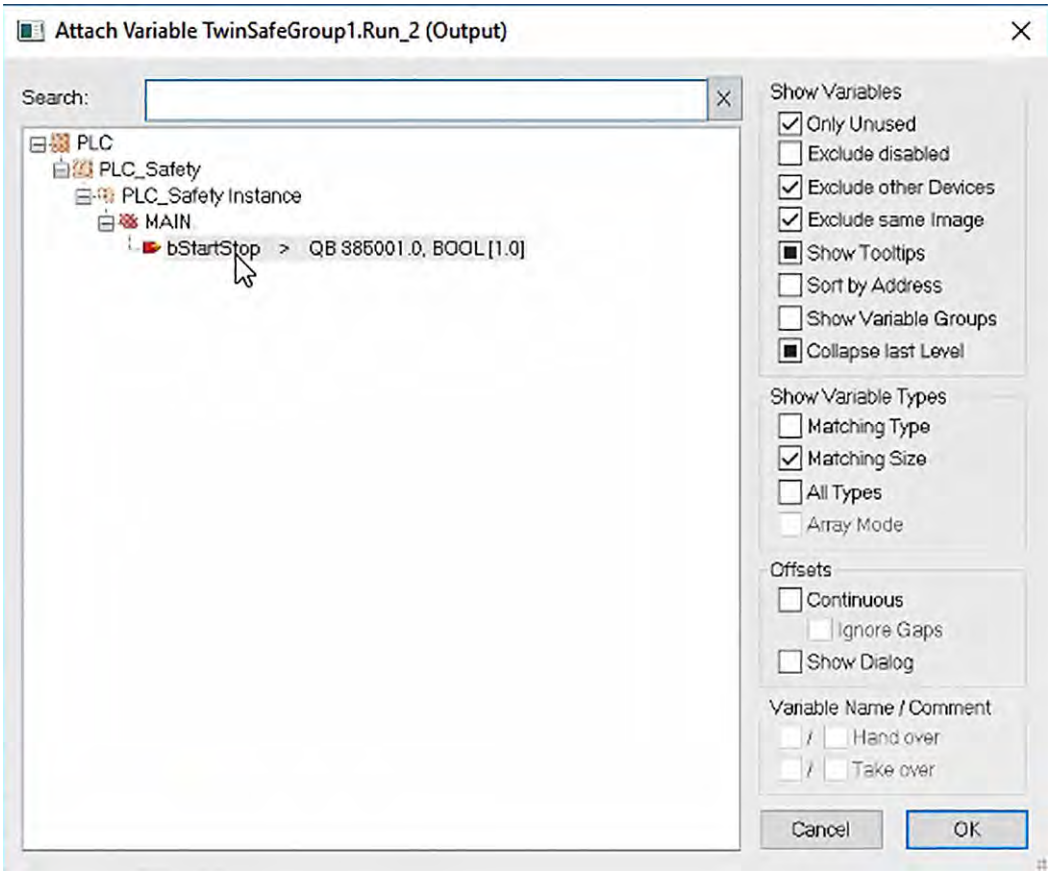


Fig. 106: TwinCAT 3 - Attach Variable bStartStop to Run

⇨ The *Linked to:* field shows that the link has been successfully established.

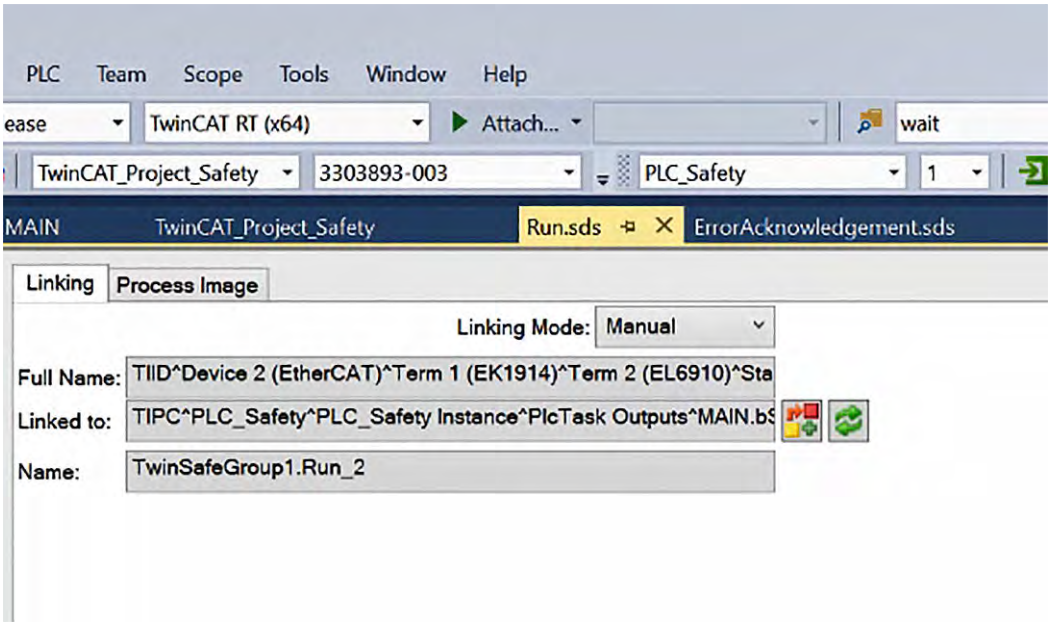


Fig. 107: TwinCAT 3 - Variable bStartStop attached to Run

13. Save the programme.

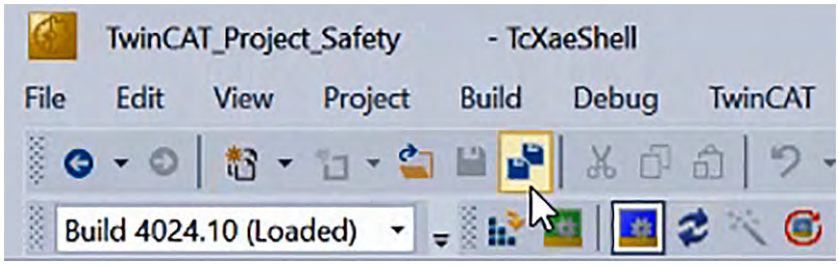


Fig. 108: TwinCAT 3 - Save all

14. Activate the configuration.

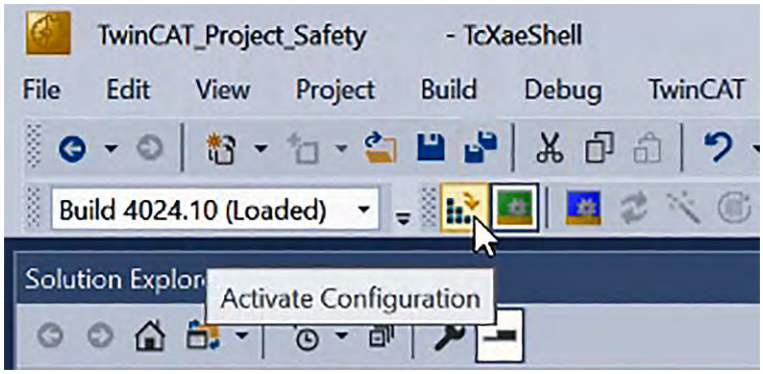


Fig. 109: TwinCAT 3 - Activate Configuration

⇨ Confirm the activation of the configuration.

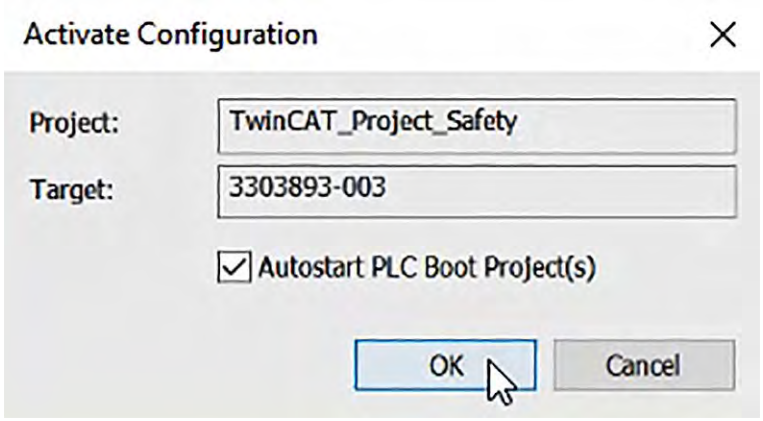


Fig. 110: TwinCAT 3 - Activate Configuration Dialog box

A restart of the TwinCAT system in *Run Mode* is not necessary.

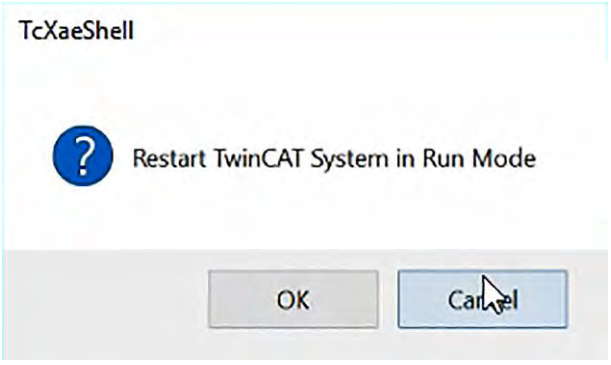


Fig. 111: TwinCAT 3 - Restart TwinCAT System in Run Mode - Cancel

5.3.5.2 Configuring a Safety Function Block in the TwinSAFE Group

1. Double-click on the *TwinSafeGroup1.sal* safety application in the *Solution Explorer* to open an empty safety application.

   The *TwinCAT Safety Project Wizard* has automatically created the first "network". The safety programme is written with the function plan (FUP) and is divided into "networks". *Network1* can be renamed to a meaningful name (such as *safeAnd*).

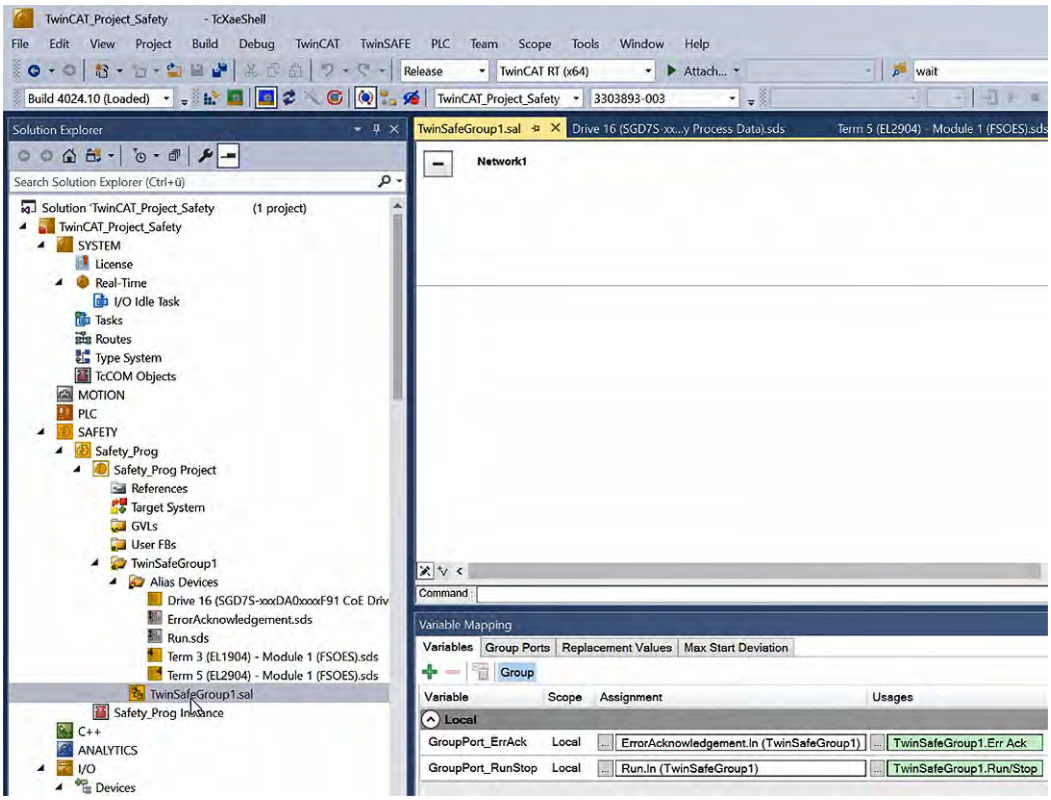


Fig. 112: TwinCAT 3 - Start Programming in TwinSafeGroup1

⇨

TwinSAFE group

Safety programming takes place in the TwinSAFE group (here: TwinSafeGroup1.sal).

TwinSAFE groups are a way to logically separate safety programmes. If an application consists of, for example, two physically separate work cells that are both controlled by the same TwinSAFE EL6900 safety PLC, it makes sense to separate the logic into two separate TwinSAFE groups, since logically they are two different machines.

The purpose of the groups is to manage error responses. If a safety malfunction is detected, then the entire group goes into a faulty state, all outputs return to their "safe" state (i.e. logical "0"), and the error must be acknowledged with the error acknowledgement signal. In the event that you have two physically separate machines controlled by the same safety PLC, it makes sense to separate them into two groups so that a malfunction of the safety device on one machine does not cause the other machine to stop.

A communication error is indicated by the output (COM ERR) of the TwinSAFE group and acknowledged via the input ERR ACK. A function block error is indicated by the FB ERR output and acknowledged by the same ERR ACK input as the communication error. The safe state of the outputs of the TwinSAFE group is only cancelled when the error is no longer present and has been acknowledged.

In addition, the TwinSAFE group has an input (RUN) with which the processing of the assigned function blocks can be started or stopped. In the stopped state, all outputs assigned to the TwinSAFE group are in the safe state. The RUN input must always be linked to a standard signal for the EL6910 and newer logics.

2. Now we start adding function blocks to the network. The available safety function blocks are located in the toolbox window on the right-hand side of the screen.

The safety function blocks are available on the TwinSAFE terminal EL6910.

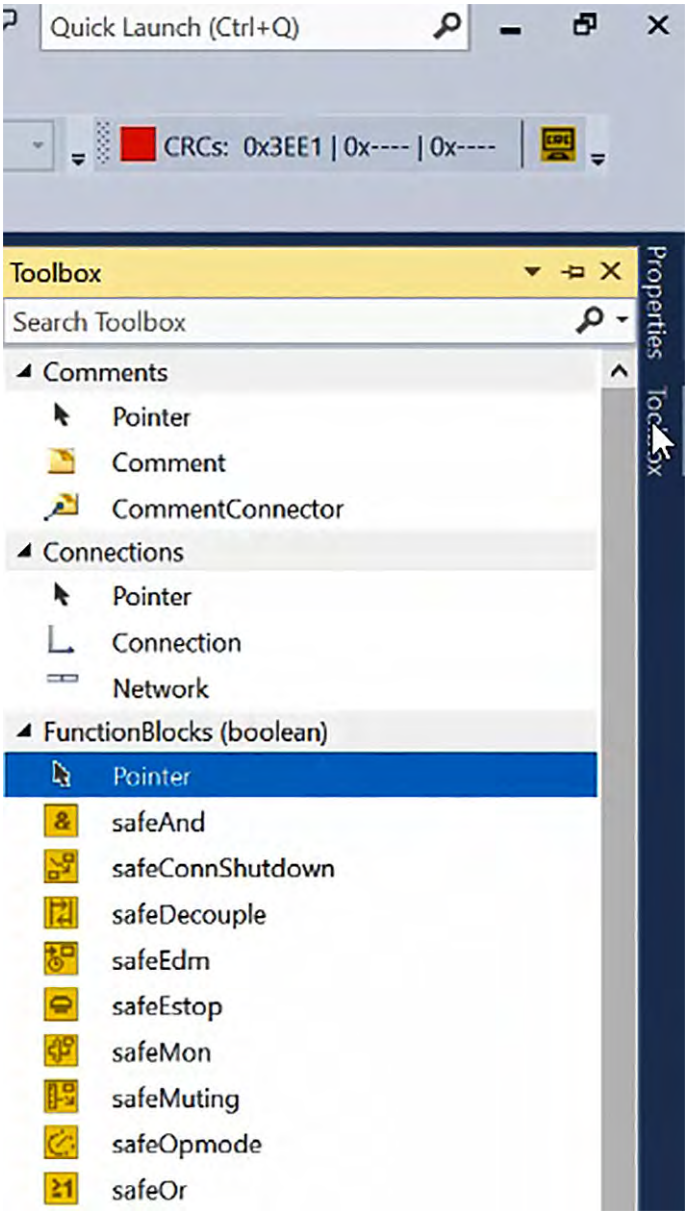


Fig. 113: TwinCAT 3 - Toolbox window

⇨

If there are no safety function blocks when you first open the toolbox, save and close the project. After reloading the project, there should be safety function blocks in the toolbox.

3. Click on the desired safety function block and drag it into the network.

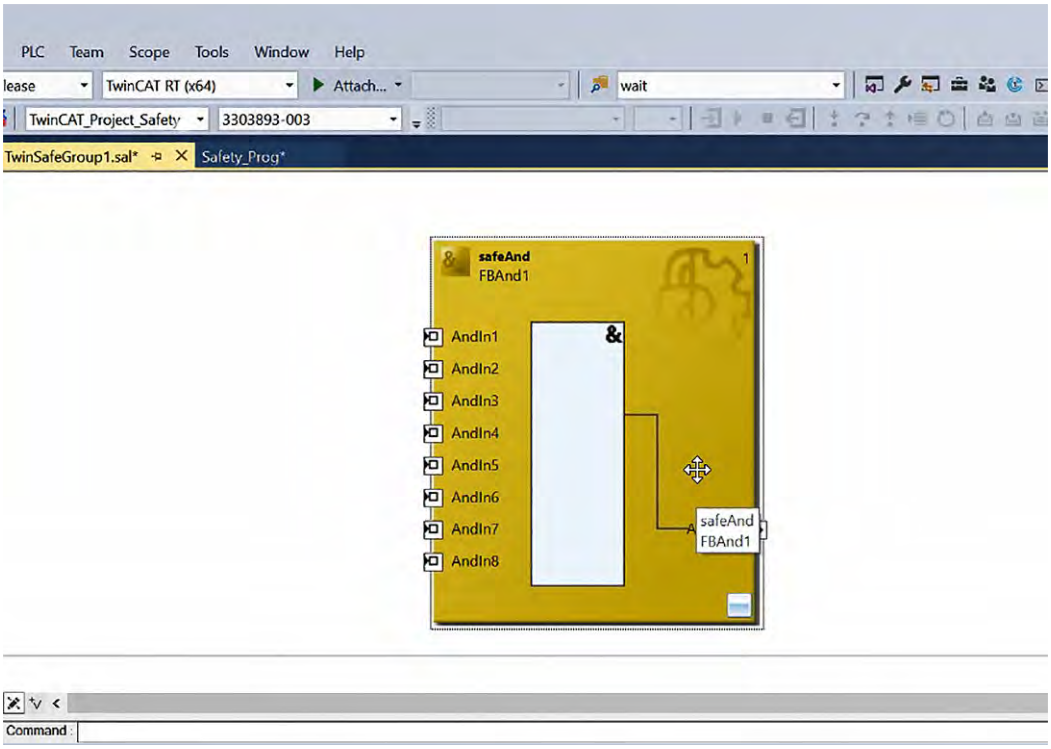


Fig. 114: TwinCAT 3 - safeAnd dropped in TwinSafeGroup1

⇨

There must be at least 1 network with a safety function block so that the safety project can be transferred to the controller.

The safety function block *safeAnd* was selected here because it can be connected to a non-safe input at the first terminal. Due to the AND link, the safety of the application is guaranteed, because the second terminal must be connected to a safe input.

4. Click on the green plus sign in the *Variables* tab of the *Variable Mapping* window to create the variable *Var_In1*. Then click on the green plus sign again and create the variable *Var_In2*.

> *The Variable Mapping window at the bottom of the screen is not displayed automatically. It must be explicitly selected.*

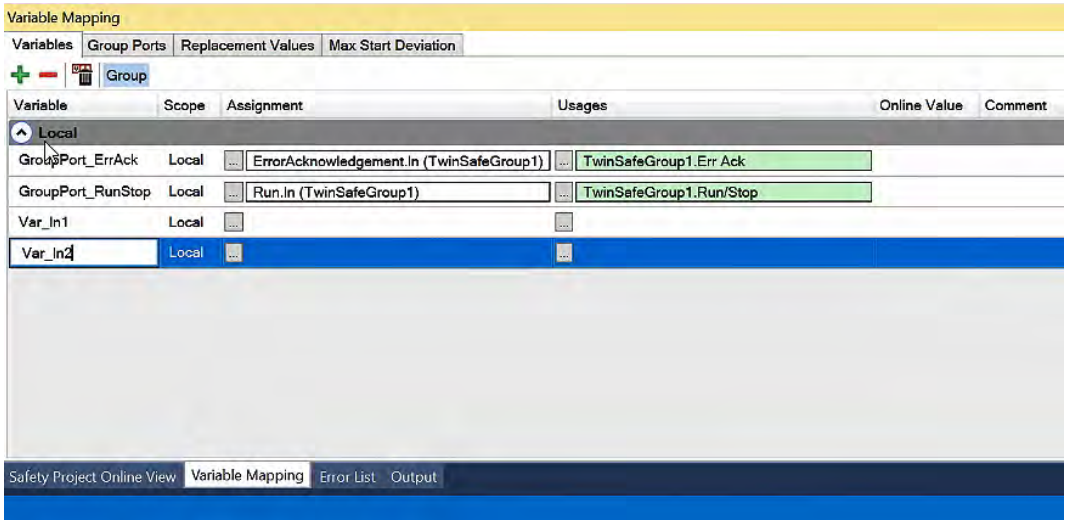


Fig. 115: TwinCAT 3 - Create variables Var_In1 and Var_In2 for safeAnd

5. We now link these two variables to the inputs of the *safeAnd*.

   Click on the *Map to* button in the *Var_In1* row.

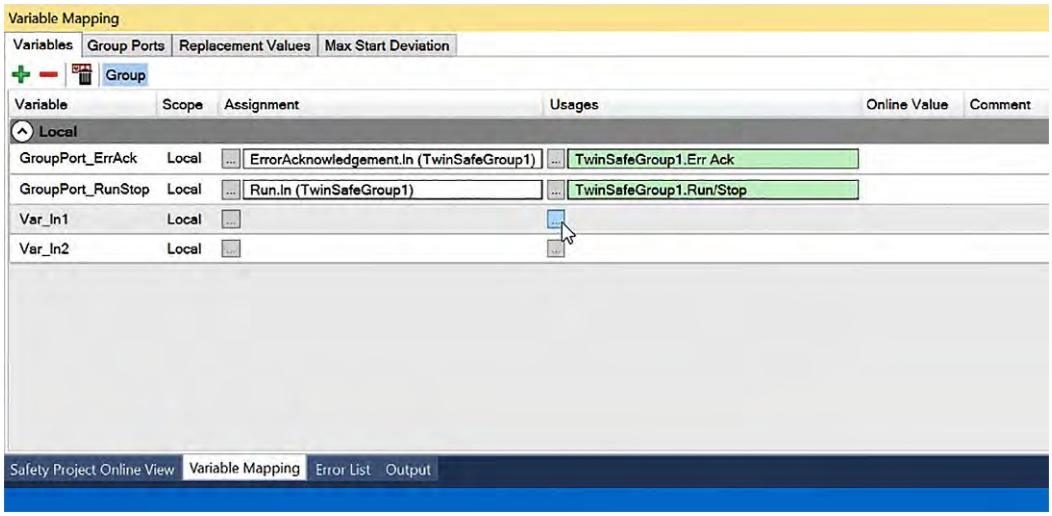


Fig. 116: TwinCAT 3 - Open Usage Map to dialog for variable Var_In1

6. In the *Map to* dialogue box, select the *AndIn1* input of the *safeAnd* and confirm with *OK*.

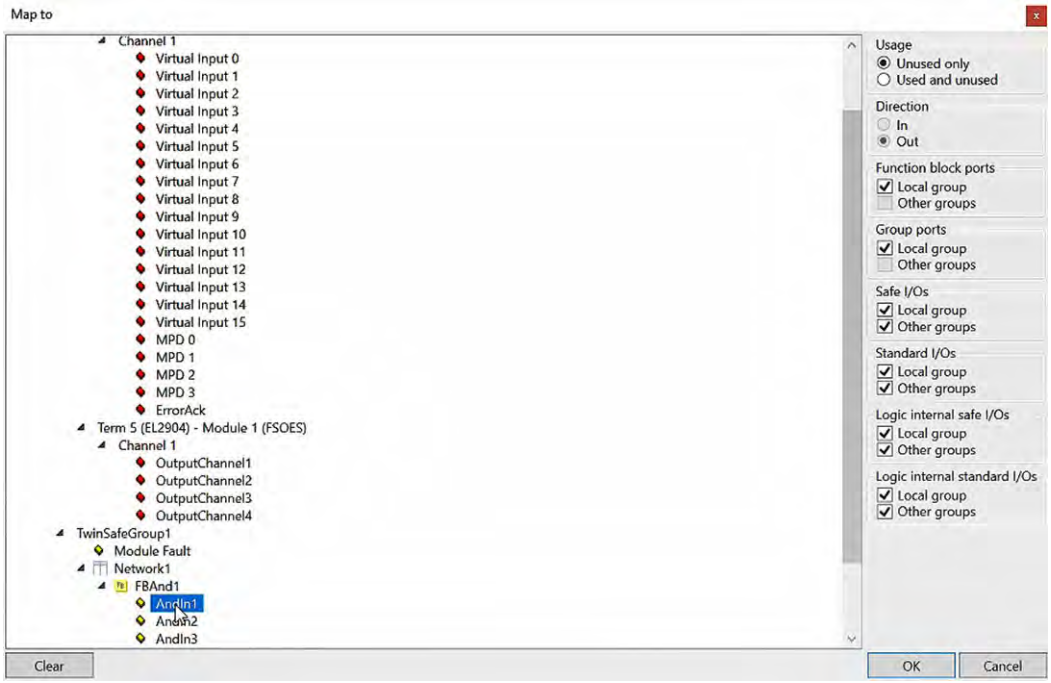


Fig. 117: TwinCAT 3 - Map Usage to AndIn1 for variable Var_In1

7. In the *Var_In2* row, click on the *Map to* button under *Usage*.

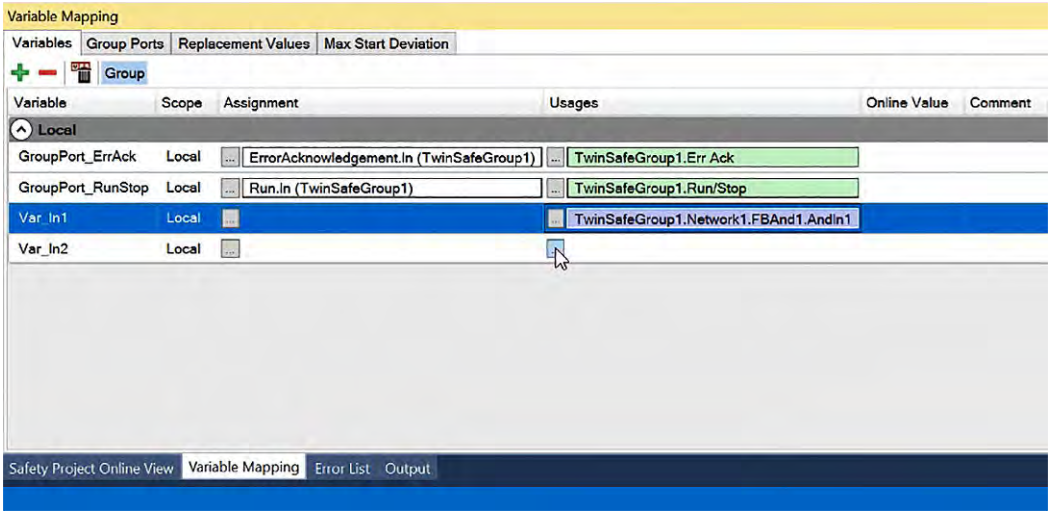


Fig. 118: TwinCAT 3 - Open Usage Map to dialog for variable Var_In2

8. In the *Map to* dialogue box, select the *AndIn2* input of the *safeAnd* and confirm with *OK*.

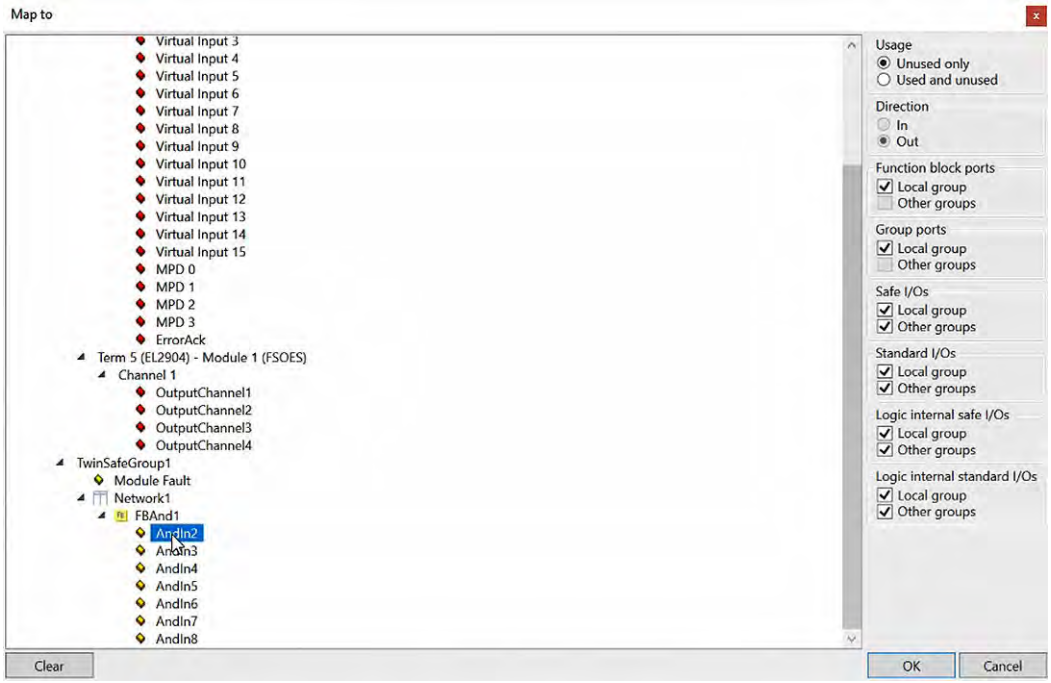


Fig. 119: TwinCAT 3 - Map Usage to AndIn2 for variable Var_In2

⇨ As *Usage*, the two variables are now linked to the inputs of the *safeAnd*.

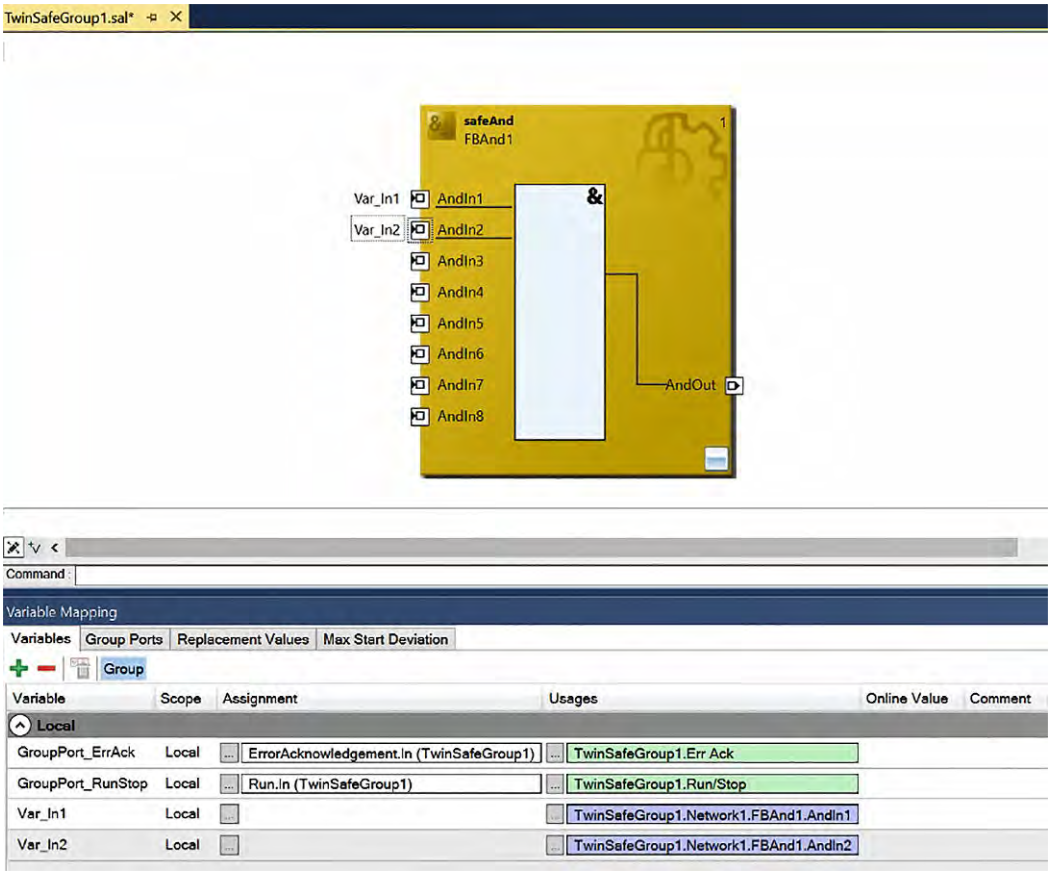


Fig. 120: TwinCAT 3 - Variable Var_In1 and Var_In2 linked to safeAnd

9. We now assign the variable *Var_In2* to *InputChannel1* of the TwinSAFE input terminal EL1904.

In the *Var_In2* row, click on the *Map to* button under *Assignment*.

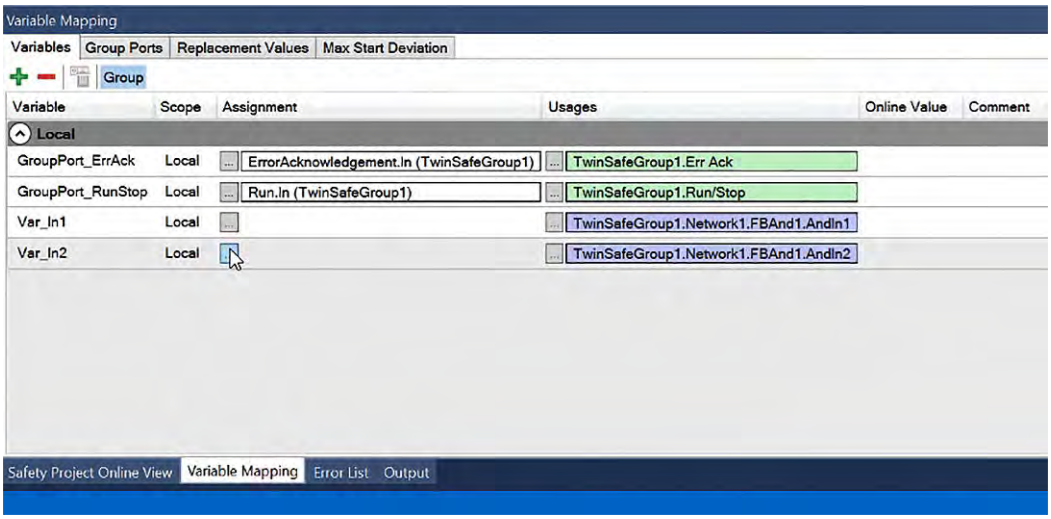


Fig. 121: TwinCAT 3 - Open Assignment Map to dialog for variable Var_In2

10. In the *Map to* dialogue box, select the input *InputChannel1* of *EL1904* and confirm with *OK*.

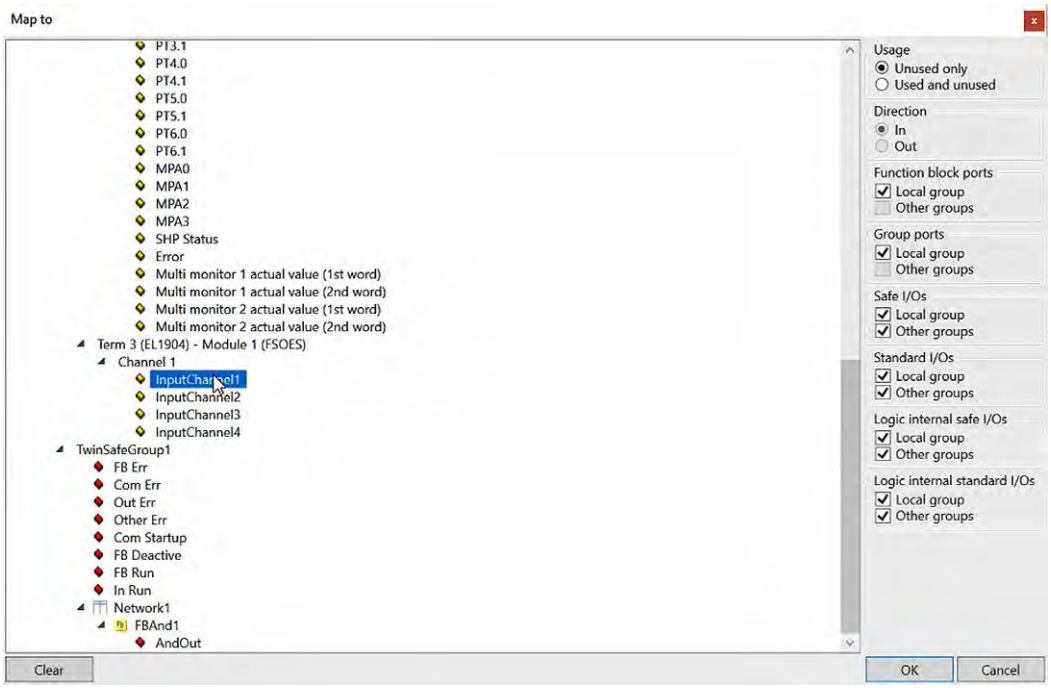


Fig. 122: TwinCAT 3 - Map variable Var_In2 to InputChannel1 of EL1904

⇨ The variable *Var_In2* is now assigned to *InputChannel1* of the TwinSAFE input terminal EL1904.

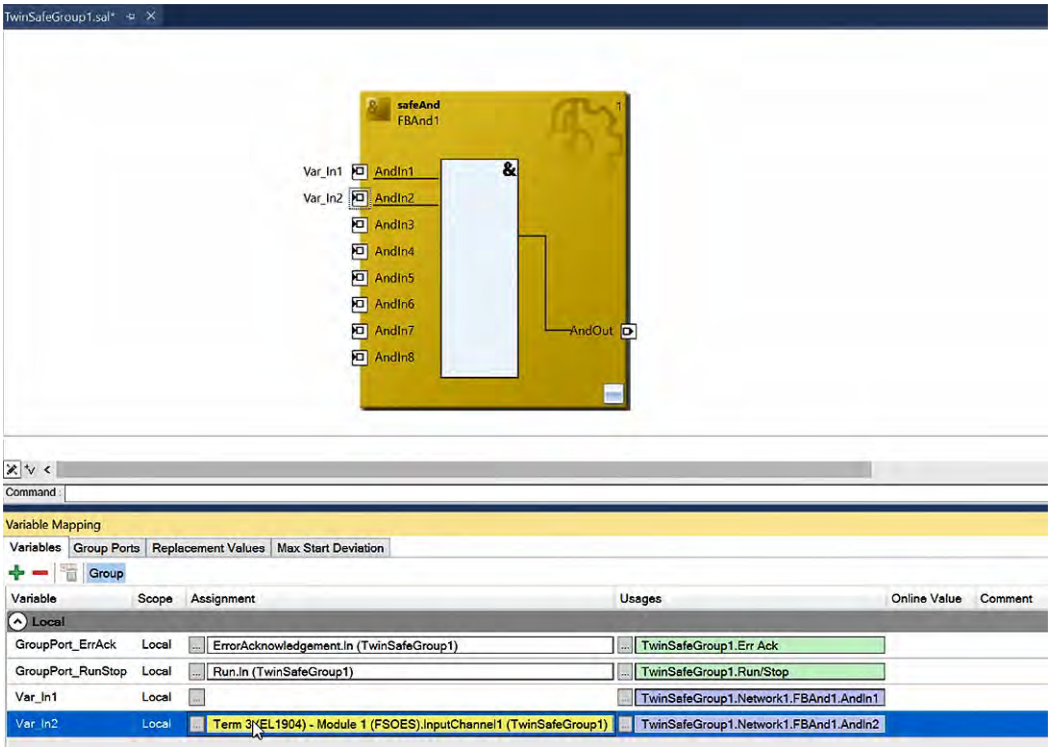


Fig. 123: TwinCAT 3 - Variable Var_In2 assigned to InputChannel1 of EL1904

Fields with a yellow background belong to Safe I/O, fields with a green background belong to GroupPort and fields with a purple background belong to FunctionBlock Port.

This colour code is displayed as context-sensitive help when the mouse pointer is on the Assignment or Usage fields.

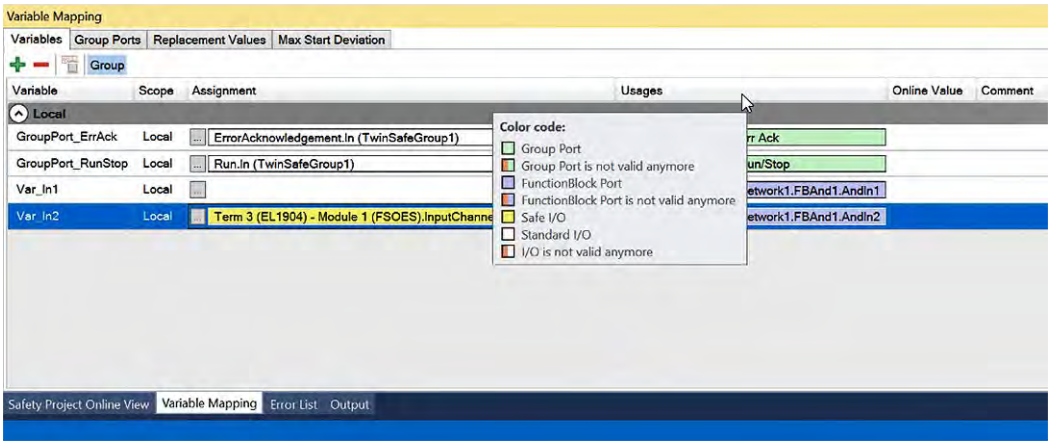


Fig. 124: TwinCAT 3 - Color code for variable mapping

11.

Only safe inputs can be selected as Assignment via Map to. The use of non-safe inputs is only possible via Alias Devices.

We therefore add an alias for the non-safe input in *TwinSafeGroup1* under *Alias Devices*.

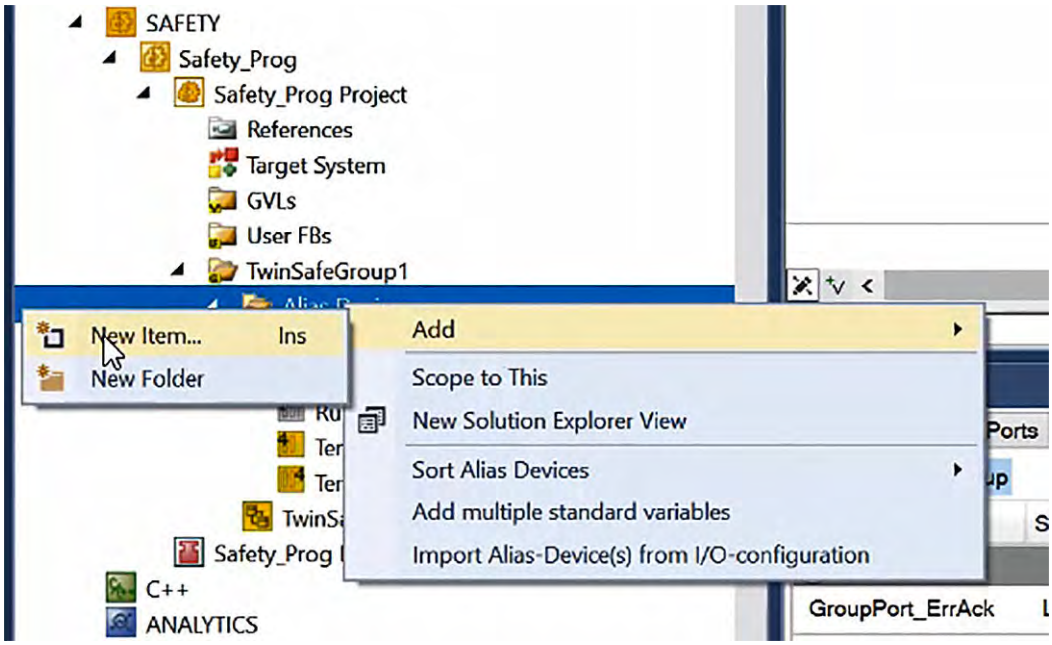


Fig. 125: TwinCAT 3 - Add Alias Device in TwinSafeGroup1

⇨ In the *Add New Item* dialogue box, select *1 Digital Input (Standard)* and confirm with *Add*.

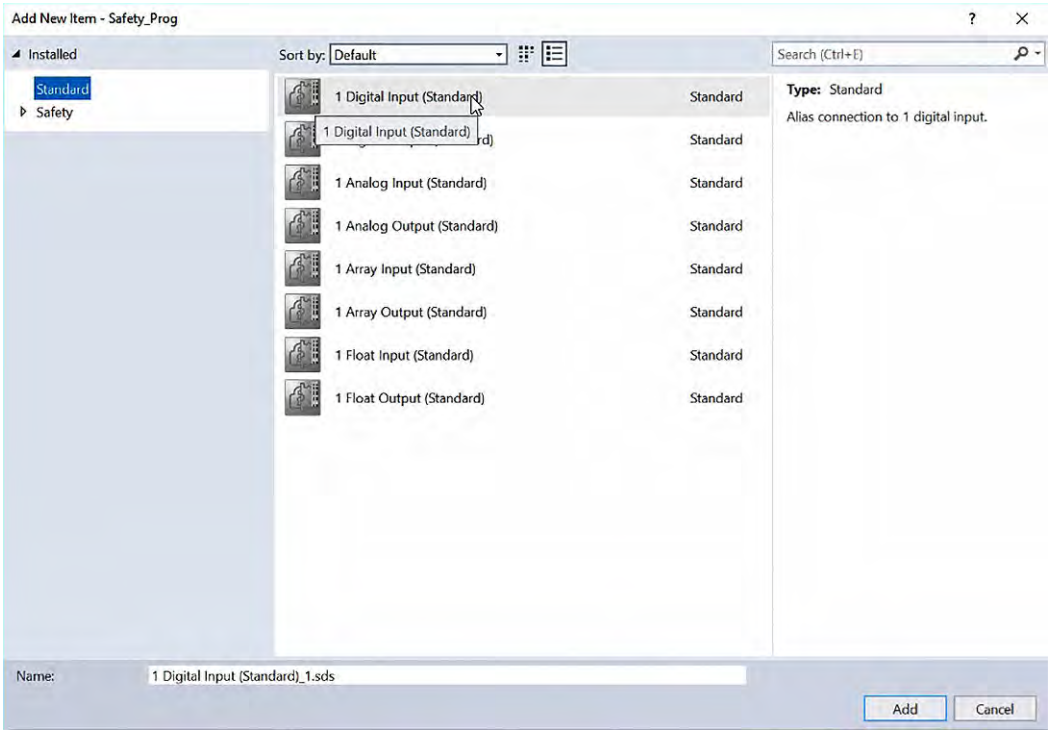


Fig. 126: TwinCAT 3 - Add Digital Input as Alias Device in TwinSafeGroup1

The digital input is set up as an *Alias Device*.

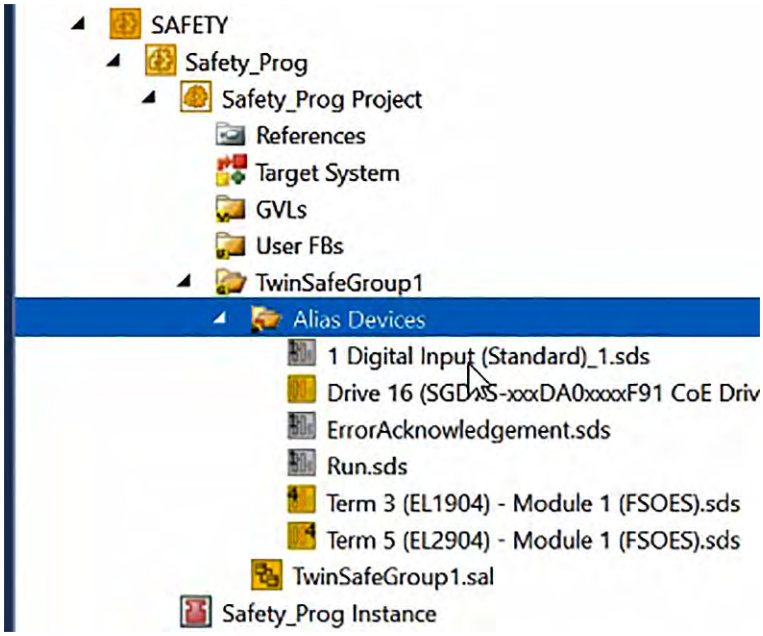


Fig. 127: TwinCAT 3 - Digital Input as Alias Device in TwinSafeGroup1 added

12. Rename the created digital input via *Rename* in the context menu.

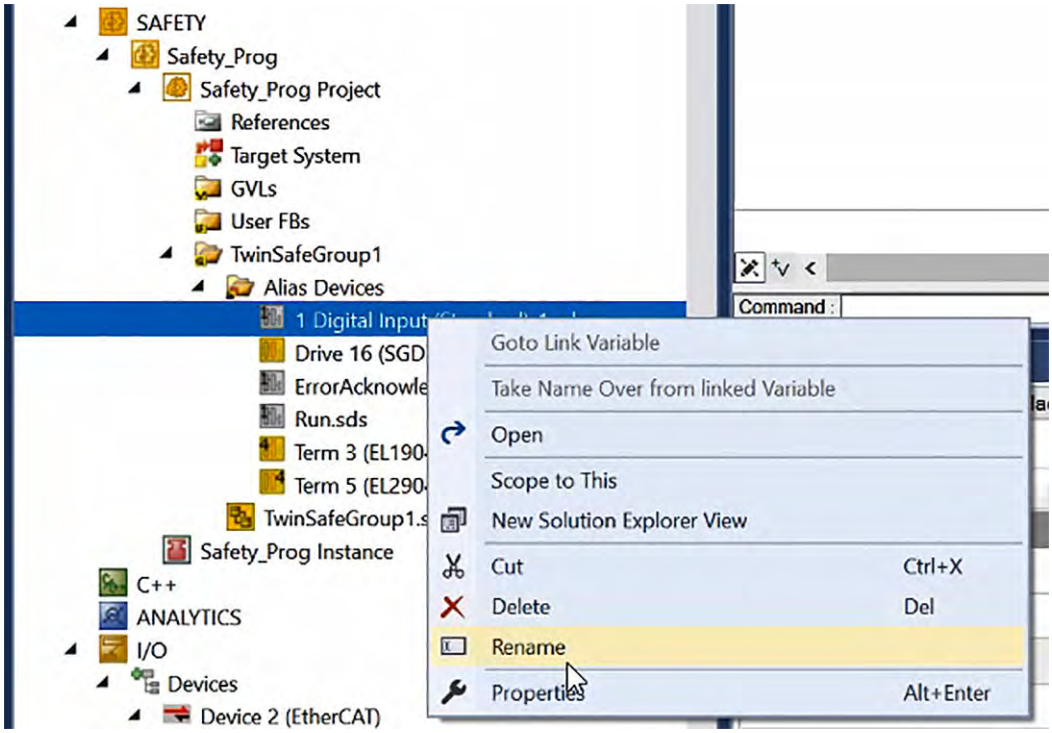


Fig. 128: TwinCAT 3 - Rename added Digital Input in TwinSafeGroup1

⇨ The digital input is renamed Var_from_PLC_ALIAS.

> *It is advisable to add the variable name 'Alias', otherwise it is easy to lose track.*

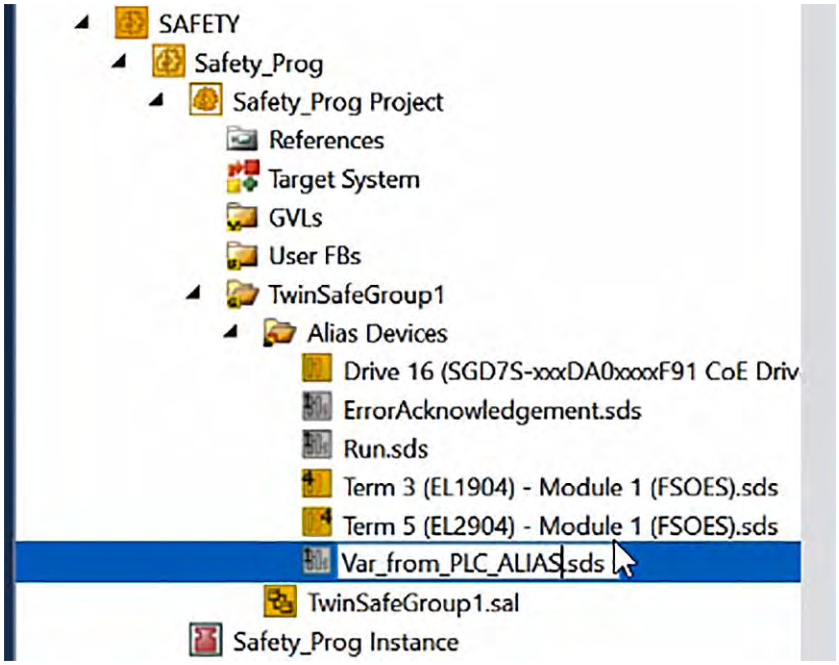


Fig. 129: TwinCAT 3 - Digital Input in TwinSafeGroup1 renamed as Var_from_PLC_ALIAS

13. We now assign the *Alias Device* we just created *Var_from_PLC_ALIAS Var_In1*.

Double-click on *Var_from_PLC_ALIAS.sds* in the *Solution Explorer* to call up the *Alias Device*.

In the *Var_In1* row, click on the *Map to* button under *Assignment*.

In the *Map to* dialogue box, select the input *In (Channel 1)* of *Var_from_PLC_ALIAS* and confirm with *OK*.

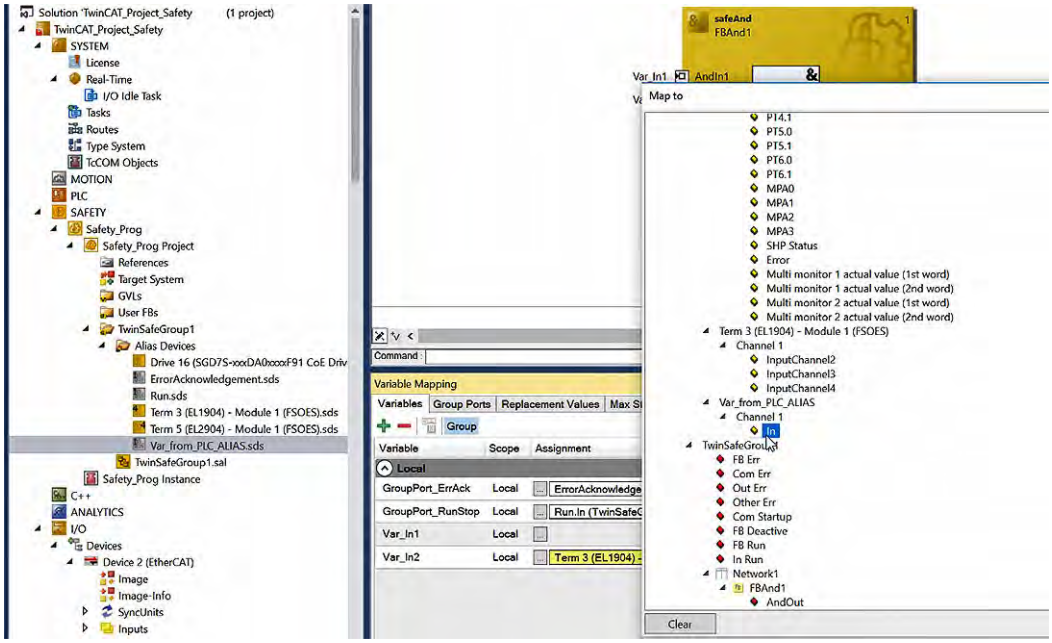


Fig. 130: TwinCAT 3 - Assign Var_In1 to Var_from_PLC_ALIAS

⇨ The created *Alias Device Var_from_PLC_ALIAS* is assigned to *Var_In1*. The white background in the *Var_In1* line shows that the *Alias Device* is of the *Standard I/O* type.

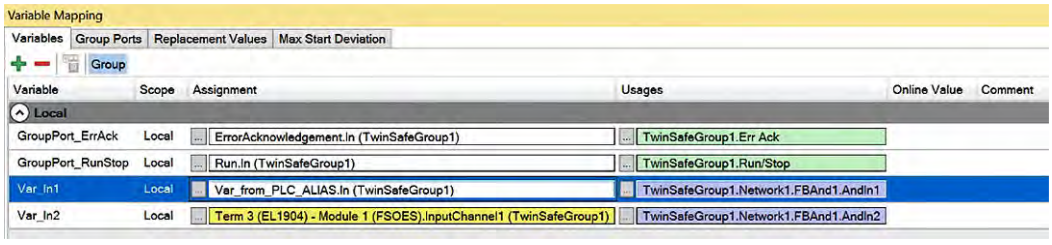


Fig. 131: TwinCAT 3 - Var_from_PLC_ALIAS assigned to Var_In1

The Alias Device Var_from_PLC_ALIAS can be linked to a variable declared in the PLC node.

We now link Var_from_PLC_ALIAS to an input of the 4-channel digital input terminal EL1004, to which a switch is connected.

14. Double-click on *Var_from_PLC_ALIAS.sds* in the *Solution Explorer* to call up the *Alias Device*.

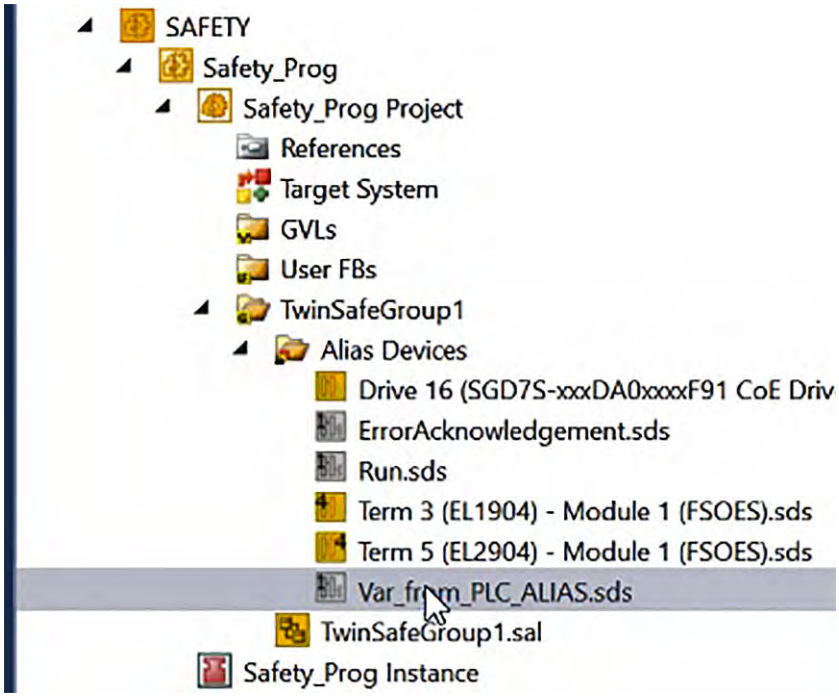


Fig. 132: TwinCAT 3 - Open Var_from_PLC_ALIAS in Solution Explorer

15. In the main window, click on the link button on the right side of the *Linked to:* field.

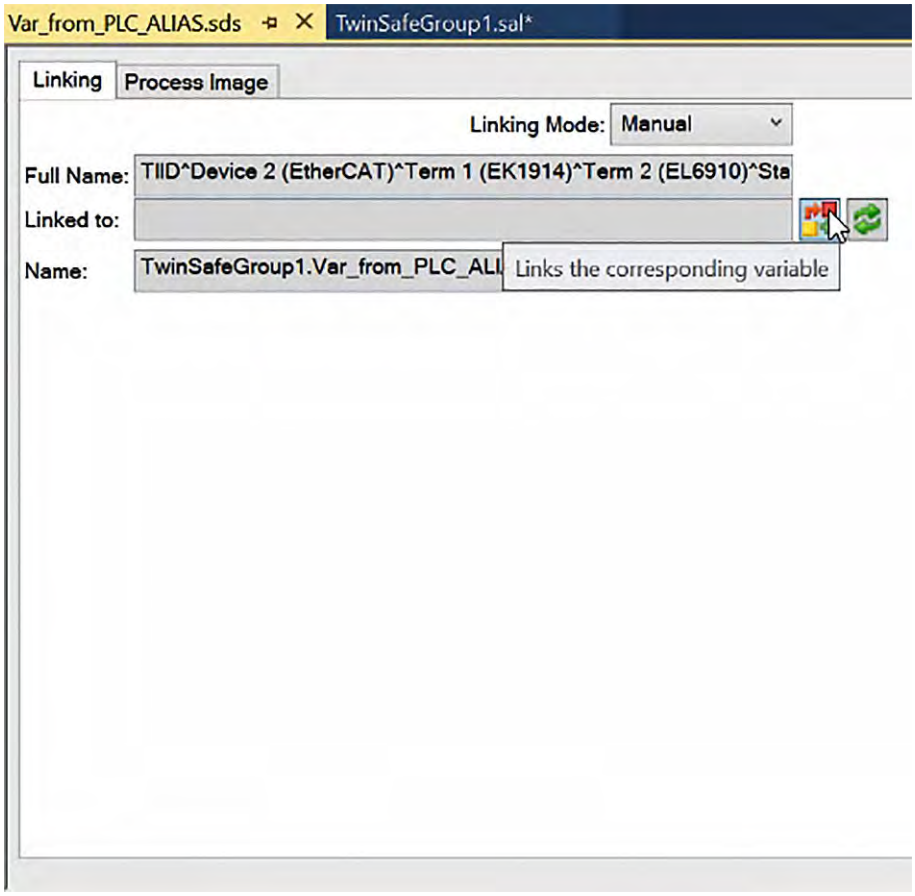


Fig. 133: TwinCAT 3 - Link Button of Var_from_PLC_ALIAS

16. Select the input of Term 6 (EL1004) and confirm the dialogue box with OK.

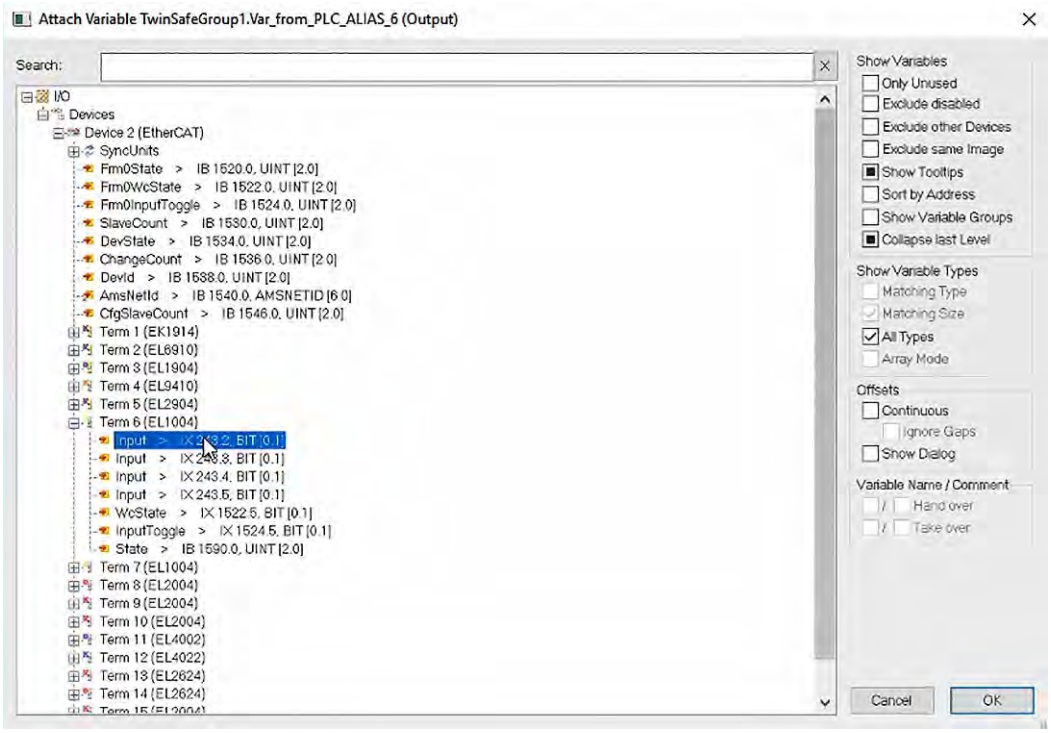


Fig. 134: TwinCAT 3 - Link Var_from_PLC_ALIAS to EL1004

⇨ The Linked to: field shows that the link has been successfully established.

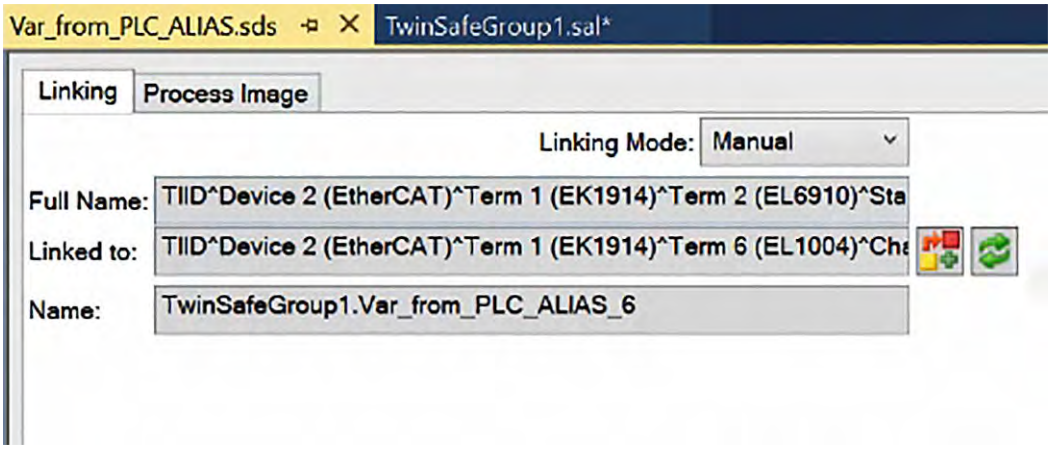


Fig. 135: TwinCAT 3 - Var_from_PLC_ALIAS linked to input of EL1004

17. The *AndOut* output of the safety function block *safeAnd* is now assigned to a virtual input in the *Advanced Safety Module* as an activation input.

For this purpose, another variable must be created in the variable mapping of the safety function block. We give this variable the name *Out_to_ASM7_Input*.

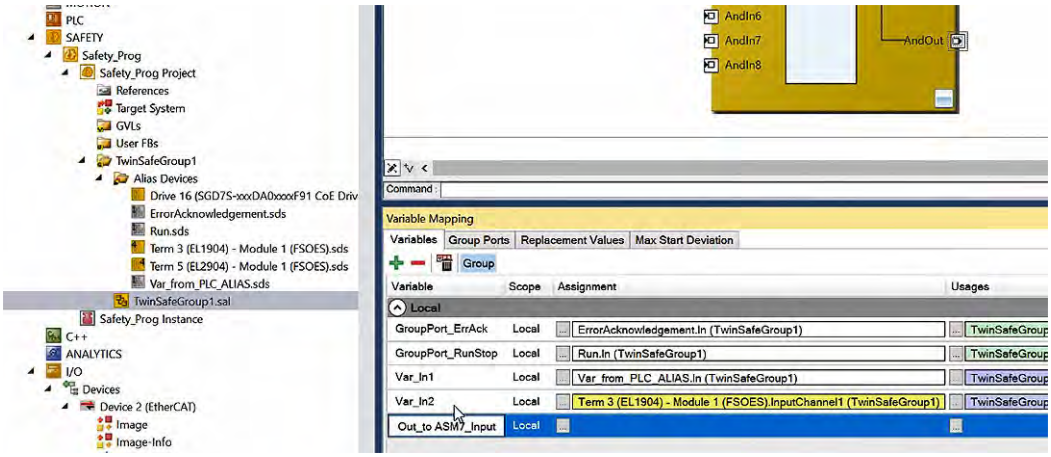


Fig. 136: TwinCAT 3 - Create variable Out_to_ASM7_Input in TwinSafeGroup1

18. In the *Out_to_ASM7_Input* row, click on the *Map to* button under *Assignment*.

In the *Map to* dialogue box, select the *AndOut* output of *FBAnd1* and confirm with *OK*.

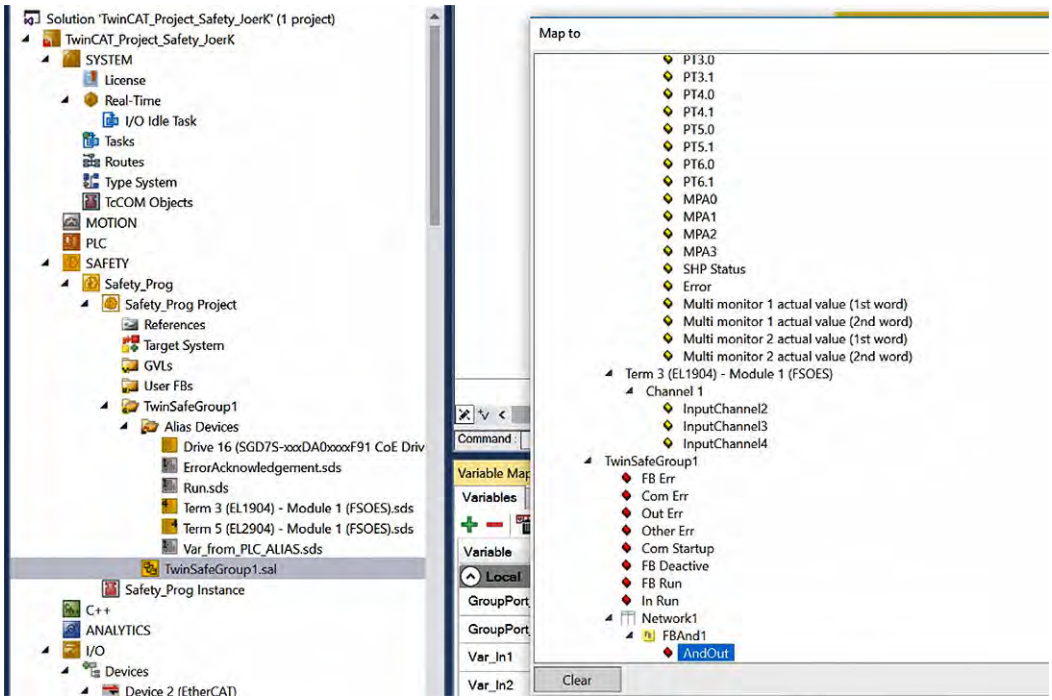


Fig. 137: TwinCAT 3 - Assign Out_to_ASM7_Input to FBAnd1

⇨ The created *Alias Device Out_to_ASM7_Input* is assigned to *FBAnd1*. The purple background in the line *Out_to_ASM7_Input* shows that the *Alias Device* is of type *FunctionBlock Port*.

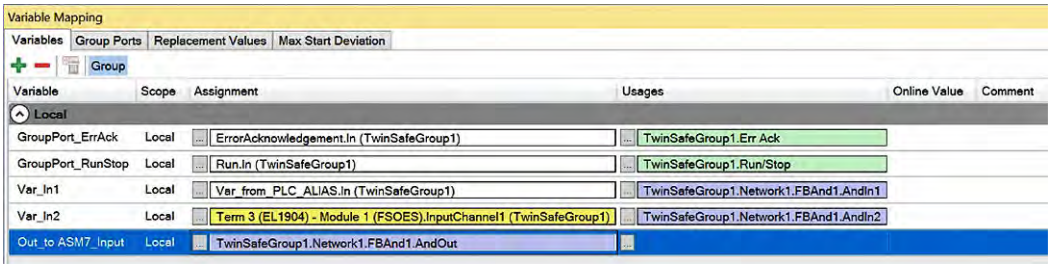


Fig. 138: TwinCAT 3 - Out_to_ASM7_Input assigned to FBAnd1

19. In the *Out_to_ASM7_Input* row, click on the *Map to* button under *Usages*.

In the *Map to* dialogue box, select the input *Virtual Input 0* of *SGD7S-xxxDA0xxxxF91 CoE Drive* and confirm with *OK*.

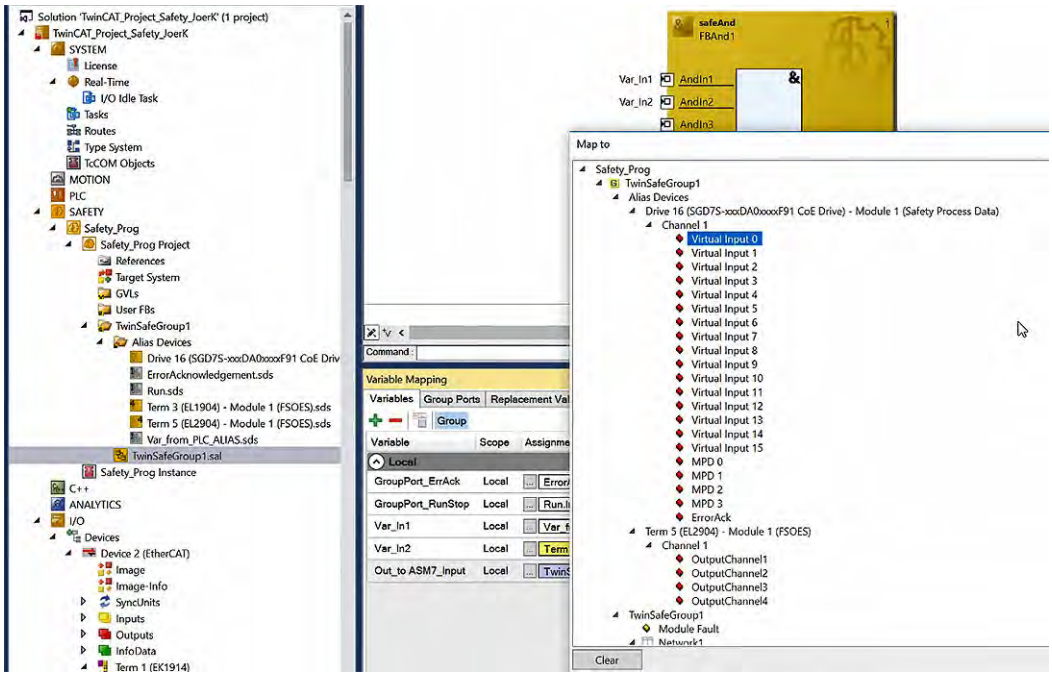


Fig. 139: TwinCAT 3 - Assign Virtual Input 1 to Advanced Safety Module

⇨ The created *Alias Device Out_to_ASM7_Input* is assigned to *Virtual Input 0*. The yellow background in the line *Out_to_ASM7_Input* shows that the *Alias Device* is of type *Safe I/O*.

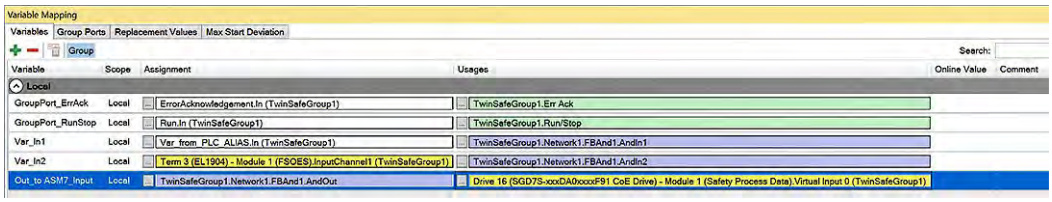


Fig. 140: TwinCAT 3 - Out_to ASM7_Input assigned to Advanced Safety Module

20. Click on the *Verify Safety Project* icon in the *TwinCAT Safety* toolbar.

⇨ This checks the validity of the safety project.

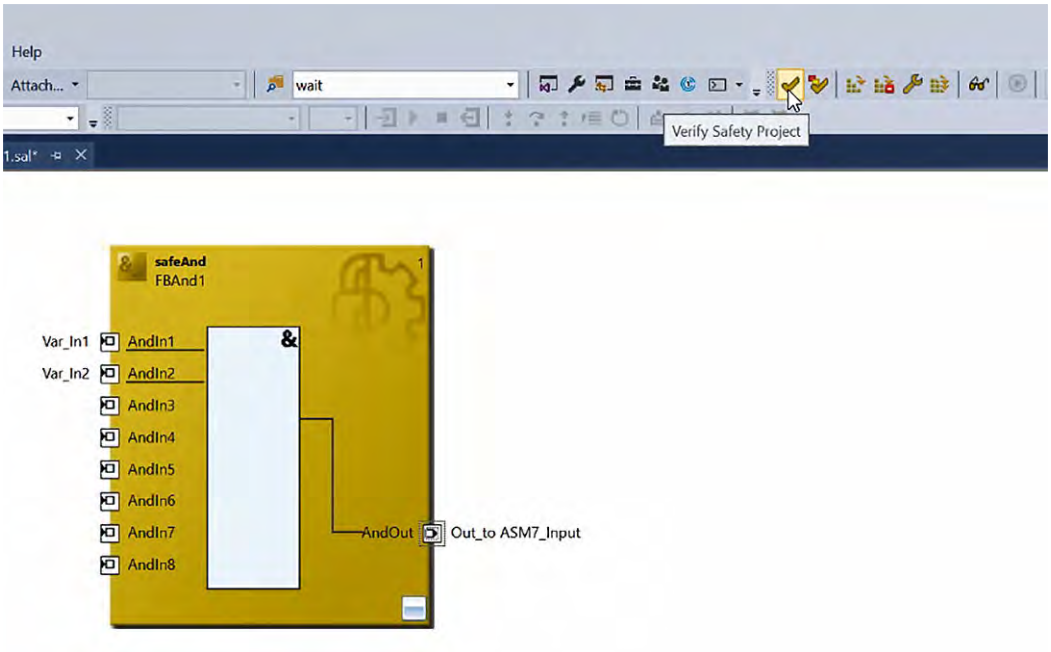


Fig. 141: TwinCAT 3 - Verify Safety Project

If errors are detected during the check, this is indicated with the dialogue box *There were validation errors, continue save?*. In addition, the *Error List* at the bottom of the screen, alongside other messages or warnings, indicates which error was detected.

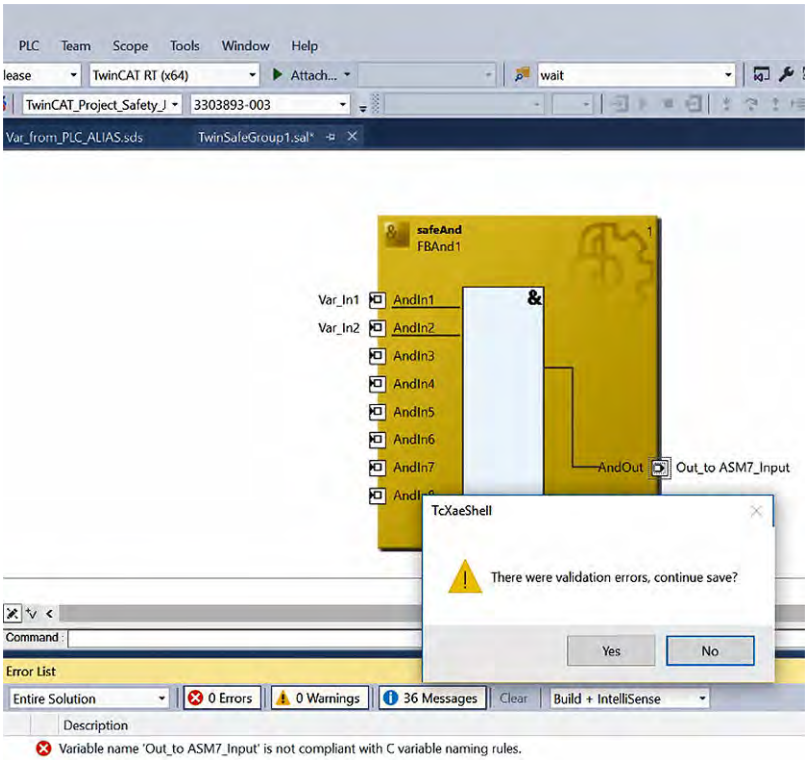


Fig. 142: TwinCAT 3 - Verify Safety Project - There were validation errors

If *No* was clicked in this dialogue box, the following dialogue box appears, indicating that not all files of the safety project could be saved.

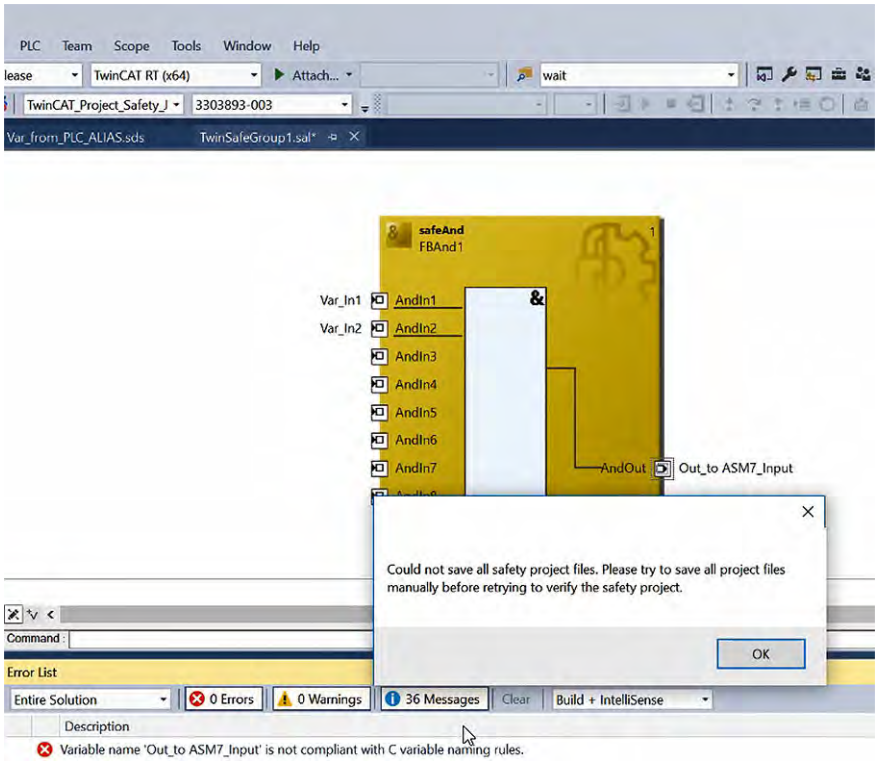


Fig. 143: TwinCAT 3 - Verify Safety Project - Could not save all safety project files

When the safety project has been successfully checked for validity, the message *Verification Process Succeeded* is displayed at the bottom left of the screen.

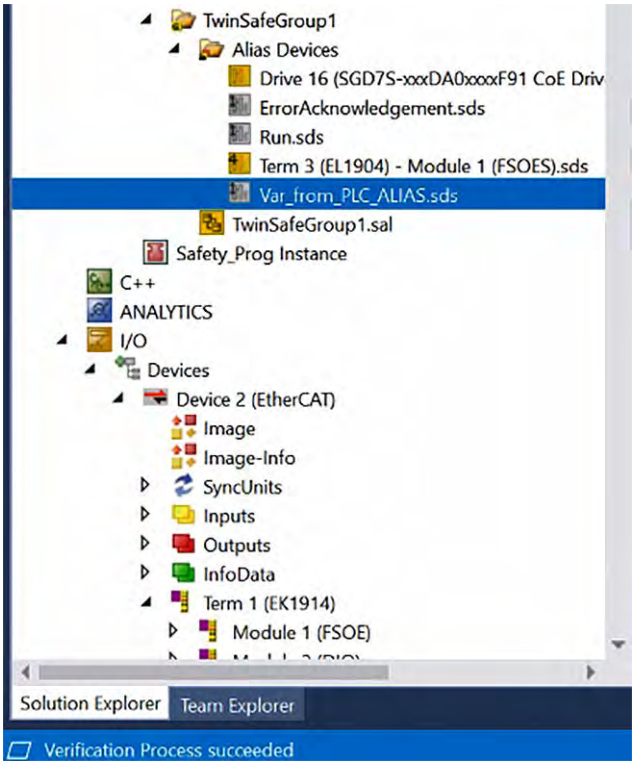


Fig. 144: TwinCAT 3 - Verify Safety Project - Verification Process Succeeded

5.3.6 Download the Safety Project

If no errors were detected when checking the safety project for validity (message "Verification Process Succeeded"), you can continue with the download of the project.

1. In the *TwinCAT Safety* toolbar, click on the *Multi-Download Safety Project(s)* icon. This allows multiple safety projects to be downloaded to the corresponding logic components at the same time.

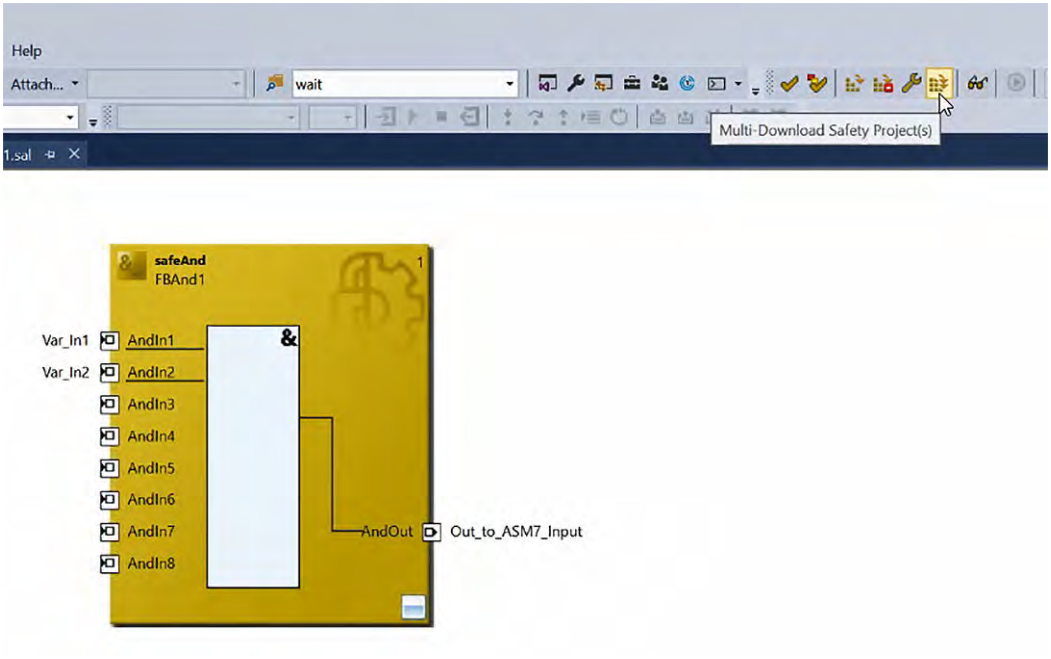


Fig. 145: TwinCAT 3 - Multi-Download Safety Project(s)

2. In the *Select Valid Project(s)* dialogue box, select the projects for which a simultaneous download is to be performed (in the scenario described here, there is only one project).

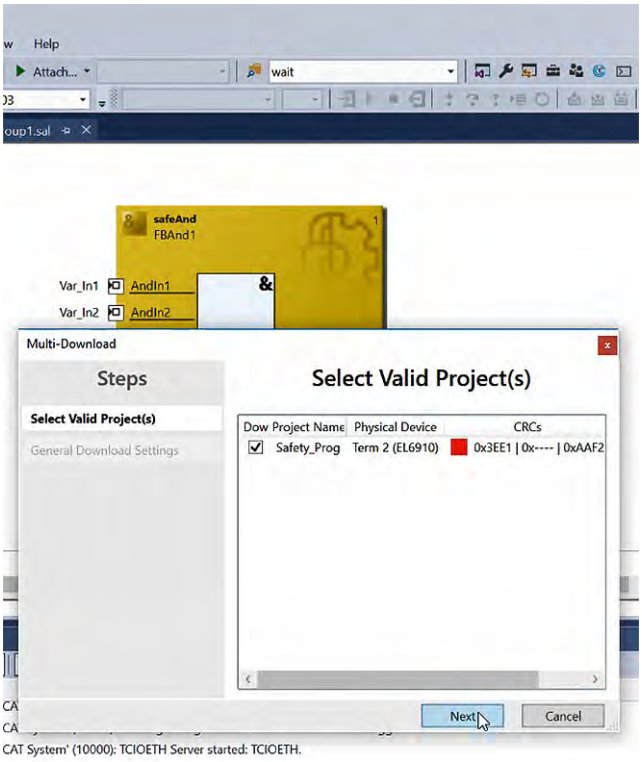


Fig. 146: TwinCAT 3 - Select Valid Project(s)

3. In the *General Download Settings* dialogue box, the user name and password are entered first.

   The default user is *Administrator* and the default password is *TwinSAFE*. The input is case sensitive.

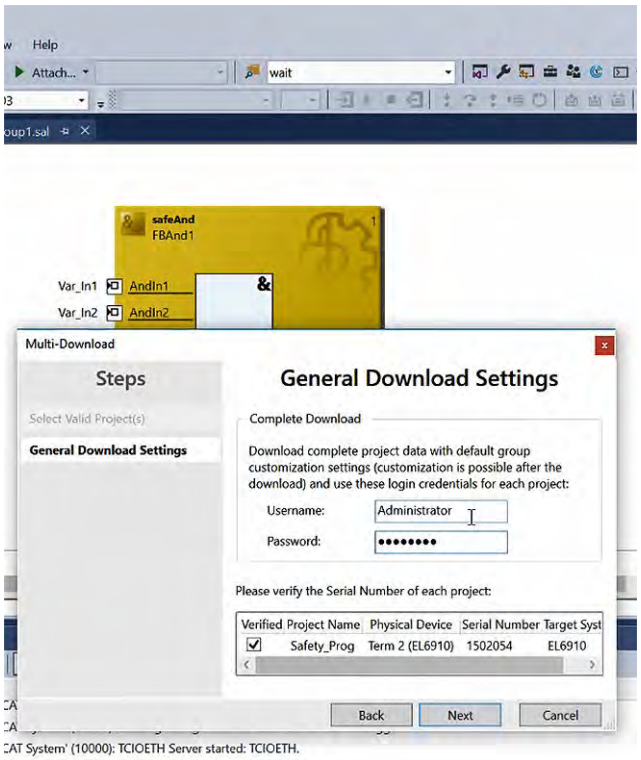


Fig. 147: TwinCAT 3 - General Download Settings

⇨ In the *Verified* checkbox, confirm that the correct serial numbers are displayed and used. Start the download with the *Next* button.

4. In the *Final Verification* dialogue box, confirm the correctness of the checksums (*Online CRC* and *Calculated CRC*) by selecting the checkbox and clicking *Next*.

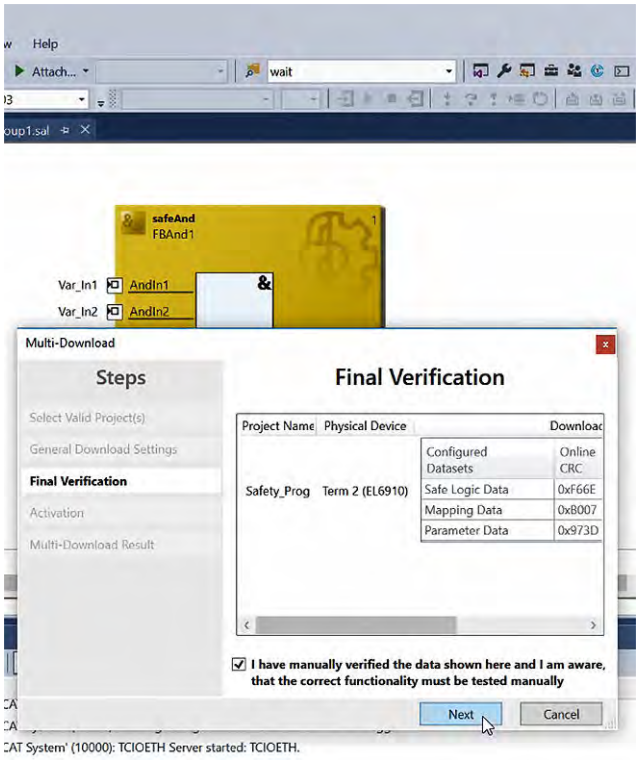


Fig. 148: TwinCAT 3 - Final Verification

5. In the *Activation* dialogue box, enter the password of the user you are using again and click *Next*.

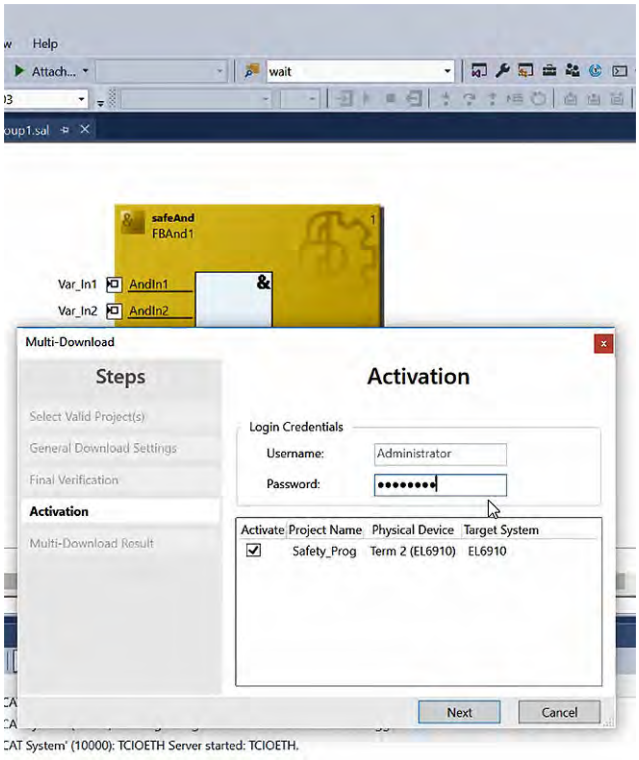


Fig. 149: TwinCAT 3 - Activation

6. In the *Multi-Download Result* dialogue box, all projects with the status *Activated* and *Downloaded* are listed. Use the *Finish* button to finish the download.

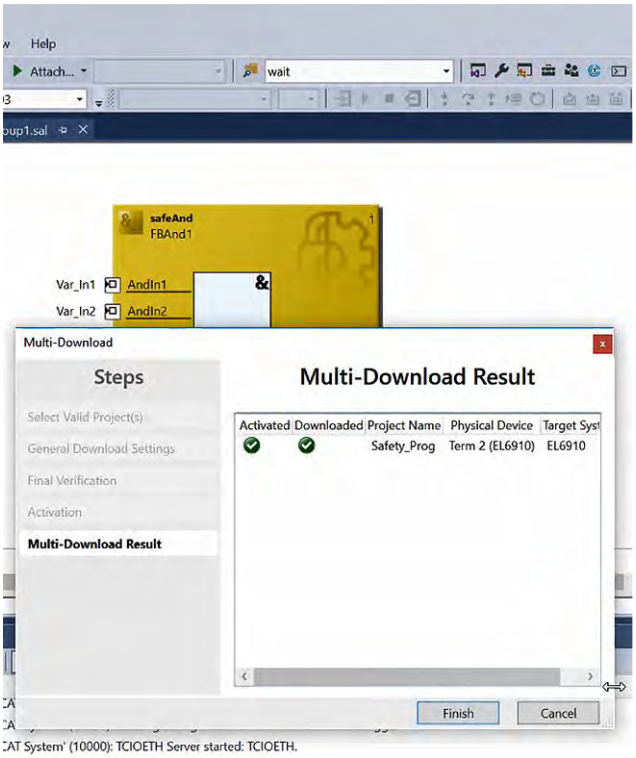


Fig. 150: TwinCAT 3 - Multi-Download Result

5.3.7 Activate Configuration and Display Online Data

1. Activate the downloaded configuration by clicking the *Activate Configuration* icon.

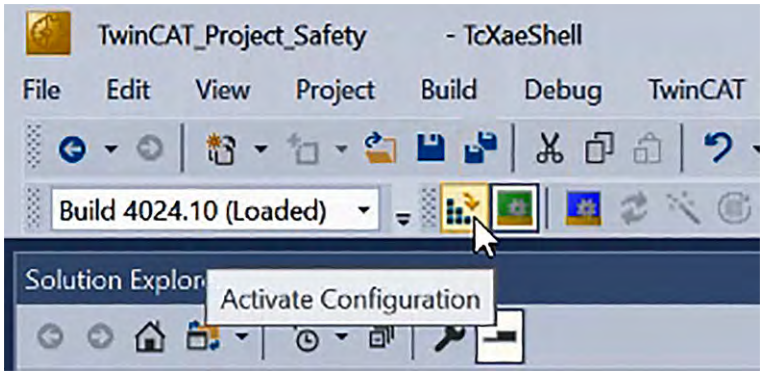


Fig. 151: TwinCAT 3 - Activate Configuration

2. Confirm the activation of the configuration by clicking *OK* in the *Activate Configuration* dialogue box.

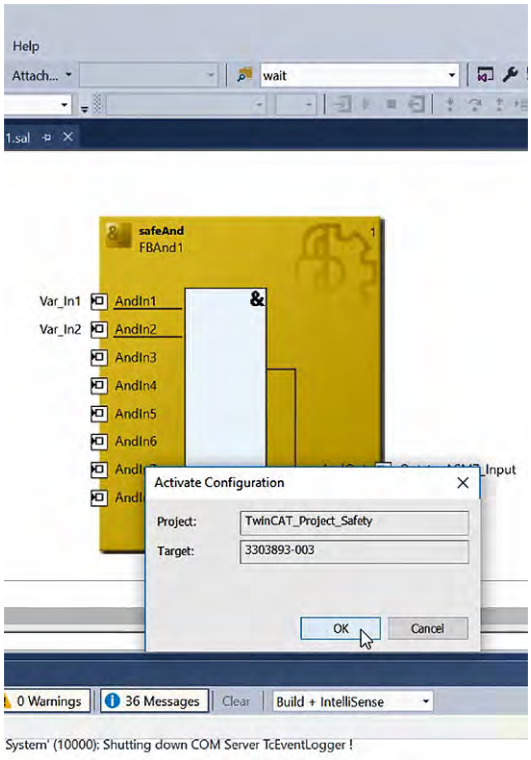


Fig. 152: TwinCAT 3 - Confirm Activation

3. Restart the TwinCAT system in Run Mode by clicking *OK*.

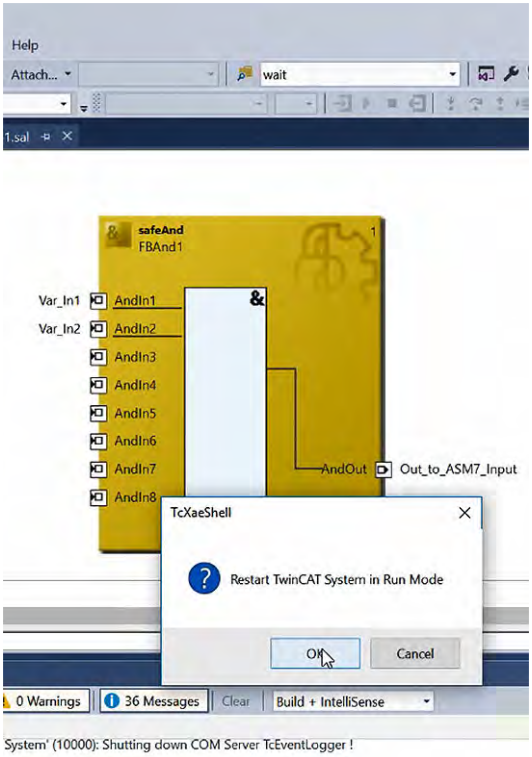


Fig. 153: TwinCAT 3 - Restart TwinCAT System in Run Mode

4. Click on the *Show Online Data* icon in the *TwinCAT Safety* toolbar.

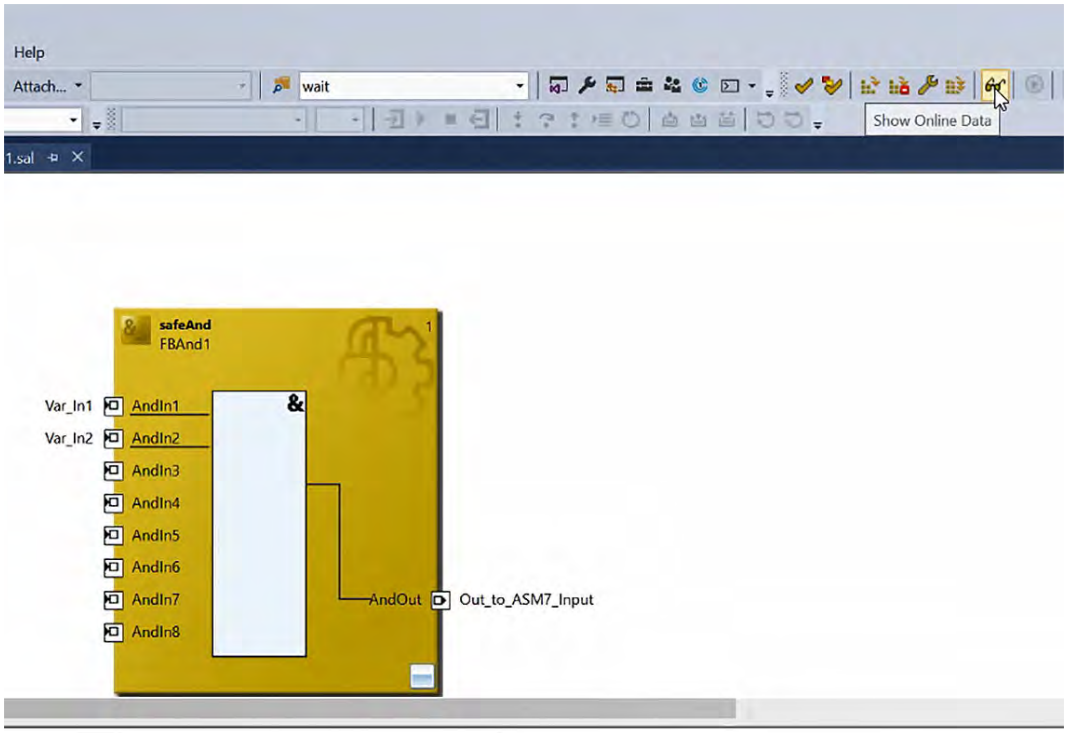


Fig. 154: TwinCAT 3 - Show Online Data

⇨ This causes the display to change to the current values within the safety project.

In the following example, the TwinSafeGroup1.sal worksheet is outlined in dark red. This indicates that the group is in *Unknown* state.

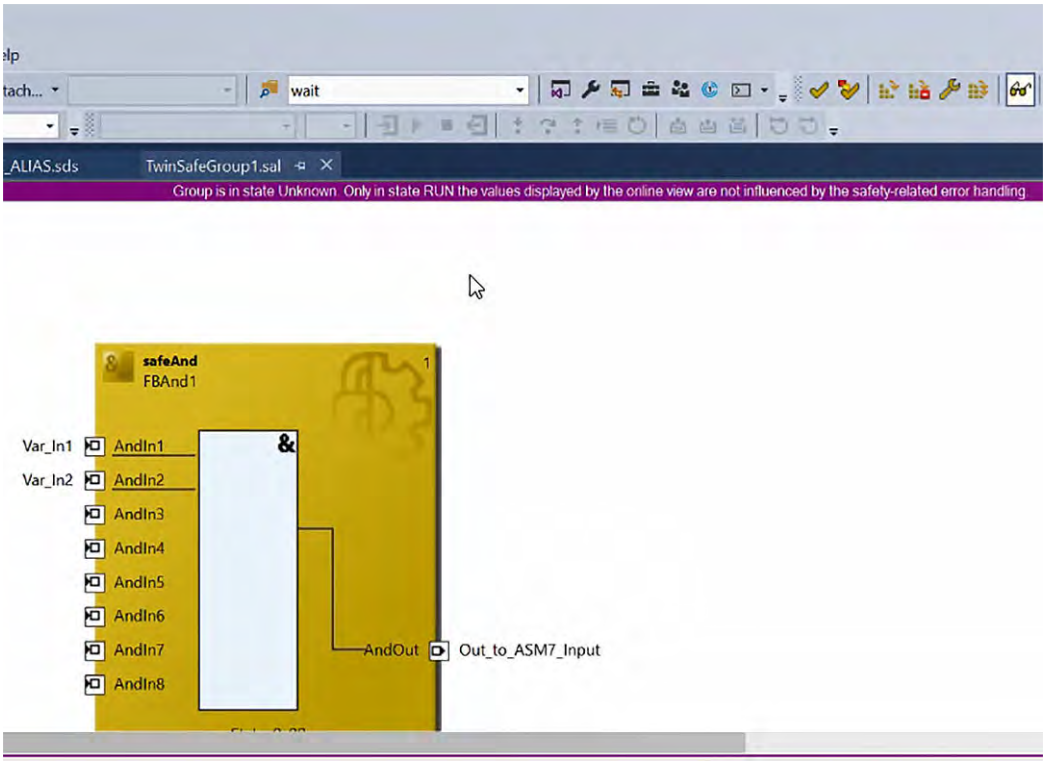


Fig. 155: TwinCAT 3 - Group is in state Unknown

In this example, the TwinSafeGroup1.sal worksheet is outlined in green. This indicates that the group is in *Run* state.

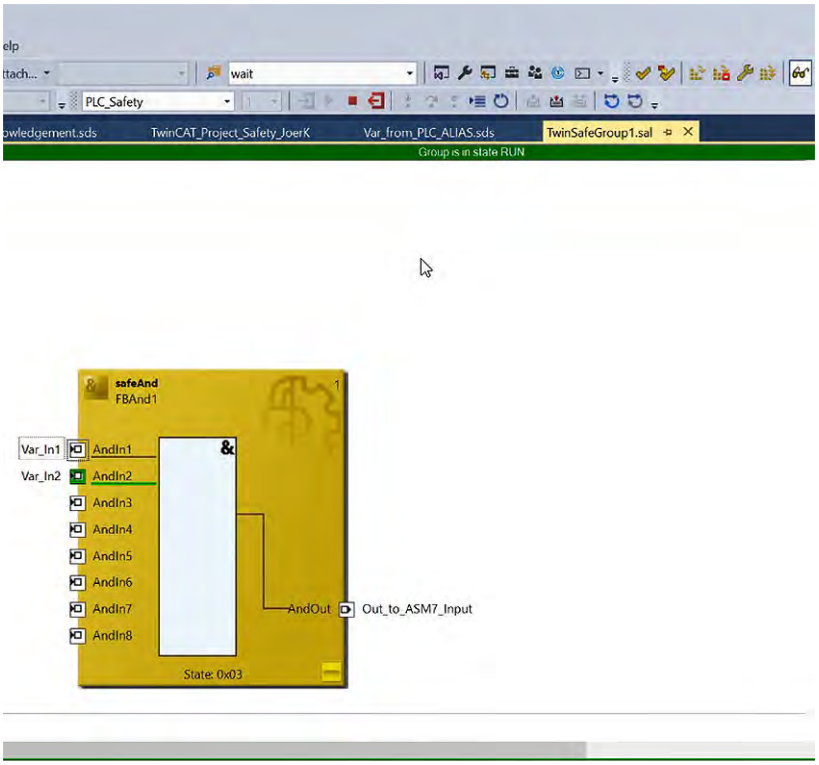


Fig. 156: TwinCAT 3 - Group is in state RUN

6 EDM output concept of SGD7S-OSB01A/OSB02A compared to SGDV-OSA01A

Input behaviour of SGDV-OSA01A

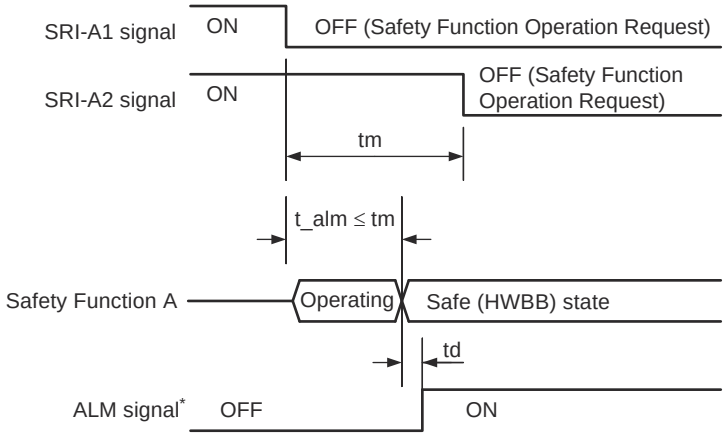


Fig. 157: Input behaviour of SGDV-OSA01A

tm Time period during which time measurement is performed: Measurement is performed until an alarm occurs.
t_alm Specified value
td Alarm output delay time (40 ms max.)

The time period *tm* is the *Discrepancy Time* and is equal to 10 seconds within the SGDV-OSA01A.

> *You can set the same time (up to 1000 ms) inside the SGD7S-OSB01A/OSB02A.*

The following figure shows the parameterisation of the *Discrepancy Time* in the *Advanced Safety Module Parameter Editor*.

Fig. 158: Setting Discrepancy Time in the Advanced Safety Module Parameter Editor

External Device Monitor output signals of SGDV-OSA01A

These signals are output when the following two conditions are met:

- The safety function is operating normally.
- No malfunction occurs in the safety function.
  If a malfunction occurs in the safety function when the safety function is operating, this signal will not be output.
  By monitoring this signal from an external device, a sequence can be designed for returning to normal operations from the safety function operation state.
  The following figure shows the relationship between the External Device Monitor Signal and safety function.

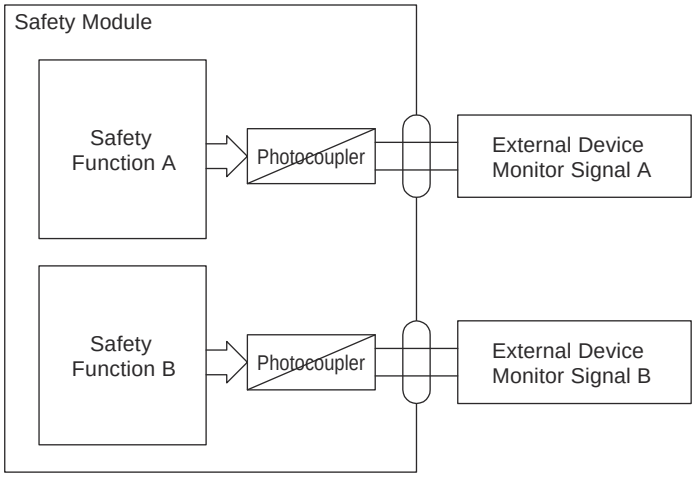


Fig. 159: Relationship between the External Device Monitor Signal and safety function

Each safe output of the SGD7S-OSB01A/OSB02A can be used as 2 EDM outputs.

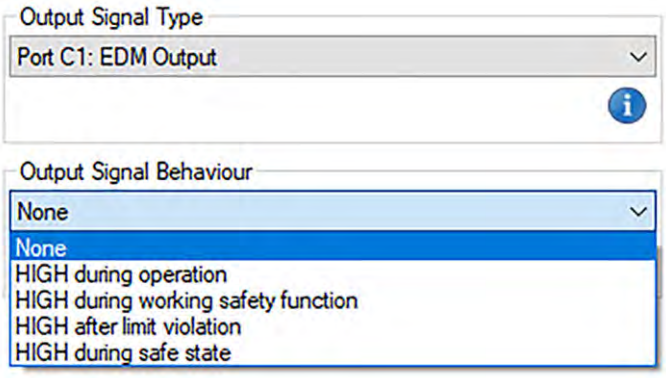


Fig. 160: Output Signal Type and Output Signal Behaviour

Failure of the safety functions can be detected by monitoring the Safety Request Input Signals and the External Device Monitor Output Signals.

The following table shows the logic for the Safety Request Input Signals and the External Device Monitor Output Signals.

Signal Name	Code	Logic			
Safety Request Input Signal A1	SRI-A1	ON	ON	OFF	OFF
Safety Request Input Signal A2	SRI-A2	ON	OFF	ON	OFF
External Device Monitor Output Signal A	EDM-A	OFF	OFF	OFF	ON

This logic is the same for the Safety Request Input Signal B.

EDM remains OFF, it takes the specified time until a malfunction can be recognized.

Only when both Inputs (A1, A2) are OFF the External Device Monitor can change to ON … even if the safety function is already running.

In the SGD7S-OSB01A/OSB02A we test the inputs continuously. There is no need to use an unsafe External Device Monitor.

EDM output functions of SGDV-OSA01A

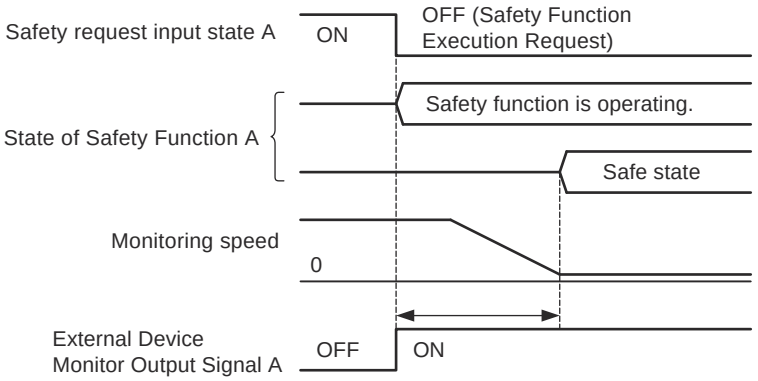


Fig. 161: Operation Timing When Pc01.0 = 0 (Output Condition = Safety Function Operation)

This signal behaviour corresponds to EDM = ON (HIGH) during working safety function.

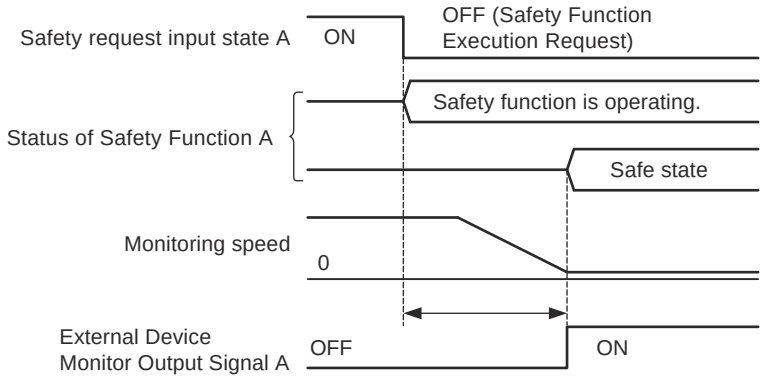


Fig. 162: Operation Timing When Pc01.0 = 1 (Output Condition = Safe State)

This signal behaviour corresponds to EDM = ON (HIGH) during safe state.

*SGD7S-OSB01A/OSB02A has **four** possible External Device Monitor signals:*

- *HIGH during operation*
- *HIGH during working safety function*
- *HIGH after limit violation*
- *HIGH during safe state*

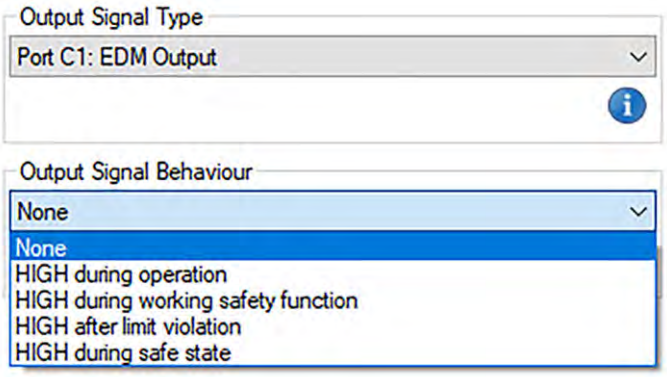


Fig. 163: Output Signal Type and Output Signal Behaviour

Difference of EDM output behaviour

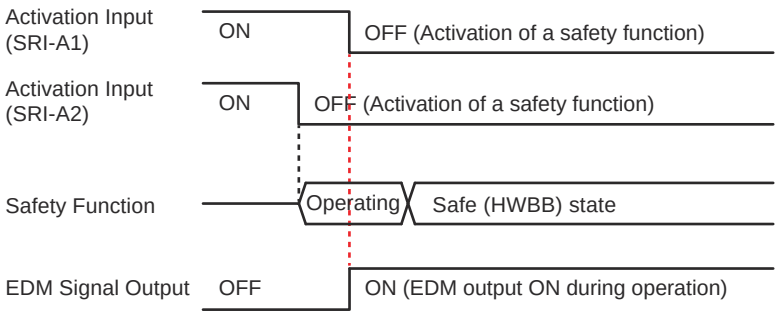


Fig. 164: EDM output behaviour of SGDV-OSA01A

The SGDV-OSA01A can have a delay of the specified time (state does not change to ON until both inputs are OFF).

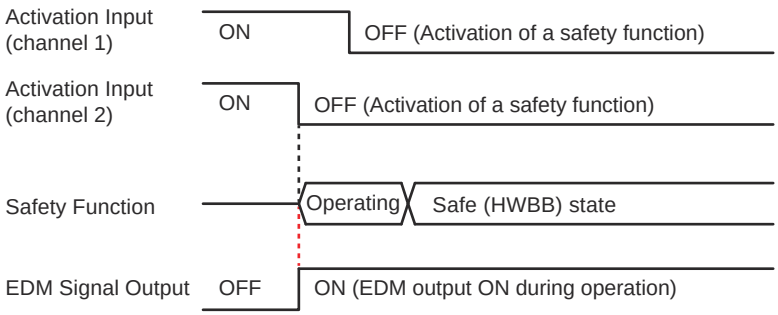


Fig. 165: EDM output behaviour of SGD7S-OSB01A

The SGD7S-OSB01A/OSB02A can immediately have the "ON state" when the safety function is in operation.

*Another advantage of the SGD7S-OSB01A/OSB02A (compared to competitor products) is that it provides the EDM signal **without** an additional relay. A change of an OSSD output (such as is present in safety light curtains) directly changes the state of the EDM output.*

Change EDM State behavior of SGD7S-OSB01A/OSB02A to SGDV-OSA01A

If it is desired that SGD7S-OSAB01A/OSB02A behaves like SGDV-OSA01A, this can be achieved as shown in the following figure.

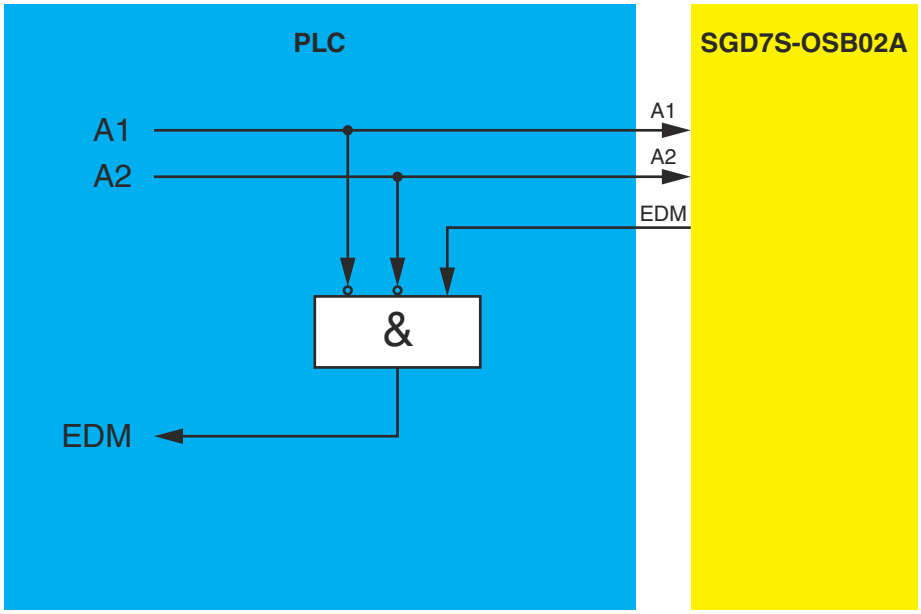


Fig. 166: Change behaviour of SGD7S-OSB01A/OSB02A to SGDV-OSA01A

EDM = /A1 & /A2 & EDM_ASM7

7 Error Handling

7.1 Introduction

There are several indicators for the status of security:

- The 2 LEDs on the Advanced Safety Module board
- The Alarm display of the SERVOPACK
- The FSoE status message
- The monitor function in SigmaWin+

For detailed information on the indicators mentioned, please refer to the Product Manual of the Advanced Safety Module:

Name	Manual number
Advanced Safety Module for Sigma-7 SERVOPACKs SGD7S-□□□DA0□8□□F91, 400 V, Product Manual	SIEP YEUOS7S 01

7.2 Advanced Safety Module LEDs

Refer to chapter 12.5 "Status Display" of the Advanced Safety Module Product Manual.

7.3 SERVOPACK Alarm Display

Refer to chapter 14.3 "List of alarms" of the Advanced Safety Module Product Manual.

7.4 FSoE Status

Refer to the chapters A.3.2.2 "Rx Process Data" and A.3.2.2.1 "Detailed Parameter Description of Rx Process Data" in the Appendix of the Advanced Safety Module Product Manual.

7.5 SigmaWin+ Monitoring

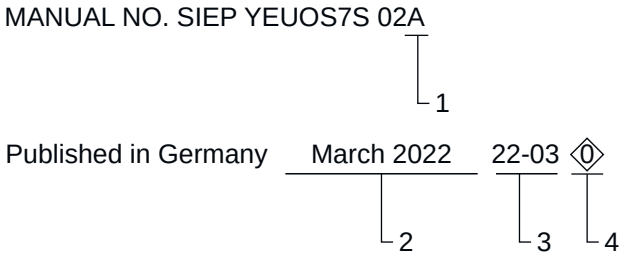
Refer to chapter A.4 "Monitoring Parameters" in the Appendix of the Advanced Safety Module Product Manual.

7.6 Troubleshooting

Refer to chapter 14.4 "Troubleshooting of alarms" of the Advanced Safety Module Product Manual.

8 Revision History

The revision dates and numbers of the revised manuals are given on the bottom of the back cover.



1 Manual version
2 Date of publication
3 Date of original publication
4 Revision number

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Advanced Safety Module

for Sigma-7 SERVOPACK SGD7S-□□□DA0□8□□F91, 400 V

Application Manual

YASKAWA EUROPE GmbH
Hauptstraße 185
65760 Eschborn
Germany
Phone: +49-6196-569-500
http://www.yaskawa.eu.com

YASKAWA AMERICA, INC.
2121, Norman Drive South,
Waukegan, IL 60085, U.S.A.
Phone: 1-800-YASKAWA (927-5292) or +1-847-887-7000
Fax: +1-847-887-7310
http://www.yaskawa.com

YASKAWA ELECTRIC CORPORATION
2-1 Kurosakishiroishi,
Yahatanishi-ku, Kitakyushu
806-0004 Japan
Phone: +81-93-645-8801
http://www.yaskawa.co.jp

In the event that the end user of this product is to be the military and said product is to be employed in any weapons systems or the manufacture thereof, the export will fall under the relevant regulations as stipulated in the Foreign Exchange and Foreign Trade Regulations. Therefore, be sure to follow all procedures and submit all relevant documentation according to any and all rules, regulations and laws that may apply.

Specifications are subject to change without notice for ongoing product modifications and improvements.

Contact Yaskawa or your nearest sales representative for details on the contents of this manual.

YASKAWA EUROPE GmbH

SIEP YEUOS7S 02A
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March 2022
Published in Germany
Original Instructions

YASKAWA