

Quick instructions:

Programming of SmartPLC AC14/AC4S with CODESYS V3



CODESYS

This document is valid for the software bundle:

CODESYS V3.5.4.2
AC4S-Package: >= V1.3.2.2
AC4S-Firmware: >= V4.0.2



Important note:

These instructions are structured so that all necessary configuration steps are described in the correct order. So it can be used as step-by-step instruction or as a general reference guide.

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1. Electrical connection of the SafeLine SmartPLC

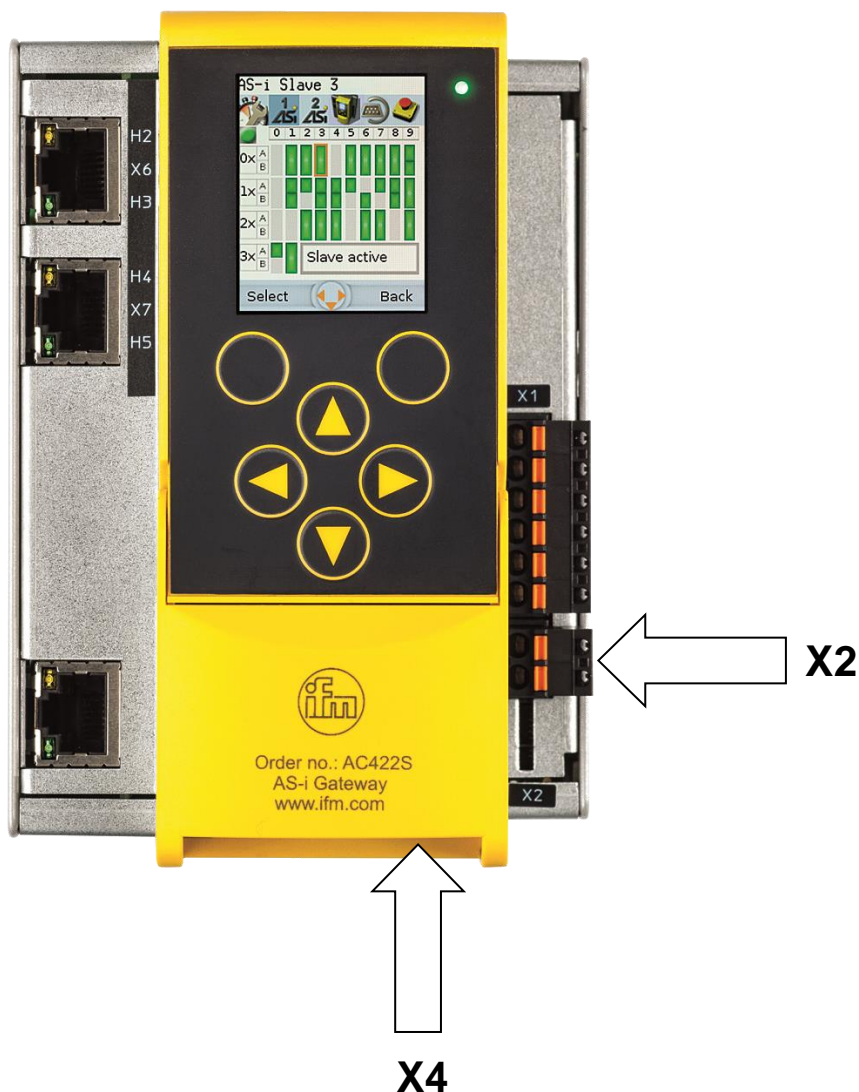
Additionally to the power supply on the plug connector X2 the power supply must be connected to plug connector X4 (pins 13+15 or 14+16). If the power supply isn't connected to X4 the fail-safe PLC detects the missing connection and change over to a fatal error state.

In the menu this icon is shown



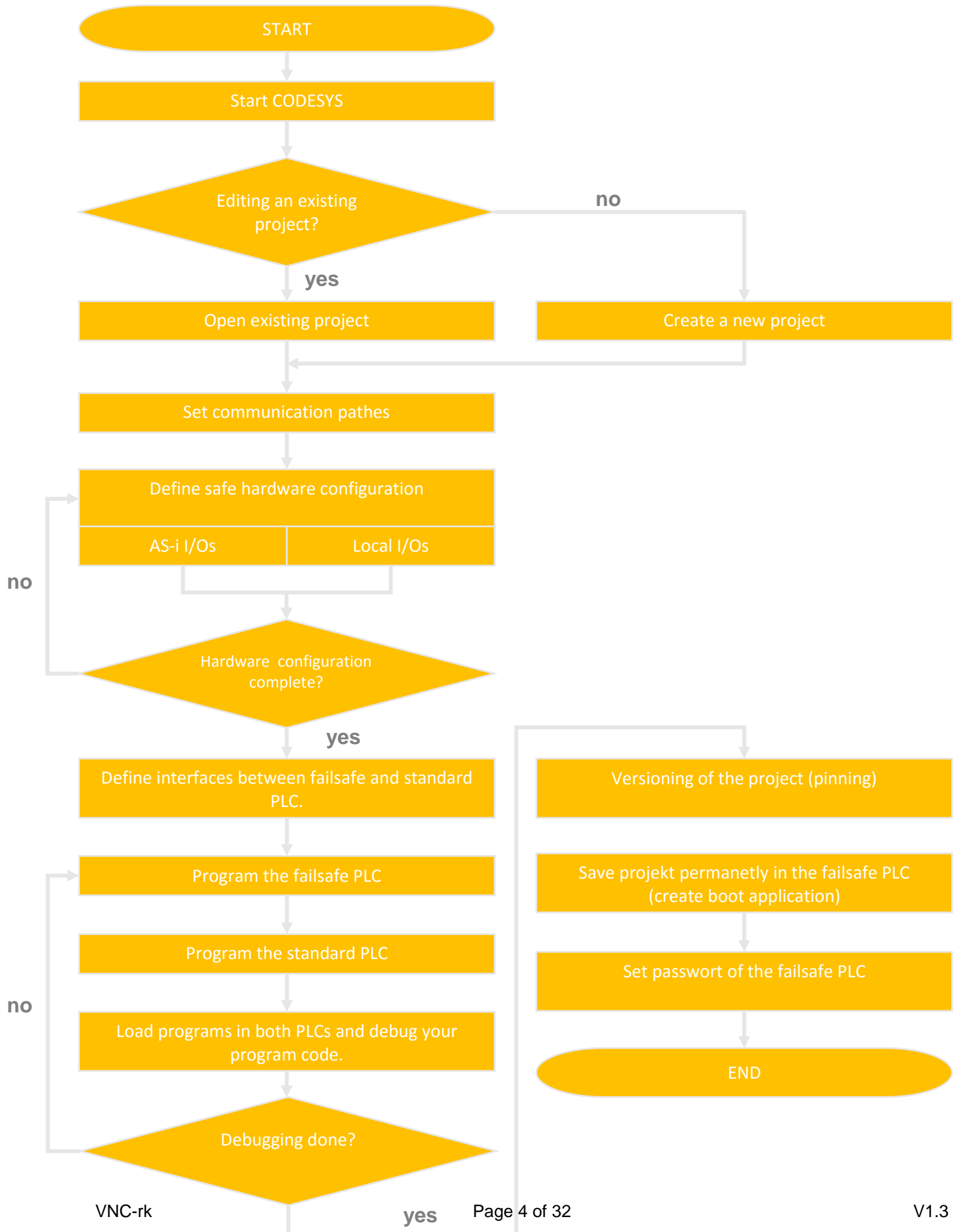
and in the clear text messaging system (OSC) the following fault message is shown:

System fault: BIT_CC_FORCE_FATAL_ERR_1; tmn=0x40000000; ln=0x197; p1=0x0; p2=0x0





2. Recommended procedure



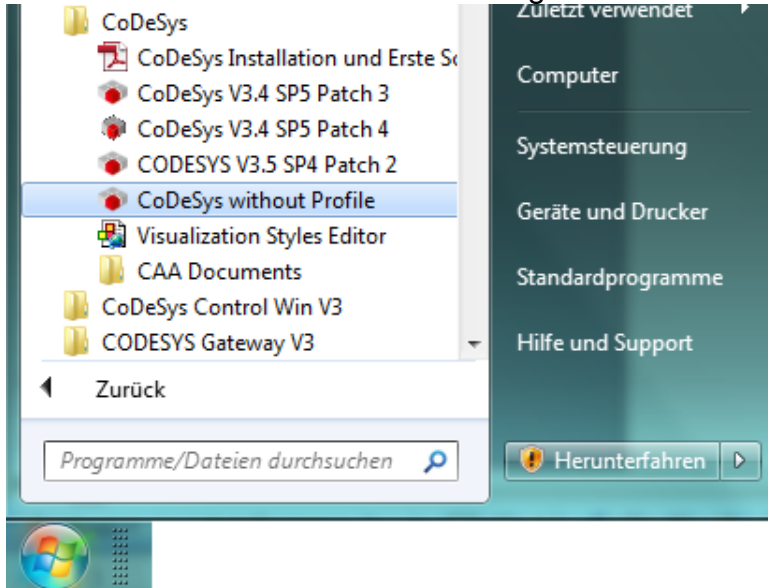


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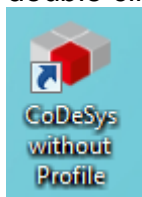
3. Start CODESYS

Windows 7 → Start button → All Programs

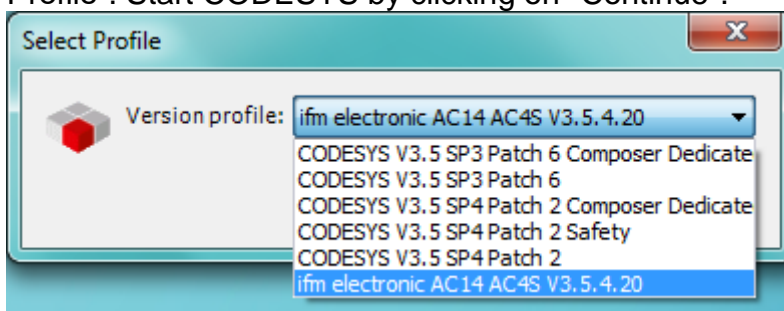


Select "CODESYS without Profile" or

double click on the desktop link, if already created.



Select the version profile "ifm electronic AC14 AC4S V3.5.4.20" in the window "Select Profile". Start CODESYS by clicking on "Continue".



Note

Existent AC4S-CODESYS projects shouldn't be opened directly by double clicking on the project file because CODESYS is otherwise started with a wrong profile.

The non-safe SmartPLC AC14 can also be programmed via the standard CODESYS version V3.5.4.2. For these devices it's not required to install the safety package or to start CODESYS with a special profile.



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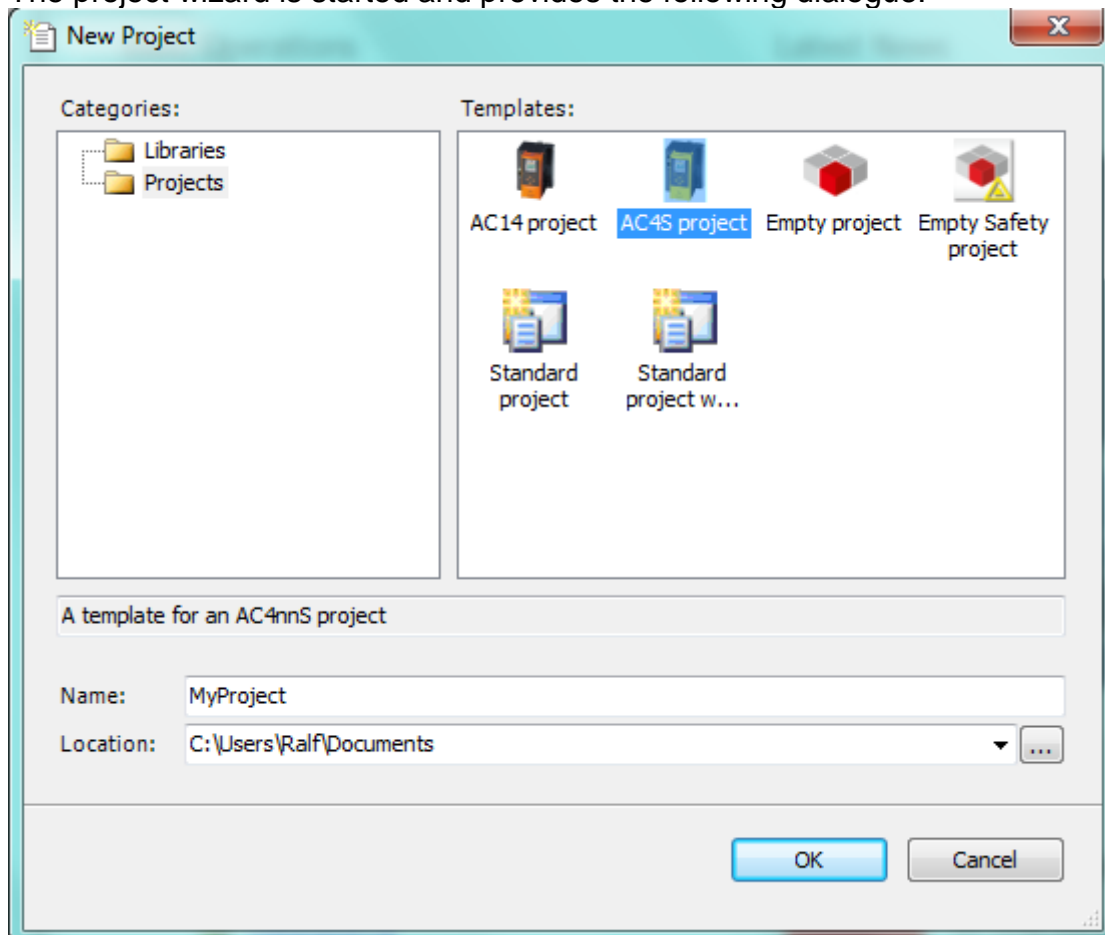
4. Creating a new project

Menu: File → New Project...

Keyboard shortcut: CTRL + N

Icon:

The project wizard is started and provides the following dialogue:



Select the requested unit "AC14" or "AC4S" under "Templates:", assign a project name under "Name:".

Select the directory in which you wish to save the project under "Location:".

Confirm your entries with "OK".



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5. Window "Devices" (device window)

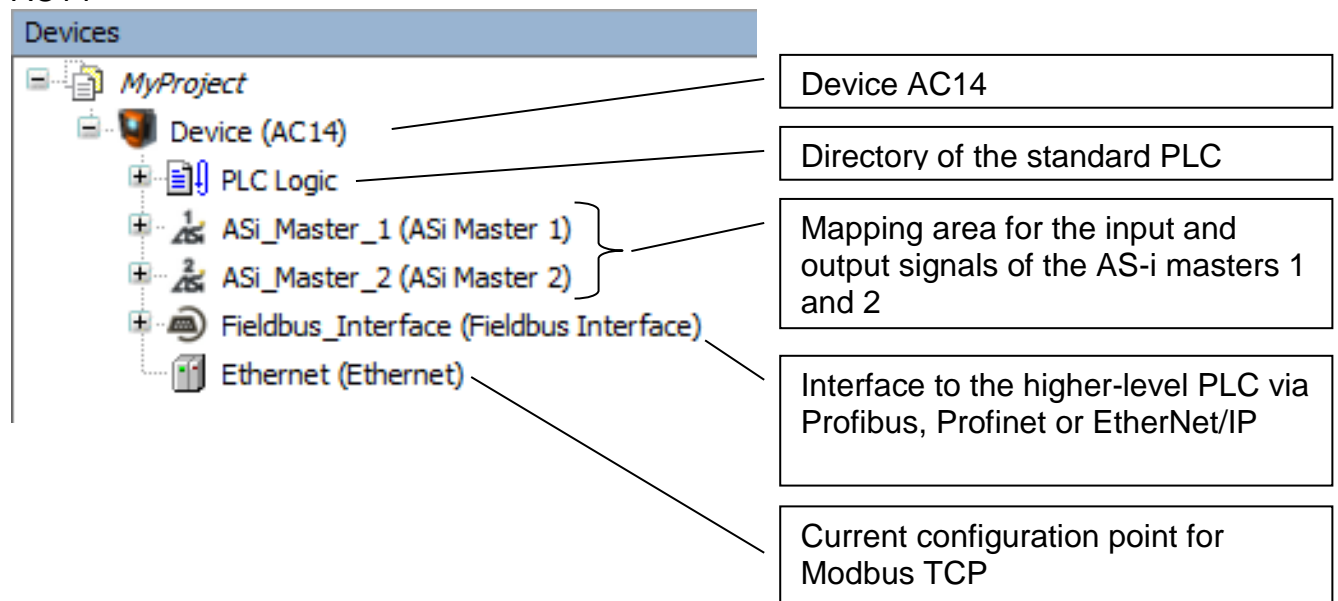
In this window, the devices which have been added to the project are displayed by means of a tree structure. If the window is not visible, it can be displayed as follows:

Menu: View → Devices

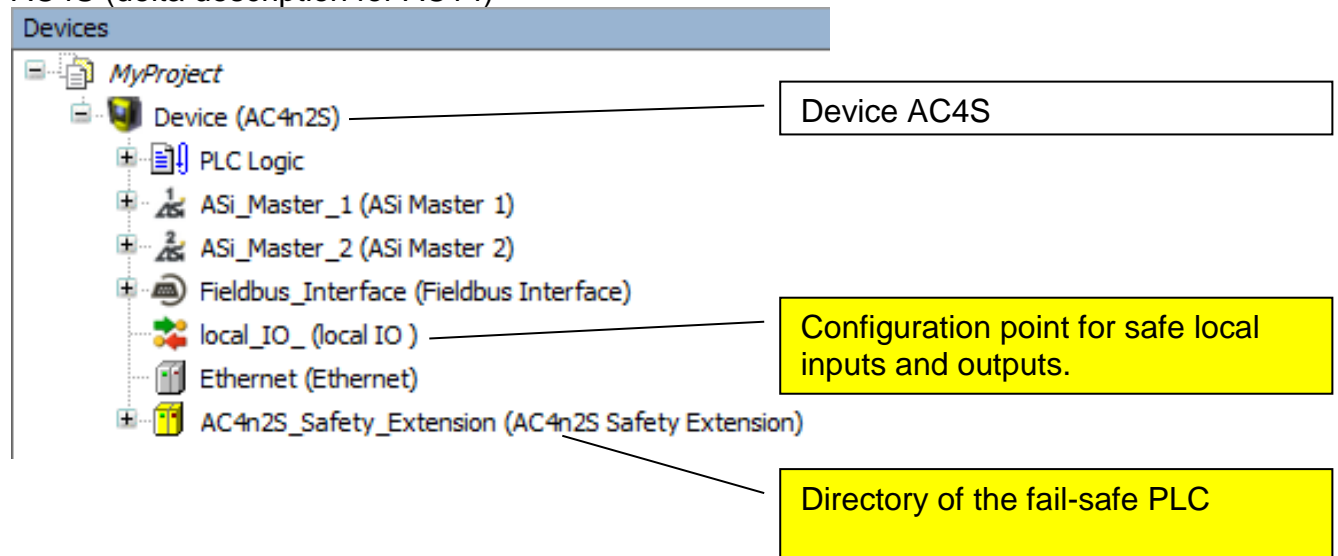
Keyboard shortcut: Alt + 0

The ifm devices are shown as follows in the window "Devices":

AC14

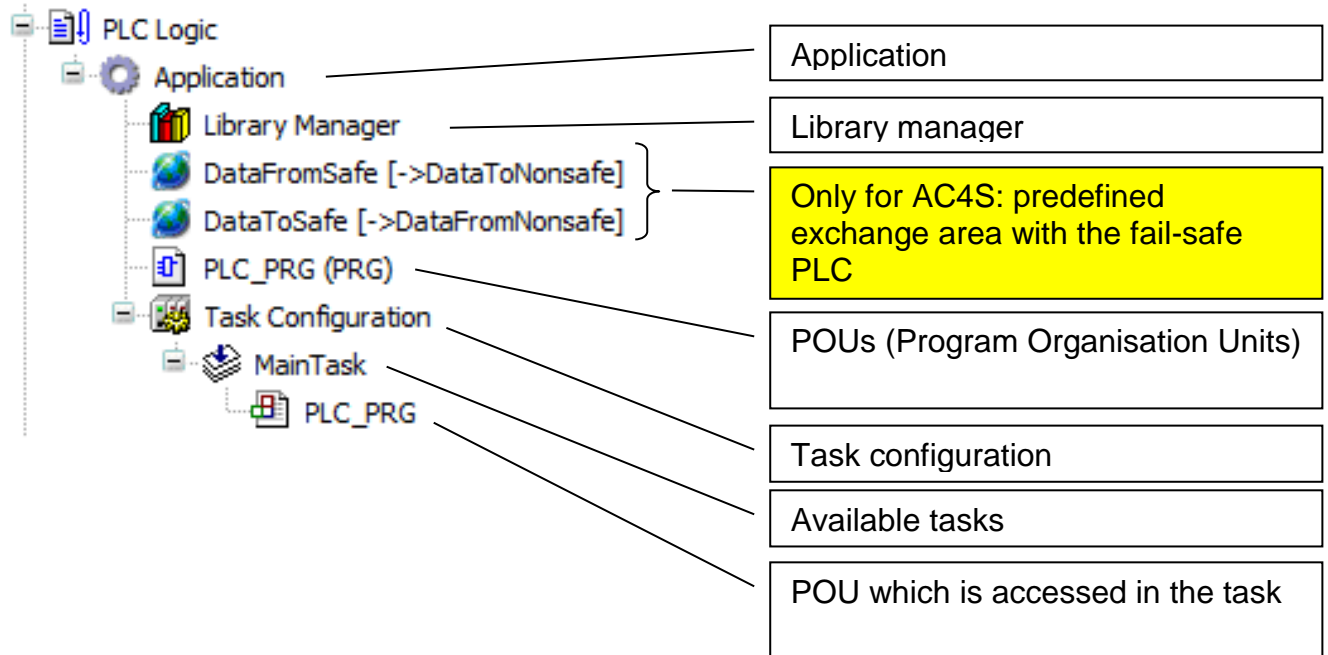


AC4S (delta description for AC14)

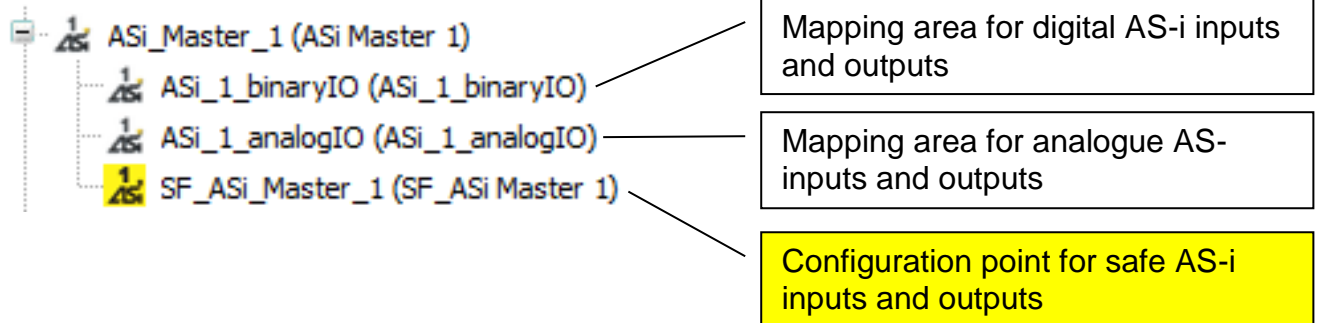




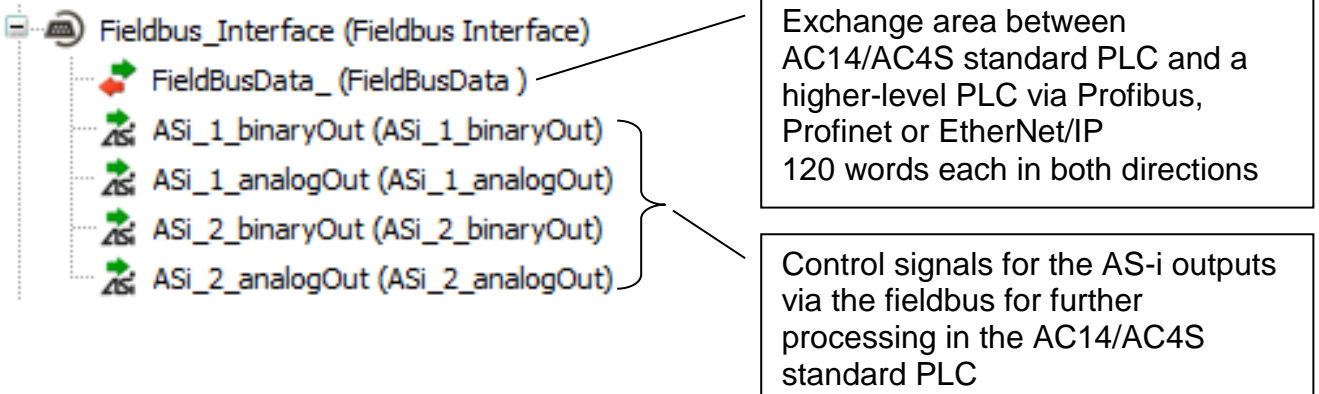
5.1 Directory of the standard PLC



5.2 Directory of the AS-i mapping areas



5.3 Fieldbus exchange area

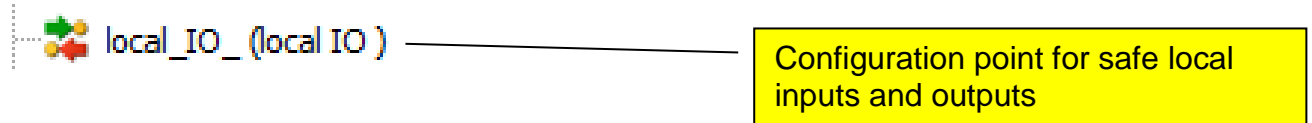




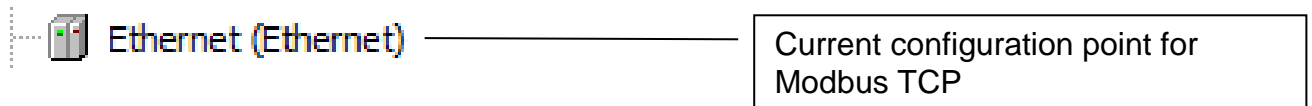
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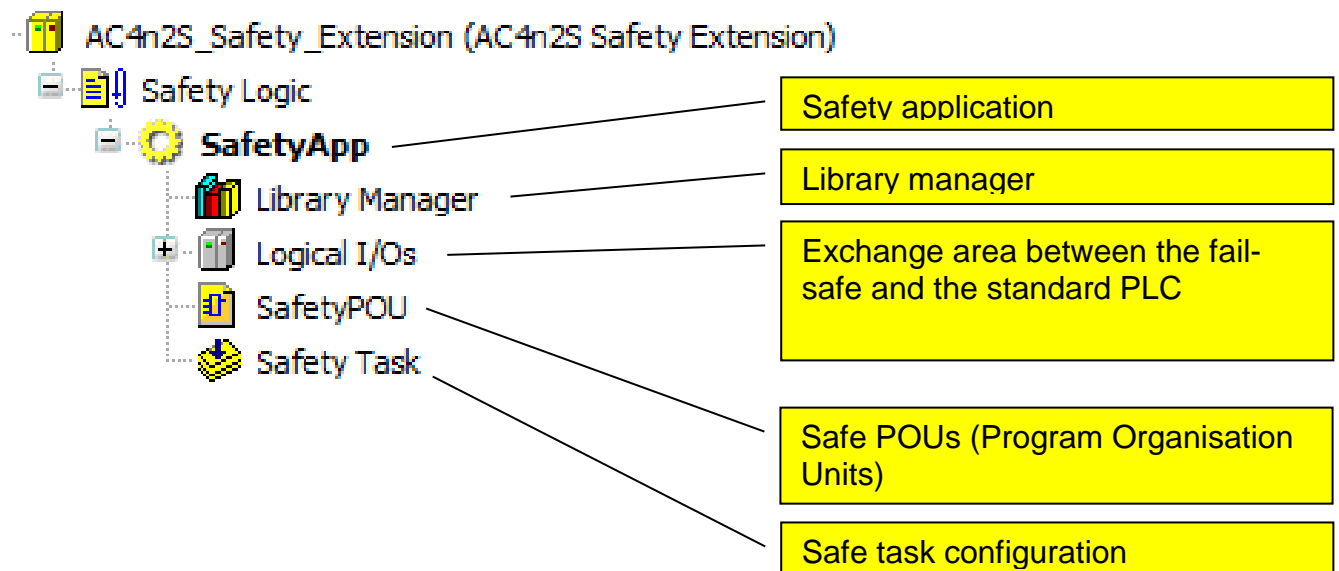
5.4 Configuration point of the safe local inputs and outputs



5.5 Ethernet interface (AC14/AC4S configuration interface)



5.6 Directory of the fail-safe PLC





6. Adding objects in the device window

In the device window, objects can only be added via the context menu. To display the context menu, right click onto the requested point in the device window at which an object or device is to be added. The contents of the displayed window are context-dependent. At least one of the following menu entries can be found in almost all menus:

Add Object
Add Device...

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7. Communication settings

To be able to connect to a PLC with the CODESYS programming environment, the communication path to the requested PLC must be set first. If a device has several PLCs, as in the case of AC4S, the communication paths to both PLCs must be set separately.

7.1 Setting the communication path of the standard PLC (AC14 and AC4S)

Double click on the device in the device window

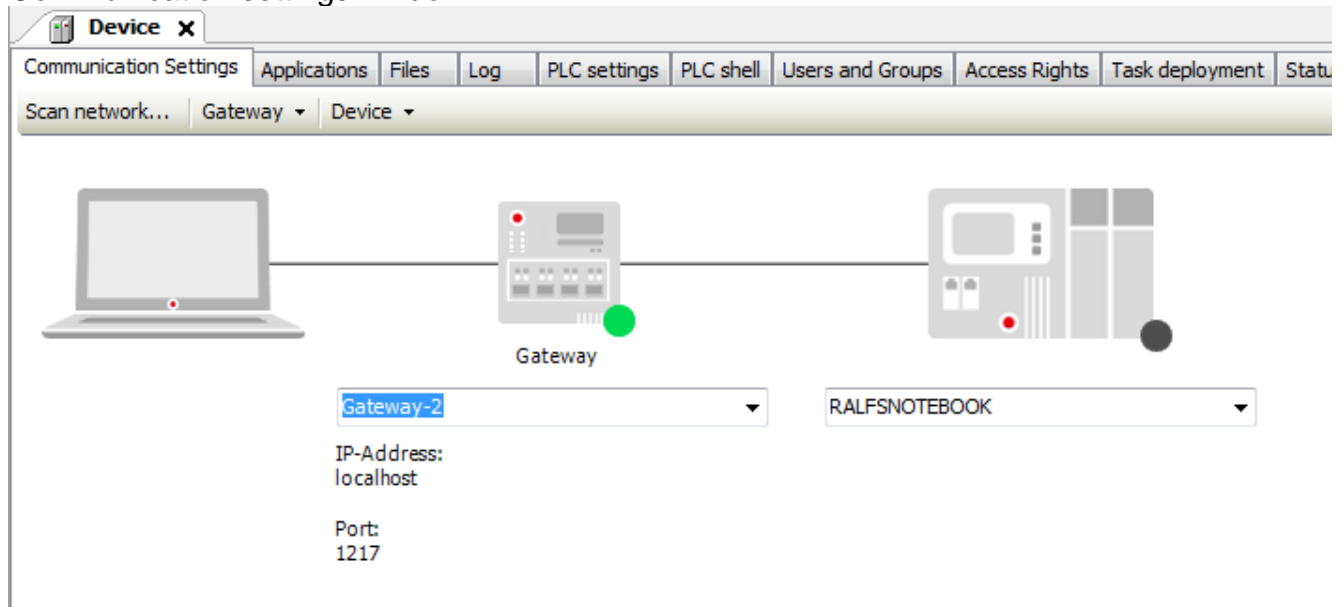


(AC14) or

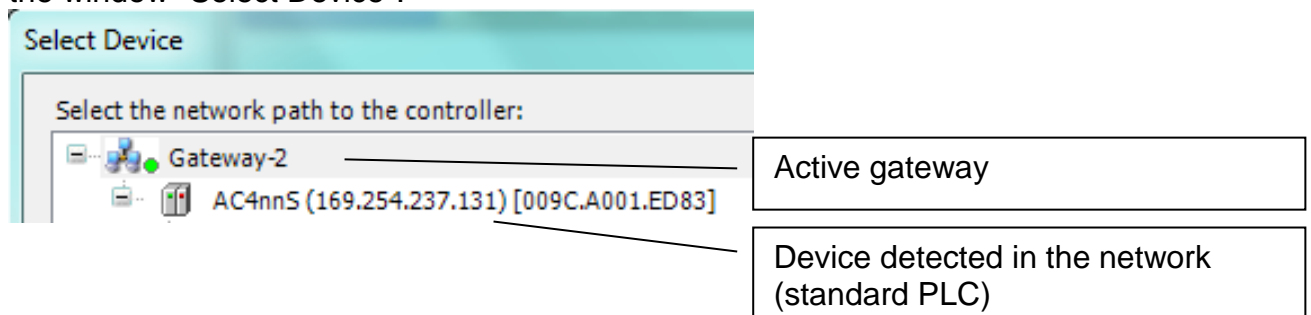


(AC4S)

Communication settings window



Click on "Scan network...". The system opens the window "Select Device" and scans the network for devices programmable with CODESYS. The search results are directly shown in the window "Select Device":



In order to assign the correct device, double click on the corresponding device or mark the device by clicking on it and then close the window "Select Device" using the "OK" button.



Quick instructions:

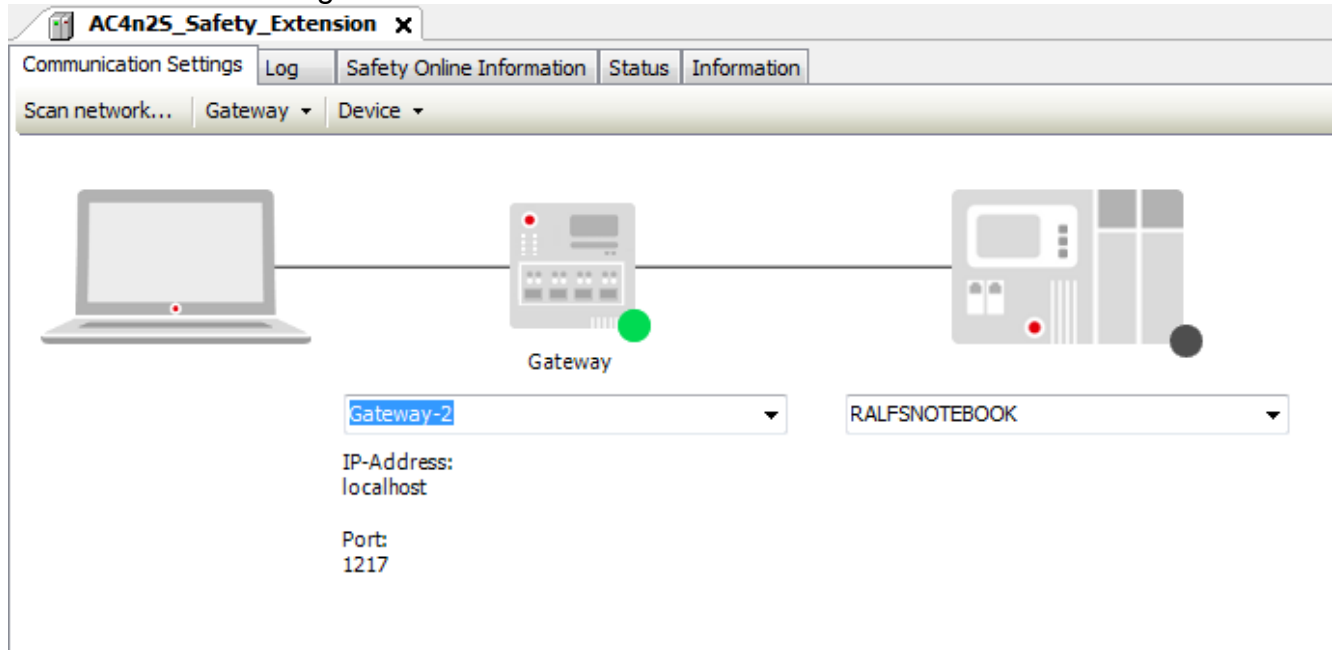
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7.2 Setting the communication path of the fail-safe PLC (AC4S)

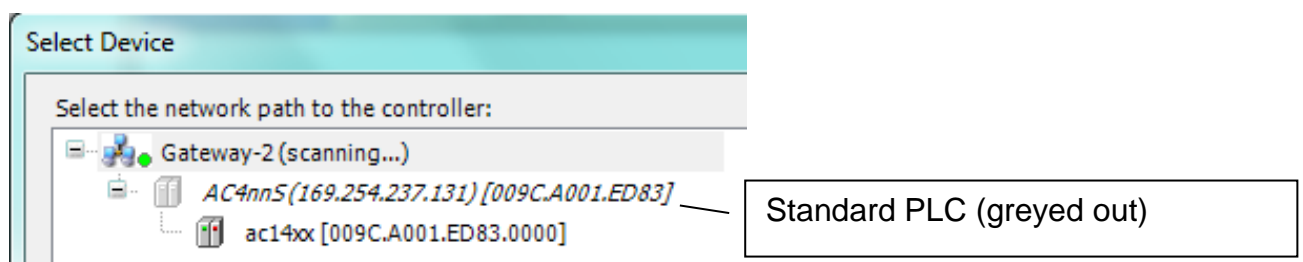
Double click on the AC4n2S Safety Extension in the device window

...  AC4n2S_Safety_Extension (AC4n2S Safety Extension)

Communication settings window



Click on "Scan network...". The system opens the window "Select Device" and scans the network for devices programmable with CODESYS. The search results are directly shown in the window "Select Device". To assign the correct device:



Double click on the corresponding device or mark the device by clicking on it and then close the window "Select Device" using the "OK" button.

Note:

The designation "Gateway" in the communication settings has nothing to do with the AS-i gateways AC14 or AC4S. The term "gateway" refers to the connection software between the CODESYS programming system and the connected devices. This gateway software is



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running on the programming system (PC, notebook) and also on the device (e.g. AC14, AC4S). If a device search in the network is unsuccessful, this may be due to the gateway settings on the PC. In this case, the gateway can be edited (message window on the gateway) and the setting "localhost" can be replaced by the IP address of the device to be connected. In this case, the gateway software on the device is addressed.



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8. Adding safe inputs and outputs to the configuration

Safe inputs and outputs can be added to the respective configuration points in the device window. On the configuration points, only basic parameters of the inputs and outputs can be defined (pure hardware configuration).


8.1 Safe AS-i I/Os:

Required settings:

- Type of sensor / monitoring used
- Instance name (unambiguous)
- AS-i slave address





Procedure:

Right click on the configuration point of the safe AS-i slaves

 SF_AS_i_Master_1 (SF_AS_i Master 1)

Select the point "Add Device..." in the context menu.

A list with the available I/O types appears. The type of sensor / monitoring used can be individually selected for each slave. This list exactly corresponds to the modules which were also available in the previous software "ASiMon":

Miscellaneous			
	SF_IN_AS_i_conditionally_dependent	ifm electronic	3.5.4.2
	SF_IN_AS_i_dependent	ifm electronic	3.5.4.2
	SF_IN_AS_i_dependent_filter_nshutdown	ifm electronic	3.5.4.2
	SF_IN_AS_i_dependent_filter_ntestreq	ifm electronic	3.5.4.2
	SF_IN_AS_i_dependent_filter_w_testreq	ifm electronic	3.5.4.2
	SF_IN_AS_i_forced	ifm electronic	3.5.4.2
	SF_IN_AS_i_independent	ifm electronic	3.5.4.2
	SF_OUTcontrol_AS_i	ifm electronic	3.5.4.2

Safe AS-i inputs:

Conditionally dependent

Dependent

Dependent with filtering no shutdown

Dependent with filtering no test request

Dependent with filtering and test request

Forced

Independent

Safe AS-i outputs:

Control: control slave (ASiMon: actuator slave)

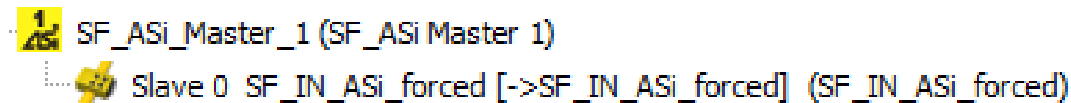
By double clicking on one of the modules, the selected module is added below the selected configuration point. So, all safe AS-i slaves can be added to the configuration before the window is closed.



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Configuration point AS-i master 1 with one AS-i slave of the type 'forced':



Assign an unambiguous (unique) instance name:

The displayed instance name "SF_IN_ASi_forced" can be adapted individually.

Attention: only **unambiguous** names must be used, because a function block is instantiated in the background under this name.

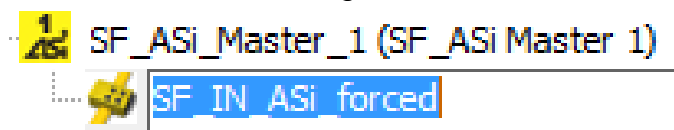
Note

The name syntax specifies:

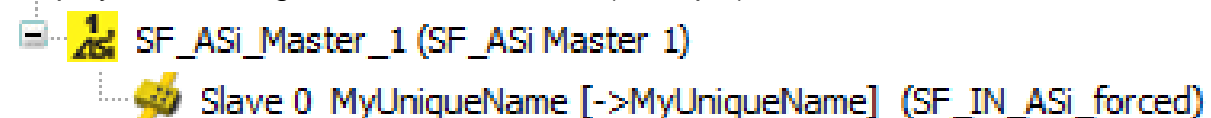
- Blank spaces and special characters are not allowed
- Underscores can be used

To change the name, click on the default name and hold the mouse pointer on the name for about 1 second.

Instance name in editing mode:



Display after editing of the instance name (example)

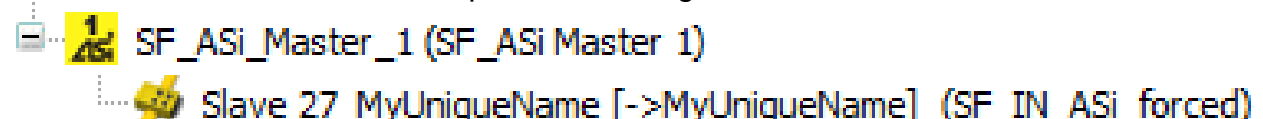


Setting of the corresponding AS-i address

Double click on the AS-i slave below the configuration point. The IO configuration of the safe AS-i slave is displayed:

MyUniqueName X					
Safe ASi IO Configuration		Safe ASi IO I/O Mapping	Status	Information	
Parameter	Type	Value	Default Value	Unit	Description
SlaveAddress	BYTE(0..31)	0	0		

Start the editing mode by double clicking on the field value of the parameter "SlaveAddress". Change the value from "0" to the requested AS-i address and then click on any point in the device window. Here is an example of the configured AS-i slave:

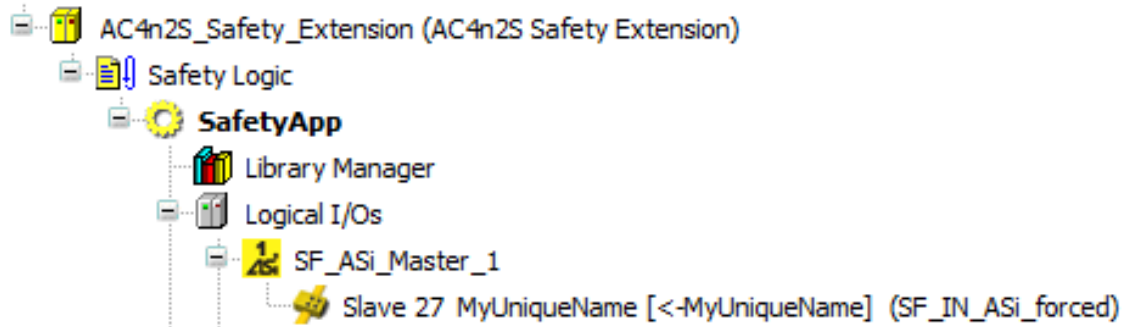




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Each configured AS-i slave with its safe parameters is also automatically displayed below the fail-safe PLC:



By double clicking on the AS-i slave in the structure of the fail-safe PLC, the safe parameters and the symbolic name of the safe I/O information of the slave can be set.

Display of the safe parameters (here shown at the example of a forced contact, different for other types of sensor / monitoring):

MyUniqueName x				
Safe configuration I/O mapping Information				
In Work				
Name	Value	Symbolic value	Description	Unit
SlaveAddress	27		ASi Slave Adresse	
ASi_Master	1		ASi Master	
EnableStartupTest	0	FALSE	After startup test sequence expected	
DisableLogging	0	FALSE	Disable Logging of Non-ErrorStatetransfer	

Change to the tab "I/O mapping" to assign a unique identifier to the safe I/O information of the selected AS-i slave:

MyUniqueName x				
Safe configuration I/O mapping Information				
In Work				
Variable	Channel	Type	Unit	Description
...	Input	SAFEBYTE		S_IN_forced
...	bit0	SAFEBOOL		



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CODESYS always reserves one byte for each AS-i slave. Of this byte however, only bit 0 can be used (safe information). By double clicking on the variable field of bit 0, the field switches to the editing mode. Assign an unambiguous name here again:

MyUniqueName x				
Safe configuration I/O mapping Information				
In Work				
Variable	Channel	Type	Unit	Description
...	Input	SAFEBYTE		S_IN_forced
MySafeInput	bit0	SAFEBOOL		

The last modification in the safe editor is always marked by a red frame.

8.2 Safe local I/Os

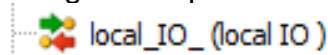
Required settings:

- Type of sensor / monitoring used
- Instance name (unambiguous)
- Terminal numbers used

The procedure for adding safe local inputs and outputs is only slightly different from that for the previously described AS-i slaves. These are the differences:

- The configuration point for the safe local inputs and outputs is different:

Configuration point for safe local inputs and outputs:



- Instead of one safe AS-i control slave (triggering of safe AS-i outputs), three different local outputs are available:

Miscellaneous			
SF_IN_local_conditionally_dependent	ifm electronic	3.5.4.2	
SF_IN_local_dependent	ifm electronic	3.5.4.2	
SF_IN_local_dependent_filter_nshutdown	ifm electronic	3.5.4.2	
SF_IN_local_dependent_filter_ntestreq	ifm electronic	3.5.4.2	
SF_IN_local_dependent_filter_testreq	ifm electronic	3.5.4.2	
SF_IN_local_forced	ifm electronic	3.5.4.2	
SF_IN_local_independent	ifm electronic	3.5.4.2	
SF_OUT_local_dual	ifm electronic	3.5.4.2	
SF_OUT_local_single	ifm electronic	3.5.4.2	
SF_OUT_local_testpulse	ifm electronic	3.5.4.2	

Dual: two-channel output

Single: one-channel output

Test pulse: test pulse generator for the supply of mechanical contacts

- Instead of an AS-i address, the terminal numbers used must be set for the safe local inputs and outputs.



9. Adding safe POU

To add safe POU to the project, right click on the safety application in the device window and select "Add Object" from the context menu.

Note:

If the project was created as "AC4S project", a POU with the name "SafetyPOU" of the type "Basic" is already predefined.

Two different POU types are available.

Basic POU:

- Basic functions (recommended for standard applications)

Extended POU:

- Extended functions (XOR, NOT, mathematical operations, MUX, SEL, Flip Flop,...)
- Special requirements regarding verification and documentation of the POU could be required!

For standard applications only the basic POU should therefore be used, if possible. In principle however, both variants are permitted for AC4S.



10. Editing safe POU

The editor for the safe POU (Program Organisation Units) is opened by double clicking on a POU. Only the function block diagram (FBD) display is available in the safe editor.

Programming is mostly made using predefined function blocks and operands which can be moved into the editor via drag & drop from the adjoining tool window.

Note:

If the tool window is not visible, it can be accessed via the menu "View ➔ ToolBox".



11. Exchange of data between standard PLC and fail-safe PLC

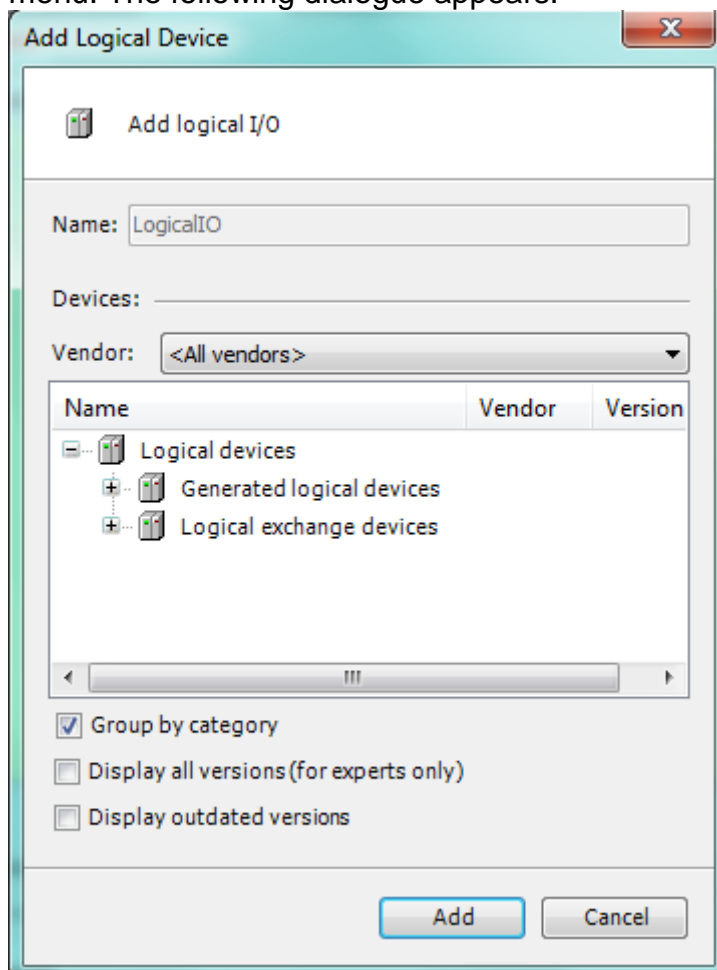
The fail-safe PLC has no direct access to the non-safe input and output information, with the exception of the local inputs and outputs. For data exchange between the fail-safe and the standard PLC however, so-called logical exchange objects can be created by means of which data can be exchanged. Different logical exchange objects are available for different data types / data lengths.

Note:

If the project was created as "AC4S project", 2 logical exchange objects are already completely preconfigured. These enable data exchange of one byte each in both directions.

Approach for creating new logical exchange objects:

Right click on "Logical I/Os" and select "Add Object" → "Logical Device..." in the context menu. The following dialogue appears.



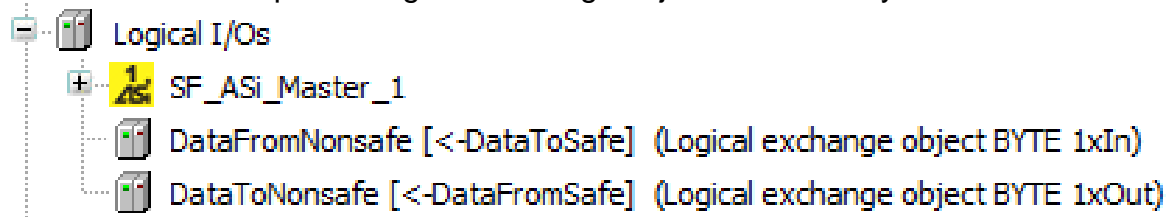
Open the node "Logical exchange devices" and select an object with the requested data direction and size. Assign an appropriate name for the data to be transmitted under "Name:" and click on "Add". The system now provides a data channel between the two PLCs which you can fill with your individual data.



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Here are two examples of logical exchange objects with one byte of data each:

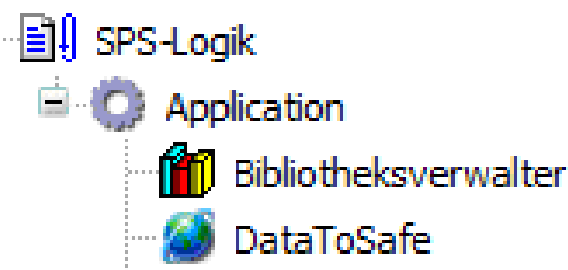


Double click on an exchange object to edit it:

Variable	Channel	Type	Unit	Description
	Input	BYTE		
Restart	bit0	BOOL		
EDM_Signal	bit1	BOOL		
FaultReset	bit2	BOOL		
MutingSwitch1	bit3	BOOL		
MutingSwitch2	bit4	BOOL		
	bit5	BOOL		
	bit6	BOOL		
	bit7	BOOL		

Enter an unambiguous name for each element which you want to transmit via the exchange object.

When the definition of your data in the fail-safe PLC has been completed, the logical exchange object has to be assigned in the standard PLC. To do so, right click on the application of the standard PLC, select "Add Object" and "Logical Exchange GVL...". Assign an unambiguous name for the list of variables under "Name:" and click on "Add".

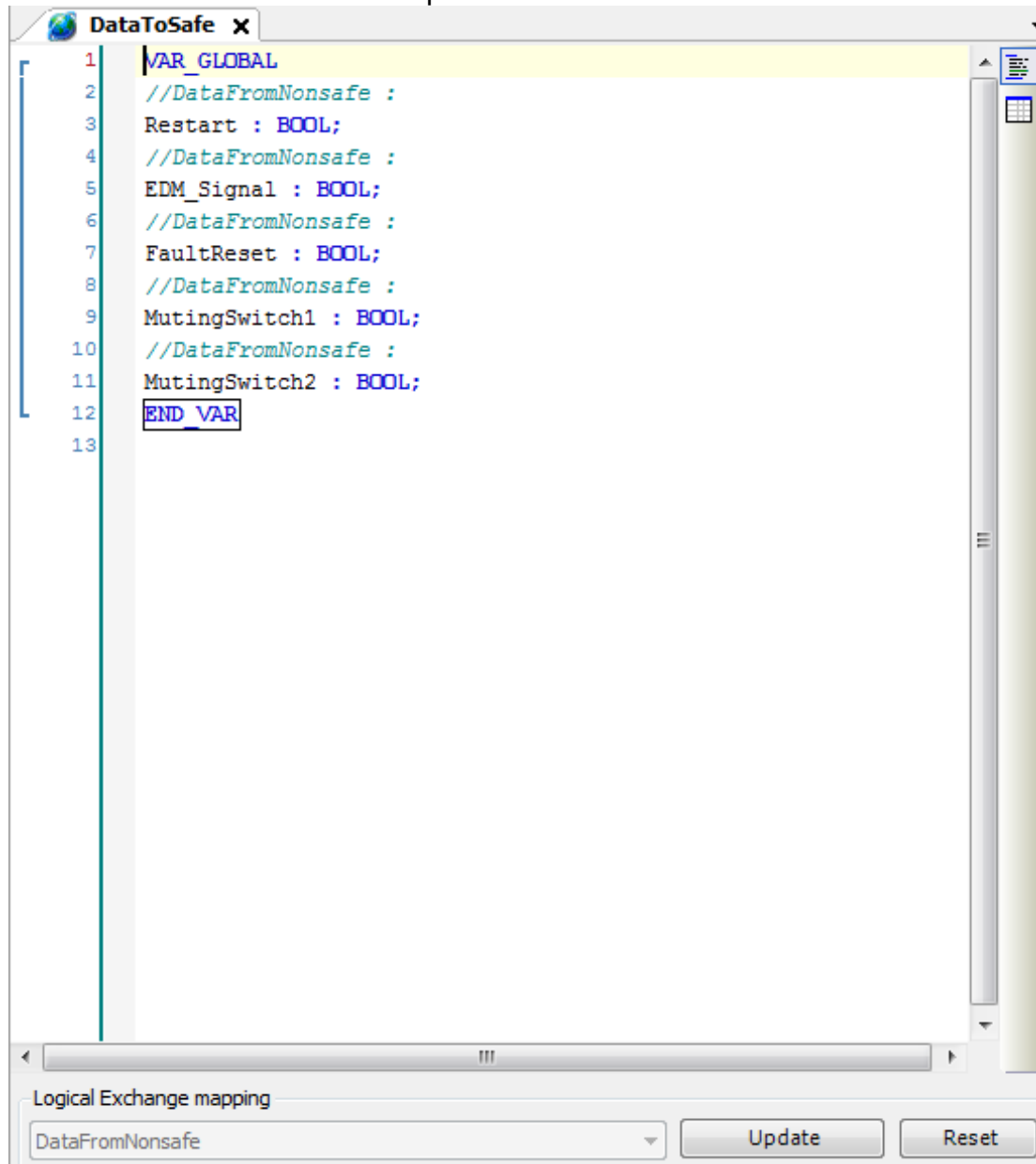




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Double click on the GVL to open the editor in which you can define which of the logical exchange objects defined in the safe part is to be linked to the GVL. This definition is made via the list selector in the lower part of the window:



All of the variables defined in the fail-safe PLC are immediately displayed in the GVL, but cannot be modified here. The variables are now available to the standard PLC as global variables. If the declaration of variables is later edited in the fail-safe PLC, an update has to be made on the side of the standard PLC. To do so, click on "Update".

Note:

If the interface between the safe and the standard PLC has been modified subsequently, it may happen that newly added data points are not updated. In this case the 'Clean all' function in the menu 'Build' must be used and the modified project needs to be reloaded into the SmartPLC AC4S.



Quick instructions:

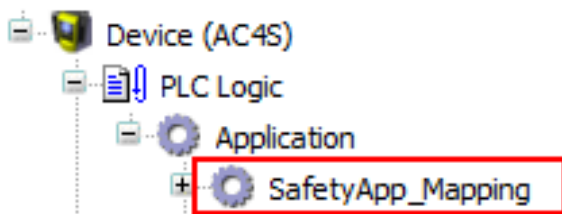
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Important note

As there is a known bug in the CODESYS runtime which can't be corrected within the first AC4S release, it could happen that the data exchange between the fail-safe PLC and the standard PLC is not working after the project has been downloaded to the device. The fault is indicated by a red triangle in front of the "AC4n2_Safety_Extension".

Currently the following workaround exists:

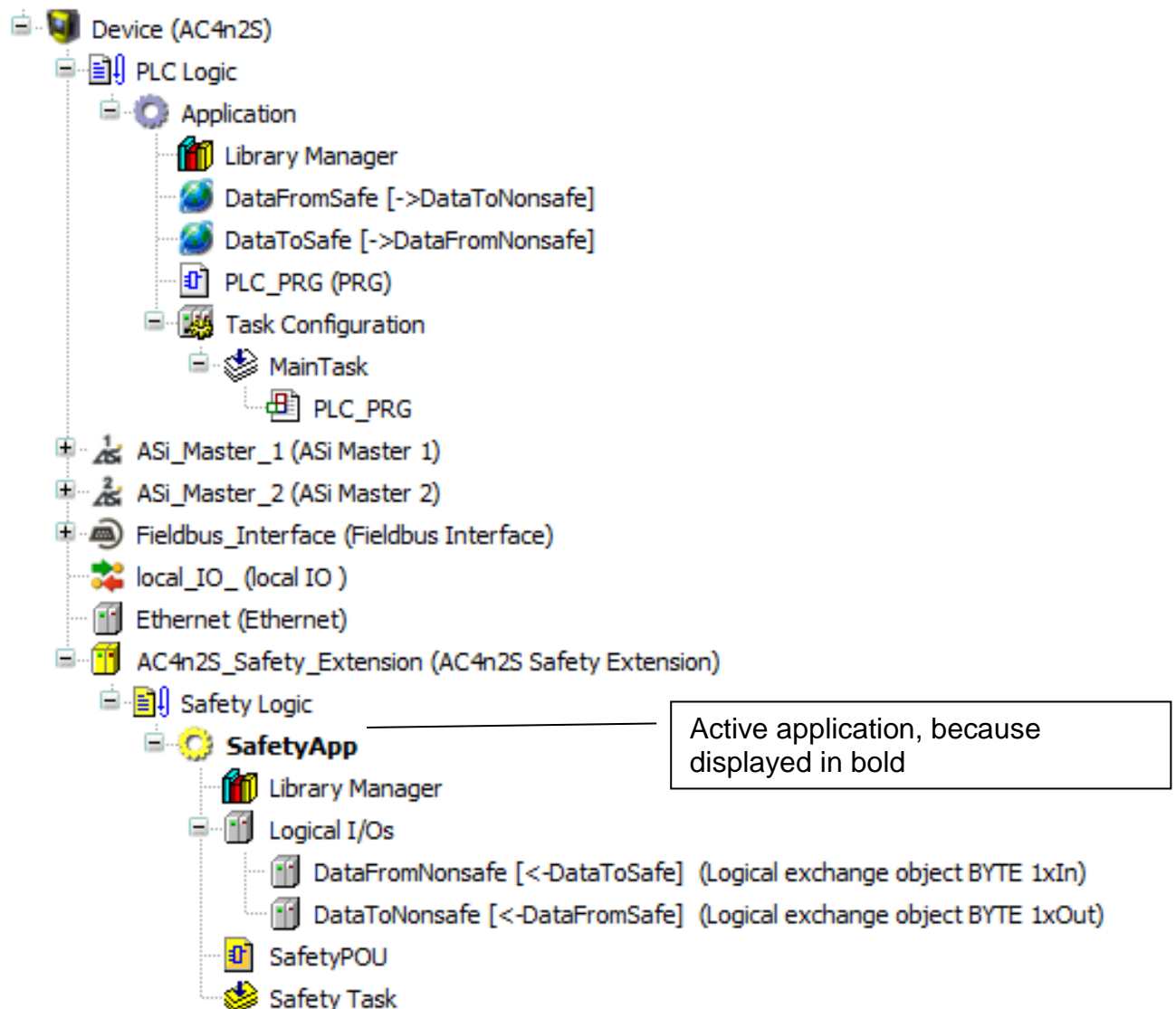
In case that the fault occurs please login with the application "SafetyApp_Mapping" (see picture below). While doing so the data exchange will automatically be initialized. There is no need to start or stop this application.





12. Activating an application

When the complete program has been created, the two PLC programs can be loaded into the controller. Given that the menus and icons for "Login", "Logout", "Start" and "Stop" are only available once, you can define in the device window which application is to be controlled using the above menus and icons. The activated application is shown in bold.



By right clicking on an inactive application, it can be activated via the context menu "Set active Application". The previously activated application is immediately deactivated.

Note:

Via the context menu, inactive applications can be logged in, logged out, start and stopped at any time.



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13. Translating the program

Activate the application and start the translation.

Menu: Build -> Build

Keyboard shortcut: F11

Icon: 

If there are errors in the application, these are now displayed in the message window.

If the message window is not visible, it can be displayed via

Menu: View -> Messages

Keyboard shortcut: Alt + 3



14. Login, identification and password

Login is possible when the application has been translated without errors, i.e. loading the program into the PLC.

When the application is active:

Menu: Online -> Login

Keyboard shortcut: Alt + F8

Icon: 

When the application is inactive, login can be made via the context menu. To do so, right click on the application and select "Login" from the context menu.

Notes:

First time logging into the safe PLC of AC4S an identification number has to be entered. Please type in the serial number of the device. You can find it on a sticker on the left side of the device or in the HMI menu (System > Information). The leading zeros of the serial number can be ignored.

Additionally several other message windows appear, asking to confirm the organisational safety of the plant. Also, a password has to be entered. As long as no password has been defined, it is sufficient to click on "OK" without entering a password.



15. Starting the PLC

When the program download to the controller has been completed, the PLC can be started.

When the application is active:

Menu: Debug -> Start

Keyboard shortcut: F5

Icon:



Note:

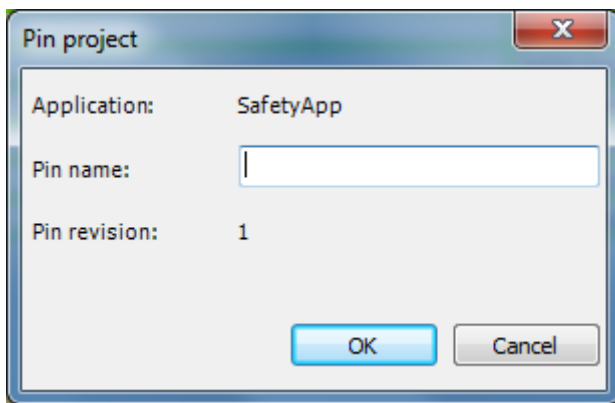
When the application is inactive, the PLC can also be started via the context menu.
To do so, right click on the application and select "Start" from the context menu.



16. Project pinning (project versioning)

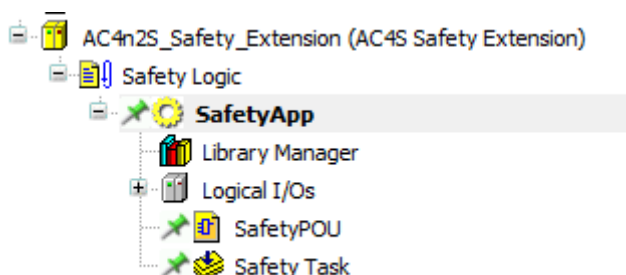
If the PLC project is in the final status, i.e. debugging has been successfully completed, the project should be versioned. This ensures that unintentional changes to the project will be detected immediately.

For versioning (pinning) the safety project please double click on the safety application (SafetyApp). An overview of all objects and devices used in the safety project is displayed. By clicking on the button "Pin project" a window opens where you can freely assign a pin name for the project.



When you exit the window via the button "OK", checksums are generated in the object and device table for this version.

After pinning, all elements in the device tree are marked with a green pin.



If an element is changed after the pinning, the project checksum of the object will be automatically changed. This results in a difference between the respective project checksum and the versioned checksum. In this case the green pin in the device tree for the respective element will disappear.



17. Create a boot application in the fail-safe PLC

As long as no boot project has been created in the fail-safe controller, the safety application will be automatically deleted from the device after each logout. If the safety application is to be stored non-volatily in the controller, a boot project is to be generated.

For generating a boot project you have to be online, i.e. logged in.

Via

menu: online → generate boot application

the project is stored in the flash memory of the device. Depending on the size of the application, this can take some minutes.

When you log out again, the system will tell you that a boot application is in the device, and will ask you whether this boot application is to be loaded now. If you answer this question with "Yes", the debugging function for the current application will be deactivated and the boot application will be loaded.

If you answer the question with "No", just the debugging function will be deactivated.

A boot application stored in the device will be automatically loaded and started after every power reset of the device.



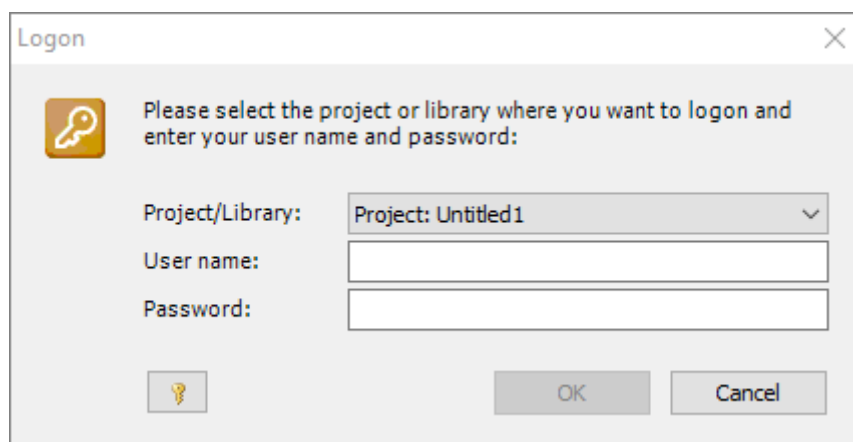
18. Set password of the fail-safe PLC

To protect the fail-safe PLC against unauthorized write access, a password **must** be set finally. A precondition to set a password is, that the programmer is logged on as known user to the user management of the project. The current user is displayed in the CODESYS status bar:



In the example above no user is logged on. To log on as a user select:

Menu: Project → User Management → User Logon



A default user of each Project is the user 'Owner' (no password). With this user name it's possible to log on.

Via:

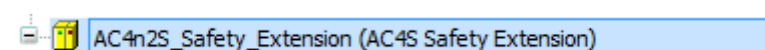
Menu: Project → Project Settings → Users and Groups

new users can be defined or existing users can be administrated. More information to this topic could be found in the online help of CODESYS.

As soon as a user has been logged on to the system, it's displayed in the CODESYS status bar:



Now the password of the fail-safe PLC can be set. To do that please make a double-click on the 'AC4n2S_Safety_Extension',



change to the tab 'Safety Online Information' and click on the button 'Set password':

Quick instructions:
Programming of SmartPLC AC14/AC4S with CODESYS V3



AC4n2S_Safety_Extension X

Communication Settings Log Safety Online Information Status Information

Node name: Refresh

Boot application

Application: Delete

Comment: Restart

Execution version: Set password

Created:

Boot application pin

Name:

Revision:

CRC:

Created:

Safety device

Firmware: Update FW

Reset to FW

In appearing window the new password has to be entered twice. Close the window by click on 'OK':

Set boot application password X

Node name: ifm SafeLine SmartSPS AC402S

Password:

Confirm password:

The password will be set. Do you want to proceed?

OK Cancel



Quick instructions:

Programming of SmartPLC AC14/AC4S with CODESYS V3

In the window below the current password must be entered:

Authorization

Node name: ifm SafeLine SmartSPS AC402S

For performing this interaction with the safety device please enter the password for the related boot application.

Password

OK Cancel

The new password is set to the fail-safe PLC.

Note:

The default password setting of a new SmartPLC SafeLine is empty. Out of that reason it's enough to just click on 'OK', without entering a password before.

Important information:

The password, which has been defined here, must be stored by the user in a way, that he could get access to the device at any time. If the password gets lost, there is no way to get writable access to the fail-safe PLC anymore!