Controlling distributed I/Os and drives from two controllers via PROFINET (Shared Device via Object Manager)

SIMATIC & SINAMICS

Application Example • May 2012

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SIMATIC & SINAMICS Shared Device

Application Example

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1 Problem

1.1 Overview

Introduction

PROFINET IO provides the functionality **Shared Device** in order to access an IO-Device from two IO-Controllers.

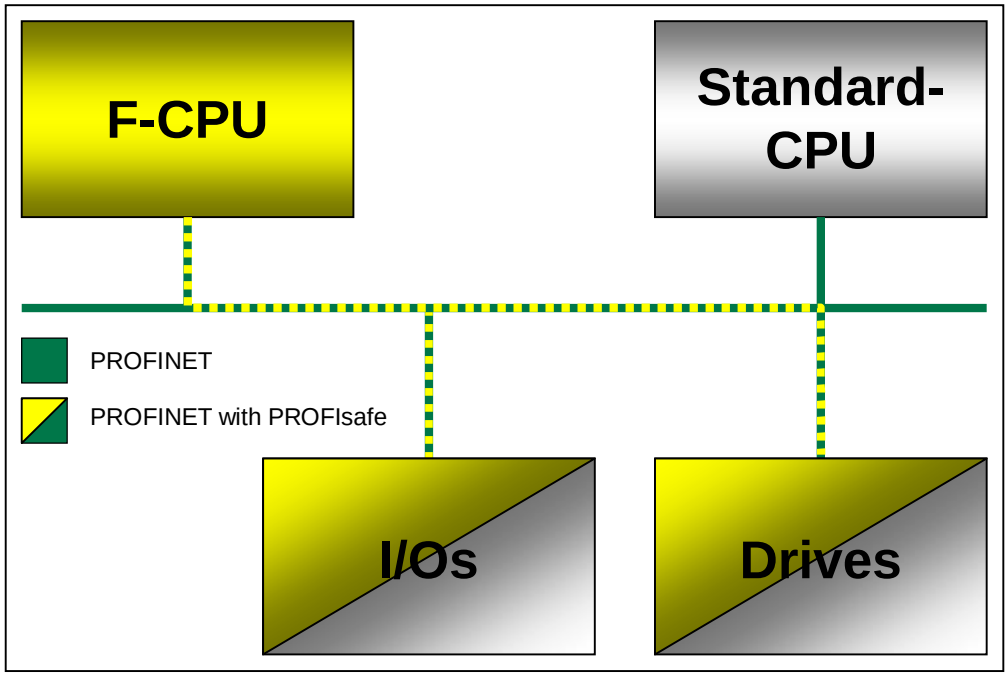
Shared Device allows to flexibly assign the input and output data to two different IO-Controllers. This functionality is used to activate the drive internal safety functions from a F-CPU. The command velocity is specified in parallel from a Standard-CPU.

Other possibilities to activate the drive internal safety functions using the terminal extension module TM54F as well as the activation via PROFIBUS with PROFIsafe are described in further application examples.

Overview about the automation task

The following figure provides an overview about the automation task.

Fig. 1-1



A system is automated using a failsafe F-CPU and a Standard-CPU, as well as distributed I/Os and drives via PROFINET.

The Standard-CPU uses the non-failsafe inputs and outputs and specifies the command velocity for the drives.

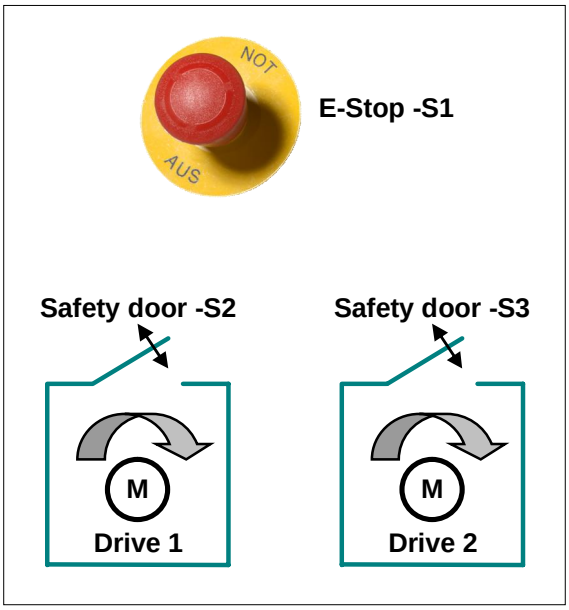
The F-CPU uses the failsafe inputs and outputs and activates the drive internal safety functions via PROFINET with PROFIsafe.

The following drive internal safety functions are used in the corresponding sample project.

- **STO**
  When actuating the emergency OFF switch -S1, STO is selected on the drive 2 (blue), that means, the drive coasts down. The pulses are deleted immediately and the power supply is safely interrupted electronically.
- **SS1**
  When actuating the emergency OFF switch -S1, SS1 is selected on the drive 1 (red), that means, the drive does not coast down and is decelerated along the OFF3 ramp. Afterwards, STO is active on this drive.
- **SOS**
  When opening the protective door 1 -S2, SOS is selected on the drive 1 (red), that means the standstill position of drive 1 is safely monitored after a configurable delay time.
- **SLS**
  When opening the protective door 2 -S3, SLS is selected on the drive 2 (blue), that means the speed of drive 2 is monitored for a configurable maximum value after a configurable delay time. As a fault reaction of SLS upon exceeding of the safe speed, STOP C (SS2) is triggered on the relevant drive.

The safety-relevant signals are recorded via failsafe inputs. In the safety program of the F-CPU, the bits activating the drive internal safety functions are set depending on the safety-relevant signals. The communication to the drive is established via a failsafe PROFIsafe telegram.

Fig. 1-2: Safety-relevant signals



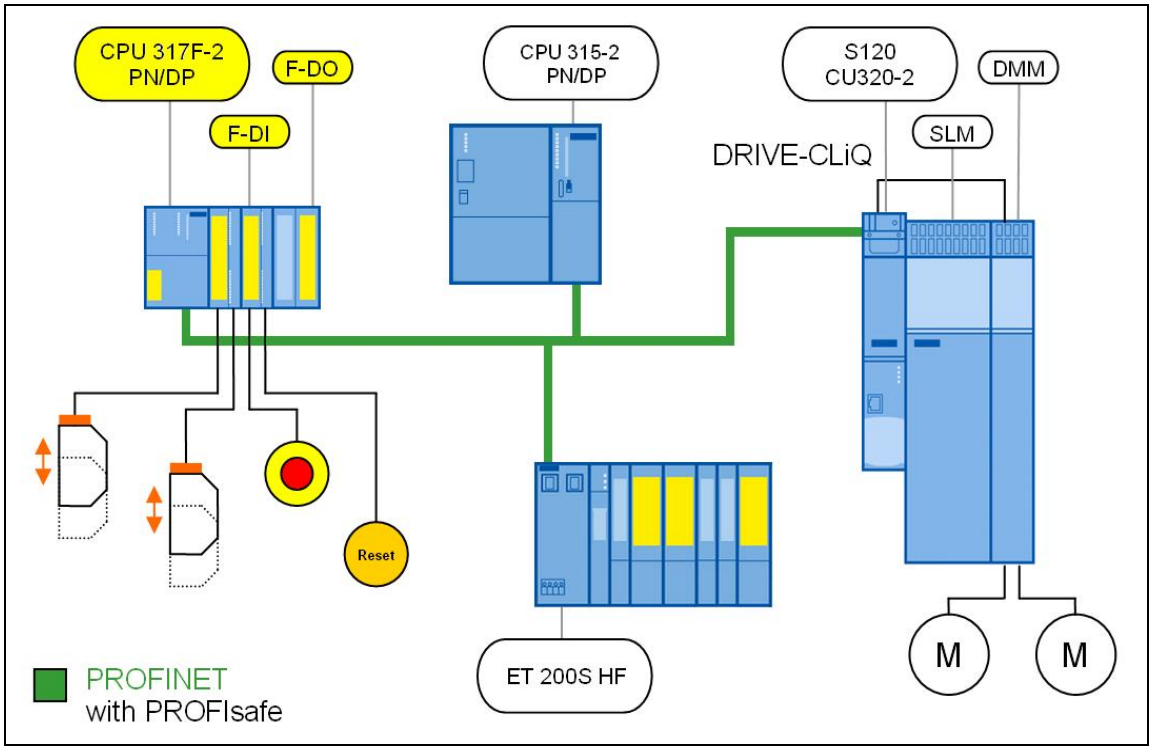
2 Solution

2.1 Solution overview

Display

The following figure displays the most important components of the solution:

Fig. 2-1



This application example shows the activation of the safety functions STO, SS1, SOS and SLS via PROFINET with PROFIsafe on a distributed SINAMICS S120 drive.
Here, the PROFINET functionality **Shared Device** is used, that means the SIMATIC CPU 315-2 PN/DP specifies the command speed and the CPU 317F-2 PN/DP activates the safety functions in the drive.
The SINAMICS Control Unit is integrated into both IO-Controllers via PROFINET as **Shared Device**.

The SINAMICS S120 drive in Booksize format comprises an infeed unit (SLM) and a Double Motor Module (DMM). The motor is controlled via a Control Unit (CU). The two mutually independent servomotors are actuated via the Double Motor Module.

Both drives use different safety functions. The safety-relevant signals (see Fig. 1-2) are recorded via a F-CPU with failsafe inputs of the SIMATIC ET 200. The failsafe PROFIsafe communication allows to individually activate the safety functions for each drive. The F-CPU serves both as F-Host and PROFINET IO-Controller.

Delimitation

This application example does not include a description of the

- general drive functions of the SINAMICS

You must have acquired basic knowledge regarding these topics.

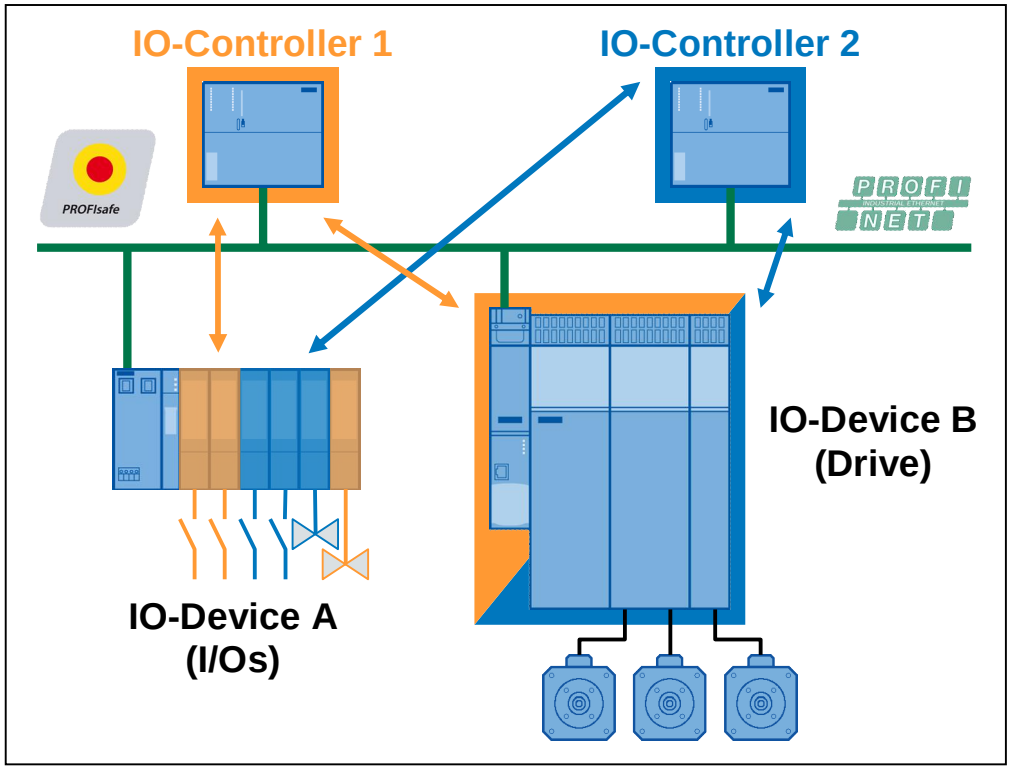
Basic knowledge

You must have acquired basic knowledge regarding the configuring of SIMATIC controllers with the STEP7 engineering system and the configuring of SINAMICS drives with STARTER resp. SIMOTION SCOUT.

2.2 Description of the core functionality

Overview and description of the core functionality

Fig. 2-2



Advantages provided by this solution

The solution presented here provides the following advantages:

- Convenient activation of the drive integrated safety functions
- Convenient setup due to standardized technology
- The existing system can be expanded conveniently and quickly.
- Space-saving and low-cost setup due to drive internal safety functions – no additional hardware required
- An ET200 interface module for standard and failsafe modules

Supplementary conditions

- **No arbitrary assignment of the standard and PROFIsafe telegrams on the drive**
  With SINAMICS as **Shared Device**, the F-CPU can only access the PROFIsafe telegrams of the drives. In contrast to this, the Standard-CPU can only access the standard telegrams of the individual drives. That means, an IO-Controller must specify the command speed for all drives, a second IO-Controller (F-CPU) establishes the PROFIsafe communication to all drives.
  On an ET 200 Station as **Shared Device**, the input and output modules can be arbitrarily assigned to one of the two controllers.
- **You must ensure the sequence of telegrams for the functionality Shared Device via Object Manager.**
  First of all, you have to create the telegrams to the SERVOs, then the telegram to the infeed and then – if required – the telegram to the Control Unit.

2.3 Required Hardware and Software Components

The application was generated with the following components:

Hardware components

Table 2-1

Component	No.	MLFB / order number	Note
Safety training case	1		
SIMATIC 317F-CPU	1	6ES7317-2FK14-0AB0	As from firmware V3.2
SIMATIC 315 CPU	1	6ES7315-2EH14-0AB0	As from firmware V3.2
SIMOTION training case	1	6ZB2 470-0AE00	
CU320-2 DP (+ CBE20) alternatively CU320-2 PN alternatively CU310-2 PN	1	6SL3040-1MA00-0AA0 6SL3040-1MA01-0AA0 6SL3040-1LA01-0AA0	As from firmware V4.5 As from firmware V4.5 As from firmware V4.5
CompactFlash Card	1	6SL3054-0ED00-1BA0	
CBE20	1	6SL3055-0AA00-2EB0	Optional for CU320-2
SIMATIC ET 200S HF	1	6ES7151-3BA23-0AB0	As from firmware V7.0

Note

The sample project has been created using the hardware components listed. Alternatively, you can also use other, functionally equivalent components. For this, you may have to use another parameterization and component wiring.

Regarding the **Shared Device** configuration of a CU310-2 PN resp. CU320-2 PN or a SINAMICS G120 V4.5 with PROFINET interface proceed as shown in the application example displayed here. A CU320-2 DP + CBE20 is used in the application example and in the sample project.

Further components supporting **Shared Device** you can take out of following link:

http://support.automation.siemens.com/WW/view/en/44383954

Standard software components

Table 2-2

Component	No.	MLFB / order number	Note
STEP7	1	6ES7810-4CC10-0YA5	V5.5 SP2
S7 Distributed Safety	1	6ES7833-1FC02-0YA5	V5.4 SP5
S7 F ConfigurationPack	1	---	V5.5 SP9
STARTER	1	6SL3072-0AA00-0AG0	V4.3
SIMOTION SCOUT	1	---	V4.3.1 (alternativ zu STARTER und Drive ES Basic)
Drive ES BASIC	1	6SW1700-5JA00-4AA0	V5.5

Licenses

Table 2-3

License	MLFB / order number	Note
SINAMICS LICENSE SAFETY INTEGRATED EXTENDED FUNCTIONS	6SL3074-0AA10-0AA0	per axis

Sample files and projects

The following list includes all files and projects that are used in this example.

Table 2-4

Component	Note
50207311_Example_Shared_Device_V2_0.zip	STEP 7 project
50207311_Application_Example_Shared_Device_V2_0_en.pdf	This document

2.4 Alternative solutions

SIMOTION I-Device-F-Proxy

At present, the use of SINAMICS drive as **Shared Device** on a SIMOTION controller is restricted as follows.

As the drive must be configured in the HW Config via a GSD file when using the **Shared Device** functionality, automatic adjustment mechanisms between SCOUT and the HW Config are not supported. Thus, you must explicitly ensure consistency of the telegram configuration in the SIMOTION project.

Note When using PROFIsafe via PROFINET with SIMOTION and SINAMICS, you must always use the communication via the I-Device-F-Proxy. More detailed information about the I-Device-F-Proxy is provided in the following article.

http://support.automation.siemens.com/WW/view/en/50207350

3 Basics

3.1 PROFINET communication

Not only the MAC address but also the device name is used to identify the devices for PROFINET. This device name must be unique across the PROFINET network.

During the commissioning phase, the HW Config or the Primary Setup Tool (PST) is used to a make an initial online assignment of a device name for each PROFINET device (a so-called node initiation). This online-assigned device name is stored retentively in the PROFINET device and must match the device name in the project.

If a device is replaced, e.g. because of a defect, the new device has a different MAC address. If it is initiated with the same device name as the replaced device (e.g. by reconnecting a CF card / MMC that stores the device name retentively), it can assume the function of the replaced device without any changes in the configuration (spare part).

Rules for assigning names

A device name must be stored retentively on a PROFINET device. This name must match the device name in the project. The following rules apply in this case:

- The device name stored retentively in the device must only contain lowercase letters.

Note

The device name in the project must only contain uppercase letters.
During the initiation, the engineering system replaces the uppercase letters with lowercase letters.

- Letters a-z and digits 0-9 may be used.
- Special characters are not permitted: ! " § $ % & / ( ) = ? * ' _ : ; > < , # + | ~ \ }] [{
- Blanks are also not permitted.
- The total maximum length for a name is 240 characters.
- Reserved names that cannot be used:
  "port-xyz" or "port-xyz-abcde" (a, b, c, d, e, x, y, z = 0...9)
- The minus character must not be used for a SIMOTION controller.

3.2 PROFIsafe communication

Each drive with a configured PROFIsafe telegram represents a F-Device with PROFIsafe communication to the F-Host.

A separate PROFIsafe telegram 30 is created for each drive. This telegram has 6 bytes of input data and 6 bytes of output data. The first two bytes (PZD1) comprise the safety user data each. The remaining bytes are required for failsafe PROFIsafe communication.

F-CPU → Drive

Fig. 3-1: The F-CPU sends the following control signals to the drive.

PROFIsafe control word (S_STW1, PZD1 in telegram 30)															
Byte 0								Byte 1							
0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7
STO	SS1	SS2	SOS	SLS	Res	Res	Int. Ev. ACK	Res	SLS Limit sel.	SLS Limit sel.	Res	SDI pos.	SDI neg.	Res	Res

Drive → F-CPU

Fig. 3-2: The drive reports the status of the safety functions to the F-CPU.

PROFIsafe-ZSW (S_ZSW1, PZD1 in telegram 30)															
Byte 0								Byte 1							
0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7
STO act.	SS1 act.	SS2 act.	SOS act.	SLS act.	Res	Res	Int. Ev.	Res	SLS Limit	SLS Limit	SOS sel.	SDI pos. act.	SDI neg. act.	Res	SSM

Note Unused safety functions must be deselected via a safe high signal in the PROFIsafe control word.

At present, the SINAMICS S120 drive provides the following Safety Integrated Extended Functions according to IEC 61800-5-2. These also include the Safety Integrated Basic Functions.

Table 3-1: Overview about the safety functions of the SINAMICS S120

Name	Function	Description
STO	Safe Torque Off	• Failsafe interruption of the torque-forming power supply to the motor • Restarting is disabled via the power on disable. • Stop function of Category 0 acc. to EN 60204-1
SBC	Safe Brake Control	• SBC is only used with existing motor brake, the motor brake is connected via the outputs to the power connector. • SBC always reacts in combination with STO or as soon as internal safety monitors respond with failsafe pulse suppression.

Name	Function	Description
SS1	Safe Stop 1	• Fast and failsafe monitored drive stopping along the OFF3 ramp • Transition to STO upon expiry of a delay time or when reaching creep speed • Stop function of Category 1 acc. to EN 60204-1 Braking is not monitored with Safety Integrated Basic Functions. Further, the transition to STO only depends on expiry of the delay time.
SS2	Safe Stop 2	• Fast and failsafe monitored drive stopping along the OFF3 ramp • Transition to SOS upon expiry of a delay time (the drive remains under control) • Stop function of Category 2 acc. to EN 60204-1
SOS	Safe Operating Stop	• Failsafe monitoring of the standstill position (the drive remains under control)
SLS	Safely-Limited Speed	• Failsafe monitoring of the speed • Parameterizable stop reaction when exceeding the limit speed
SSM	Safe Speed Monitor	• Failsafe display of speed limit violation (n < nx)
SDI	Safe Direction	• As from SINAMICS Firmeware V4.4 • Failsafe monitoring of the moving direction (positive and negative direction) • Parameterizable stop reaction when traversing in the non-released direction

These safety functions can be activated both via PROFIBUS or PROFINET with PROFIsafe, and via a terminal extension module TM54F.

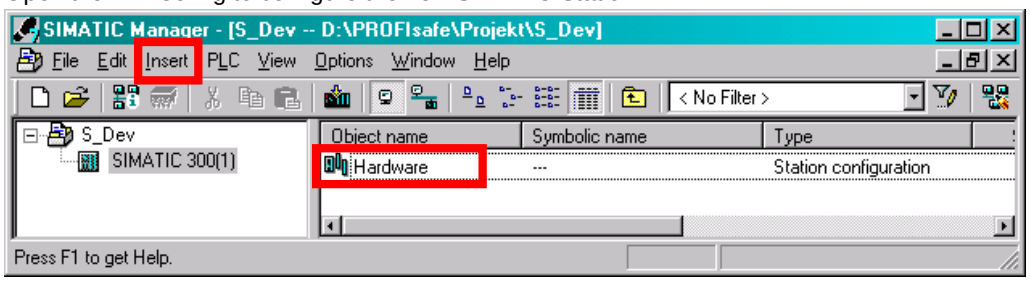
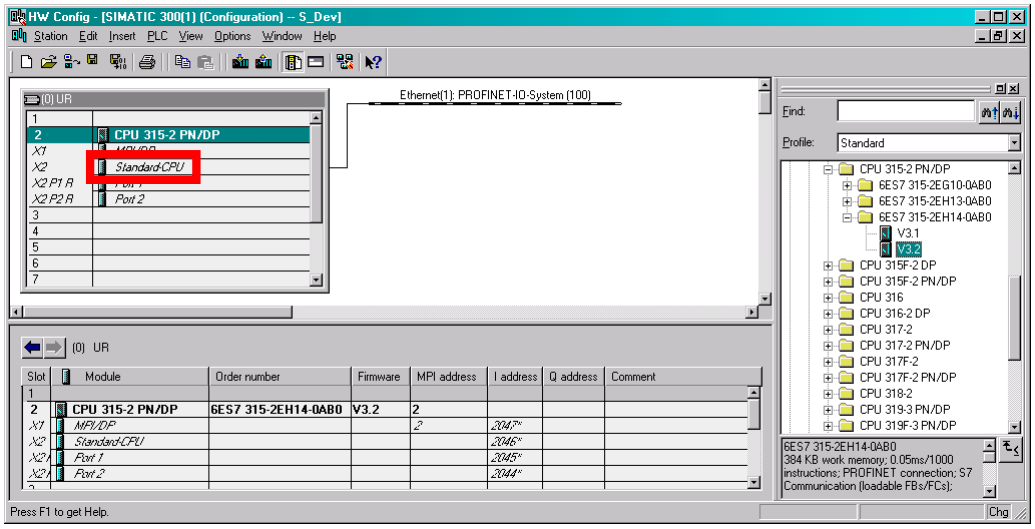
In this example, the safety functions are activated from a SIMATIC F-CPU via PROFINET with PROFIsafe.

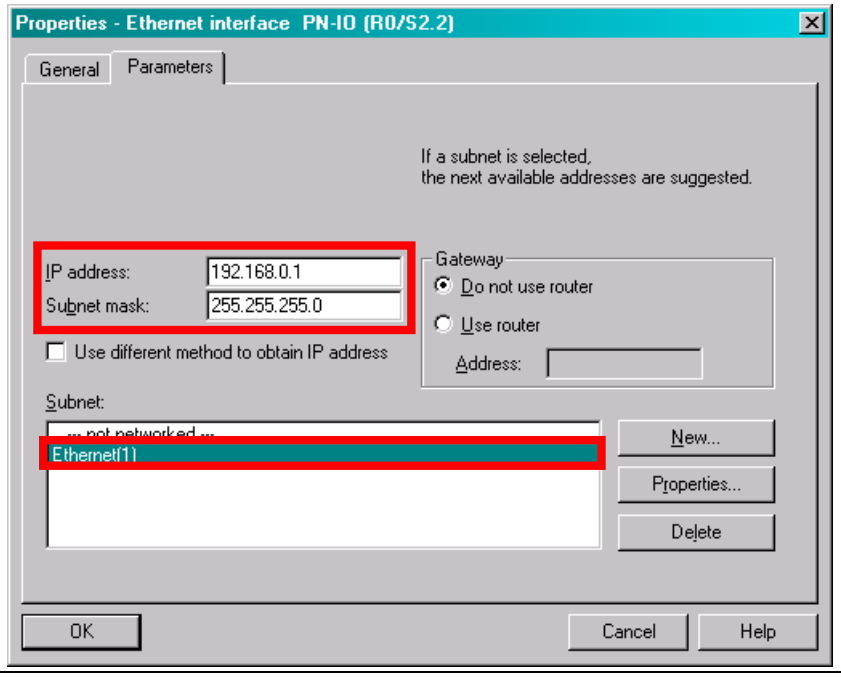
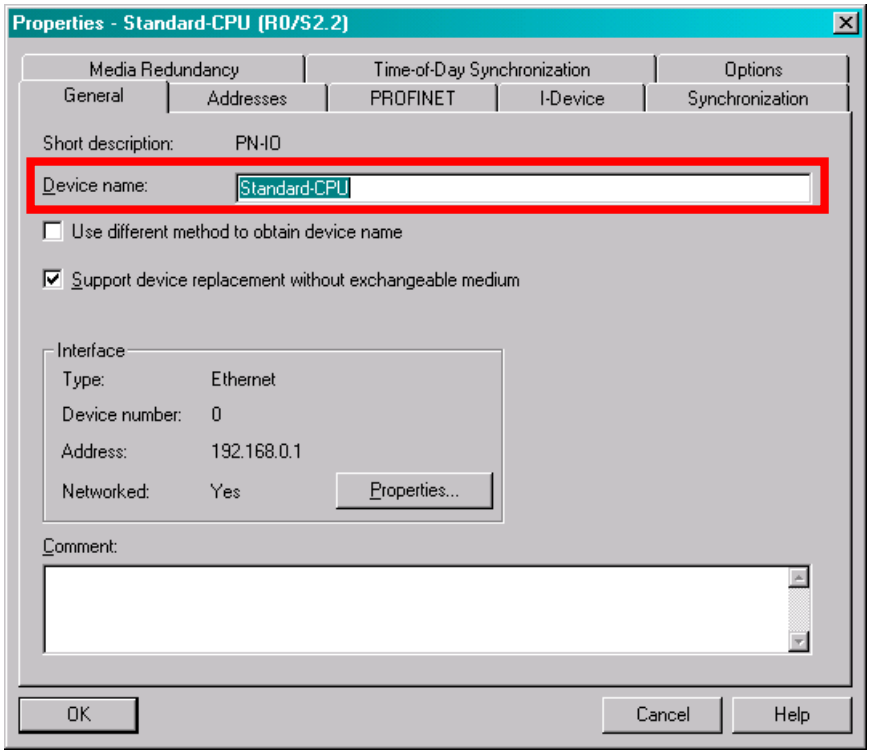
4 Configuration

4.1 HW Config of the SIMATIC Standard-CPU

In the sample project, a SIMATIC CPU 315-2 PN/DP V3.2 - which is configured as follows - is used to specify the command speeds for the drives.

Table 4-1

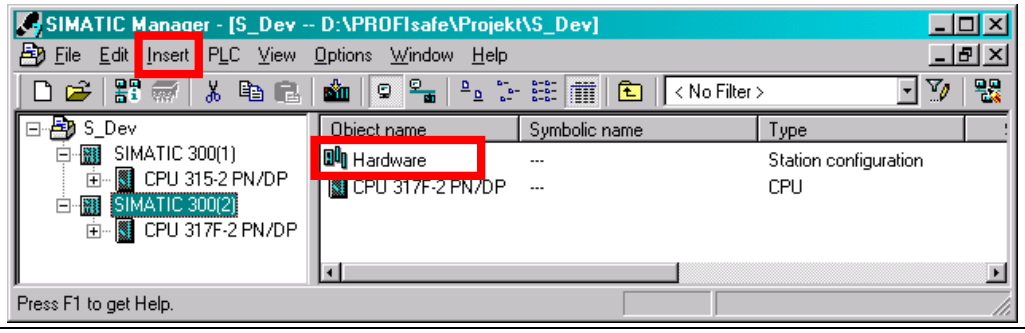
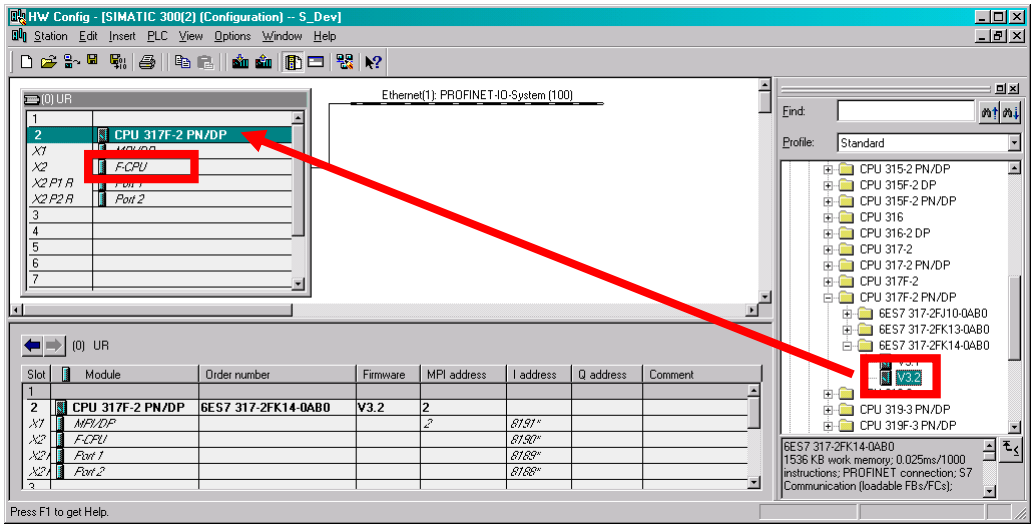
No.	Action
1.	Insert a new SIMATIC Station in the SIMATIC Manager. Open the HW Config to configure the new SIMATIC Station. 
2.	Insert a SIMATIC CPU 315-2 PN/DP V3.2 in the HW Config.  Press F4 to automatically arrange the existing modules in the HW Config.

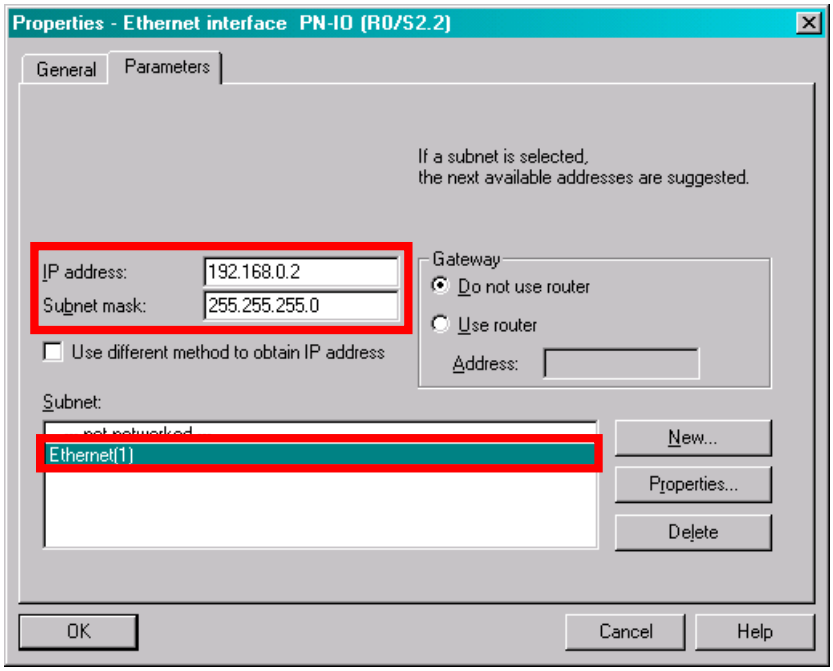
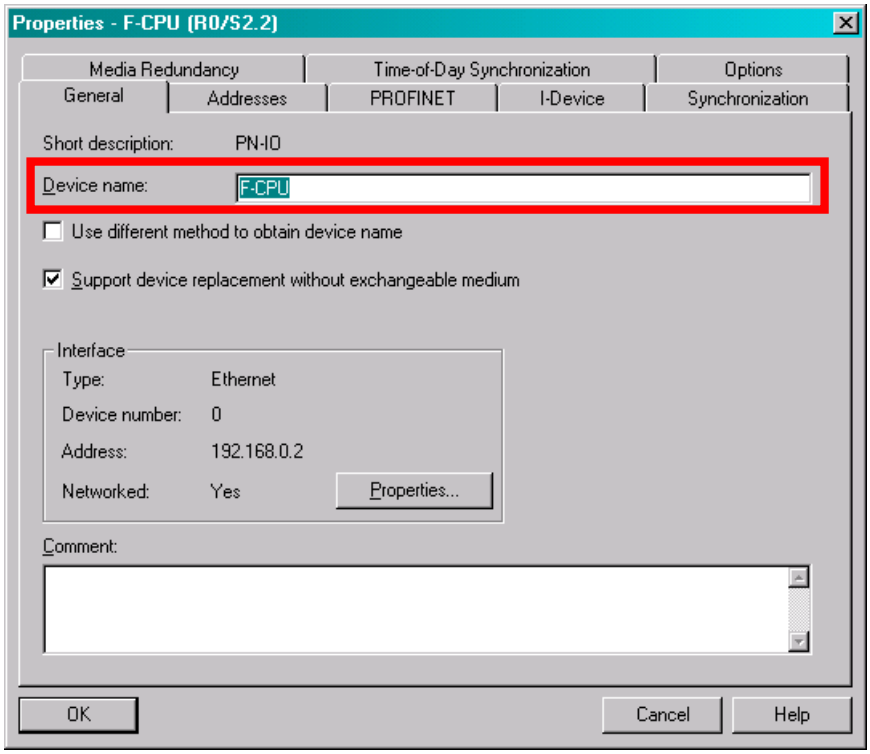
No.	Action
3.	Create a new Ethernet subnet and assign an IP address. 
4.	Double-click the PROFINET interface (see No. 2) to open the properties screen. Define the device name. In the sample project, the device name is “Standard-CPU“. The device name remanently stored on the PROFINET device must therefore be “standard-cpu“. 

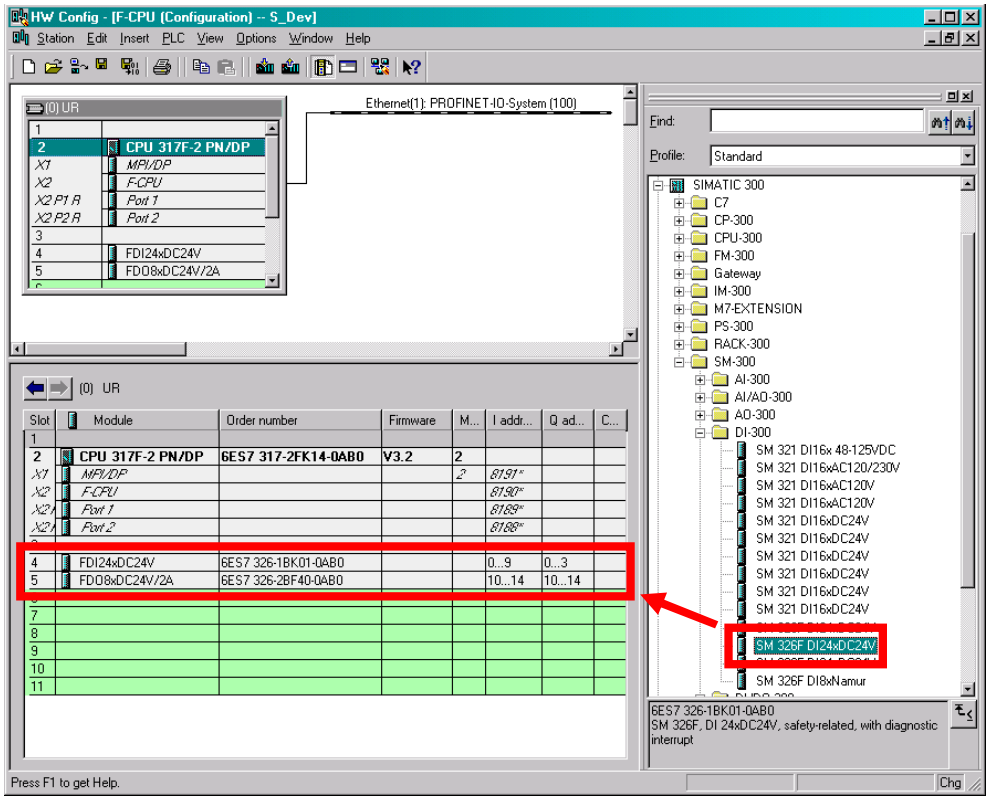
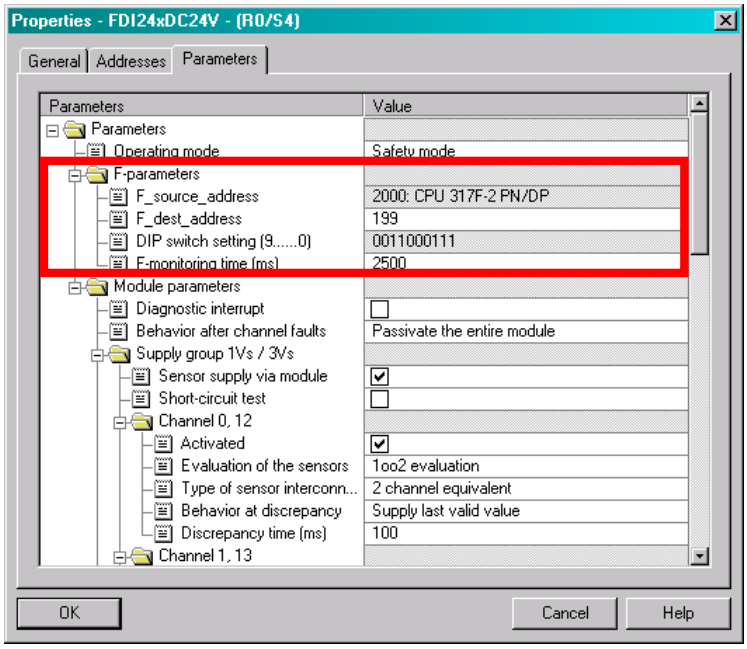
4.2 HW Config of the SIMATIC F-CPU

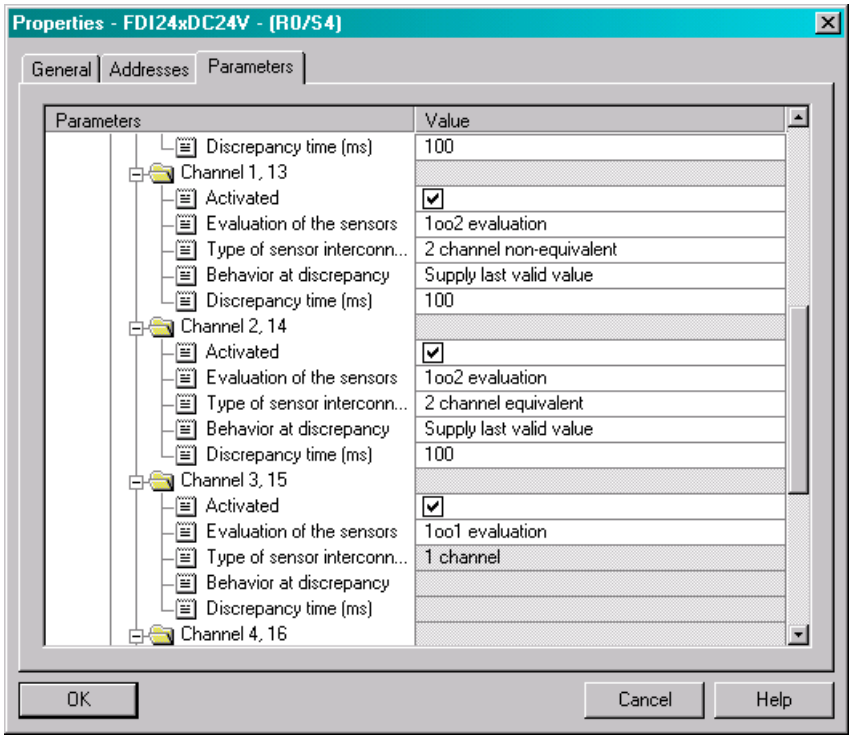
A safety training case is used to activate the safety functions in the drive. A SIMATIC CPU 317F-2 PN/DP V3.2 - which is configured as follows - is used as F-CPU.

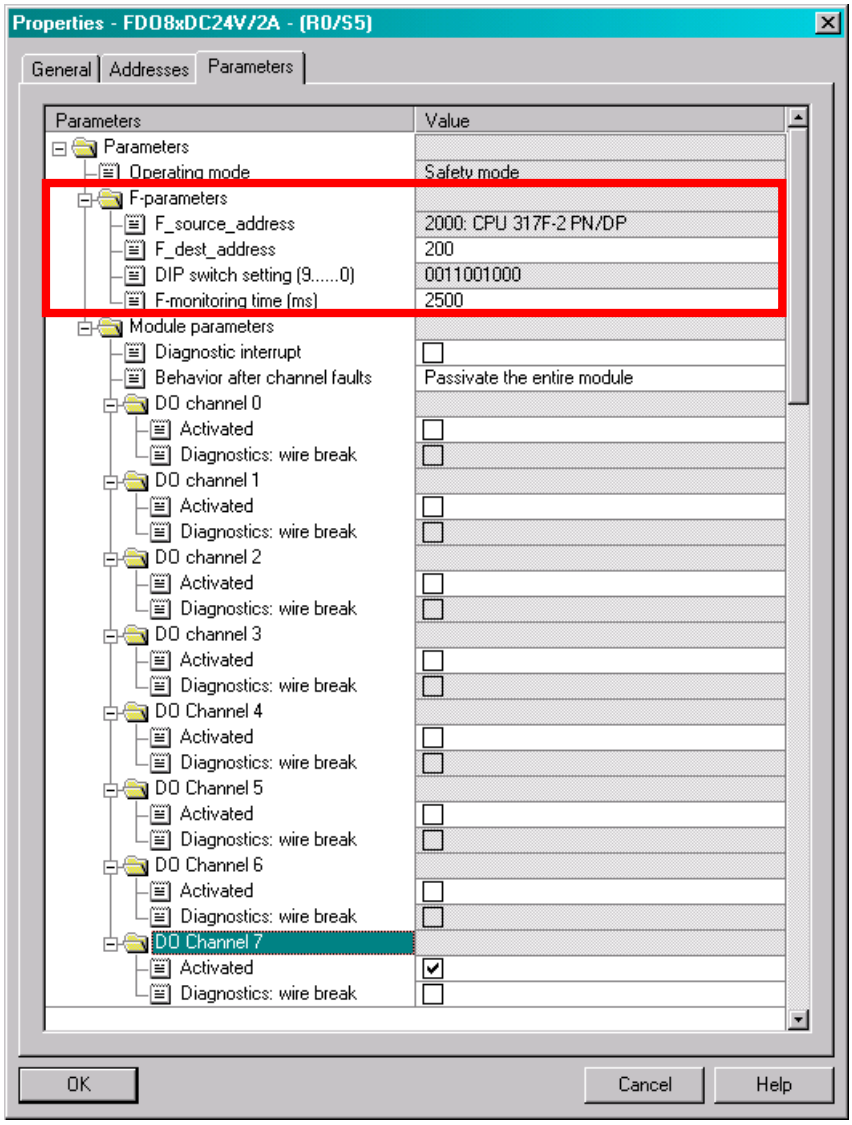
Table 4-2

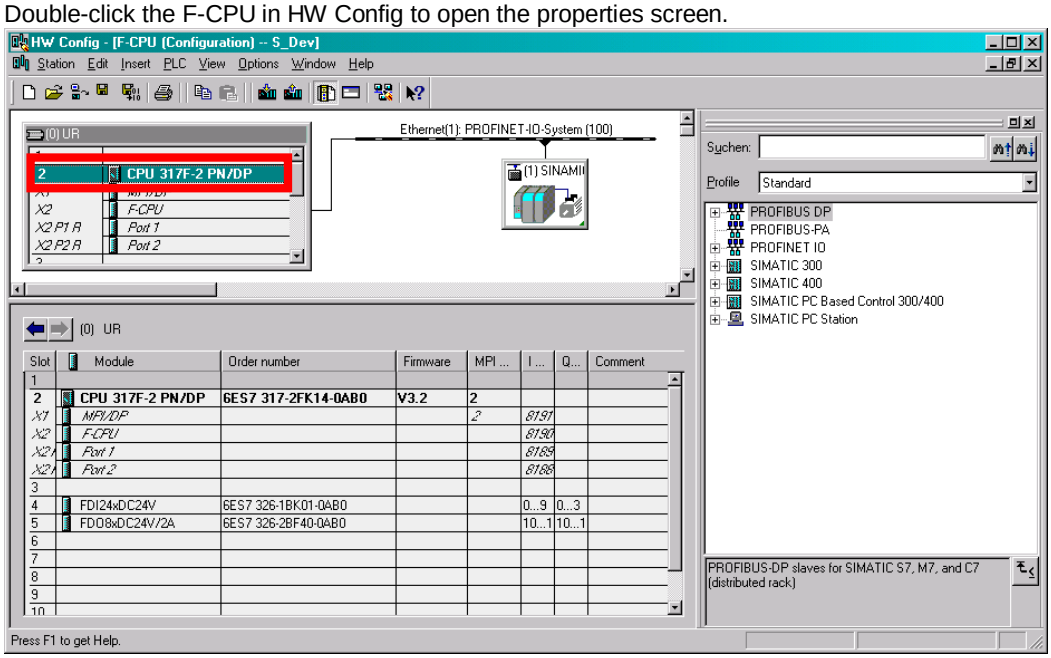
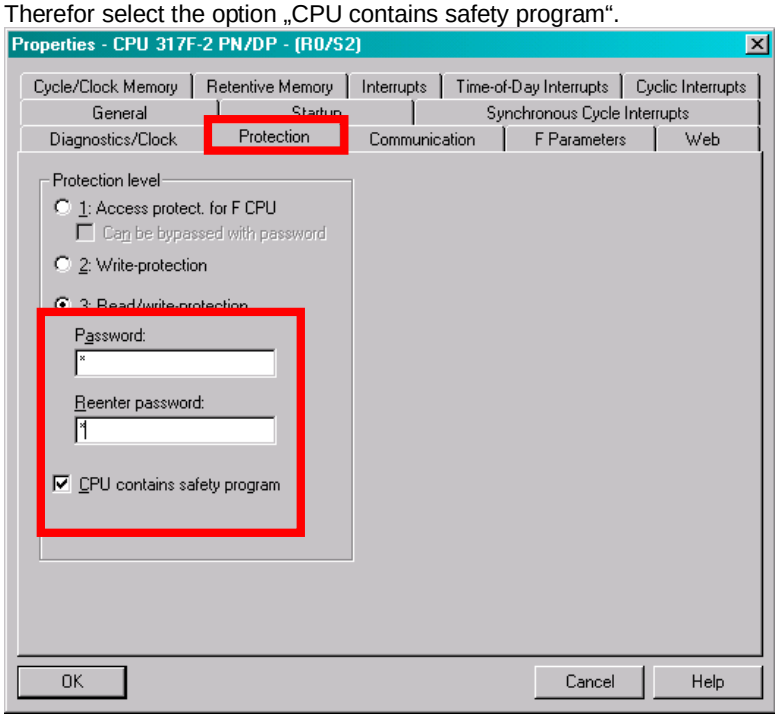
No.	Action
1.	Insert another SIMATIC Station in the SIMATIC Manager. Open the HW Config to configure the new SIMATIC station. 
2.	Insert a SIMATIC CPU 317F-2 PN/DP V3.2 in the HW Config.  Press F4 to automatically arrange the existing modules in the HW Config.

No.	Action
3.	Select the existing Ethernet subnet and assign an IP address. 
4.	Double-click the PROFINET interface (see No. 2) to open the properties screen. Define the device name. In the sample project, the device name is “F-CPU“. The device name remanently stored on PROFINET must therefore be “f-cpu“. 

No.	Action
5.	Insert the input and output modules of the safety training case. 
6.	Double-click the relevant module to open the Properties screen. In the *Parameters* tab, the safety settings are made as follows. The emergency OFF switch is connected to the *Channel 0, 12* (equivalent).  Please check whether the DIL switch position at the rear of the ET 200M modules corresponds to the configured *F_dest_address*. In the sample project, the *F_dest_address* is set to 199.

No.	Action
7.	The switch for the protective door 1 -S2 is connected to the *Channel 1, 13* (antivalent). The switch for the protective door 2 -S3 is connected to the *Channel 2, 14* (equivalent). The switch -S4 for fault acknowledgement and depassivating the safety modules is connected to the *Channel 3* (single-channel).  The remaining inputs are not used in the sample project!

No.	Action
8.	The outputs only use the *Channel 7* to actuate the signal lamp -S4.  Please check whether the DIL switch position at the rear of the ET 200M modules corresponds to the configured *F_dest_address*. In the sample project, the *F_dest_address* is set to 200.

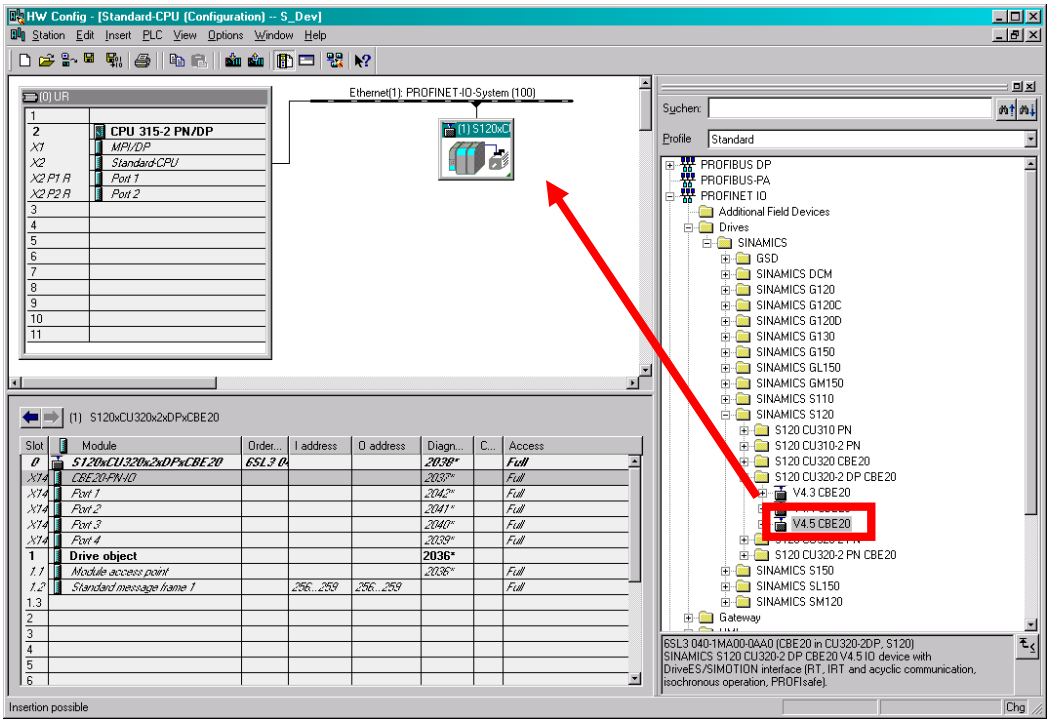
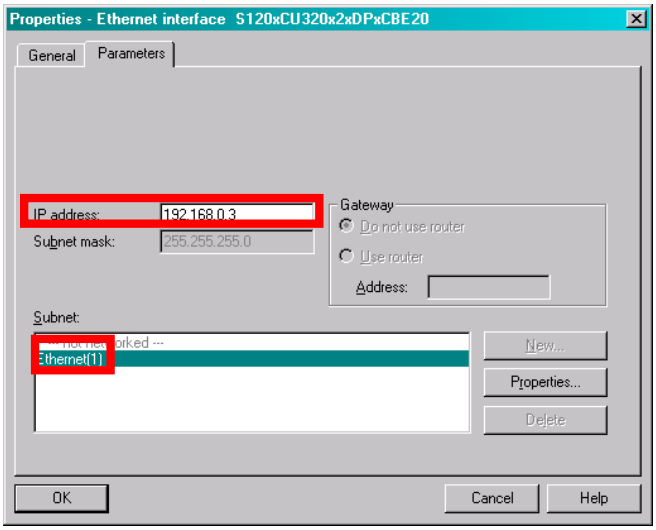
No.	Action
9.	Double-click the F-CPU in HW Config to open the properties screen. 
10.	In the *Protection* tab select the option “Read/write-protection“ and assign a new password (in application example: 1). The CPU contains the safety program to activate the safety functions in the drives. Therefor select the option „CPU contains safety program“. 
11.	Save and compile the HW Config. 

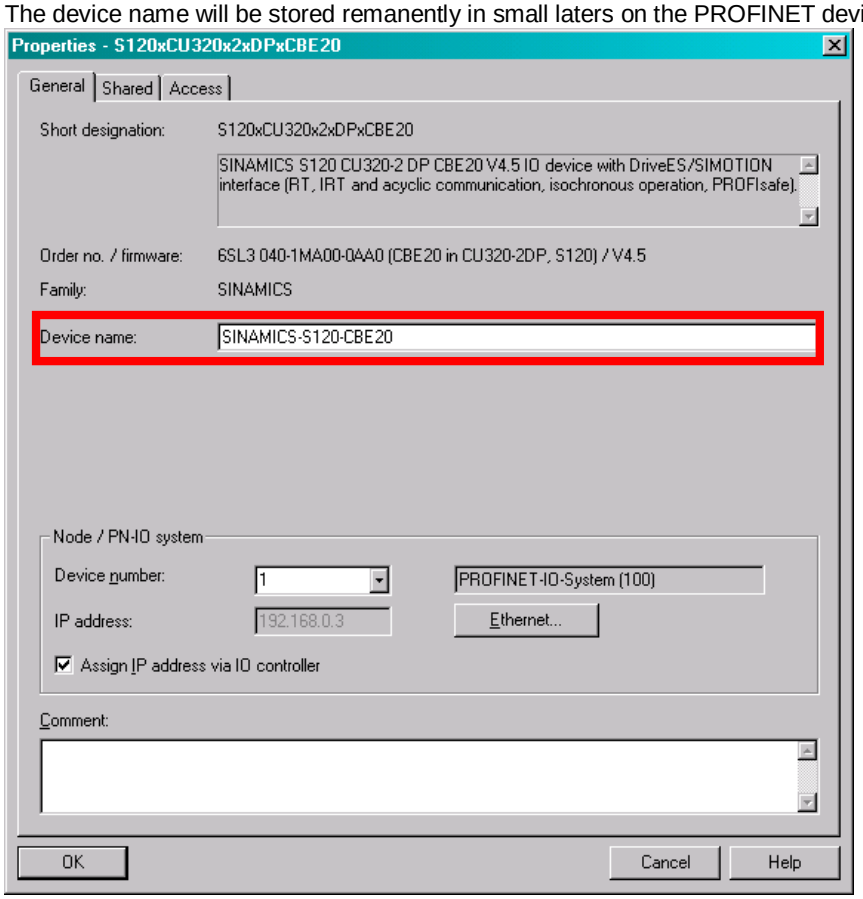
4.3 HW Config of the distributed SINAMICS drive

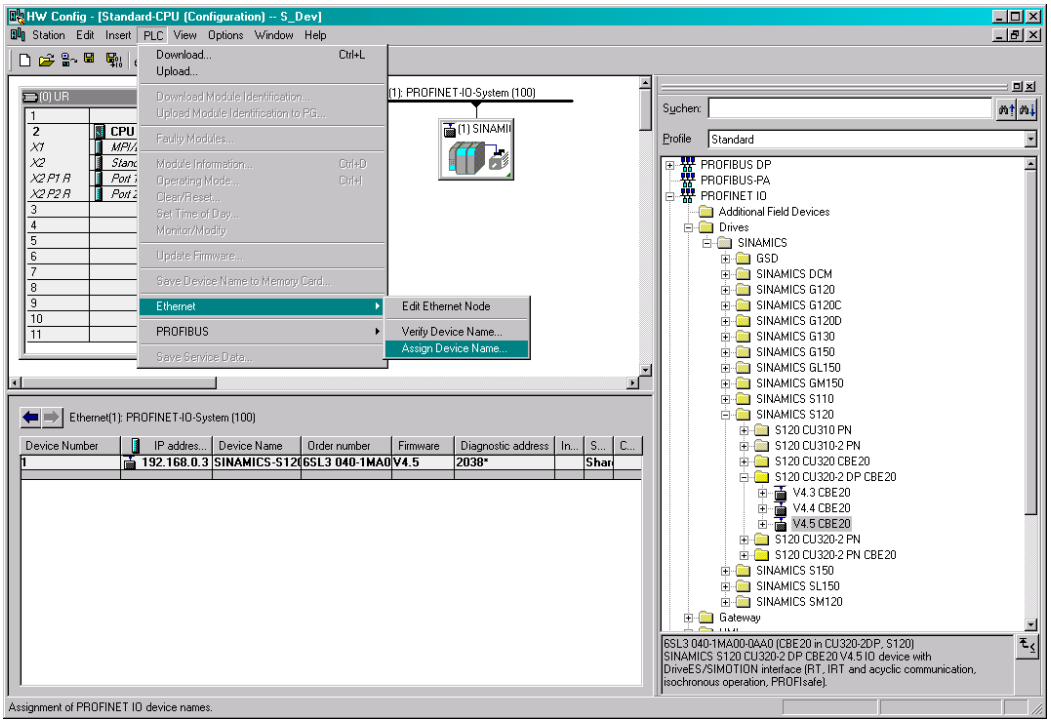
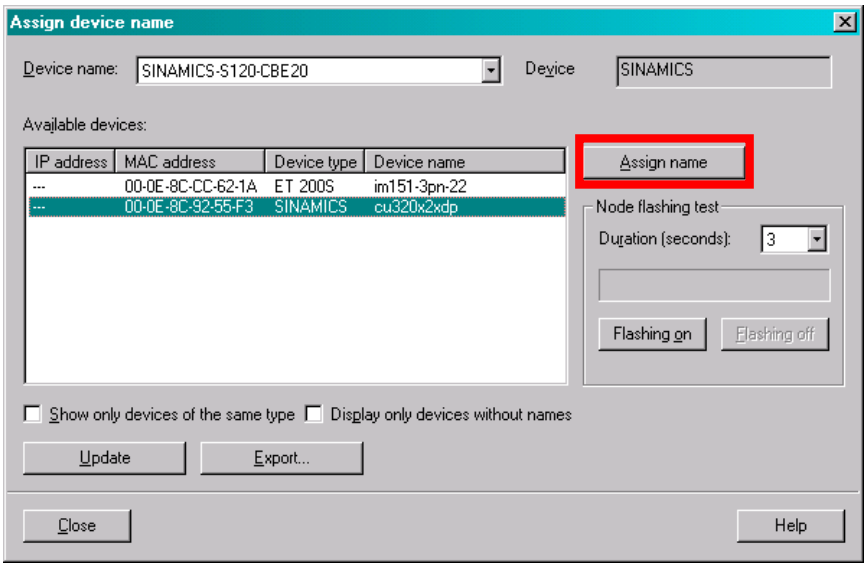
As from firmware V4.5 SINAMICS drives with the functionality **Shared Device** can be configured directly via the DeviceOM (Object Manager).

For the configuration you have to observe some rules that are shown in the following steps.

Table 4-3

No.	Action
1.	At the beginning of the **Shared Device** configuration you have to pay attention that the SINAMICS drive is inserted in the HW Config of the Standard-CPU first. Insert the CU320-2 DP + CBE20 in the HW Config of the SIMATIC CPU 315-2 PN/DP. 
2.	Select the existing subnet and assign a new IP address. 

No.	Action
3.	Open the properties of the SINAMICS drive. Define the device name “SINAMICS-S120-CBE20“. The PROFINET device has to be batized with the same device name. The device name will be stored remanently in small laters on the PROFINET device.  When ticking the checkbox “Assign IP address via IO-Controller“, the configured IP address 192.168.0.3 is assigned to the SINAMICS device during the startup. For this, the SINAMICS device (IO-Device) must be connected to the IO-Controller.

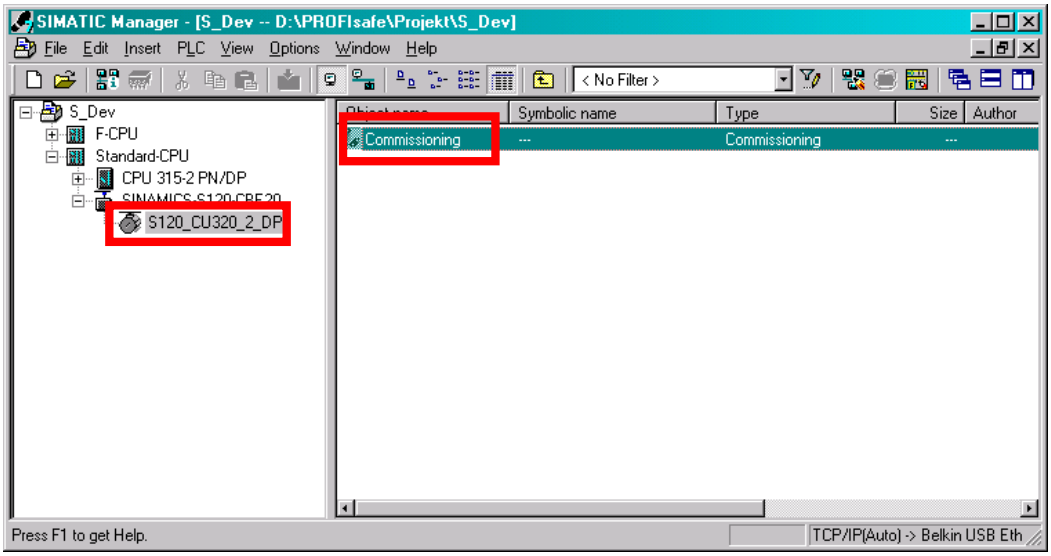
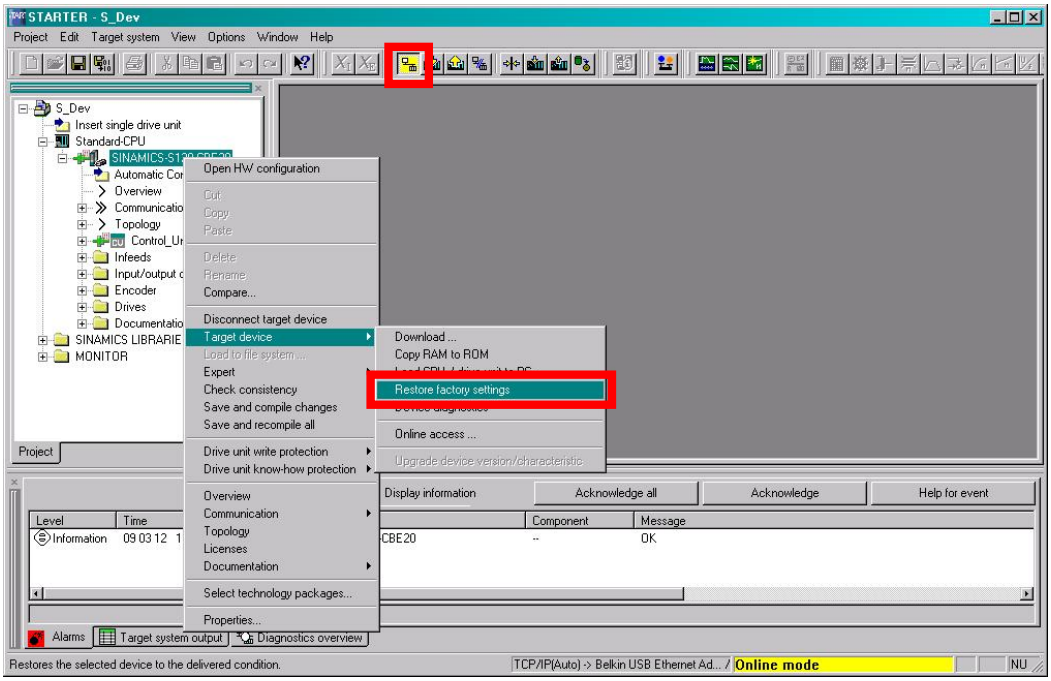
No.	Action
4.	The device name has to be assigned to the SINAMICS drive afterwards. Therefor select the PROFINET IO-system. Open the screen for assigning the device name via *PLC > Ethernet > Assign Device Name*. 
5.	To assign the name you have configured in the HW Config select the SINAMICS drive and click on the button *Assign name*. 
6.	Save and compile the HW Config. 

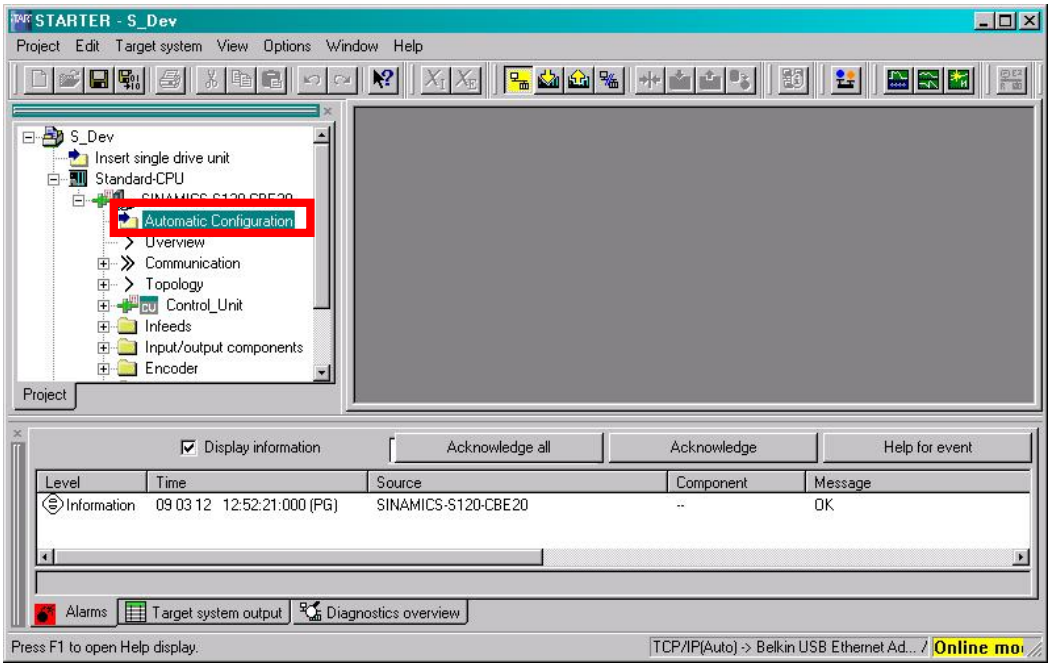
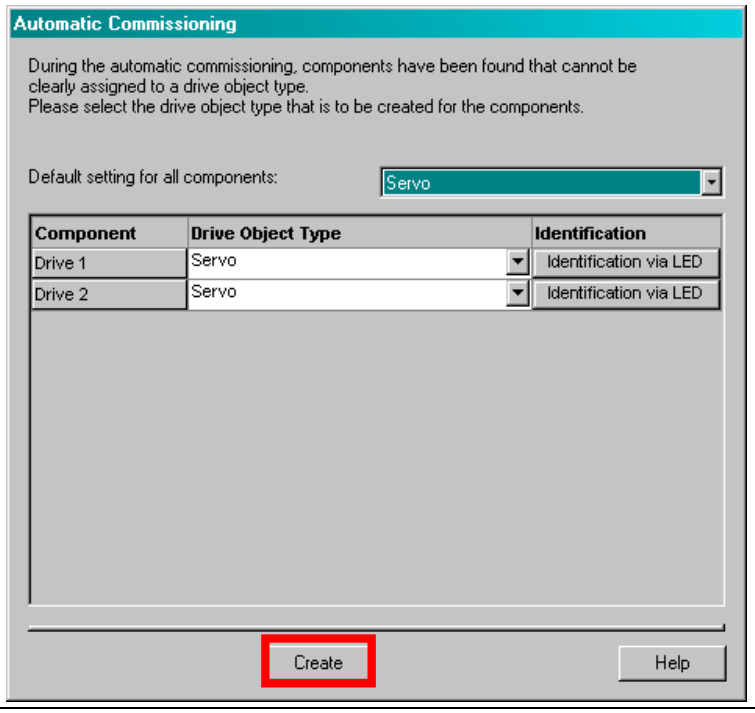
4.4 Configuring the distributed SINAMICS drive

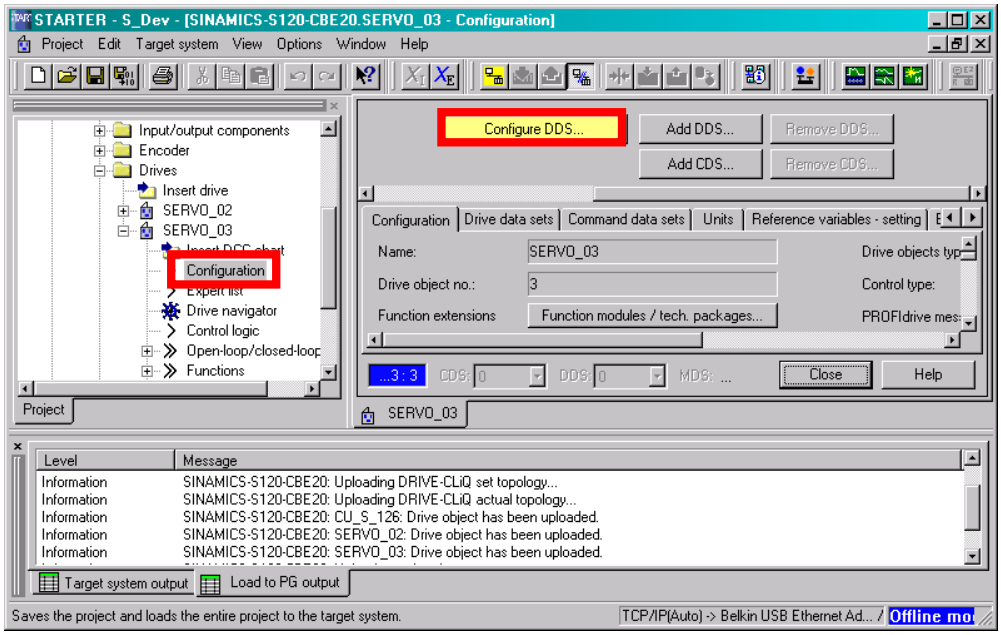
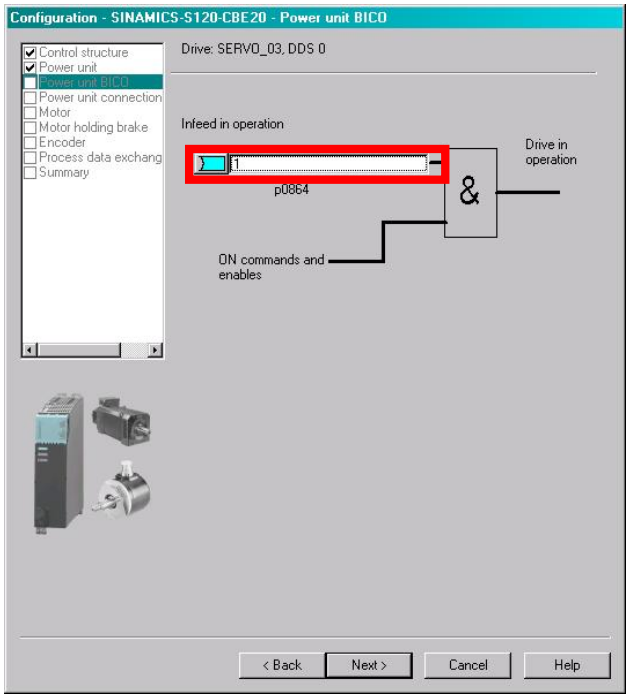
Before inserting the SINAMICS drive as **Shared Device** in HW Config of the F-CPU the configuration of the telegrams in STARTER respectively HW Config has to be finished.

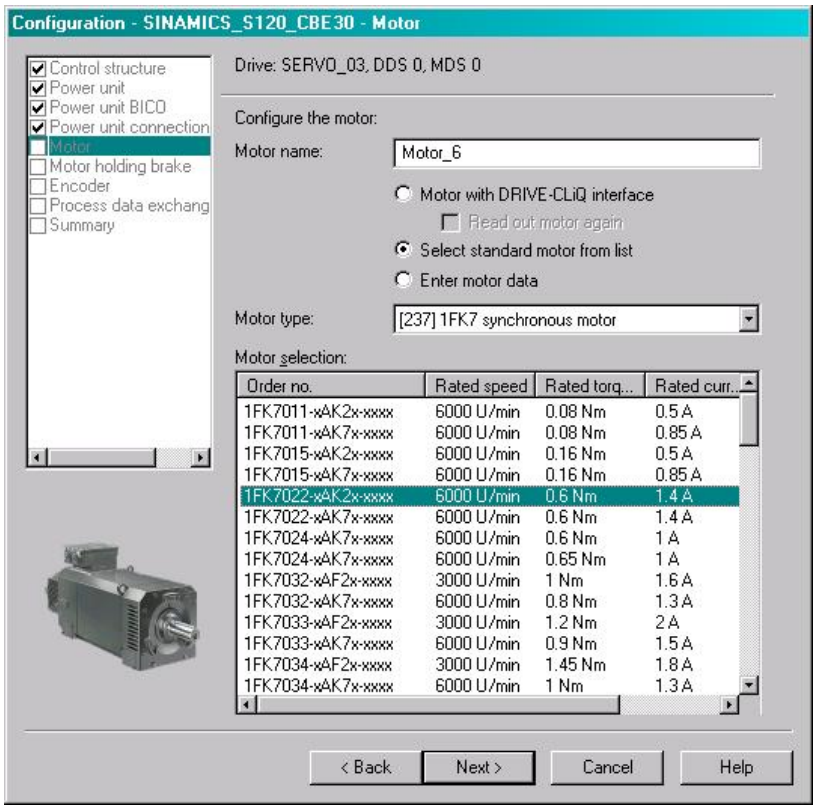
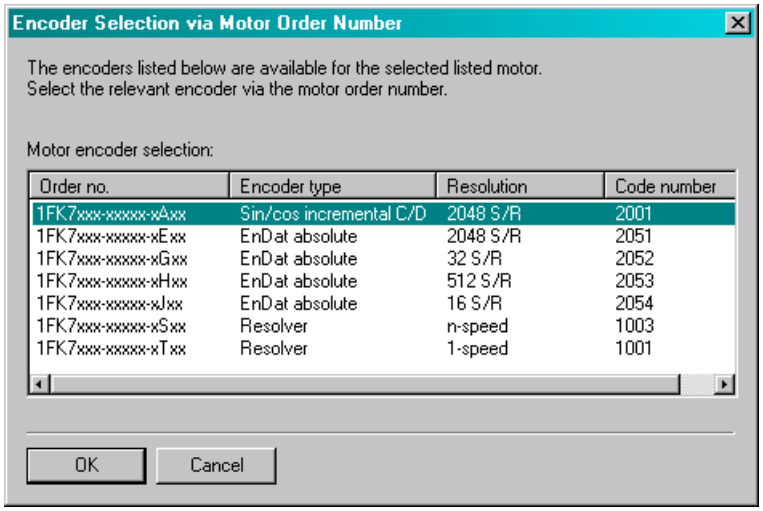
In the following the configuration of the SINAMICS drive with the STARTER engineering system is shown.

Table 4-4

No.	Action
1.	Open the actual project in the STARTER engineering system. 
2.	Establish an online connection to the SINAMICS drive and restore the factory settings. 

No.	Action
3.	Perform the automatic drive configuration. 
4.	The SIMOTION training case has two SERVO engines. 

No.	Action
5.	On the SIMOTION training case the blue drive (SERVO_03) must be reconfigured after performing the automatic configuration because this is not equipped with a DRIVE-CliQ interface. a) Go offline.  b) Open the drive configuration (all screens which are not displayed can be skipped).  c) Connect the release for the infeed (p0864) to the fixed binector 1. 

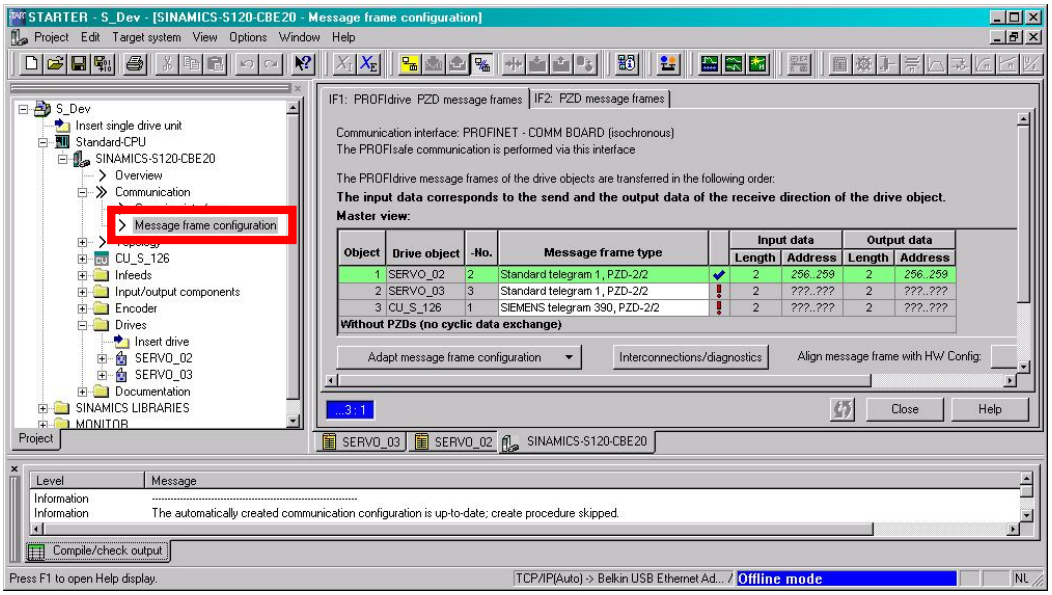
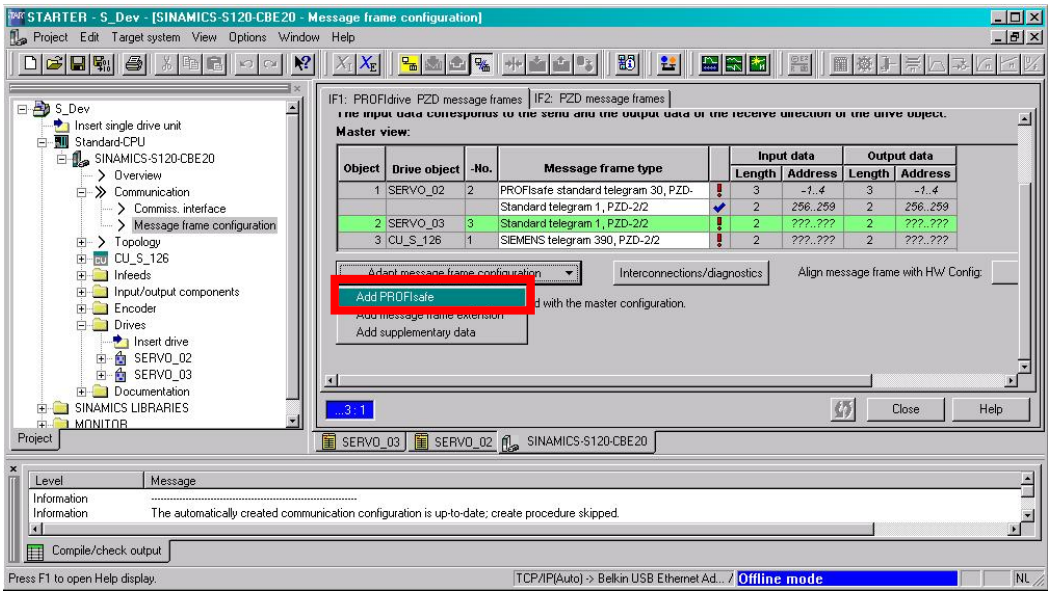
No.	Action
6.	d) Select the correct motor type without DRIVE-CLiQ interface.  e) Further, you have to select the encoder type. 

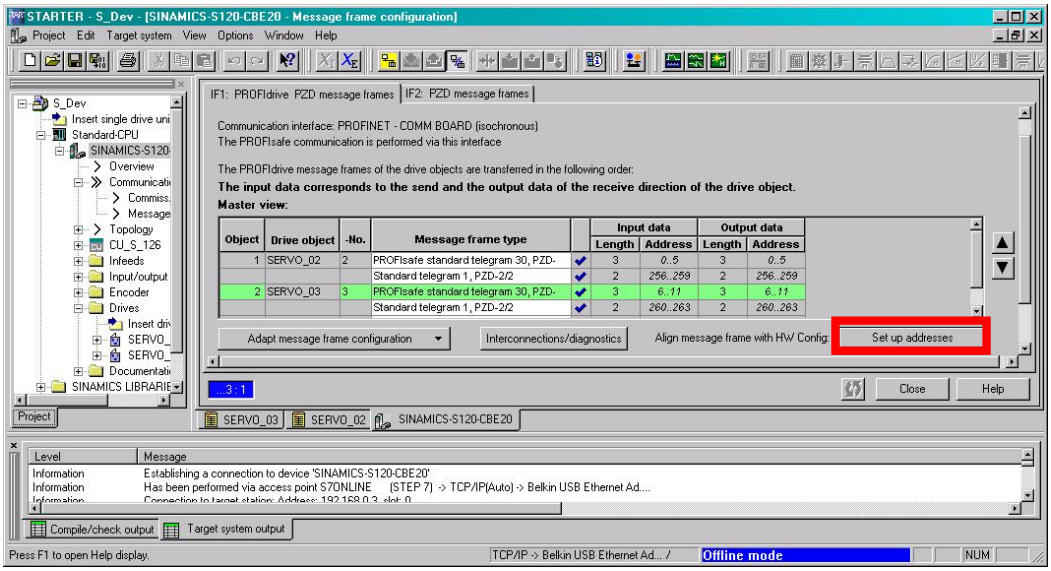
<table>
<tr><th>No.</th><th>Action</th></tr>
<tr><td>7.</td><td>f) Store your settings.
 
g) Go online.
 
h) Perform a download.
 
i) Copy RAM to ROM.
  </td></tr>
<tr><td>8.</td><td>The following parameters of both drives (SERVO_02 + SERVO_03) must be checked after the automatic configuration. For this, open the expert list.

<table>
<tr><th>Parameter</th><th>Description</th><th>Value</th></tr>
<tr><td>p0340</td><td>Complete calculation</td><td>0</td></tr>
<tr><td>p0210</td><td>Supply voltage</td><td>345 V</td></tr>
<tr><td>p0864</td><td>Infeed in operation</td><td>1</td></tr>
<tr><td>p1244[0]</td><td>Upper voltage limit for the dc link</td><td>401 V</td></tr>
<tr><td>p1248[0]</td><td>Lower voltage limit for the dc link</td><td>240 V</td></tr>
<tr><td>p1460[0]</td><td>P-share for the speed controller (in the sample project)</td><td>0.01 Nms/rad</td></tr>
<tr><td>p1462[0]</td><td>Reset time for the speed controller (in the sample project)</td><td>20 ms</td></tr>
</table></td></tr>
<tr><td>9.</td><td>Depending on whether you are working offline or online, save your changes by copying RAM to ROM, and load the online data in your offline project. Save your data to enter the uploaded data in the offline project.</td></tr>
</table>

NOTE Further information about the configuration of the SINAMICS training case is included in the following article:

http://support.automation.siemens.com/WW/view/en/27038754

No.	Action
10.	For the cyclic communication between SERVO and Standard-CPU you have to choose a telegram. In the application example standard telegram 1 is used. Create the telegrams for both SERVOs. 
11.	For activating the drive internal safety functions *PROFIsafe telegram 30 (PZD-3/3)* is used. Select SERVO_02 respectively SERVO_03 and insert the telegram via *Adapt message frame configuration > Add PROFsafe*. 

No.	Action
12.	Afterwards adapt the message frame configuration with HW Config. The correct adaption with HW Config is signalized through blue check marks behind the telegrams. 
13.	Save the settings of the project and exit afterwards the STARTER engineering system. 

NOTE

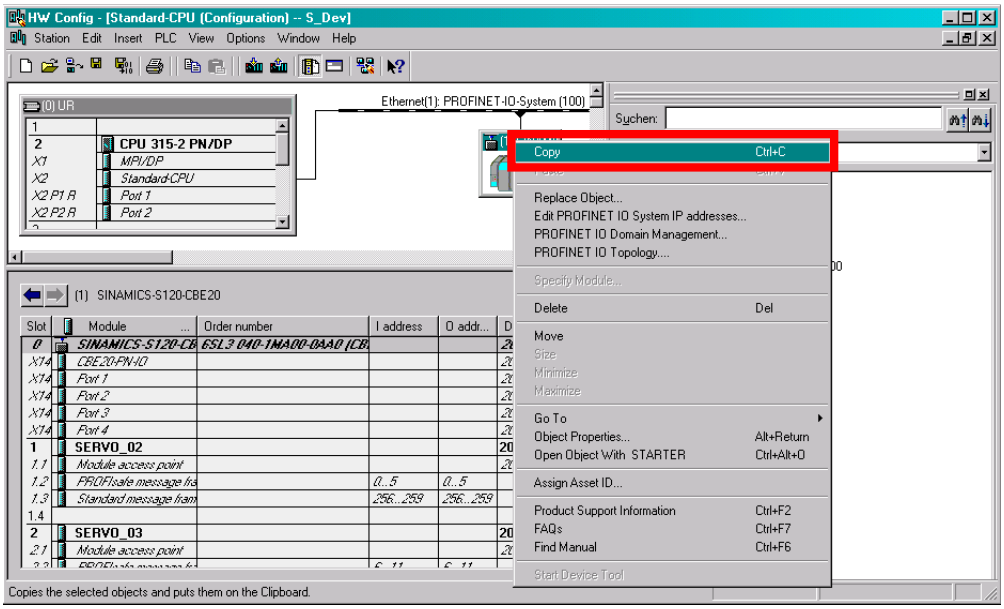
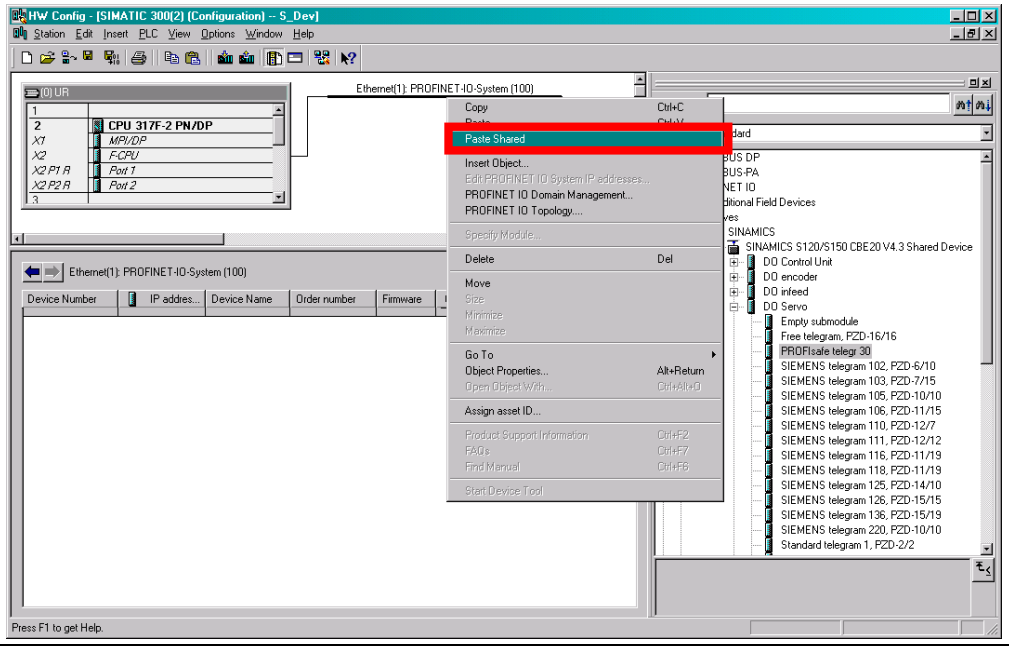
To ensure the **Shared Device** functionality the following telegram order has to be followed!

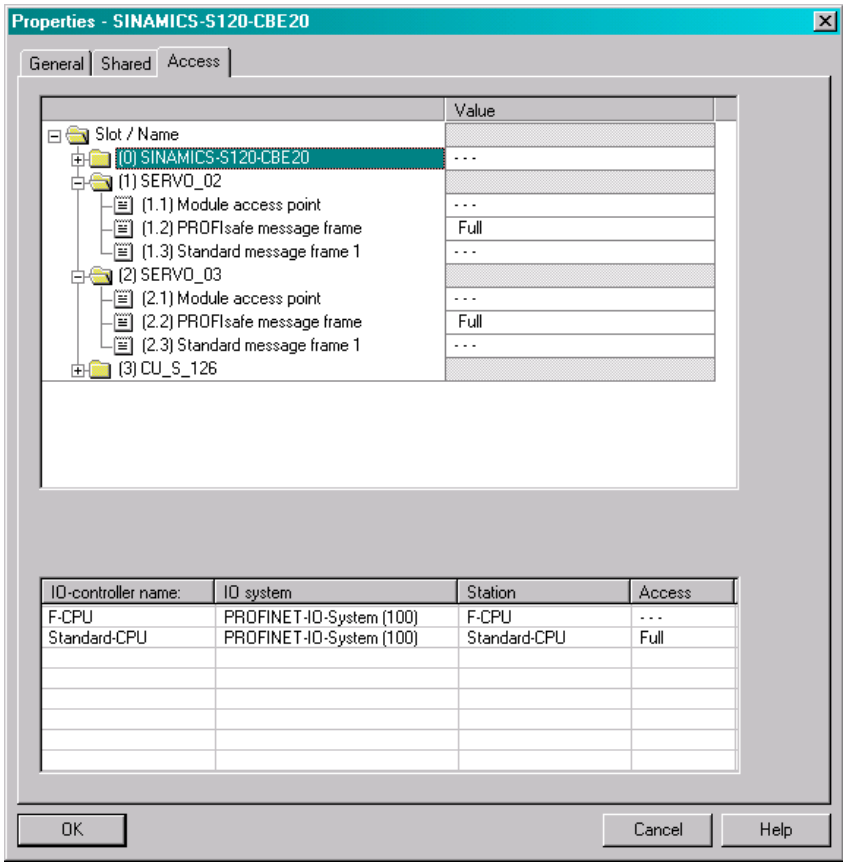
First of all create the telegrams of all SERVOs, then the telegram for the infeed (when needed) and afterwards the telegram for the Control Unit.

4.5 HW Config of the distributed SINAMICS drive as Shared Device

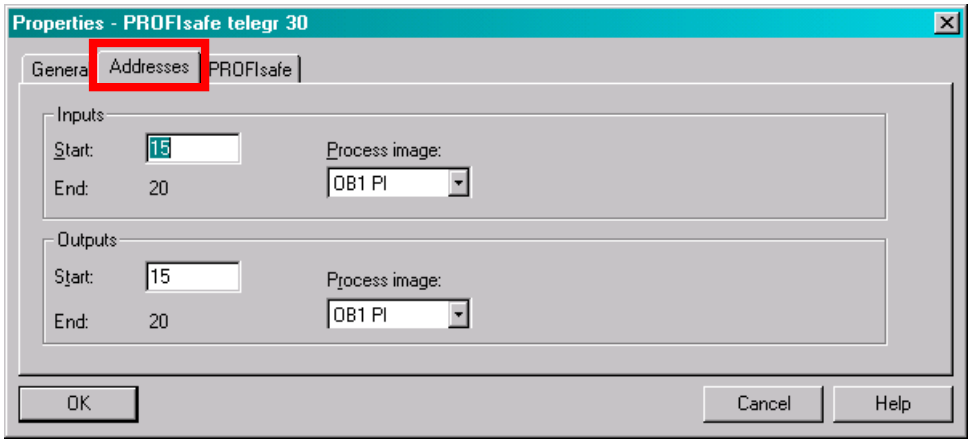
After the SINAMICS drive is successfully configured and compiled it can be copied in the HW Config (right mouse button → *Copy*) and inserted as **Shared Device** in the HW Config of the second IO-Controller.

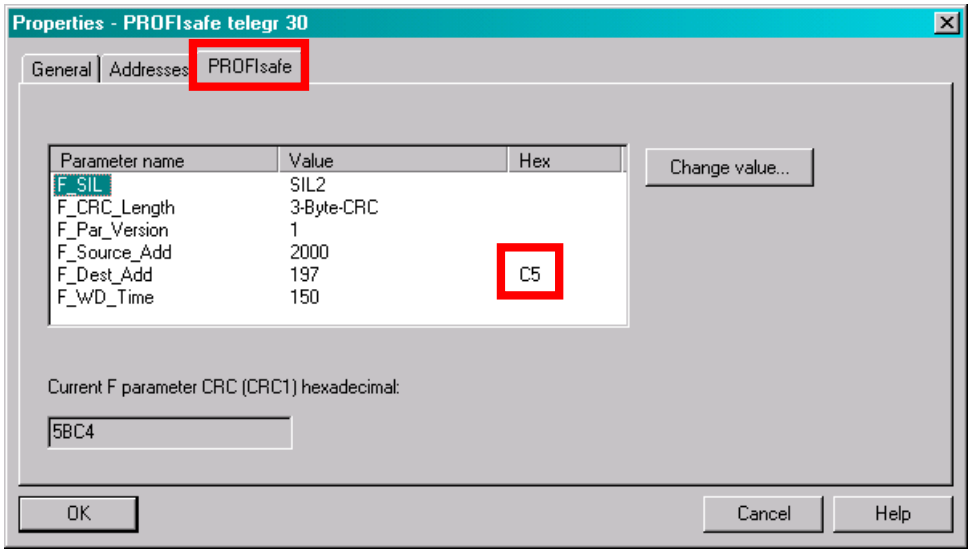
Table 4-5

No.	Action
1.	Open the HW Config of the Standard-CPU and copy the SINAMICS drive. 
2.	Insert the SINAMICS drive as **Shared Device** in the HW Config of the F-CPU by marking the Ethernet subnet and clicking with the right mouse button → *Paste Shared.* 

No.	Action
3.	There are two ways to set the access to the individual submodules (e.g. PROFIsafe telegram 30) (see also No. 4). The F-CPU needs full access to both PROFIsafe telegrams. Mark the relevant submodule → Right mouse button → *Change Access* → *Full Access*. On the other IO-Controller, the access modes are automatically adjusted!
4.	Alternatively, you can select the access mode for the individual submodules station-wide by double-clicking the station under the *Access* tab. The figure shows the HW Config for the SIMATIC CPU 317F-2 PN/DP.  On the other IO-Controller, the access modes are automatically adjusted!

<table>
<tr><th>No.</th><th>Action</th></tr>
<tr><td>5.</td><td>
Double-click the PROFIsafe telegram 30 to open the properties screen.
Under the Addresses tab, the logic addresses are defined to activate the drive internal safety functions.
The F_Des_Add is later required for the drive configuration.

The following addresses are used in the sample project.
<table>
<tr><th rowspan="2">Axis</th><th colspan="2">Logic address (addresses)</th><th rowspan="2">F_Dest_Add</th></tr>
<tr><th>Inputs</th><th>Outputs</th></tr>
<tr><td>SERVO_02 (red)</td><td>Byte 15…20</td><td>Byte 15…20</td><td>$C5_{hex}$</td></tr>
<tr><td>SERVO_03 (blue)</td><td>Byte 21…26</td><td>Byte 21…26</td><td>$C6_{hex}$</td></tr>
</table>




When activating the drive internal safety functions via PROFIsafe, the set F_Dest_Add (hex) must correspond to the PROFIsafe address in the STARTER (see Section 4.8, No. 2).
</td></tr>
<tr><td>6.</td><td>Save and compile the HW Config of the F-CPU as well as the HW Config of the Standard-CPU. The project afterwards is consitent.</td></tr>
</table>

NOTE

PROFIsafe telegrams can only be assigned to the F-CPU!

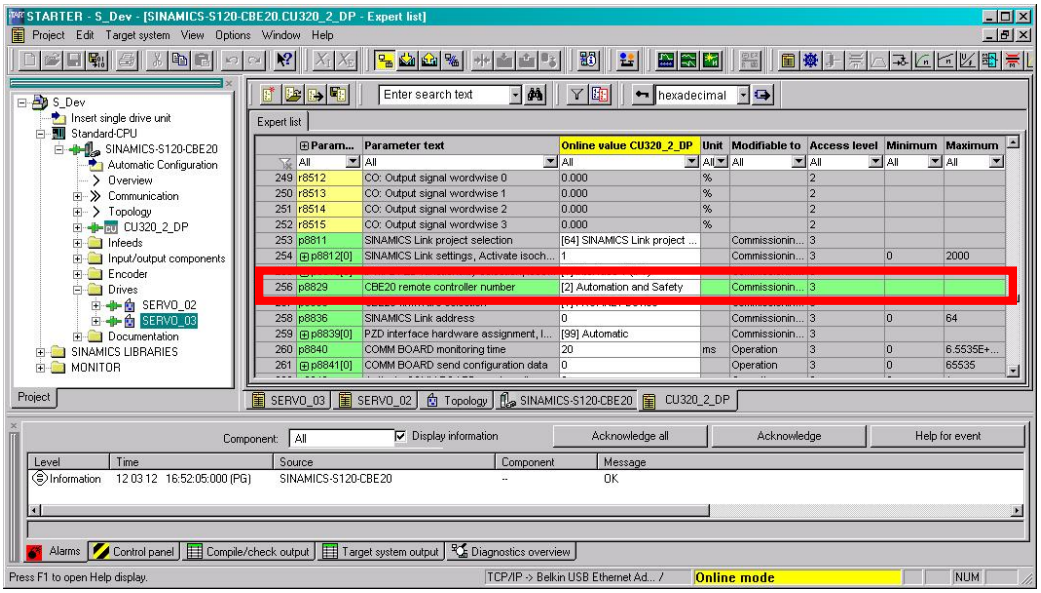
Changes in the STARTER engineering system can only be done if they have no effect on the telegram structure, after the configured SINAMICS drive is inserted in the HW Config of the F-CPU as **Shared Device.** Changing the telegrams (type of telegram, etc.) is not possible anymore!

Therefor you have change the access of all telegrams in the HW Config of the Standard-CPU to *Full Access*. Delete the SINAMICS drive in the HW Config of the F-CPU and save both stations. Afterwards you can adapt the telegrams again.

After adapting the telegrams the SINAMICS drive has to be inserted in the HW Config of the F-CPU again as **Shared Device**.

4.6 Configuring the SINAMICS drive as Shared Device

Table 4-6

No.	Action
1.	If the drive shall act as **Shared Device**, set the parameter p8829 (only with CBE20) in the Control Unit CU320-2 DP to *2 = "Automation and Safety"*. For this, the parameter p9 must be set to *1 = "Device configuration"*.  **Note** On the CU320-2 PN, the parameter p8929 for the onboard PN interface X150 must be set to *2 = "Automation and Safety"*.

4.7 Activating the drive internal safety functions

In order to activate the drive internal safety functions, the safety training case includes a switchbox with a emergency OFF switch -S1, two rotary switches -S2 and -S3, as well as a switch -S4. These switches are connected to the failsafe input module *SM 326F DI24xDC24V*.

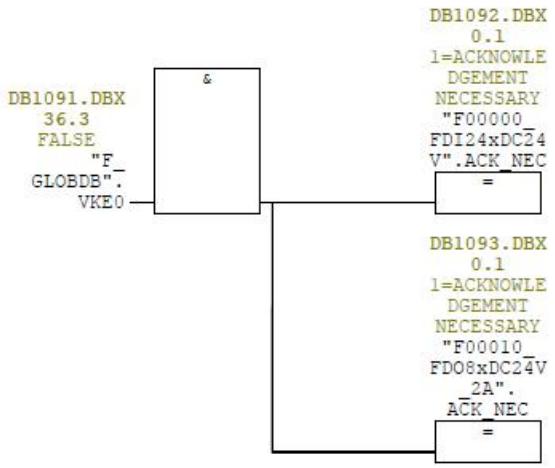
The application example uses a FC1 (F-CALL) which is called in the OB35 (50 ms). The FC1 defines the F-runtime group in which the FB1 (F-Program) is called up. The FB1 includes the safety program and is described in the following.

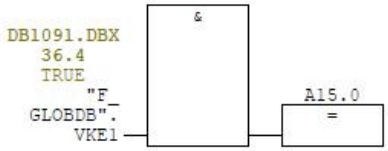
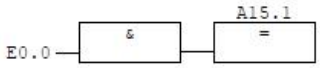
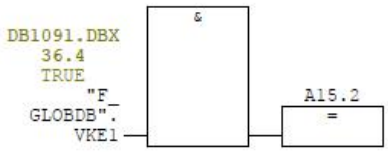
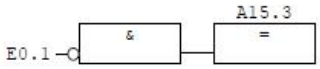
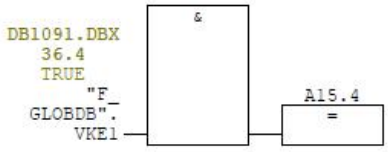
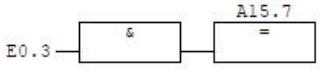
The comment in the safety program refers to the following axes.

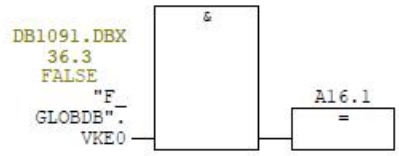
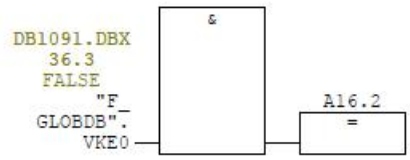
Table 4-7

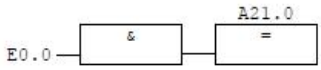
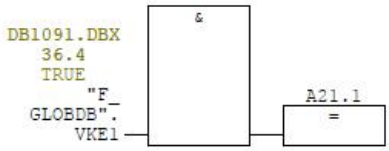
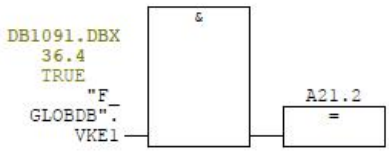
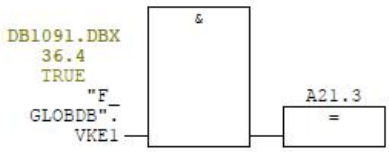
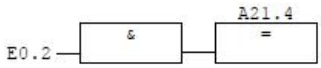
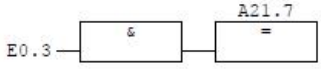
Comment	Axis
Drive 1	SERVO_02 (red)
Drive 2	SERVO_03 (blue)

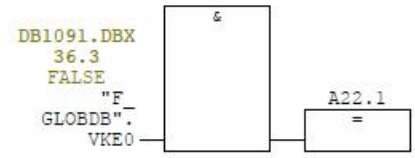
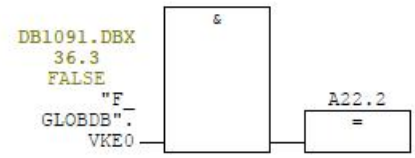
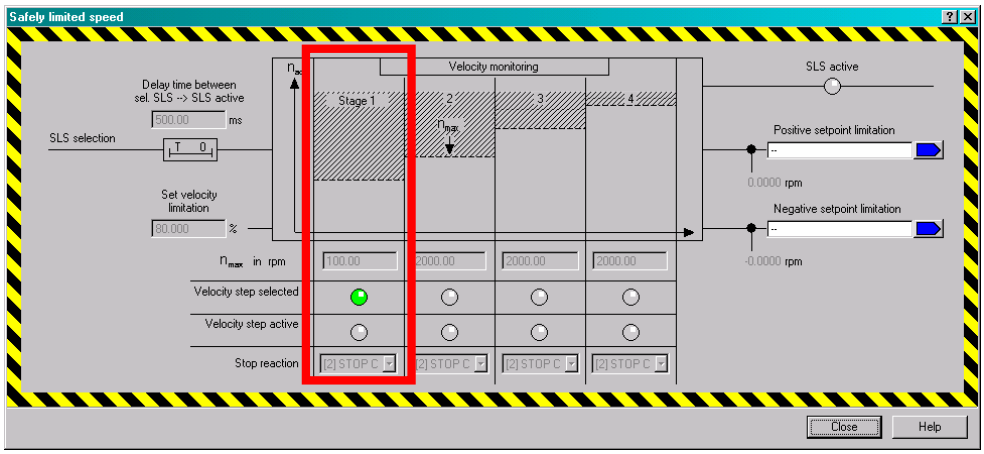
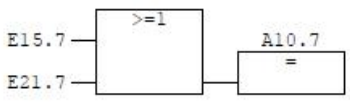
Table 4-8

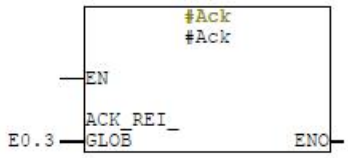
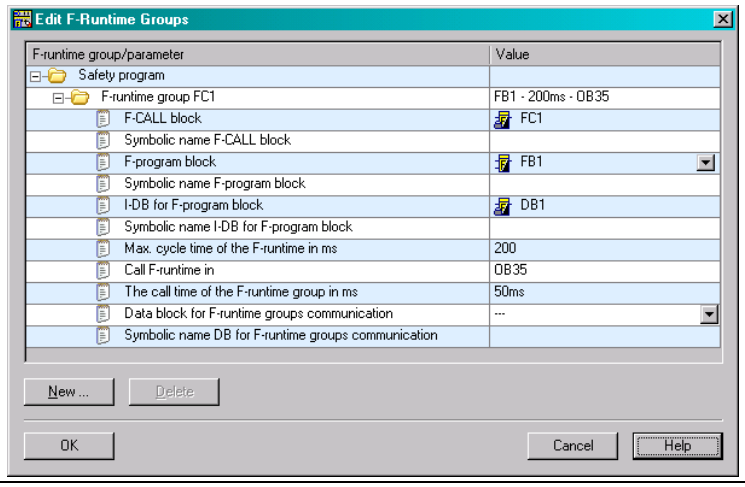
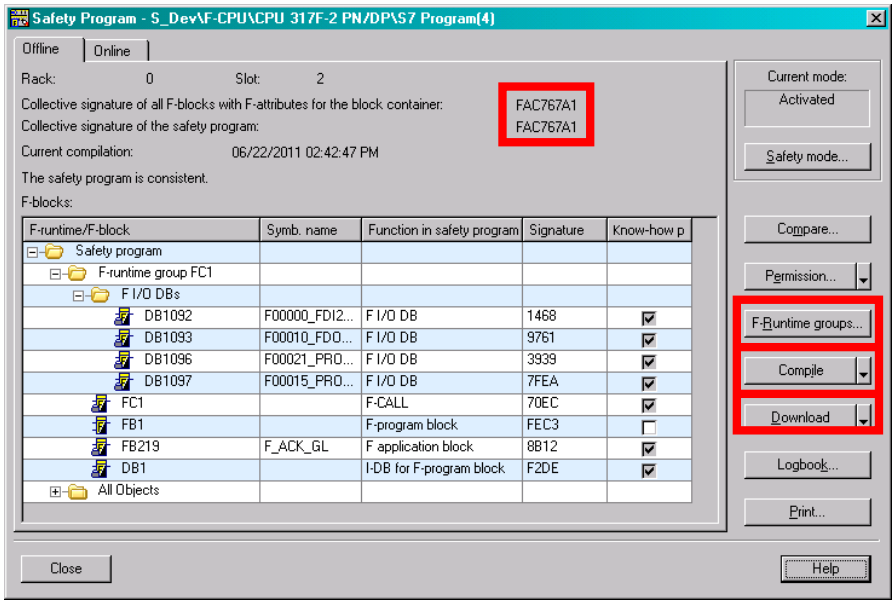
No.	Action
1.	Block: FB1 Failsafe PLC program This program mainly forwards the signals received at the F-DI module to the PROFIsafe telegram. Network: 1 1=ACKNOWLEDGEMENT NECESSARY With the setting of ACK_NEC=0 the reintegration will be done automatically (exception communication faults).  The failsafe modules *SM 326F DI24xDC24V* and *SM 326F DO8xDC24V/2A* are automatically depassivated by the setting *ACK_NEC = 0*.

No.	Action
2.	Network: 2 PROFIsafe drive 1 STO With safe VKE1, STO at drive 1 is deactivated permanently.  Network: 3 PROFIsafe drive 1 SS1 Activate SS1 at drive 1 with e-stop -S1.  Network: 4 PROFIsafe drive 1 SS2 With safe VKE1, SS2 at drive 1 is deactivated permanently.  Network: 5 PROFIsafe drive 1 SOS Activate SOS at drive 1 with -S2. Inverting is necessary because -S2 will be handled as NO (normaly open) contact.  Network: 6 PROFIsafe drive 1 SLS With safe VKE1, SLS at drive 1 is deactivated permanently.  Network: 7 PROFIsafe drive 1 acknowledgement Acknowledgement of drive 1 with -S4.  The drive internal safety functions are activated via the PROFIsafe control word. • Bit 1 (SS1) is connected to the digital input E0.0 (emergency OFF switch -S1). • Bit 3 (SOS) is connected to the digital input E0.1 (protective door -S2, inverted. • Bit 7 (ACK) is connected to the digital input E0.3 (acknowledgement button). The bits for the unused safety functions require a failsafe high signal.

No.	Action
3.	Network: 8 PROFIsafe drive 1 SLS velocity step Bit 0 With safe VKE0, SLS velocity step Bit 0 is activate permanently.  Network: 9 PROFIsafe drive 1 SLS velocity step Bit 1 With safe VKE0, SLS velocity step Bit 1 is activate permanently.  The speed level for the safety function SLS is controlled by the bits 9 and 10 in the PROFIsafe control word. As the bit 4 (SLS) is connected to the failsafe high signal, the safety function SLS is not used at the red axis. The connection of these two bits has therefore no importance. The remaining outputs for the PROFIsafe control word (S_STW1) are reserved and need not be connected.

No.	Action
4.	Network: 10 PROFIsafe drive 2 STO Activate STO at drive 2 with e-stop -S1.  Network: 11 PROFIsafe drive 2 SS1 With safe VKE1, SS1 at drive 2 is deactivated permanently.  Network: 12 PROFIsafe drive 2 SS2 With safe VKE1, SS2 at drive 2 is deactivated permanently.  Network: 13 PROFIsafe drive 2 SOS With safe VKE1, SOS at drive 2 is deactivated permanently.  Network: 14 PROFIsafe drive 2 SLS Activate SLS at drive 2 with -S3.  Network: 15 PROFIsafe drive 2 acknowledgement Acknowledgement of drive 2 with -S4.  The drive internal safety functions are activated via the PROFIsafe control word. • Bit 0 (STO) is connected to the digital input E0.0 (emergency OFF switch -S1). • Bit 4 (SLS) is connected to the digital input E0.2 (protective door -S3). • Bit 7 (ACK) is connected to the digital input E0.3 (acknowledgement button). The bits for the unused safety functions require a failsafe high signal.

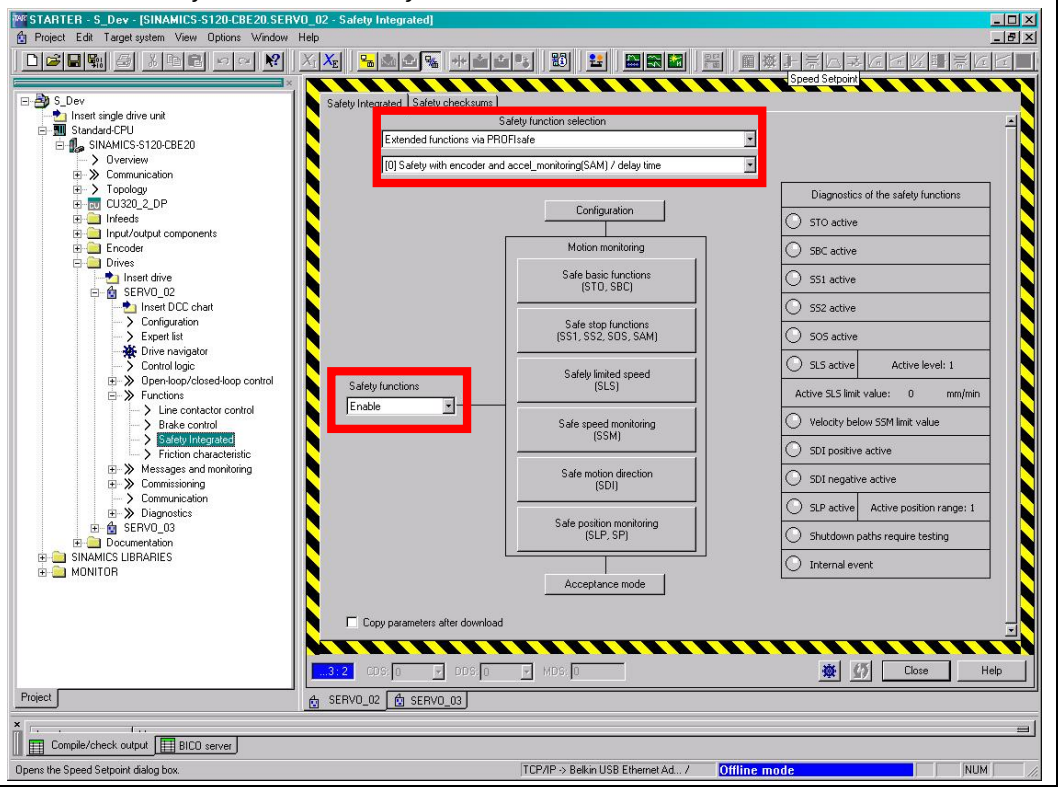
No.	Action
5.	Network: 16 PROFIsafe drive 2 SLS velocity step Bit 0 With safe VKE0, SLS velocity step Bit 0 is activate permanently.  Network: 17 PROFIsafe drive 2 SLS velocity step Bit 1 With safe VKE0, SLS velocity step Bit 1 is activate permanently.  The speed level for the safety function SLS is actuated via these bits in the PROFIsafe control word. • Bit 9 (SLS speed level bit 0) is connected to the failsafe zero signal. • Bit 10 (SLS speed level bit 1) is connected to the failsafe zero signal. → Speed level 1 is thus always selected (see the following figure showing the safety function SLS).  The remaining outputs for the PROFIsafe control word (S_STW1) are reserved and need not be connected.
6.	Network: 18 Activate lamp in switch -S4 Lamp in -S4 is switched on, if internal event on any drive is high.  The signal lamp -S4 lights up when a safety fault occurs which needs to be acknowledged.

No.	Action
7.	Network: 19 Reintegration of all F-Slaves This function block is used to reintegrate (acknowledge) all PROFIsafe-Slaves after an error.  Press the switch -S4 to depassivate all PROFIsafe slaves (F-Slaves, F-Devices).
8.	Define the F-runtime group. Open the runtime group via *Options → Edit safety program → F-Runtime groups…* 
9.	Compile the safety program and load it into the controller. 

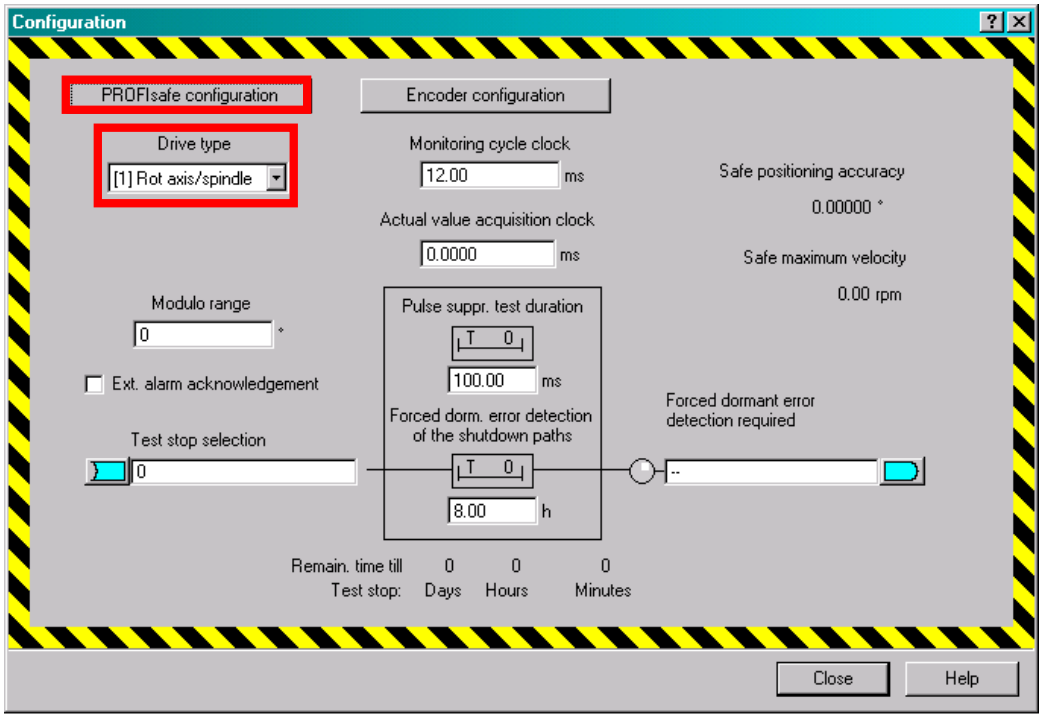
4.8 Configuring the drive internal safety functions

It is assumed that the SINAMICS drive has been commissioned and the axes can be traversed via the control panel. The drive internal safety functions can be configured online or offline.

Table 4-9

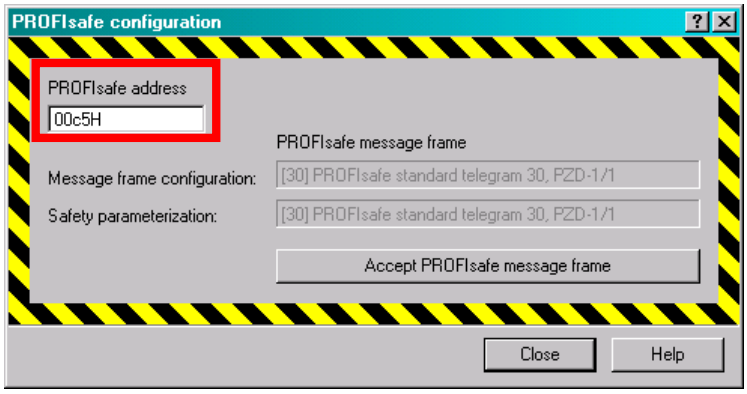
No.	Action
1.	Select *"Extended functions"* to activate the **extended safety functions**. If the safety functions are activated **via PROFINET** (or PROFIBUS), *"via PROFIsafe"* must be selected. → *"Extended functions via PROFIsafe"* In the sample project, all safety axes have an encoder. → *"Safety with encoder and accel_monitoring(SAM) / delay time"* Activate the safety functions → *"Safety functions = Enable"* 

No.	Action
2.	Perform the **PROFIsafe configuration** in the *Configuration* screen.



Select the axis type rotational axis.

When activating the safety functions via PROFIsafe, the **PROFIsafe address** must correspond to the set *F_Dest_Add* (hex) in the HW Config (see Section 4.5, No. 5).



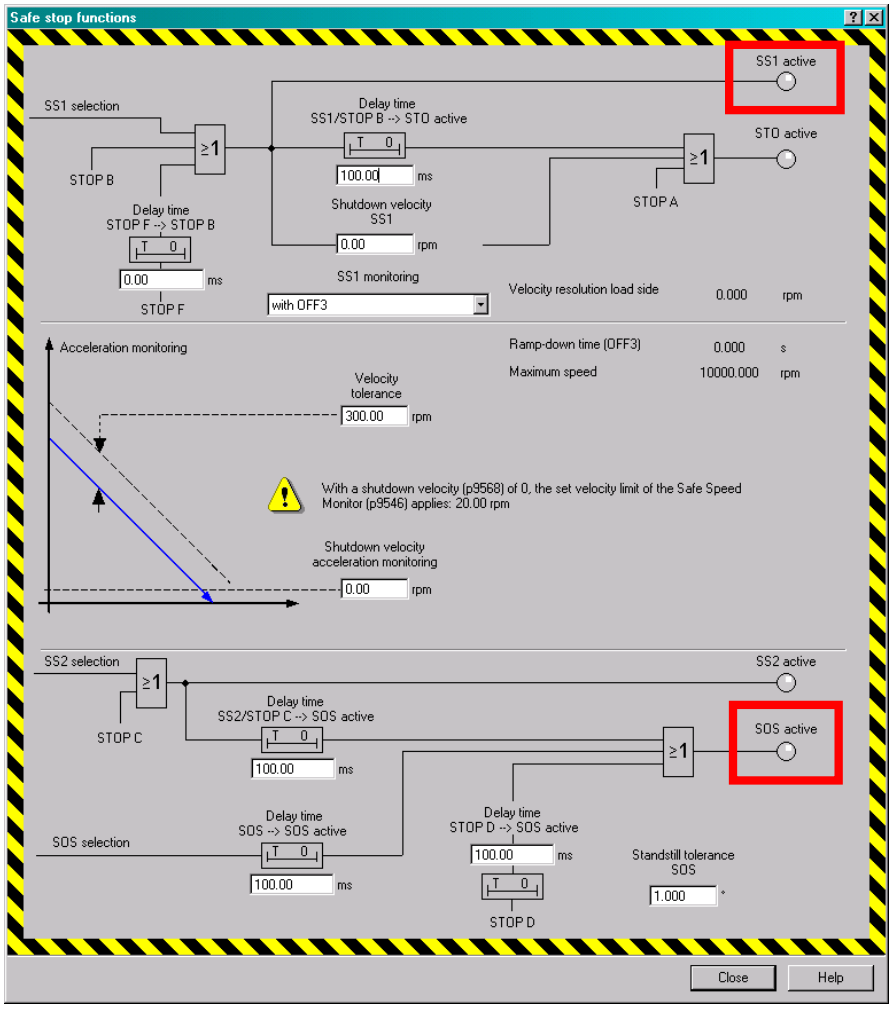
The following PROFIsafe addresses are used in the sample project.

Axis	PROFIsafe address (F_Dest_Add)
SERVO_02 (red)	$C5_{hex}$
SERVO_03 (blue)	$C6_{hex}$

Note

The functionality **Test stop** is not configured in the sample project.

No.	Action
3.	In the sample project, the safety function **SS1** is selected at the red axis (SERVO_02) by actuating the emergency OFF switch -S1. That means, this axis actively decelerates to the speed 0 rpm. Afterwards, the releases are canceled.



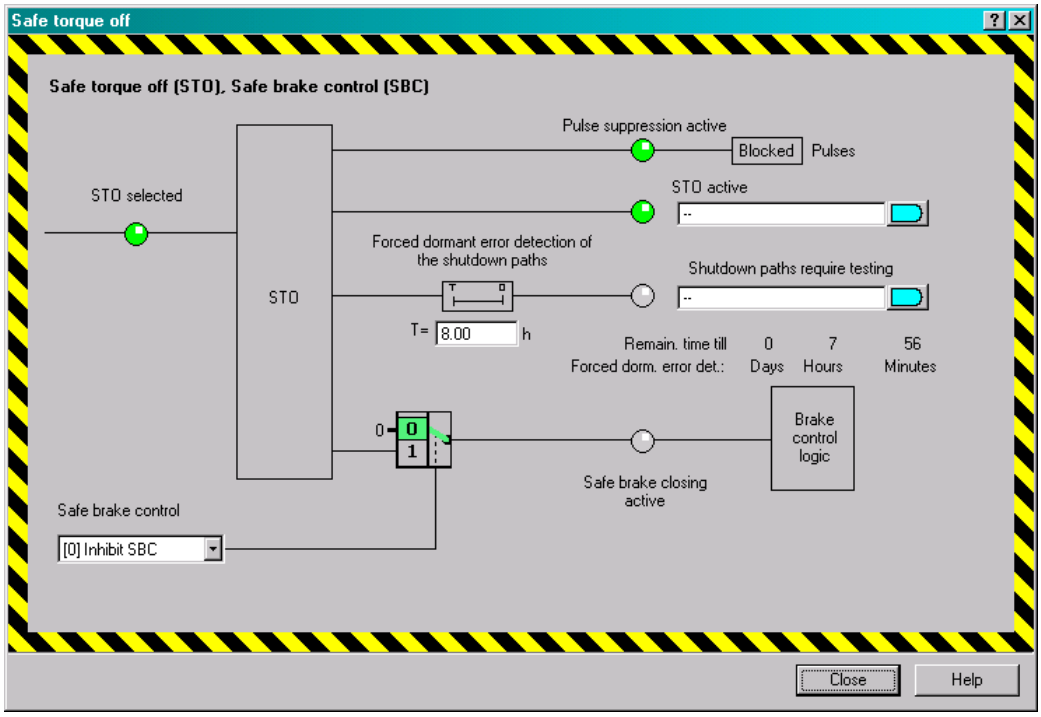
In the sample project, the standstill of the red axis (SERVO_02) is monitored (**SOS**) when the protective door -S2 is opened. Before, the Standard-CPU must specify a command speed of 0 rpm by setting the marker *M0.1 "boSafetyDoor"*. That means if the marker *M0.1 "boSafetyDoor"* is set, the blue axis must stop instead of rotating at ~187 rpm. When actuating the protective door -S2, no safety alarm may occur.

If the marker *M0.1 "boSafetyDoor"* is not set, the safety alarms "STOP B triggered" and "STOP A triggered" are output by the CU and the red axis (SERVO_02) by the Motor Module when actuating the switch -S2 and upon expiry of a parameterizable delay time.

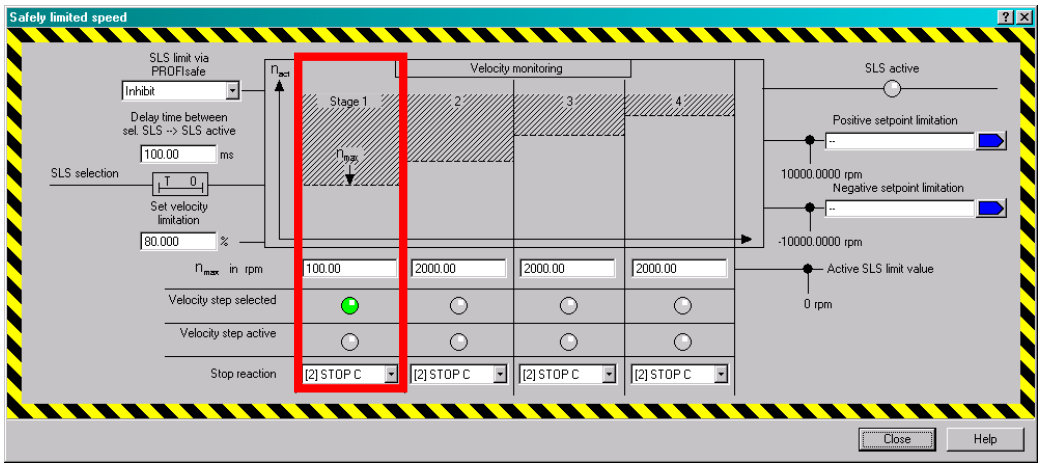
The delay time *"SOS → SOS active"* can be parameterized according to the respective requirement.

After closing the protective door -S2 resp. setting the marker *M0.1 "boSafetyDoor"* (command speed = 0 rpm), the alarms can be acknowledged with the switch -S4. After acknowledging the alarms, the drives continue running if the marker *M0.0 "boMove"* is set in the Standard-CPU.

No.	Action
4.	In the sample project, **STO** is selected at the blue axis (SERVO_03) when actuating the emergency OFF switch -S1, that means the axis coasts down. The releases are immediately canceled.



No.	Action

5.	In the sample project, the speed of the blue axis (SERVO_03) is monitored (**SLS**) when opening the protective door -S3. Before, the Standard-CPU must specify a command speed of less than 100 rpm by setting the marker *M0.1 "boSafetyDoor"*. That means if the marker *M0.1 "boSafetyDoor"* is set, a command speed of ~93 rpm is specified in the sample project. When actuating the protective door -S3, no safety alarm may be output.
	If the marker *M0.1 "boSafetyDoor"* is not set, the safety alarms "STOP B triggered" and "STOP A triggered" are output after actuating the switch -S3 and upon expiry of a parameterizable delay time.
	After closing the protective door -S3 resp. setting the marker *M0.1 "boSafetyDoor"* (command speed lower than 100 rpm), the alarms can be acknowledged with the switch -S4. After acknowledging the alarms, the drives continue running if the marker *M0.0 "boMove"* is set in the Standard-CPU.
	As in the sample project the bits 9 and 10 in the PROFIsafe control word (S_STW1) for the blue axis are connected to the failsafe zero signal, the speed level 1 is always selected for **SLS**. Thus, you only have to configure the speed level 1 in the sample project.
	 
	
	`Network: 4 Transmit STW (Bit Master control by PLC)`
	`drive 2 (blue motor)`
	`U "boMove"`
	`SPBN S011`
	`L W#16#47E //= 2#0100_0111_1110`
	`T MW 1`
	`L W#16#1FF //511 = 6000 rpm * 511/16384 = 187,13 rpm`
	`U "boSafetyDoor"`
	`SPBN S014`
	`L W#16#FF //= 93,38 rpm < 100 rpm for SLS`
	`S014: T AW 262`
	`UN E 264.0 //restart inhibit`
	`U(`
	`L EW 260`
	`L W#16#211 //= 2#0010_0001_0001`
	`UW`
	`L W#16#211`
	`==I`
	`)`
	`SPBN S012`
	`L W#16#47F //= 2#0100_0111_1111`
	`T MW 1`
	`S012: L MW 1`
	`T AW 260`
	`SPA S013`
	`S011: L W#16#400 //= 2#0100_0000_0000`
	`T AW 260`

No.	Action
6.	If the configuration has been performed offline, checkmark “Copy Parameter“, save the project and perform a download. If the configuration has been performed online, copy the parameters and activate them for both axes.
7.	Copy RAM to ROM. 
8.	Go offline. 
9.	Power OFF/ON
10.	Go online. 
11.	Load the drive configuration into the PG. 
12.	Save the project.  The offline and online configurations are now consistent.

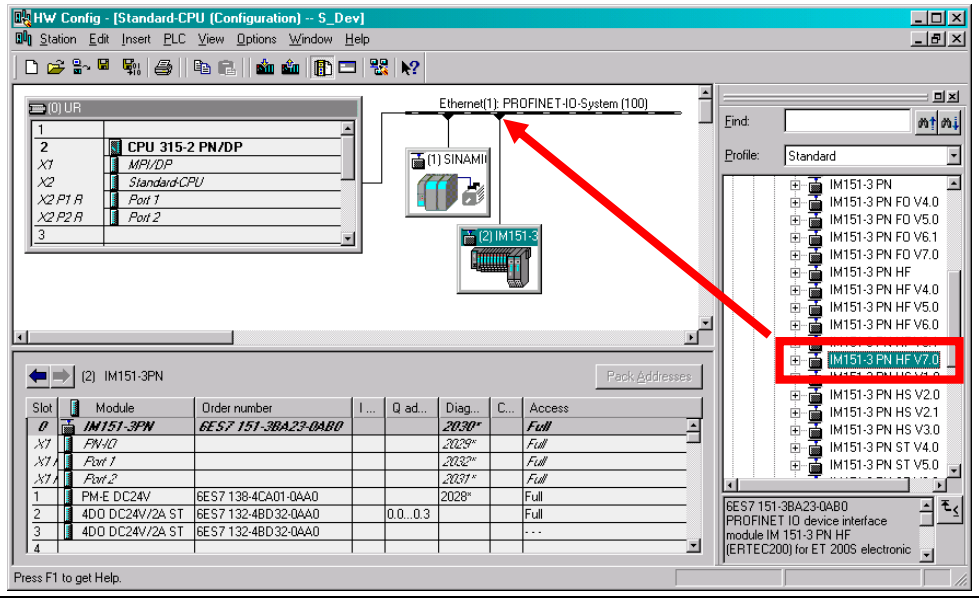
4.9 Configuring the distributed SIMATIC ET 200 Station

The following firmware versions of the SIMATIC ET 200 Station support the PROFINET functionality **Shared Device**.

Table 4-10: Necessary firmware versions for SIMATIC ET 200

Hardware	Version
ET 200M	As from V3.0
ET 200S (not High Speed version)	As from V7.0
ET 200S HS	As from V3.0
ET 200pro	As from V7.0

Table 4-11

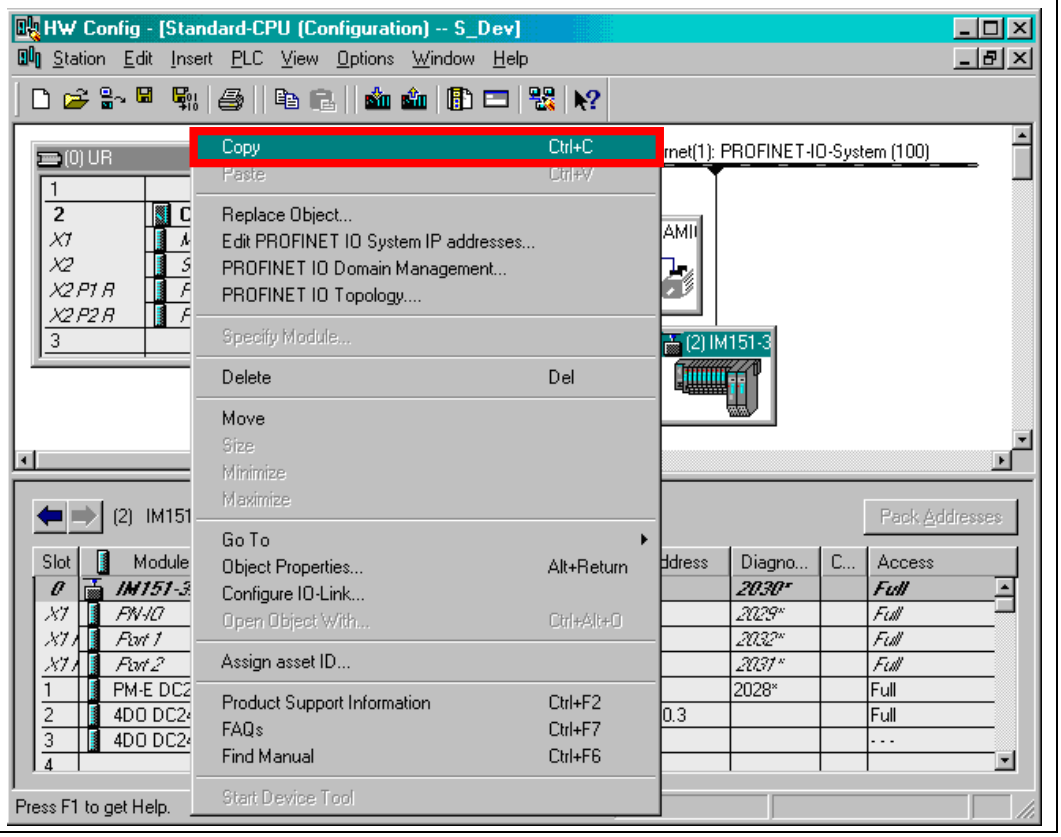
No.	Action
1.	Drag the required SIMATIC ET 200 Station from the hardware catalog to the PROFINET IO system. In the detailed screen, you can insert the required electronic modules. The sample project uses an ET 200S HF V7.0, a power module and two digital output modules. Each digital output module is assigned to an IO-Controller. For this, you must insert the SIMATIC ET 200 Station as **Shared Device** at the second PROFINET IO-Controller. 

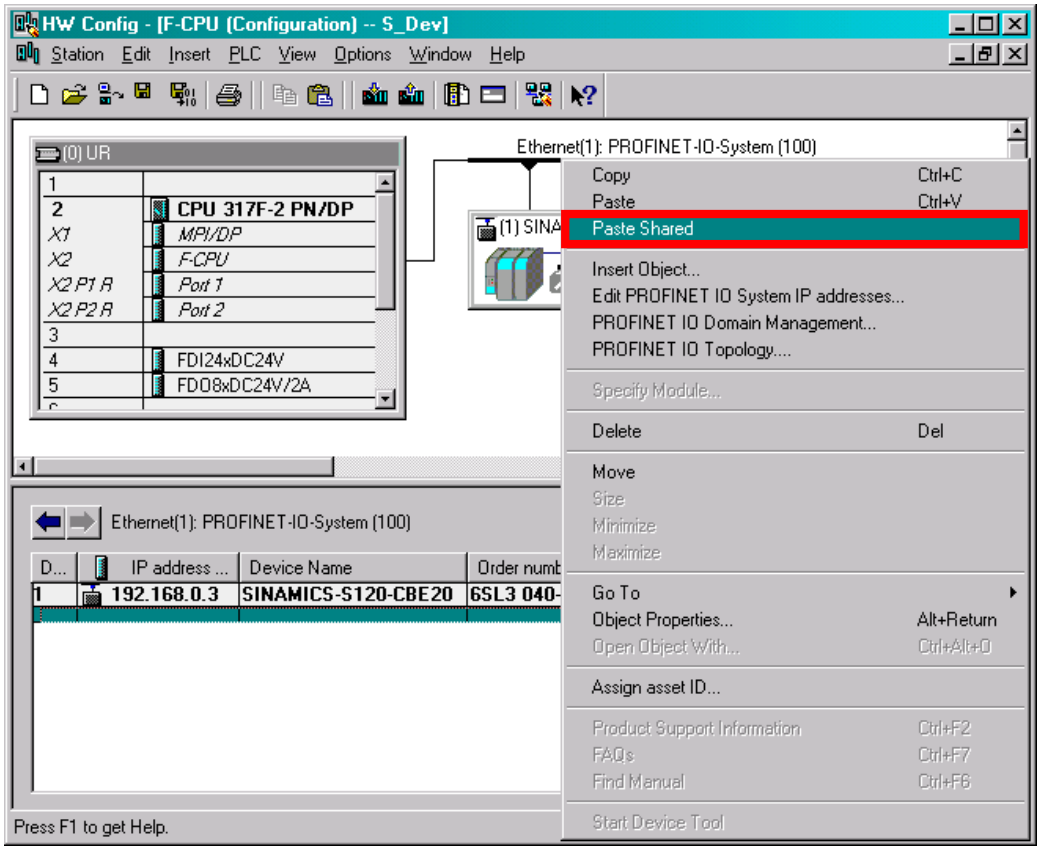
2.	In the sample project, the OB33 “Cyclic Interrupt“ is called up every 500 ms. In the OB33, the output byte 0 (Slot 2 → 4DO DC24V/2A ST) is incremented in each cycle by 1. That means the LEDs of the respective digital outputs graphically display incrementing as soon as the Standard-CPU is in the RUN state.
	This allows to show the **Shared Device** functionality by switching both CPUs alternately to STOP.
	
	<u>Standard-CPU, OB33 (500 ms), network 1:</u>
	`L AB 0`
	`INC 1`
	`T AB 0`

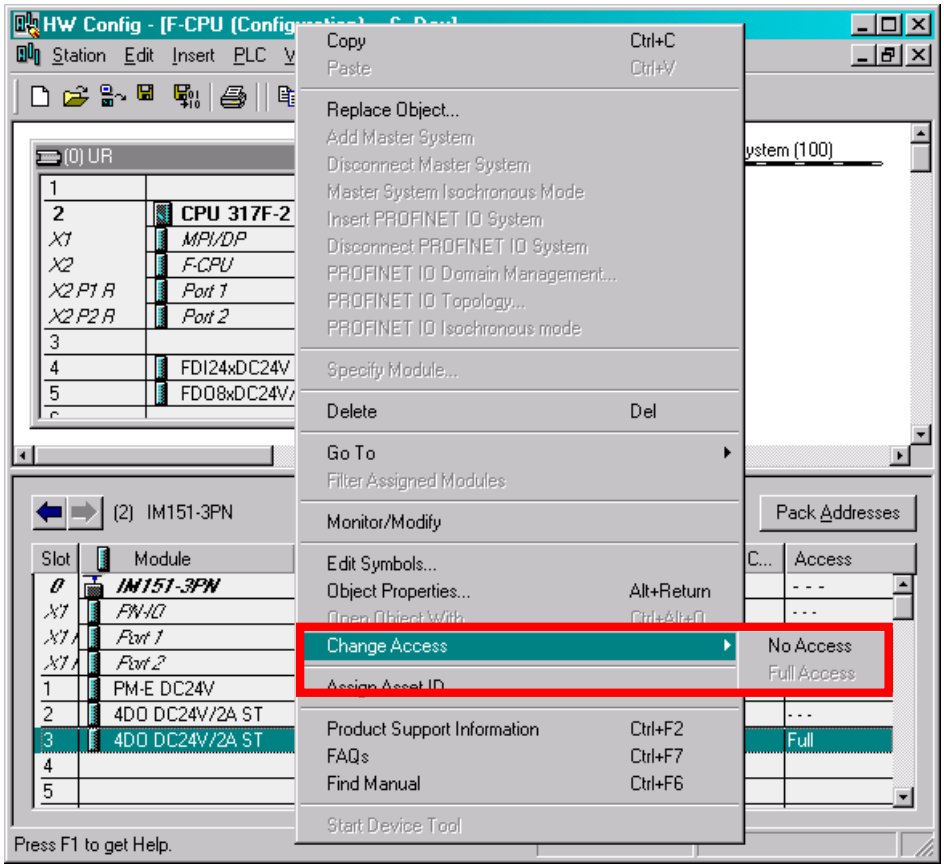
4.10 Configuring the SIMATIC ET 200 Station as Shared Device

Note Proceed as follows to connect a SIMATIC ET 200 Station as **Shared Device** to a SIMOTION controller.

Table 4-12

No.	Action
1.	After configuring and successfully compiling the SIMATIC ET 200 Station it can be copied in the HW Config (right mouse button → *Copy*) and inserted as **Shared Device** at the second IO-Controller. 

No.	Action
2.	Insert the SIMATIC ET 200 Station as **Shared Device** in the HW Config of the second IO-Controller by marking the Ethernet subnet and clicking with the right mouse button → *Paste Shared*. For this, the HW Config of the first IO-Controller must have been successfully compiled. In the sample project, the SIMATIC ET 200S Station is inserted as **Shared Device** at the SIMATIC CPU 317F-2 PN/DP. Both controllers must be located in the same project. 

No.	Action
3.	To assign individual modules to a PROFINET IO-Controller, mark the respective module → Right mouse button → *Change Access* and select the requested function. The respective module access is automatically adjusted for the second IO-Controller. 

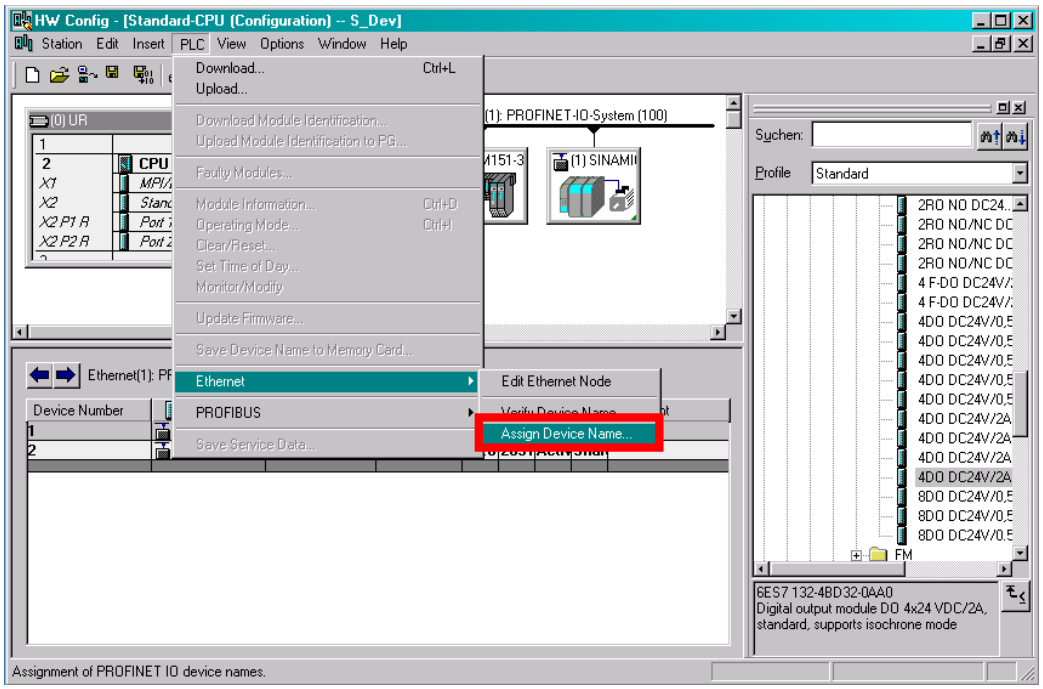
4.	In the sample project, the OB33 “Cyclic Interrupt“ is called up every 500 ms. In the OB33, the output byte 4 (slot 3 → 4DO DC24V/2A ST) is incremented in each cycle by 1. That means the LEDs of the respective digital outputs graphically display incrementing as soon as the F-CPU is in the RUN state.
	This allows to show the **Shared Device** functionality by switching both CPUs alternately to STOP.
	
	<u>F-CPU, OB33 (500 ms), network 1:</u>
	`L AB 4`
	`INC 1`
	`T AB 4`

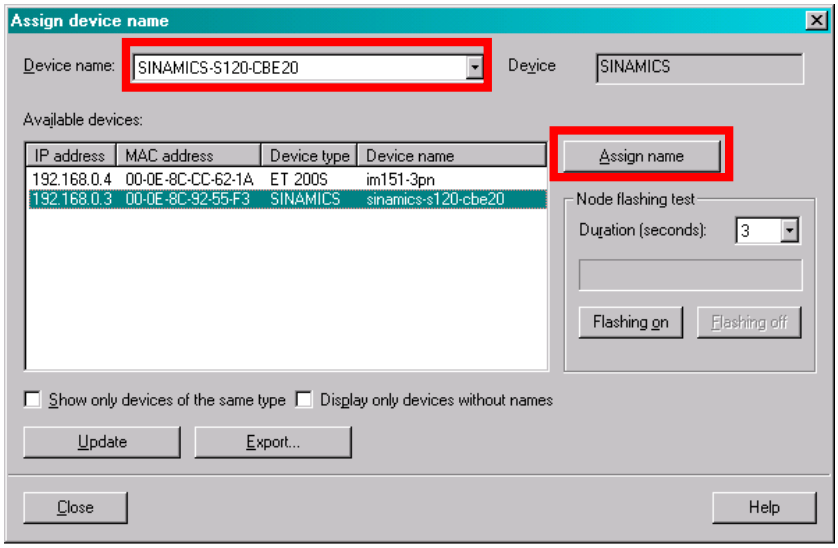
5 Startup of the application

The following steps must be taken to startup the application.

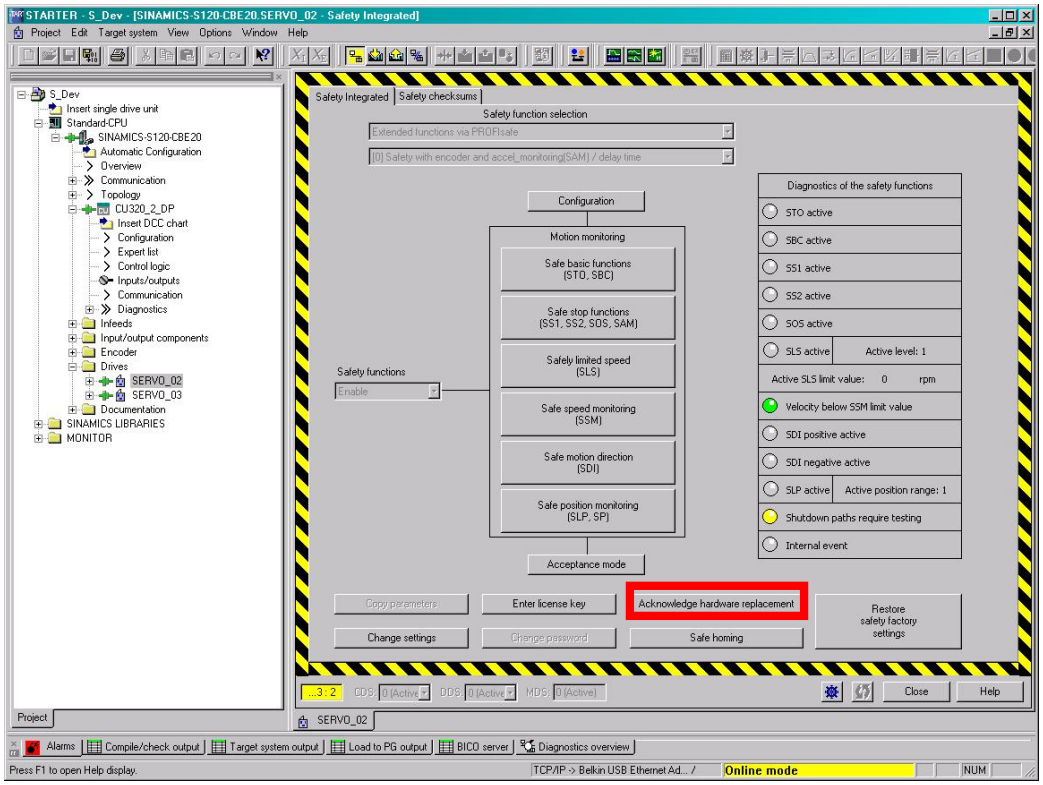
5.1 Startup

Table 5-1

No.	Action
1.	All hardware components (see Table 2-1, Page 10) are provided and upgraded to the necessary firmware.
2.	All PROFINET components are interconnected and can be accessed via the engineering system.
3.	The Ethernet interface of the engineering system has been correctly configured. IP address: 192.168. 0 . 99 Subnetmask: 255.255.255. 0
4.	Start the STEP7 SIMATIC Manager engineering system.
5.	Dearchive the sample project “50207311_Example_Shared_Device_V2_0.zip“.
6.	Open the S7 Project “S_Dev“.
7.	Load the configuration of the Standard-CPU into the respective device.
8.	Load the configuration of the F-CPU into the respective device. The password for downloading / processing the safety program is “1“.
9.	Open the HW Config to initiate the node.  Mark the PROFINET line and open the screen *Assign Device Name*.

No.	Action
10.	Here, you can select the configured device name and assign it to the respective device (IO-Device).  **Note** Only IO-Devices are listed here. IO-Controllers are assigned the device name by downloading the HW Config.
11.	Alternatively, you can also use the Primary Setup Tool (PST) to initate the node. The PST can be downloaded at the following link. http://support.automation.siemens.com/WW/view/en/19440762

5.1 Startup

No.	Action
12.	Start the STARTER engineering system.
13.	Go online. 
14.	Load the configuration of the SINAMICS drive into the respective device. The password for processing the safety functions is “1“.
15.	Acknowledge the hardware replacement 
16.	Copy RAM to ROM. 
17.	Go offline. 
18.	Power OFF/ON
19.	The sample project can now be operated.

6 Operation of the application

6.1 Overview

On the one hand, the sample project is operated via the switch box of the safety training case, and on the other hand via the SIMATIC Manager used to modify markers.

The axis command speeds are permanently stored in the STEP7 standard program and can be selected via markers.

6.2 Distributed SIMATIC ET 200 Station as Shared Device

Testing the PROFINET Shared Device functionality

Each of the two output modules is assigned to another controller. As long as the assigned controller is in the RUN state, the LEDs of the respective output module show the incrementing of the corresponding output byte which is incremented by 1 in the OB33 (500 ms).

Table 6-1

No.	Action
1	Switch one of the two SIMATIC CPUs alternately to STOP and RUN. → In the STOP operating state, the LEDs of the corresponding output module are off.

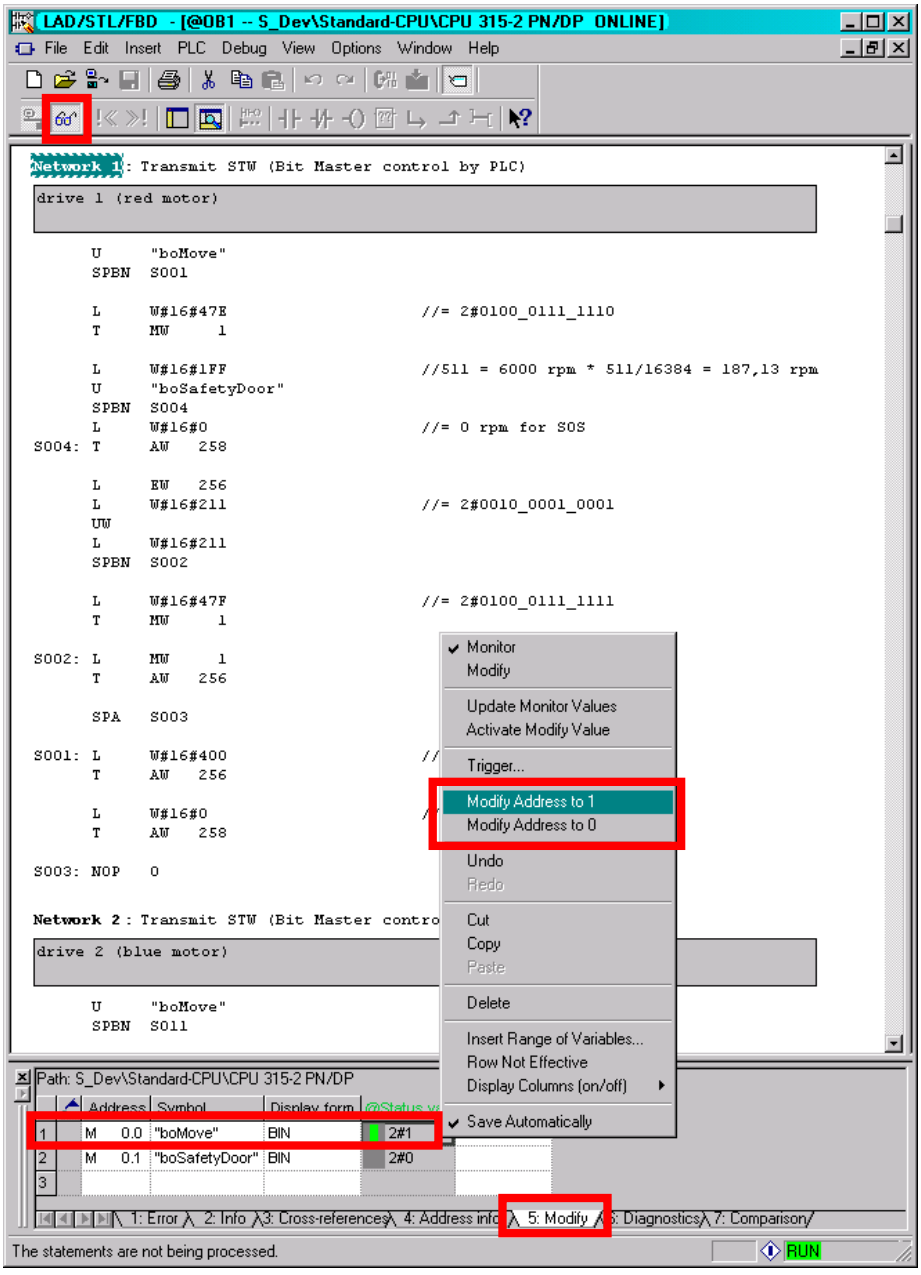
6.3 Distributed SINAMICS drive as Shared Device

Testing the safety functions in the drive (Shared Device)

The standard functionality is assumed by the Standard-CPU, and the safety functions are activated by the F-CPU. The **Shared Device** functionality is used for this.

Table 6-2

No.	Action
1	Actuate the switch -S4 to depassivate all F-Devices.
2	Deselect all drive internal safety functions by unlocking the emergency OFF switch -S1 and closing both protective doors (-S2 and -S3).

No.	Action
3	Open the OB1 in the Standard-CPU. Mark the *Modify* tab in the detailed screen and go online. Start both axes via the Standard-CPU with the marker *M0.0 "boMove" = TRUE*. → Both axes must rotate at ~187 rpm, which corresponds to the command value $1FF_{hex} = 511$.  The command speeds for the red and blue axes are specified in the networks 1 and 2.
5	When actuating the emergency OFF switch, both axes must stop. Both axes are restarted when unlocking the emergency OFF switch and actuating the fault acknowledgement -S4.
6	If the marker *M0.1 "boSafetyDoor"* is set, the protective doors 1 and 2 (-S2 and -S3) can be opened without triggering a safety fault. If the marker *M0.1 "boSafetyDoor"* is not set, that means both drives rotate at ~187 rpm, a safety fault is triggered when opening the protective door 1 resp. 2 (-S2 resp. -S3).

7 Contact

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8 History

Table 8-1

Version	Date	Modifications
V1.1	07/2011	First version Configuring Shared Device via GSD file
V1.2	05/2012	Update
V2.0	05/2012	Configuring Shared Device via Object Manager