SINAMICS S120
Safety Integrated Extended Functions
Failsafe Drives
Activation of the CU320 via PROFIsafe with PROFIBUS

safety
INTEGRATED

SIEMENS

Preliminary remarks

>The Functional Examples dealing with "Safety Integrated" are fully functional and tested automation configurations based on I DT & IA standard products for simple, fast and inexpensive implementation of automation tasks in safety engineering. Each of these Functional Examples covers a frequently occurring subtask of a typical customer problem in safety engineering.

>Aside from a list of all required software and hardware components and a description of the way they are connected to each other, the Functional Examples include the tested and commented code. This ensures that the functionalities described here can be reset in a short period of time and thus also be used as a basis for individual expansions.

Important note

>The Safety Functional Examples are not binding and do not claim to be complete regarding the circuits shown, equipping and any eventuality. The Safety Functional Examples do not represent customer-specific solutions. They are only intended to provide support for typical applications. You are responsible for ensuring that the described products are correctly used.

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1   Warranty, Liability and Support

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applications.erlf.aud@siemens.com

2 Automation Function

2.1 Functional example description

At present, the following safety functions are integrated in SINAMICS S120 drives according to IEC 61800-5-2:

Name	Function	Description
STO	Safe Torque Off	• Safe disconnection from the torque-forming energy supply to the motor. • Restarting is interlocked via the switch-on inhibit. (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 at the performance connector. • SBC always responds in conjunction with STO or when internal safety monitors respond with safe pulse suppression.
SS1	Safe Stop 1	• Fast and safely monitored drive stopping at the OFF3 ramp. • Upon expiry of a delay time resp. reaching the shutdown speed, transition to STO. (Stop function of Category 1 acc. to EN 60204-1)
SS2	Safe Stop 2	• Fast and safely monitored drive stopping at the OFF3 ramp. • Upon expiry of a delay time, transition to SOS; the drive remains under control. (Stop function of Category 2 acc. to EN 60204-1)
SOS	Safe Operating Stop	• This function is used to safely monitor the drive standstill position; the drive remains under control.
SLS	Safely-Limited Speed	• Safe drive speed monitoring. • Parameterizable shutdown response with limit violation.
SSM	Safe Speed Monitor	• Safe display of speed limit violation (n < nx).

These extended safety functions can be activated both via PROFIsafe with PROFIBUS or PROFINET and via a terminal expansion module TM54F. In the present example, the safety functions are activated from a SIMATIC F-CPU via PROFIBUS, via the PROFIsafe telegram.

Task description

Extended safety functions which have been integrated in the SINAMICS S120 drives shall be activated via PROFIsafe with PROFIBUS. Both drives use different safety functions. The F-CPU is responsible for the safety-related logical processing of the input signal. The F CPU acts as F master and as PROFIBUS master.

This functional example is based on the SINAMICS S120 training case (6ZB2 480-0BA00) and the SAFETY training case.

The following picture provides a sample overview of the machine configuration assumed.
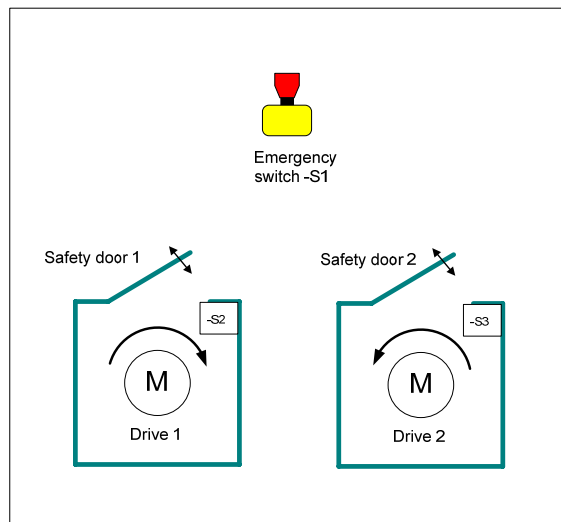
The following safety functions are the basis for further considerations.

Safety function	Description	Reaction
SF1	Actuates the emergency stop button	Fast stopping of drive 1 and drive 2 -> then pulse suppression (SS1)
SF2	With an open protective door 1, the drive 1 may not exceed a maximum speed	Speed monitoring on Drive 1 (SLS)
SF2	With an open protective door 2 the drive 2 may not exceed a maximum speed	Speed monitoring on drive 2 (SLS)

Solution

Hardware overview
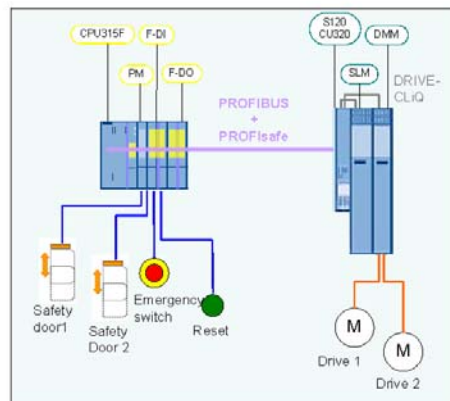
This functional example shows the activation of the safety functions SS1 and SLS via PROFIsafe with PROFIBUS on a SINAMICS S120 drive group.

The drive group in booksize format comprises an infeed unit and a Double Motor Module. The motor is controlled via a Control Unit CU320. The extended setpoint channel is used to specify the speed. The two independent servomotors are controlled via the Double Motor Module. A Smart Line Module serves as infeed unit.

The safety-related signals are sensed via failsafe F-CPU inputs and evaluated in the F-CPU. The drive-integrated safety functions in each drive of the SINAMICS S120 drive group are individually activated via the failsafe PROFIsafe communication.

Upon emergency stop request, both drives are stopped by the drive-integrated safety function SS1.

Each drive is assigned a protective door. When the corresponding protective door is opened, the speed of the relevant motor is safely monitored for the preset speed limit value (SLS). The speed is reduced by the non-failsafe setpoint channel. The other drive is not influenced. As a fault reaction of SLS when the safe speed is exceeded, STOP C (SS2 → SOS) is triggered on the relevant drive.

Other functional examples describe further variants used to activate the drive-integrated safety functions using the terminal expansion module TM54F and the activation via PROFIsafe.

2.2 PROFIsafe communication

Each drive with configured PROFIsafe slot in the drive unit represents a PROFIsafe slave (F slave) with failsafe communication to the F master (F host) via PROFIBUS.

A separate PROFIsafe telegram is created for each drive (PROFIsafe slot). This telegram has a length of 6 bytes for each drive. The first two bytes comprise useful safety data.

The F-CPU outputs the following control signals to the drive:

F-CPU -> Drive

<table>
<tr><td colspan="16" align="center">PROFIdrive Safety Block 1 (F Process Data)</td></tr>
<tr><td colspan="8" align="center">Byte 0</td><td colspan="8" align="center">Byte 1</td></tr>
<tr><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr>
<tr><td>STO</td><td>SS1</td><td>SS2</td><td>SOS</td><td>SLS</td><td>Res.</td><td>Res.</td><td>Int. Ev. ACK</td><td>Res.</td><td>SLS Limit sel.</td><td>SLS Limit sel.</td><td>Res.</td><td>Res.</td><td>Res.</td><td>Res.</td><td>Res.</td></tr>
</table>

- PROFIsafe Output Data

The drive returns the status of the safety functions to the F-CPU.

Drive -> F-CPU

<table>
<tr><td colspan="16" align="center">PROFIdrive Safety Block 1 (F Process Data)</td></tr>
<tr><td colspan="8" align="center">Byte 0</td><td colspan="8" align="center">Byte 1</td></tr>
<tr><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr>
<tr><td>Power rem.</td><td>SS1 act.</td><td>SS2 act.</td><td>SOS act.</td><td>SLS act.</td><td>Res.</td><td>Res.</td><td>Int. Ev.</td><td>Res.</td><td>SLS-Limit</td><td>SLS-Limit</td><td>SOS selected</td><td>Res.</td><td>Res.</td><td>Res.</td><td>SSM</td></tr>
</table>

- PROFIsafe Status Data

Note   Non-used drive-integrated safety functions must be deselected by a high signal.

2.3 Advantages / customer benefits

- Convenient activation of the drive-integrated safety functions

- Convenient setup through standardized technology

- The existing system can be quickly and easily extended.

- Space-saving and low-cost setup through integrated safety functions – no additional hardware required

- This allows to implement complex safety concepts.

3   Components Required

3.1   Hardware components

SAFETY training case (major components)

Component	Type	MLFB/order data	No.	Manufacturer
SITOP power supply	SITOP SMART 120W	6EP1 333-2AA01	1	Siemens
SIMATIC S7-300 CPU	CPU 315F-2 PN/DP	6ES7 315-2FH13-0AB0	1	Siemens
	SIMATIC Micro Memory Card, 512KB	6ES7 953-8LJ20-0AA0	1	Siemens
SIMATIC S7 failsafe input module	SM 326 F-DI 24	6ES7 326-1BK01-0AB0	1	Siemens
SIMATIC S7 failsafe output module	SM 326 F-DO 8	6ES7 326-1BF40-0AB0	1	Siemens
SINAMICS failsafe Terminal Module	TM54F	6SL3050-0AA00-3BA0	1	Siemens
Drive-CLiQ	Cable, gray, metal plug	6FX2002-1DC00-1AC0	1	Siemens
Protective door simulation switch S2 and S3	Toggle switch 0-I, latching, 16mm, black	3SB2000-2AB01	2	Siemens
	Holder with solder pins	3SB2908-0AB	2	Siemens
Emergency stop control device S1	Mushroom bushbutton, red, 16mm	3SB2000-1AC01	1	Siemens
	Holder with solder pins	3SB2908-0AB	1	Siemens
Reset button S4	Pushbutton, flat button, 16mm, white	3SB2000-0AG01	1	Siemens
	Holder with lamp socket, lamp and solder pins	3SB2455-1B	1	Siemens
Load resistors R1 .. R8	1kOhm 1W	Type PO595-0 Style 0207 Power metaloxide film resistors	1	Yageo Europe
Terminals for load resistors (R1..R8)	ST 2,5-QUATTRO-TG	3038451	8	Phoenix Contact
	Component plug P-CO	3036796	8	Phoenix Contact
Load resistor R9	SMA0207 1K2 1% TK	WID_MET_SHT_1K2_+-1%_600mW_+50ppm_0207	1	Beyschlag
Terminals for load resistor (R9)	KLEMMEN_ZUB_LEERSTECKER_TYP1_GRAU	280-801	1	WAGO
	KLEMME_4-LEITER_GRAU	280-686	1	WAGO

SINAMICS training case

Component	Type	MLFB/order data	No.	Manufacturer
SINAMICS training case	S120 CU320	6ZB2 480-0BA00	1	SIEMENS

Note	The functional example has been tested using the listed hardware components. Alternatively, you can also use other components providing the same functions. In such a case, you may have to use another parameterization and another component wiring.

3.2 Software components

3.2.1 Engineering software

Table 3-1

Component	Type	MLFB/order data	No.	Manufacturer
STEP 7	V5.4 SP4	6ES7810-4CC08-0YA5	1	Siemens
S7 Distributed Safety Programming	V5.4 SP4	6ES7833-1FC02-0YA5	1	Siemens
S7 F Configuration Package	V5.5 SP5		1	Siemens
STARTER	V4.1 SP2	6SL3072-0AA00-0AG0	1	Siemens
Drive ES Basic	V5.4 SP3	6SW1700-5JA00-4AA0	1	Siemens
Or as an alternative to the STARTER & DRIVE ES Basic software:				
SIMOTION SCOUT	V4.1 SP2	6AU1810-1BA41-1XA0	1	Siemens

3.2.2 Firmware

All SINAMICS components must be provided with Firmware Version V2.5 SP1 (or later).

4   Configuration and Wiring

4.1   Overview of the hardware configuration
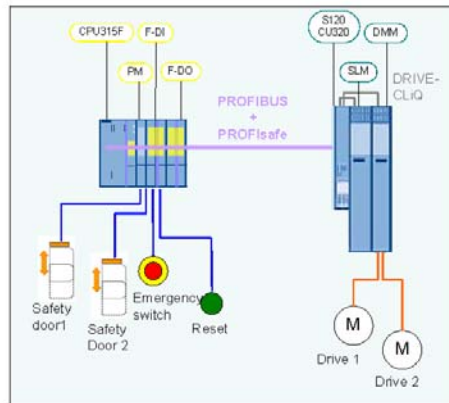
Basic configuration

4.2   Hardware component wiring

4.2.1   Control voltage wiring
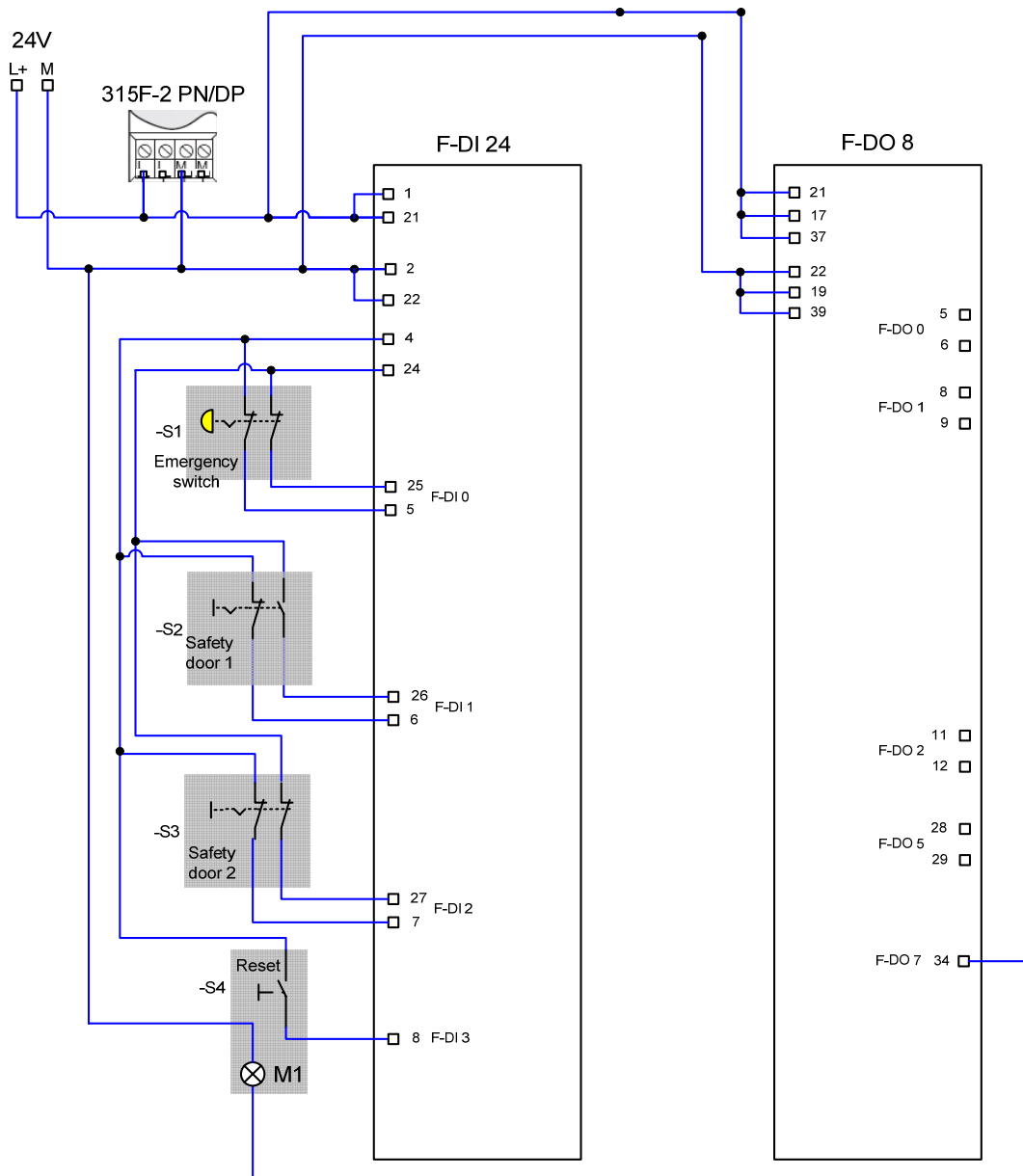
Wireing safety training case

4.2.2   DRIVE-CliQ connection
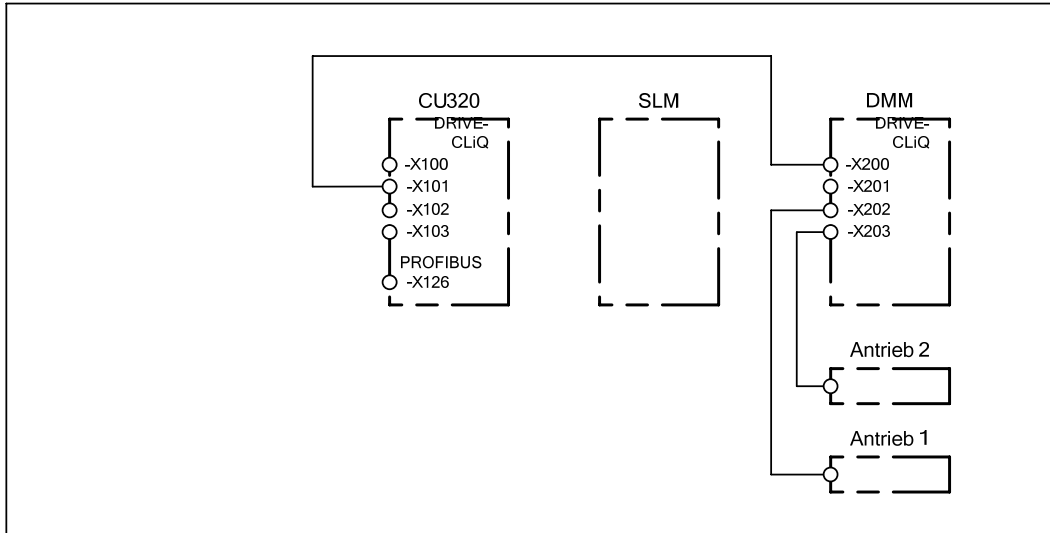
DRIVE-CliQ connection

4.3   Important hardware component settings

In the present functional example, the PROFIBUS interfaces for F-CPU and SINAMICS S120 are used for programming and exchanging PROFidrive data as well as failsafe signals.

4.3.1   Bus interfaces

Programming device / PC

- PROFIBUS address = 0

- As the F-CPU used is the bus master, the PROFIBUS interface of the programming device may not be the only configured master on the bus (the field "PG/PC is the only master on the bus" may not be ticked).
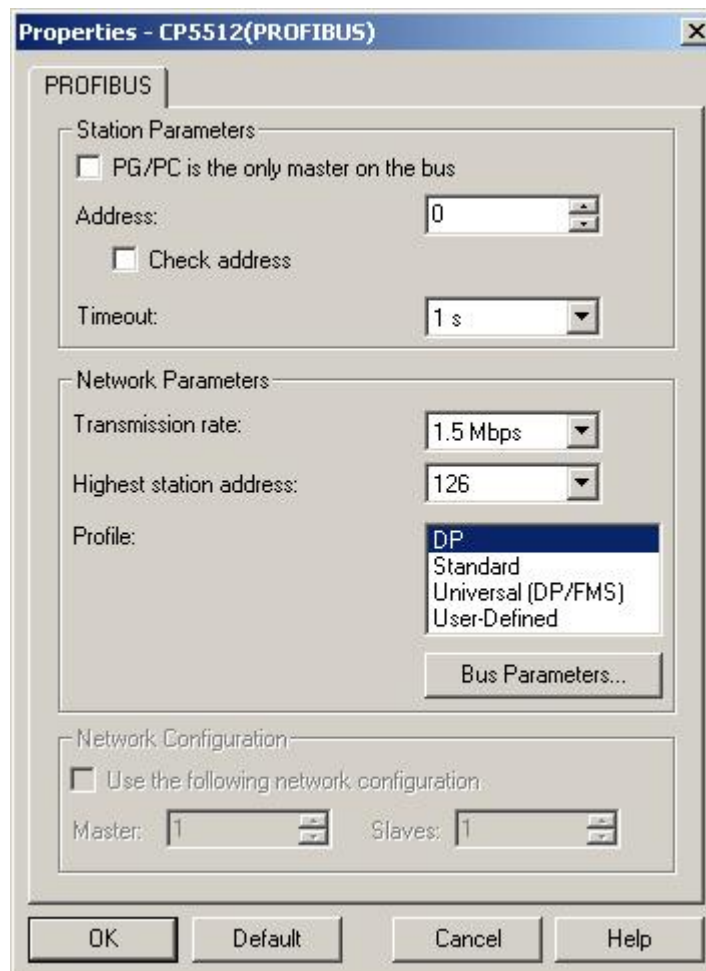
SINAMICS S120 CU320

- PROFIBUS address = 3

- The PROFIBUS address is set via the HW Config and must correspond to the DIP switch setting on the CU 320.
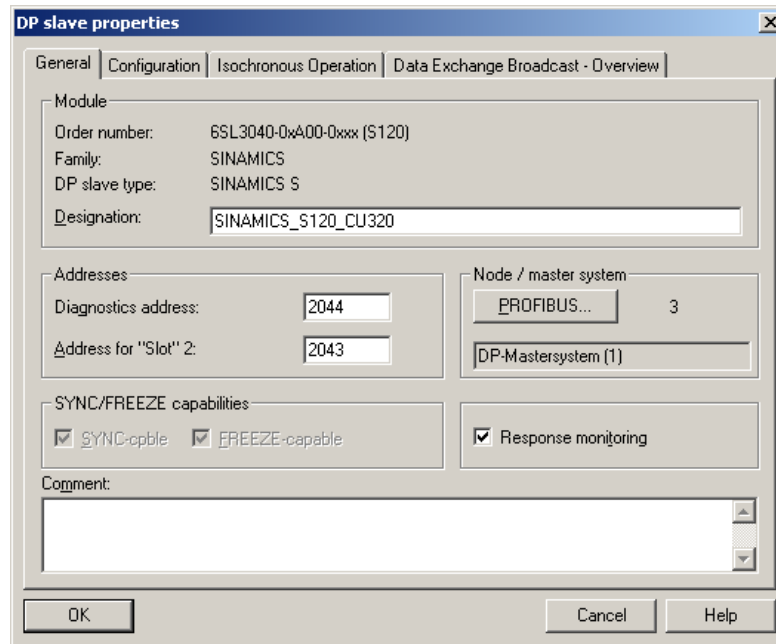
SIMATIC 315F-2 PN/DP CPU

- PROFIBUS address = 2
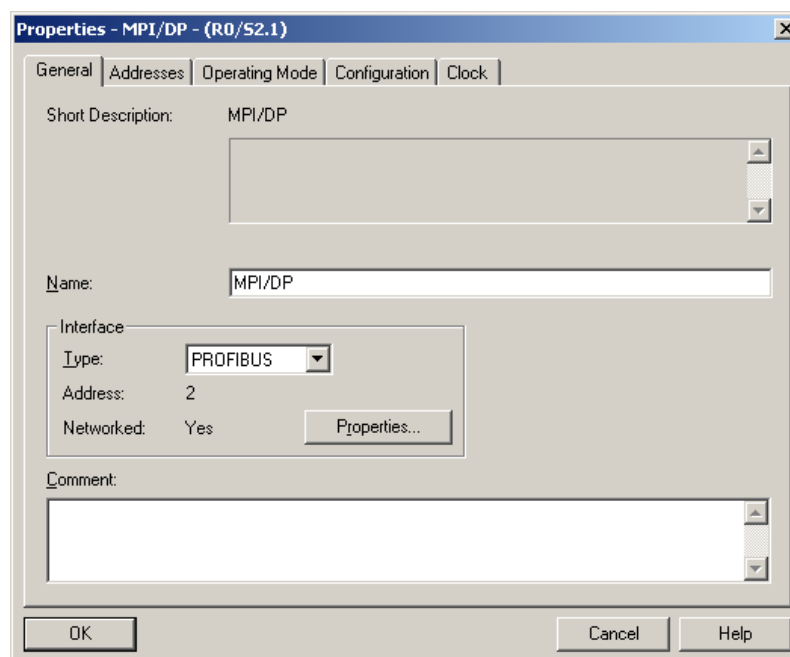
4.3.2 Prerequisites for operation

- The SIMATIC components have been installed and interconnected. The PROFIsafe addresses of the failsafe input and output modules must be set via DIL switch; see Chapt. 6.2 Failsafe

- All components are connected according to Chapter 4.2 Hardware component.

- The DRIVE-CliQ topology of the SINAMICS components is maintained.

- The motors are connected to the Motor Module via performance and encoder cables.

- The Motor Module has been properly connected to the infeed unit (DC link and control voltage DC 24 V).

- The infeed unit is connected to the power supply.

- The components are supplied with DC 24 V.

5 Overview and Operation

5.1 Description of operation
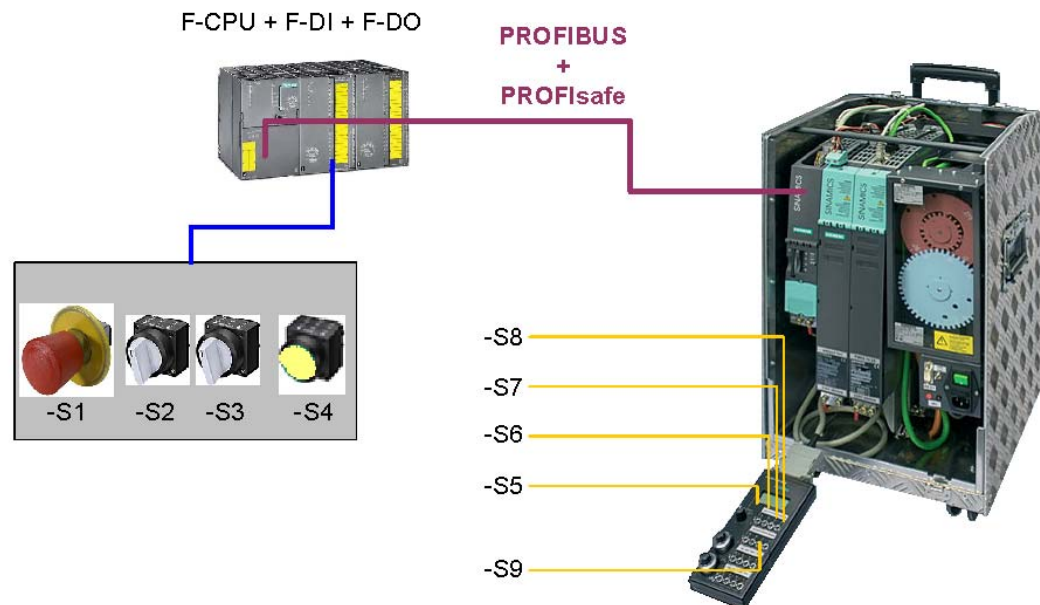
Hardware overview

The switches -S1 to -S4 are located on a switch box included with the safety training case which allows to select the different safety functions. The switches -S5 bis –S9 are located on a switch box included with the SINAMICS training case. These switches allow to activate / deactivate the drives, preset different speeds, start the test function for the safety functions and acknowledge pending errors.

Before you can traverse the drives, unlock the emergency stop button -S1. The switch -S5 activates both drives (OFF1). with -S6 you can toggle between the speed setpoint 0 and 800 rpm (drive 1) resp. 333 rpm (drive 2). Pending alarms on the SINAMICS can be acknowledged with –S7 – except safety alarms which have to be acknowledged failsafe via -S4. The cyclically performed test stop for the safety functions is activated via S8.

With a closed protective door 1 (switch –S2), the drive 1 rotates at n=800 rpm. When opening the protective door 1, a data set switchover is performed in drive 1 and the setpoint speed is n=20 rpm for drive 1. With an open switch -S1, the safety function SLS is activated in drive 1. When closing the protective door 1, speed n=800 rpm is preset again. Drive 2 is not influenced.

With a closed protective door 2 (switch –S3), speed setpoint n=333 rpm is preset for drive 2. When opening the protective door 2, the drive 2 is set to

n=33 rpm through data set switchover. With an open switch –S2, the safety function SLS is activated in drive 2. When closing the protective door 2, speed n=333 rpm is preset again. The drive 1 is not influenced.

When actuating the button –S9, the drives are supplied with a higher set-point value independently of the protective door position. With drive 1, this is n=1000 rpm and with drive 2 n=666 rpm. With an open protective door, the SLS limit value is violated and the affected drive is stopped with internal SS2 (Stop C) and switched to SOS with n=0 rpm. In order to further traverse the drive, the reaction triggered by the internal SS2 (Stop C) must be acknowledged via den reset button –S4.

5.2   List of input signals

Digital SINAMICS inputs

DI0	**-S5**	Drive 1 / drive 2	Activate / deactivate drive
DI1	**-S6**	Drive 1 / drive 2	Switch over speed setpoint (fixed setpoint) Bit 0
DI2	**-S7**	Drive 1 / drive 2	Acknowledge alarms
DI3	**-S8**	Drive 1 / drive 2	Trigger test stop
DI4	**-S9**	Drive 1 / drive 2	Setpoint increase with SLS

Failsafe inputs on the F-DI module

F-DI0	**-S1**	Emergency stop button	Drive 1 & drive 2: SS1
F-DI1	**-S2**	Protective door 1 (for drive 1)	SLS
F-DI2	**-S3**	Protective door 2 (for drive 2)	SLS
F-DI3	**-S4**	Acknowledgement button	Failsafe acknowledgement (drive 1 & 2) and depassivation (all F slaves)

Note	The drives can only be traversed with activated infeed unit and loaded dc link.

6   Sample Project

This Chapter describes how to parameterize the individual components. Both the STARTER and DRIVE ES Basic, and SIMOTION SCOUT can be used as engineering software for the SINAMICS S120.

SIMOTION SCOUT was used to create this example. STEP 7 and distributed safety are required to program the F-CPU.

The following paragraph describes how the software project belonging to this functional example was set up.
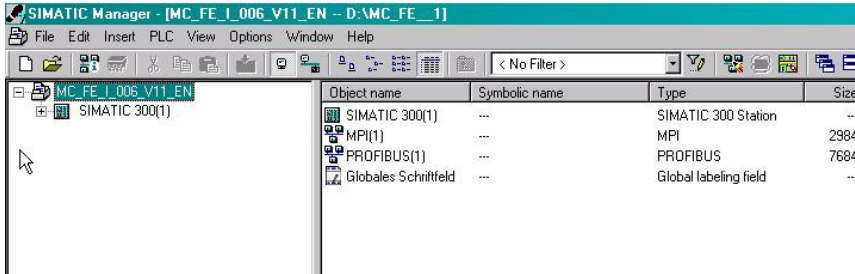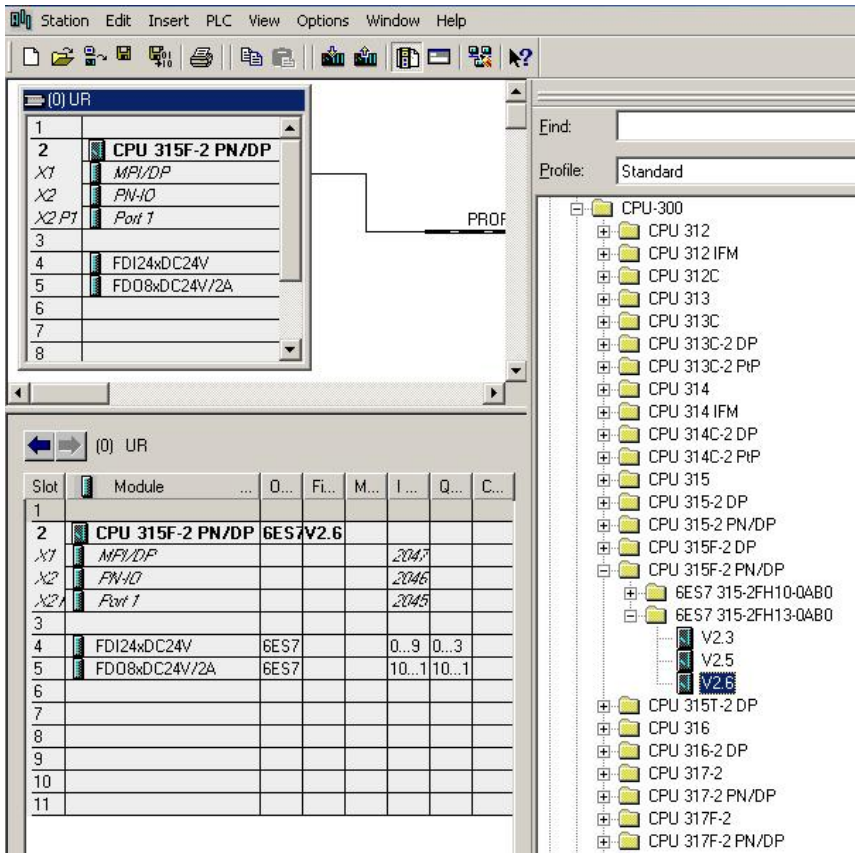
6.1   Passwords

To simplify matters, a common safety password for program and hardware is used for the SIMATIC components in the project. A common password for the drives is also used for the safety configuring of the SINAMICS components.
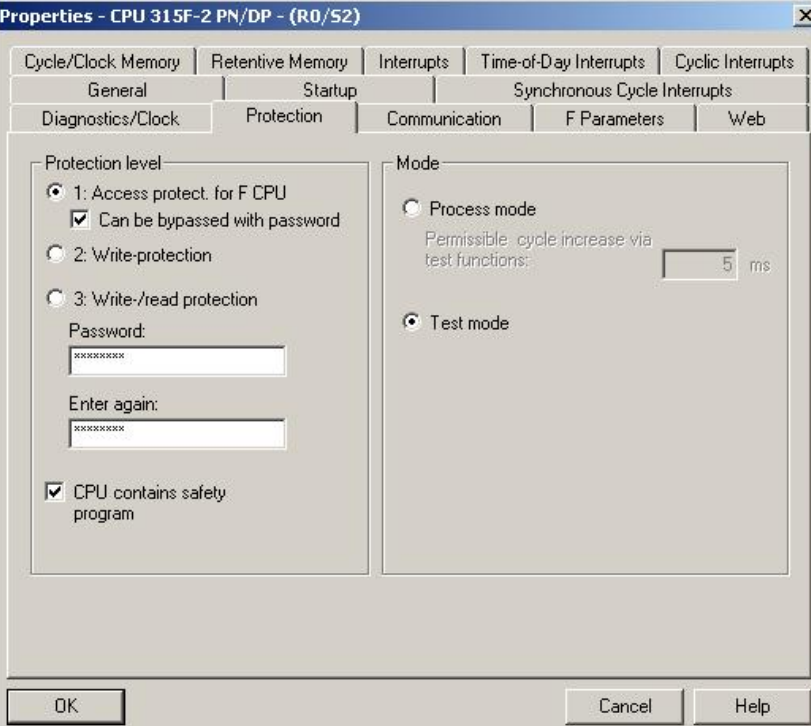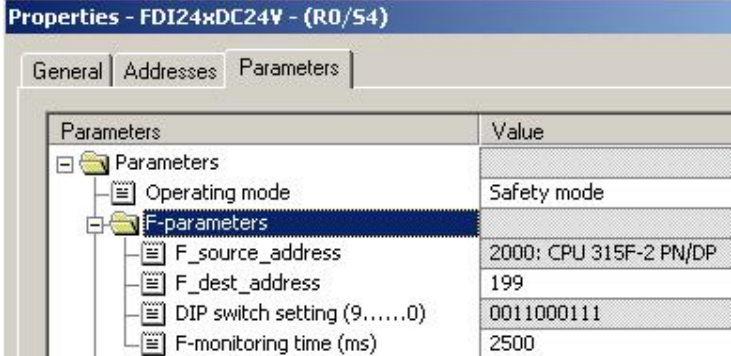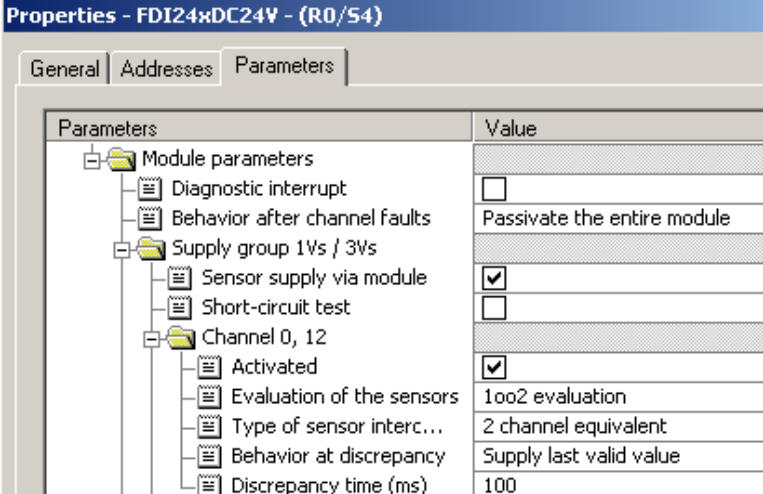
- **Safety password on F-CPU: "0"**

- **Safety password on SINAMICS: "1"**

We recommend that you change these passwords in real applications !
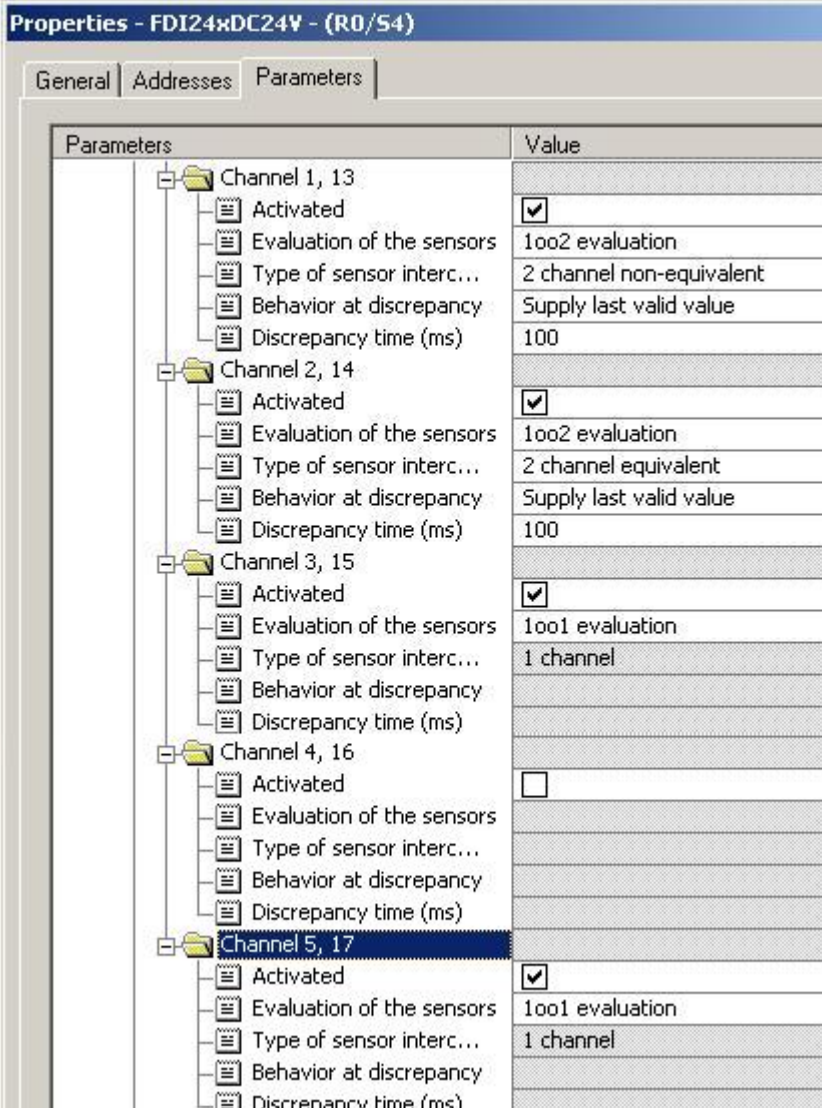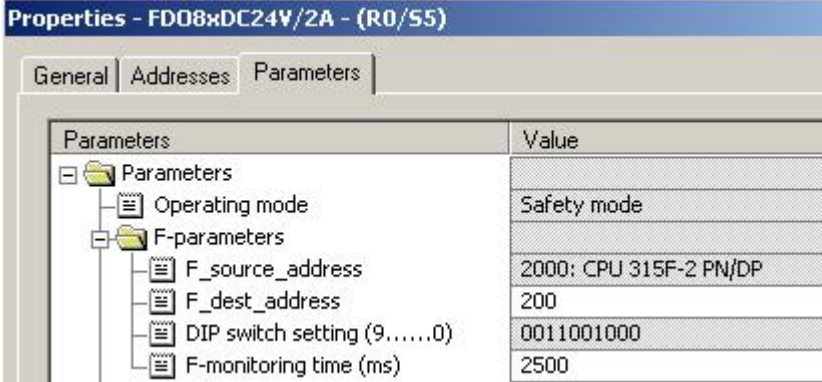
6.2   Failsafe controller hardware configuration
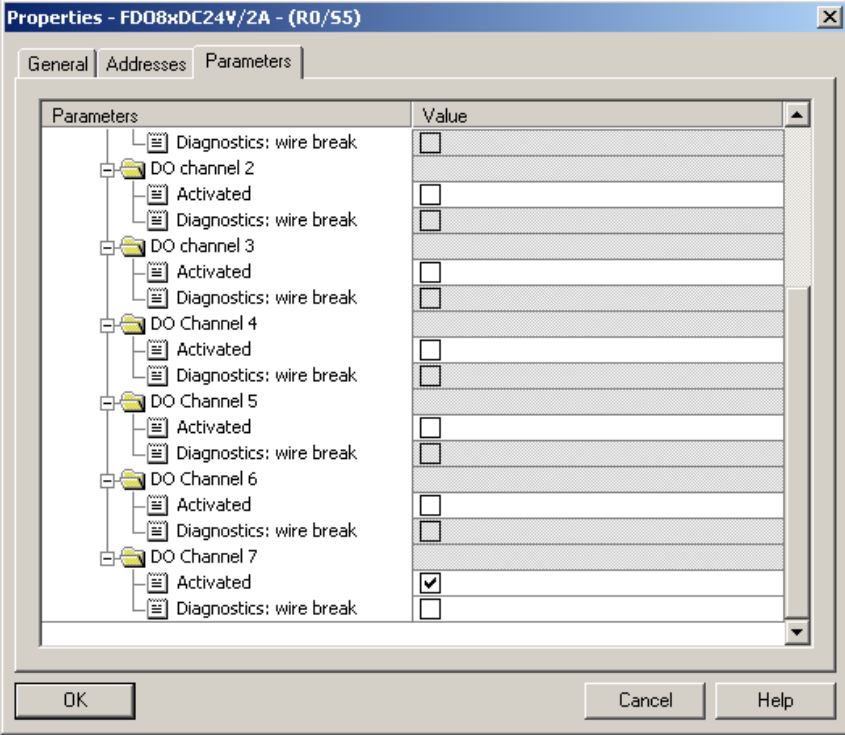
Description	Remark
In the SIMATIC Manager, enter a SIMATIC 300 station in the project.	
In the HW Config, completely create and parameterize the station. For this, move the modules included in the parts list from Chapt. 3.1 Hardware component via Drag&Drop from the catalog screen to the configuration screen. Perform address settings for the DP interface as described in Chapt. 4.3.	

Description	Remark
Configuring the F-CPU In the Properties screen of the F-CPU, activate the access protection for the F-CPU in the Protection tab and protect with a password. Activate safety program ("CPU comprises safety program.")	
Configuring the F-DI module. Configure PROFIsafe address acc. to DIL switches.	
Configuring the F-DI module. Configuring F-DI 0 (channel 0, 12)	

Description	Remark
Configuring the F-DI module. Configuring F-DI 1 (channel 1, 13) Configuring F-DI 2 (channel 2, 14) Configuring F-DI 3 (channel 3, 15) Configuring F-DI 5 (channel 5, 17)	**Properties - FDI24xDC24V - (R0/S4)** General | Addresses | Parameters Parameters — Value Channel 1, 13 Activated — ✔ Evaluation of the sensors — 1oo2 evaluation Type of sensor interc... — 2 channel non-equivalent Behavior at discrepancy — Supply last valid value Discrepancy time (ms) — 100 Channel 2, 14 Activated — ✔ Evaluation of the sensors — 1oo2 evaluation Type of sensor interc... — 2 channel equivalent Behavior at discrepancy — Supply last valid value Discrepancy time (ms) — 100 Channel 3, 15 Activated — ✔ Evaluation of the sensors — 1oo1 evaluation Type of sensor interc... — 1 channel Behavior at discrepancy — Discrepancy time (ms) — Channel 4, 16 Activated — ☐ Evaluation of the sensors — Type of sensor interc... — Behavior at discrepancy — Discrepancy time (ms) — Channel 5, 17 Activated — ✔ Evaluation of the sensors — 1oo1 evaluation Type of sensor interc... — 1 channel Behavior at discrepancy — Discrepancy time (ms) —
Configuring the F-DO module. Configure PROFIsafe address acc. to DIL switches.	**Properties - FDO8xDC24V/2A - (R0/S5)** General | Addresses | Parameters Parameters — Value Parameters Operating mode — Safety mode F-parameters F_source_address — 2000: CPU 315F-2 PN/DP F_dest_address — 200 DIP switch setting (9......0) — 0011001000 F-monitoring time (ms) — 2500

Description	Remark
Configuring the F-DO module. Configuring F-DO 7 (signal light)	
Enter SINAMICS S120 CU320 on the PROFIBUS. Set Profibus address 3. Select device version 2.5.	
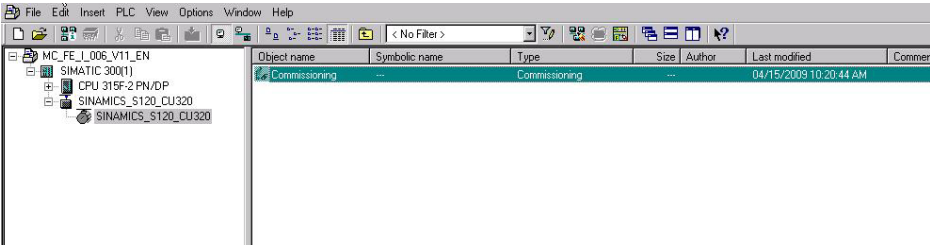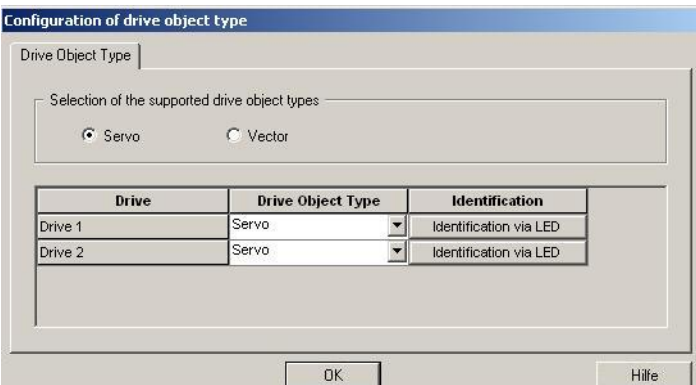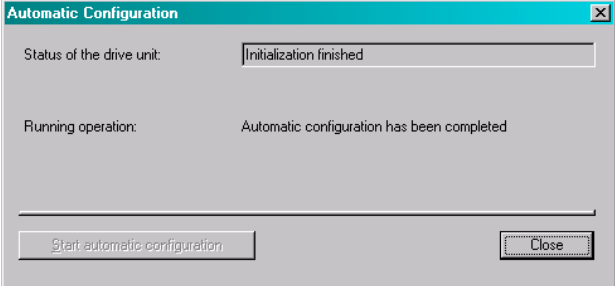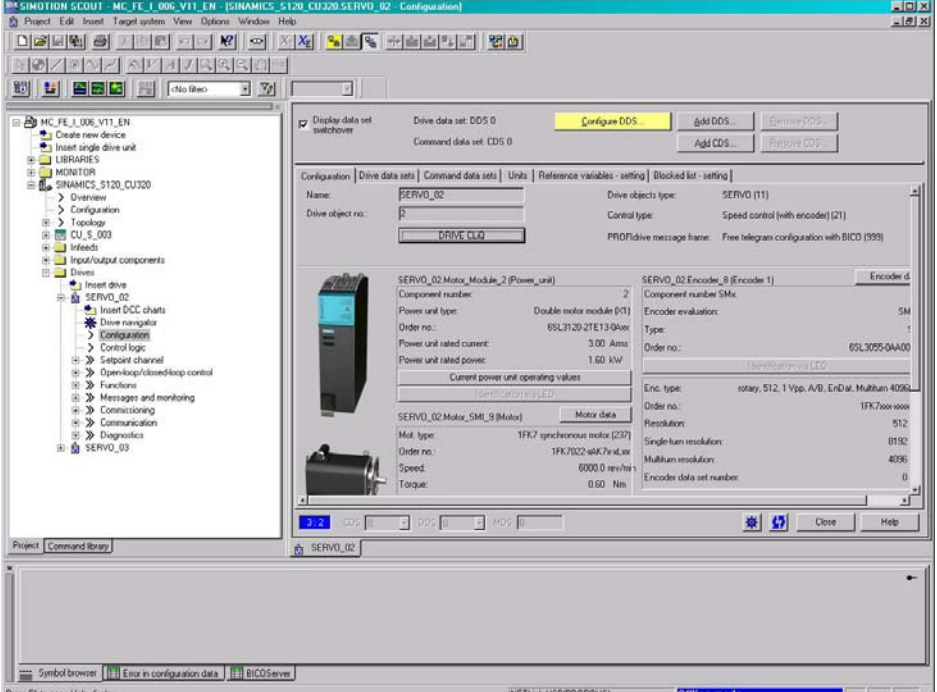
Description	Remark
Store and compile HW Config Load HW Config into the F-CPU.	

6.3   SINAMICS configuration
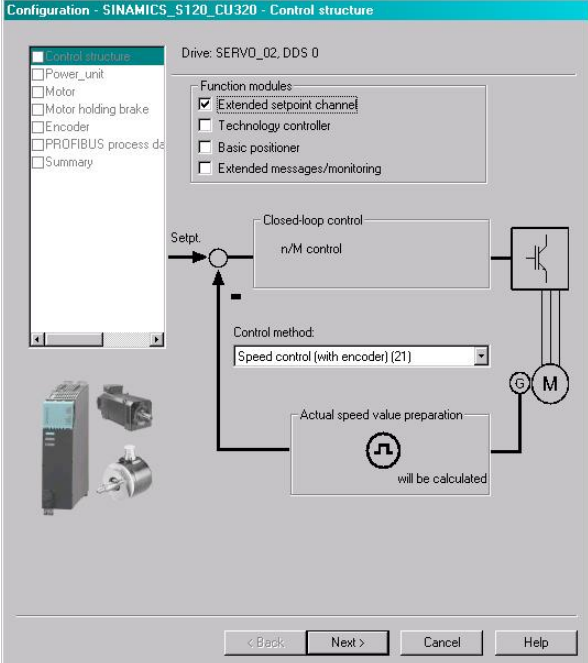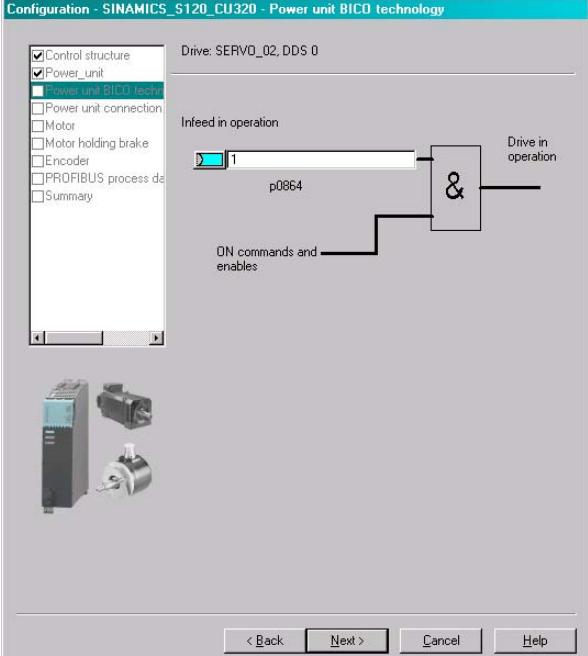
First, commission the hardware included in the drive system and set up the required movement functions.

Hardware commissioning
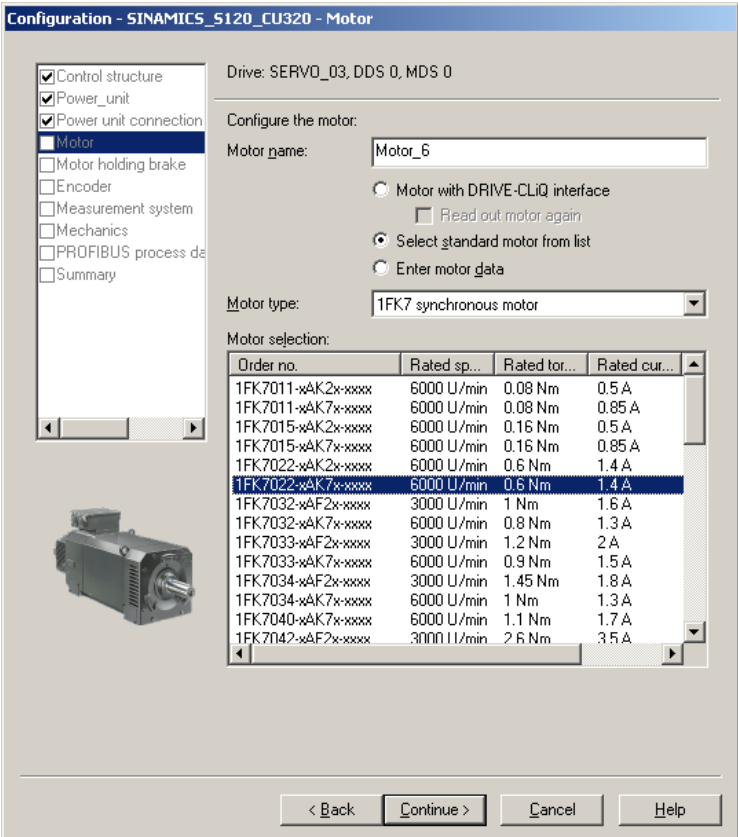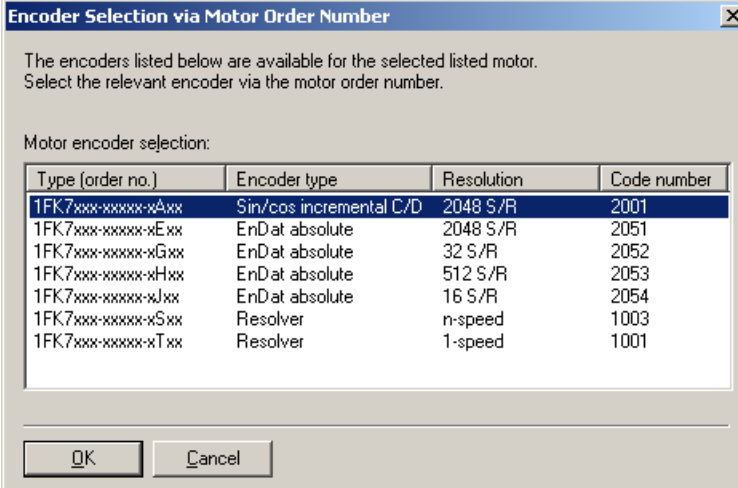
Description	Remark
Double click on commissioning to open the STARTER program.	
Go online.	
Perform the automatic first commissioning for the drive group.	
Select "Servo" as drive object type.	
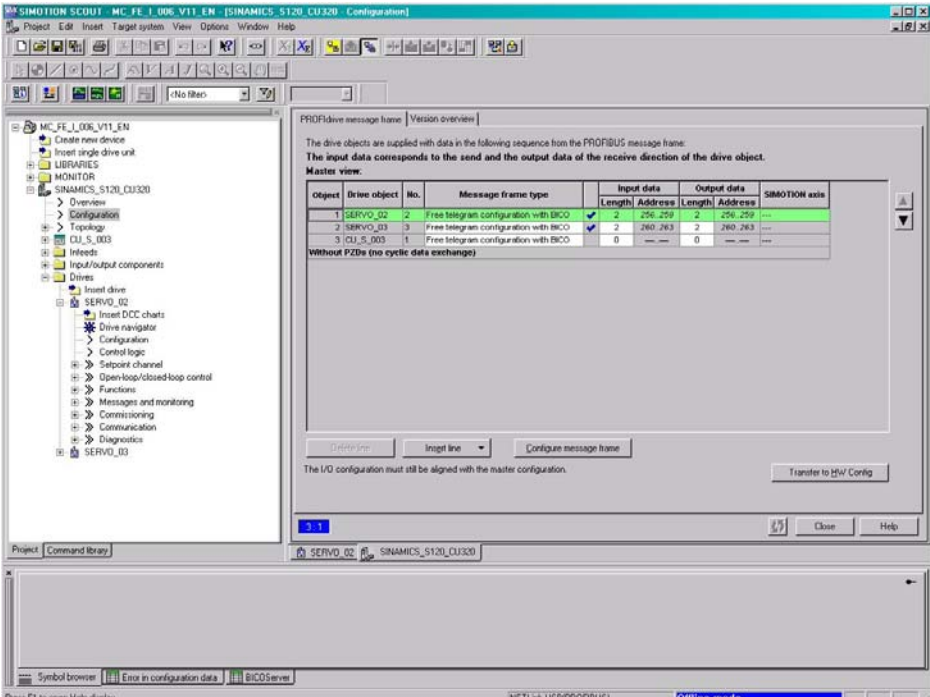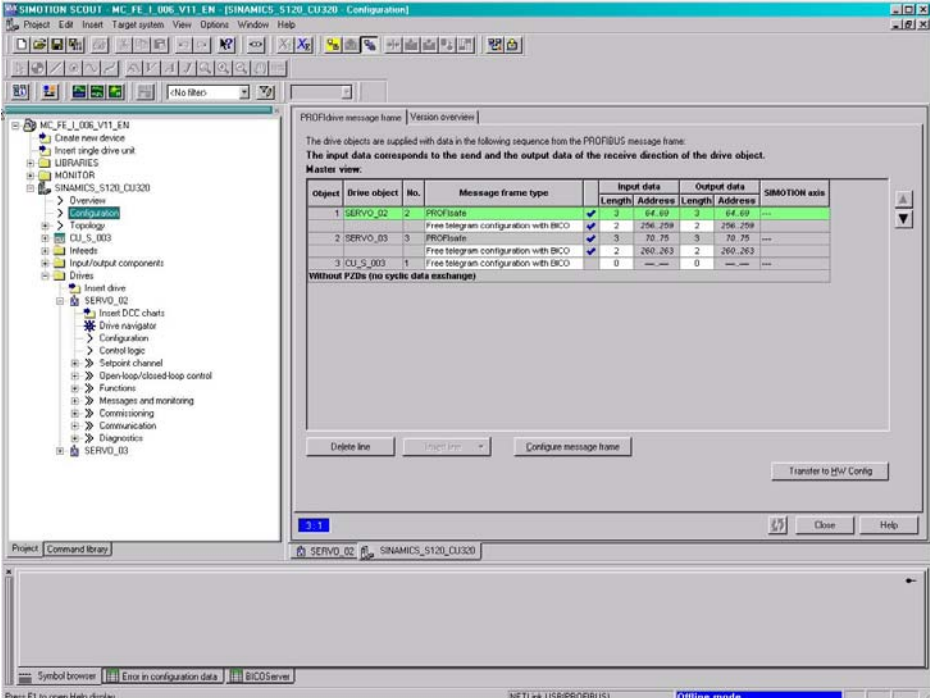
Description	Remark
Complete the automatic configuration.	
Go offline and "Store and compile"	
Reconfiguring both drives In the project navigator, open the configuration screen with drive 1 (SERVO_02). "Configure DDS" starts the guided reconfiguration. Note: The following paragraph only describes the screens to be changed.	
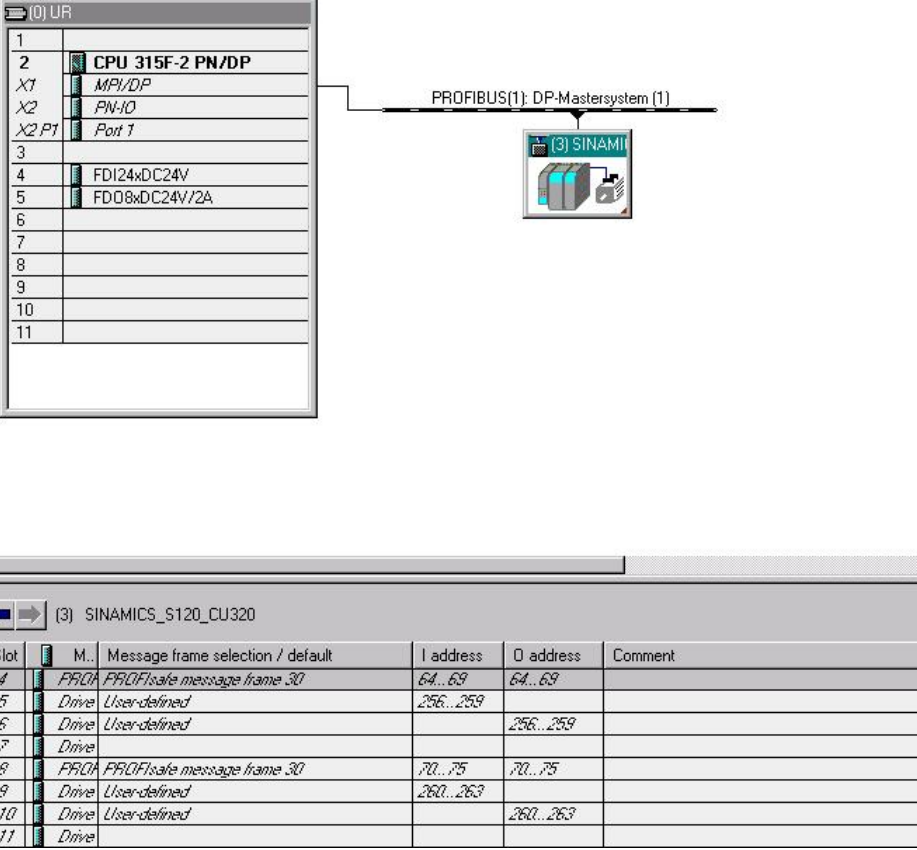
Description	Remark
Reconfiguring both drives Under control structure, activate "Extended setpoint channel".	
Reconfiguring both drives Configure a signal for "Infeed in operation" (p0864). Fixed binector 1 is used in the present example.	
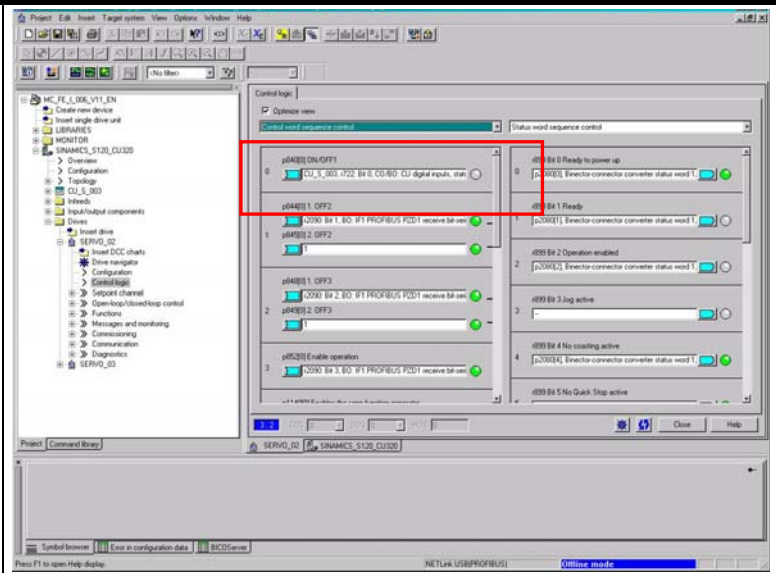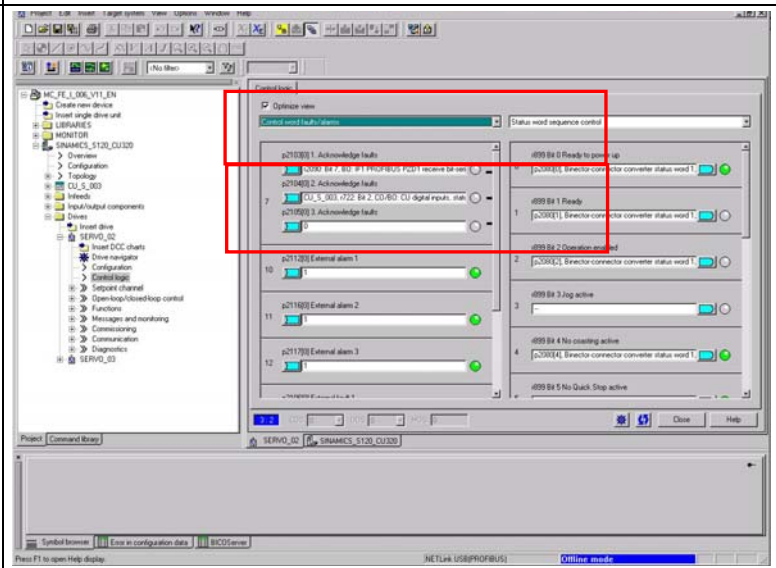
Description	Remark
Reconfiguring drive 2 The second drive is not equipped with a Drive-CliQ encoder; the motor must be selected manually. Motor shown in the example: Type 1FK7022 - 5AK71 - 1AG0.	
Reconfiguring drive 2 Like the motor, you must also manually select the encoder using the type number (MLFB).	

Description	Remark
Select standard telegram 1 for both drives. Then change to "Free telegram configuring with BICO". The telegram 1 is retained. It can, however, be later adapted for the relevant example.	
For both drives, press the buttons "Insert line" and "PROFIsafe" to create a PROFIsafe slot. Then transfer the configuration to HW Config.	

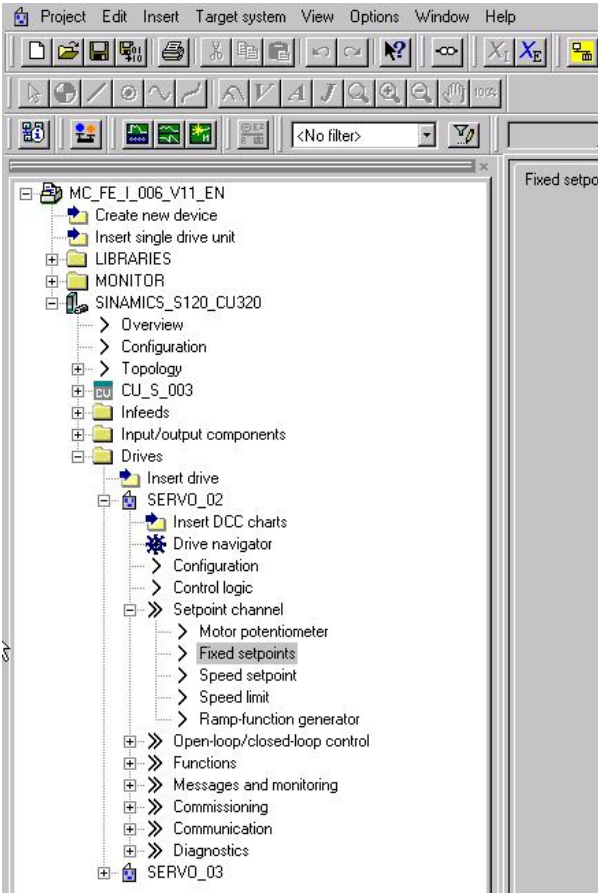| Description	Remark
The telegram selection and address assignment have been automatically entered in HW Config. The address assignment can be changed here.	
Store and compile the hardware configuration.	
Then load the hardware configuration into the target system.	
As the SLM 5 kW has no DRIVE-CLiQ interfaces, the infeed unit need not be parameterized.	**Notice** ! When using a Single Line Module for 1AC 230V (included in the training cases), adapt the dc link parameters as follows: p0210: 345V p1248[0]: 240V p1244[0]: 401V See also FAQ ID: 27038754 Upgrading/replacing a Motor Module in the SINAMICS S120 training case http://support.automation.siemens.com/WW/view/de/27038754

Movement function commissioning (without safety)

Description	Remark
Configuring both drives Under control logics, connect the ON/OFF 1 enable to digital input 0.	
Configuring both drives In the control word "Faults / warnings", connect the input "2. Acknowledge faults" to digital input 2.	
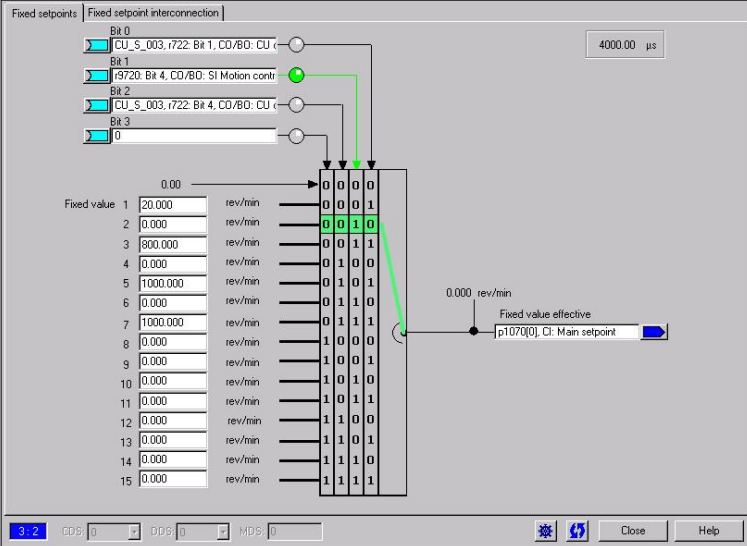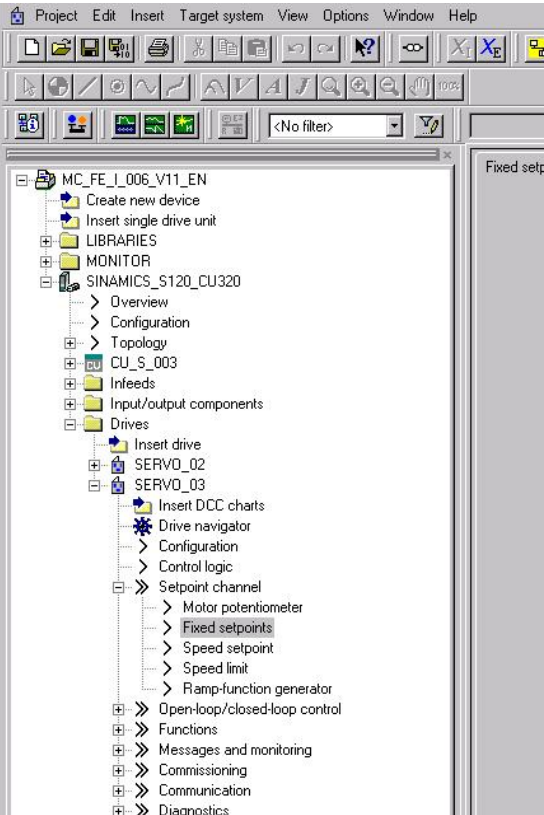
Description	Remark
Configuring both drives Under setpoint channel / ramp-up encoder, set the OFF3 ramp-down time and the standard ramp-down time.	
Configuring both drives Press button.	
Configuring both drives Set ramp-down time (p1121) such that the drive remains below the SLS limit value when selecting SLS within p9551. The OFF3 ramp-down time (p1135) is used for decelerating at SS1.	
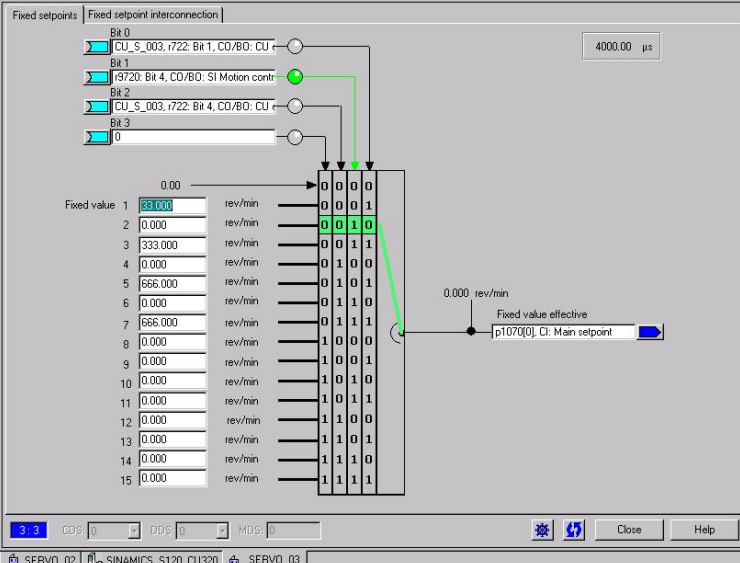
Description	Remark
Configuring drive 1 Specify drive speeds for normal mode and for the safety function SLS. For this, open the relevant setting screen under drive / setpoint channel / fixed setpoints.	

Description	Remark
Configuring drive 1 Perform the following wirings: Bit0: Control Unit DI0 Bit1: r9720.4 (SLS deselected) Bit2: Control Unit DI4 Bit3: 0 The following fixed values must be entered: Fixed value 1: 20 rpm Fixed value 3: 800 rpm Fixed value 5: 1000 rpm Fixed value 7: 1000 rpm Fixed setpoint active p1024 must be connected to p1070 main setpoint. **Explanation:** When the signal "SLS deselected" is active, the protective door is closed and high speed is specified. With a low signal, the system changes from high speed to low speed. When actuating–S9 (DI 4), a fixed speed of n=1000 rpm is preset while the drive is running, independently of the status of the protective door.	

Description	Remark
Configuring drive 2 Specify drive speeds for normal mode and for the safety function SLS. For this, open the relevant setting screen under drive / setpoint channel / fixed setpoints.	

Description	Remark
Configuring drive 2 Perform the following wirings: Bit0: Control Unit DI0 Bit1: r9720.4 (SLS deselected) Bit2: Control Unit DI4 Bit3: 0 The following fixed values must be entered: Fixed value 1: 33 rpm Fixed value 3: 333 rpm Fixed value 5: 666 rpm Fixed value 7: 666 rpm Fixed setpoint active p1024 must be connected to p1070 main setpoint. **Explanation:** When the signal "SLS deselected" is active, the protective door is closed and high speed is specified. With a low signal, the system changes from high speed to low speed. When actuating–S9 (DI 4), a fixed speed of n=1000 rpm is preset while the drive is running, independently of the status of the protective door.	
Store project.	
Go online.	
Load project into the target device and copy RAM to ROM.	

6.4   SIMATIC – generating the standard program

In this functional example, standard programs are not required because the drives are only controlled via BICO wirings in SINAMICS. For most of the real applications, we expect a program that is independent of the safety program and uses a standard telegram.

In this example, only the enables required are specified in the control word in OB1.

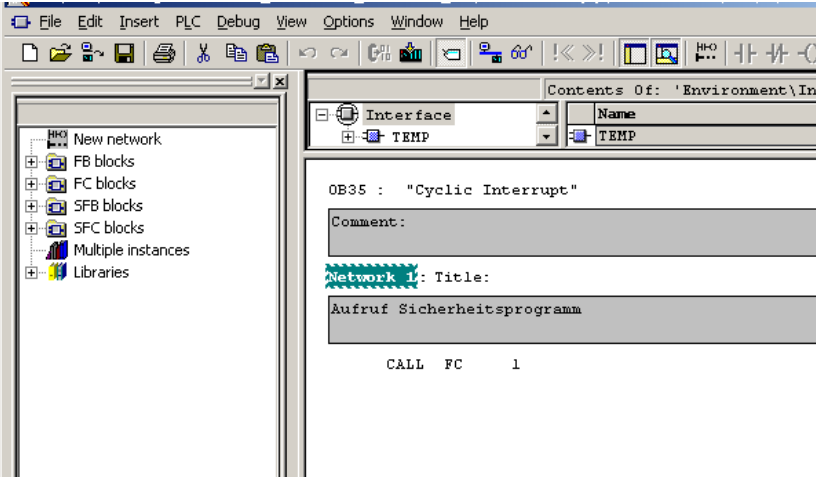| Description	Remark
OB1: Permanent writing of all enables on the STW	OB1 : "Main Program Sweep (Cycle)" Comment: Network 1: Transmit dummy STW (Bit Master control by PLC) Comment: L 1150 T AW 256 T AW 260

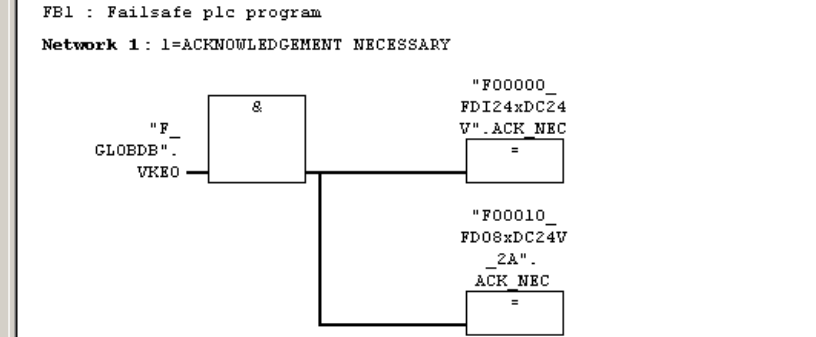## 6.5   Programming the failsafe controller

In this example, the safety program in the F-CPU is processed in the fail-safe function block FB1. A simple program sequence illustrates the functions. More detailed information regarding the complex safety logics and supplementary conditions applying when creating the safety program is included in the relevant functional examples and the Distributed Safety manuals.
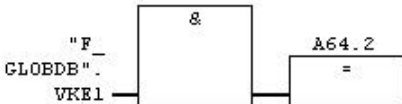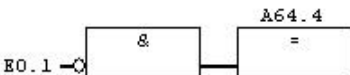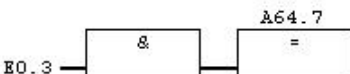
Notice:
Such programs may not be used for real applications.

Start with the F-Call block which is required to call up the safety program. For this, insert a function (here FC1) in the block directory using the generation language F-Call. The alarm OB35 is required for a cyclical call of the safety program.
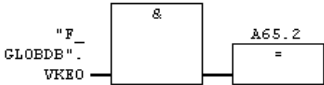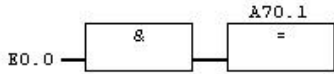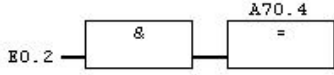
In this example, the safety program is processed in a function block (here FB1); that means the FB 1 must be inserted using the generation language F-KOP or F-FUP.

Description	Remark
Programming OB35 Call up the safety program	
Programming FB1 Network 1: Activate automatic acknowledgement	
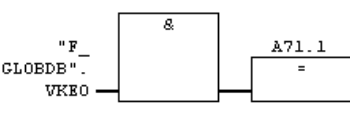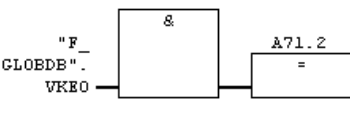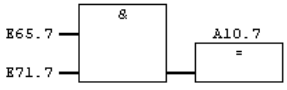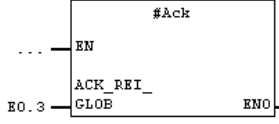
Description	Remark
Drive 1: Address 64 corresponds to byte 0 on the PROFIsafe data block. Network 2: - Permanent deselection of the function STO with VKE1 on the PROFIsafe STW. Network 3: -S1 (emergency stop) is connected to PROFIsafe STW with SS1. Network 4, 5: - Permanent deselection of the functions SS2 and SOS with VKE1 on the PROFIsafe STW. Network 6: -S2 (protective door 1) is connected to PROFIsafe STW with SLS. Inversion required because -S2 has been connected as NO contact/NC contact Network 7: -S4 (acknowledge) is connected to PROFIsafe STW with internal event acknowledge.	Network 2: PROFIsafe Drive 1 STO "F_GLOBDB".VKE1 — & — A64.0 = Network 3: PROFIsafe Drive 1 SS1 E0.0 — & — A64.1 = Network 4: PROFIsafe Drive 1 SS2 "F_GLOBDB".VKE1 — & — A64.2 = Network 5: PROFIsafe Drive 1 SOS "F_GLOBDB".VKE1 — & — A64.3 = Network 6: PROFIsafe Drive 1 SLS E0.1 —O & — A64.4 = Network 7: PROFIsafe Drive 1 acknowledgement E0.3 — & — A64.7 =
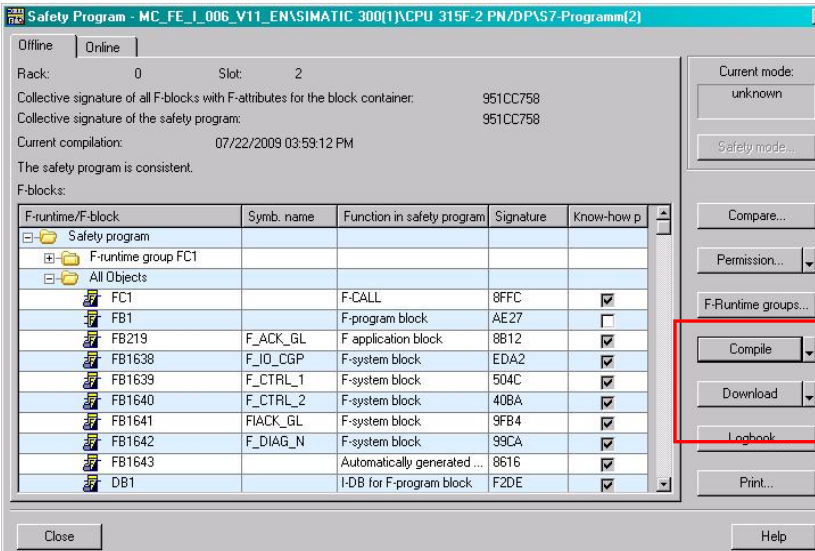
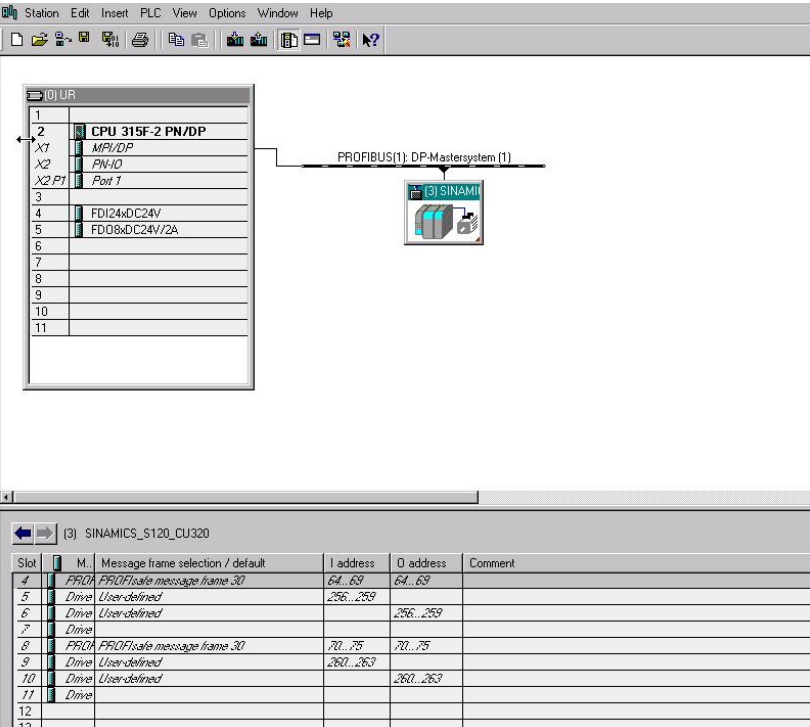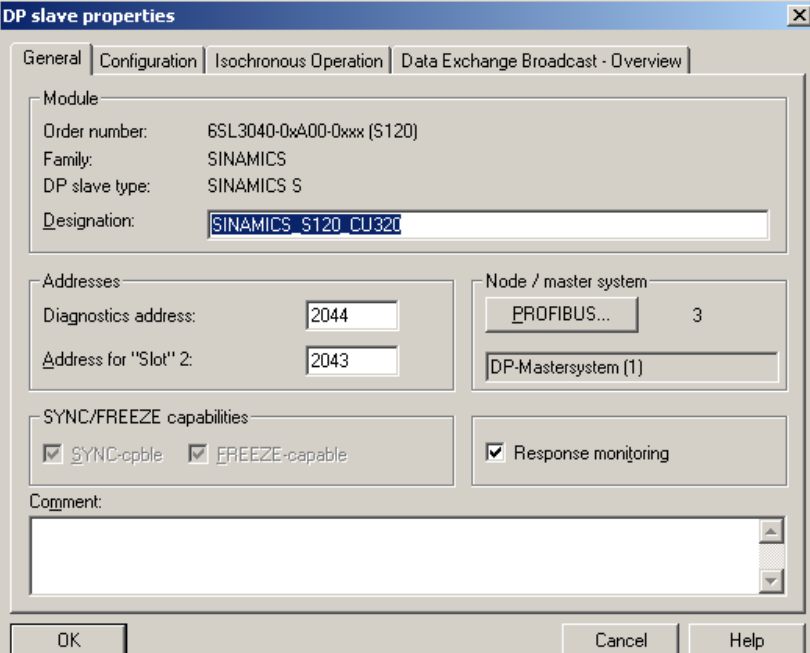| Description	Remark
Drive 1: Address 65 corresponds to Byte 1 on the PROFIsafe data block. Network 8 and 9: - Permanent selection of the SLS velocity step 1 on the PROFIsafe STW.	**Network 8** : PROFIsafe Drive 1 SLS velocity step Bit 0 "F_GLOBDB".VKE0 — & — A65.1 = **Network 9** : PROFIsafe Drive 1 SLS velocity step Bit 1 "F_GLOBDB".VKE0 — & — A65.2 =
Drive 2: Address 70 corresponds to Byte 0 on the PROFIsafe data block. Network 10: - Permanent deselection of the function STO with VKE1 on the PROFIsafe STW. Network 11: -S1 (emergency stop) is connected to PROFIsafe STW with SS1. Network 12, 13: - Permanent deselection of the functions SS2 and SOS with VKE1 on the PROFIsafe STW. Network 14: -S3 (protective door 2) is connected to PROFIsafe STW with SLS. Network 15: -S4 (acknowledge) is connnected to PROFIsafe STW with internal event	**Network 10** : PROFIsafe Drive 2 STO "F_GLOBDB".VKE1 — & — A70.0 = **Network 11** : PROFIsafe Drive 2 SS1 E0.0 — & — A70.1 = **Network 12** : PROFIsafe Drive 2 SS2 "F_GLOBDB".VKE1 — & — A70.2 = **Network 13** : PROFIsafe Drive 2 SOS "F_GLOBDB".VKE1 — & — A70.3 = **Network 14** : PROFIsafe Drive 2 SLS E0.2 — & — A70.4 = **Network 15** : PROFIsafe Drive 2_acknowledgement E0.3 — & — A70.7 =

Description	Remark
acknowledge.	
Drive 2: Address 71 corresponds to Byte 1 on the PROFIsafe data block. Network 16 and 17: - Fixed selection of the SLS velocity step 1 on the PROFIsafe STW.	**Network 16** : PROFIsafe Drive 2 SLS velocity step Bit 0 "F_ GLOBDB". VKE0 —&— A71.1 = **Network 17** : PROFIsafe Drive 2 SLS velocity step Bit 1 "F_ GLOBDB". VKE0 —&— A71.2 =
Network 18: Activation of signal light in S4 with safe standstill detection. Network 19: -S4 is used for reintegration of all components.	**Network 18** : Switching the lamp in switch S4 E65.7 —&— A10.7 = E71.7 **Network 19** : Reintegration of all f-slaves #Ack ... — EN ACK_REI_ E0.3 — GLOB ENO
Creation of a new F runtime group Here, the safety program (FB1) is assigned to the FC1, the relevant I-DB is defined.	**Define New F-Runtime Group** F-CALL block: FC1 F-program block: FB1 I-DB for F-program block: DB1 Max. cycle time of the F-runtime in ms: 200 DB for F-runtime group communication: --- OK Cancel Help
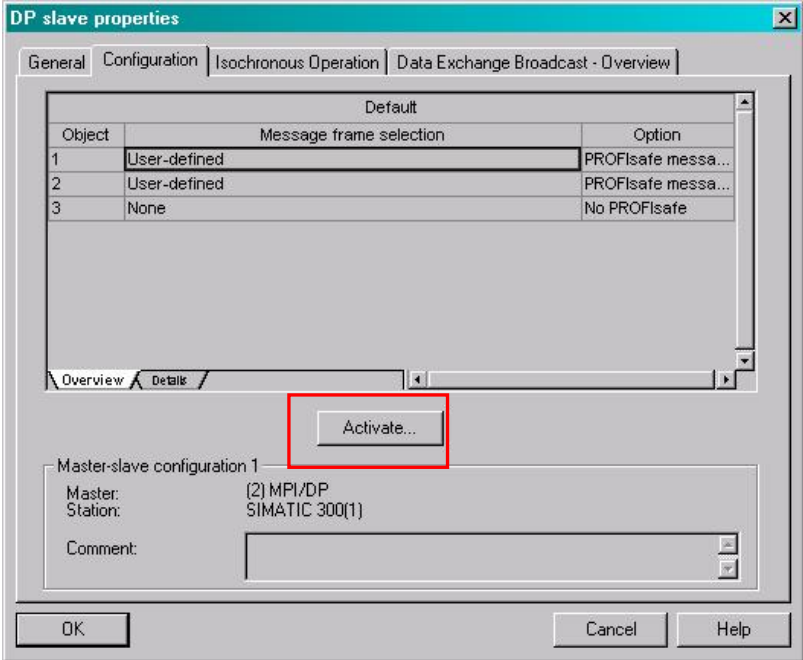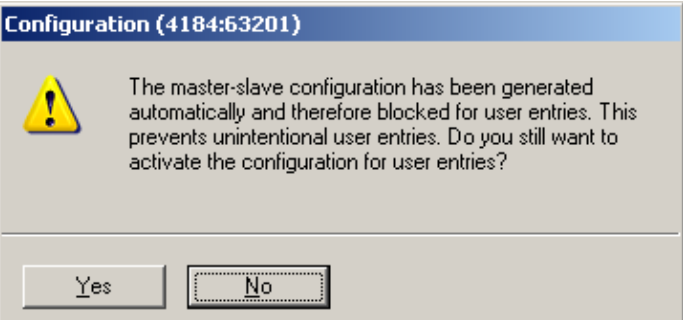
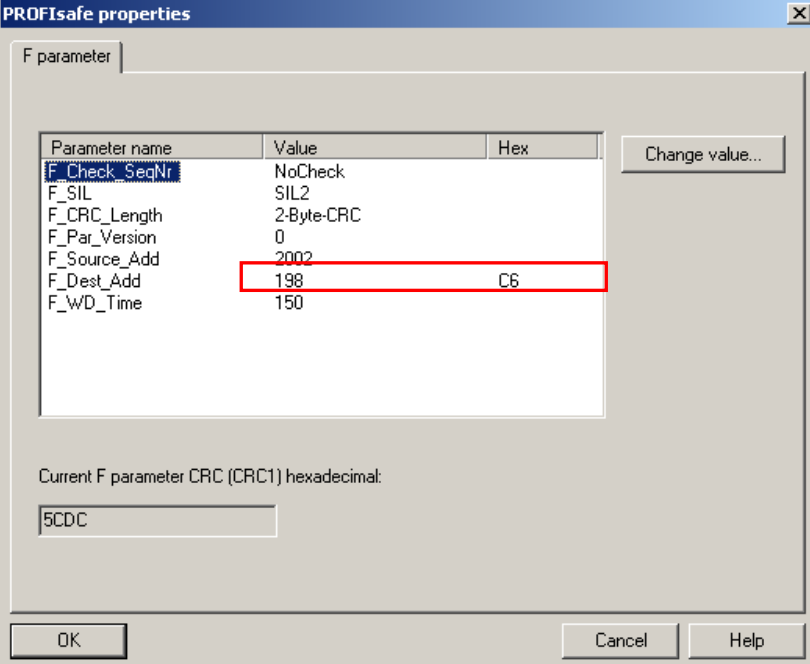| Description	Remark
Then generate the safety program and load it into the CPU. In addition, load the standard blocks into the F-CPU.	
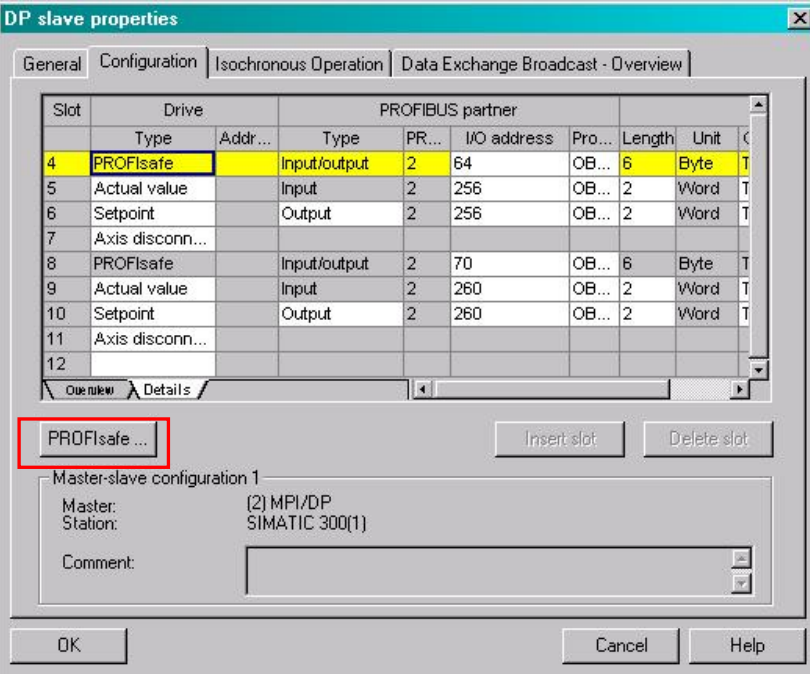
6.6   Parameterizing the safety function activation (PROFIsafe)

Description	Remark
Open HW Config	
Double click on SINAMICS to open the DP slave properties.	

Description	Remark
Under the "Configuration" tab, press the "Activate…" button.	
Press the "Yes" button to confirm the message	

Description	Remark
Press the "PROFIsafe" button to make further settings.	
The value of F_Dest_Add must be entered in hex format in the Starter for drive 1. In this example, c6hex for drive 1 and c5hex for drive 2. See also Chapt. 6.7 SINAMICS – Parameterizing the drive-integrated safety functions **Note:** The watchdog time (F_WD_Time = 150msec) must fit to the OB35 cycle. In the example, it is 100msec.	
Make settings for drive 2 analogously to drive 1.	
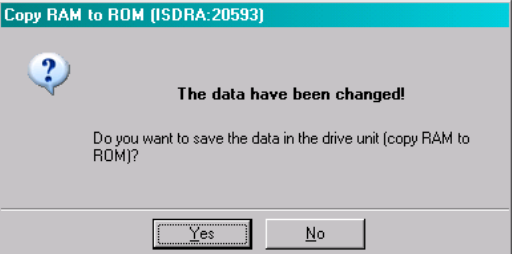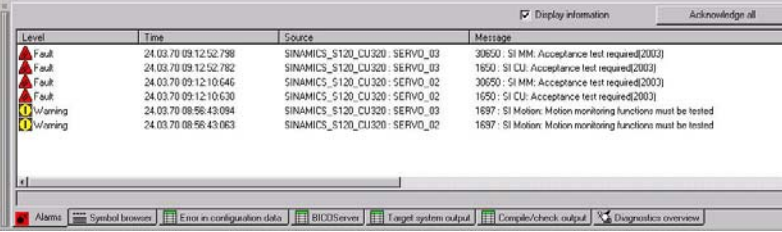
Description	Remark
Store and compile the hardware configuration.	
Then load the hardware configuration into the target system.	

6.7　　　　SINAMICS – Parameterizing the drive-integrated safety functions

Description	Remark
In the Starter, go online.	
Configuring both drives Open the "Safety integrated" screen of drive 1/2 (SERVO_02 / SERVO_03) and activate commissioning mode with "Change settings". The first commissioning password is "0".	
Configuring both drives Change control selection to "Motion monitoring via PROFIsafe".	
Configuring both drives Confirm message with "OK".	

Description	Remark
Configuring both drives Click on "configuration".	
Configuring both drives Configure the following in the example: PROFIsafe address with c6hex (for drive 1) resp. C5hex (for drive 2) Drive type: Rotary axis/spindle Signal source test stop with DI3 of SINAMICS.	
The drive encoder data are entered in the "Encoder synchronization" screen. The values need not be changed in this example.	
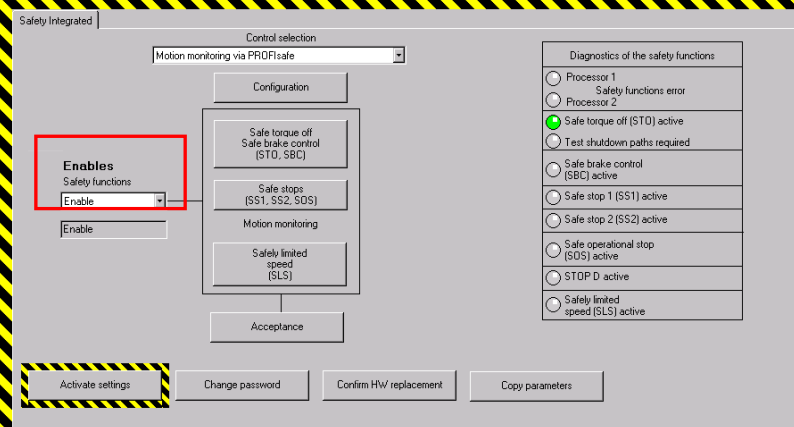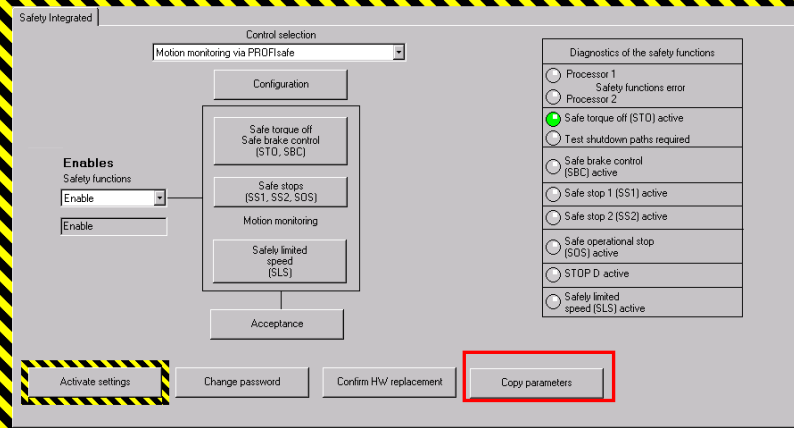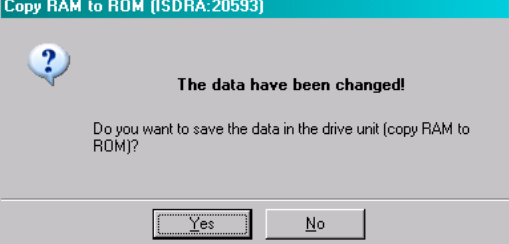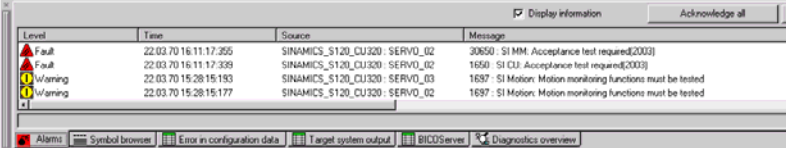
Description	Remark
Configuring both drives Click on "Activate settings".	Activate settings
Configuring both drives During commissioning, you are re-quested to change the safety pass-word. The password preset for first commissioning is "0". In the exam-ple, the new password is the value "1".	Password — Change password: Password up-to-date, New password, Confirm password, OK, Cancel, Help
Configuring both drives Click on "Entire project" to save the changes in the drive.	Do you want to save? — The project must be saved and then a restart performed for the new safety parameters to take effect! An acceptance test is also required. Entire project / Axis parameters / No
Configuring both drives Confirm the following message with "Yes". The data are copied from RAM to ROM.	Copy RAM to ROM (ISDRA:20593) — The data have been changed! Do you want to save the data in the drive unit (copy RAM to ROM)? Yes / No
Repeat this procedure for the second drive !	
Then perform a power ON reset of the Control Unit.	POWER ON
Go online, load the configuration into the PG and store. As from now, the speed is displayed in rpm instead of mm/min in the safety parameterization screen.	
Checksum errors occur after POWER ON. These are caused by the modified data structure, when switching on from linear axis to ro-tary axis. These errors can be corrected by restarting to copy parameters in the safety screen. In this example, this is done during the next parameterization.	Display information — Acknowledge all — Level / Time / Source / Message alarms list

Description	Remark
In the "Safe Stops" screen, enter the following values for the relevant example: Delay time SS1 -> pulse suppression = 400msec Delay time Stop C /SS2 -> SOS active = 400msec Acceleration monitor = 300 rpm Shutdown speed SS1 = 0mm/min Standstill tolerance SOS = 1.0deg	
In the screen "safely limited speed (SLS)", enter the maximum limit speed (limit speed: Speed permissible with open protective door). Only step 1 is used for speed monitoring. In addition, select the stop reaction initiated in case of limit value violation. (STOP C - internal SS2) Within the delay time "selection SLS -> SLS active" (p9551), the drive speed must be below the limit value n_max. The following is entered in the example: Delay time SLS -> SLS active: 500ms N max with step 1: 25 rpm for drive 1 40 rpm for drive 2	

Description	Remark
Enable safety functions.	
Click on "Copy parameters" to accept the settings made.	
Click on "Activate settings".	
Click on "Entire project" to save the changes in the drive.	
Confirm the following message with "Yes". The data are copied from RAM to ROM.	
Repeat this procedure for the second drive !	

Description	Remark
Acknowledge messages regarding the acceptance test; Notice: On real machines, an acceptance test must be performed. See also Chapter 6.9 Acceptance test.	
Copy RAM to ROM (on SINAMICS Integrated).	
Then perform a power ON reset of the Control Unit.	POWER ON
Go online, load the configuration into the PG and store.	

After completing the safety commissioning for all drives, you can traverse the drives with deselected emergency stop.

The use of drive-integrated safety functions is selected, these can be activated resp. deactivated via the control elements on the F-CPU.

Only the following messages should be displayed.
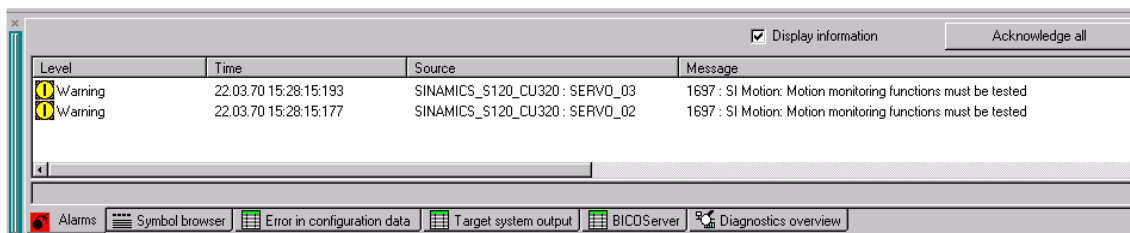
These messages do not influence the functionality described above. They only state that the test stop of the safety functions is required on the drives (A1697). These are warnings, that means the drives can be activated and traversed as soon as the SIMATIC S7 configuration has been completed.

In this example, the test stop can be performed via switch S9 (DI3).

6.8   Downloading the sample project

In the previous paragraphs you have learned step by step how to generate the configuration of the functional example. If you wish to load the sample project directly onto the hardware, you have to observe the following.

First perform a general reset of all components (S7-F-CPU and SINAMICS S120) resp. reset them to the factory setting.

6.8.1   Loading the S7-F-CPU configuration

First, download the hardware configuration of the S7-F-CPU. Double click on "Hardware" to open the hardware configuration.
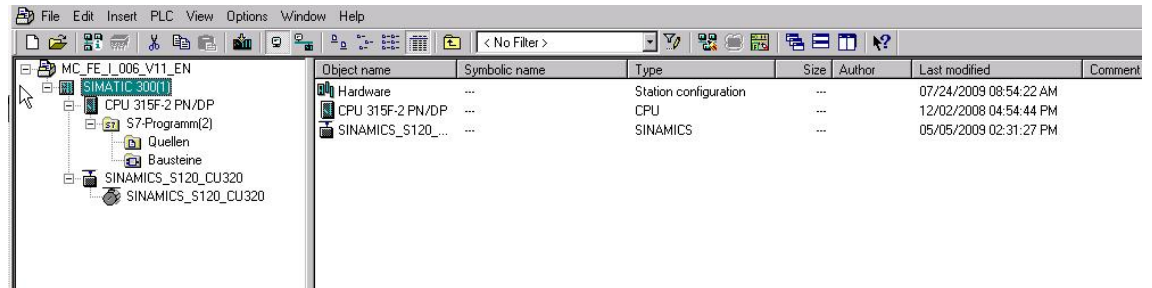
Depending on the preset values resp. the previous F-CPU configuration, you may have to adapt the baudrate of the PC/PG interface in order to download the F-CPU hardware configuration.

Note:

If a safety program has already been installed on the CPU, this is password-protected. You must know this password for downloading. If you do not know the password, you have to delete the memory card using a suitable device (e.g. SIEMENS PG). The card is destroyed when being deleted resp. formatted with a card reader.

After successfully downloading the hardware configuration, load the program blocks onto the F-CPU.
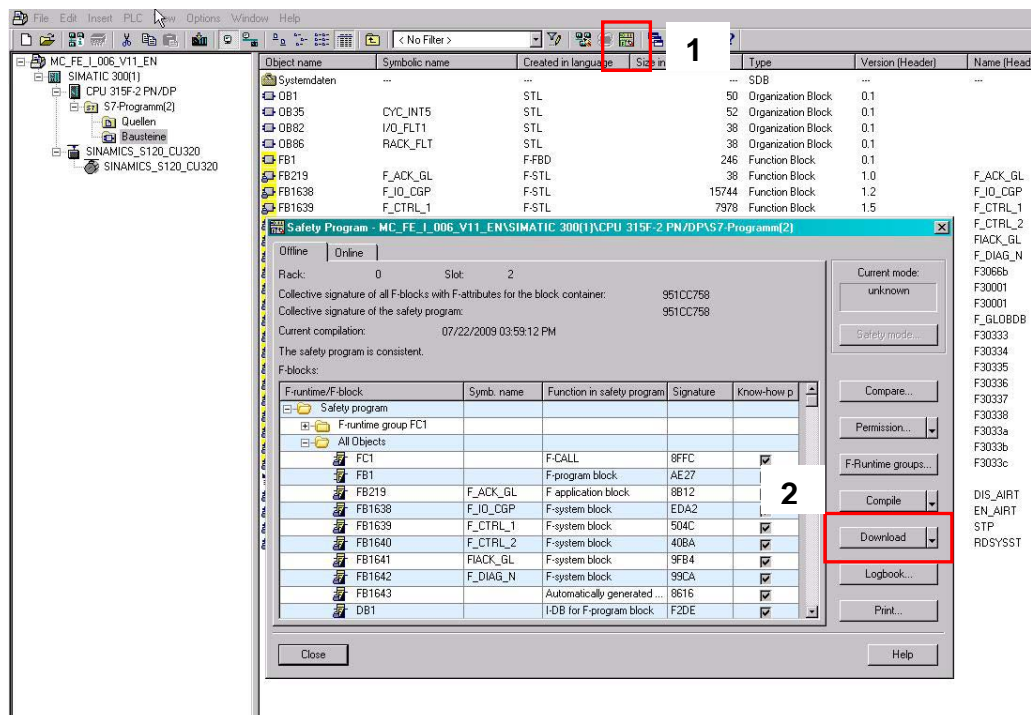
Press the "yellow" button in the function bar to open the screen for loading the safety function. In this screen, press the "Load" button to initiate the download. The remaining (non-failsafe) blocks are loaded as usual.

6.8.2   Loading the SINAMICS S120 configuration

The configuration can be directly loaded into the SINAMICS S120. As the serial numbers of the encoder modules do not correspond to the devices used for generating the sample project, various safety faults are pending after the download. Analogously to series commissioning, the new serial numbers must be entered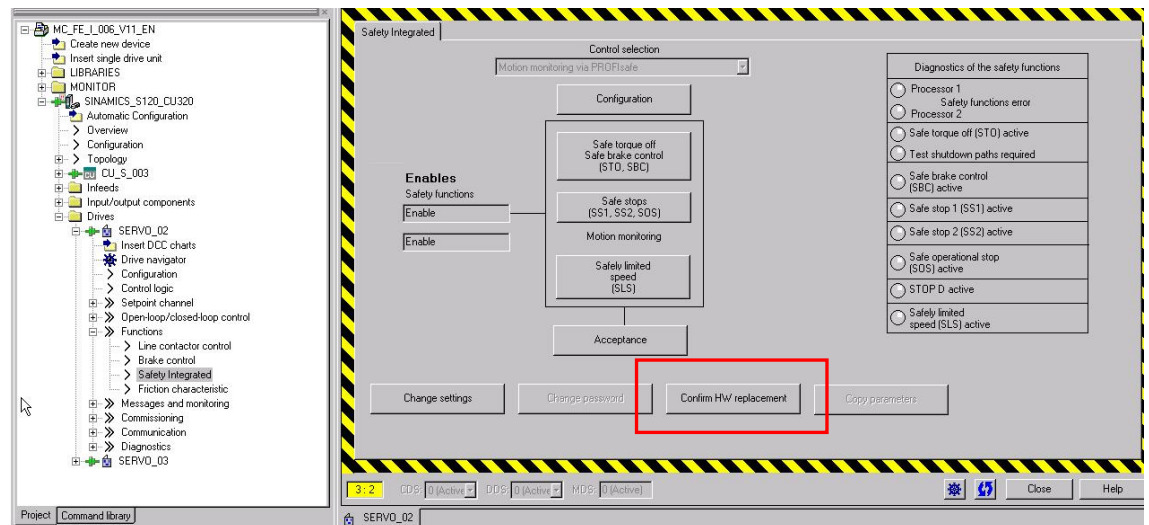 into the safety configuration. This is performed via "Acknowledge hardware replacement". A very simple method is to open the safety screen on **both** drives and press the "Acknowledge hardware replacement" button.

Then, start the saving procedure from RAM to ROM for the SINAMICS and perform a restart (power ON reset).

6.9   Acceptance test

In order to verify safety-related parameters, an acceptance test must be performed when first commissioning the machine resp. changing the safety-related parameters. The acceptance test must be recorded accordingly. The acceptance certificates must be properly stored and archived.

The acceptance test must be performed after successful parameterization and power ON reset.

More detailed information regarding the acceptance test, acceptance certificate as well as an example for an acceptance certificate are provided in the "Function Manual SINAMICS S120 Safety Integrated" (FHS) , Chapter Acceptance test and acceptance certificate.

7 History

Table 7-1 History

Version	Date	Change
V1.0	May 9, 2008	First edition
V1.1	July 24, 2009	Revision