SINAMICS S110
EPOS via FB283

Control via PROFIBUS – Safety via F-DI

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1 Automation function

1.1 Description of the functionality

The SINAMICS S110 frequency converter is a modular, single-axis drive with the basic positioning function. It comprises the function units Control Unit (CU) and Power Module (PM).

When using the CU305 DP, a PROFIBUS DP interface is available. It is possible to exchange data between the converter and the control system via this interface.

The safety-relevant applications can be controlled via fail safe digital inputs (F-DI) or PROFIsafe in this function example the safety-relevant applications are controlled via F-DI.

2 Functionality of the function example

2.1 Task description

The SINAMICS S110 should be controlled via a fieldbus (PROFIBUS) from an S7 300 CPU. In this case, it should also be possible to change the traversing blocks from the control system.

Optionally, the safety functions should be used.

2.2 Solution

In this function example, function block FB 283 is used for this purpose. FB 283 controls the cyclic communication, and offers various types of non-cyclic jobs. This also includes a function to read and write traversing blocks, but also a user-friendly option of changing or reading any parameters.

User-specific data types (User Defined Types / UDTs) are used to improve the transparency and increase the flexibility by appropriately structuring large quantities of data.

If the safety functions of the S110 are to be used, then a corresponding chapter is provided in these instructions where it is described as to how the functions are set-up.

In addition, there are extended safety functions, what are known as motion monitoring functions. These require a license and are not discussed in this example.

2.3 Structure of the function example

The function example is sub-divided into various steps. First of all, the technical prerequisites for use are shown and how the components are connected up.

Commissioning and operation then follow, which are shown using the function example provided.

For the case that you wish to create your own project, in Chapter 7, an explanation is provided as to how you can create your own program example.

3 Components required

This example is intended for the SINAMICS S110 demonstration case (MLFB 6AG1067-1AA18-0AA0). If instead of this, you wish to use a design with a different configuration, then you can use the following products. It can also be implemented with compatible components. To do this, it may be necessary to change the hardware configuration (HW Config) or in the STARTER parameterizing tool.

3.1 Hardware components

Table 3-1

Component	Qty.	MLFB/order number	Note
Power supply PS307 5A	1	6ES7307-1EA00-0AA0	
S7-300-CPU CPU 315-2 PN/DP	1	6ES7315-2EH13-0AB0	
Memory Card e.g. MMC 512 kB	1	6ES7953-8LJ11-0AA0	
Mounting rail	1	6ES7390-1AE80-0AA0	
PROFIBUS connector	2	6ES7972-0BB50-0XA0	
PROFIBUS cable	2 m	6XV1830-3BH10	
SINAMICS S110 CU CU305 DP – FW 4.4	1		
SINAMICS S110 PM PM340	1	6SL3210-1SB12-3AA0	
Motor Synchronous servomotor	1	1FK7022-5AK71-1DA0	For Safety, a sin/cos encoder is required for synchronous motors

3.2 Software components

Table 3-2

Component	Qty.	MLFB/Order No.	Note
STARTER V4.2 commissioning tool	1	6SL3072-0AA00-0AG0 Or download from http://support.automation.siemens.com/WW/view/de/26233208	
STEP 7 V5.5	1	6ES7822-1AA01-0YA5	Alternatively: 5.4 SP5
Distributed Safety V5.4	1	6ES7833-1FC02-0YA5	min. 5.4 SP5

Example files and projects

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

Table 3-3

Component	Note
S110STD.zip	<This zip file includes the STEP 7 project.>
S110STD.pdf	This document.
....	....

4 Structure and wiring

The chapter describes the hardware design and how to connect up the function example.

Carefully observe the subsequent safety notes regarding the use of SINAMICS S110:

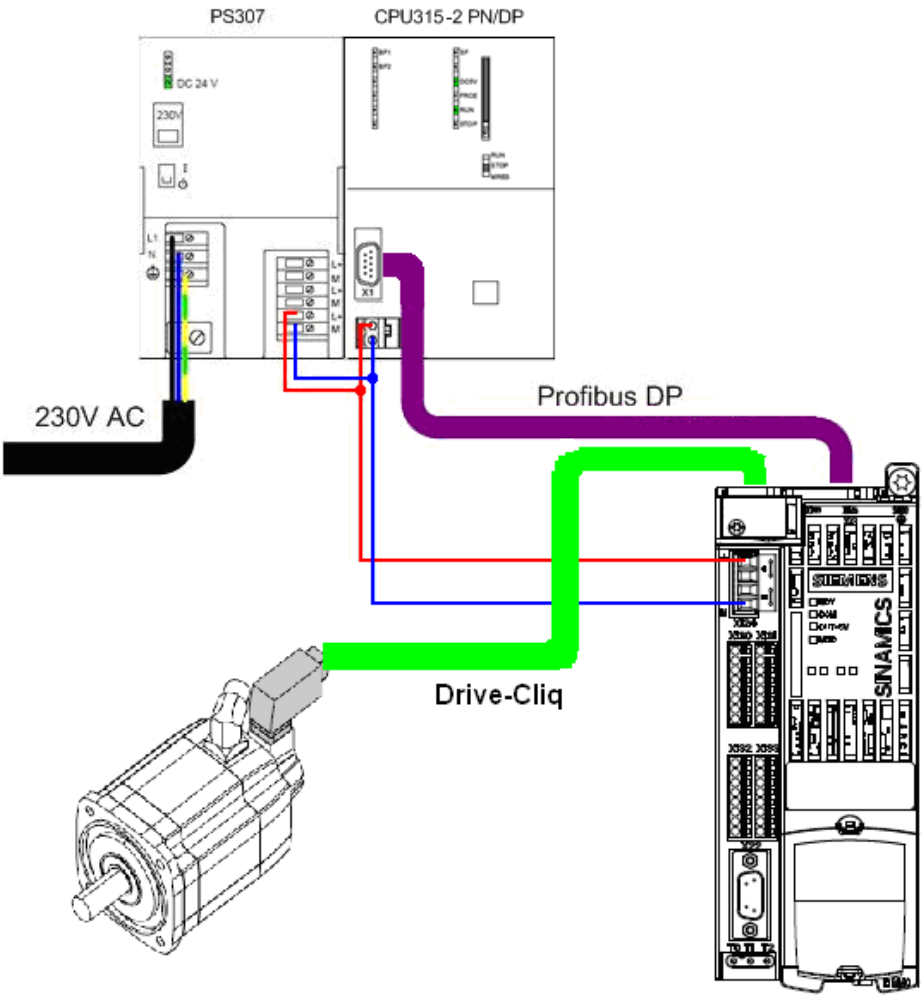
WARNING

The SINAMICS S110 has components at hazardous voltage levels and controls rotating mechanical equipment, which is also hazardous. If this warning is not carefully observed, or if the notes provided in the various SINAMICS S110 instructions are not followed, then this can result in death, severe bodily injury or significant material damage.

4.1 Connecting-up the hardware components

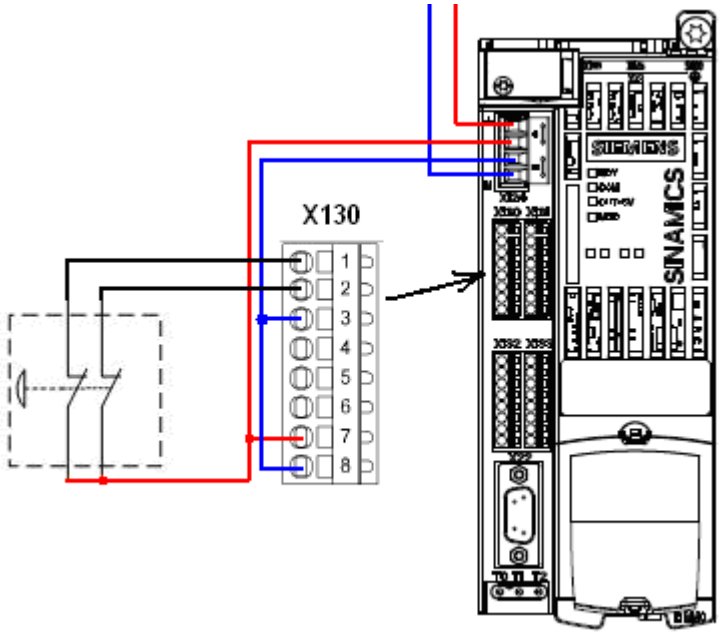
4.1.1 Connecting up S7-300 and S110 for PROFIBUS

Fig. 4-1



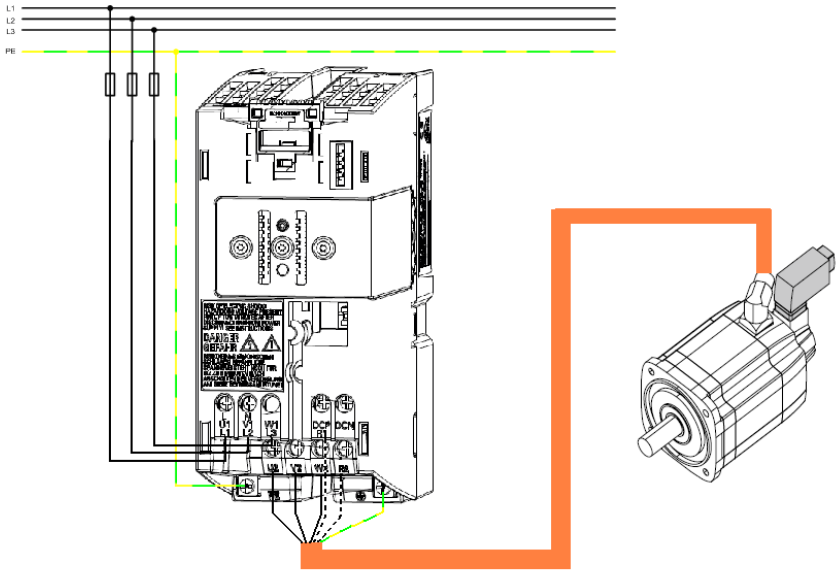
4.1.2 F-DI for Safety via terminal (optional)

Fig. 4-2



4.1.3 PM340 with motor

Fig. 4-3

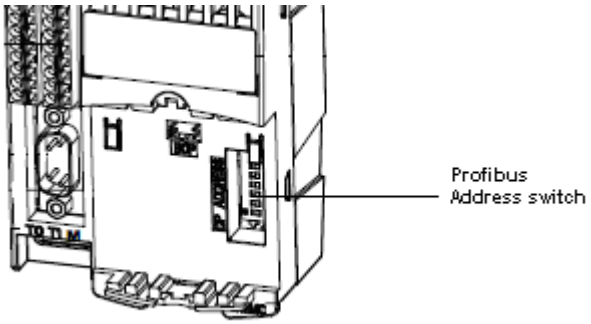


4.2 Settings at the hardware components

4.2.1 PROFIBUS address at the S110

At the S110, set the PROFIBUS address to 5 by setting the DIP switch to the positions as shown below. This DIP switch is located under the front cover or the Basic Operator Panel (BOP).

Fig. 4-4



Weighting:

2^0	2^1	2^2	2^3	2^4	2^5	2^6	
1	2	4	8	16	32	64	
■		■					ON
	■		■	■	■	■	OFF

Example: PROFIBUS address = 1 + 4 = 5

5 Download

5.1 S7 program

To download the S7 program, you require a connection between the MPI interface of your PG/PC and the MPI interface of the S7-CPU.

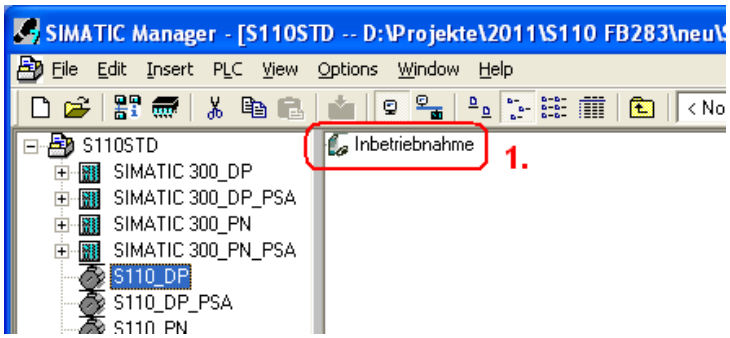
- Start the "SIMATIC Manager".
- De-archive the function example provided.
- Open the "S110_FB283" project.
- Connect the control with your PG/PC via the MPI/PROFIBUS interface.
- Using "Options> Select PG/PC…", select the "AUTO" interface identification of the "MPI/PROFIBUS" interface. And configure the interface based on the results of the automatic identification.
- Select the configuration example “SIMATIC 300_DP“.
- Open "HW Config" and download this to the control system. After the download, close "HW Config" again.
- By loading "HW Config", it is possible that the control system interfaces have changed. Therefore, check your "PG/PC interface" and if necessary, reconfigure.
- In the SIMATIC Manager, select the block folder via "CPU > S7 program > Blocks".
- Download all of the S7 program blocks into the CPU

5.2 SINAMICS S110 configuration

Then download the SINAMICS S110 configuration using the STARTER parameterizing tool.

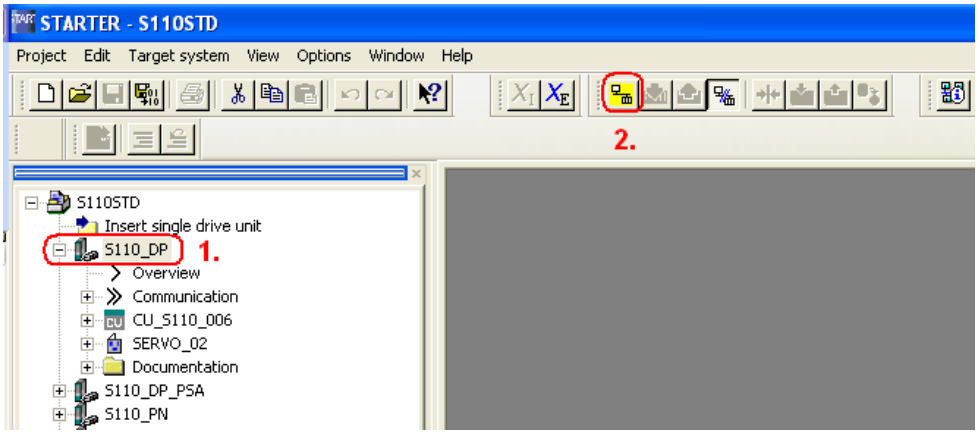
- Starting from the main path of the SIMATIC Manager, start the parameterizing software STARTER by selecting the "SINAMICS_S110" icon and double clicking on the "Commissioning" icon.

Fig. 5-1



- If you have components that deviate from Chapter 3.1, then in the configuration screen form, select "Configure DDS" and follow the Wizard. In so doing, you change the motor and power unit data. (For Drive-Cliq motors, the checkmark "Read out motor again" should be activated)
- In the project navigator of the STARTER parameterizing software, then select object "S110" **(1.)** and press the button  **(2.)** to establish the online connection to the frequency converter.

Fig. 5-2

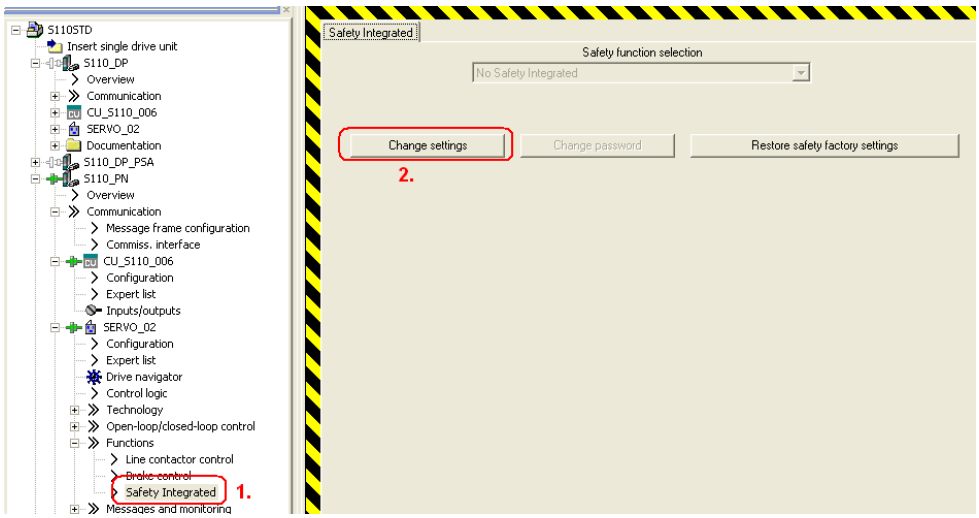


- After the online connection has been established, to download the SINAMICS S110 drive parameters, select the button  .

It is not necessary to separately activate Safety, as the checksums are not checked at download. For details, see 7.2.5.

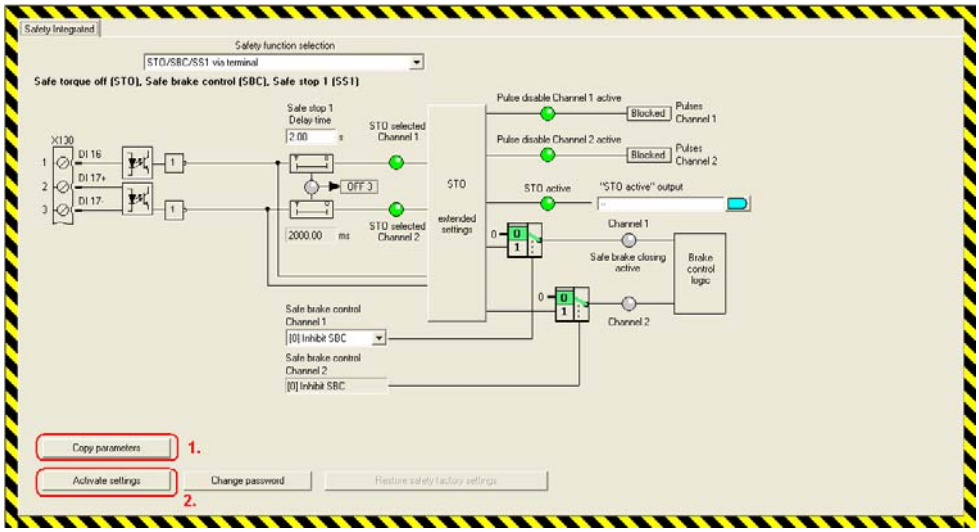
- To activate the Safety functions, you must first go to Change settings in the Safety screen form. **(2.)**

Fig. 5-3:



- After this, you can activate the Safety functions using Copy parameters **(1.)** and Activate settings **(2.)**.
- More detailed information on the topic of Safety Integrated is provided in the S110 Function Manual.

Fig. 5-4:



- In the subsequent screen forms, first output the checksums and then backup the data of the complete drive unit into the ROM.
- The drive is then ready for operation after a power on reset.

5.3 Exiting the STARTER parameterizing software

- If you do not wish to make any additional parameter settings, then you can now exit the STARTER parameterizing software.
- In the tree, select the SINAMICS S110 and transfer all parameter changes into the ROM memory of the SINAMICS S110 by pressing the  button.
- Then, transfer all of the parameters into your offline project by pressing the  button.
- Disconnect the connection between the PG / PC and the SINAMICS S110 by pressing the  button.
- You can then exit STARTER via "Project > Exit" or by pressing the  button.

6 Using the application

Two options are available to use the application:

In Chapter 6.1, an S7 block is shown, which can be used in conjunction with a digital input module to control the individual functions of the S110.

How the functions are activated using different variable tables is explained in Chapter 6.2.

6.1 Via digital inputs (additional 16xDI is required)

6.1.1 Preparation

- Deviating from the target hardware, a digital input module for 16 digital inputs is required (alternatively, 2x 8xDI).
- Insert your particular module into HW Config. Ensure that the address range of the module is EW 0.
- Further, FC1 must be called in OB1. For this purpose, remove the comments for:

CALL FC 1

6.1.2 Operator control

Table 6-1

Bit	
I 0.0	On/Off 1
I 0.1	Acknowledge
I 0.2	Jogging in the positive direction (jog 2)
I 0.3	Jogging in the negative direction (jog 1)
I 0.4	Start reference point approach
I 0.5	Manually set reference point (home position)
I 0.6	MDI absolute (1) or relative (0)
I 0.7	MDI continuous setpoint transfer (1) or signal edge
I 1.0	Activate MDI
I 1.1	Value transfer
I 1.2	Reject traversing task (0)
I 1.3	Intermediate stop (0)
I 1.4	Traversing block selection, bit 0
I 1.5	Traversing block selection, bit 1
I 1.6	Traversing block selection, bit 2
I 1.7	Traversing block selection, bit 3

(The values for MDI must be set in the control, the traversing blocks in STARTER)

6.1.3 Example

Acknowledge → Deactivate continuous setpoint transfer → Switch-on (edge) → Traverse to the required reference point with jogging → Set reference point → Deactivate MDI → Select traversing block 0 → Reject the traversing task and set intermediate stop to 1 → Activate value transfer (edge) → Drive executes traversing block → Set MDI to relative → Activate MDI → Activate value transfer (edge) → Drive traverses by the specified position value → Set MDI to absolute → Drive traverses to the specified target position. → Switching-off with Off1.

6.2 Variables table

6.2.1 Reference – controlling the referencing operating mode

A referenced drive is necessary for absolute positioning. This axis referencing can be performed using the "Reference" variable table.

Table 6-2

Variable	Significance	Example
DB72.DBW 172	Control word 1	
DB72.DBX 173.0	p0840[0] On/off1 Switch-on the drive.	0 → 1 Switch-on
DB72.DBX 213.3	The converter has an active fault message	
DB72 DBW 230	Actual fault number	
DB72.DBX 173.7	p2103.0 Acknowledge fault Faults are acknowledged for a positive edge.	
DB72.DBX 172.0	p2589 EPOS jogging 1 Drive is traversed in jogging mode 1 (standard = negative traversing direction)	1 = traversing in the negative direction of rotation
DB72.DBX 172.1	p2590 EPOS jogging 2 Drive is traversed in jogging mode 2 (standard = positive traversing direction)	1 = traversing in the positive direction of rotation
DB72.DBX 172.3	Starting referencing (active/passive)	0
DB72.DBX 177.1	Manually setting the reference point	0 → 1 Set reference point
DB72.DBX 176.0	Selecting the referencing type 0 = reference point approach (active) 1 = flying referencing (passive)	
DB72.DBX 177.2	Signal for the reference cams (Required for active referencing using the reference cams and encoder zero mark)	
DB72.DBX 176.1	Homing start direction (active homing)	
DB72.DBD 222	Position actual value	

Variable	Significance	Example
DB72.DBX 212.3	Feedback signal, drive referenced	

Control example – manually setting the reference point

Switch-on the drive → Traverse to the reference position, jogging → Manually set the reference point. For more detailed information on referencing, see Chapter 7.2.7 Overview and settings of the basic positioning screen forms in the Referencing section.

6.2.2 MDI – control of the direct setpoint input

The variable table MDI is used to control the MDI operating mode, which is also called direct setpoint input.

Table 6-3

Variable	Significance	Example
DB72.DBW 172	Control word 1	
DB72.DBX 173.0	p0840[0] On/off1 Switch-on the drive.	0 → 1 Switching-on
DB72.DBX 173.4	p2641 EPOS reject traversing task Must be "true" for traversing. For "false", the task is rejected.	1 Do not reject task
DB72.DBX 173.5	p2640 EPOS intermediate stop Must be "true" for traversing. For "false", the drive is stopped.	1 No intermediate stop
DB72.DBX 173.6	*(p2631 activate traversing task* *Selected traversing task is activated.* *If MDI is activated (p2647 = "true"), not relevant)* p2650 MDI setpoint transfer Accepts the MDI setpoint for a positive edge. (If p2649 = "false")	0 → 1 Accepts the MDI setpoint
DB72.DBX 213.3	The converter has an active fault message	
DB72 DBW 230	Actual fault number	
DB72.DBX 173.7	p2103.0 Acknowledge fault Faults are acknowledged for a positive edge.	
DB72.DBX 172.0	p2589 EPOS jogging 1 Drive is traversed in jogging mode 1 (standard = negative traversing direction)	0
DB72.DBX 172.1	p2590 EPOS jogging 2 Drive is traversed in jogging mode 2 (standard = positive traversing direction)	0
DB72.DBX 174.0	p2648 MDI positioning type "true" = absolute positioning (axis must be referenced) "false" = relative positioning	0 Relative positioning

Variable	Significance	Example
DB72.DBX 174.1	p2651 MDI direction selection, positive *)	
DB72.DBX 174.2	p2652 MDI direction selection, negative *)	
*)	**EPOS direction selection when setting up:** Preselection, traversing direction The axis remains stationary if both are selected or deselected. **EPOS direction selection when positioning and activated modulo correction and absolute positioning:** Absolute positioning in the selected direction The axis positions along the shortest path if both are selected or deselected.	
DB72.DBX 174.4	P2649 EPOS MDI transfer type, selection. If "false", then the values are only transferred for a positive edge of p2650. If "true", the values are continuously transferred and relative positioning is not permissible.	0 Transfer setpoint for edge
DB72.DBX 174.6	p2653 Setting up MDI. The drive is traversed with the selected velocity and acceleration values for MDI with p2651 (positive direction) and p2652 (negative direction).	0
DB72.DBX 174.7	p2647 MDI selection With "true", positioning is activated via MDI.	1 Positioning via MDI
DB72.DBW 180	p2646 Velocity override Scaling factor for the velocity as a %.	16384 (= 100%)
DB72.DBD 182	p2642 MDI position setpoint Enter the position setpoint.	360000
DB72.DBD 186	p2643 MDI velocity setpoint Enter the velocity setpoint in LU/min.	1440000 (= 4000 rpm)
DB72.DBW 190	p2644 MDI acceleration override Scaling factor for the acceleration as a %.	16384 (= 100%)
DB72.DBW 192	p2645 MDI deceleration override Scaling factor for the deceleration as a %.	16384 (= 100%)
DB72.DBW 212	r0052 Status word 1	
DB72.DBX 213.2	r899.2 Operation enabled	
DB72.DBD 222	r2521.0 Position actual value, position controller	
DB72.DBD 226	r0063 Speed actual value, smoothed	

Control example – relative traversing using MDI

Deselect setting up and jogging (0) → Reject traversing task and deactivate intermediate stop (1) → Select positioning type → Select transfer type → Select MDI→ Enter setpoints → Switch-on drive→ Activate traversing task

For more detailed information on MDI, refer to Chapter 7.2.7 Overview and settings of the basic positioning screen forms in Section, Direct selection/MDI.

6.2.3 TVB – controlling traversing blocks

Traversing blocks can be controlled using the variable table TVB.

Table 6-4

Variable	Significance	Example
DB72.DBW 172	Control word 1	
DB72.DBX 173.0	p0840[0] On/off1 Switch-on the drive.	0 → 1 Switching-on
DB72.DBX 173.4	p2641 EPOS reject traversing task Must be "true" for traversing. For "false", the task is rejected.	1 Do not reject task
DB72.DBX 173.5	p2640 EPOS intermediate stop Must be "true" for traversing. For "false", the drive is stopped.	1 No intermediate stop
DB72.DBX 173.6	(p2631 activate traversing task Selected traversing task is activated. *p2650 MDI setpoint transfer* *Accepts the MDI setpoint for a positive edge. (If p2649 = "false")*	0 → 1 Activate traversing task
DB72.DBX 213.3	The converter has an active fault message	
DB72 DBW 230	Actual fault number	
DB72.DBX 173.7	p2103.0 Acknowledge fault Faults are acknowledged for a positive edge.	
DB72.DBX 172.0	p2589 EPOS jogging 1 Drive is traversed in jogging mode 1 (standard, negative direction)	0
DB72.DBX 172.1	p2590 EPOS jogging 2 Drive is traversed in jogging mode 2 (standard, positive direction)	0
DB72.DBX 174.7	p2647 MDI selection With "false", positioning via MDI, which has priority, is deactivated.	0 Deactivate MDI
DB72.DBB 175	Traversing block number	0 Select traversing block 0
DB72.DBX 175.0	p2625 Traversing block selection, bit 0 Weighting: $2^0 = 1$	
DB72.DBX 175.1	p2626 Traversing block selection, bit 1 Weighting: $2^1 = 2$	
DB72.DBX 175.2	p2627 Traversing block selection, bit 2 Weighting: $2^2 = 4$	
DB72.DBX 175.3	p2628 Traversing block selection, bit 3 Weighting: $2^3 = 8$	
DB72.DBX 175.4	p2629 Traversing block selection, bit 4 Weighting: $2^4 = 16$	

Variable	Significance	Example
DB72.DBX 175.5	p2630 Traversing block selection, bit 5 Weighting: $2^5 = 32$	
DB72.DBW 212	r52 Status word 1	
DB72.DBX 213.2	r899.2 Operation enabled	
DB72.DBB 215	Active traversing block	
DB72.DBX 215.0	r2670.0 Active traversing block bit 0 Weighting: $2^0 = 1$	
DB72.DBX 215.1	r2670.1 Active traversing block bit 1 Weighting: $2^1 = 2$	
DB72.DBX 215.2	r2670.2 Active traversing block bit 2 Weighting: $2^2 = 4$	
DB72.DBX 215.3	r2670.3 Active traversing block bit 3 Weighting: $2^3 = 8$	
DB72.DBX 215.4	r2670.4 Active traversing block bit 4 Weighting: $2^4 = 16$	
DB72.DBX 215.5	r2670.5 Active traversing block bit 5 Weighting: $2^5 = 32$	
DB72.DBD 222	r2521.0 Position actual value, position controller	

Control example – starting traversing block 0

Deselect jogging (0) → Reject traversing task and deactivate intermediate stop (1) → Deselect MDI (0) → Enter traversing the block number → Switch-on drive→ Activate traversing block.

For more detailed information on MDI, refer to Chapter 7.2.7 Overview and settings of the basic positioning screen forms in Section, Direct selection/MDI.

6.2.4 Acyclic tasks

Using acyclic tasks, in addition to the cyclic telegrams, data can be sent and received To do this, the cyclic tasks must be individually initiated.

The advantage of acyclic tasks is that also parameters can be addressed, which cannot be addressed using cyclic communication. Further, you can process a larger data quantity.

It should be noted that not just any number of acyclic tasks can be called. The reason for this is that the control system can only simultaneously process a limited number of tasks, and while processing the task, the drive rejects other tasks.

More information on the number of acyclic tasks that can be simultaneously processed is provided under the following link
http://support.automation.siemens.com/WW/view/de/32210587

With the task interface, two types of acyclic tasks can be started:

- Parameter tasks
- Special tasks

Using the parameter tasksi, normally a single parameter task is started. The number that has been entered into tasksi corresponds to the parameters to be processed. However, there is also a reserved area, which is not available for parameter tasks, but instead starts special tasks.

List of special tasks

30000: Read/write individual traversing blocks.

30001: Read/write traversing blocks

30002: Read-out fault memory

30010: Read/write up to 10 parameters

30011: Preassign traversing blocks 0 to 63 (only S120, not possible for S110)

6.2.5 Parameters – read/write parameters

Individual parameters can be accessed using this variable table.

Table 6-5

Variable	Significance	Example
DB72.DBW 16	tasksi Specification of the **parameter number**	1135 Parameter for OFF3 ramp-down time
DB72.DBW 18	ind Subparameter number, subindex	0 Index 0
DB72.DBD 20	Data Contains the parameter value to be written to or read out	5.0 Set a down ramp of 5 seconds
DB72.DBX 14.0	RD Starts a read task. The parameter value is saved in "Data".	0 No read task
DB72.DBX 14.1	WR Starts a write task. The value from "Data" is written to the converter.	0 → 1 Start write task
DB72.DBX 14.3	busy Transfer is active.	
DB72.DBX 14.2	Done The task was successfully executed.	
DB72.DBX 14.7	Error The task was canceled with an error.	
DB72.DBW 24	ErrorNumbr If Error = “true”, contains the error number with which the task was canceled. (see Chapter 7.3.1 single.ErrorNumbr)	

Control example – changing the down ramp

Set "tasksi" (1135) → Set index (0) → Enter the down ramp into Data (5.0) → Start write task with positive edge

6.2.6 Para_1_10- read/write 1-10 parameters

The list Para_1_10 is used to simultaneously read/write up to 10 parameters.

Table 6-6

Variable	Significance	Example
DB72.DBW 16	tasksi Contains the special task number "30010" for simultaneously reading/writing up to 10 parameters.	30010 Special task number
DB72.DBW 18	Ind Specifies the number of the first parameter task to be processed.	1
DB72.DBD 20	Data Specifies the number of the last parameter task to processed.	2
DB72.DBX 14.0	RD Starts the parameter tasks as read tasks.	0 → 1 Start read task
DB72.DBX 14.1	WR Starts the parameter tasks as write tasks.	0 No write task
DB72.DBX 14.3	busy Transfer is active.	
DB72.DBX 14.2	Done The task was successfully executed.	
DB72.DBX 14.7	Error The task was canceled with an error.	
DB72.DBW 24	ErrorNumbr If Error = “true”, contains the error number with which the task was canceled. (see Chapter 7.3.1 single.ErrorNumbr)	
Parameter 1		
DB72.DBW 54	PNU_1 Parameter number of parameter task X	2585 Parameter EPOS jogging 1
DB72.DBW 56	Ind_1 Sub parameter number of parameter task X	0
DB72.DBD 58	Data_1 Parameter value of parameter task X, read/to be written	
Parameter 2		
DB72.DBW 62	PNU_2 Parameter number of parameter task X	2586 Parameter EPOS jogging 2
DB72.DBW 64	Ind_2 Sub parameter number of parameter task X	0
DB72.DBD 68	Data_2 Parameter value of parameter task X, read/to be written	

Variable	Significance	Example
.		
.		
.		
Parameter 10		
DB72.DBW 126	PNU_10 Parameter number of parameter task X	
DB72.DBW 128	Ind_10 Sub parameter number of parameter task X	
DB72.DBD 130	Data_10 Parameter value of parameter task X, read/to be written	

Control example – reading out the EPOS jog velocities

Set the particular parameter number (2585 or 2586) → Set the particular index (0) → Enter the number of the first task (index = 1)→ Enter the number of the last task (Data = 2) → Start read task with positive edge

6.2.7 TVBsingle – changing/reading out a traversing block

Traversing blocks can be individually transferred in this variable table. In so doing, it must be observed that also the values that are not required for the traversing task (with a gray background in STARTER), must have a valid value if they are to be transferred. Otherwise errors will occur at data transfer.

Table 6-7

Variable	Significance	Example
DB72.DBW 16	tasksi Contains the special task number "30000" for reading and writing a traversing block	30000 Special task number
DB72.DBW 18	Ind Specifies the traversing block position 0 to 15. (Corresponds to the index 1 to 16)	11 Processing the 12th traversing block
DB72.DBD 20	Data No significance	
DB72.DBX 14.0	RD Starts to read-out the traversing block	0 No read task
DB72.DBX 14.1	WR Starts to write to the traversing block	0 → 1 Write traversing block
DB72.DBX 14.3	busy Transfer is active.	
DB72.DBX 14.2	Done The task was successfully executed.	
DB72.DBX 14.7	Error The task was canceled with an error.	
DB72.DBW 24	ErrorNumbr If Error = “true”, contains the error number with which the task was canceled. (see Chapter 7.3.1 single.ErrorNumbr)	
DB72.DBB 134	Preselection as to which parameters should be transferred. Bit 0 Block number Bit 1 Position Bit 2 Velocity Bit 3 Acceleration Bit 4 Deceleration Bit 5 Command Bit 6 Command parameter Bit 7 Mode	1011 1111 Transfer everything except the command parameter.
DB72.DBW 136	block_no Specifies the traversing block number (-1 to 63) the number must be unique. The tasks are executed according to the traversing block number. For -1, the traversing block is ignored. (-1 can be used as often as required)	40

Variable	Significance	Example
DB72.DBD 138	position Specifies the position setpoint.	45000
DB72.DBD 142	velocity Specifies the velocity in [1000 LU/min].	3600
DB72.DBD 146	accel_over Specifies the percentage acceleration value.	50.0
DB72.DBD 150	decel_over Specifies the percentage deceleration value.	50.0
DB72.DBW 154	command Specifies the task type: 1: Positioning 2: Fixed endstop 3: Endless, positive 4: Endless, negative 5: Wait 6: GoTo 7: Set_Output 8: Reset_Output 9: Jerk limiting	1
DB72.DBD 156	command_par Also specifies the task parameter WAIT: Waiting time in [ms] GOTO: Block number which is jumped to. SET_Output: Setting digital output 1, 2 or both (3) RESET_Output: Resetting digital output 1, 2 or both (3) JERK: "1" activate or "0" deactivate. FIXED STOP: Enters the clamping torque in [Nm]	

Variable	Significance	Example
DB72.DBW 160	mode Specifies the traversing block mode. **Display traversing block (bit 3-0)** xxxx xxxx xxxx **xxx0** displays the traversing block xxxx xxxx xxxx **xxx1** hides the traversing block Hiding corresponds to -1 traversing block is ignored. **Advance (bit 7-4)** xxxx xxxx **0000** xxxx End (0) xxxx xxxx **0001** xxxx Continue with stop (1) xxxx xxxx **0010** xxxx Continue flying (2) xxxx xxxx **0011** xxxx Continue external (3) xxxx xxxx **0100** xxxx Continue external wait (4) xxxx xxxx **0101** xxxx Continue external alarm (5) **Positioning mode (bit 11-8)** xxxx **0000** xxxx xxxx Absolute (0) xxxx **0001** xxxx xxxx Relative (1) xxxx **0010** xxxx xxxx Absolute positive(2)*) xxxx **0011** xxxx xxxx Absolute negative(3)*) *) Only when modulo correction activated	0000 0000 0000 0000 Display traversing block (active) After end of traversing block Absolute positioning

6.2.8 TVBblock – changing/reading out a traversing block

This allows traversing blocks to be transferred. In so doing it should be observed that also the values that are not required for the traversing task (with a gray background in STARTER), must have a valid value if they are to be transferred. Otherwise errors will occur at data transfer.

Table 6-8

Variable	Significance	Example
DB72.DBW 16	tasksi Contains the special task number **"30001"** for reading and writing several traversing blocks	30001
DB72.DBW 18	Ind Position of the first data block that is transferred.	0
DB72.DBD 20	Data Position of the last data block that is transferred.	15
DB72.DBX 14.0	RD Starts to read-out the traversing blocks.	0 → 1 Start read task
DB72.DBX 14.1	WR Starts to write to the traversing blocks.	0 No write task
DB72.DBX 14.3	busy Transfer is active.	
DB72.DBX 14.2	Done The task was successfully executed.	
DB72.DBX 14.7	Error The task was canceled with an error.	
DB72.DBW 24	ErrorNumbr If Error = “true”, contains the error number with which the task was canceled. (see Chapter 7.3.1 single.ErrorNumbr)	
DB72.DBB 134	Preselection as to which parameters should be transferred. See chapter 6.2.7 TVBsingle	1111 1111 Transfer all parameters
//traversing block 0		
DB72.DBW 264	Block0 See chap 6.2.7 TVBsingle Entryblock_no	
DB72.DBD 266	Position0 See chap 6.2.7 TVBsingle Entry position	
DB72.DBD 270	Velocity0 See chap 6.2.7 TVBsingle Entry velocity	
DB72.DBD 274	Accel_over0 See chap 6.2.7 TVBsingle Entry accel_over	
DB72.DBD 278	Decel_over0 See chap 6.2.7 TVBsingle Entry decel_over	
DB72.DBW 282	Command0 See chap 6.2.7 TVBsingle Entry command	

Variable	Significance	Example
DB72.DBD 284	Command parameter0 See chap 6.2.7 TVBsingle Entry command_par	
DB72.DBW 288	Mode0 See chap 6.2.7 TVBsingle Entry mode	
//traversing block 1		
DB72.DBW 290	Block1 See chap 6.2.7 TVBsingle Entry block_no	
DB72.DBD 292	Position1 See chap 6.2.7 TVBsingle Entry position	
DB72.DBD 296	Velocity1 See chap 6.2.7 TVBsingle Entry velocity	
DB72.DBD 300	Accel_over1 See chap 6.2.7 TVBsingle Entry accel_over	
DB72.DBD 304	Decel_over1 See chap 6.2.7 TVBsingle Entry decel_over	
DB72.DBW 308	Command1 See chap 6.2.7 TVBsingle Entry command	
DB72.DBD 310	Command parameter1 See chap 6.2.7 TVBsingle Entry command_par	
DB72.DBW 314	Mode1 See chap 6.2.7 TVBsingle Entry mode	
.		
.		
.		
//traversing block 15		
DB72.DBW 654	Block15 See chap 6.2.7 TVBsingle Entry block_no	
DB72.DBD 266	Position15 See chap 6.2.7 TVBsingle Entry position	
DB72.DBD 270	Velocity15 See chap 6.2.7 TVBsingle Entry velocity	
DB72.DBD 274	Accel_over15 See chap 6.2.7 TVBsingle Entry accel_over	
DB72.DBD 278	Decel_over15 See chap 6.2.7 TVBsingle Entry decel_over	
DB72.DBW 282	Command15 See chap 6.2.7 TVBsingle Entry command	
DB72.DBD 284	Command parameter15 See chap 6.2.7 TVBsingle Entry command_par	
DB72.DBW 288	Mode15 See chap 6.2.7 TVBsingle Entry mode	

6.2.9 FaultBuffer – Read-out fault memory

Table 6-9

Variable	Significance	Examples
DB72.DBW 16	tasksi Contains the special task number **"30002"** for reading out the fault code	30002
DB72.DBW 18	Ind Not used	
DB72.DBD 20	Data Not used.	
DB72.DBX 14.0	RD Starts to read-out the actual fault messages	0 → 1 Start read task
DB72.DBX 14.1	WR Not used	
DB72.DBX 14.3	busy Transfer is active.	
DB72.DBX 14.2	Done The task was successfully executed.	
DB72.DBX 14.7	Error The task was canceled with an error.	
DB72.DBW 24	ErrorNumbr If Error = “true”, contains the error number with which the task was canceled. (see Chapter 7.3.1 single.ErrorNumbr)	
DB72.DBW 1940	Fault entry0.fault code Indicates the fault message number.	
DB72.DBW 1942	Fault entry0.fault number Indicates the fault message number.	
DB72.DBD 1944	Fault entry0.fault time Indicates the instant in time that the fault has been received. Specified in [ms].	
DB72.DBD 1948	Fault entry0.fault value Indicates the fault value that contains supplementary information for the actual fault message.	
DB72.DBW 1952	Fault entry1.fault code Indicates the fault message number.	
DB72.DBW 1954	Fault entry1.fault number Indicates the fault message number.	
DB72.DBD 1956	Fault entry1.fault time Indicates the instant in time that the fault has been received. Specified in [ms].	
DB72.DBD 1960	Fault entry1.fault value Indicates the fault value that contains supplementary information for the actual fault message.	
.		
.		
.		
DB72.DBW 2896	Fault entry63.fault code	

Variable	Significance	Examples
	Indicates the fault message number.	
DB72.DBW 2898	Fault entry63.fault number Indicates the fault message number.	
DB72.DBD 2900	Fault entry63.fault time Indicates the instant in time that the fault has been received. Specified in [ms].	
DB72.DBD 2904	Fault entry63.fault value Indicates the fault value that contains supplementary information for the actual fault message.	

For the fault message it should be noted that it is always arranged in blocks of 8. As a consequence, the actual fault messages that are entered in fault value 0-7 are obtained.

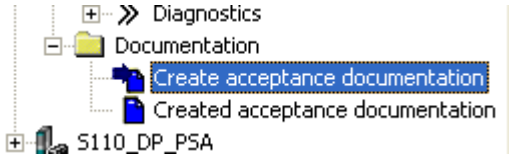
The last acknowledged fault cases are in fault values 8-15. At each acknowledgment, the fault values are shifted by 8 positions, until they drop out of the list after the 8th acknowledgment!

6.3 Function test of the safety functions

Templates for the acceptance test are available in STARTER. The acceptance document can be generated as follows.

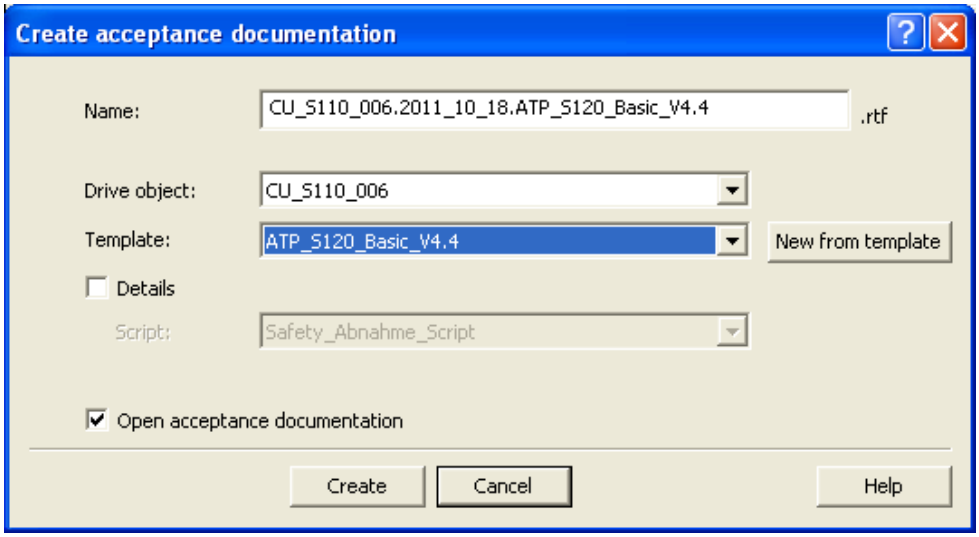
If you are not already online, then go online now. The acceptance test can only be performed online.

Fig. 6-1



- Double-click on "Create acceptance documentation" in order to access the associated window.

Fig. 6-2



- Select the drive unit. In this case, "Servo_02".
- For STARTER Version 4.2, there is still no template for the S110; however, you can use the template for the S120 with the Basic functions. This only differs regarding 2 points:
  - p9697 is not available for the S110.
  - S110 has no EP terminal (both signals are connected to Control Unit).
- You create the acceptance document by pressing the Create button.
- Perform the acceptance as described in the acceptance document.

7 More detailed information

The individual functions of the code example are explained in the following chapters, so that you are then in a position to implement your own projects.

For this function example, the described settings no longer have to be performed.

Deviations from the configuration example must be taken into account for the following points, and performed at the relevant position.

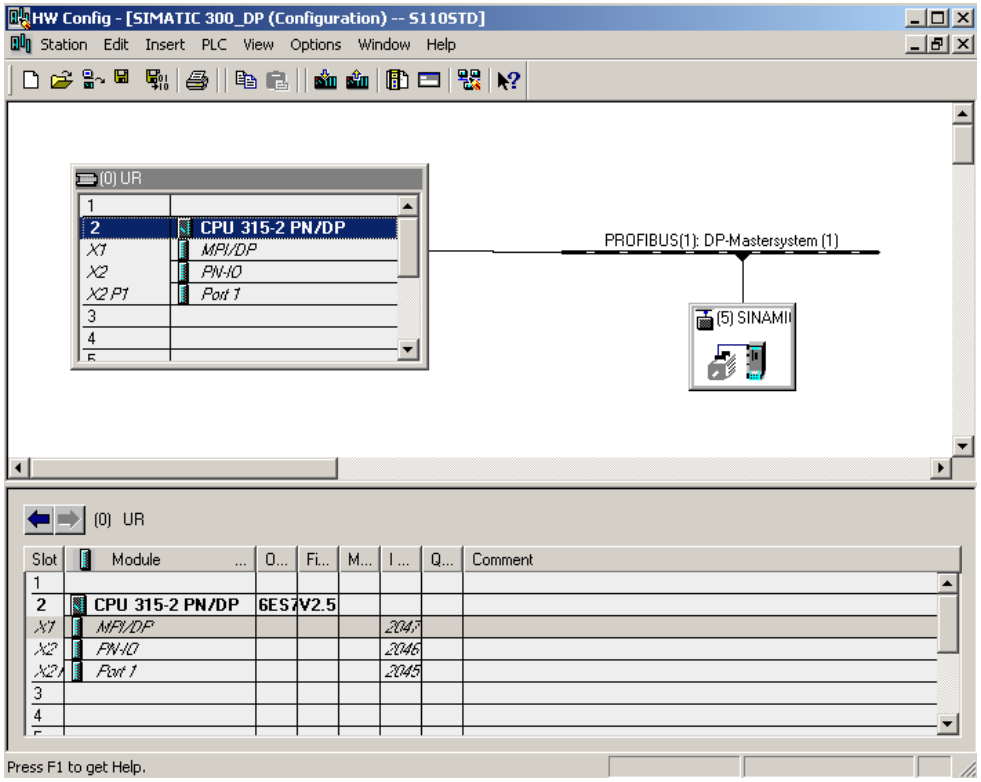
7.1 Configuration of a control

Create a project and insert a SIMATIC 300 station. Open HW Config.

7.1.1 Settings in the hardware configuration

Insert the control and the SINAMICS S110 with the CU305-DP into your project.

Fig. 7-1



You can download the GSD for the SINAMICS S110 under the following link: http://support.automation.siemens.com/WW/view/de/42705323

GSD/GSDML files are required to operate a node/station (e.g. the SINAMICS S110) on the fieldbus (PROFIBUS (GSD)) and to register the device with the configuring/engineering tools.

As telegram, select Siemens telegram 111, after pressing the  button. And then drag this and drop it at the first slot of the S110. You can access this list, if you click on the SINAMICS S110 icon on the work area. Also see Fig. 7-3.

Fig. 7-2

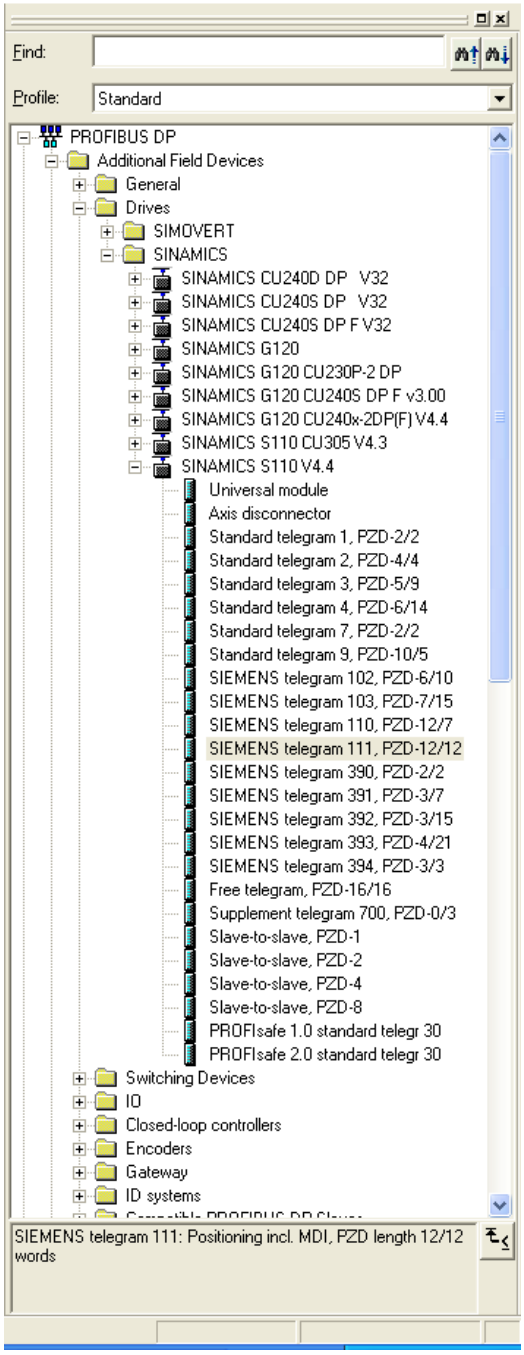
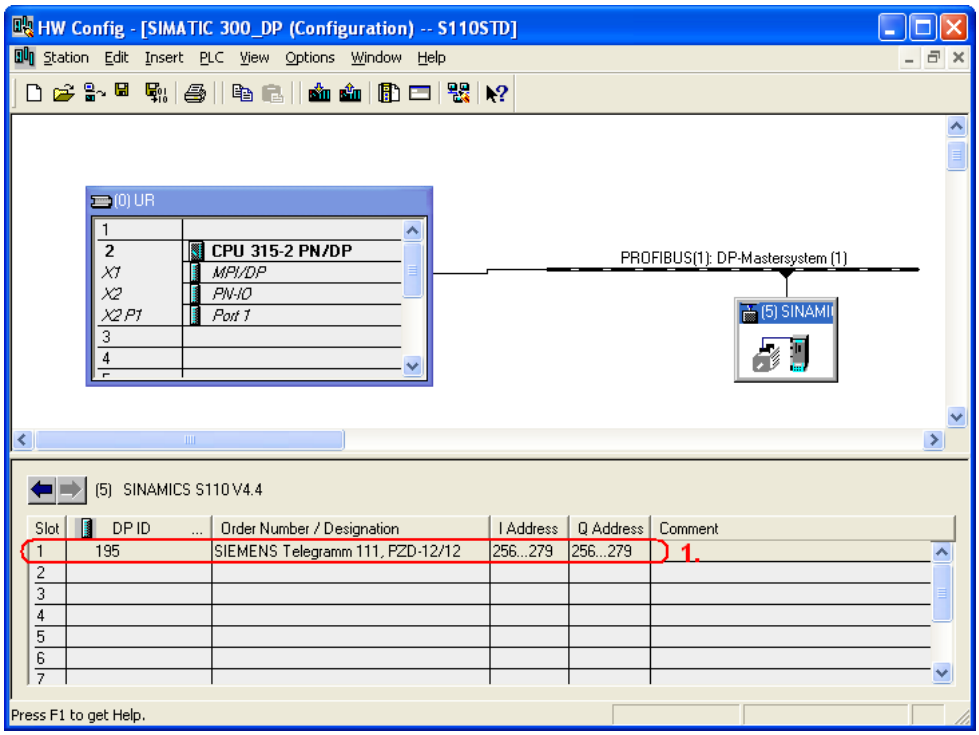


Fig. 7-3



The PROFIBUS telegram **(1.)** between the CPU and the SINAMICS S110 comprises a standard telegram, in this particular example **Siemens telegram 111**. You can also see which I/O devices have been assigned to the device.

Note **FB283 can only operate with the same start addresses for the I/O area.**

Load the HW Config into the control system.

7.1.2 S7 program

Copy the FB283, the UDTs and the variable tables into the block folder. This can either be from the project example or from the library example
http://support.automation.siemens.com/WW/view/dn/25166781

Call FB283

Create a new FC (e.g. FC72), call this FC in the OB1.

In the FC, call FB283. The call can look like this:

```
CALL  FB283 , DB283
     NR_ACHS_DB:=72
     LADDR     :=256
     LADDR_DIAG:=2042
     WR_PZD    :=P#DB72.DBX172.0 BYTE 24
     RD_PZD    := P#DB72.DBX212.0 BYTE 24
     CONSIST   :=TRUE
     RESTART   :=FALSE
     AXIS_NO   :=B#16#2
```

Table 7-1

Signal	Comment
NR_ACHS_DB	Number of the data block for the axis DB. If there is still no axis DB that can be used (e.g. DB72), then a new one must be created. (see the next page)
LADDR	Start of the I/O address of the S110 (cyclic communication → PZD)
LADDR_DIAG	Diagnostics address of the S110 (acyclic communication), see also HW Config, properties of S110)
WR_PZD	Target area for process data, master → slave (control words/setpoints) Generally, the axis DB (e.g. DB72) is used here, i.e. in the pointer, the same DB No. must be specified as at the formal parameter "NR_ACHS_DB" The start of the area to be sent is specified in the DB as the start of the area (e.g. DBX172.0) The pointer length depends on the telegram. Standard telegram1: 4 bytes Siemens telegram 111: 24 bytes P#DB72.DBX172.0 BYTE 24 is obtained from this
RD_PZD	Target area for process data, master <– slave (status words/actual values) Generally, the axis DB (e.g. DB72) is used here, i.e. in the pointer, the same DB No. must be specified as at the formal parameter "NR_ACHS_DB" The start of the area to be sent is specified in the DB as the start of the area (e.g. DBX212.0) The pointer length depends on the telegram. Standard telegram1: 4 bytes

Signal	Comment
	Siemens telegram 111: 24 bytes P#DB72.DBX212.0 BYTE 24 is obtained from this
CONSIST	Please take the required setting from your hardware configuration. **True:** The PZD area is "constant over the complete length"; transfer of process data in the area specified under WR_PZD/RD_PZD is realized with SFC 14/15. **False:** The PZD area is consistent over the unit. Process data is transferred using load/transfer commands.
RESTART	Can be used in order to re-initialize/first initialize the block. When powering up, the first initialization is always independent of the value that has been set. As a consequence, in almost all application cases, the parameter is assigned false.
AXIS_NO	The axis No. or the DriveObject_ID (DO_ID) of the axis to be addressed should be specified here. As the S110 is a single-axis system, the DO_ID is always 2!

Axis DB

The axis DB contains all of the data that the FB283 requires to execute its functions. The declaration of the axis DB can look like this:

Table 7-2

Address	Name	Type
0.0		STRUCT
+0.0	Basis	UDT30000
+162.0	MDI_Positioning	UDT30008
+252.0	Traversing blocks	UDT30001
+1928.0	Fault memory	UDT30002
2708.0		END_STRUCT

The structure of the axis DB is specified by the UDTs The basis UDT must always be used. As an alternative for the UDT30008 (telegram 111), UDT30010 (telegram 110) or UDT 30009 (closed-loop speed controlled) can be used.

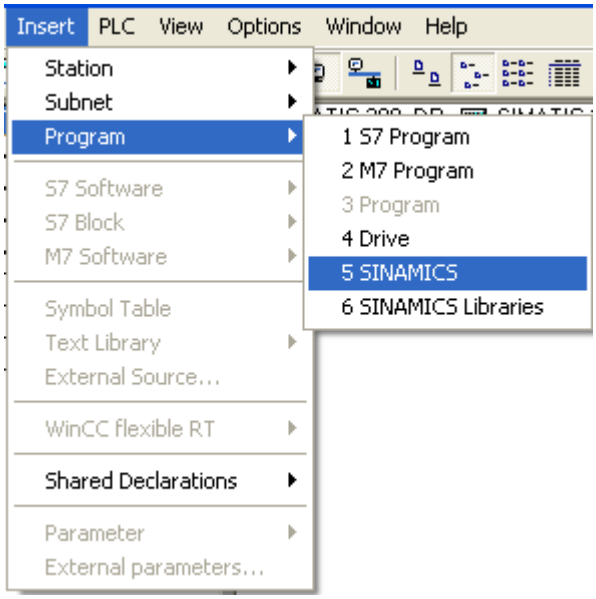
UDTs 30001 and 30002 are optional, and can be removed if they are not required.

7.2 Configuring the SINAMICS S110

7.2.1 SIMATIC Manager, inserting the SINAMICS S110

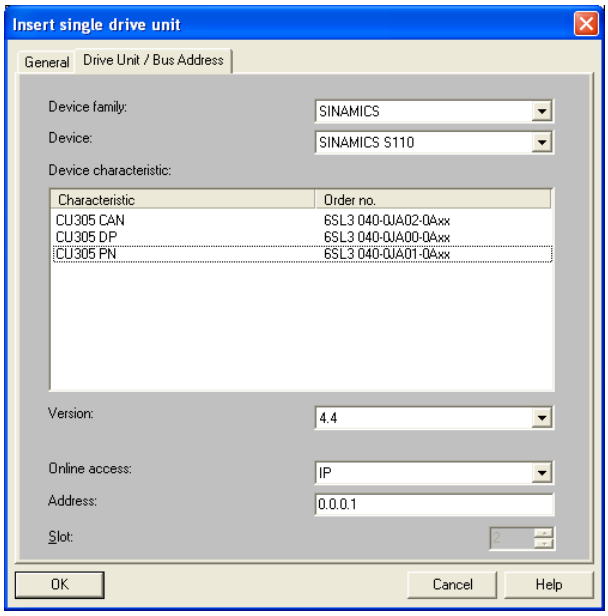
- In the SIMATIC Manager tree, select the topmost point and then via "Insert > Program > SINAMICS", select a "SINAMICS S110" type object.

Fig. 7-4



- Select an S110 according to your hardware/firmware version and then press the "OK" button.

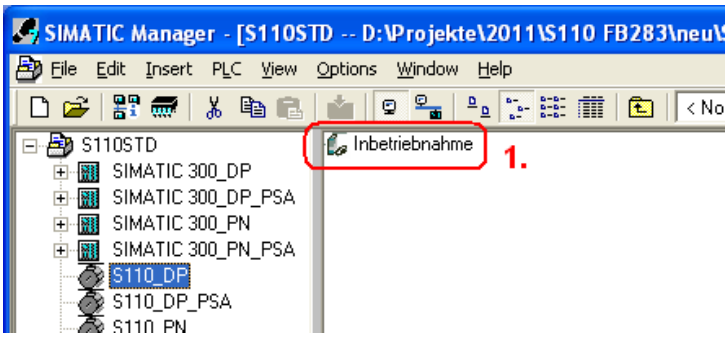
Fig. 7-5



7.2.2 Calling the STARTER parameterizing tool

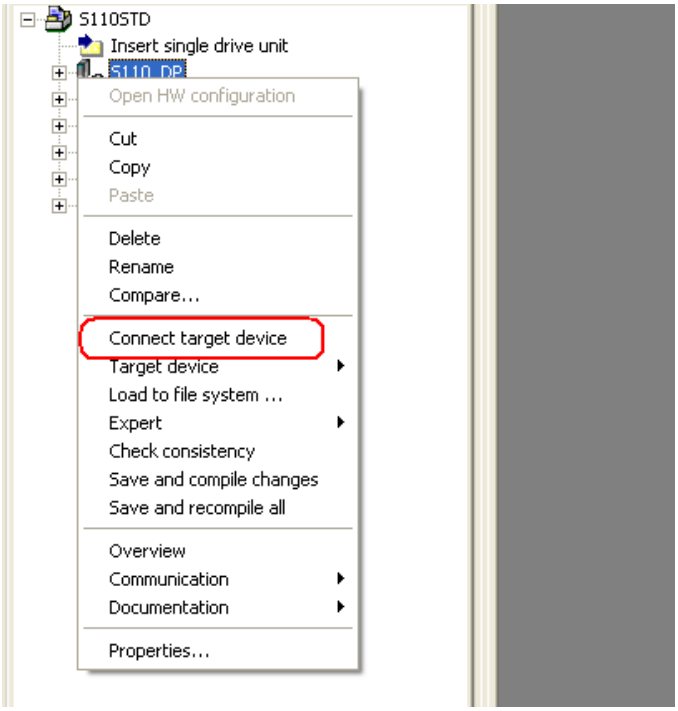
- Starting from the main path of the SIMATIC Manager, start the parameterizing software STARTER by selecting the "SINAMICS_S110" and double clicking on "Commissioning".

Fig. 7-6



- Then click to the right on the S110 and select "Connect target device".

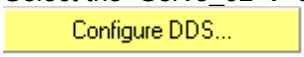
Fig. 7-7



- The screen form that might open with differences in the online/offline comparison can be closed without having to take any action. A "Load to PG" is manually performed after the factory reset.
- Restore the factory settings by pressing the  button. If the button is grayed out, then you must select the S110 in the project tree.

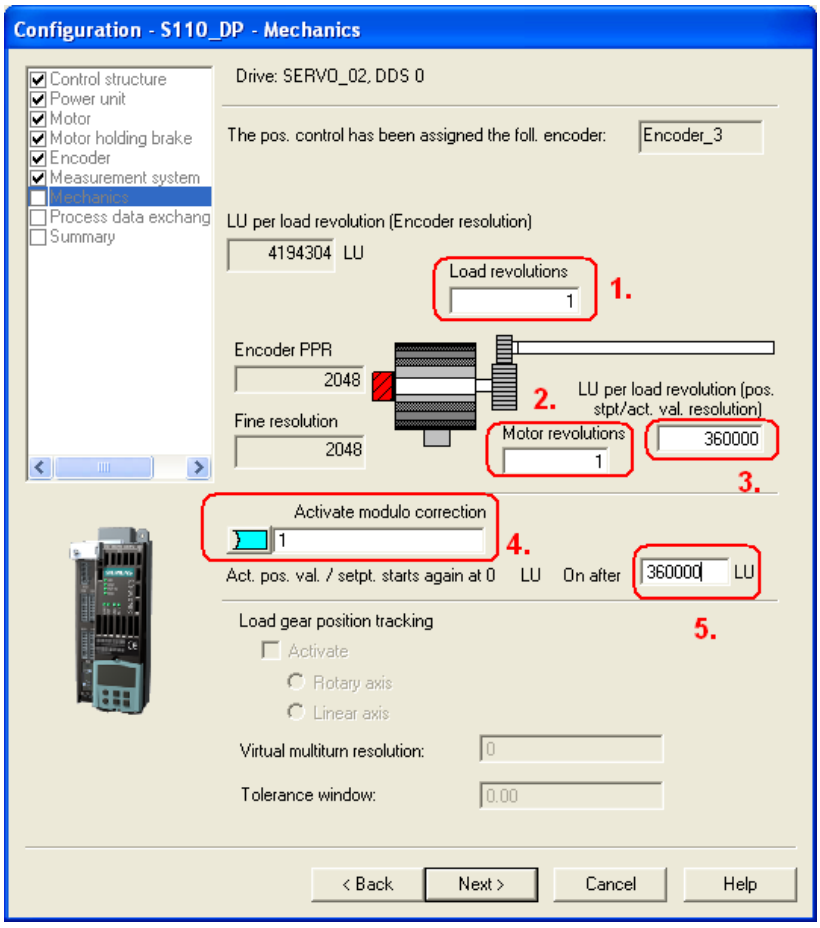
- After the factory settings have been restored, the data is loaded to the PG by pressing the  button.

7.2.3 STARTER, performing quick commissioning

- Select the "Servo_02 → Configuration" menu item and press the 

button to start to commission the motor
- The drive must go offline for commissioning. This step is done automatically if you respond to the corresponding message with yes.
- In the first screen form, the function module "Basic positioner" must be selected and control mode "[21] closed-loop speed control (with encoder)"
- The point "Power unit" and the points "Motor" to "Measurement system" are correctly preassigned for motors with integrated DRIVE-CLiQ encoder.

Fig. 7-8



- "Mechanics" screen form: In this particular example, a rotary axis is assumed. The position change of the motor shaft through 1° should correspond to 1000 LU (Length Units).
  - The gear ratio, load revolutions **(1.)** / motor revolutions **(2.)** is 1:1 for this example.

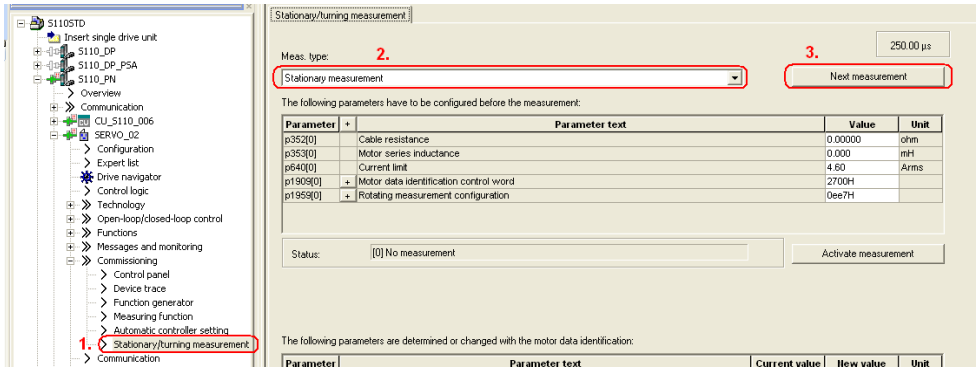
  - One revolution corresponds to 360°, therefore one revolution has 360,000 LU. This value is entered for **(3.)**.
  - The modulo correction, which can be activated via **(4.)**, is used to reset the position actual value to 0 after a defined number of LU. In this example, the reset should be after one load revolution, which corresponds to 360,000 LU **(5.)**.

- In the screen form "Process data exchange", select the "PROFIdrive telegram" as the setpoint source, and "[111] SIEMENS telegram 111, PZD-12/12" as telegram type.
- You can then check the values that you have entered in the "Summary" screen form. The configuration is completed by pressing "Finish".
- Go back on line and load the data to the target device. This is either done using the online/offline comparison screen form that then appears, or using the "Load to target device" button in the screen form that subsequently opens. Set the check mark for "After loading, copy RAM to ROM".

7.2.4 STARTER, performing motor identification

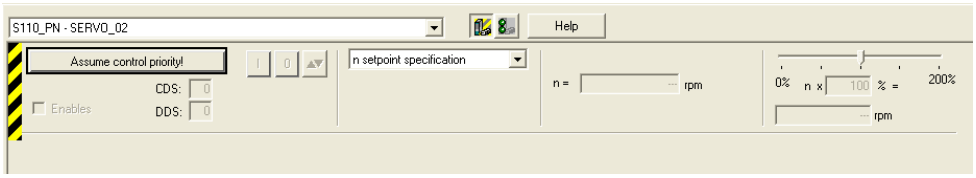
- After quick commissioning has been completed, a stationary measurement can be performed. For Drive-Clip motors, a rotating (turning) measurement is not required, as very precise motor data have already been stored. For other motors, a rotating (turning) measurement should be performed. This is realized analogous to the subsequently described "Stationary measurement".
- To activate the measurement, via "SERVO_02→Commissioning→Stationary/turning measurement" ***(1.)*** open the following screen form.

Fig. 7-9



- For the measuring type, select "Stationary measurement" ***(2.)*** and then press on "Activate measurement" ***(3.).***
- To start the motor identification, in the project navigator, select the menu item "Commissioning" and activate by double clicking on the "Control panel".

Fig. 7-10



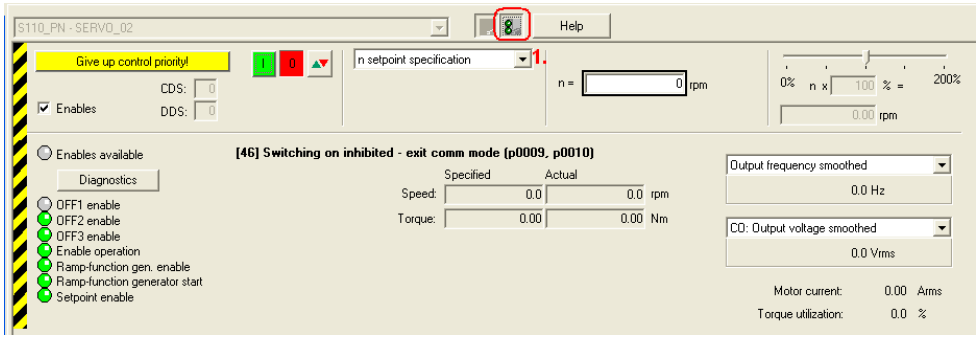
- Press the "Assume control priority" button and carefully observe the safety notes. Then activate "Enables".

WARNUNG

Only use the motor identification function if the motor cannot be turned by a connected load.

In order to avoid an external load accelerating the motor, we recommend that the motor is locked for the stationary motor identification routine.

Fig. 7-11

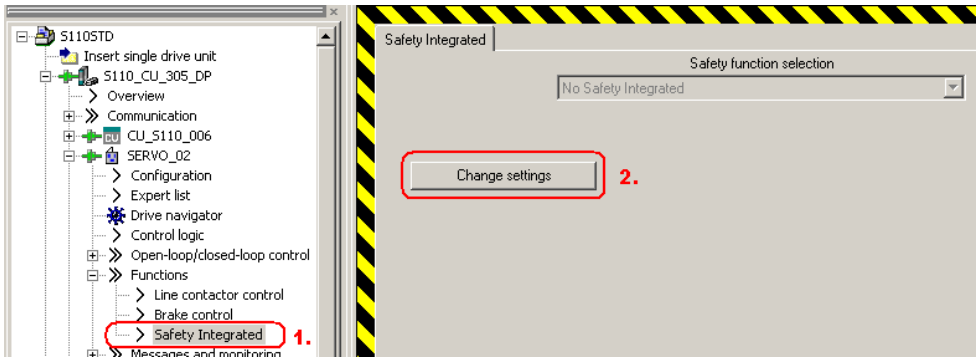


- **1.)** If the control panel on your PG/PC is not completely shown, then press the  button.
- The motor data identification routine is started by pressing the  button. Do not change from the STARTER software into another task, as otherwise, the motor data identification routine will be interrupted for safety reasons.
- Please wait until the  button changes back to the  button.
- By pressing the  button, return the control priority to the S7 control.

7.2.5 Basic Safety settings via F_DI (only for F-DI)

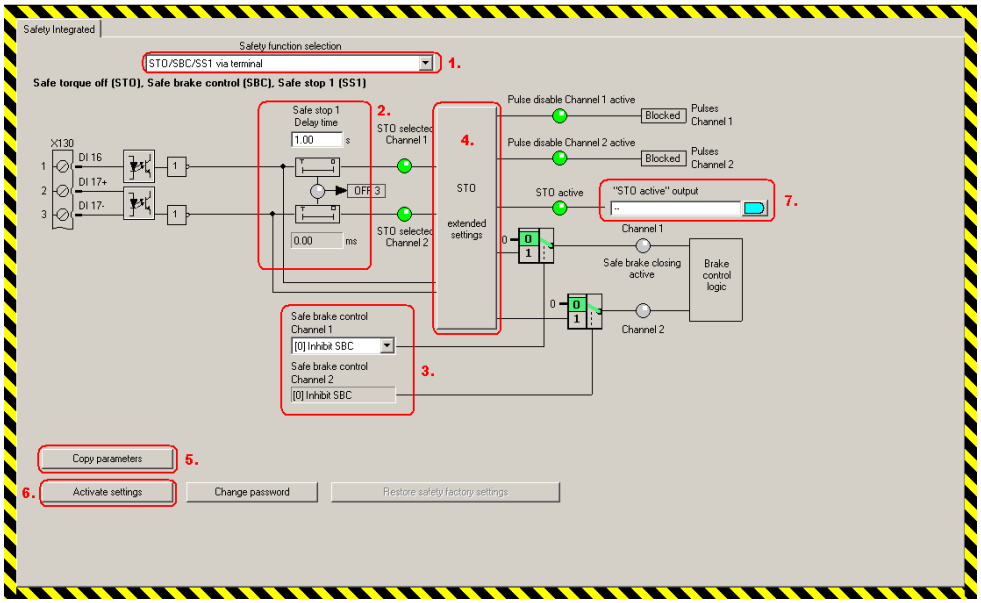
- Activate the Safety screen form by selecting "SERVO_02→Functions→Safety Integrated" ***(1.)***.
- In order to change the settings, you must press "Change settings" ***(2.)***. If you have already assigned a Safety password, you will now be asked to enter this.

Fig. 7-12



For the Basis Safety functions, three functions are available: SS1 (Safe Stop 1), STO (Safe Torque Off) and SBC (Safe Brake Control – external "Safe Brake Module" required). You can connect these via a Safety input.

Fig. 7-13



- In the drop-down menu, select "STO/SBC/SS1 via terminal" ***(1.)***.
- The "Safe Stop1 delay time" (SS1) ***(2.)*** specifies how long the drive should be braked along the fast stop ramp after pressing the Emergency Stop button before STO is initiated. For SS1 = 0s, STO is immediately initiated.
- The "Safe Brake Control" (SBC) ***(3.)*** is not used in this example. However, it can be enabled from the selection menu.

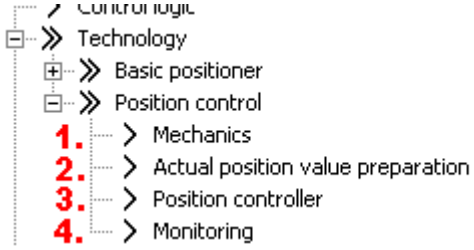
- The extended settings for STO ***(4.)*** are also not changed in this example. The standard settings are suitable for this example.
- It is also possible to interconnect the signal that STO was activated ***(7.)*** e.g. to a digital output.
- The safety functions are implemented through two channels via two processors. In order that these values are identical in both processors, the modified values must be transferred into the second processor using "Copy parameters" ***(5.)***.
- The new settings can then be activated. This is realized using "Activate settings" ***(6.)*** button. If you have still not assigned a password, then do this now.
- In order that the changes become active, they must be saved to the ROM. You can save/backup either "Complete project" (total drive unit) or only the "Axis parameters" (individual axes). Activate "Complete project".
    - For multi-axis devices (S120), saving as individual axis has the advantage that it is faster, as only data associated with the individual axis are saved from RAM to ROM. For multi-axis devices, this especially has advantages where several Safety axes must be commissioned one after the other. When saving individual axes, only the Power Module data are saved, but not the CU data. This means that on the CU, a difference between RAM and ROM is obtained until the "Complete project" is saved.

In addition to the Safety Basic functions that have been described, there are also extended functions, for example SLS (Safely-Limited Speed), SDI (Safe Direction), SSM (Safe Speed Monitor) or SOS (Safe Operational Stop). However, in this case, an additional license is required for the drive.

7.2.6 Overview and settings of the position controller screen forms

You can find the position controller settings under the main item, Technology. They are subdivided into 4 points.

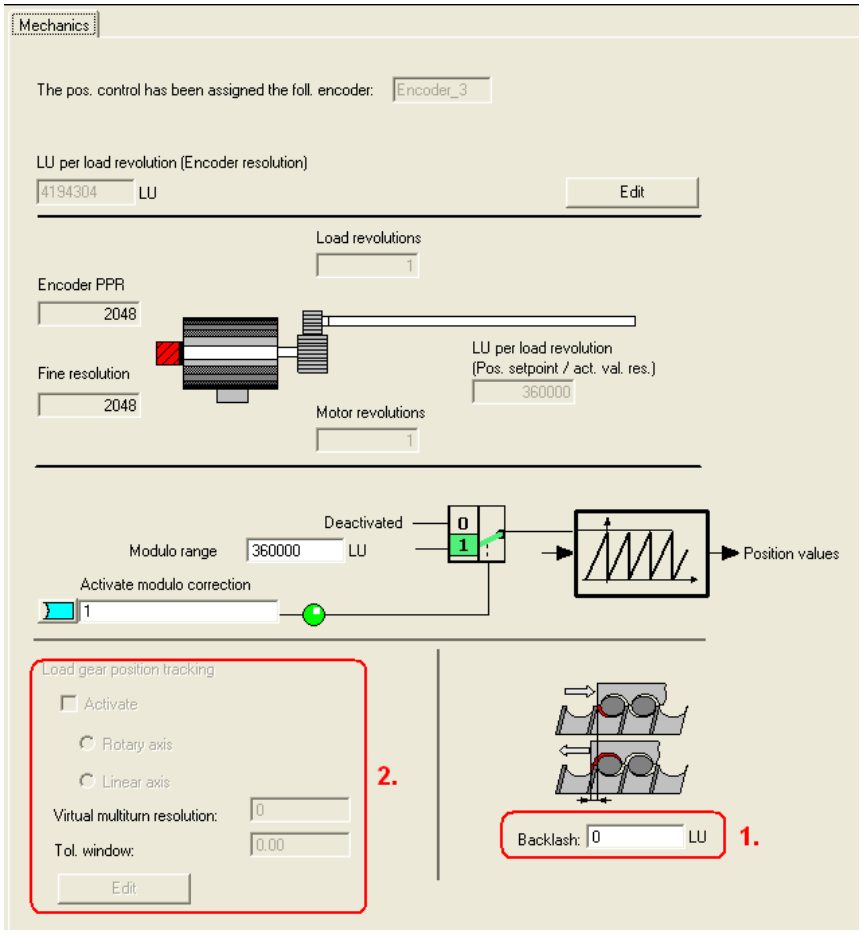
Fig. 7-14



Mechanics

The mechanical settings were already made when commissioning. As a consequence, no changes have to be made here.

Fig. 7-15



In addition to the settings already made for quick commissioning, when required, the backlash value can be set ***(1.)***, which is then taken into account for the closed-loop position control.

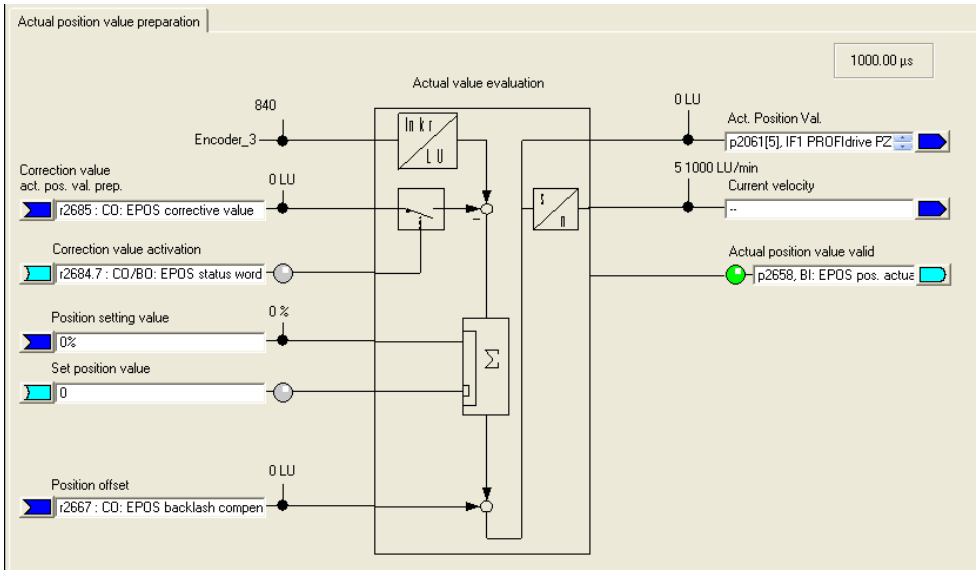
For absolute encoders, position tracking is important ***(2.)***; this ensures that encoder overflows are counted, and even if encoder overflows occur, the system can still correctly position.

Detailed information is provided in the S110 Function Manual on both of these topics.

Position actual value preparation

For position actual value preparation, various settings can be made to adapt the position actual value. However, for this example, no adaptations are required. Generally, when using EPOS, only a few changes are required in the screen form, as EPOS has its own reference system to which it refers.

Fig. 7-16



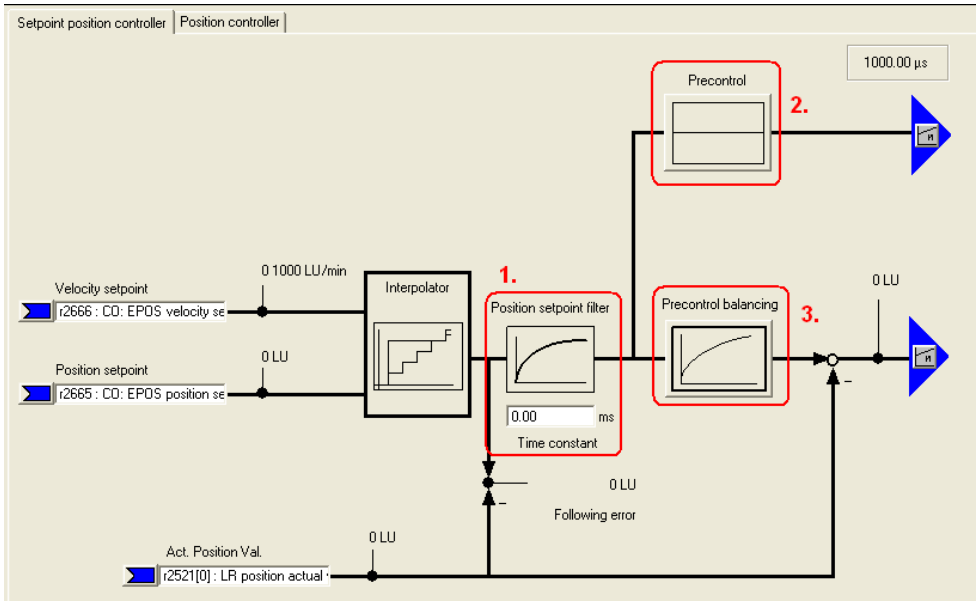
Position controller

The position controller comprises two screen forms.

- Setpoint position controller
- Position controller

The setpoint sources and position actual value source can be adapted for the setpoints for the position controller. As we are using EPOS, EPOS already preassigns these values, and they should not be changed.

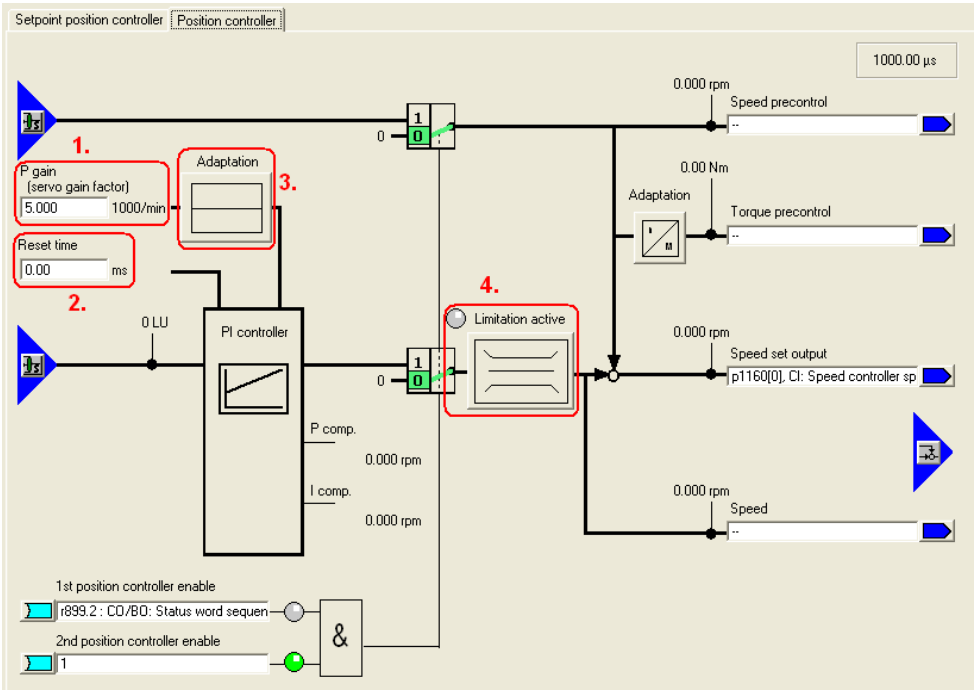
Fig. 7-17



- The position setpoint is filtered using a PT1 element with the selected time constant via the position setpoint filter ***(1.)***. This filtering reduces the pre-control dynamics and jerk limiting.
- With pre-control ***(2.)***, a percentage (0 – 200 %) can be entered, with which the position setpoint precontrols a speed/velocity on the speed controller, bypassing the position controller. (0 % = deactivated)
- With pre-control balancing ***(3.)***, the position setpoint signal can be filtered again in order to emulate the behavior of the speed control loop. To achieve this, a dead time filter (0.0 – 2.0), which represents the factor of the position controller sampling time (1s), and a PT1 element (0 – 100 ms) are available.

With the position controller screen form, the settings of the position controller can be adapted, the controller enable assigned, and the outputs of the position controller interconnected.

Fig. 7-18



- The position controller can be optimized using the P gain ***(1.)*** and the reset time ***(2.)***.
- In addition, the P component can be modified using an adaptation ***(3.)***. This can be used to variably scale the P gain. This means that different position controller settings can be set for various situations.
- The maximum permissible traversing velocity is set for limitation active***(4.)***.

Monitoring

The monitoring function comprises three screen forms:

- Position and standstill (zero speed) monitoring
- Following error monitoring
- Cams

In these screen forms, it is possible to set the position monitoring functions.

Note

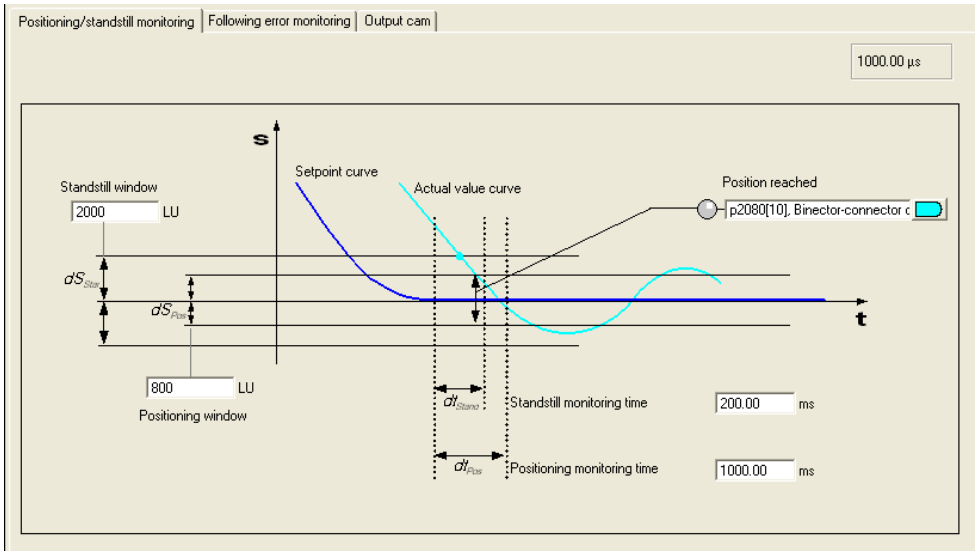
In this case, all values that refer to LU should be increased as a minimum by a factor of 10, as the set value of 360,000 LU is significantly higher than the factory value of 10,000 LU, for which the values have been selected.

Note

The various monitoring functions can be deactivated by entering 0.

The corresponding values should be parameterized under "Positioning/standstill monitoring".

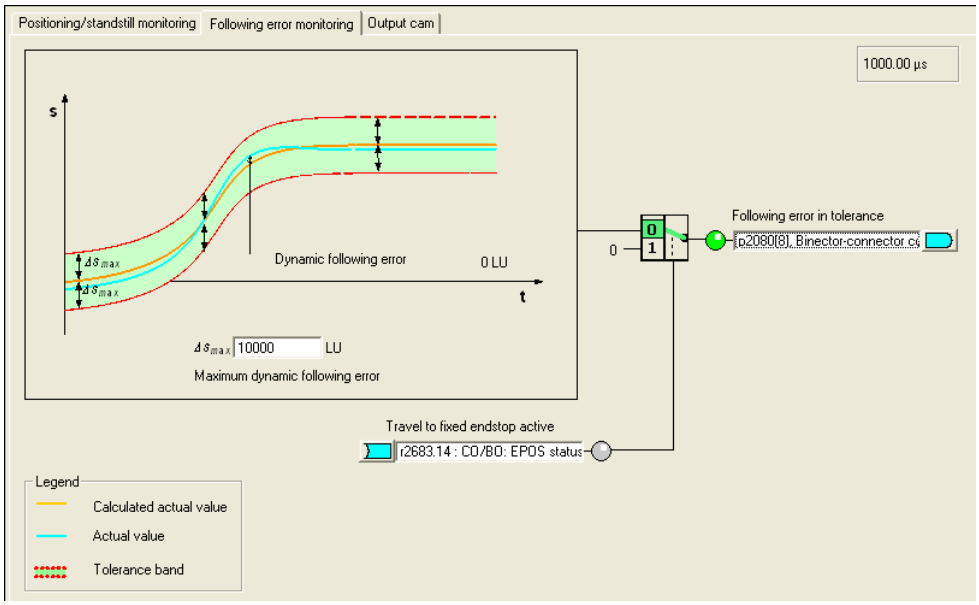
Fig. 7-19



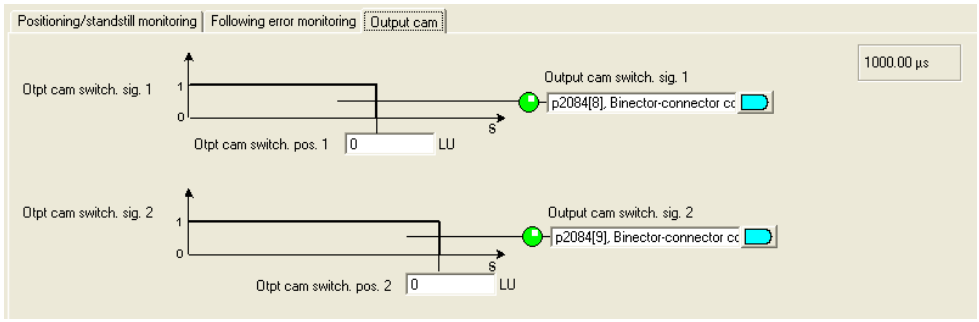
The maximum delta between the setpoint and actual value is set under "Following error monitoring".

If the "Travel to fixed endstop" function is used, then when the following error is exceeded, a fault is not output, but the fixed endstop reached bit is output.

Fig. 7-20



Two cam positions can be set under "Output cams".



The output cams provide a feedback signal of "1" if the actual position is less than the value of the output cam – or 0, if the actual position is greater than the value that has been set.

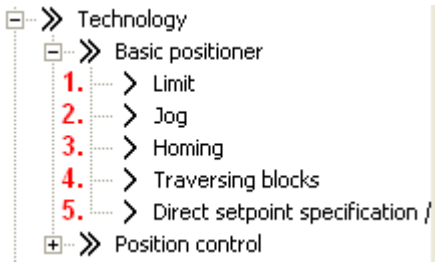
WARNUNG

Only after the axis has been referenced (homed) can it be ensured that the output cam switching signal has a "true" position reference when it is output.

7.2.7 Overview and settings of the basic positioning screen forms

For EPOS. there are 5 subpoints that are used to configure the individual functions.

Fig. 7-21

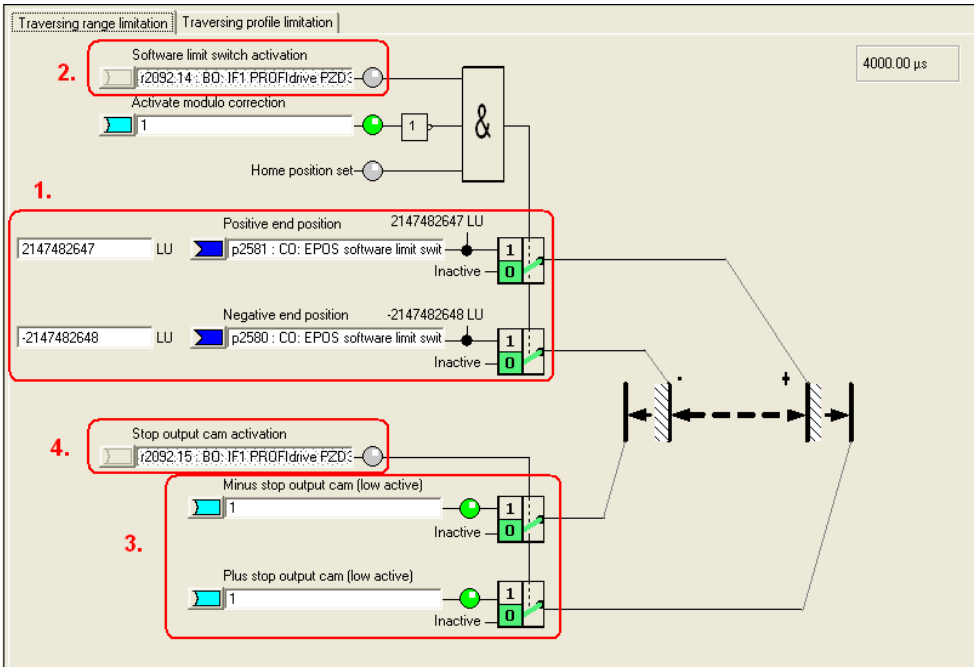


Limitation

The limitation comprises two tabs. One for the traversing range limitation and one for the traversing profile limitation.

For the traversing range limitation, the software limit switches and stop output cams are parameterized. This parameterization is only required if you want to use the associated functions.

Fig. 7-22



For the software limit switches ***(1.)***, the end positions are specified in LU, which the drive must not pass. Generally, these end positions are located in front of the stop output cams.

The software limit switches output various alarms:

- A7469 or A7470 — Target position in a traversing block exceeds the software limit switch range in the negative/positive direction.
- A7477 or A7478 — The target position when actually traversing is less than/greater than the negative/positive end position.
- A7479 or A7480 — Axis is located at a negative/positive limit switch position – an active traversing block has been canceled/interrupted.
- F7481 or F7482 — Software limit switch, negative/positive activated.

Using "Software limit switch activation" ***(2.)*** , the limit switches can be activated; however, only if the modulo correction is not active and the axis has been referenced (homed). When using telegram 111, the software limit switch is activated using bit 14 of positioning control word 2.

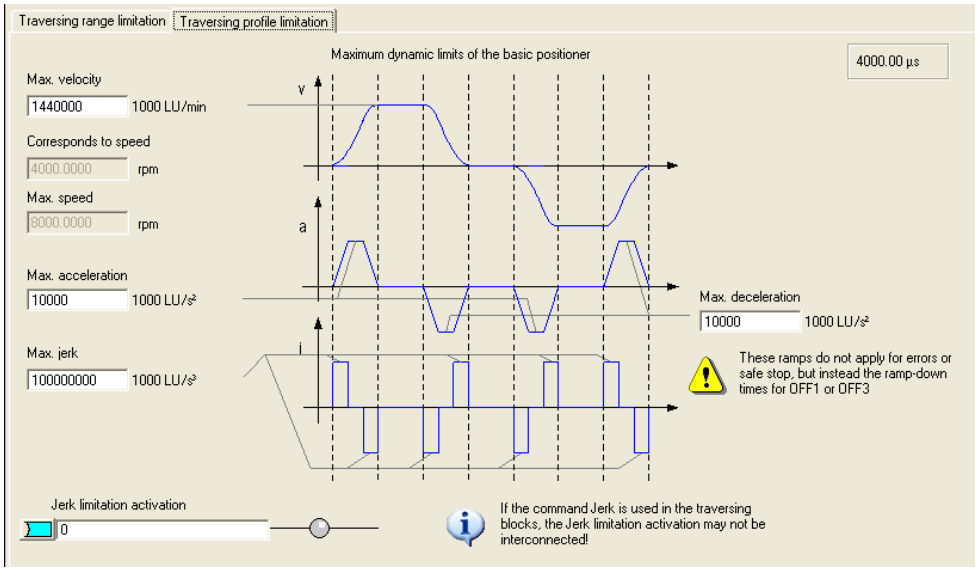
There are also the stop output cams ***(3.).*** Generally, these are interconnected with sensors at the digital inputs. A response is initiated if the output stop cam is activated (passed).

NOTE A fault as standard response can be adapted in the expert list using p2117 and p2119 to become an alarm.

The stop output cams can be activated using "Stop output cam activation" ***(4.)***. This is realized for a telegram using bit 15 of the positioning control word 2.

The limits for maximum velocity, acceleration, deceleration and jerk can be entered under the traversing profile limitation tab. Just the same as for the monitoring functions, these values can be increased, as it involves a higher resolution than in the basic settings. The mechanical load on a motor operating under no-load conditions is low. This means that the positioning velocity can be set to the maximum velocity without any problem, and the acceleration and deceleration rates can be correspondingly increased. **When a mechanical system is connected to the motor, then the load limits of the mechanical system must be taken into consideration.**

Fig. 7-23



For the velocity, the maximum velocity can be set in 1000 LU/min. However, this must lie below the maximum motor speed. The value converted into speed is shown in the screen form under Corresponds to speed.

The acceleration rate of the drive can be determined using acceleration. This is comparable with the acceleration time. You must perform the following calculation if you want to convert the acceleration rate into an acceleration time:

$$\frac{\max.velocity\left[\frac{1000\ LU}{\min}\right]}{60\left[\frac{s}{\min}\right] \bullet \max.acceleration\left[\frac{1000\ LU}{s^2}\right]} = acceleration\ time\,[s]$$

Analogous to acceleration, there is also deceleration. Using the same formula, this can be converted into a deceleration time.

The jerk limitation specifies the jerk when the drive accelerates. As standard, this is not active but must be separately activated. If it is active, then it rounds-off the ramps. The rounding-off time can be calculated as follows:

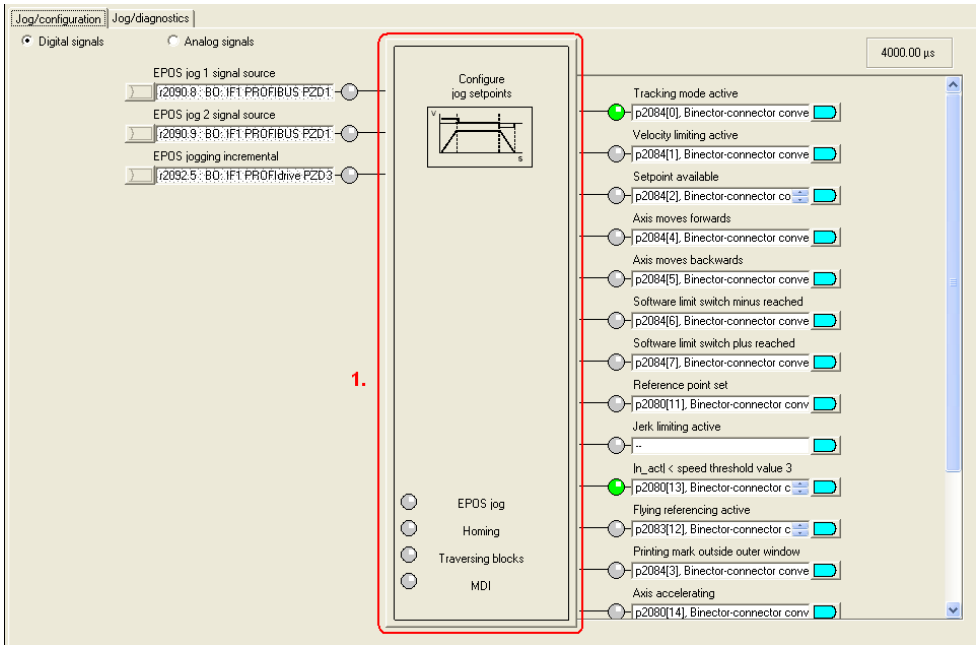
$$\frac{\max.\ acceleration\left[\frac{1000\ LU}{s^2}\right]}{\max.\ jerk\left[\frac{1000\ LU}{s^3}\right]} = rounding-off\ \ time\,[s]$$

Jogging

Here, there are two screen forms; one for configuring and one for diagnostics.

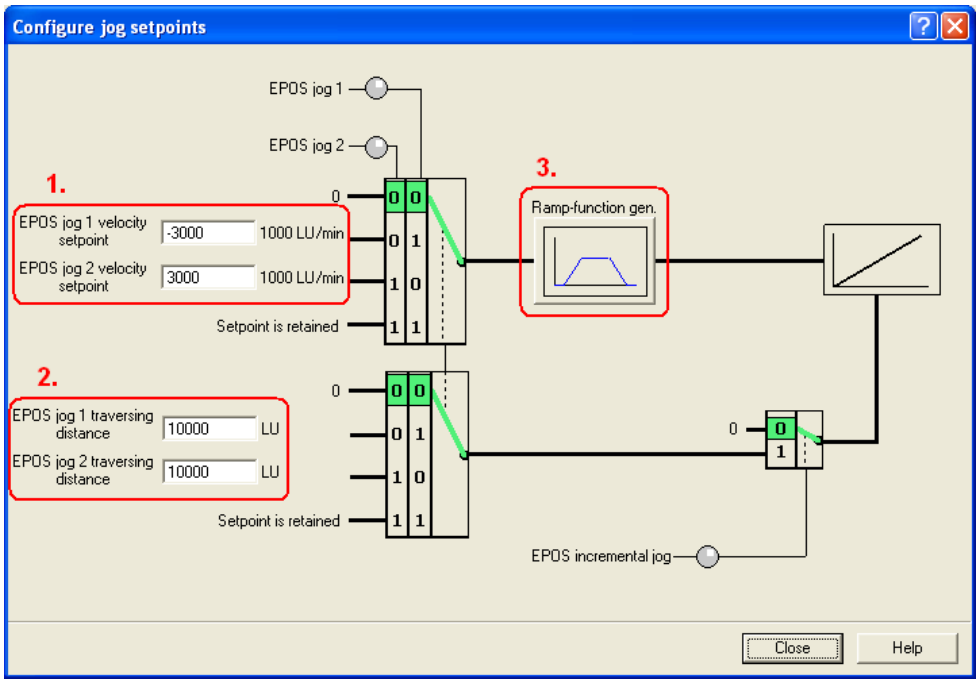
When configuring, you can toggle between the digital and analog inputs/outputs of the jog function by making the appropriate selection at the top left. All of the settings of this screen form are correctly set when selecting the telegram, and do not have to be changed.

Fig. 7-24



By clicking on the jog block ***(1.)***, the box to configure the jog setpoints is opened. Here, you should increase the values, as they are too low for the mechanical settings that have been made.

Fig. 7-25



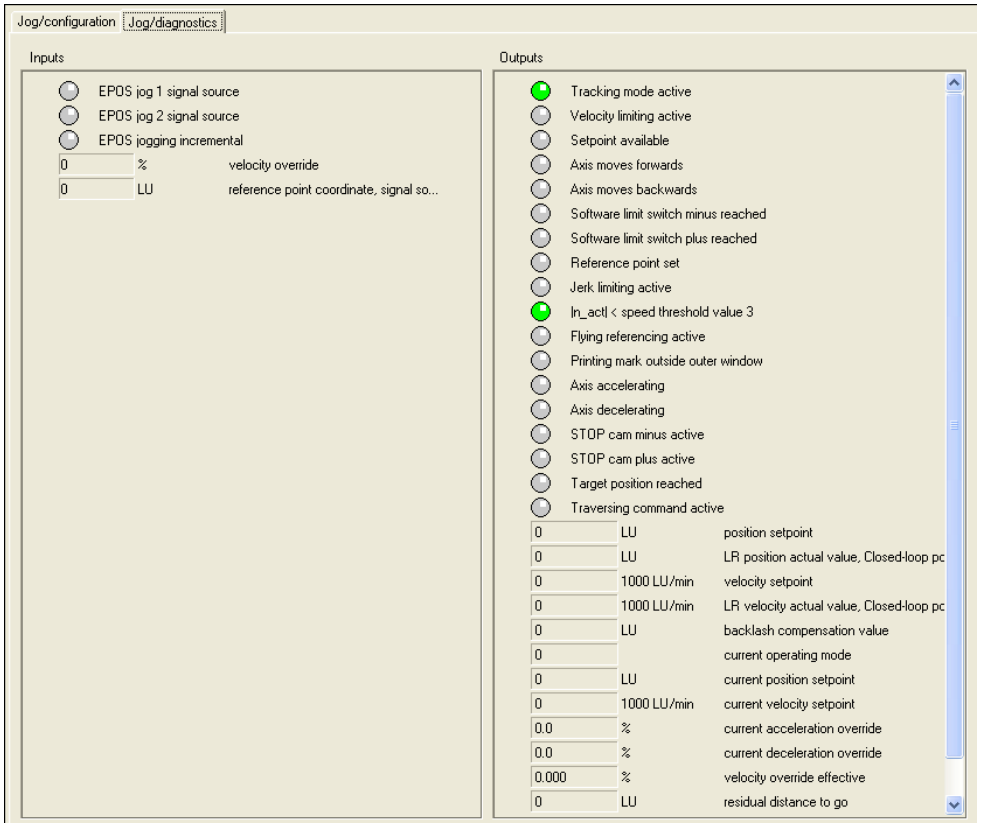
The traversing velocity when jogging can be defined using the setpoint velocity values (1.).

The traversing distance settings (2.) specify how far the drive is traversed for incremental jogging. Incremental jogging must be separately activated, and is then controlled using the same inputs as for normal jogging.

In the ramp-function generator, you can set an up ramp, which is only applicable for jogging.

An overview of the analog and digital inputs and outputs is provided in the diagnostics screen form.

Fig. 7-26

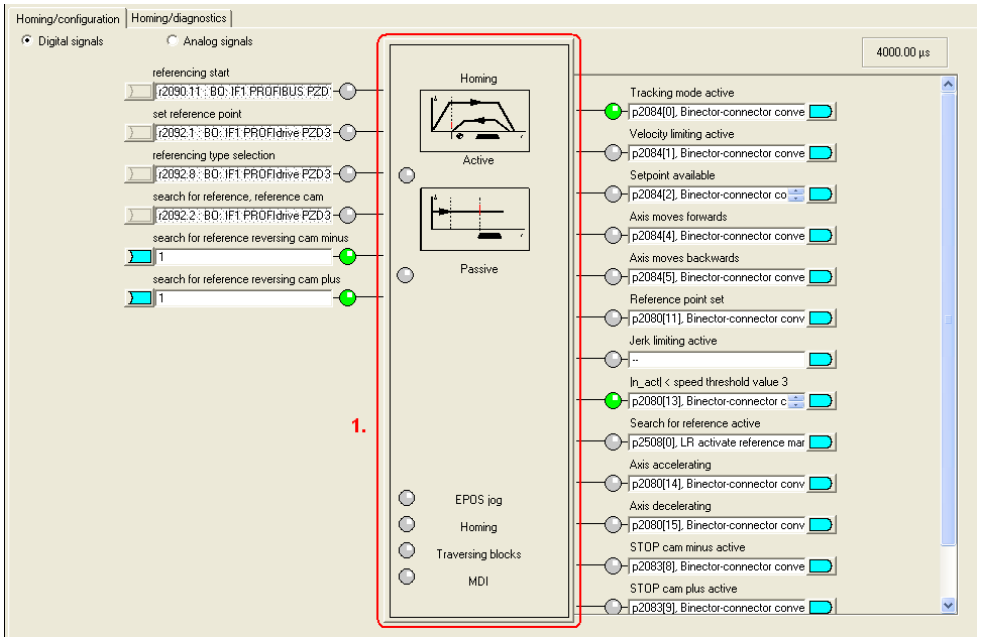


Homing

The screen forms for homing have a similar structure to those for jogging.

When homing, two inputs, which are not covered by the standard telegram 111, are still available. These are for the reversing output cams, where the drive, when performing an active search, changes its direction and searches for the homing points (reference points) in the other direction. However, these are not used in the example.

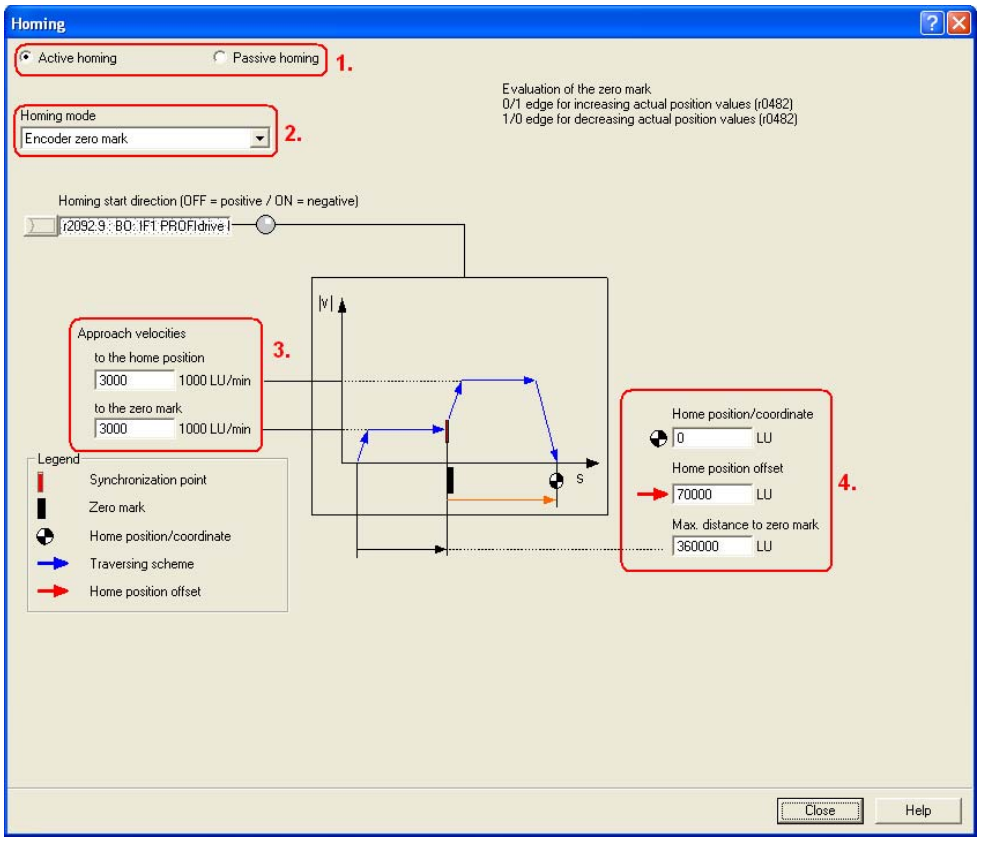
Fig. 7-27



You can select the homing mode by double-clicking on the homing block ***(1.)***. In the example, active homing is used and as homing mode, the encoder zero mark. When selecting homing, the drive is automatically traversed in order to search for the homing point, which is the encoder zero mark. On the other hand, for passive homing, the axis is homed during normal traversing when detecting the homing signal.

The following screen form is available for active homing for **incremental encoders**.

Fig. 7-28



You can select between different homing types ***(1.)*** and homing modes ***(2.)***.

The possible homing modes are active (specifically requested automatic homing) and passive (the axis is automatically homed during normal traversing)

For the homing mode, the following can be selected for the reference signal:

- Reference cam and encoder zero mark
- Encoder zero mark
- External zero mark

The settings for the approach velocities ***(3.)*** should be set corresponding to the mechanical system. In this example, this means that the value should be increased, as we have set a relatively high resolution.

There are two options for correcting the position value to the required value: ***(4.)***

1. Home position/coordinate
   The value is entered, which is the position actual value at the zero mark.
   This means that for active homing, the motor remains stationary at the encoder zero mark, which represents the home position.

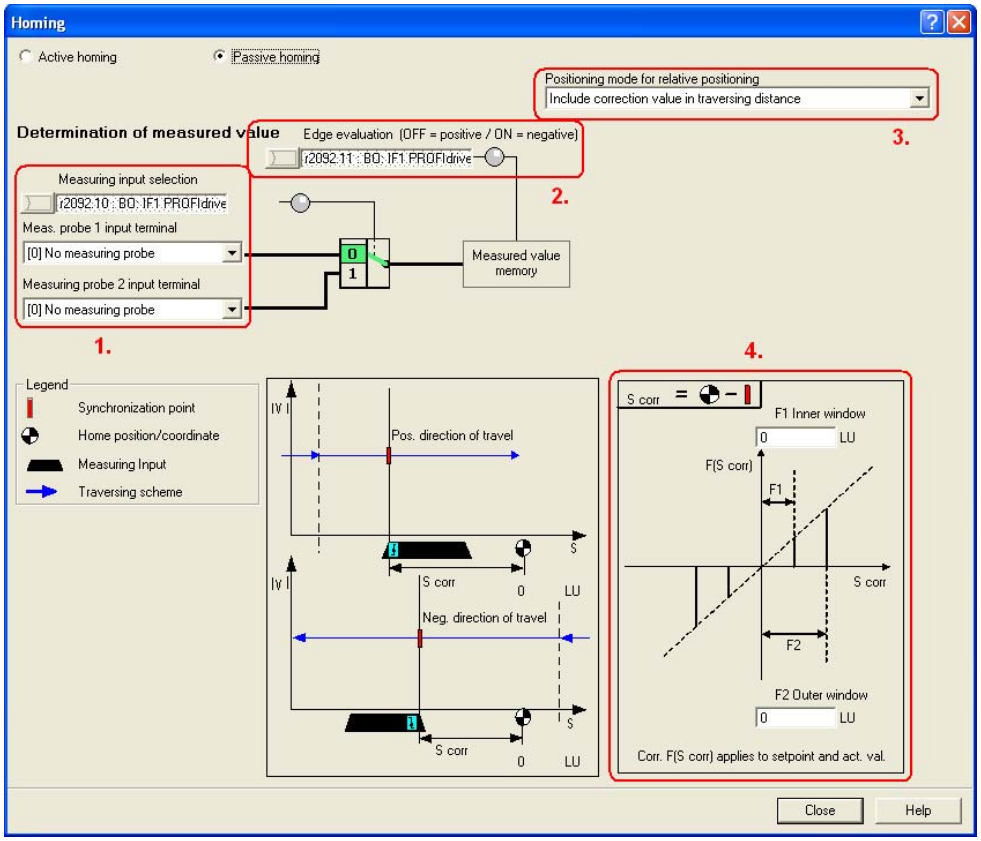
2. Home position offset
   It is specified as to how many LU the home position should be shifted in the positive direction.
   This means that for active homing, the motor remains stationary at the home position (0 LU).

For **absolute encoders**, in the screen form "Active homing", there is just one button "Absolute encoder adjustment" as well as one input field for the home position coordinates. Absolute encoders have the advantage that they do not have to be re-homed each time that the system is switched on.

Passive homing is also possible for absolute encoders.

The screen form for passive homing is the same both for absolute as well as incremental encoders; however, it is not used for the example.

Fig. 7-29



For passive homing, you can parameterize two measuring probes as home position source for passive homing. ***(1.)*** For telegram 111, the active measuring probe is selected via PROFIBUS.

Using the edge evaluation ***(2.)***, you can set whether measuring probe high or low active is used.

You can set whether a position actual value correction should be taken into account for relative positioning ***(3.)*** or only for absolute positioning.

When entering the inner and outer windows ***(4.)***, you can set separate correction values. This means that the measuring probe width can be compensated.

Otherwise, this would automatically result in different zero positions, dependent on the direction of travel.

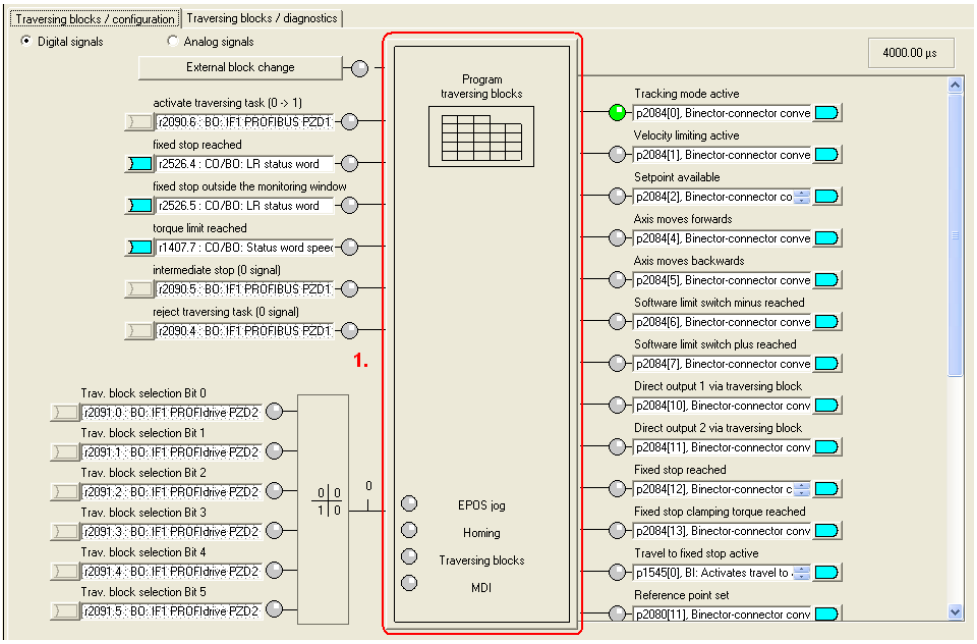
Traversing blocks

For the traversing blocks, just as for the previous, there is one screen form for configuring

and one for diagnostics.

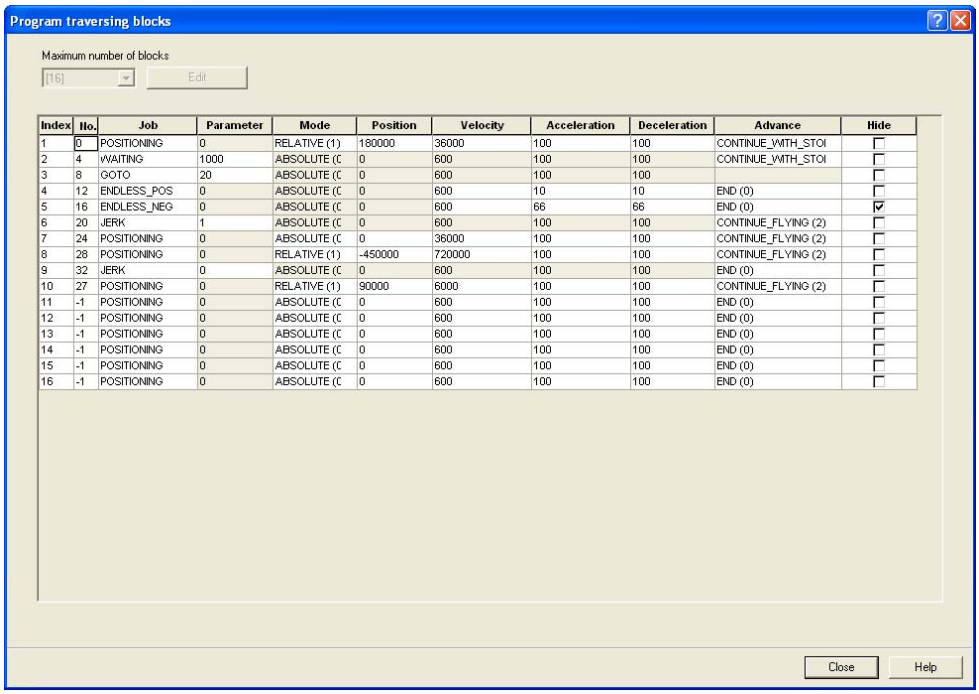
All of the settings of this screen form are correctly set when selecting the telegram, and should not be changed.

Fig. 7-30



You can get to the traversing block screen form via the block for the traversing block ***(1.)***.

Fig. 7-31



Index	No.	Job	Parameter	Mode	Position	Velocity	Acceleration	Deceleration	Advance	Hide
1	0	POSITIONING	0	RELATIVE (1)	180000	36000	100	100	CONTINUE_WITH_STOI	☐
2	4	WAITING	1000	ABSOLUTE ((	0	600	100	100	CONTINUE_WITH_STOI	☐
3	8	GOTO	20	ABSOLUTE ((	0	600	100	100		☐
4	12	ENDLESS_POS	0	ABSOLUTE ((	0	600	10	10	END (0)	☐
5	16	ENDLESS_NEG	0	ABSOLUTE ((	0	600	66	66	END (0)	☑
6	20	JERK	1	ABSOLUTE ((	0	600	100	100	CONTINUE_FLYING (2)	☐
7	24	POSITIONING	0	ABSOLUTE ((	0	36000	100	100	CONTINUE_FLYING (2)	☐
8	28	POSITIONING	0	RELATIVE (1)	-450000	720000	100	100	CONTINUE_FLYING (2)	☐
9	32	JERK	0	ABSOLUTE ((	0	600	100	100	END (0)	☐
10	27	POSITIONING	0	RELATIVE (1)	90000	6000	100	100	CONTINUE_FLYING (2)	☐
11	-1	POSITIONING	0	ABSOLUTE ((	0	600	100	100	END (0)	☐
12	-1	POSITIONING	0	ABSOLUTE ((	0	600	100	100	END (0)	☐
13	-1	POSITIONING	0	ABSOLUTE ((	0	600	100	100	END (0)	☐
14	-1	POSITIONING	0	ABSOLUTE ((	0	600	100	100	END (0)	☐
15	-1	POSITIONING	0	ABSOLUTE ((	0	600	100	100	END (0)	☐
16	-1	POSITIONING	0	ABSOLUTE ((	0	600	100	100	END (0)	☐

Here, you can parameterize the traversing blocks. Parameters that are not required are grayed out. The sequence is defined by the block number and not by the sequence of the list; this means that when making subsequent changes, a new line can be simply attached with the corresponding number.

This example is only intended to show what traversing blocks can look like.

More detailed information on setting traversing programs is provided in the S110 Function Manual.

Direct setpoint input MDI

The direct setpoint input / MDI, just like the previous points, is subdivided into 2 tab sheets for configuration and diagnostics.

All of the settings of this screen form are correctly set when selecting the telegram, and should not be changed.

You can assign the input signals for MDI here. As standard, all of the inputs are already preassigned via PROFIBUS. By selecting the "Positioning MDI" block ***(1.)***, you can set 4 fixed setpoints, which are active if a setpoint has not been specified via the bus.

Fig. 7-32

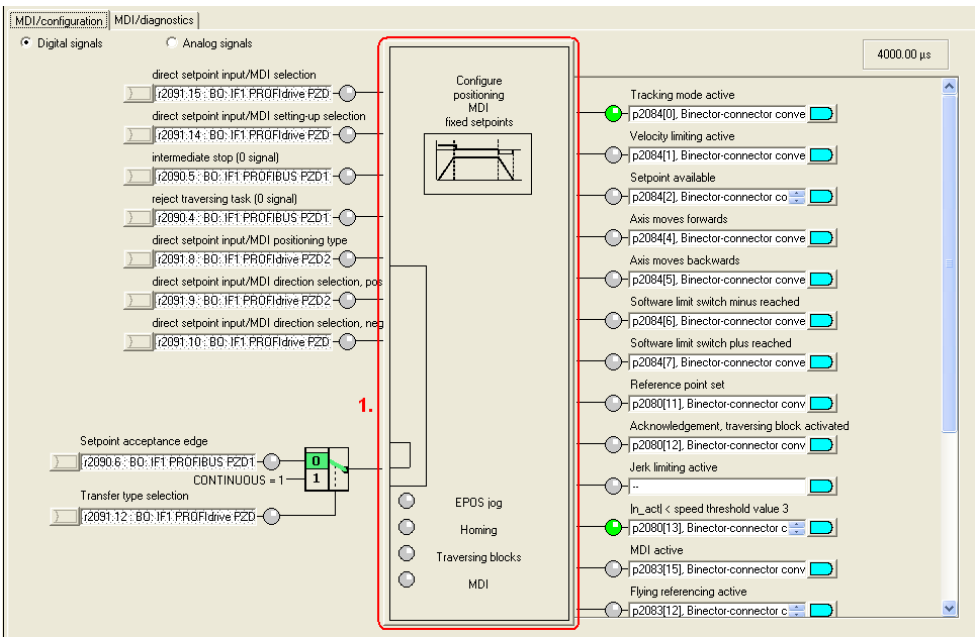
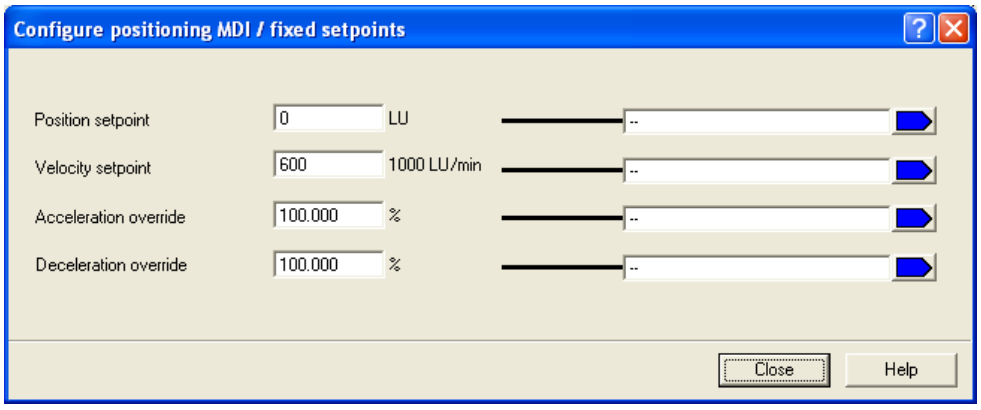


Fig. 7-33

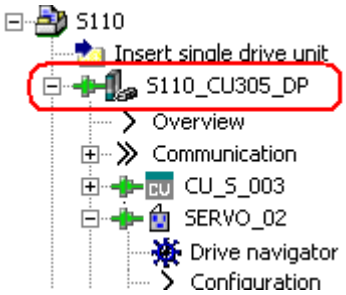


In this screen form, you can set the setpoints that are used as long as they are not externally entered. As in this example the setpoints are received via the control (telegram 111), changes in this screen form have no effect for this example.

7.2.8 Completing commissioning

- To complete, you only have to backup the SINAMICS S110 configuration in the ROM memory of the converter. To do this, in the project navigator, select the menu item ***S110_CU305_DP.***

Fig. 7-34



- In the toolbar, press the  button.
- Please wait until the operation has been completed.

7.3 FB283 error messages

7.3.1 single.ErrorNumbr

Table 7-3

ErrorNumbr	Significance
10XY	Network 2: SFC6 RET_VAL <> 0
11XY	Network 2: obligatory Udt30000 not available in the axis DB or is not at the start of the axis DB *Remedy* ***1.) Reboot the CPU*** *2.) Create the axis DB corresponding to the documentation,* *e.g. UDT30000, UDT30001, ..., at the end, own variables.*
20XY	Network 3: SFC15 RET_VAL <> 0, error when writing process data
21XY	Network 3: SFC21 RET_VAL <> 0, error when deleting the status words
22XY	Network 3: SFC20 RET_VAL <> 0, error when copying from #rdz to #hilf_zsw
30XY	Network 4: #AuftrArt has an invalid value
40XY	Network 5: single.taski = 0
41XY	Network 5: single.taski has an invalid value
42XY	Network 5: The task 30011 "Pre-assign traversing blocks 0..63" cannot be started with a positive edge of bit single.RD
43XY	Network 5: The task 30002 "Read-out fault memory" cannot be started with a positive edge of bit single.WR
50XY	Network 6: #AuftrSchritt has an invalid value
51XY	Network 6: Incorrect return value (ParameterValues.Format) from SINAMICS S120
60XY	Network 7: #AuftrSchritt has an invalid value
61XY	Network 7: Internal program error
70XY	Network 8: #AuftrSchritt has an invalid value
71XY	Network 8: singl.Ind < 0 (permitted values: 0...63)
72XY	Network 8: singl.Ind > 63 (permitted values: 0...63)
80XY	Network 9: #AuftrSchritt has an invalid value
81XY	Network 9: optional UDT30001 not available in the axis DB, this means that the task "Read/write traversing block" cannot be executed. *Remedy* ***1.) Reboot the CPU*** *2.) Create the axis DB corresponding to the documentation,* *e.g. UDT30000, UDT30001, ..., at the end, own variables.*
82XY	Network 9: single.Ind > 63 (permitted values: 0...63)
83XY	Network 9: single.Ind < 0 (permitted values: 0...63)
84XY	Network 9: single.Data > 63 (permitted values: 0...63)
85XY	Network 9: single.Data < single.Ind (note: single.Ind must be <= single.Data)
86XY	Network 17: single.Ind > 10 (permitted values: 1...10)
87XY	Network 17: single.Ind < 1 (permitted values: 1...10)
88XY	Network 17: single.Data > 10 (permitted values: 1...10)
89XY	Network 17: single.Data < 1 (permitted values: 1...10)

8AXY	Network 17: single.Ind =< single.Data (Note: single.Ind must be >= single.Data)
90XY	Network 10: #AuftrSchritt has an invalid value
91XY	Network 10: optional UDT30002 not available in the axis DB, this means that the task "Read-out fault memory" cannot be executed. *Remedy* ***1.) Reboot the CPU*** *2.) Create the axis DB corresponding to the documentation,* *e.g. UDT30000, UDT30001, ..., at the end, own variables.*
92XY	Network 10: Internal program error when generating the task - jump bar
93XY	Network 10: Internal program error when evaluating the task - jump bar
94XY	Network 10: Internal program error when evaluating the task - fault code
95XY	Network 10: Internal program error when evaluating the task - fault number
96XY	Network 10: Internal program error when evaluating the task - fault value
A0XY	Network 12: #AuftrSchritt has an invalid value
B0XY	Network 12: #AuftrSchritt has an invalid value
B1XY	Network 12: A value was not able to be read
B2XY	Network 12: Internal program error when evaluating the task.
C0XY	Network 13: #AuftrSchritt has an invalid value
C1XY	Network 13: A value was not able to be written
D0XY	Network 14: Error for non-cyclic write access using SFB53 (SFB errors, refer below)
D1XY	Network 14: Error for non-cyclic read access using SFB52
D2XY	Network 14: Internal program error
E0XY	Network 15: Error for non-cyclic access using SFB
E1XY	Network 14/15: Request Error task completed with error (Response ID = 0x81/82); additional tasks canceled. For a more precise error number, refer to instance DB DBW322 (response.Error_Nr). Significance of the error numbers, refer to the Manual, Chapter "Acyclic communication"
F0XY	Network 17/18: #AuftrSchritt has an invalid value
F1XY	Network 17: Incorrect return value (ParameterValues.Format) from SINAMICS S120

7.3.2 SINAMICS S110

A detailed description of the SINAMICS S110 error messages is provided in the associated List Manual (Chapter 3.2 List of faults and alarms):

http://support.automation.siemens.com/WW/view/de/49129886

Or in the STARTER online help.

7.4 FAQ on FB283

Q: The system blocks SFC 14/15 signal an area length error in the diagnostics buffer of the S7 CPU?

A: Check the access width of the WR_PZD and RD_PZD in the FB283 call with HW Config. The access width (in bytes) must be the same size. The PROFIBUS address must be correct.

Q: Cyclic communication runs, but acyclic communication does not function?

A1: Check the diagnostics address (this can be found in HW Config). Generally, the preset diagnostics address of the example is not appropriate.

A2: Check the axis object number. The drive object number of the axis in STARTER corresponds to the axis object number in the FB283 call.

Q: Is it possible to acyclically access a drive line-up of several SINAMICS connected in parallel?

A : No **-** The task interface of the FB283 only permits acyclic access operations. If several SINAMICS are to be accessed, then this must be done sequentially.

Q: Is it possible to acyclically access a CU320 with several axes in parallel?

A: No - as PROFIBUS node, a CU320 has only ONE diagnostics address – accessing axes of a CU must be realized sequentially.

Q: Why does the S7 CPU signal an area length error for the FB283 in the diagnostics buffer when using a multi-instance for several drives?

A : Within a multi-instance, the FB283 can only manage a limited number of axis data blocks. In tests, this limit was defined to be 6. If more axes are managed, then the FB283 should be used under a new name (for example FB284).

Q: Why does the FB283 output an error when attempting to write to one/several traversing blocks on an axis?

A : Writing to one/several traversing blocks requires correct parameterization of the traversing blocks - incorrect traversing blocks are not transferred or the transfer is canceled for a traversing block at this position.

Q: Why can parameters of an OA application not be read out/written to with a parameter value greater than 30000?

A : There is an internal limit of all readable/writable parameters in the FB283. This limit is 29999. In this case, standard blocks SF52 / 53 must be used.

8 References

8.1 Internet links - data

This list in no way complete and only reflects a selection of suitable information.

Table 8-1

	Subject area	Title
\1\	Reference to the article	http://support.automation.siemens.com/WW/view/en/58703186
\2\	Siemens I IA/DT Customer Support	http://support.automation.siemens.com
\3\	GSD file for S110 CU305 DP	http://support.automation.siemens.com/WW/view/en/42705323
\3\	GSD file for S110 CU305 PN	http://support.automation.siemens.com/WW/view/en/48924746
\5\	SINAMICS S110 List Manual	http://support.automation.siemens.com/WW/view/en/49129886
\6\	Toolbox v2.1 SINAMICS S120	http://support.automation.siemens.com/WW/view/en/25166781

9 Contact

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10 History

Table 10-1

Version	Date	Change
V1.0	16.02.2012	First Edition