

SIEMENS

SIMATIC

S7-300

Connection of the SINAMICS S120 to the Technology CPU

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Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠ DANGER
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⚠ WARNING
indicates that death or severe personal injury may result if proper precautions are not taken.
⚠ CAUTION
with a safety alert symbol, indicates that minor personal injury can result if proper precautions are not taken.
CAUTION
without a safety alert symbol, indicates that property damage can result if proper precautions are not taken.
NOTICE
indicates that an unintended result or situation can occur if the relevant information is not taken into account.

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The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

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We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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Definitions and warnings

Purpose of document

This document presents the most important standard options to use the SINAMICS S120 drive system on the CPU 31xT-2 DP Technology CPU. Other functions can definitely also run together with SINAMICS S120, but they must be considered individually.

Document scope

- CPU 31xT(F) as of V2.7/5.1.5
- SINAMICS S120 as of V2.6.2
- S7 Technology as of V4.2 SP1

Required basic knowledge

To understand this document you must have general knowledge about automation and drive technology. In particular, you must be familiar with the SINAMICS S120 drive system.

In addition, you must know how to work with the STEP 7 basic software and the S7 Technology option package.

Getting Started "CPU 317T-2 DP: Controlling a SINAMICS S120" is provided as an introduction.

Qualified personnel

Qualified personnel with regard to the documentation are those persons responsible for the installation, assembly, commissioning, operation and maintenance of the Technology CPU and SINAMICS S120 product and who have the following qualifications:

- Trained and authorized to energize, de-energize, clear, ground and tag circuits and equipment in accordance with established safety procedures.
- Trained in the proper care and use of protective equipment in accordance with established safety procedures.
- First aid training.

Warnings are not explicitly given in this documentation. However, explicit reference is made to the warning notes in the operating instructions for the associated product of the SINAMICS series.

Document scope

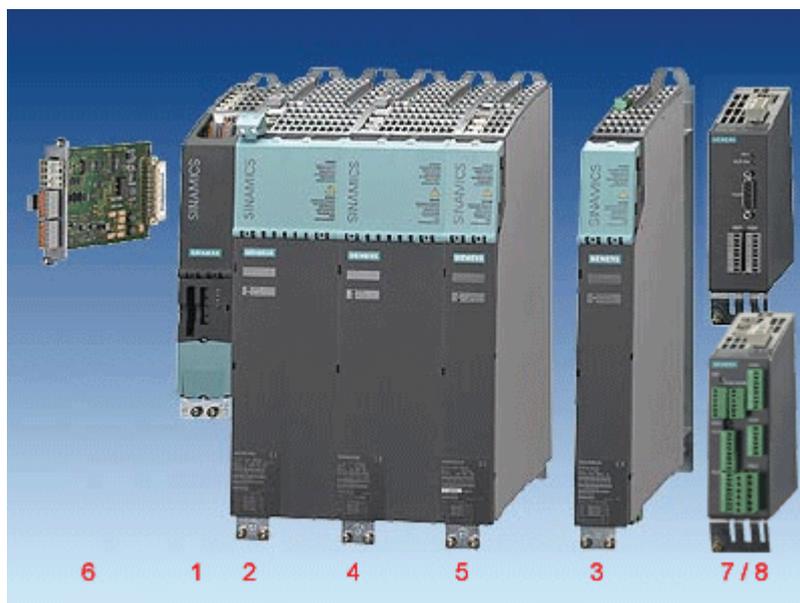
This description does not replace the device documentation for SINAMICS S120. A complete description of the SINAMICS S120 function scope is contained in the function description.

Information on SIMATIC and SINAMICS products is available on the Internet (<http://www.siemens.com/automation/service&support>).

SINAMICS S120 automation components

2.1 System overview

Because SINAMICS S120 can be used to solve sophisticated drive tasks for a very wide spectrum of industrial applications, it is constructed as a modular system. From the large number of matched components and functions, users combine just those units that best match their requirements.



Legend:

1	Control unit	5	Double Motor Module
2	Active Line Module	6	Terminal Board
3	Smart Line Module	7	Sensor Module Cabinet
4	Single Motor Module	8	Terminal Module

2.2 Control unit

In a **CU320 Control Unit**, the communications, open- and closed-loop functions execute for one or more Motor Modules and Active Line Modules. The Control Unit is designed for multi-axis operation.

Note

Only the CU 320(-2 DP) and CU 310 Control Units are supported when using the SINAMICS S120 drive system in connection with the technology CPU.

2.3 Line Modules

The Line Modules perform the function of the central energy infeed for the DC link. The following Line Modules are available:

- The **Active Line Module (ALM)** is a self-controlled infeed/regenerative feedback unit for creating a regulated DC link voltage. This decouples the connected Motor Modules from the supply voltage and fluctuations within the permitted supply tolerances do not have any effect on the motor voltage.

The Active Line Module communicates via DRIVE-CLiQ with the CU320 control unit.

- The **Basic Line Module (BLM)** is an infeed unit that cannot actively regenerate into the supply. This means that it can only be used for those applications in which the energy exchange takes place between the motor- and the generator-driven axes in the DC link.

The Basic Line Module communicates via DRIVE-CLiQ with the CU320 control unit.

- The **Smart Line Module (SLM)** is a non-regulated infeed/regenerative feedback unit with 100% regenerative continuous capability. The regenerative capability of the module can be deactivated using a digital input.

Certain SLM types have a DRIVE-CLiQ interface (usually starting with 16 Kw).

The Smart Line Modules with DRIVE-CLiQ interface are treated like Active Line Modules (see Interconnection of the DRIVE-CLiQ components (Page 17)). The control of the modules without DRIVE-CLiQ interface must be implemented with hard wiring (see Additional hardware wiring for Smart Line Modules without DRIVE-CLiQ (Page 21)).

2.4 Motor Modules

The Motor Modules operate as inverters and are available for various output currents and in various performance classes. They obtain the energy for the motors from the DC link of the attached Line Module.

The following Motor Module classes for controlling the motors are available for the SINAMICS S120:

- **Single Motor Modules** in single-axis design in booksize format
- **Double Motor Modules** in two-axis design in booksize format

2.5 Expansion and system components

Expansion and system components can be used to expand the SINAMICS S120 base system so that it can perform functions directly in the drive system, record encoder signals, etc.

Components

For example, the following components are available for SINAMICS S120:

- The **Terminal Board TB30** can be used to expand the CU320 control unit with additional digital and analog inputs/outputs.
- You require the **Sensor Module Cabinet-Mounted SMC10, SMC20, SMC30** when a motor is to be used without the DRIVE-CLiQ interface or an additional external encoder is to be attached to the drive system.
- The **communication board CB10** provides an interface between the control unit CU320 and a CAN bus system.
- The **CBE30 communication board** provides an interface between the CU320 control unit and a PROFINET system.
- The **Terminal Modules TM15, TM17, and TM41** provide additional inputs/outputs with extended functionality (High Feature) that can be used as an output cam or measuring input in the technology. Terminal modules are connected directly to the CU 320 control unit by means of the DRIVE-CLiQ interface.

2.6 Determining the firmware version number

The SINAMICS S120 firmware can generally be determined in various ways. What is important is whether a configuration already exists in S7T Config.

Determining the firmware version of the SINAMICS S120 from the CF Card

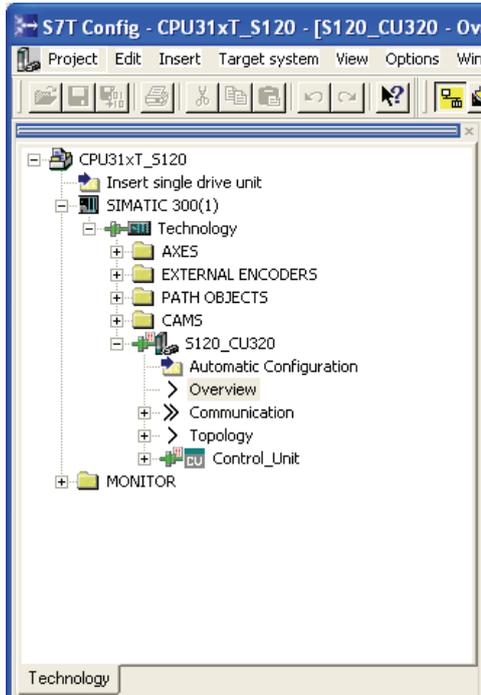
The version number of the SINAMICS S120 is stored on the Compact Flash Card. The firmware of the SINAMICS S120 must be read from the CF Card when the firmware of the SINAMICS S120 is not known and no current configuration is available in S7T Config.

The CF Card contains the "CONTENT.txt" file in the root directory. The "internal version 02.20.28.00" line shows the currently loaded firmware. The number 02.20.28.00 shown in this example is the current version number of the firmware.

Determining the firmware version of the SINAMICS S120 in S7T Config

If a current configuration of the SINAMICS S120 is available in S7T Config, the firmware of the SINAMICS S120 can be determined as follows.

Select in the project navigator for S7T Config the appropriate SINAMICS S120. Double-click "Overview".



Open the **Version overview** tab. Take the firmware version of the SINAMICS S120 from this table.

Overview Version overview

Project set Specified Actual CF card serial number: ST0B8359620000012619

Component	-Ilo.	FW version	Type	Order no.	HW version	Serial no.
				Actual	Actual	Actual
Control_Unit.Control_Unit_1	1	2604200	Closed-loop c	6SL3040-0MA00-0AA1	E	T-T22003950
Motor_Module_2	2	2604200	Power_unit	6SL3120-2TE13-0AA3	B	T-XD2026819
Motor_Module_3	3	2604200	Power_unit	6SL3120-2TE13-0AA3	B	T-XD2026819
SM_4	4	2604200	SMC20	6SL3055-0AA00-5BA1	B	T-T12049291
SMI20_7	7	2604200	SMI20 / DGI	6SL3055-0AA00-5MA0	B	T-T12050259
TB30_10	10	--	TB30	6SL3055-0AA00-2TA0	D	T-T21005643

Filter: DRIVE CLiQ + option slot Update topology Firmware update...

4 : 1 Close Help

S120_CU320

CP5512(PROFIBUS) Online mode

Note

Ensure that your configuration is consistent in S7T Config online. This is necessary to ensure that the firmware versions shown here can be loaded online.

2.7 SINAMICS Support Packages

Definition of the SINAMICS Support Package

S7 Technology features the integrated STARTER commissioning tool which supports the use of SINAMICS Support Packages (SSP) as of V4.1 SP2. This allows users to make new drive firmware versions known to an existing STARTER/S7-Technology version without having to carry out a new installation and without the drive being actually available.

To provide support for SINAMICS versions not included in the current STARTER/S7 Technology version, you will have to install a SINAMICS Support Package. SINAMICS Support Packages are available for download on the Product Support pages. Users are informed of new SSPs in Product Support as soon as a new SINAMICS version is released for delivery.

Note

The SSPs that exist at the time of the delivery release of S7 Technology are automatically included in the S7 Technology installation.

Content of the SINAMICS Support Package

An SSP contains only description files of the devices and drive objects. Install an SSP to add new drive objects and devices to an existing STARTER installation without modification of the STARTER/S7-Technology software installation.

After having completed installation, you can configure all the functions of the new SINAMICS version by means of the Expert list. All screens and wizards are available for the functions which are downward compatible.

An SSP can contain the following items:

- New drive objects
- New device versions
- New and changed parameters in the Expert list
- New and revised faults, alarms and messages
- New and revised sequential parameterizations
- Expansions of the component catalog (new motors, encoders, DRIVE-CLiQ components)
- Expansion of the configuration catalog (SD)
- Revised Online Help files (parameter help, function charts)

When a new STARTER/S7-Technology version is created and delivered it contains all released or compatible SSPs.

Installation

All SSPs released for a product version can be installed in any order.

Do not run STARTER/S7 Technology during SSP installation.

To install a new SSP from CD, follow these steps:

1. Place the SSP CD into the CD drive of your programming device/PC, or save and unpack the SSP you downloaded from Product Support.
2. Select and run setup.exe in Windows Explorer
3. Follow the installation instructions and restart the computer after successful installation.

After having successfully completed installation, you can open S7T Config to configure the SINAMICS versions you installed in offline mode, or to operate them in online mode (for example, by selecting "Accessible nodes").

The SINAMICS Support Packages you installed are displayed as "SSP SINAMICS ..." in SIMATIC > Product Information > Installed Software , "Components" tab.

Commissioning

3.1 Commissioning procedure

Operational sequence

The commissioning procedure is divided into two parts:

1. Create a STEP 7 project and make the settings of the technology CPU for the connected hardware using the HW Config and S7T Config programs. Special attention is placed on the parameterizations that must be performed both in the technology CPU and in the SINAMICS S120.
2. Parameterize SINAMICS S120, create drives and axes. The base device commissioning required for the connection to the technology CPU is also described here.

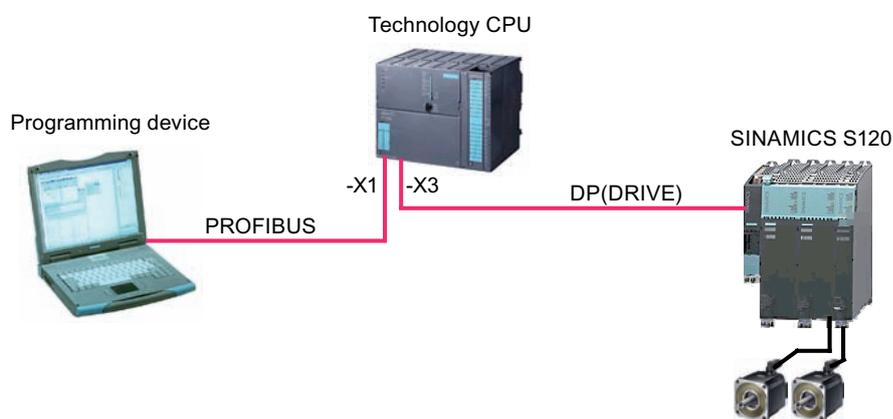
The following sections describe these settings in detail, both for the technology CPU as well as the SINAMICS S120.

3.2 Connecting hardware components

3.2.1 PROFIBUS interconnection

Introduction

Connect the programming device to the PROFIBUS X1 terminal and the SINAMICS S120 drive system to the PROFIBUS DP (DRIVE) X3 terminal of the Technology CPU.



Setting of a fixed PROFIBUS address on the SINAMICS S120

In general, for the operation of the SINAMICS S120 together with the Technology CPU, the setting of a fixed PROFIBUS address using the DIP or rotary switches directly on the SINAMICS S120 is recommended.

When the values 0 or 127 are set, the PROFIBUS address set in the p0918 parameter will be used for the communication.

Note

The address 126 in the p0918 parameter of the SINAMICS S120 is set as default setting of the PROFIBUS address. To prevent access problems caused by an unknown PROFIBUS address during the commissioning, the address should be predefined using the DIP or rotary switches before the commissioning (e.g. "address 4").

Note

When you use a CB10 (CAN bus interface) or CBE20 (PROFINET interface) option module, the SINAMICS firmware switches off the PROFIBUS interface. It is not possible to run two different communication interfaces in parallel. It is not possible to switch off a configured CB10 (CAN bus interface) or CBE20 (PROFINET interface) option module via configuration.

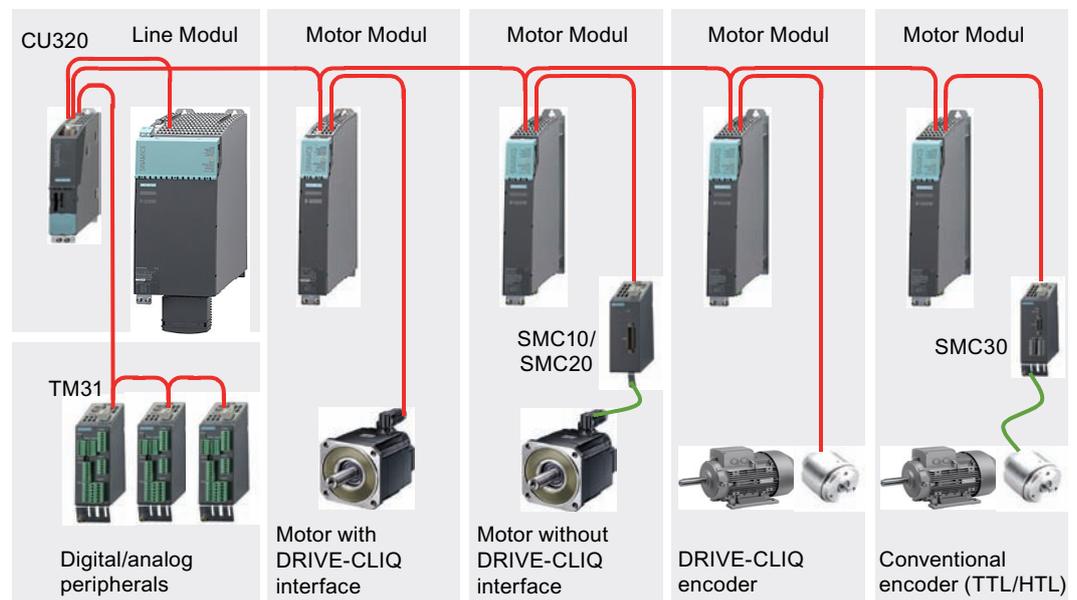
3.2.2 Interconnection of the DRIVE-CLiQ components

System overview

The SINAMICS S120 components are connected with each other using an integrated bus system, the DRIVE-CLiQ. Not only can be the individual modules of the drive system, such as Line Modules and Motor Modules, connected with the Control Unit, but also motor encoders or external encoders can be connected with the Motor Modules.

Conversion modules (Sensor Module Cabinet) for the conversion of traditional encoder signals on DRIVE-CLiQ are available for non-Siemens motors and retrofit applications.

The following figure shows a sample configuration with different system components.



Rules for the interconnection of DRIVE-CLiQ components

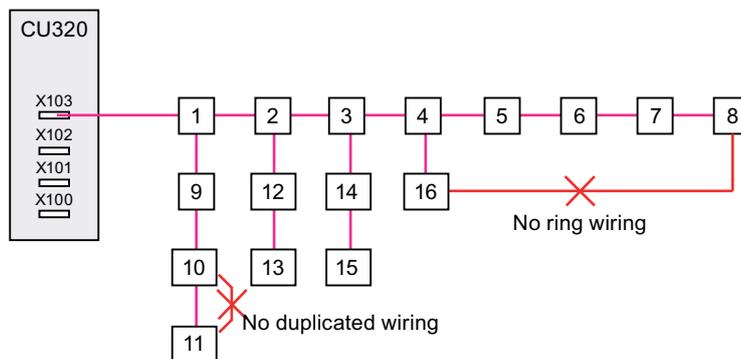
To work with DRIVE-CLiQ technology and to use technology functions, e.g. the automatic topology recognition, certain rules must be followed for the commissioning of the SINAMICS S120 drive system. A distinction is made here between **mandatory** DRIVE-CLiQ rules that must be adhered to without exception and **recommended** rules that should be observed to avoid having to change the topology created offline in S7T Config. The most important rules are explained briefly in the following:

Mandatory DRIVE-CLiQ rules for CU 320-2 and higher

The mandatory rules are a prerequisite for error-free operation. The following rules are generally applicable, provided they are not subject to limitations according to the firmware version:

- Observe the maximum number of nodes:
 - maximum 8 components in series
 - maximum 16 on a DRIVE-CLiQ line of the Control Unit
- No duplicated wiring
- No ring wiring
- Only one Active Line Module for each CU320 Control Unit
- Double Motor Module not as single drive
- Max. 9 Sensor Modules
- Preset sampling times must be retained

The following figure illustrates the rules using a DRIVE-CLiQ line as an example.



The maximum permitted number of SINAMICS S120 drive objects depends on the firmware version used.

Recommended DRIVE-CLiQ rules

When the recommended rules for DRIVE-CLiQ wiring are observed, the components will be automatically assigned to the drives during online configuration or during topology recognition.

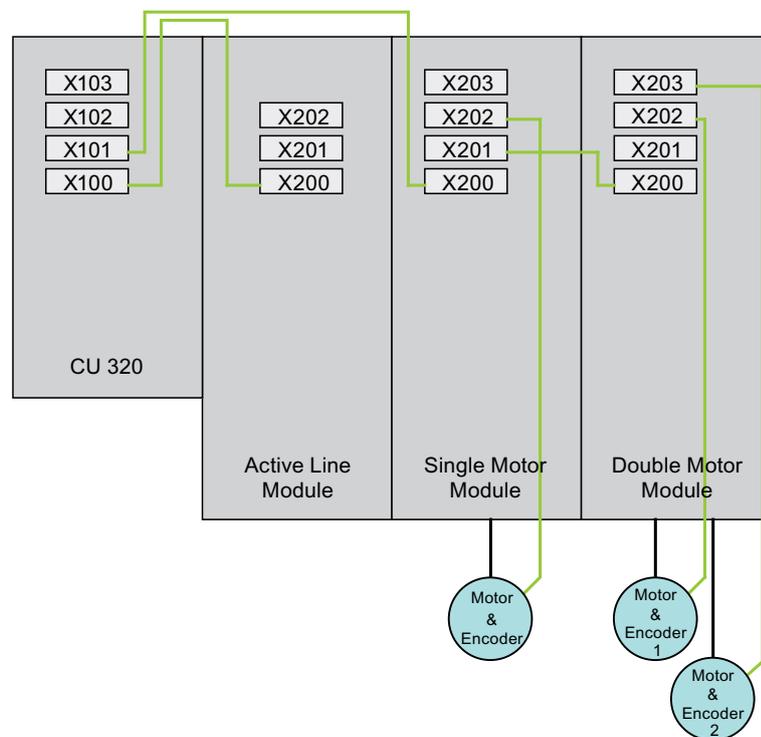
Note

Complete, detailed information about these rules is contained in the documentation for the SINAMICS S120 drive system available on the Internet

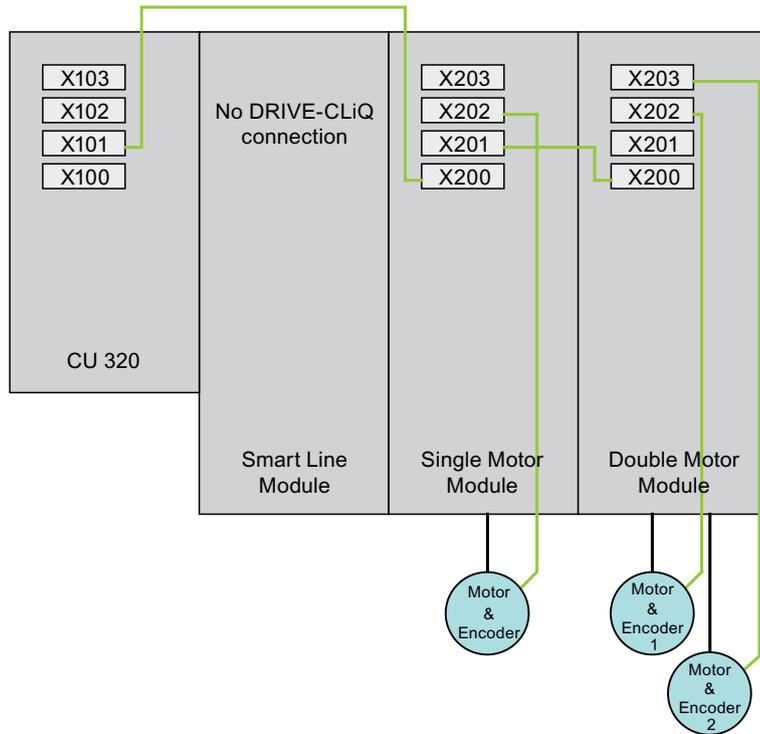
(http://apps01.industry.siemens.com/content/00000100/Content/syn_s120.aspx?rc=1).

Examples

Sample interconnection with an Active Line Module:



Sample interconnection with a Smart Line Module:



3.2.3 Additional hardware wiring for Smart Line Modules without DRIVE-CLiQ

For Smart Line Modules without a DRIVE-CLiQ interface, the signals of these modules must be connected through hardware wiring with the CU320 control unit.

The following signals must be wired between the Smart Line Module (SLM) and the CU320 control unit.

Signal	SLM		TB30	Comment
SLM Ready	DO: X21.1	⇒	DI: X481.1	SLM operational
Overtemperature Prewarning	DO: X21.2	⇒	DI: X481.3	Overtemperature prewarning
Reset	DI: X22.3	⇐	DO: X481.5	Reset faults

The wiring using the TB30 Terminal Board on the SINAMICS S120 was realized in the table. As an alternative to the wiring using the digital inputs of the TB30 Terminal Board, the wiring can also be made directly at the digital inputs of the CU320 control unit.

CAUTION

Damage to the infeed.

If the operational signal of the Smart Line Module (SLM) is not wired to the control unit and evaluated there, this can cause damage to the infeed.

Detailed information on the wiring is available in the documentation on the SINAMICS S120 drive system available on the Internet

(http://apps01.industry.siemens.com/content/00000100/Content/syn_s120.aspx?rc=1).

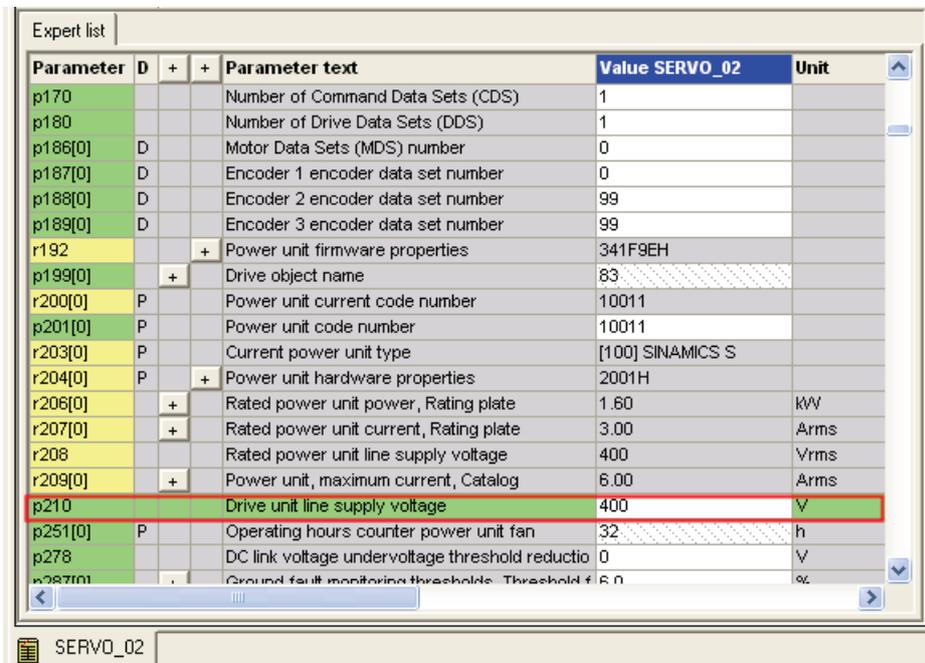
3.2.4 Special features of the SINAMICS S120 Training Case

Basic procedure

The devices are designed for use with the 230 V AC power supply, so you must change the setting for the device connection voltage of the motor modules if you are using the SINAMICS S120 Training Case.

To change the setting, follow these steps:

1. Select the respective drive in S7T Config.
2. In the context menu, select the **Experts > Expert List** command.
3. There you change the following parameters:
 - "p210 device supply voltage" to the value "400 V"
 - "p1248" to "244"



Note

The motor modules integrated into the training case were adapted at the factory for the 230 V AC connection voltage up to order number MLFB 6SL3120 - xTE13 - 0AA2, so they cannot be replaced.

With SINAMICS firmware version V2.5 SP1 x x and higher, it is possible to replace motor modules but only in conjunction with motor modules with DAC processors (order number MLFB 6SL3120 - xTE13 - 0AA3 and higher). The configuration settings to change the connection voltage to 230 V AC are done in the expert list for the motor module. If the training case you are using has motor modules with DAC processors (MLFB 6SL3120 - xTE13 - 0AA3 and higher), make sure you read the following additional information on the Internet (<http://support.automation.siemens.com/WW/view/en/27038754>).

3.3 Preparing the connection to the SINAMICS

3.3.1 Overview

Introduction

To establish a connection for the configuring of the SINAMICS S120 between the programming device and the drive system, several preliminary tasks must be performed; these tasks are discussed in detail in the following sections.

3.3.2 Creating a STEP 7 project

Procedure

To create a new project, start the SIMATIC Manager and use the **File > New** menu command to create a new project, for example, a project with the name DSC_SINAMICS.

Then use the **Insert > Station > SIMATIC 300 station** menu command to add a new S7 300 station.

3.3.3 Configuring in HW Config

Introduction

Now double-click the "Hardware" element to configure the hardware of the SIMATIC 300 station using the HW Config tool.

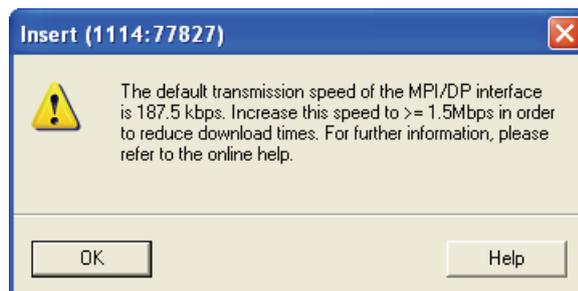
Technology CPU: configuring the hardware

1. Select the "SIMATIC Technology CPU" hardware catalog and add there a mounting rail with drag-and-drop to the configuration.
2. Then give the mounting rail at slot 1 a power supply, e.g. PS 307 2A, the mounting rail at slot 2 a CPU, e.g. the Technology CPU 317T-2 DP.

Note

When you add the Technology CPU, pay attention to the firmware version or the order number of the CPU that is located on the front panel of the CPU.

3. Click **OK** to confirm the displayed message for downloading the system data when the Technology CPU is added.



Technology CPU: Configuring PROFIBUS DP (DRIVE)

1. After selecting the Technology CPU, the "Properties - PROFIBUS interface DP(DRIVE) (R0/S3.1)" dialog box will be displayed. Click the "New" button to create a new PROFIBUS network there.

2. In the "Network settings" tab of the "PROFIBUS Properties" dialog, set the following properties:

- Highest PROFIBUS address: 2

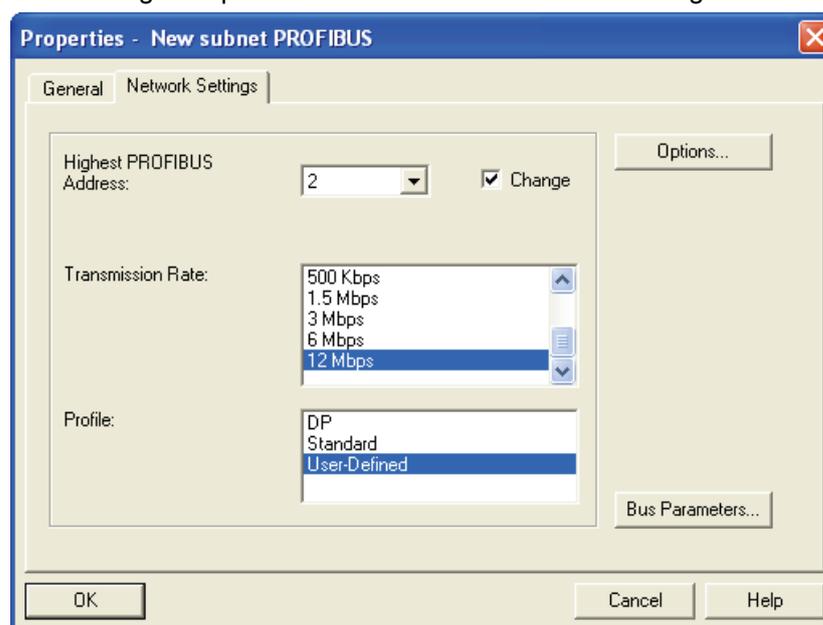
The setting of the highest PROFIBUS address should correspond to the highest address of an active PROFIBUS node. This setting reduces the PROFIBUS time to search for a new active PROFIBUS node.

- Transmission rate: 12 Mbps

This transmission rate permits the largest possible data throughput on the PROFIBUS. Pay attention, however, to the maximum transmission rate of the CP in the programming device. If the value is set too large, access to the CPU will no longer be possible.

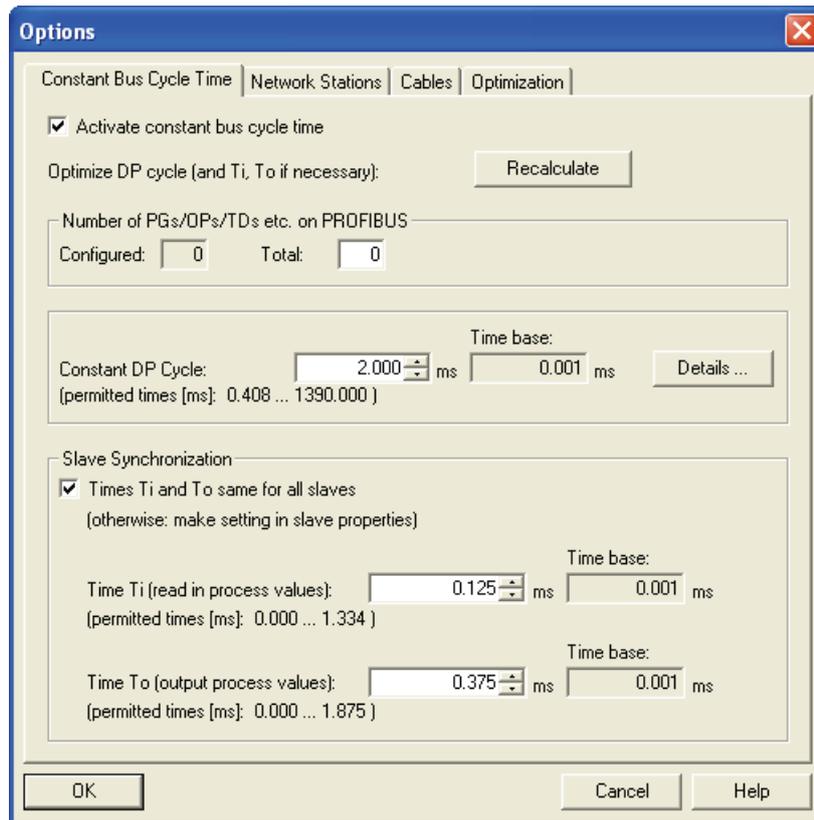
- Profile: "User-defined"

The "user-defined" setting is required, when a message frame extension with BICO wiring is required in addition to the standard message frames.



3.3 Preparing the connection to the SINAMICS

- Click the "Options" button to make additional settings for PROFIBUS. In the "Constant bus cycle time" tab, activate the "Activate constant bus cycle time" function. Also activate the "Slave Synchronization" to keep the time values identical for all connected slaves. Then click the "Recalculate" button to calculate the constant DP cycle time and the T_i and T_o times. Round up the calculated constant DP cycle time (0.250 ms step) and enter the rounded value in the input box. Recommended rounded values are, for example, 1.5 ms or 2.0 ms.



Click the "OK" button to confirm the settings. The configured objects are then added to the SIMATIC 300 station.

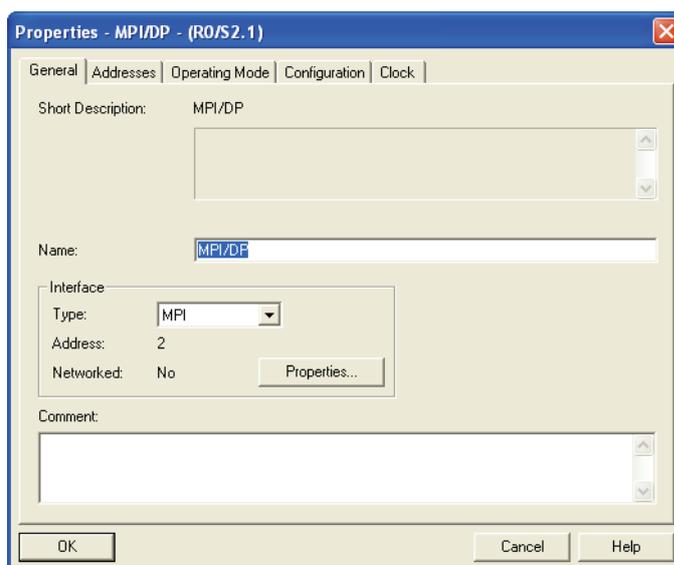
- To automatically generate the technology system data, open the **object properties** in the shortcut menu of the technology. In the "Technology system data" tab, activate the "Generate technology system data" function.

Technology CPU: configuring the MPI interface

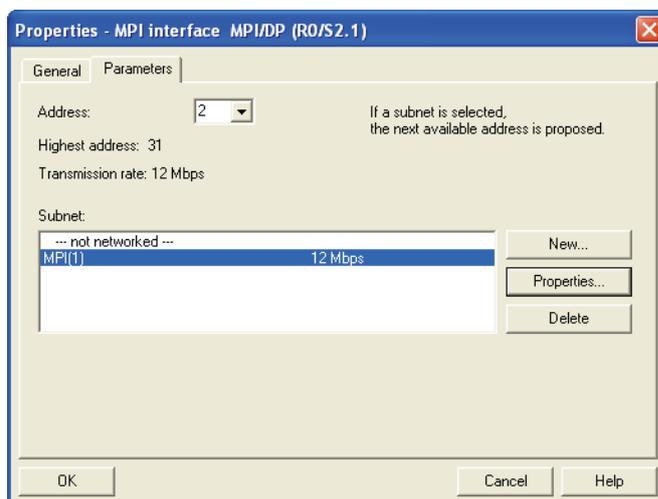
The X1-MPI/DP interface of the CPU is set by default to MPI communication with 187.5 KBit/s and to "not networked". To access the Technology CPU and the SINAMICS S120, the transmission rate of the interface should be set to the highest transmission rate supported by the programming device, for example 12 Mbps.

To do this, press the right mouse button to open the object properties of the X1-MPI/DP interface and set the maximum possible transmission rate:

1. Click the "Properties" button in the "Interface" field of the "General" tab.



2. Set address 2 and select the MPI subnet from "Subnet". Click the "Properties" button.



3. Set the transmission rate to 12 Mbps in the "Network properties" tab.

Note

If the transmission rate of the X1-MPI/DP interface is set to a value larger than the transmission rate supported by the programming device, it will no longer be possible to access the CPU after the HW Config has been downloaded.

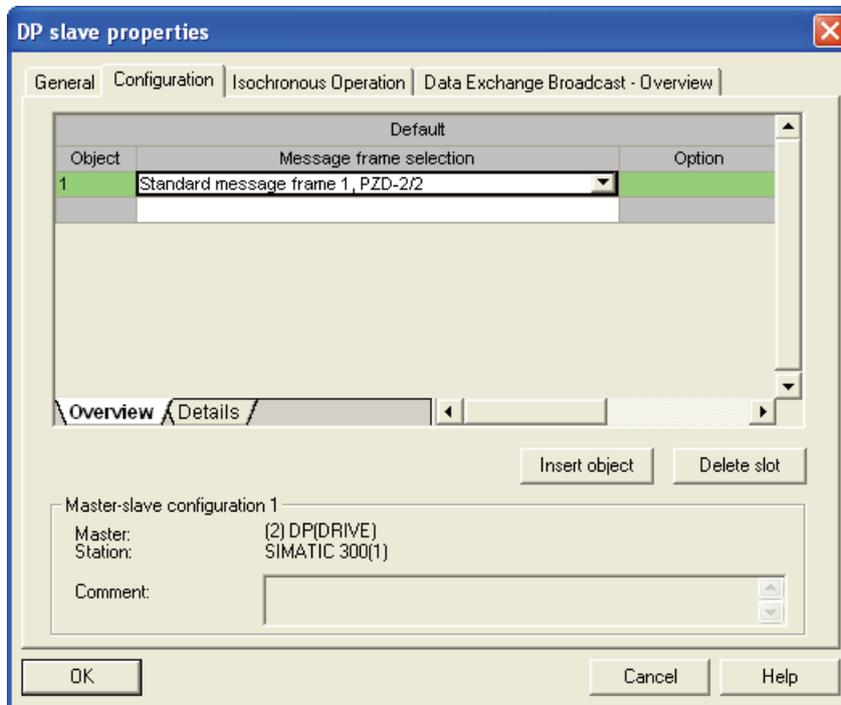
SINAMICS S120: configuring the hardware

1. In HW Config, insert a SINAMICS S120 drive on PROFIBUS-DP (DRIVE).
To do this, select a SINAMICS S120 in the hardware catalog under "SIMATIC-Technology \PROFIBUS DP (DRIVE) \Drives\SINAMICS".
2. In the "Properties" dialog, assign a PROFIBUS address (for example 4) and set the device version to the current firmware version of the SINAMICS S120.

Note

The device version cannot be changed later in HW Config. A change can only be made in S7T Config. To do this, mark the SINAMICS_S120 with the right mouse button and select **Target device > Device version**.

3. Accept the properties without change in the "DP Slave Properties" dialog in the "Configuration" tab. The properties can be entered at a later time using S7T Config.



- In the "Isochronous operation" tab, activate isochronous operation for this slave. Then click the "Align" button to perform the isochronous alignment of the slave with the Technology CPU.

DP slave properties

General | Configuration | **Isochronous Operation** | Data Exchange Broadcast - Overview

Synchronize drive to equidistant DP cycle (Ti/To same for all slaves)

Network settings in ms

Equidistant bus cycle activated

Equidistant DP cycle: 2.000 Data_Exchange_Time comp. Tdx: 0.079

Master application cycle Tmapc [ms]:	2.000	=	Factor: 1	x	Grid / base time [ms]: 2.000
DP cycle Tdp [ms]:	2.000	=	Factor: 16	x	Frame / base time [ms]: 0.125
Time Ti [ms] (actual value acquisition):	0.125	=	Factor: 1	x	Grid / base time [ms]: 0.125
Time To [ms] (setpoint acceptance):	0.375	=	Factor: 3	x	Grid / base time [ms]: 0.125

Align

OK Cancel Help

- Click "OK" to accept the settings.

Saving and compiling the project

Save and compile the hardware configuration and load the project into the attached Technology CPU.

Note

If an error message appears during the save and compile, check the settings for T_i and T_o in the PROFIBUS DP (DRIVE) options. The times must be a multiple of the 0.250 ms interval.

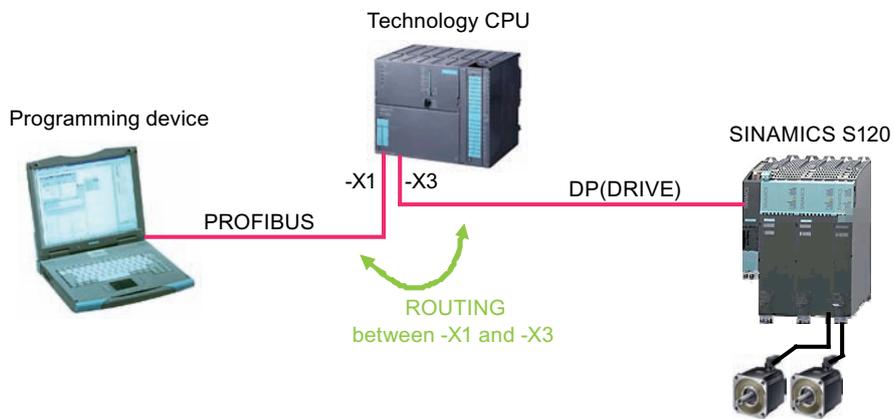
3.3.4 Activating routing in NetPro

Introduction

To establish an online connection between the programming device and the SINAMICS S120 drive system, the "Routing of a SIMATIC PC station" in NetPro must be activated.

This is necessary because the programming device is connected via the X1-MPI/DP interface to the technology CPU and to the SINAMICS S120 on the PROFIBUS DP (DRIVE) of the Technology CPU.

To allow the programming device to access the SINAMICS S120 online, a routing must take place between the X1-MPI/DP interface and the PROFIBUS DP (DRIVE) through the Technology CPU.



Procedure

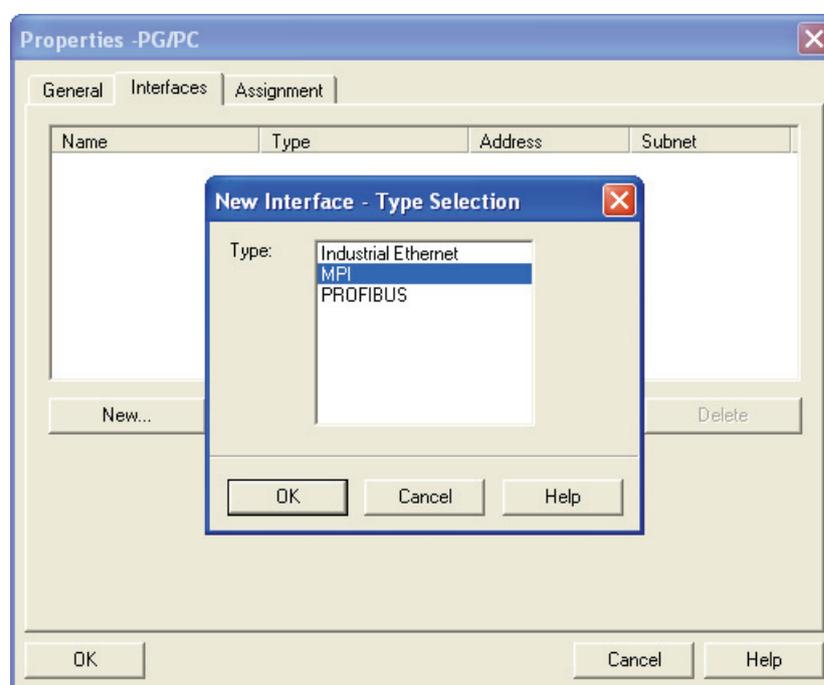
To enable routing for the programming device, follow these steps:

1. Open the NetPro program in the SIMATIC Manager with the menu command **Options > Configure Network**.
2. Add a PG/PC station from the "Network objects" catalog from the "Stations" directory.

Note

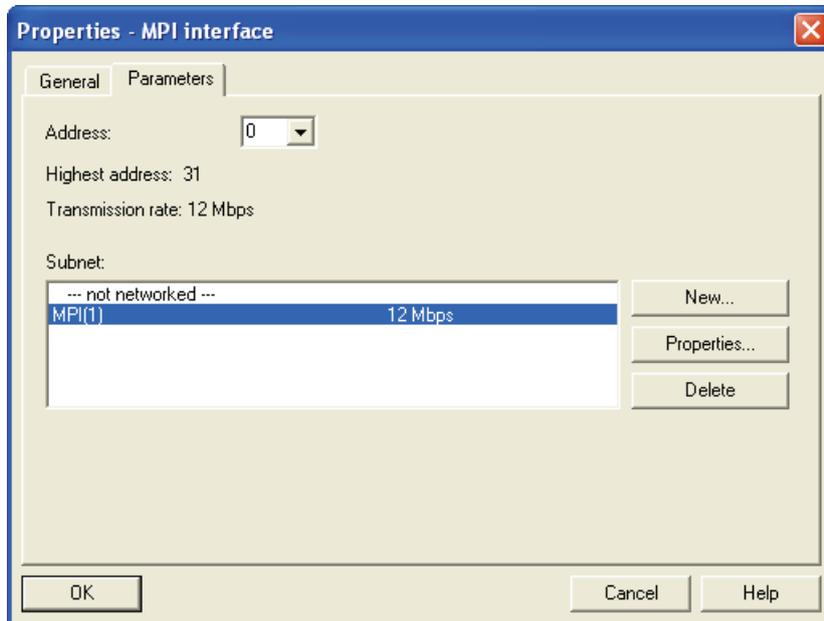
If the SINAMICS S120 is not displayed in NetPro, switch in the **View** menu to the "With DP Slave / IO Devices" display.

3. Select the PG/PC station and right-click to open the properties.
4. Click the "New" button in the "Interfaces" tab to add an MPI type interface.



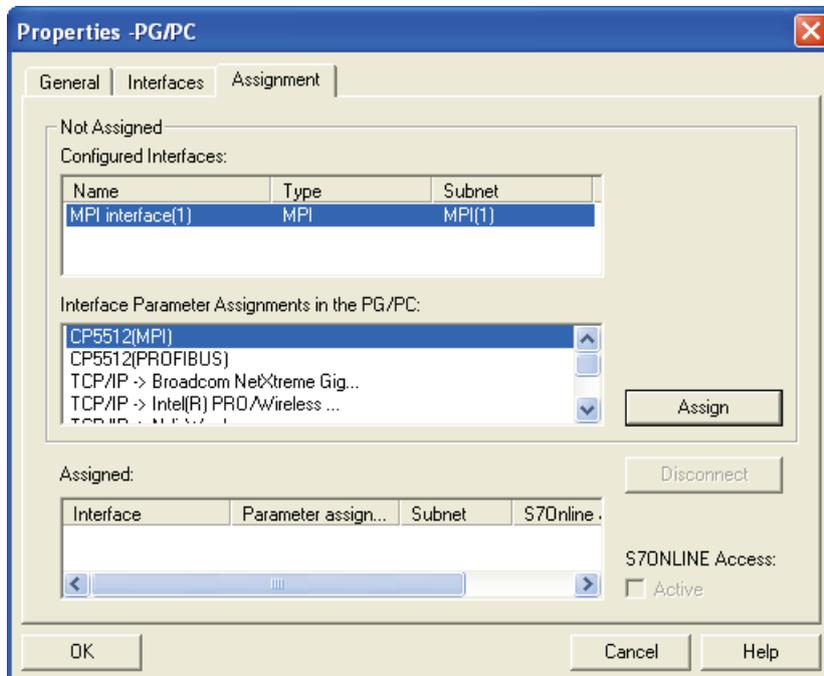
3.3 Preparing the connection to the SINAMICS

- As PROFIBUS address, set the address "0" for the PG (recommended default address). Click the "OK" button to confirm the setting.

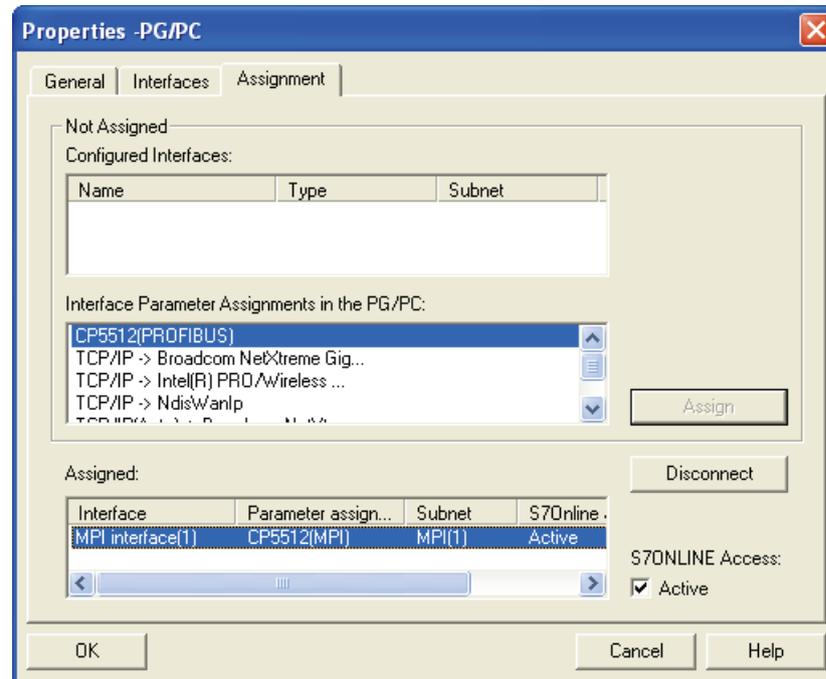


- In the "Assignment" tab, assign the MPI interface of your programming device to the interface module of the PG/PC.

Select the MPI interface in the upper window and the interface module of the PG/PC in the middle window and click the "Assign" button.



Select the "Active" check box in the "S7Online access" field.



Note

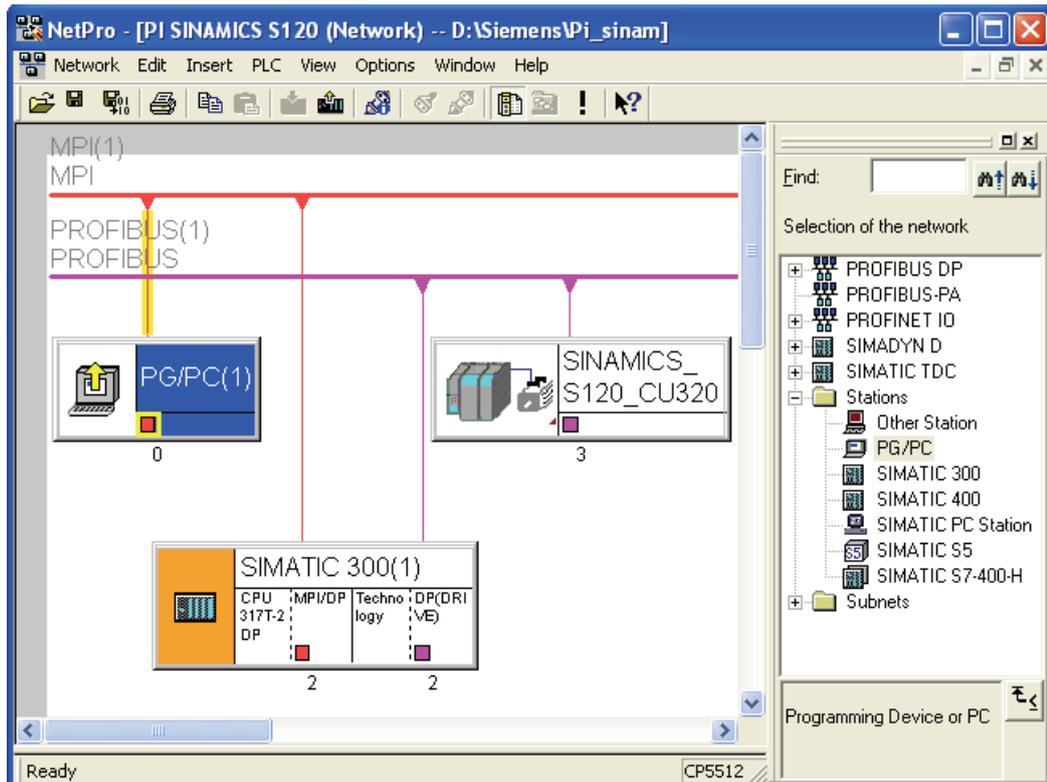
If the project is transferred to a different programming device, this assignment must be repeated because these settings are device-dependent.

Result

The network configuration is now completed. Once again check the MPI address settings of the PG/PC interface (address 0) and the Technology CPU (address 2) in the overview and save and compile the network configuration.

Load the configuration into the target device.

The successful activation of the routing function is indicated by the connection of the PG/PC interface with the MPI network having a yellow background in the overview.



3.4 Configuring the drive components

3.4.1 Overview

Basic procedure

You configure the drive components in S7T Config.

You open S7T Config by double-clicking the "SINAMICS_S120...\Commissioning" entry in the SINAMICS_S120... folder in the SIMATIC Manager.

Configuration

The drive components can be configured in two ways:

- Automatic configuration:

S7T Config will automatically detect the topology of the drive system and the components of the drive system, provided they are equipped with a DRIVE-CLiQ interface.

- Manual configuration:

This requires that the structure of the drive system is created manually and the present modules selected manually from the configuration lists.

Components not equipped with a DRIVE-CLiQ interface can only be configured manually or, if necessary, must be set up manually after an automatic configuring.

The two configuring types for the drive components are introduced in the following sections.

3.4.2 Automatic configuring

Introduction

The automatic configuring can only be performed in online mode of S7T Config.

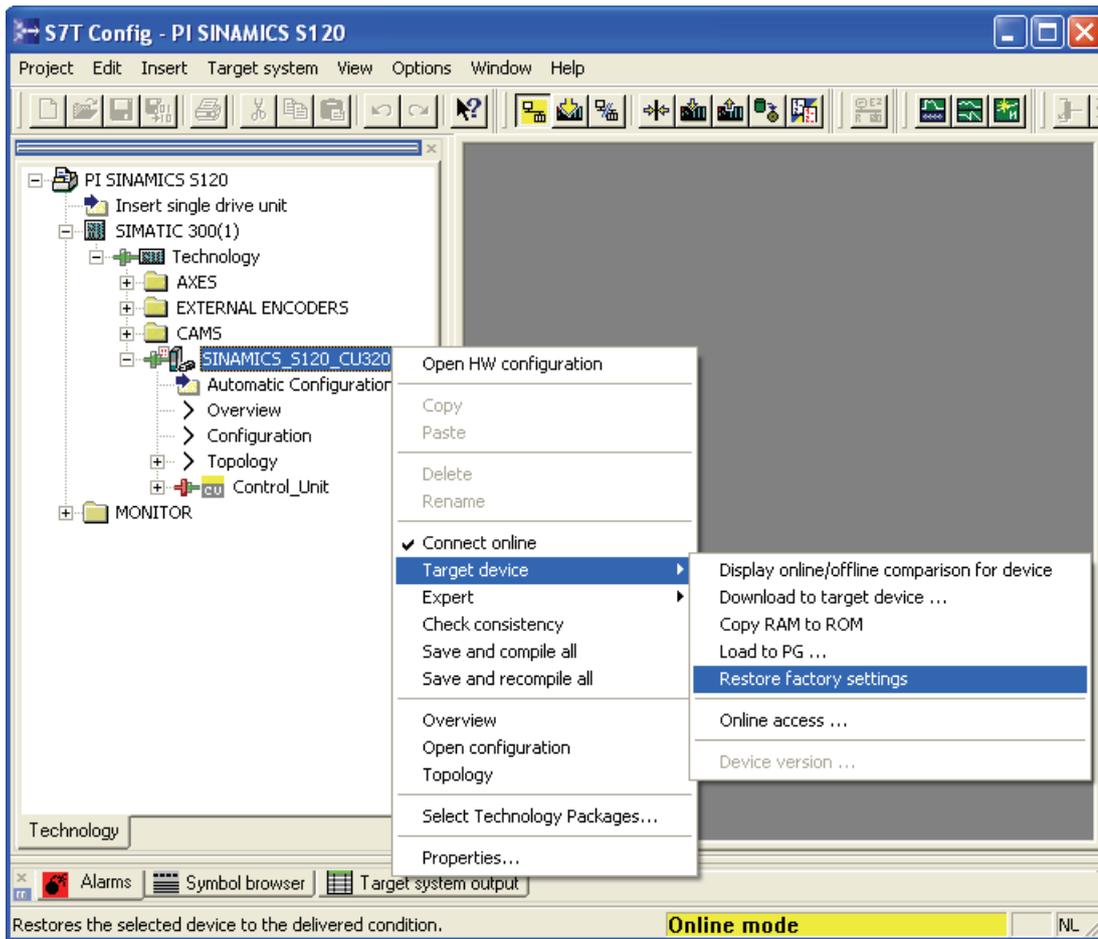
The existing components of the drive system are entered automatically into the configuration via the DRIVE-CLiQ connection.

Note

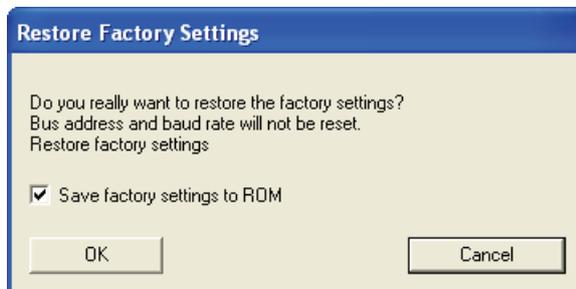
If necessary, components that cannot be selected in the configuration lists with manual configuration can be detected by S7T Config with automatic configuration.

Procedure

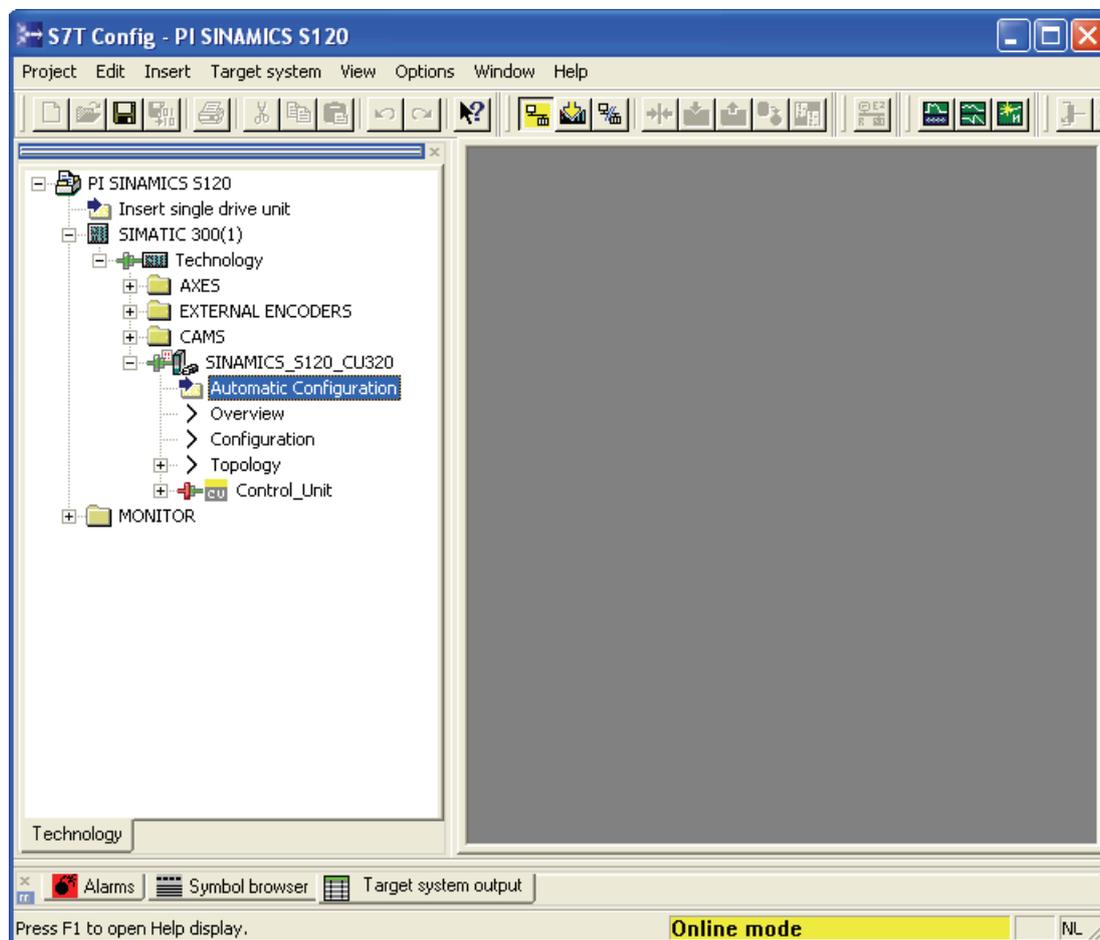
1. Use the **Project > Connect to target system** menu command to establish an online connection to the SINAMICS S120 in S7T Config.
2. Place the SINAMICS S120 in the initial state by restoring the factory settings. To do this, mark "SINAMICS_S120" and select the **Target device > Restore factory settings** menu command in the shortcut menu.



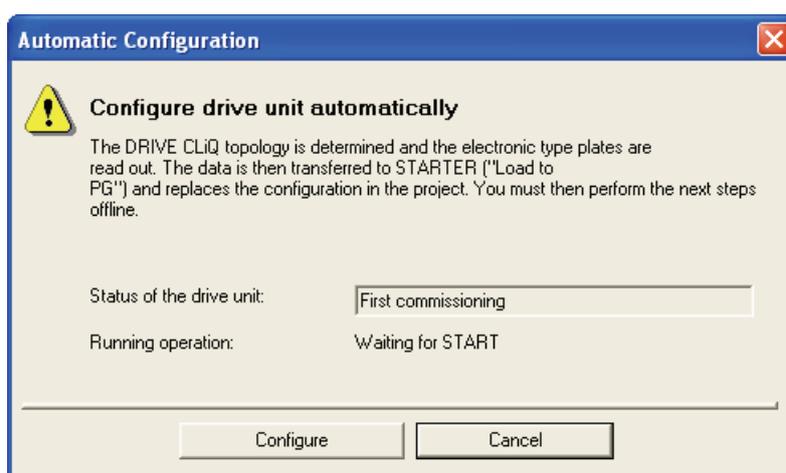
Pay attention to any messages and acknowledge them. Also save the factory settings in the ROM of the drive.



3. Double-click on the "Automatic configuration" entry of the SINAMICS S120 in the project navigation.

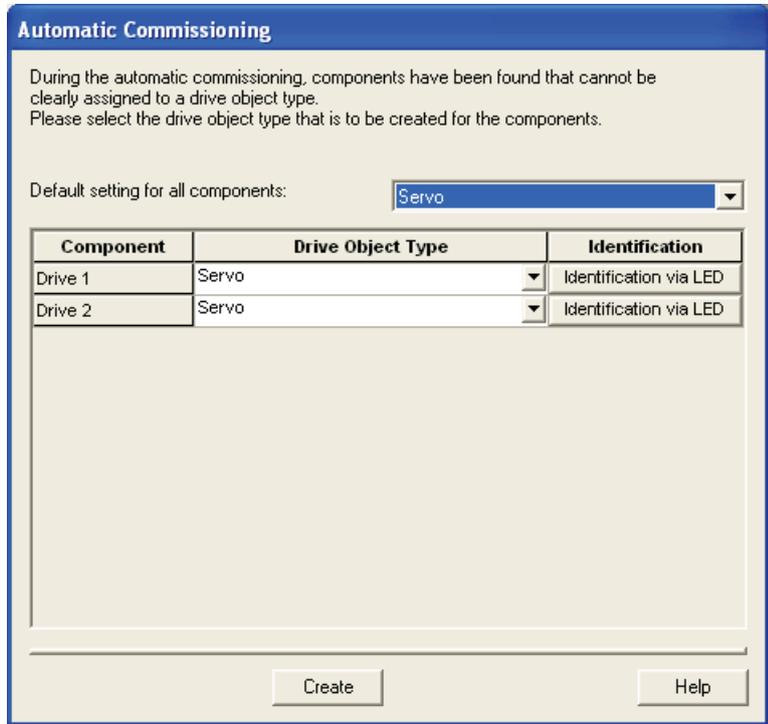


4. Click the "Configure" button to start the configuration.



3.4 Configuring the drive components

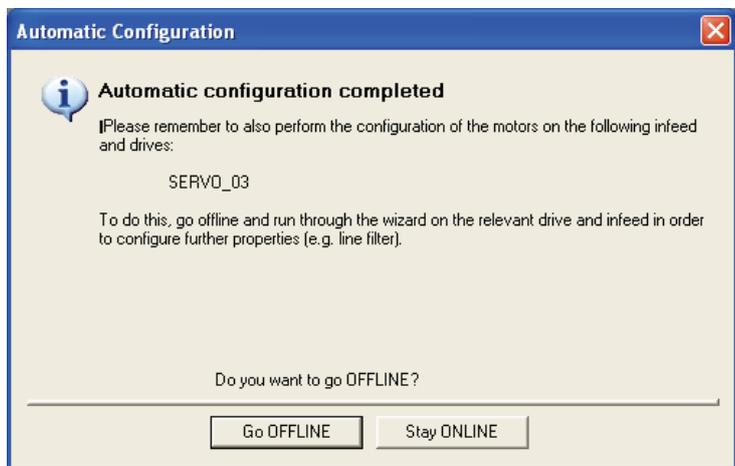
- 5. Select the type of the drive object. In this example, a servo type drive is to be configured. To configure the individual drives differently, the type for each drive can be selected separately in the lower part of the dialog box. Click the "Create" button to confirm the settings.



Result

The configuration is created and will be loaded to the programming device. Switch to offline mode.

This completes the automatic configuration of the drive system. Components that do not have any DRIVE-CLiQ interface must now be configured manually. The message is displayed to indicate this and can be acknowledged by clicking "OK".



3.4.3 Manual configuring

Introduction

The manual configuring can only be performed in offline mode of S7T Config. The components of the drive system that are present must be configured manually using S7T Config.

Various infeed modules of the SINAMICS

The procedure to be adopted for the manual configuring depends on the SINAMICS infeed. Three different types of SINAMICS infeeds are available:

- Active Line Modules (ALM)
- Basic Line Modules (BLM)
- Smart Line Modules (SLM)

The same dialogs are used for configuring of Active Line Module and the Basic Line Module; the configuring of the Smart Line Module differs in some configuration steps.

Note

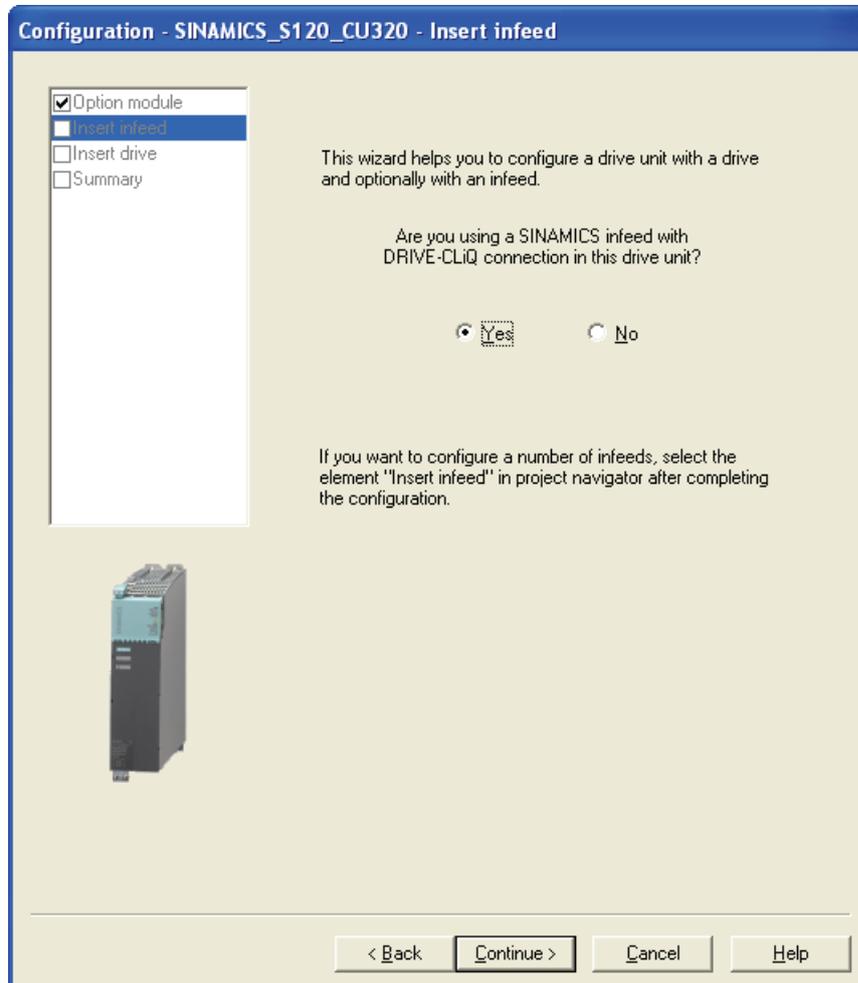
The configuring with an Active Line Module (ALM) and the configuring of the Smart Line Module (SLM) is described separately in the following sections. Each configuring guide contains all required steps. Therefore, select the appropriate section for your configuration.

Configuring with Active Line Module (ALM)

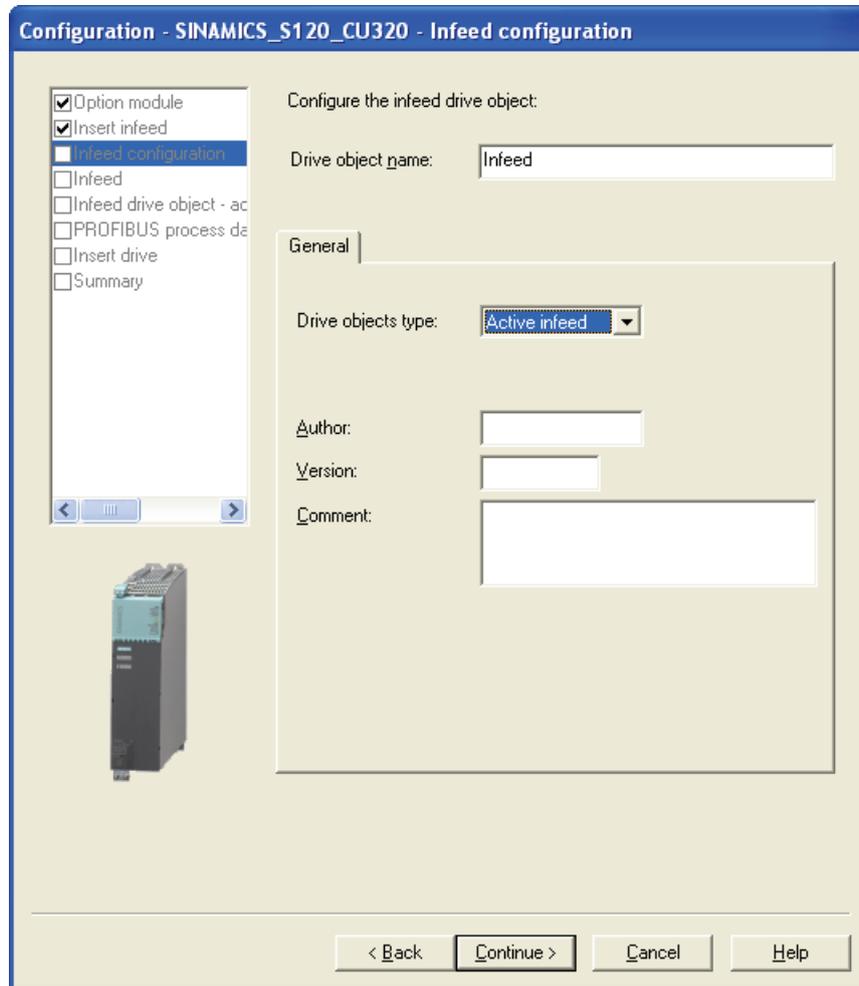
1. In S7T Config, open the SINAMICS S120_CU320 folder, and double-click the "Configure drive unit" entry or the drive.
2. First create the control unit, and the option modules. If you are using the TB30 terminal board, select it from the drop-down list, and click the "Next" button to confirm the setting.



3. For the selection of the SINAMICS infeed, you can choose between modules with or without DRIVE-CLiQ connection. Select "Yes" for the active line module, then click "Next" to confirm the setting.



4. In the next dialog, select "Active infeed" for the active line module, and click "Next" to confirm the setting.



5. Then select the appropriate module from the list and click the "Next" button to accept the other settings without change.

Configuration - SINAMICS_S120_CU320 - Infeed

Option module
 Insert infeed
 Infeed configuration
 Infeed
 Infeed drive object - ac
 PROFIBUS process da
 Insert drive
 Summary

Infeed: Infeed

Configure the infeed component:

Component name:

Supply voltage range:

Cooling method:

Type:

Selection

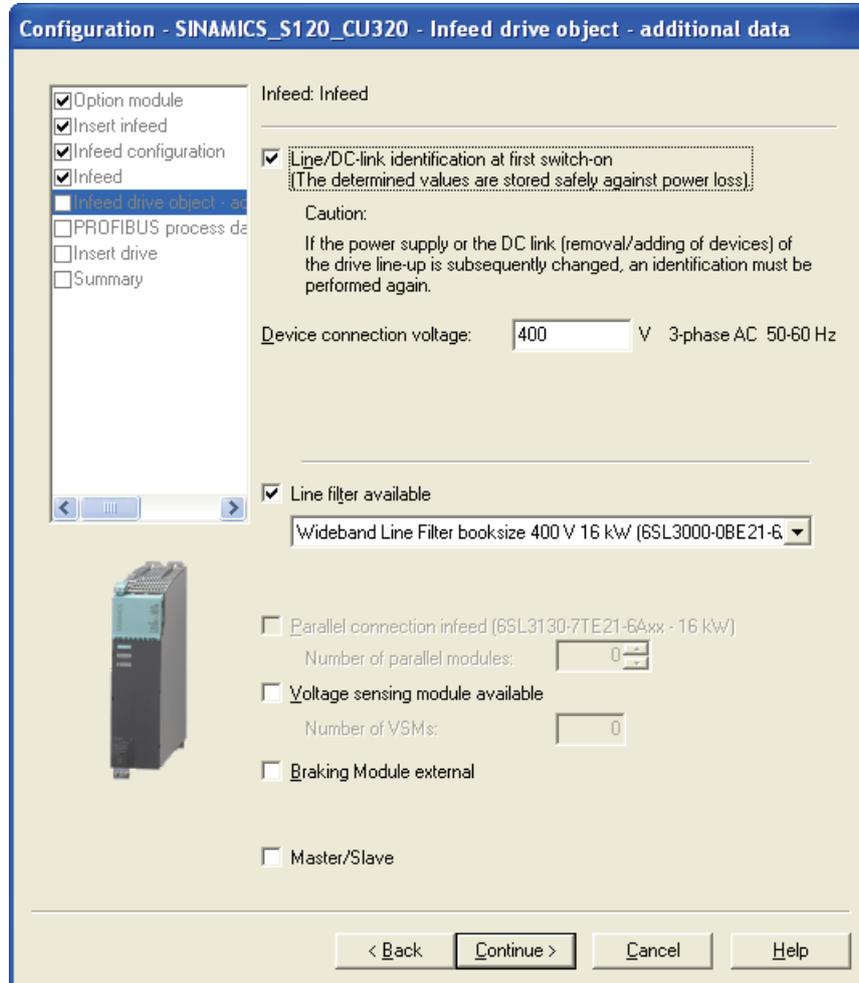
Order no.	Rated power	Rated current
6SL3130-7TE21-6Axx	16 kW	27 A
6SL3130-7TE23-6Axx	36 kW	60 A
6SL3130-7TE25-5Axx	55 kW	92 A
6SL3130-7TE28-0Axx	80 kW	133 A
6SL3130-7TE31-2Axx	120 kW	200 A
6SL3330-7TE32-1Axx	132 kW	210 A
6SL3330-7TE32-6Axx	160 kW	260 A
6SL3330-7TE33-8Axx	235 kW	380 A
6SL3330-7TE35-0Axx	300 kW	490 A
6SL3330-7TE36-1Axx	380 kW	605 A
6SL3330-7TE38-4Axx	500 kW	840 A
6SL3330-7TE41-0Axx	630 kW	985 A
6SL3330-7TE41-4Axx	900 kW	1405 A



< Back Continue > Cancel Help

3.4 Configuring the drive components

6. Check the settings for the line/DC link identification, line filter, voltage sensing module, and braking module, and adapt them to your application, if necessary. Click the "Next" button to confirm the settings.



7. For the process data communication between the Technology CPU and the infeed, select the "SIEMENS message frame 370 for the infeed". Click "Next" to confirm the setting.

Configuration - S120_CU320 - Process data exchange (infeed drive object)

Option module
 Insert infeed
 Infeed configuration
 Infeed
 Infeed drive object - ac
 Process data exchange
 Insert drive
 Summary

Infeed: Infeed

Select the PROFIdrive message frame type:

[370] SIEMENS telegram 370, PZD-1/1

Length (words)

Input data / actual values: 1

Output data / setpoints: 1

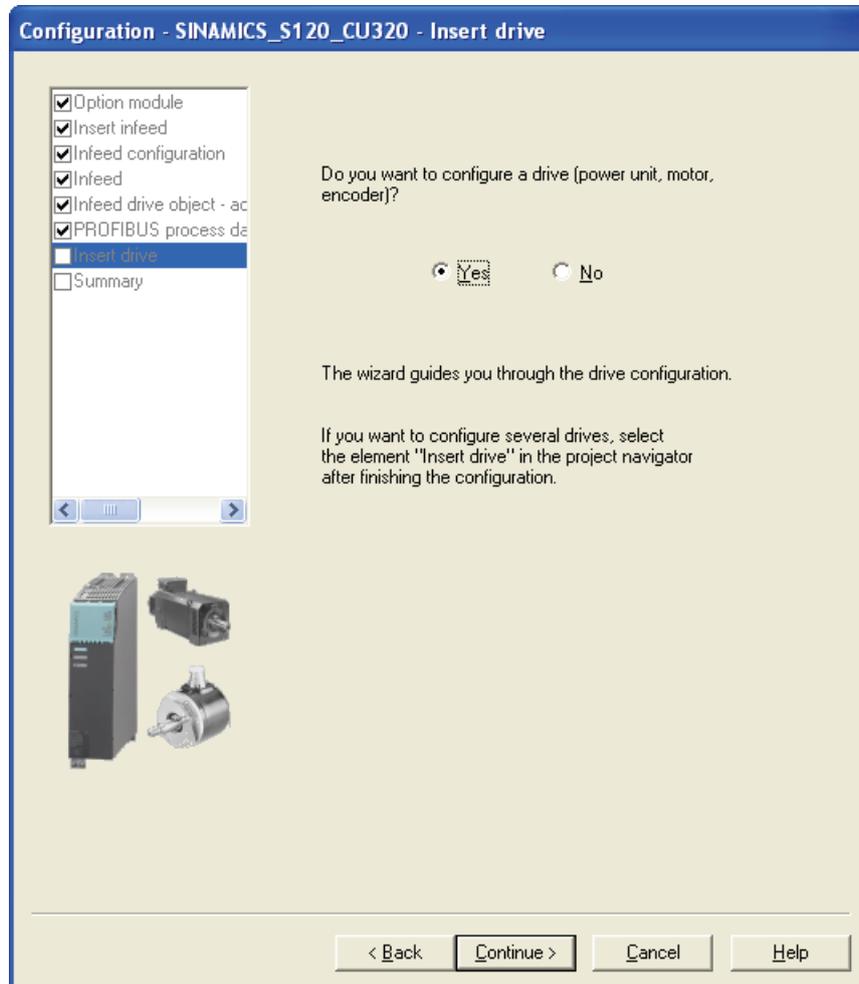
Notes:

1. The PROFIdrive process data will be interconnected to BICO parameters in accordance with the selected message frame type. These BICO parameters cannot be subsequently changed.
2. This data is relevant for Interface 1 in accordance with the settings on the control unit.

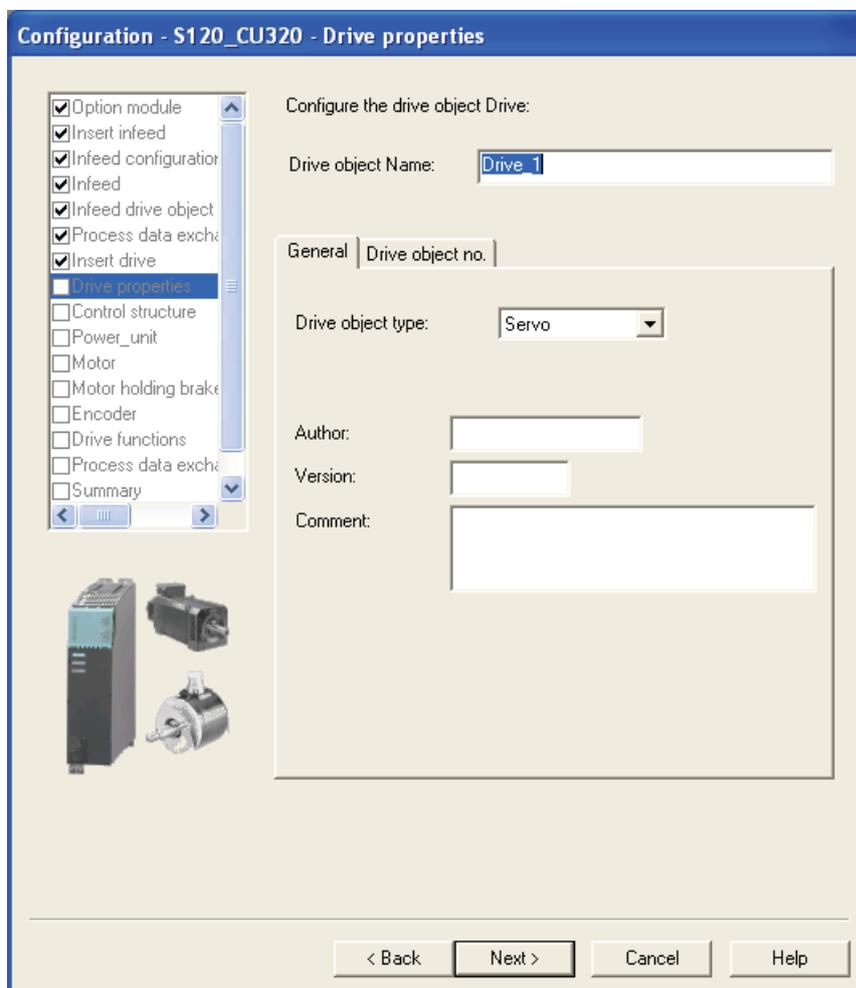


< Back Next > Cancel Help

8. Now start the configuration of the drive by selecting "Yes" and clicking the "Next" button to confirm the setting.

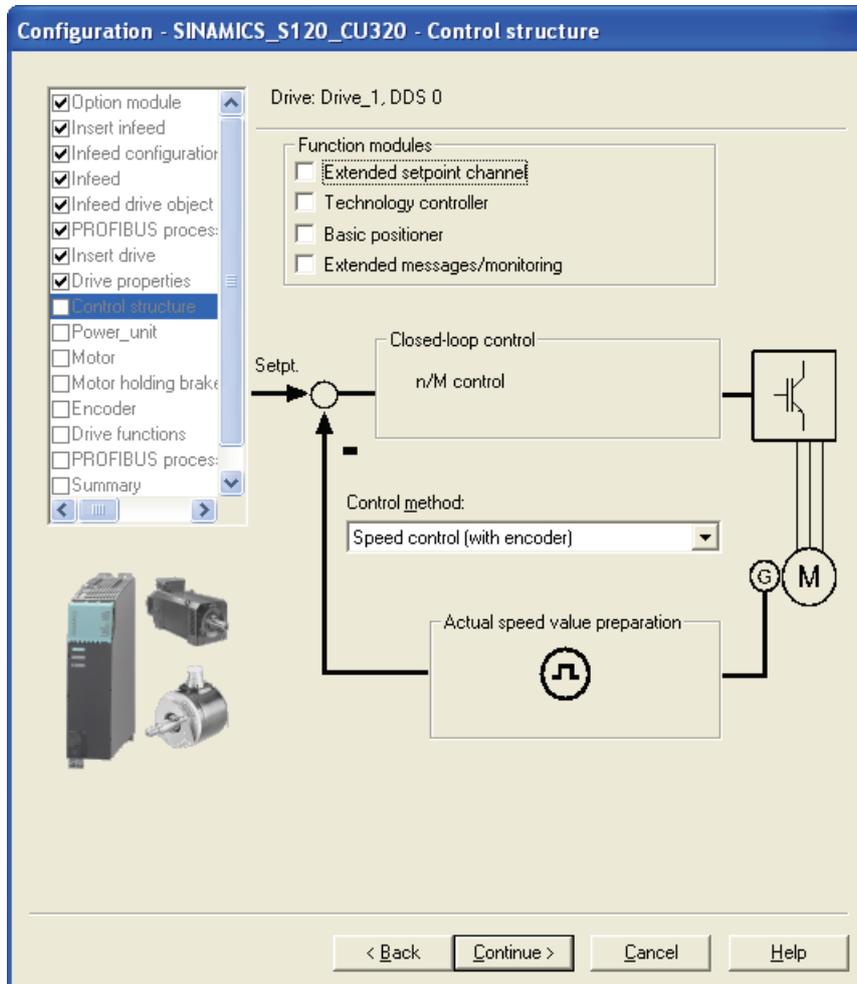


9. Enter the name of the drive "Drive_1" in the "Drive properties" dialog.
10. Select the "Servo" type on the "General" tab. Select the "Drive object no." tab. Enter a drive object number. Click the "Next" button to confirm the settings.

**Note**

If you want to set a different operating mode later, you have to reconfigure the drive.

11. Select "Speed control (with encoder)" as the control method, and click "Next" to confirm the setting.



12. Select the appropriate power section component from the list, and click "Next" to confirm the setting.

Configuration - SINAMICS_S120_CU320 - Power_unit

Drive: Drive_1, DDS 0

Configure the power section component:

Component name: Power_unit

Connection voltage: 510 - 720 VDC

Cooling method: Internal air cooling

Type: All

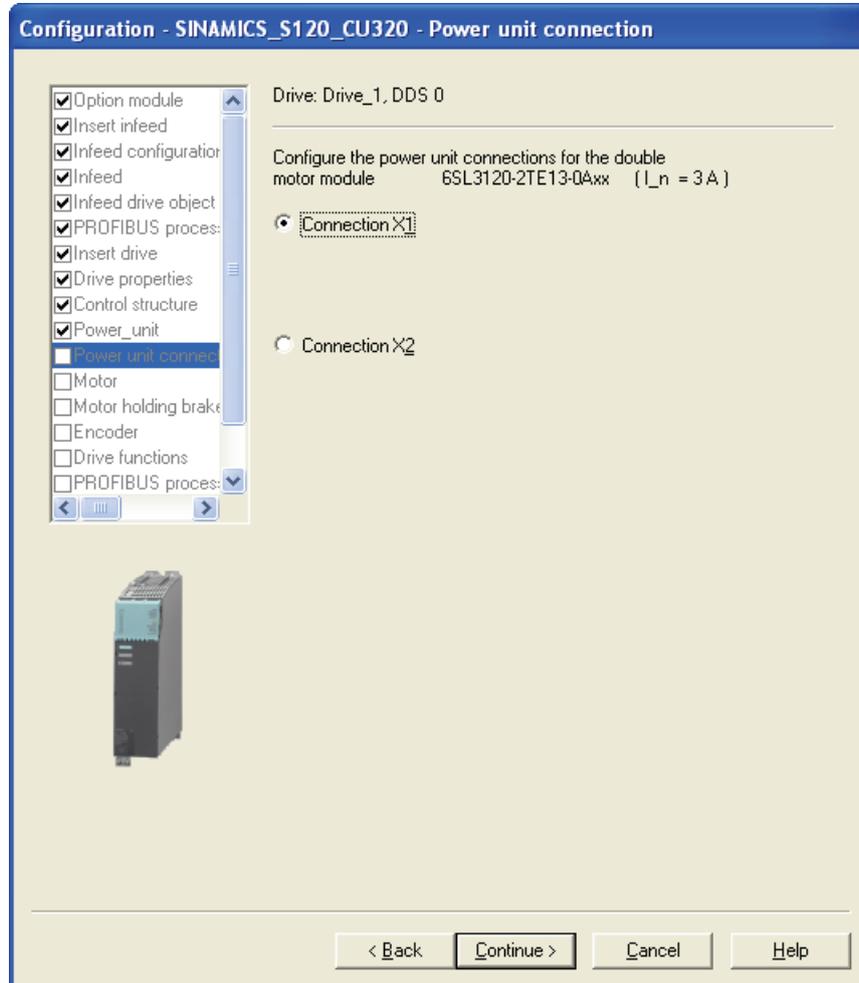
Only display double motor modules with free connections

Power unit selection:

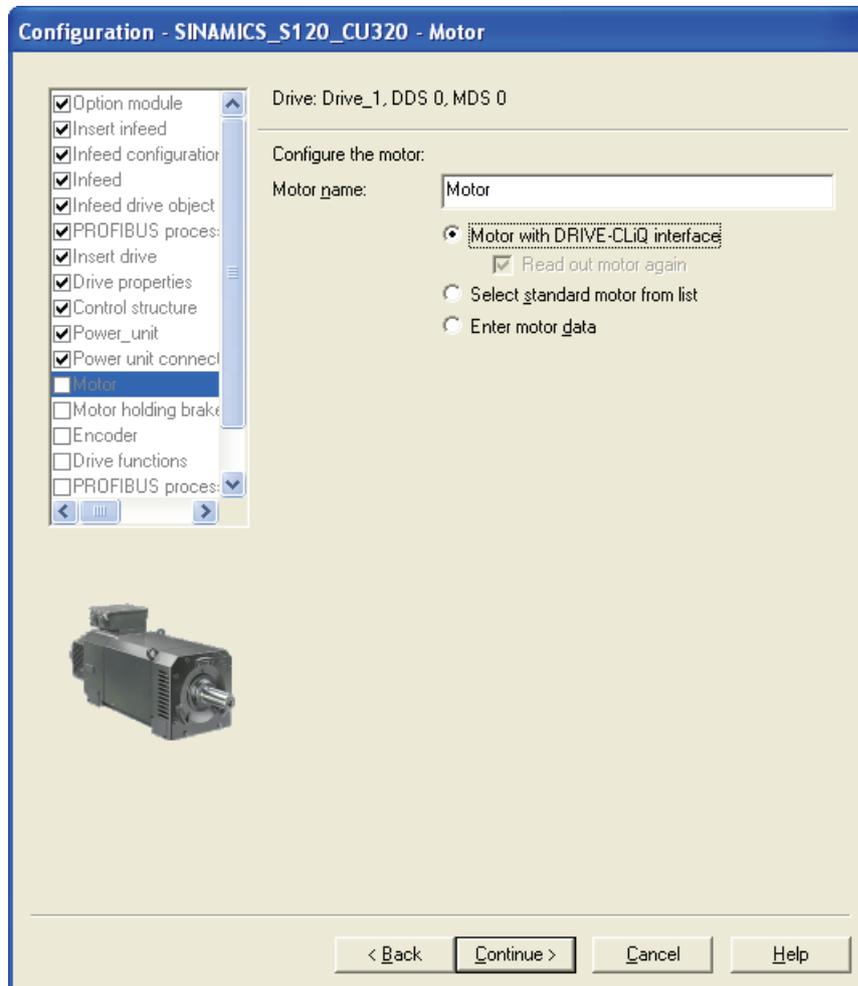
Order no.	Rated po...	Rated cur...	Execution
6SL3420-2TE11-7Axx	1 kW	1.7 A / 1...	DC/AC
6SL3120-1TE13-0Axx	1.6 kW	3 A	DC/AC
6SL3120-2TE13-0Axx	1.6 kW	3 A / 3 A	DC/AC
6SL3420-1TE13-0Axx	1.6 kW	3 A	DC/AC
6SL3420-2TE13-0Axx	1.6 kW	3 A / 3 A	DC/AC
6SL3120-1TE15-0Axx	2.7 kW	5 A	DC/AC
6SL3120-2TE15-0Axx	2.7 kW	5 A / 5 A	DC/AC
6SL3420-1TE15-0Axx	2.7 kW	5 A	DC/AC
6SL3420-2TE15-0Axx	2.7 kW	5 A / 5 A	DC/AC
6SL3120-1TE21-0Axx	4.8 kW	9 A	DC/AC
6SL3120-2TE21-0Axx	4.8 kW	9 A / 9 A	DC/AC

< Back Continue > Cancel Help

13. If you have configured a Double Motor Module, you must now select the power unit connection of the motor on the module. For the first motor, select, for example, the Connection X1. Click "Next" to confirm the setting.

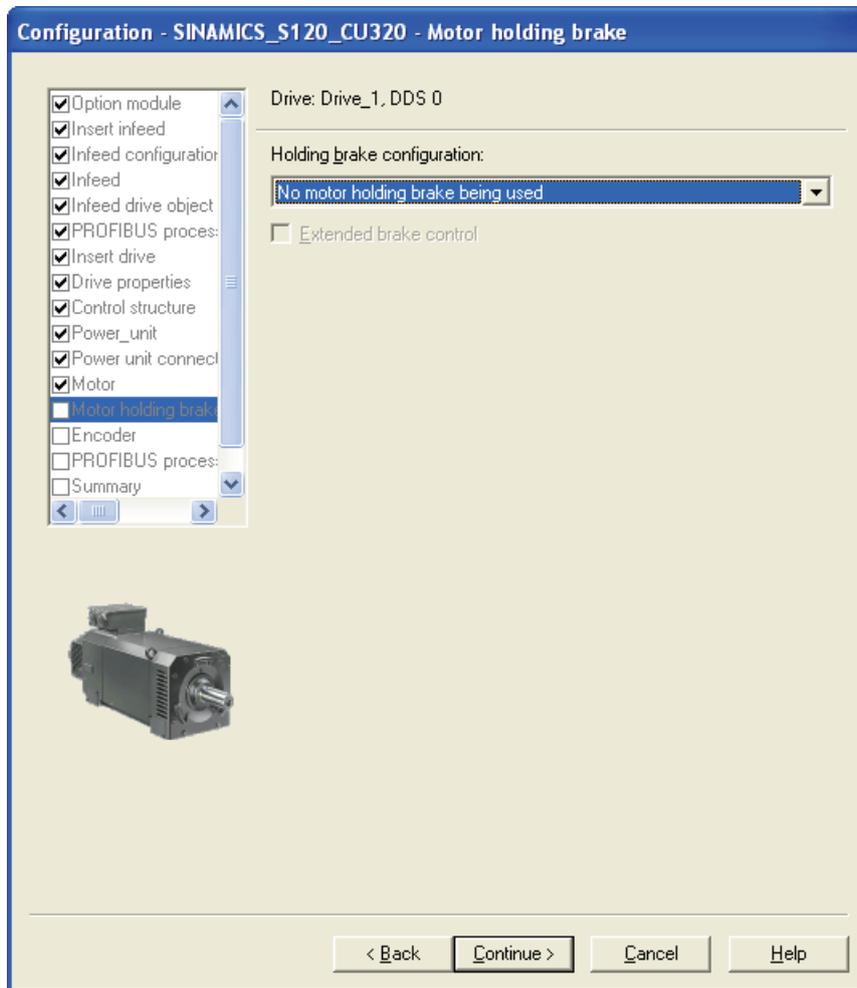


14. Select the connected motor. If a motor with a DRIVE-CLiQ interface is used, select this setting. The motor data is then read from the electronic nameplate of the motor via the DRIVE-CLiQ connection. Alternatively, you can select the (standard) motor from a list, or enter the motor data directly. Then click "Next" to confirm the setting.

**Note**

If you select a "Motor with DRIVE-CLiQ interface", the motor data will not be read immediately from the electronic nameplate of the motor. The data will not be transferred until you switch to online mode.

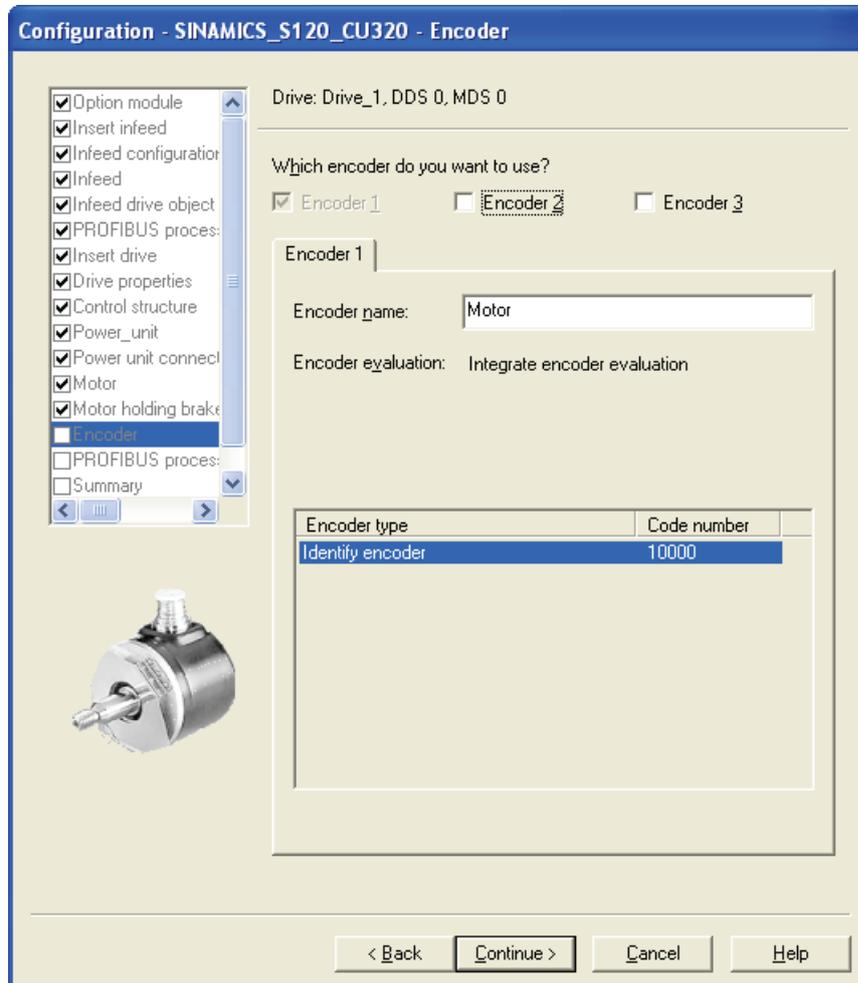
15. Configure the motor holding brake, if there is one, and click "Next" to confirm the setting.



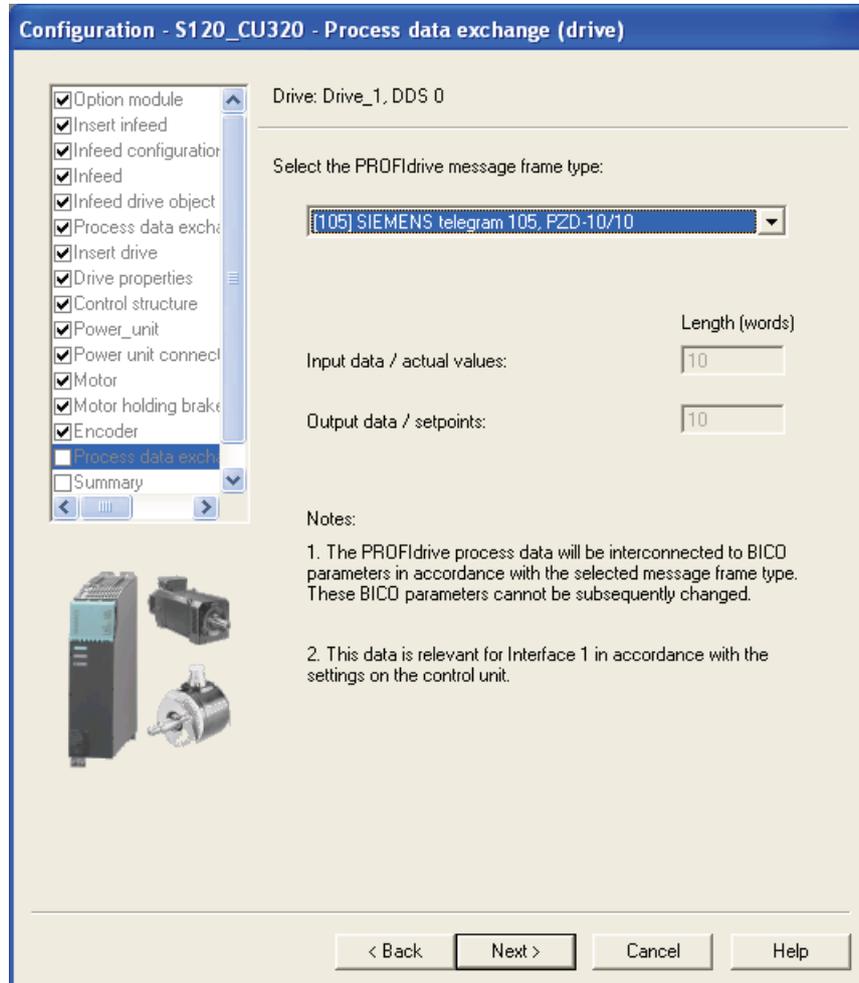
For motor holding brakes which are a direct component of the motor block, use the "Motor holding brake acc. to sequential control" setting. For externally fitted motor holding brakes, select the "Motor holding brake acc. to sequential control, brake connection via BICO interconnection" setting, and also link it to a free output.

In both cases, you must enable the "Extended brake control" option.

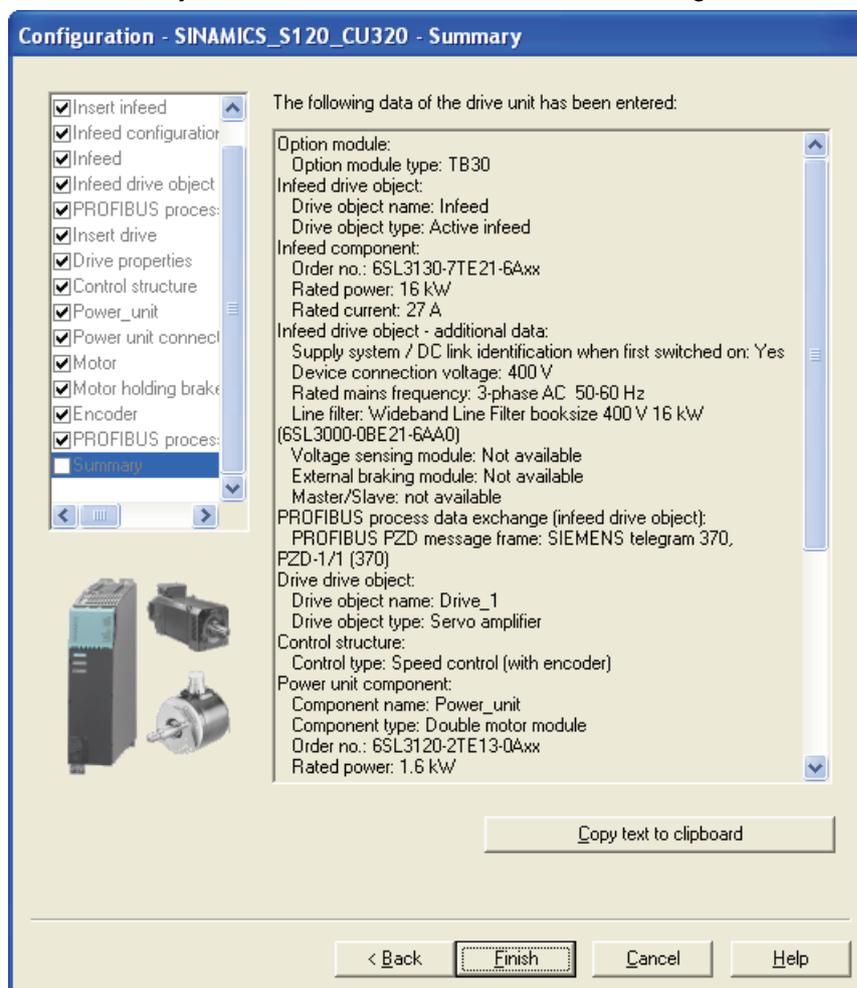
16. If you did not activate encoder sensing via the Drive CLiQ interface, you can select the relevant encoder from the list box. Select the desired encoder and the encoder evaluation, then click "Next" to confirm the setting.



- 17. For process data communication between the Technology CPU and power section via PROFIBUS DP (DRIVE), set a suitable message frame, such as message frame 105. You can find further information about the properties of the individual message frames in the "Extending a PROFIdrive message frame (Page 130)" chapter. Click "Next" to confirm the setting.



This completes the configuration. You can review your parameter settings again in the summary; click the "Finish" button to close the configuration.



18. Then repeat the configuration for any other motors connected to the drive system.

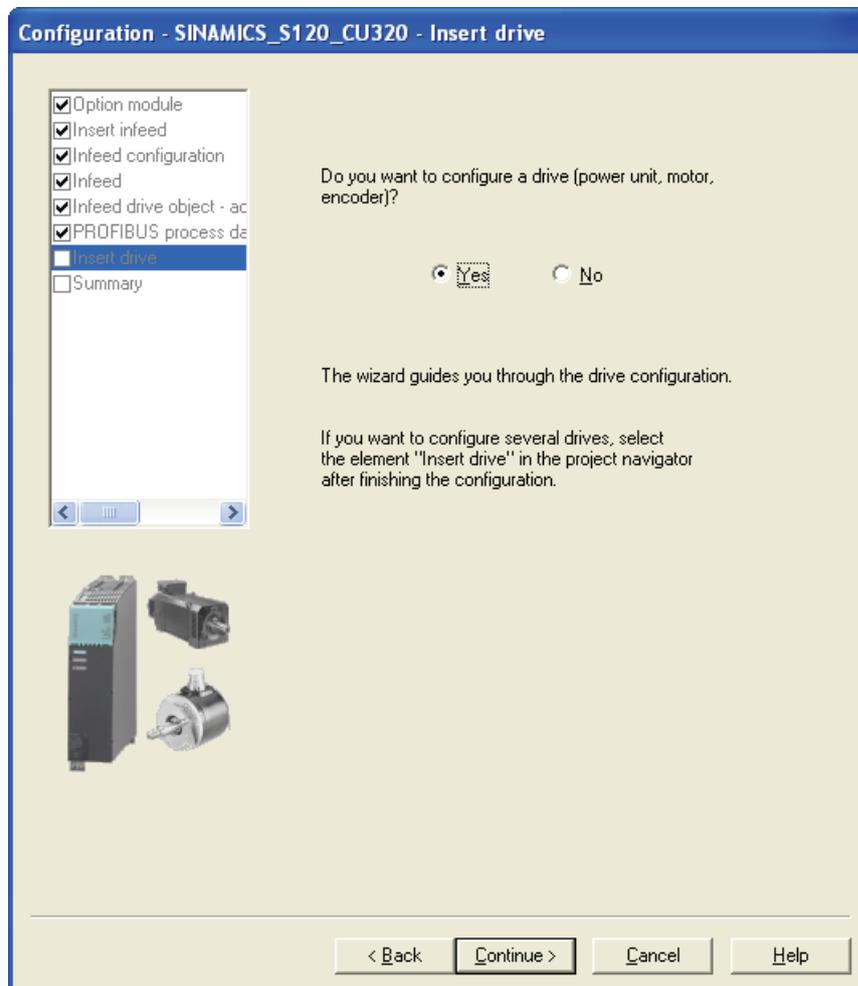
Configuring with Smart Line Module (SLM)

1. In S7T Config, open the SINAMICS S120_CU320 folder, and double-click the "Configure drive unit" entry or the drive.
2. Insert the control unit and optionally the add-on modules, for example TB30 terminal board. Select the desired values and click "Next" to confirm the settings.
3. For the selection of the SINAMICS infeed, you can choose between modules with or without DRIVE-CLiQ connection. Select the appropriate setting and click "Next" to confirm the setting. The following steps are for Smart Line Modules without DRIVE-CLiQ.

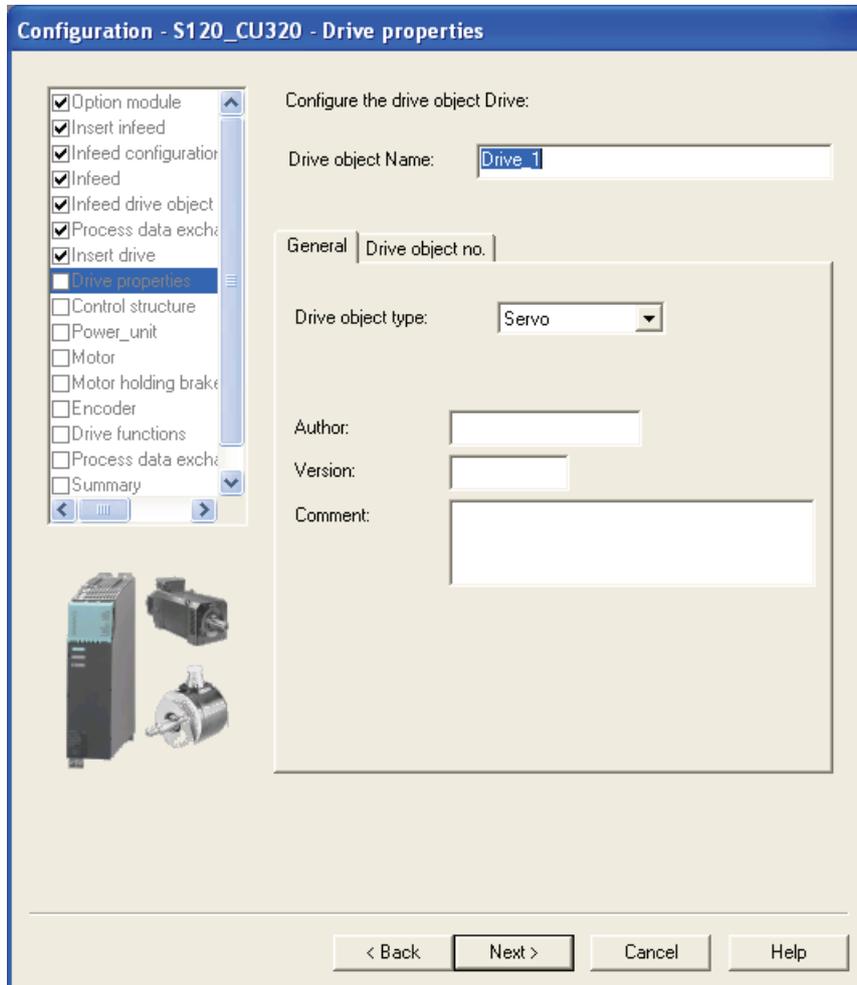


For modules with DRIVE-CLiQ infeed, proceed as for the configuration with Active Line Modules (ALM).

4. Start the configuration of the drive by selecting "Yes" and clicking the "Next" button to confirm the setting.



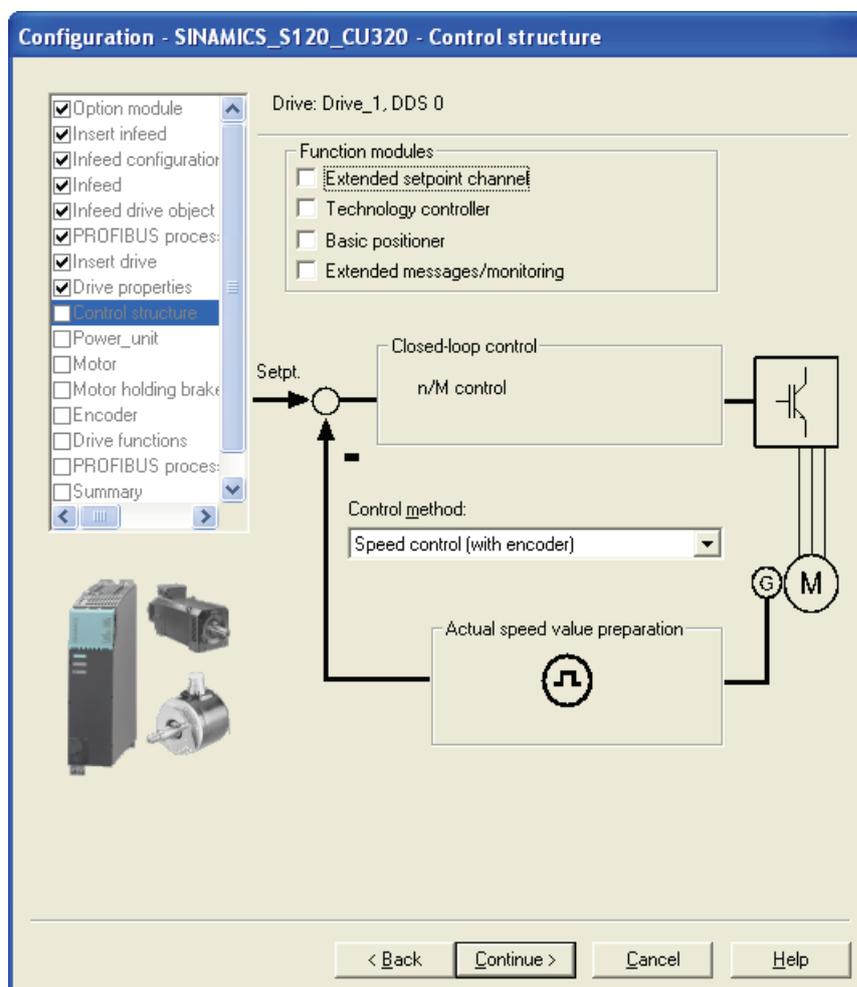
5. Enter the name of the drive "Drive_1" in the "Drive properties" dialog.
Select the "Servo" type on the "General" tab. Select the "Drive object no." tab.
Enter a drive object number.
Click the "Next" button to confirm the settings.



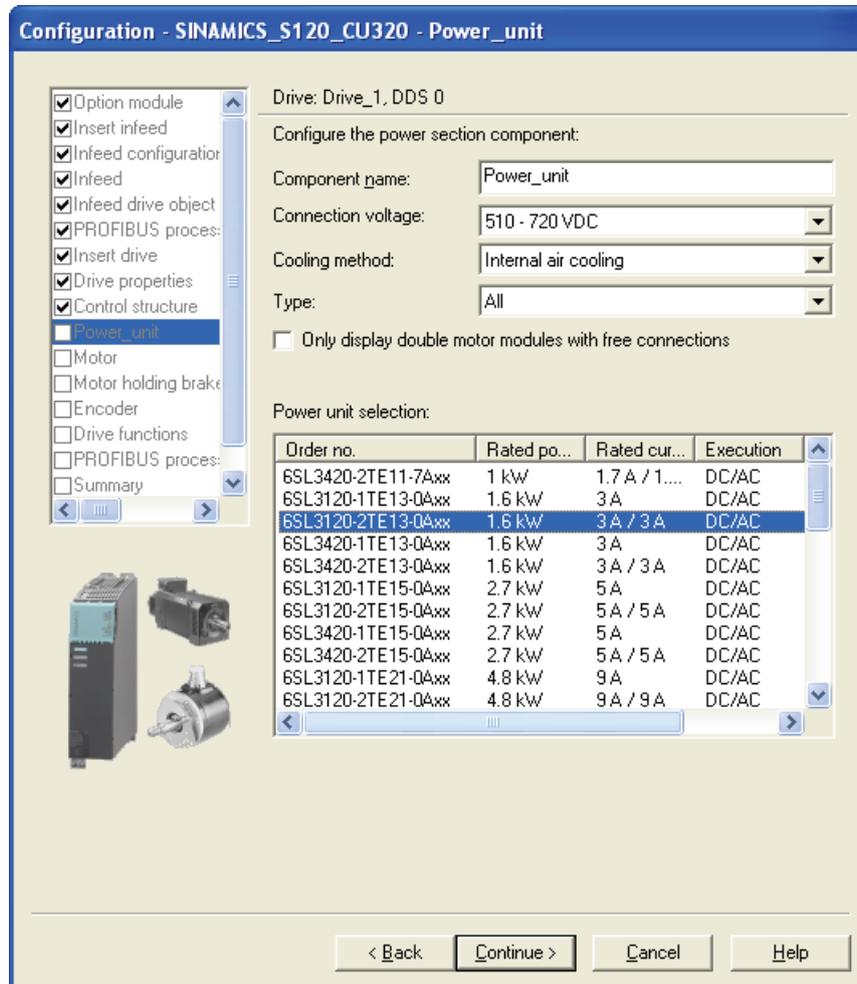
Note

If you subsequently want to change the drive object type, you will have to reconfigure the drive.

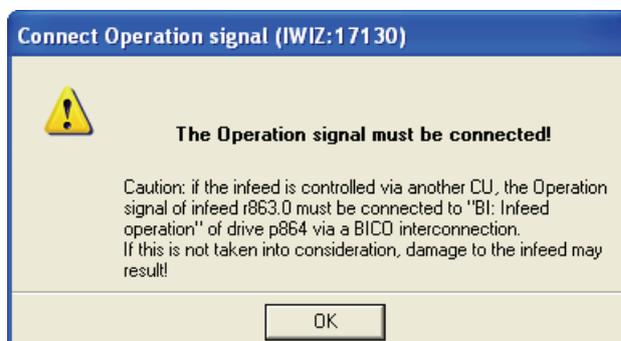
6. Select "Speed control (with encoder)" as the control method, and click "Next" to confirm the setting.



7. Select the appropriate power section component from the list, and click "Next" to confirm the setting.



8. For Smart Line Modules without DRIVE-CLiQ interface, a message appears with information on the hardware wiring of the ready signals between infeed and the drive. Read this information and confirm the message with "OK".

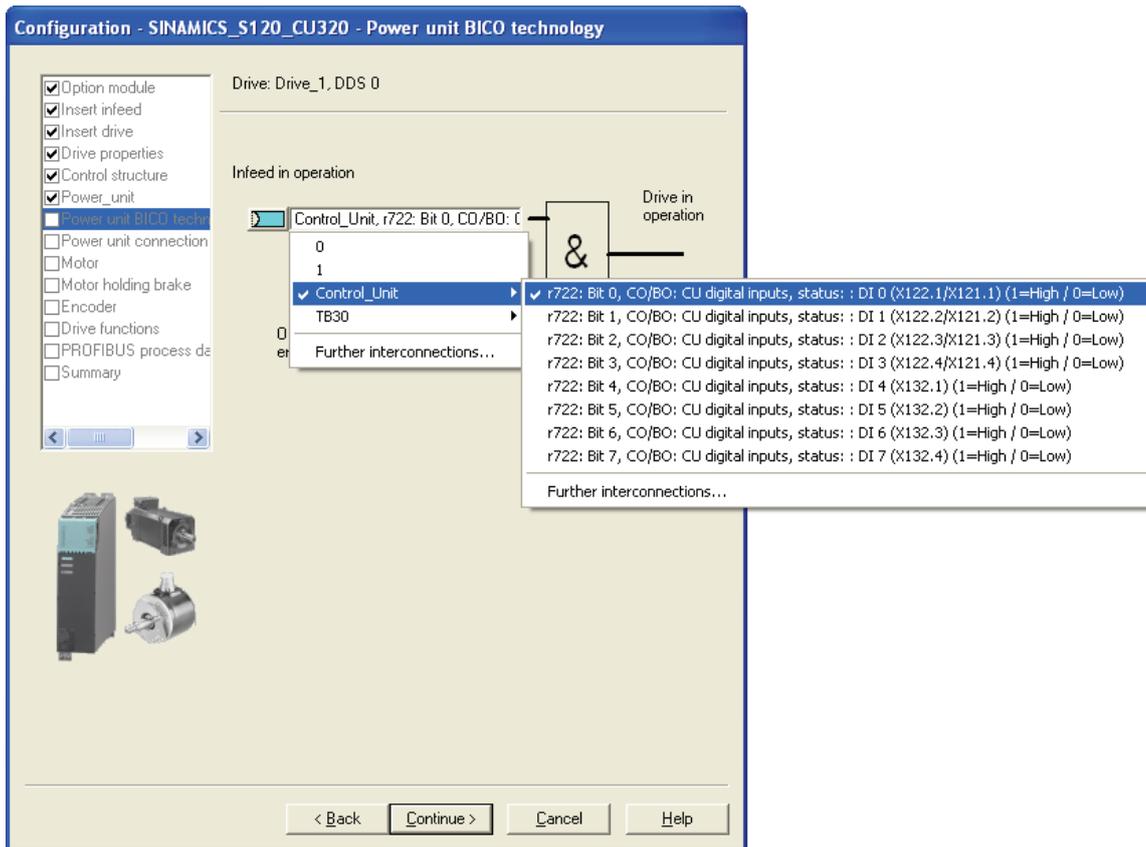


Note

For SLM without DRIVE-CLiQ, the hardware wiring of the ready signal for the infeed can take place either via the digital inputs of the CU 320 control unit or via the additional digital inputs of the TB 30 terminal board.

The appropriate input of the signal is then used for the subsequent internal wiring of the BICO signals.

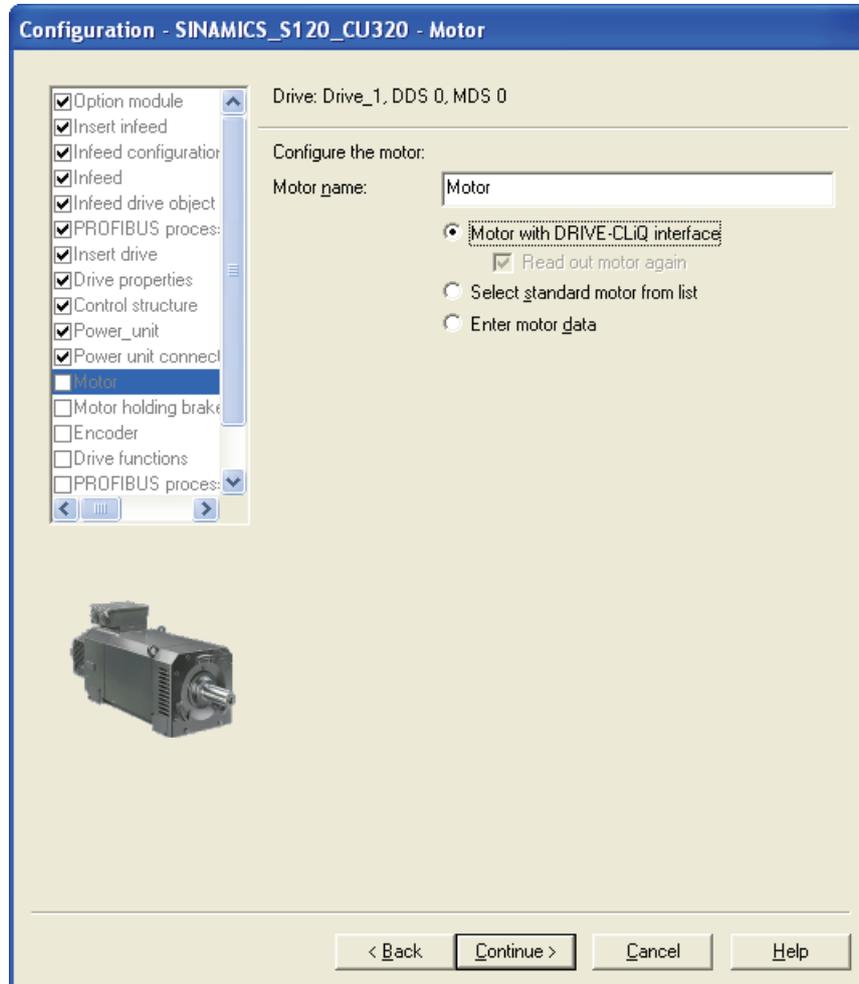
- Now perform the internal wiring of the Ready to run signal using the BICO engineering of the SINAMICS S120. Click the blue icon for the wiring of the binector and select "Control unit" or "Further interconnections". The dialog for the possible interconnections of the individual components opens. Select, for example, the "r722 Bit0 CO/BO parameter here: CU digital inputs, status: DI 0 X122.1...." on the control unit and click the "OK" button to confirm the selection. Click the "Next" button to close the BICO wiring.



10. If you have configured a Double Motor Module, you must now select the power unit connection of the motor on the module. For the first motor, select the X1 connection, for example. Click the "Next" button to confirm the setting.



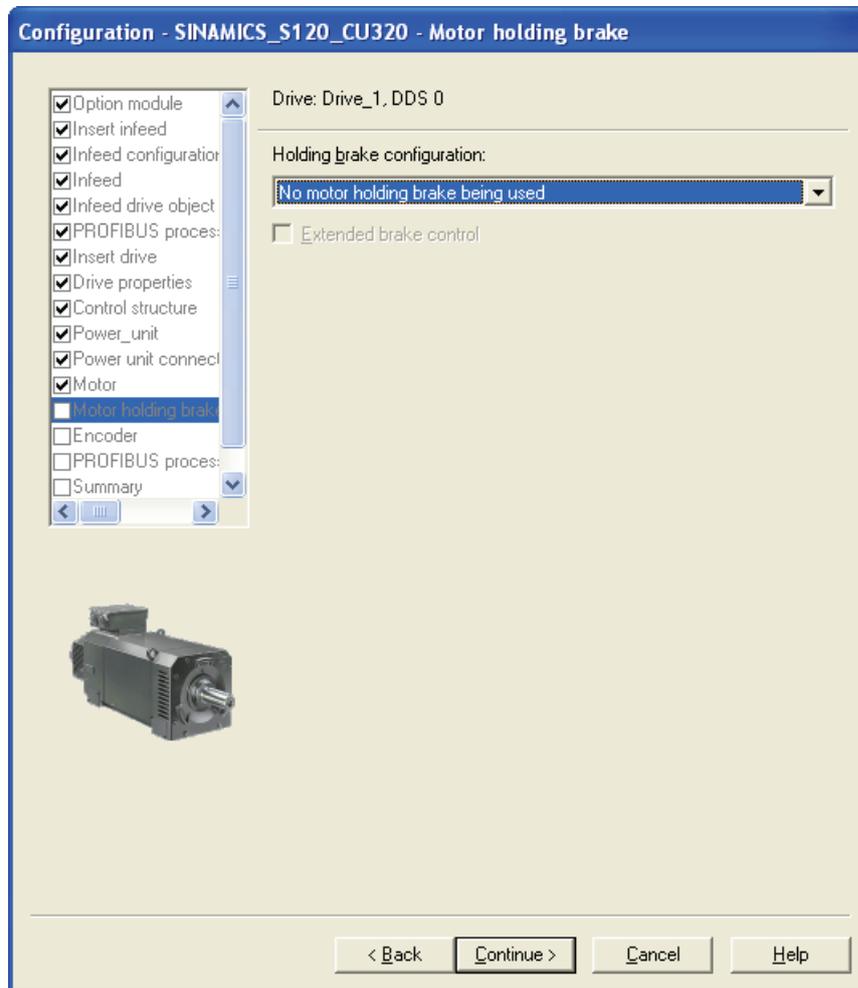
11. Select the connected motor. If a motor with a DRIVE-CLiQ interface is used, select this setting. The motor data is then read from the electronic nameplate of the motor via the DRIVE-CLiQ connection. Alternatively, you can select the (standard) motor from a list, or enter the motor data directly. Then click "Next" to confirm the setting.



Note

If you select a "Motor with DRIVE-CLiQ interface", the motor data will not be read immediately from the electronic nameplate of the motor. The data will not be transferred until you switch to online mode.

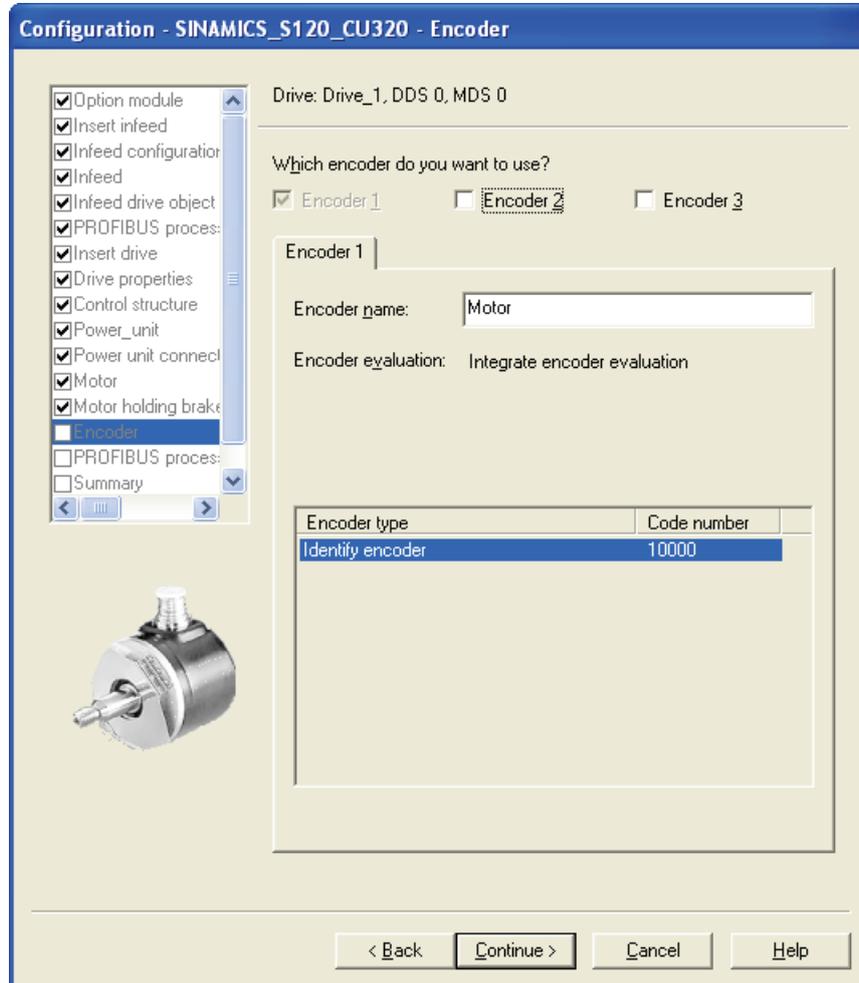
12. Configure the motor holding brake, if there is one, and click "Next" to confirm the setting.



For motor holding brakes which are a direct component of the motor block, use the "Motor holding brake with sequential control" setting. For externally fitted motor holding brakes, select the "Motor holding brake acc. to sequential control, brake connection via BICO interconnection" setting, and also link it to a free output.

In both cases, you must enable the "Extended brake control" option.

13. If you did not activate encoder sensing via the Drive CLiQ interface, you can select the relevant encoder from the list box. Select the desired encoder and the encoder evaluation, then click "Next" to confirm the setting.



14. For process data communication between the Technology CPU and power section via PROFIBUS DP (DRIVE), set a suitable message frame, such as message frame 105. You can find further information about the properties of the individual message frames in the "Extending a PROFIdrive message frame (Page 130)" section. Click "Next" to confirm the setting.

Configuration - S120_CU320 - Process data exchange (drive)

Drive: Drive_1, DDS 0

Select the PROFIdrive message frame type:

[105] SIEMENS telegram 105, PZD-10/10

	Length (words)
Input data / actual values:	10
Output data / setpoints:	10

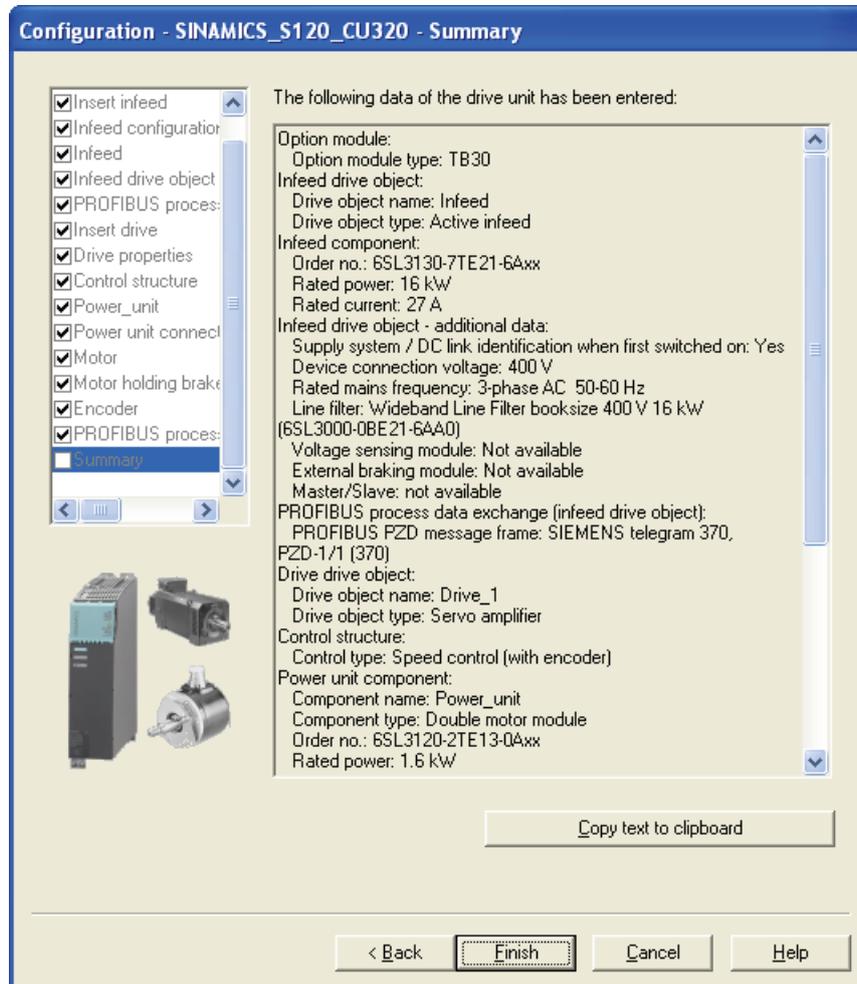
Notes:

1. The PROFIdrive process data will be interconnected to BICO parameters in accordance with the selected message frame type. These BICO parameters cannot be subsequently changed.
2. This data is relevant for Interface 1 in accordance with the settings on the control unit.



< Back Next > Cancel Help

15. This completes the configuration. You can review your parameter settings again in the summary; click the "Finish" button to close the configuration.



16. Then repeat the configuration for any other motors connected to the drive system.

3.4.4 Alignment of the PROFIdrive message frames

Introduction

To configure the PROFIBUS communications interface, the message frame configuration in S7T Config and in HW Config must be aligned. Among other things, this alignment determines the I/O addresses for the PROFIdrive data communication between SINAMICS and the Technology CPU.

Alignment with an Active Line Module (ALM)

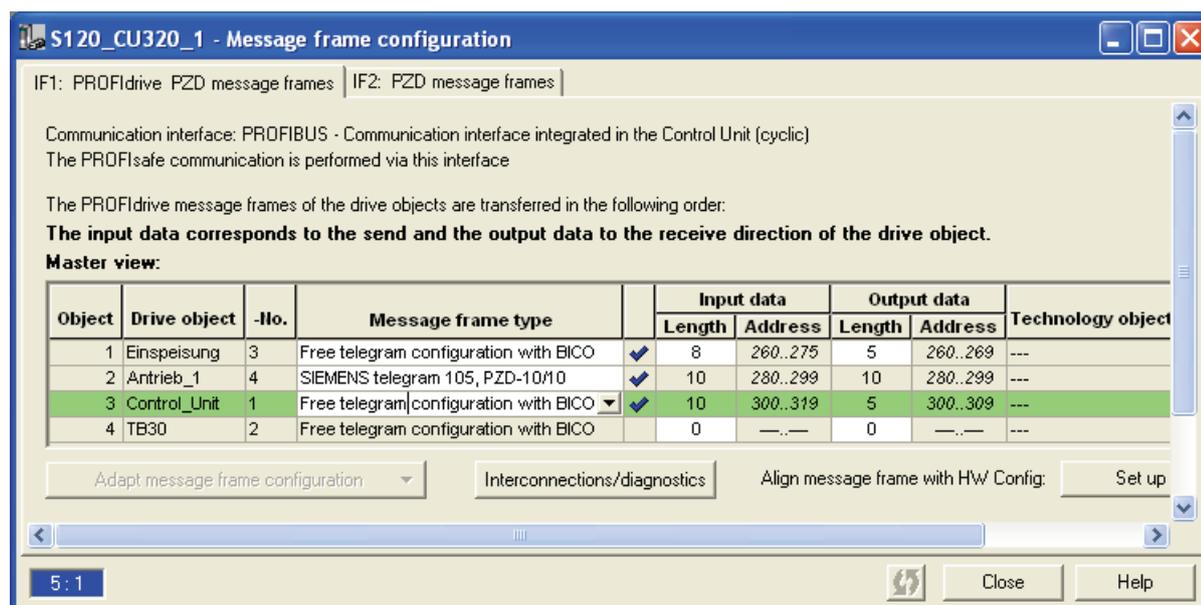
To perform the alignment, open the "S120_CU320" folder in S7T Config.

Double-click "Communication > Message frame configuration".

There you check and correct the order of the individual components.

To do this, select the relevant component and use the arrow buttons to move it up or down.

To align with HW Config, click "Align message frame with HW Config: Set up addresses" and confirm the security prompt with "Yes".



The appropriate I/O addresses of the message frames are thereby entered for all parameterized axes. The PROFIdrive message frame must be extended to read in the inputs and outputs of the terminal board or control unit. For more information, refer to the chapter "Diagnosing the SINAMICS configuration (Page 75)".

Alignment with a Smart Line Module (SLM)

To perform the alignment, open the message frame configuration in S7T Config (same as for the ALM), and check and correct the order of the individual components there.

To do this, select the relevant component, and use the arrow buttons to move it up or down.

The objects must be kept in the following order:

1. Drives
2. Option modules
3. Control unit

The alignment procedure is the same as with an Active Line Module (ALM)

This concludes the configuration. You can check the topology of your SINAMICS configuration. For more information, refer to the section "Diagnosing the SINAMICS configuration (Page 75)".

See also

Extending a PROFIdrive message frame (Page 130)

3.4.5 Loading the configuration into the drive components

Procedure

Once the configuration in S7T Config is complete, save and compile the settings and interconnections you have made. Now switch to online mode and load the configuration into the SINAMICS S120.

To do so, select **SINAMICS_S120**. In the context menu, select the **Target Device > Download** command.

Note

If an error occurs during the save and compile operation, you should check the HW Config settings for constant bus cycle time and the DP cycle on the PROFIBUS DP (Drive).

3.4.6 Optimizing the speed controller in the drive

Introduction

The controllers in the drive must be working optimally to ensure that systems are not susceptible to faults.

There are tools for automatically optimizing the controller in SINAMICS firmware version V2.5 and S7 Technology V4.1 or later.

The following requirements must be fulfilled to use automatic controller optimization:

- The drive may be moved without hitting the mechanical limits
- The drive is running in "SERVO" mode.
- The motor encoder performs the closed-loop control.
- There is an online connection to the relevant drive unit.
- The open-loop control is in STOP mode.

6. Carry out the four steps in automatic mode, or carry out the individual steps using the operating buttons in the automatic controller setting dialog.

The controller optimization results will be displayed.

Controller: Speed controller
Drive: Drive_1

Controller setting sequence:

- 1. Measurement of the mechanical system, Part 1
- 2. Measurement of the mechanical system, Part 2
- 3. Identification of the current control loop
- 4. Calculation of the speed controller setting

Expert mode

Bandwidth: 500 Hz
Parameters for the measurement of the mechanical
Amplitude: 0.083 Nm
Averaging operations: 7
Offset: 10.000 RPM

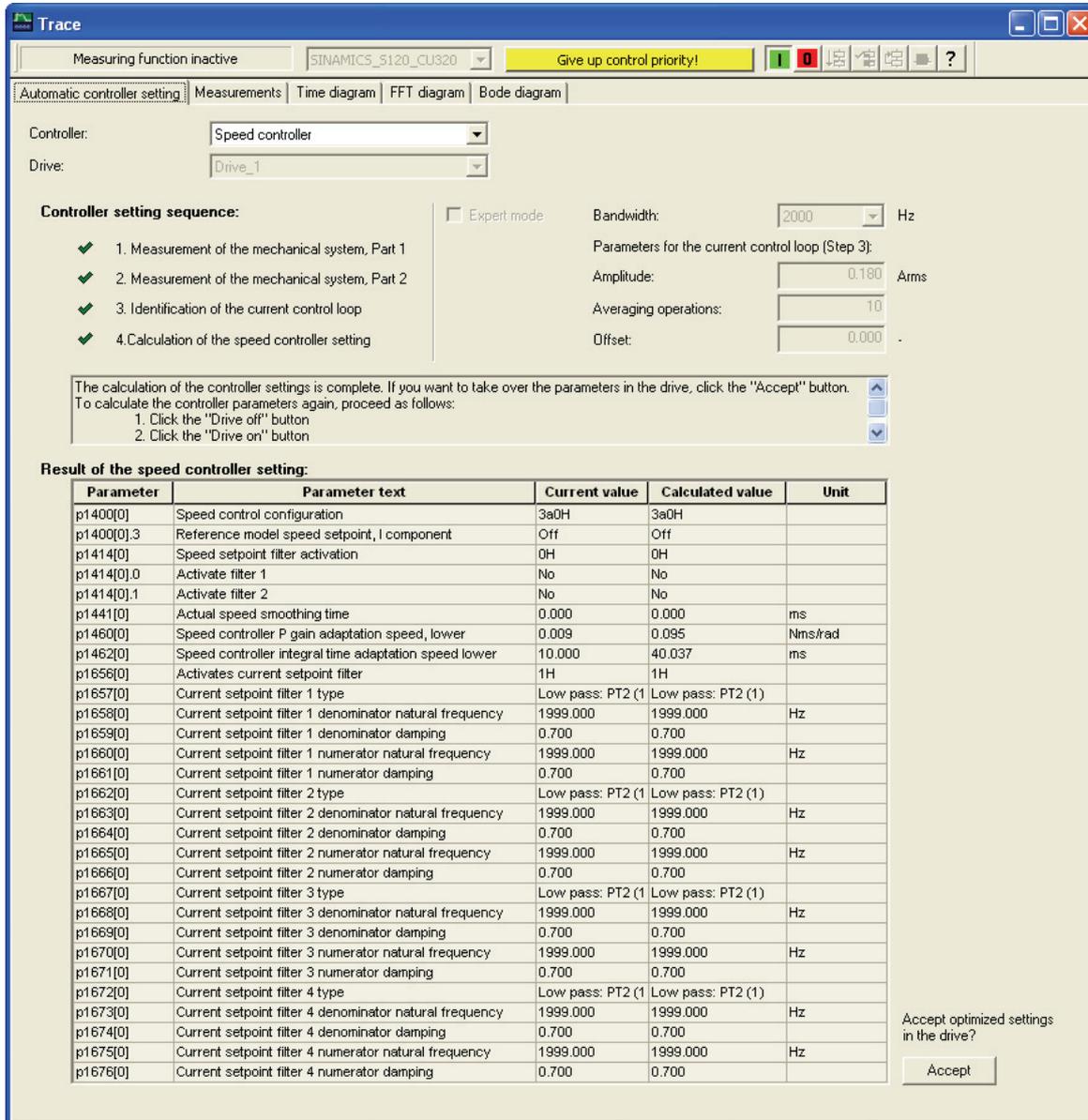
Step 1:
The mechanical system is measured in the lower frequency range.
A low speed setpoint is set for this. The drive moves.

Result of the speed controller setting:

Parameter	Parameter text	Current value	Calculated value	Unit
p1400[0]	Speed control configuration	3a0H		
p1400[0].3	Reference model speed setpoint, I component	Off		
p1414[0]	Speed setpoint filter activation	0H		
p1414[0].0	Activate filter 1	No		
p1414[0].1	Activate filter 2	No		
p1441[0]	Actual speed smoothing time	0.000		ms
p1460[0]	Speed controller P gain adaptation speed, lower	0.009		Nms/rad
p1462[0]	Speed controller integral time adaptation speed lower	10.000		ms
p1656[0]	Activates current setpoint filter	1H		
p1657[0]	Current setpoint filter 1 type	Low pass: PT2 (1)		
p1658[0]	Current setpoint filter 1 denominator natural frequency	1999.000		Hz
p1659[0]	Current setpoint filter 1 denominator damping	0.700		
p1660[0]	Current setpoint filter 1 numerator natural frequency	1999.000		Hz
p1661[0]	Current setpoint filter 1 numerator damping	0.700		
p1662[0]	Current setpoint filter 2 type	Low pass: PT2 (1)		
p1663[0]	Current setpoint filter 2 denominator natural frequency	1999.000		Hz
p1664[0]	Current setpoint filter 2 denominator damping	0.700		
p1665[0]	Current setpoint filter 2 numerator natural frequency	1999.000		Hz
p1666[0]	Current setpoint filter 2 numerator damping	0.700		
p1667[0]	Current setpoint filter 3 type	Low pass: PT2 (1)		
p1668[0]	Current setpoint filter 3 denominator natural frequency	1999.000		Hz
p1669[0]	Current setpoint filter 3 denominator damping	0.700		
p1670[0]	Current setpoint filter 3 numerator natural frequency	1999.000		Hz
p1671[0]	Current setpoint filter 3 numerator damping	0.700		
p1672[0]	Current setpoint filter 4 type	Low pass: PT2 (1)		
p1673[0]	Current setpoint filter 4 denominator natural frequency	1999.000		Hz
p1674[0]	Current setpoint filter 4 denominator damping	0.700		
p1675[0]	Current setpoint filter 4 numerator natural frequency	1999.000		Hz
p1676[0]	Current setpoint filter 4 numerator damping	0.700		

Accept optimized settings in the drive?

- Transfer the calculated speed controller parameter values to the drive by clicking "Accept" in the automatic controller setting dialog.



- Switch off the drive by clicking "Drive OFF" in the automatic controller setting dialog.
- Give up control priority by pressing the "Get control priority!" again in the automatic controller setting.
- Set the T-CPU back to RUN mode.
- Start a "Copy RAM to ROM" operation for the drive you have just optimized.
- Load the data from the drive back to the programming device.
- Save and recompile the project.

3.5 Diagnosing the SINAMICS configuration

Once the configuring for the SINAMICS S120 has been completed, the topology of the DRIVE-CLiQ wiring can be checked in online mode and the drive moved using the SINAMICS S120 control panel.

3.5.1 Checking the DRIVE-CLiQ wiring online

Procedure

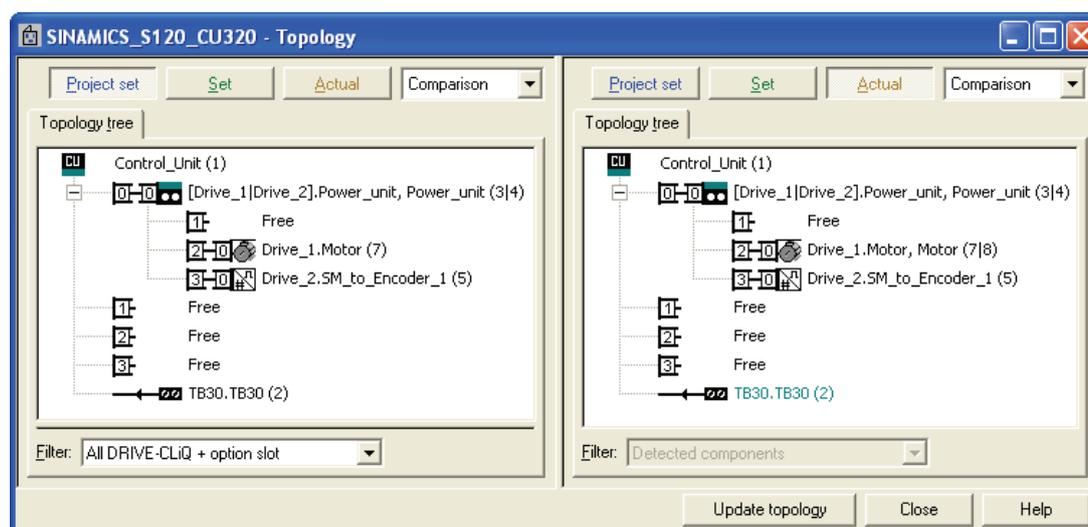
To check the DRIVE-CLiQ wiring online, follow these steps:

1. Set S7T Config to online mode.
2. Open the "S120_CU320" folder.
3. Select the "Topology" command.

Result

The "Topology" dialog will open.

By making a comparison of the planned and the actual topology in the display windows, any incorrect wiring of the DRIVE-CLiQ connections can be determined quickly.



The display topology views have the following meaning:

Topology view	Meaning
Planned project	Topology of the DRIVE-CLiQ components programmed offline in S7T Config.
Planned	Topology of the wiring of the DRIVE-CLiQ components loaded online into the drive.
Actual	Real wiring of the DRIVE-CLiQ drive components.

Corrections in the wiring can be made by means of the hardware by replugging the DRIVE-CLiQ connections or in the "Project set" window by dragging the components to the correct DRIVE-CLiQ connection.

3.5.2 Drive test using the SINAMICS control panel

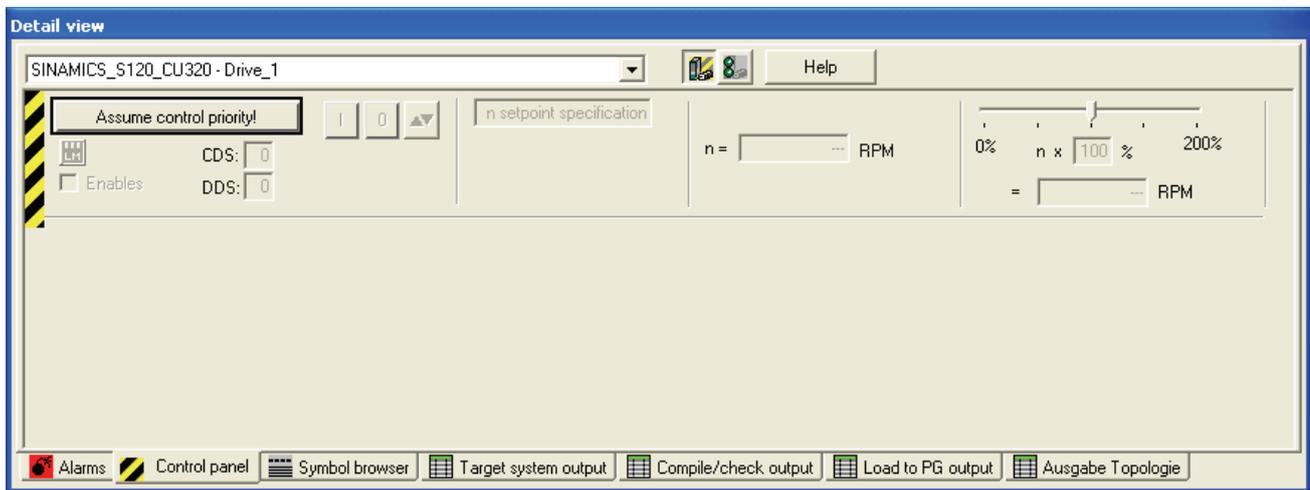
Introduction

After the successful configuring of the SINAMICS S120 drive system, the drives can be controlled and moved in speed-controlled operation using the drive control panel in S7T Config.

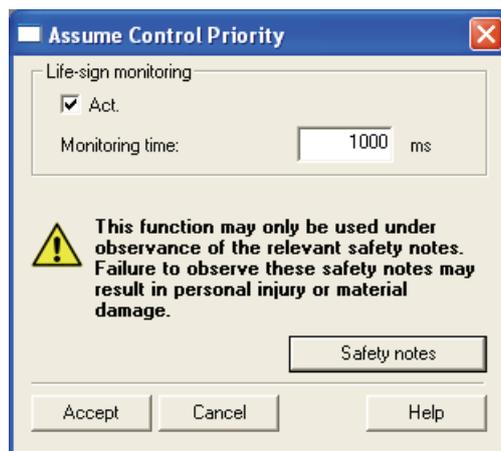
Assuming control priority

Open the "S120_CU320" folder in S7T Config.
Select the **Drives > Drive_1 > Commissioning > Control Panel** command.

Select there the drive that is to be tested. Transfer the control priority to S7T Config by clicking "Get control priority".



Read the security message.



Operation using the drive control panel

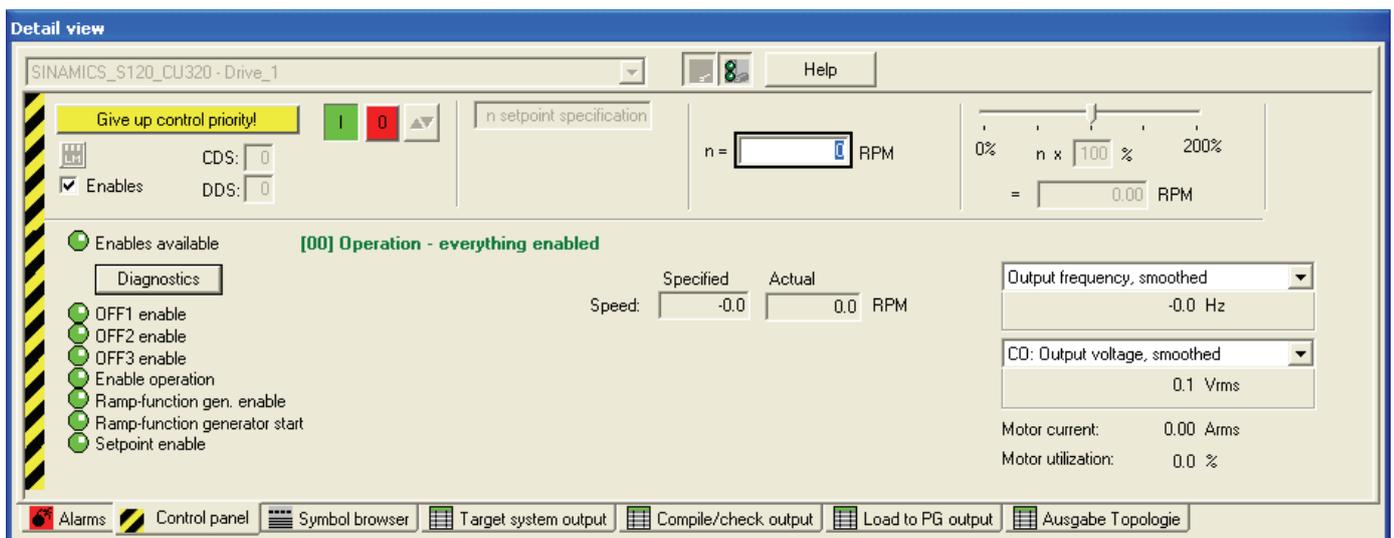
Activate the "Enables" option box and operate the drive control panel using the keys described below:

Button	Function
	Enable the infeed for an Active Line Module or for a Basic Line Module using DRIVE-CLiQ.
	Starting the motion. A speed setpoint for the axis can be specified in the Setpoint input box.
	Stopping the motion.

Note

If, after starting the drive, the "The switch-on disable of the drive is active" error message is issued, then reset the signal for the switch-on disable.

To do this, switch to the **Interrupts** tab and acknowledge the pending interrupts.



3.6 Creating technology objects

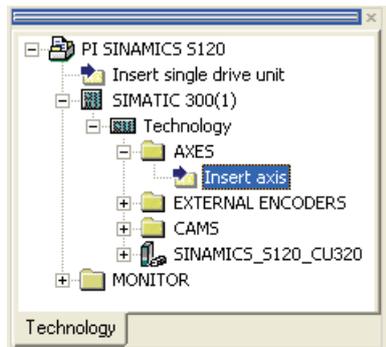
3.6.1 Creating and configuring axes

Introduction

Once the SINAMICS S120 drive system has been configured and placed in operation, the axes must now be created in the technology section of the Technology CPU. This gives the CPU the access to and the control of the axes.

Procedure

1. Open the Technology folder in S7T Config and double-click on the "Insert axis" function to add an "axis" technology object.



2. Enter in the first dialog box a name for the axis and select the required axis technology. Click on the "OK" button to confirm your entry.

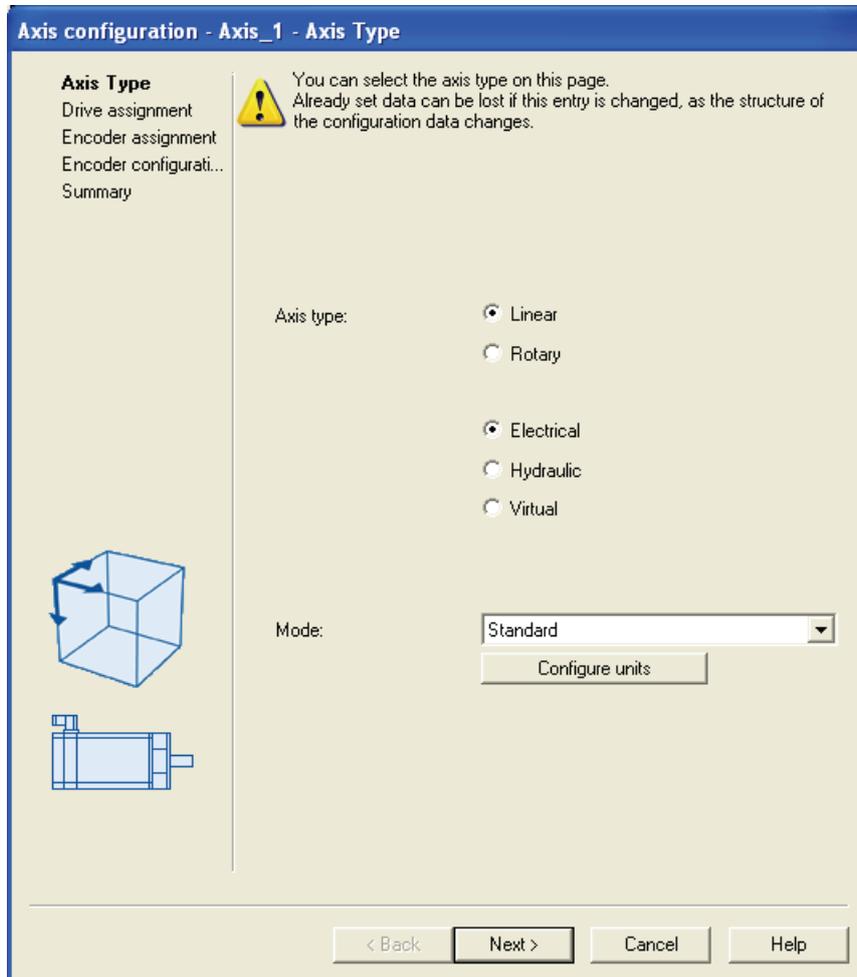
The screenshot shows the 'Insert Axis' dialog box with the following details:

- Title Bar:** 'Insert Axis' with help and close icons.
- Name:** A text box containing 'Axis 1'.
- General Tab:**
 - Which technology do you want to use?:**
 - Speed control
 - Positioning
 - Synchronous operation
 - Path interpolation
 - Author:** An empty text box.
 - Version:** An empty text box.
 - Existing Axes:** An empty list box.
 - Comment:** A large empty text area.
- Buttons:** 'OK', 'Cancel', and 'Help' buttons at the bottom.

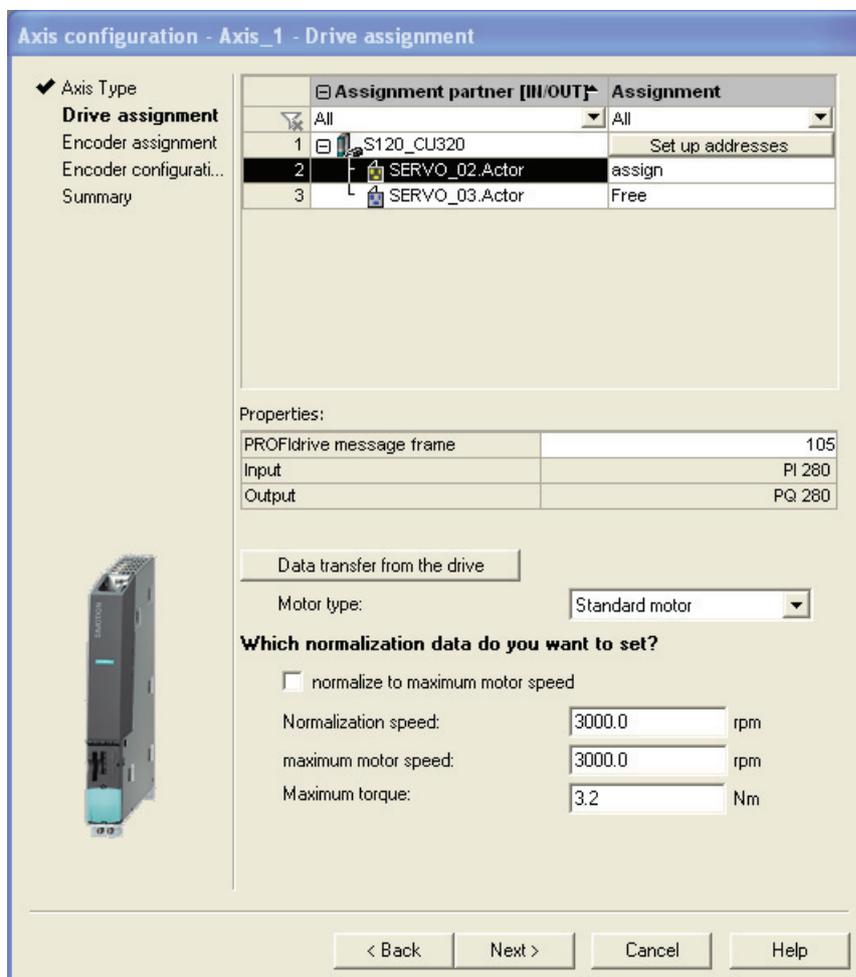
Note

The axis technology can no longer be changed once it has been selected. If a different axis technology is to be selected, the technology object must be recreated.

3. Select "Linear, Electric" as the axis type used. Select "Configure units" if needed and click "Next" to confirm the setting.



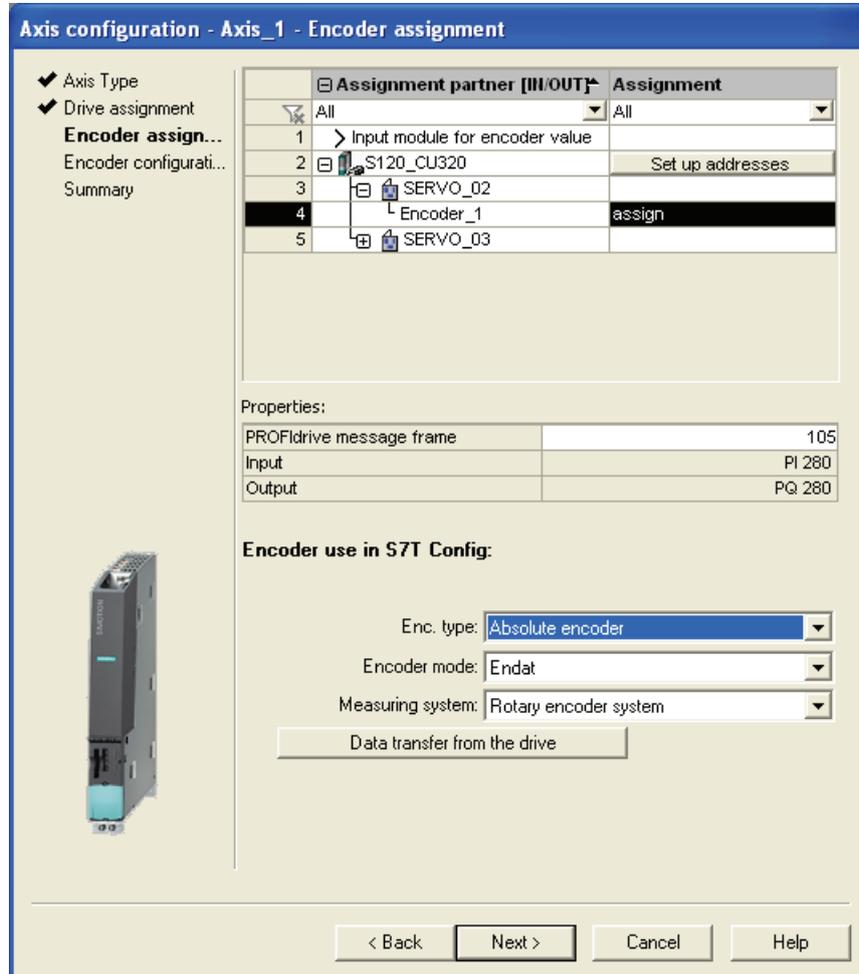
- The axis is now assigned to the drive of the SINAMICS S120. If the SINAMICS S120 is not yet available in the list of drive devices, click the "Set up addresses" button. A free drive of the selected drive device can be selected from the list for the assignment.



The message frame (e.g. message frame 105) required for the communication between the Technology CPU and the drive system will be fetched automatically from the drive configuration.

- Select the motor type. The maximum motor speed can be set to the maximum speed of the motor connected to the selected drive.
- To do this, click the "Data transfer from the drive" button to ensure that the data is consistent between the controller and drive. Click the "Next" button to accept the settings.

7. Select the encoder type, the encoder mode and the measuring system to be connected to the selected drive. Again, click the "Data transfer from the drive" button to automatically accept the data configured in the drive.



8. Enter the encoder-specific data, for example, encoder pulses per revolution and fine resolution. Additional information on this data can be obtained in the chapter "Encoder settings" (Page 93)".

If you have transferred the encoder data using the "Data transfer from the drive" button, the encoder-specific data will already be preset correctly. You can then immediately confirm the dialog with "Next".

Axis configuration - Axis_1 - Encoder configuration

- ✓ Axis Type
- ✓ Drive assignment
- ✓ Encoder assignment
- Encoder config...**
- Summary

Reference variables

Encoder pulses per rev.: 4096

Fine resolution: 0

Fine resolution of absolute value in Gn_X1ST2: 0

Data width of absolute value without fine resolution: 24

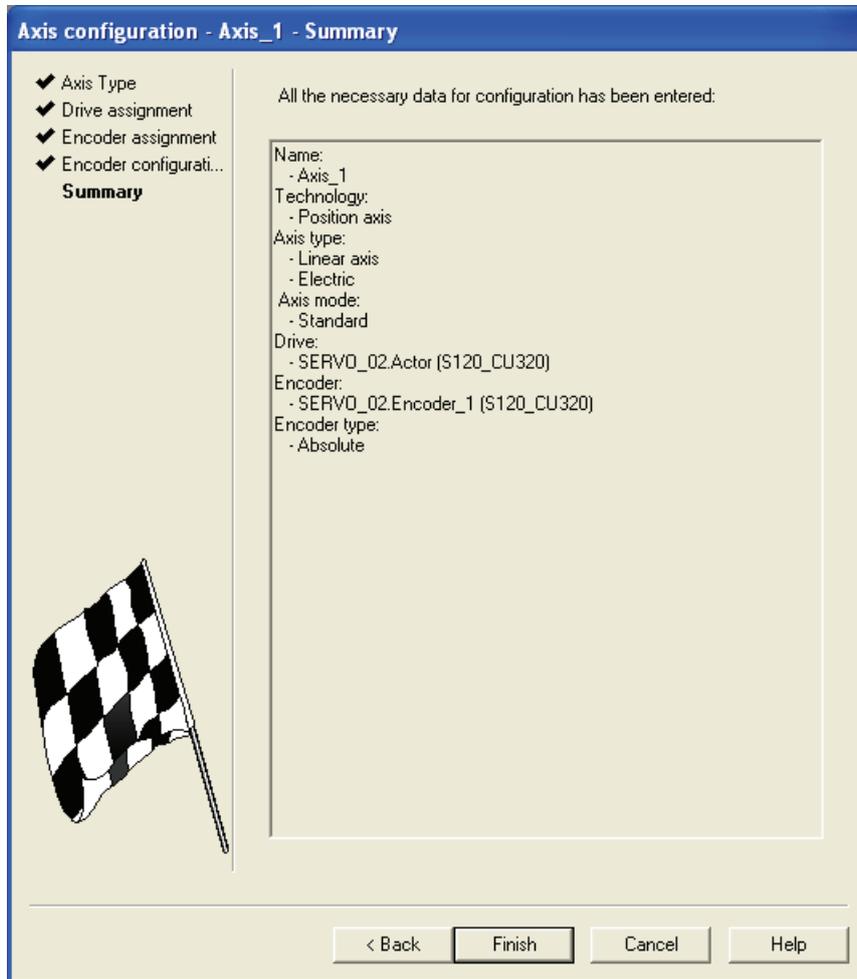
Additional settings

Tolerate the encoder failure when it is not involved in the closed-loop control

Activate encoder monitoring

< Back Next > Cancel Help

9. At the end of the configuration, you can once again check the entered data in the overview before you click the "Finish" button to close the configuration.

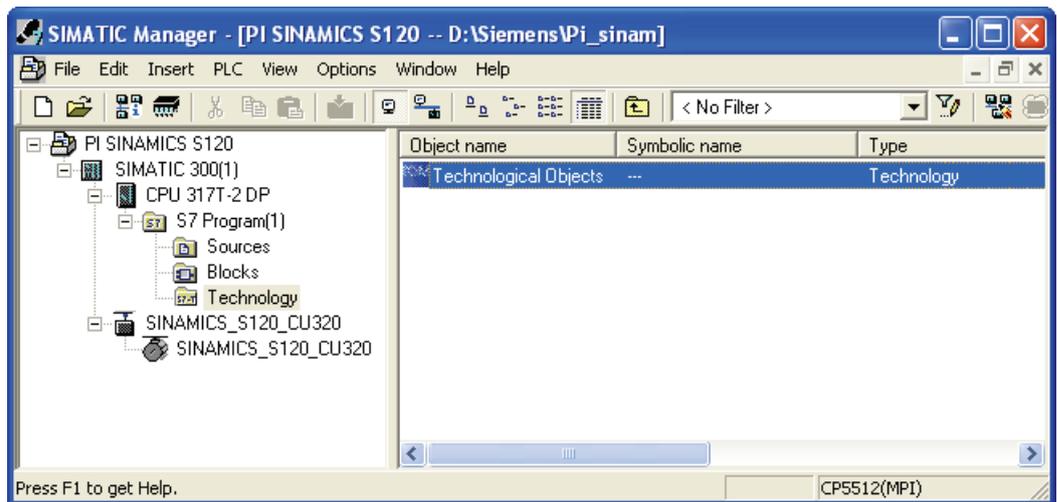


Also create the technology objects for all other axes of the SINAMICS S120 drive system and then close S7T Config.

3.6.2 Technology Objects Management (TOM)

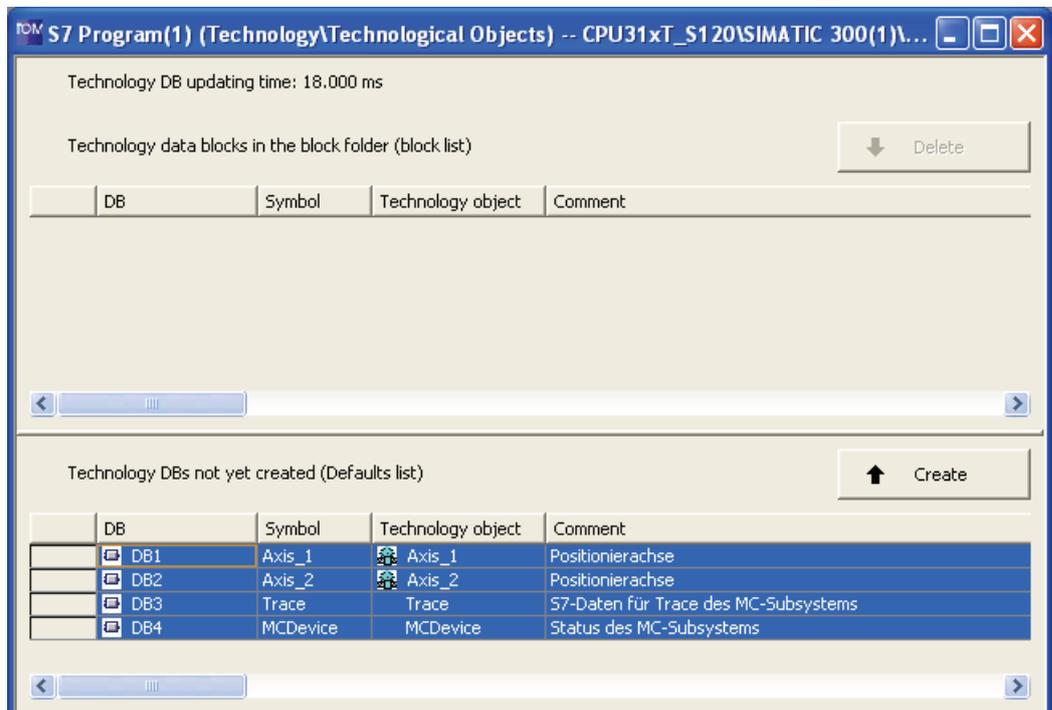
Procedure

1. Double-click the "Technology objects" entry in the "Technology" folder of the SIMATIC station to open the Technology Objects Management (TOM) in the SIMATIC Manager.

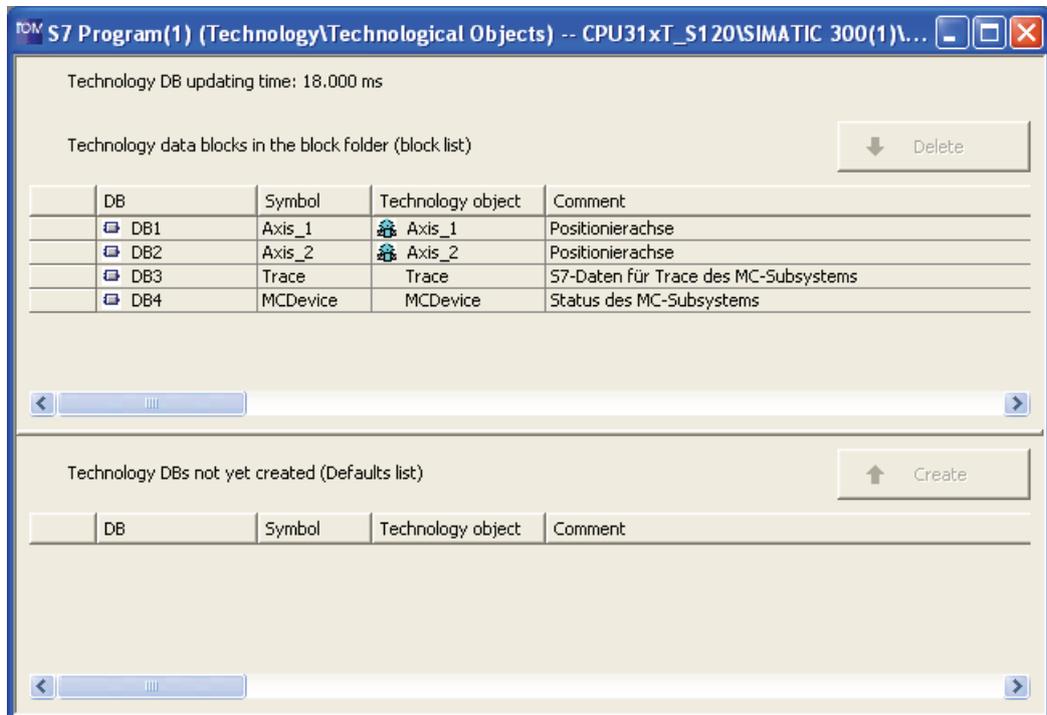


2. The list of the technology data blocks that have not yet been created contains the technology objects that have been previously configured in S7T Config or are available as standard but for which no technology data blocks have been created previously.

If necessary, change the suggested DB numbers of the technology objects in the first column of the list and click the "Create" button to create the technology data blocks.



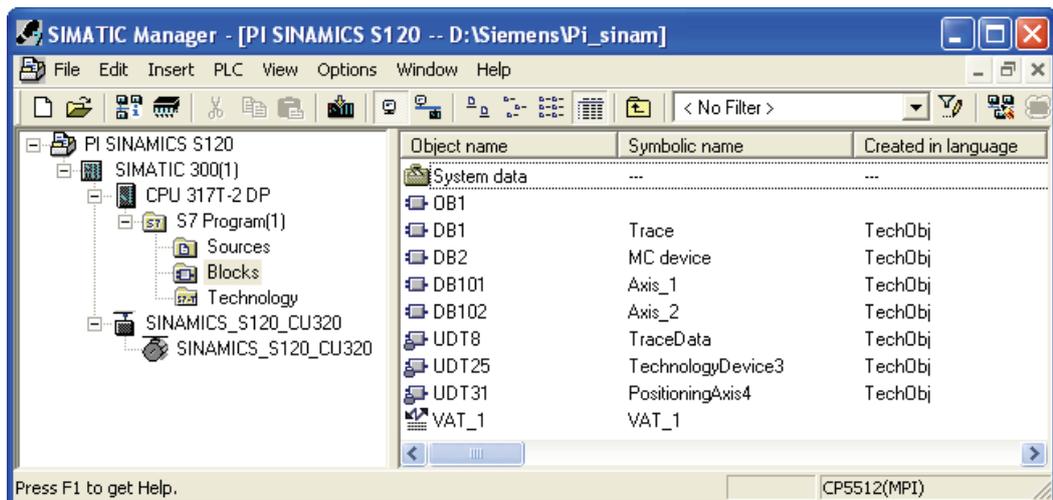
The created technology data blocks are displayed in the list of the technology data blocks in the module folder. The Technology Objects Management program can then be closed.



Result

The created technology data blocks are now also in the SIMATIC Manager in the "Blocks" folder of the SIMATIC 300 station. The icons of the data blocks are derived from the designations of the technology objects in S7T Config.

In addition to technology data blocks, a number of User Defined Datatypes (UDT) that from the basis for the technology data blocks will also be created.



3.7 Diagnosing the technology configuration

3.7.1 Overview

Introduction

The configuration of the "Axes" technology objects in S7T Config can also be checked using the axis control panel in S7T Config. The motion commands can be specified directly for the technology objects and thus the successful linking of the technology objects with the drives.

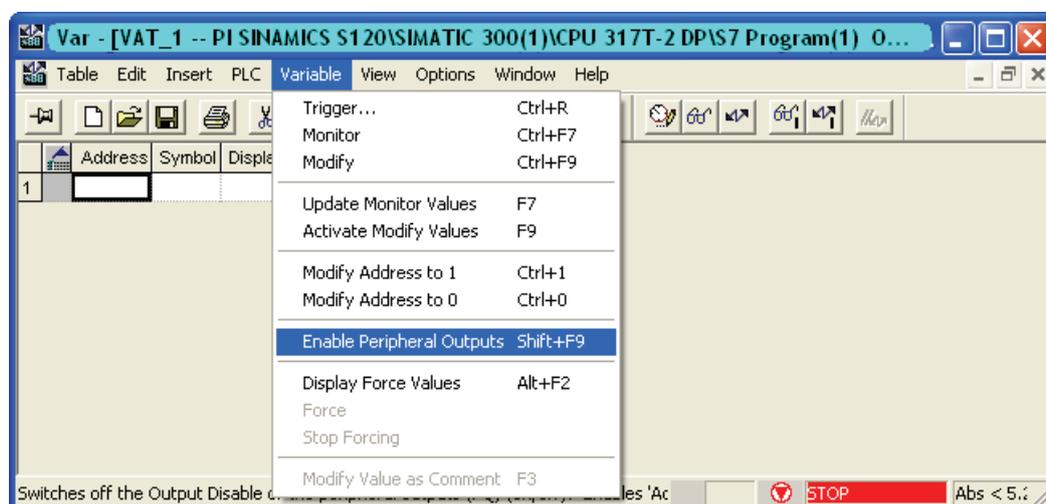
3.7.2 Preparations

Enabling CPU peripherals

To control the technology objects from the axis control panel, the CPU must be in STOP mode and the I/Os must be enabled to allow the CPU outputs to be specifically influenced.

The I/Os can only be enabled via a variable table. If necessary, create a new variable table, switch this to online mode and select the **Enable PA** function from the **Variable** menu.

In STOP mode of the CPU, you can now directly access the I/Os of the input/output modules and the axes.



Enabling the infeed for an Active Line Module or a Basic Line Module

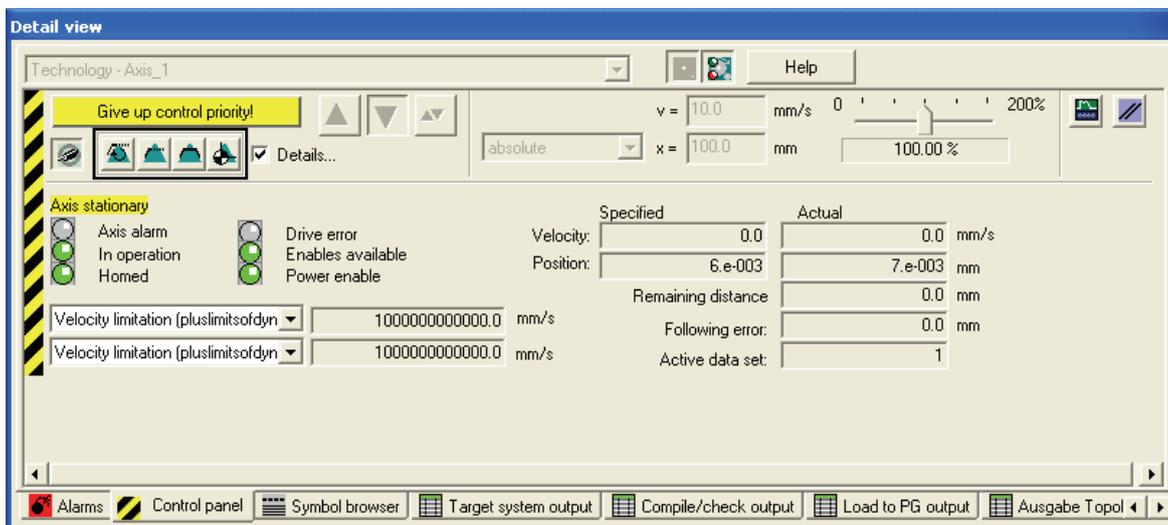
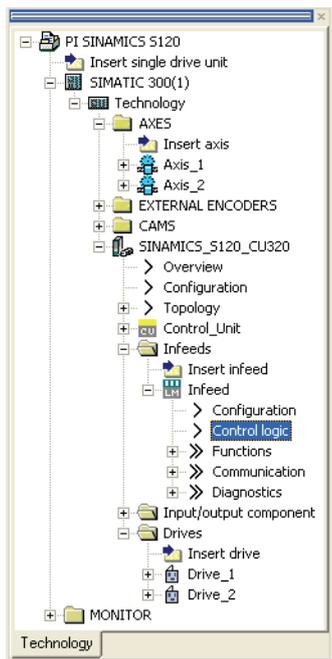
As of S7 Technology V3.0 SP2, the infeed can be enabled via the control panel.

Enabling the infeed for a Smart Line Module

The ready signal is used to enable a Smart Line Module without DRIVE-CLiQ interface. As shown in the chapter "Manual configuring" (Page 39), Configuration with Smart Line Modules (SLM)", this was connected when you configured the Smart Line Module. Ensure that the ready signal has logical value 1 in order to enable the Smart Line Module.

Enabling the axis using the axis control panel

To do this, open the axis control panel in S7T Config using "Technology\Axes\Axis_1\Control panel" and select the required axis from the dropdown list box. Transfer the control priority to the axis control panel by clicking the "Assume control priority" button and acknowledging the message that appears by clicking the "Accept" button.



3.7.3 Axis test using the technology axis control panel

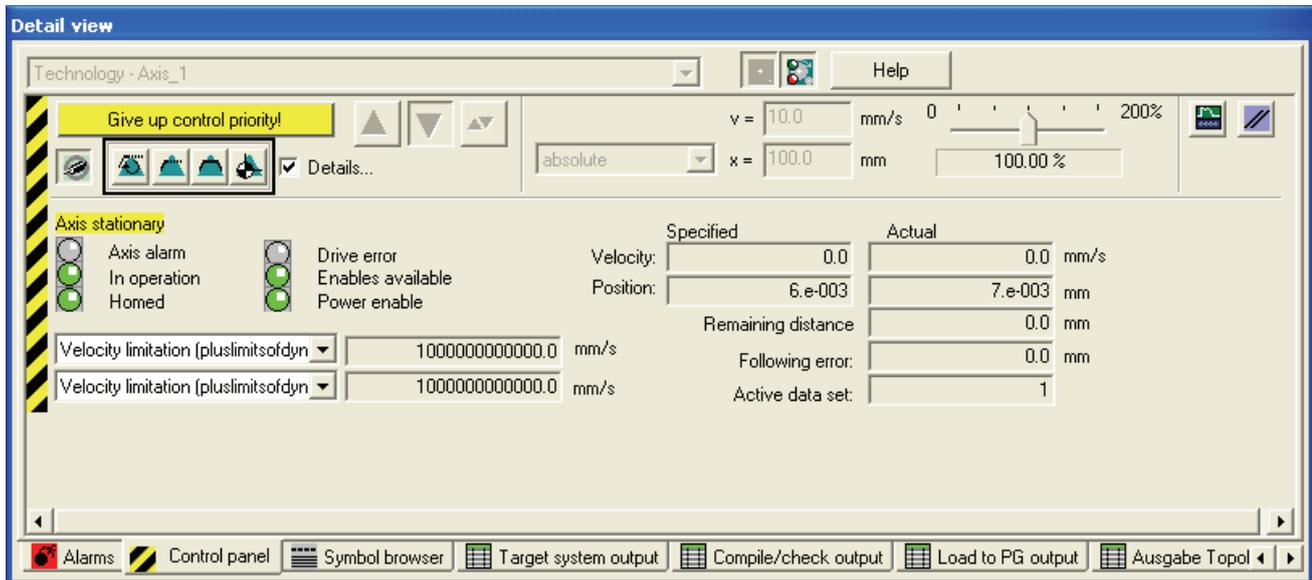
Procedure

Once the drive infeed is active, the axis control panel can be used to operate the axes.

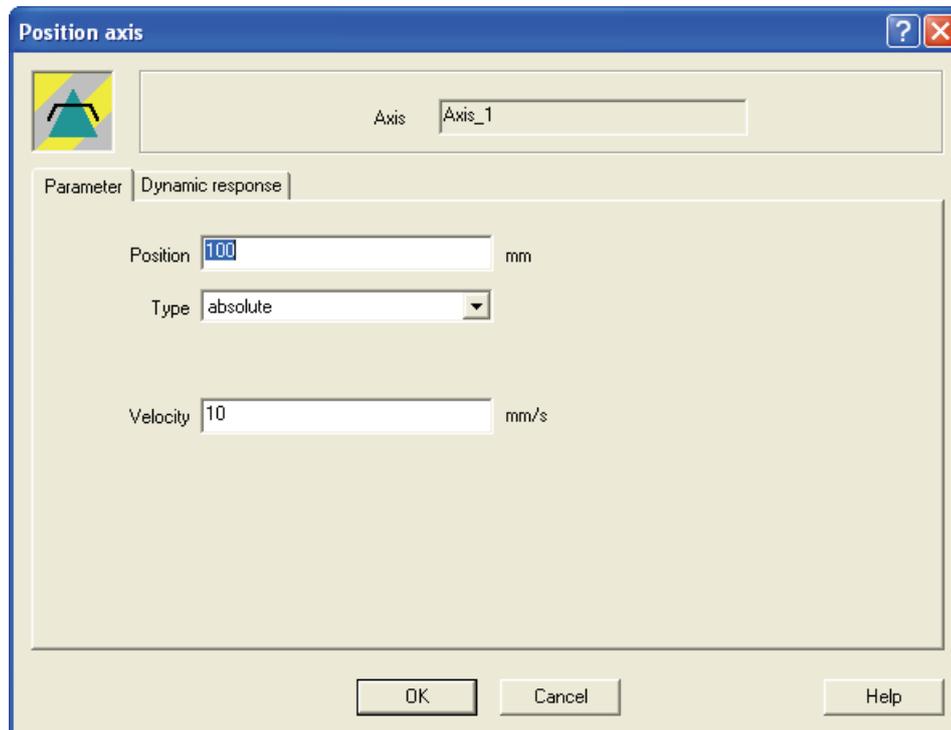
The axis control panel buttons can be used to invoke the following functions:

Button	Function
	Set axis enable.
	Select the operating mode of the axis:
	Speed-controlled operation
	Position-controlled operation
	Absolute or relative positioning
	Homing
	Start from the control panel the motion set for the axis.
	Stop the set axis motion.

Depending on the selected operating mode of the axis, various parameters for the axis motion can be specified in an additional input window.



Example: Positioning axis



3.8 Creating the user program

3.8.1 Using technology functions

The user program is used to trigger the axes in cyclic operation of the Technology CPU. Technology functions can be used to trigger the technology objects, such as axes, output cams, external encoders, measuring probes, etc.

The individual motions of the axes are programmed by calling the appropriate technology function module in the S7 user program in the correct sequence.

Sample programs in the Internet

Executable sample programs with graphical user interface for the technology CPU are available for download in the "Applications and Tools" area on the Internet (<http://support.automation.siemens.com>).

3.8.2 Special considerations for the use of an Active Line Module

Special considerations

To enable an axis using the FB 401 "MC_Power", the enable for the infeed must have already been set on the drive system.

You usually enable the Smart Line Module by means of an integral hardware contact on the module.

Enable for the Active Line Module, Basic Line Module, and specific applications of the Smart Line Module must be transferred to the infeed via PROFIBUS using control information. A block is available for this purpose on the Internet (<http://support.automation.siemens.com/WW/view/en/21971603>) for integration in your user program where it carries out the enable of the infeed.

Basic functions

4.1 Encoder settings

4.1.1 Encoder configuration (overview)

Principle

The supported encoder types depend on the device. You will find more detailed information in the supplementary descriptions, or in the manuals for the SINAMICS S120 and the drives.

The encoder is configured in S7T Config in two stages:

1. Set the encoder type when you configure the drive.
2. Set selected dependent encoder parameters, such as number of data bits, resolution etc. when you configure the axis.

4.1.2 Characteristic values for encoders

Encoder actual values

In the message frame between the drive and PLC, two encoder actual values are used to transmit the encoder position - the "cyclical actual value" Gn_XIST_1 ($n = 1$ or 2 , number of the encoder), and the "absolute actual value" Gn_XIST_2 ($n = 1$ or 2 , number of the encoder).

Cyclical actual value: Gn_XIST_1

In the "cyclical actual value" Gn_XIST_1 (n = 1 or 2, number of the encoder), the incremental change in position of the encoder is transmitted to the PLC. The drive simply evaluates the counting pulses of the encoder, and generates the "cyclical actual value" from them.

As soon as the drive control unit is connected to the supply voltage, the value zero is always transmitted via the "cyclical actual value".

The "cyclical actual value" Gn_XIST_1 is always filled by the drive unit, irrespective of whether an absolute encoder or an incremental encoder is being used.

Note

The data bits of the "cyclical actual value" Gn_XIST_1 (n = 1 or 2, number of the encoder) must correspond to the structure of the encoder actual value that is configured in S7T Config. Otherwise, the position information transferred from the encoder to the PLC will be incorrectly interpreted by the technology CPU.

Absolute actual value: Gn_XIST_2

Non-cyclical encoder values are transmitted in the "absolute actual value" Gn_XIST_2 (n = ...). These values must be requested by the PLC prior to transmission.

The following values may be requested by the PLC via the axis message frame:

- Absolute value of the encoder if an absolute encoder is being used.
- Synchronization position when a synchronization mark (e.g. reference mark) is overshoot, and requested synchronization function (e.g. on-the-fly homing).
- Measurement position when a measuring input on the drive is triggered, and a measurement function is requested.

The "absolute actual value" is not described with valid values which can then be evaluated in the PLC until the drive has executed the requested function.

Example:

The position value of an absolute encoder is set in the PLC as follows:

1. The PLC uses a command to request the absolute value of the encoder from the drive unit.
2. The drive unit reads the absolute value from the encoder.
3. The absolute value of the encoder is returned by the drive unit in the "absolute actual value" Gn_XIST_2 (n = 1 or 2, number of the encoder) to the PLC.
4. The PLC fills the position value of the axis with the reported absolute value of the encoder.

All other position changes of the axis are now reported to the PLC via the "cyclical actual value" Gn_XIST_1 (n = 1 or 2, number of the encoder) of the encoder.

Note

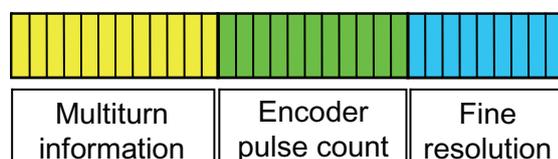
The data bits of the "absolute actual value" Gn_XIST_2 (n = 1 or 2, number of the encoder) must correspond to the structure of the encoder actual value that was configured in S7T Config. Otherwise, the position information transferred from the encoder to the PLC will be incorrectly interpreted by the technology CPU.

4.1.3 Structure of the encoder actual values

Structure of the encoder actual value

The following information is contained in the encoder actual values of the "cyclical actual value" Gn_XIST_1 (n = 1 or 2, number of the encoder), and the "absolute actual value" Gn_XIST_2 (n = 1 or 2, number of the encoder):

- Multiturn information (only with Gn_XIST_2)
- Encoder pulse count
- Fine resolution



NOTICE

The position of the data in the encoder actual value is not fixed; it depends on the values set for the encoder pulses per revolution and the fine resolution.

Multiturn information (parameter 421 in the drive)

The multiturn information contains the number of full encoder revolutions.

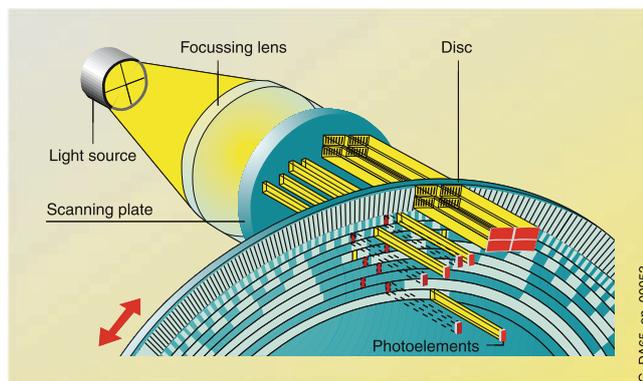
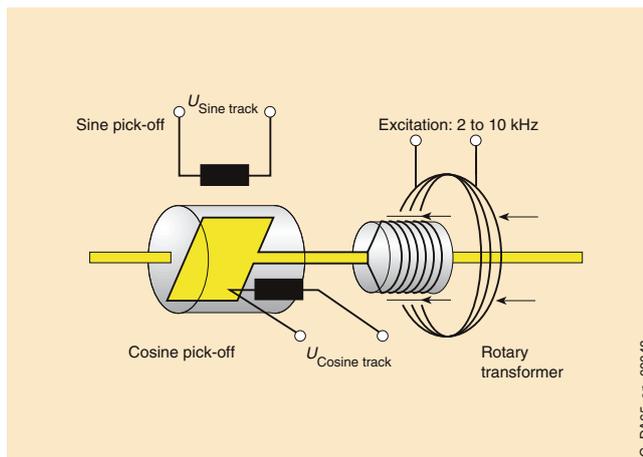
With each complete revolution of the encoder, the multiturn information is incremented by one. If the maximum data width of the multiturn information is achieved, the encoder actual value is reset to zero.

Encoder pulses per revolution (parameter 408 in the drive)

The encoder pulses per revolution is the characteristic parameter of the encoder. It defines the number of encoder tallies per revolution. For analog encoders, it specifies the number of sine / cosine oscillations per revolution. Optical encoders have tallies which are etched on a sheet of glass. The greater the number of encoder pulses per revolution, the higher the resolution of the encoder.

Sometimes the encoder data gives the encoder resolution (e.g. 12-bit resolution), rather than the number of tallies. The encoder pulses per revolution are calculated as follows:

$$\text{Encoder pulses per revolution} = 2^{\text{resolution}}$$



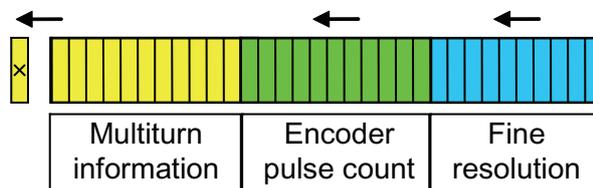
Method of functioning: photoelectric scanning

Fine resolution (parameter 418 / Parameter 419 in the drive)

Encoders can provide much more precise information via their internal sampling mechanism (sine / cosine oscillations, sub-sampling on a etched pane of glass). These can be evaluated by the drive unit, and transferred to the PLC as a fine resolution.

The encoder actual values that can be transferred from the drive to the PLC are limited to 32-bit, however. If, for example, a standard multiturn encoder with a 12-bit (4096) multiturn resolution and an 11-bit (2048) encoder resolution is used, there will be just $32-12-11 = 9$ bits (512) remaining in the encoder actual value for transferring the fine resolution.

If a greater fine resolution is to be transferred in the encoder actual value, the multiturn resolution of the encoder actual value is reduced; although this increases the precision of the encoder, it does reduce the encoder's absolute measuring range.



With the technology CPU, the fine resolution for the cyclical actual value (Gn_XIST_1) is to be set as a multiplication factor of the cyclical actual value. The factory setting of 11 bits is correct for all standard Siemens motor encoders. It does not normally have to be changed.

The multiplication factor of the absolute actual value (Gn_XIST_2) is the fine resolution of the absolute actual value. The factory setting of 9 bits is correct for all standard Siemens motor encoders and does not have to be changed.

The multiplication factor of the absolute actual value is usually smaller than the multiplication factor of the cyclical actual value, as there is more multiturn information to be transferred in the absolute actual value (Gn_XIST_2).

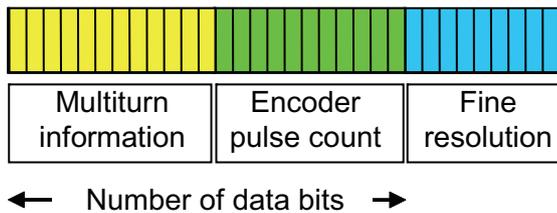
If an incremental encoder is used, the absolute actual value (Gn_XIST_2) is structured exactly as the cyclical actual value (Gn_XIST_1). The multiplication factor of the absolute actual value (Gn_XIST_2) is then irrelevant.

Number of data bits

When you configure an axis in S7T Config, you must specify the "number of data bits" for the encoder.

The "number of data bits" corresponds to the proportion of user data of the 32-bit wide encoder actual value, and is calculated from the sum of the data bits for the encoder and multiturn resolutions.

To display the position correctly, the values set in S7T Config must agree with the values configured in the drive.



Note

In firmware version 4.1 or later, the values from the drive can be transferred to the axis configuration at the press of a button in S7T Config.

4.1.4 Encoder types

Encoder type - incremental encoder

Incremental encoders output the value zero after the supply voltage has been interrupted. Axes with incremental encoders must be rereferenced after each voltage interruption.

Encoder type - absolute encoder

Absolute encoders can also provide the absolute position value after the supply voltage of the drive control unit has been interrupted. This must be requested for each encoder function from the PLC to the drive unit.

Special features of absolute encoders

The following selection possibilities are available in the "Axis configuration - Encoder assignment" dialog for the selection of an absolute encoder:

- Absolute value encoder:

In this case, the total number of overflows of the absolute actual value will not be saved when the technology CPU is switched off.

At the next switch on, the actual position value will be formed only from the absolute actual value that the converter passed to the technology CPU in Gn_XIST_2.

For a multiturn resolution of 4096 and a leadscrew pitch of 10 mm/revolution, this always produces a value that lies between 0 m and approx. 40 m.

This setting of the absolute value encoder is normally used for encoders for rotary axes (modulo axes). For this setting, the complete traversing area must be covered by the absolute value encoder.

- Absolutely cyclic absolute encoder

In this case, overflows of the multiturn information will be saved in the remanent memory area of the technology CPU on shutdown and will be used to calculate the actual position value at the next start up.

This setting must be made if the absolute encoder with its multiturn resolution does not cover the total traversing range of the axis, and it is possible for the multiturn information to overflow within the traversing range. Cyclical absolute should be selected especially for the resolver encoder structure.

4.1.5 Encoder mode

Different protocols are used to transfer the encoder data between the encoder and the drive. These protocols depend on which encoder is used.

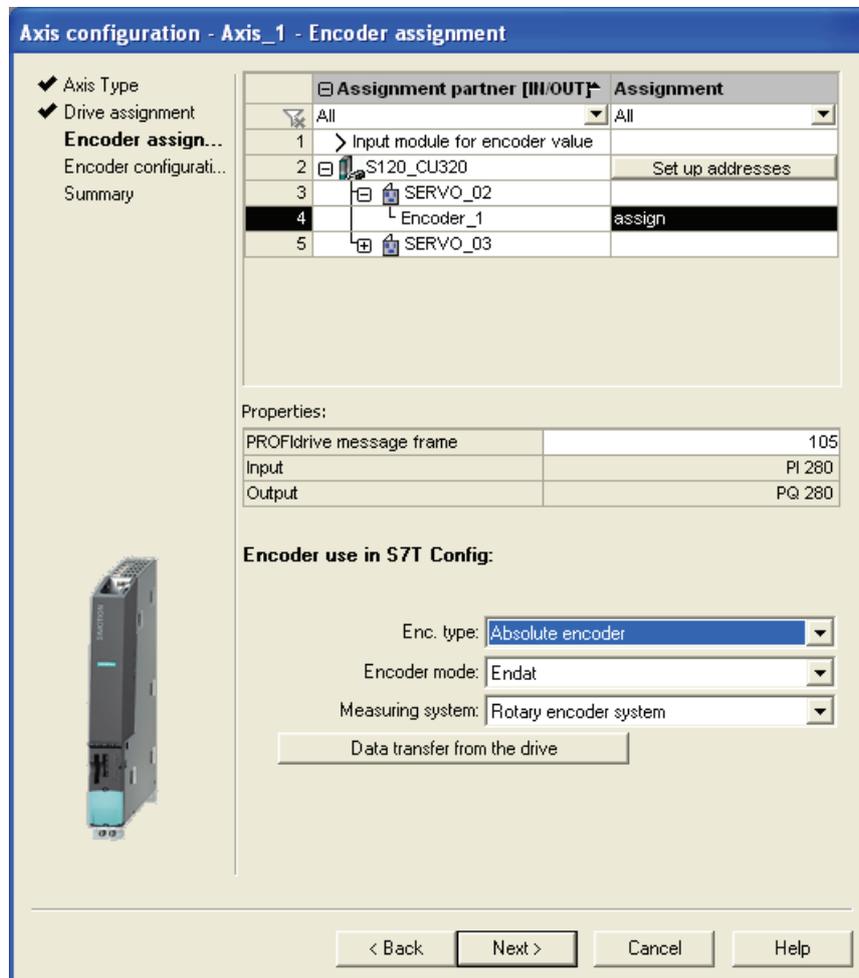
The required encoder mode can be found in the technical documentation for the encoder.

4.1.6 Setting encoder parameters in the technology

Procedure

When you configure an axis or an external encoder, you set the encoder data in the relevant dialog fields.

1. Select the encoder type, the encoder mode, and the measuring system.



Click "Data transfer from the drive" to transfer the correct encoder data from SINAMICS. In this way you can ensure that the data is consistent between the drive and the technology.

2. Click "Next".

Axis configuration - Axis_1 - Encoder configuration

- ✓ Axis Type
- ✓ Drive assignment
- ✓ Encoder assignment
- Encoder config...**
- Summary

Reference variables

Encoder pulses per rev.: 4096

Fine resolution: 0

Fine resolution of absolute value in Gn_XIST2: 0

Data width of absolute value without fine resolution: 24

Additional settings

Tolerate the encoder failure when it is not involved in the closed-loop control

Activate encoder monitoring

< Back Next > Cancel Help

Enter the encoder-specific data, such as the number of encoder pulses, the number of data bits and the multiplication factors.

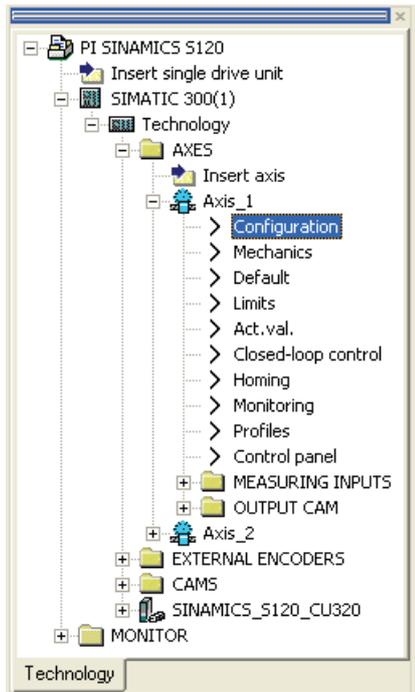
Note

If the value zero has been set for the multiplication factors, the factory settings (11-bit for Gn_XIST_1 and 9-bit for Gn_XIST_2) will be used.

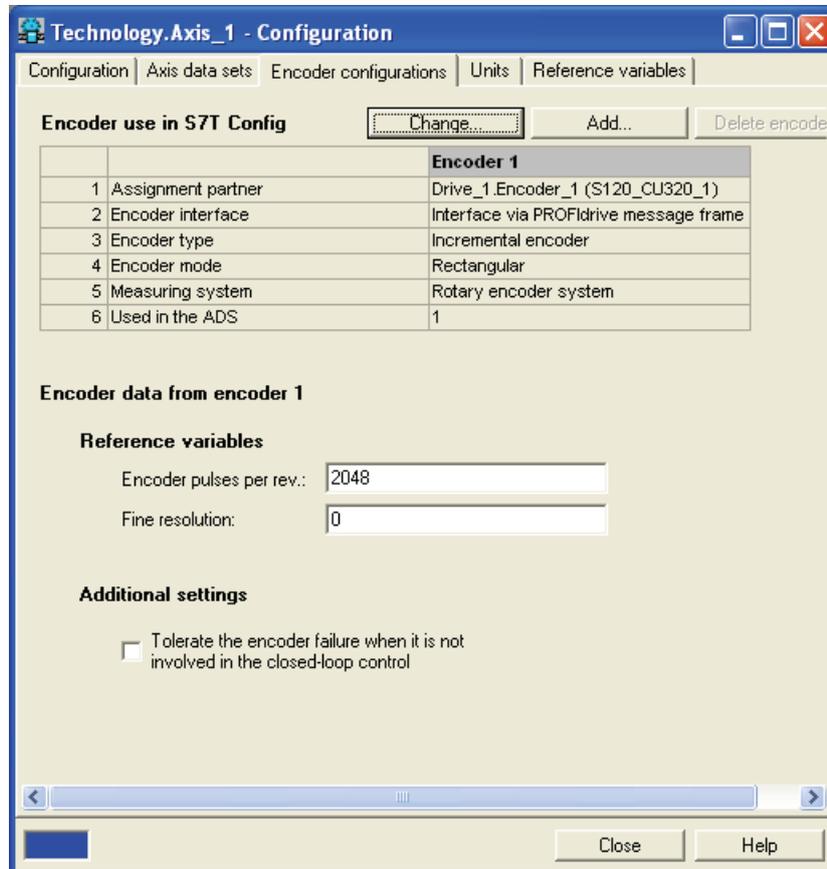
4.1.7 Display of the encoder parameters in S7T Config

Display of the encoder parameters

To display the encoder data, open the folder "\\Technology\Axes\Axis_1" for the "axis_1" in S7T Config and double-click on "Configuration" to open the dialog box for configuration of the axis.



The "Encoder configurations" area of the "Configuration" dialog box contains the encoder settings for the axis.



List of encoder parameters to be set

A current list of the encoder parameters to be set is available for download on the Internet in the "Applications and Tools" area at the following address:
(<http://support.automation.siemens.com/WW/view/en/27038754>)

4.2 Homing

4.2.1 Homing possibilities

Introduction

The "Homing" function is used to align the actual value of an encoder with the position of the machine after the supply power is switched on or after the replacement of the encoder.

Where as incremental encoders must be homed after each restart of the system, absolute encoders normally only need to be homed after a replacement of the encoder or the twisting of the spindle without encoder.

The following homing possibilities exist:

- Active homing
- Passive homing
- Direct homing

Active homing

A special traversing motion is executed for this type of homing. Any running active motion command will be cancelled.

The following homing modes can be set in S7T Config:

- Homing with reference cam and encoder zero mark
- Homing only with reference cam
- Homing only with encoder zero mark
- Correct position value
- Correct internal axis coordinate system

Passive homing

The homing does not cause any motion of the axis in this case. Any running motion commands will not be affected.

The following homing possibilities exist:

- Homing with reference cam and encoder zero mark
- Homing only with reference cam
- Homing with only encoder zero mark.

Direct homing

The axis position will be set without taking account of the reference cam (encoder zero mark or reference cam). If the home position is to be exactly assigned to a mechanical position, the axis must be stationary during the action.

Correct position value

An offset value will be subtracted from the current axis position.
Any current motions and the homing will not be affected.

Correct internal axis coordinate system

An offset value will be subtracted from the current position of the base or the superimposed coordinate system. Any current motions and the homing will not be affected.

4.2.2 Example: Active homing with homing output cam and encoder zero mark

Introduction

If in the complete travel area, the encoder has several zero marks or the passes through the zero mark several times, a second signal will be used for the unique homing. A homing output cam supplies this supplementary information. The homing function for the next zero mark passage will be enabled when the homing output cam is reached.

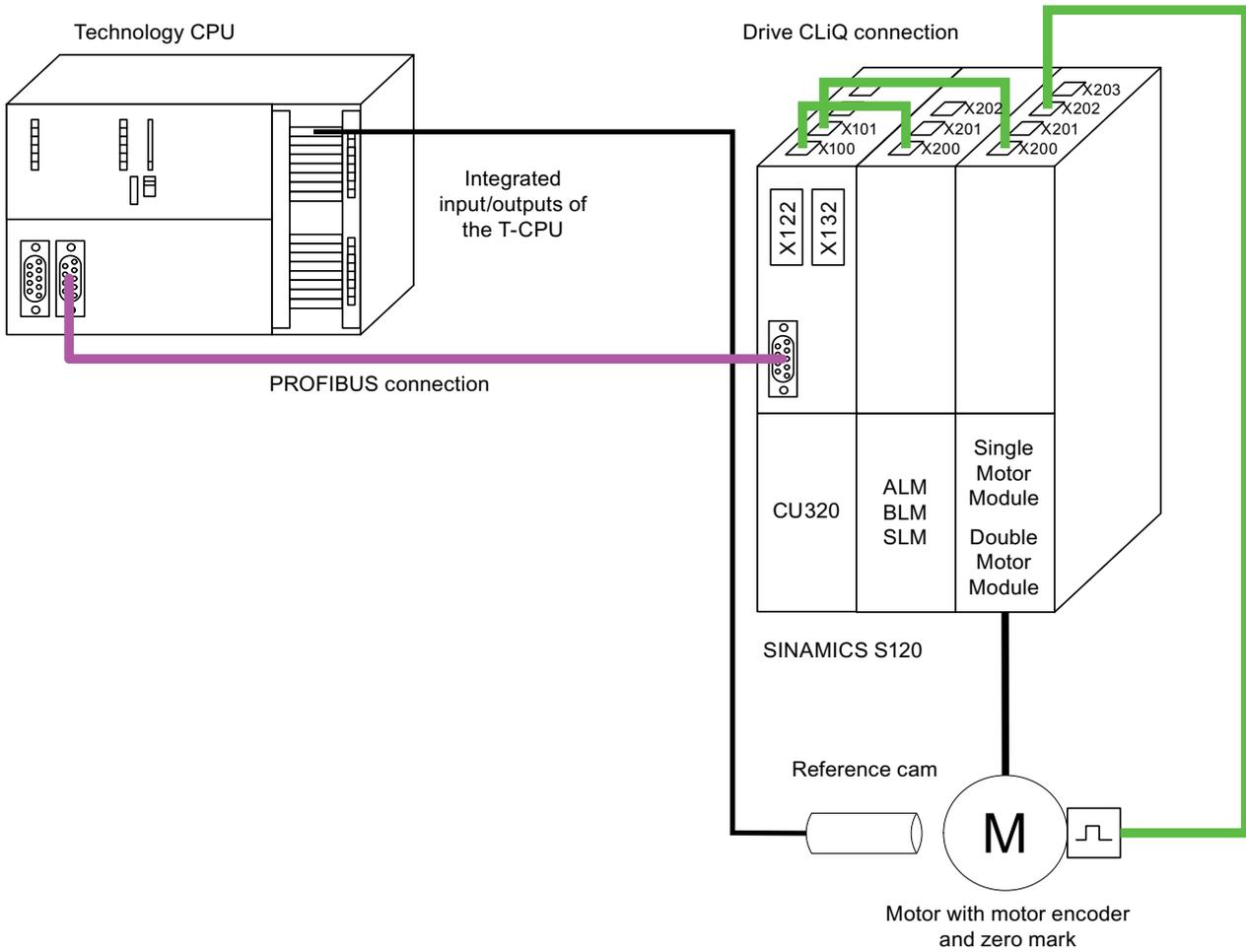
A typical application case is an axis with a multi-pole resolver motor encoder. Only homing with home position switches and zero marks should be considered for a multi-pole resolver.

Operational sequence

The axis searches in the specified direction for the reference point. When the BERO signal is attained, a switch will be made from the home position approach velocity to the home position reduced speed. After leaving the BERO, homing will be made to the next detected zero mark of the encoder.

Hardware configuration

The homing BERO is connected to a free SIMATIC peripheral input (either to an integrated input of the Technology CPU or to a distributed input (e.g. ET 200M) on the DP(DRIVE)).



Setting of the integrated inputs in the Technology CPU

In the example shown here, the digital inputs integrated in the Technology CPU are to be used to fetch the homing output cam (BERO). The hardware address of these integrated inputs are required for the settings of the homing mode in the technology. You set these during the configuration of the Technology CPU in HW Config.

The screenshot shows the HW Config software interface for a SIMATIC 300(1) system. The rack configuration table is as follows:

Slot	Module
1	
2	CPU 317T-2 DP
X1	MPI/DP
3	Technology
X3	DP(DRIVE)
X11	IO(Technology)
4	
5	
6	
7	

The hardware address table is as follows:

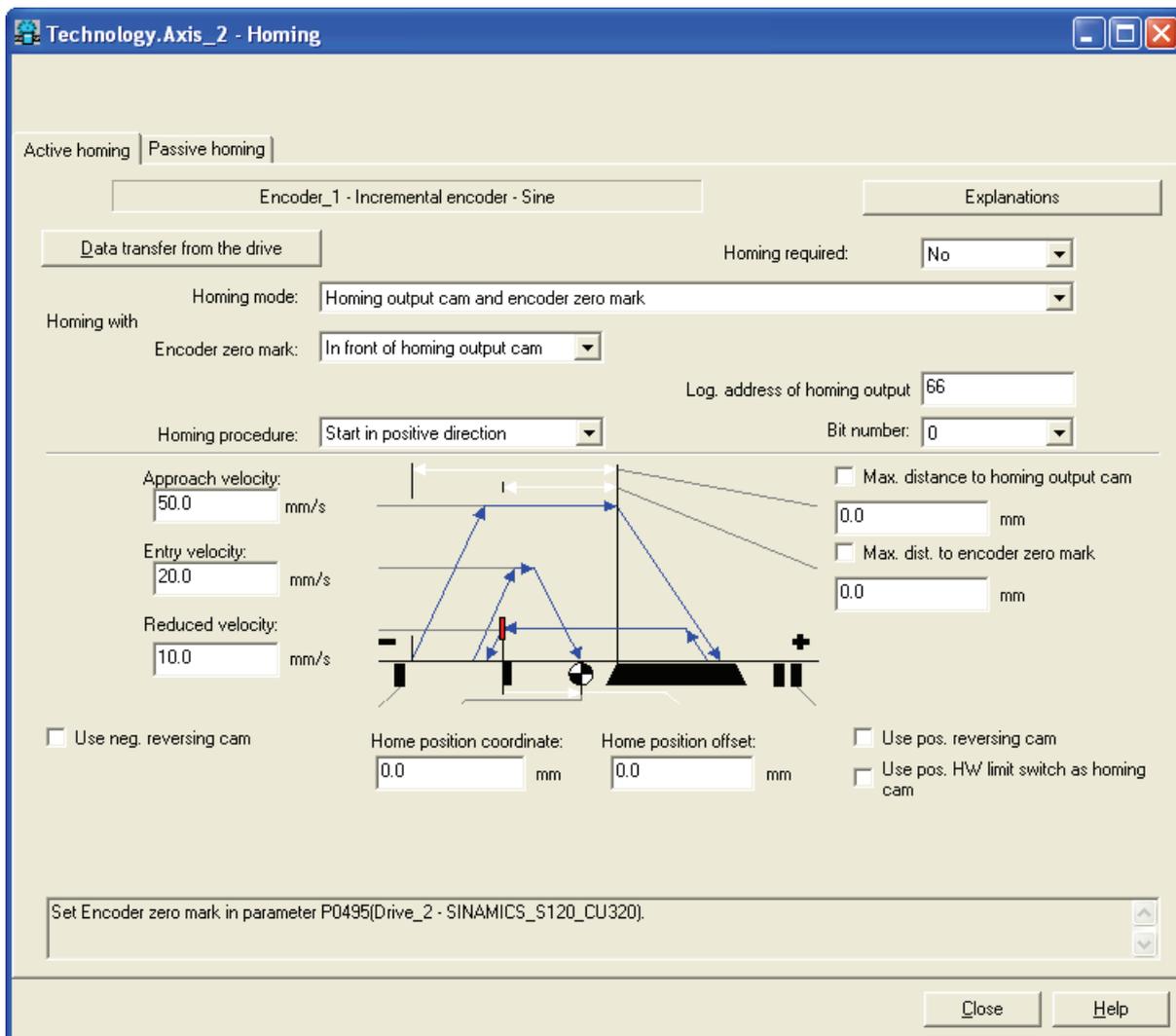
Slot	Modul...	Order num...	Firmw...	MPI ...	I address	Q address	I ...	Q...	Comment
1									
2	CPU 317T	6ES7 317-6	V2.6	2					
X1	MPI/DP			2	8191*				
3	Technology		V4.1.1						
X3	DP(DRIVE)				1023*				
X11	IO(Techno...				66	66			

In the shown example, the hardware address of the first integrated digital input is byte 66 and bit 0.

Setting of the homing mode in the technology

As next step, activate the "Homing" function and enter the address of the homing output cam.

1. To activate the "Homing" function, switch in the S7T Config project navigator to the "\\Technology\\Axes\\Axis_2\\Homing" dialog box.



2. In the "Homing" dialog box, set the homing mode to "Homing output cam and encoder zero mark".

The "Encoder zero mark" selection box specifies where the encoder zero mark is located relative to the homing output cam (BERO).

3. The logical hardware address of the homing output cam (BERO) must be specified. As described above, the first integrated digital input should be used in this example. This is configured with hardware address byte 66 and bit 0.

"Start of homing procedure" specifies the approach direction (counting direction) of the Bero

4. Enter appropriate values in the "Approach velocity", "Entry velocity", and "Reduced velocity" input boxes.

This completes the configuring of the technological part of the homing function in S7T Config.

Creating the S7 user program

Use the Technology Object Manager (TOM) to create a technology data block (TO-DB), which is assigned to the homing output cam technology object. The technology data block (TO-DB) allows the functions on the associated technology object to be executed using the provided FBs. For the homing, use the FB403 MC_Home function block in your S7 program.

4.2.3 Example: Active homing using only an external zero mark

Introduction

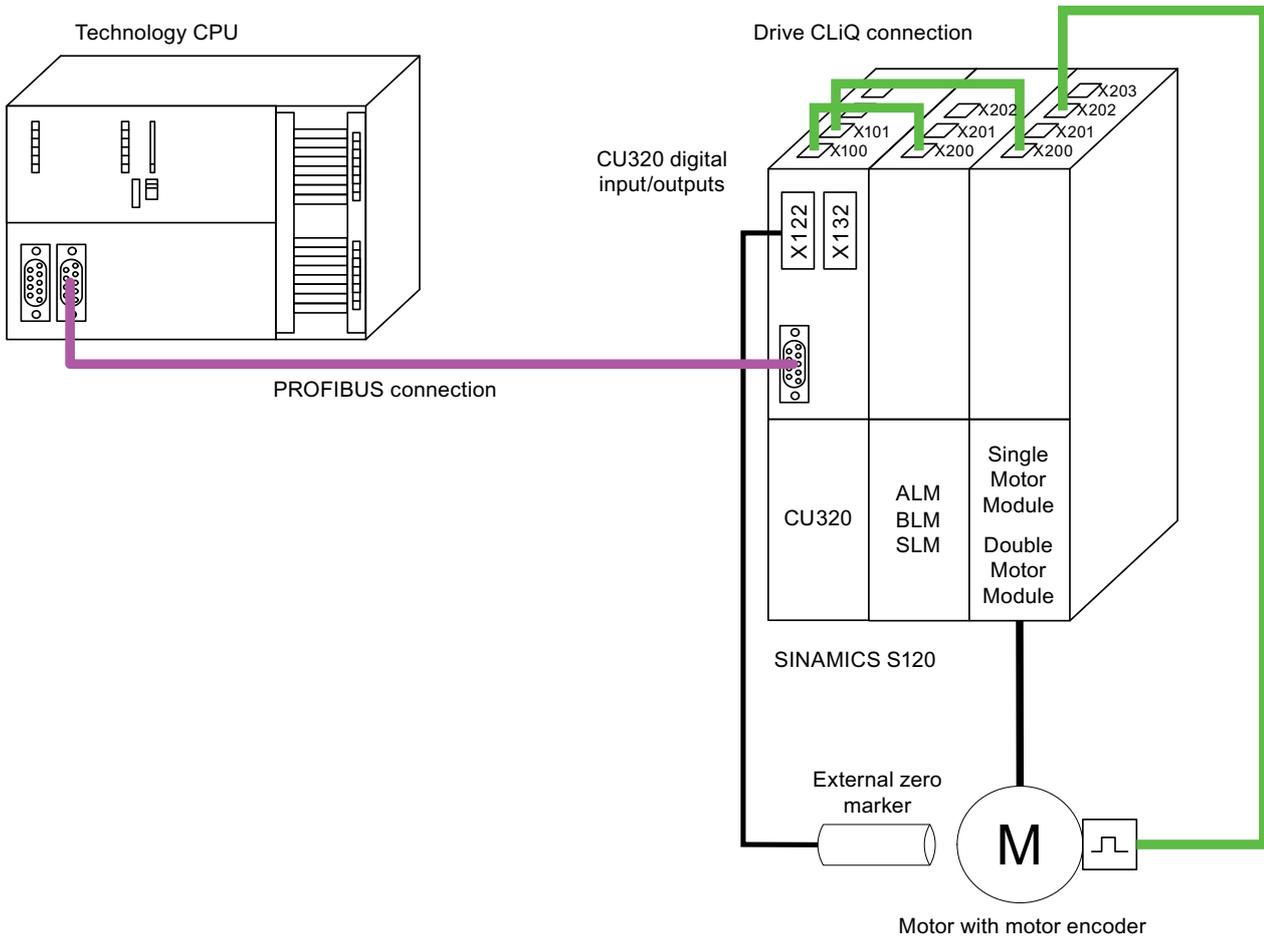
An external zero mark (Bero) should be used for homing the axis. This requires that one of the fast integrated digital inputs of the SINAMICS S120 is used. Special configuration steps must be carried out for this, and these are described below.

Operational sequence

The position is accepted when one of the defined BERO edges is passed.

Hardware configuration

A typical application example is an encoder without zero mark evaluation. An external zero mark (Bero) is used in place of the encoder zero mark. To ensure short response times, it is read indirectly via the digital inputs of the CU320.



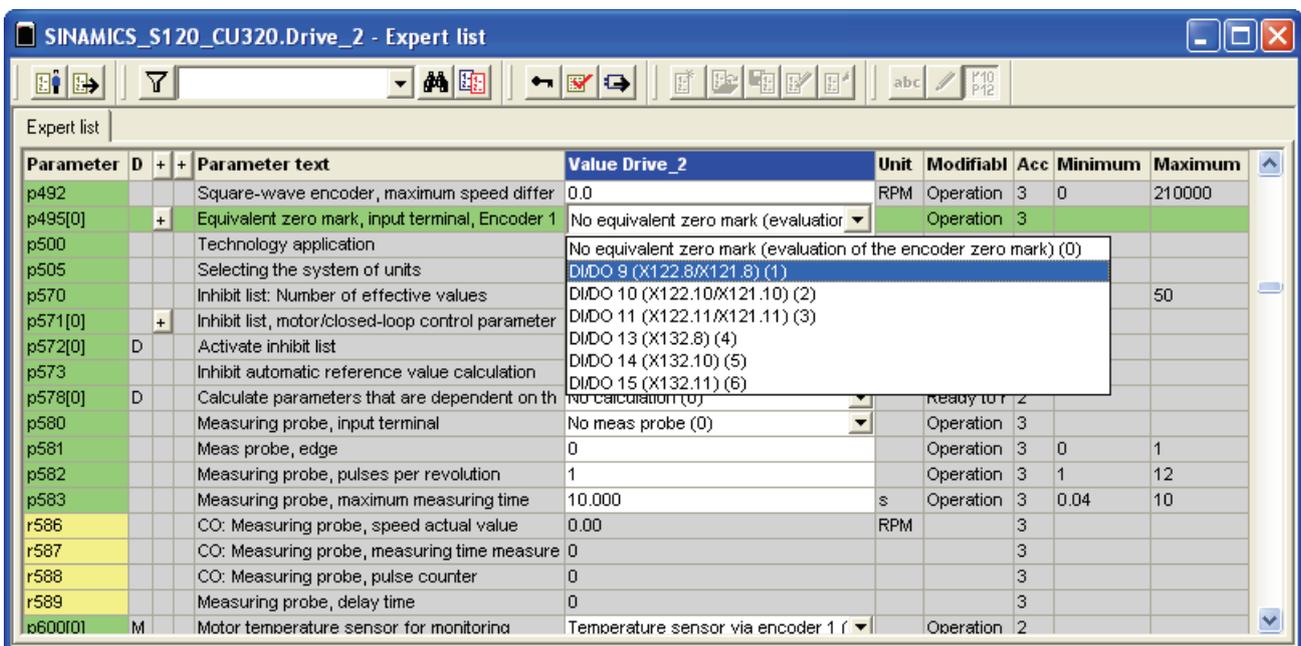
Assignment of the equivalent zero mark signal to the digital input of the SINAMICS

For homing to an external zero mark with axes on the PROFIBUS, the external zero mark must be configured as digital input on the drive. This requires that the configuration of the drive specifies which internal digital input of the CU320 is to be used to fetch the equivalent zero mark signal.

Only the fast digital inputs can be used as internal digital inputs of the CU320 for fetching the equivalent zero mark signal:

DI/DO 9	X122.8
DI/DO 10	X122.10
DI/DO 11	X122.11
DI/DO 13	X132.8
DI/DO 14	X132.10
DI/DO 15	X132.11

To parameterize the CU 320 input for fetching the equivalent zero mark signal, switch in the S7T Config project navigator to the appropriate drive. In the example shown here, to the dialog box: "\\Technology\SINAMICS_S120\Drives\SERVO_02. Start the expert list with a right mouse click on the drive and selecting Expert > Expert List in the submenu. Select the "p495 [0] equivalent zero mark input terminal encoder 1" parameter in the expert list and interconnect the parameter with the DI/DO 9 (X122.8) (1) input.



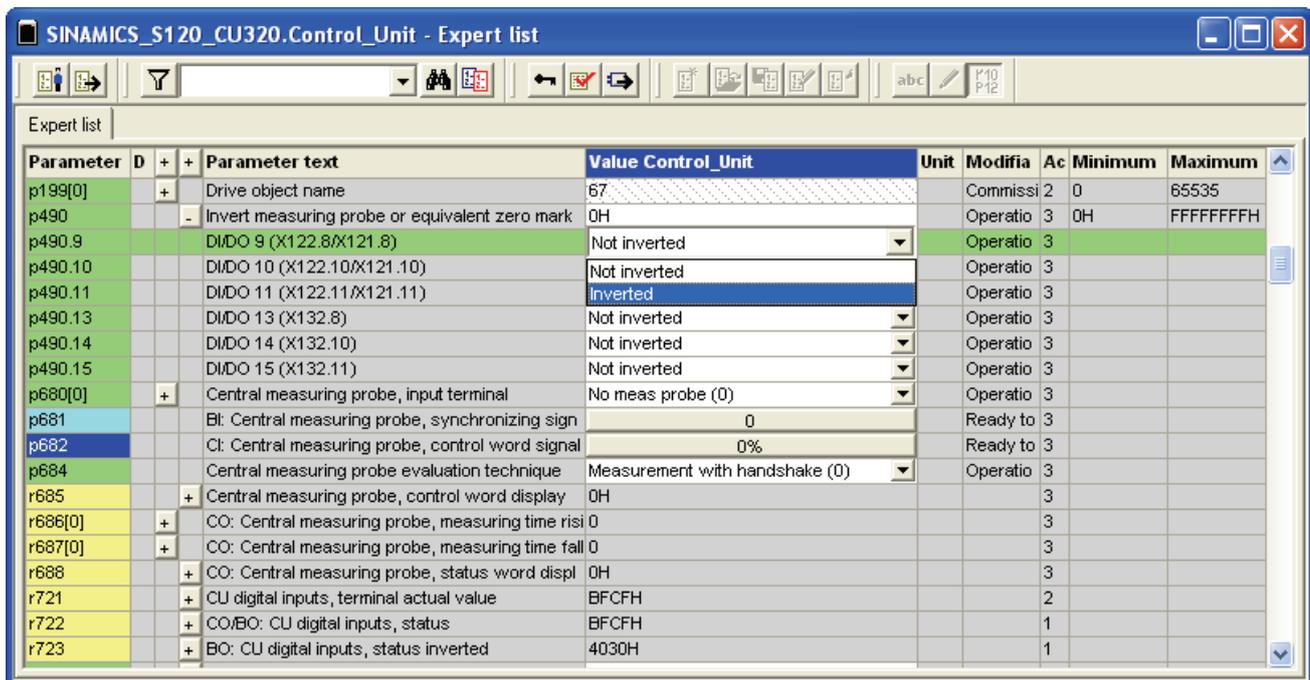
A different equivalent encoder can also be selected for the assignment of the zero mark input.

P495[0]	Encoder 1
P495[1]	Encoder 2
P495[2]	Encoder 3

Inverting the selected digital input of the SINAMICS

A general condition in conjunction with SINAMICS governs the homing only with an external zero mark. Only negative edges are permitted for the positive travel direction and only positive edges are permitted for the negative travel direction, this means that the same cam side is always used. This means that your construction circumstances may require that the BERO signal needs to be inverted.

To invert the Bero signal, switch in the S7T Config project navigator to the dialog box: "\\Technology\SINAMICS_S120\Control_Unit. Mark the "Control_Unit" entry and select **Expert list** in the shortcut menu in order to open the expert list. Parameter "p490.9 DI/DO 9 (X122.8)" allows you to invert the digital input DI/DO 9.



A separate parameter is provided for inverting each digital input that can be used to fetch the external zero mark. The following table contains the correct parameters for the selected digital input:

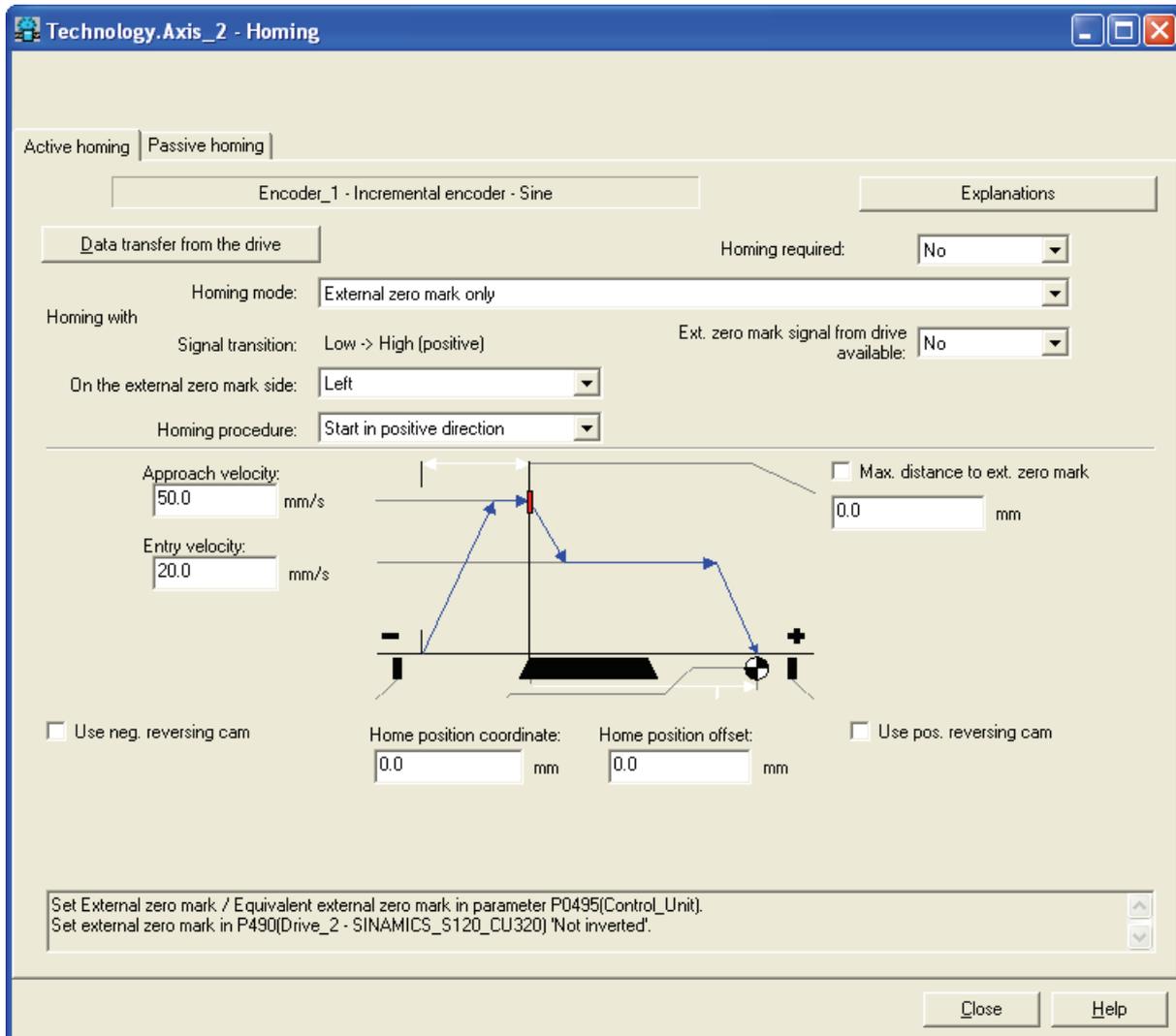
P490.9	DI/DO 9	X122.8
P490.10	DI/DO 10	X122.10
P490.11	DI/DO 11	X122.11
P490.13	DI/DO 13	X132.8
P490.14	DI/DO 14	X132.10
P490.15	DI/DO 15	X132.11

This completes the assignment of the internal digital input of the CU320 to the equivalent zero mark signal in the SINAMICS.

Setting of the homing mode in the technology

The next step is to enable the "Homing" function in the technology.

1. To activate the "Homing" function, switch in the S7T Config project navigator to the dialog: "\\Technology\Axes\Axis_2\Homing".



2. In the "Homing" dialog box, set the "Homing mode" to "External zero mark only".

The "Signal transition" selection boxes specify whether a rising or falling edge is to be evaluated to detect the Bero signal. The direction of the signal transition can be reversed by inverting the selected digital input as described above.

"On the external zero mark side" specifies on which side of the Bero the approach is made.

"Start of homing procedure" specifies the approach direction (counting direction) of the Bero

4.2 Homing

3. Enter appropriate values in the "Approach velocity", "Entry velocity", and "Reduced velocity" input boxes.

Note

Note that only negative edges are permitted for the positive travel direction, and only positive edges are permitted for the negative travel direction, which means that the same cam side is always used.

This completes the configuring of the technological part of the homing function in S7T Config.

Creating the S7 user program

Use the Technology Object Manager (TOM) to create a technology data block (TO-DB), which is assigned to the homing output cam technology object. The technology data block (TO-DB) allows the functions on the associated technology object to be executed using the provided FBs. For the homing, use the FB403 MC_Home function block in your S7 program.

4.2.4 Example for active homing with one of the external zero marks mirrored on the T-CPU.

Introduction

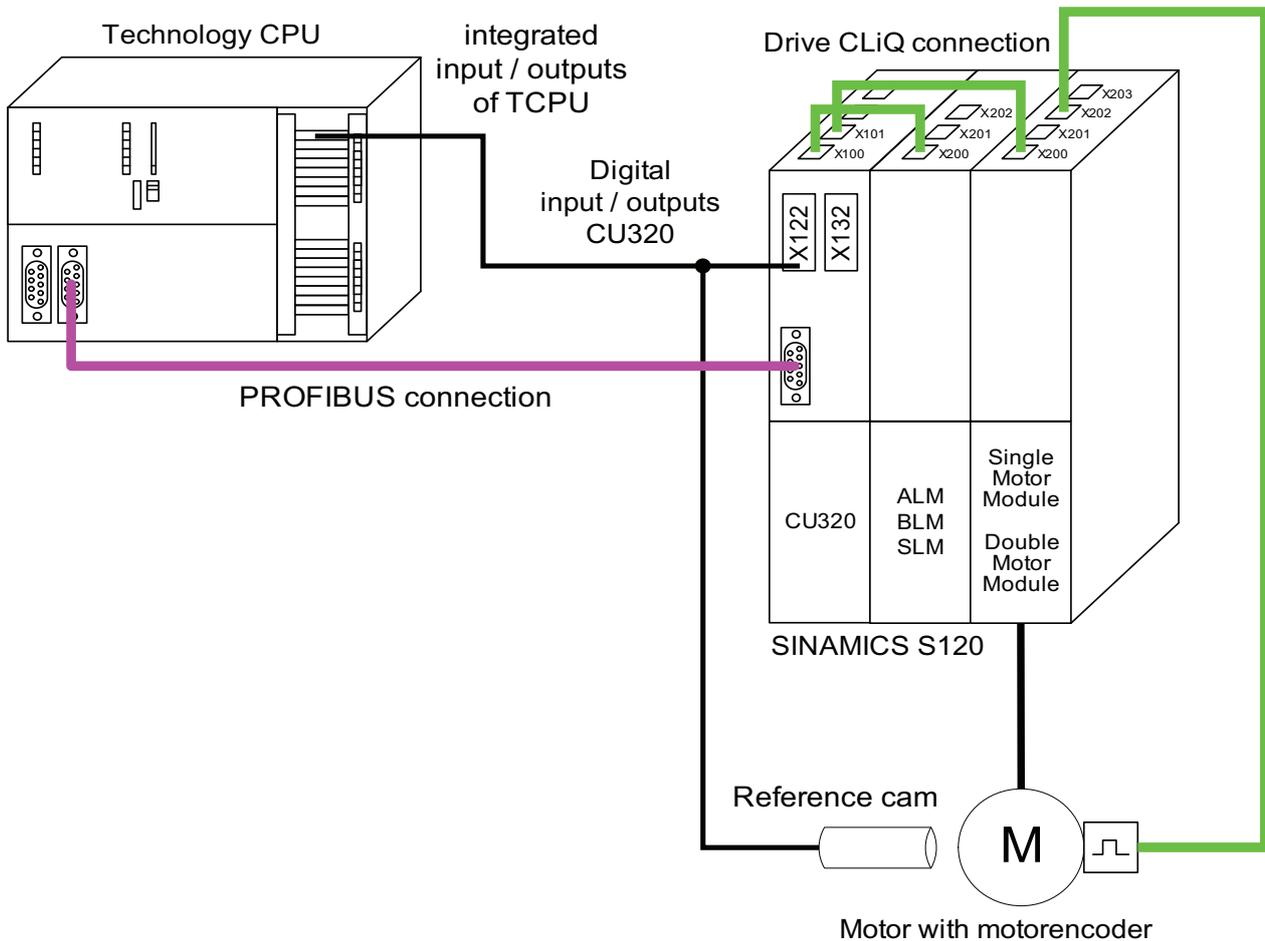
An external zero mark (Bero) should be used for homing the axis. It is therefore necessary to use one of the fast integrated digital inputs of the SINAMICS S120. In addition to the example of active homing with external zero mark only, the zero mark signal is also read into the Technology CPU.

Operational sequence

The position is accepted when one of the defined BERO edges is passed. In contrast to active homing with external zero mark only, the Technology CPU also evaluates the status of the BERO (assigned / unassigned). This allows the direction to be reversed can during homing in addition to the selected homing settings.

Hardware configuration

A typical application example is an encoder without zero mark evaluation. An external zero mark (Bero) is used in place of the encoder zero mark. To ensure short response times, it is read indirectly via the digital inputs of the CU320. The same signal is also evaluated via an integrated input on the Technology CPU.



Allocating the zero mark substitute signal to the digital input of the SINAMICS and inverting the selected digital inputs of the SINAMICS

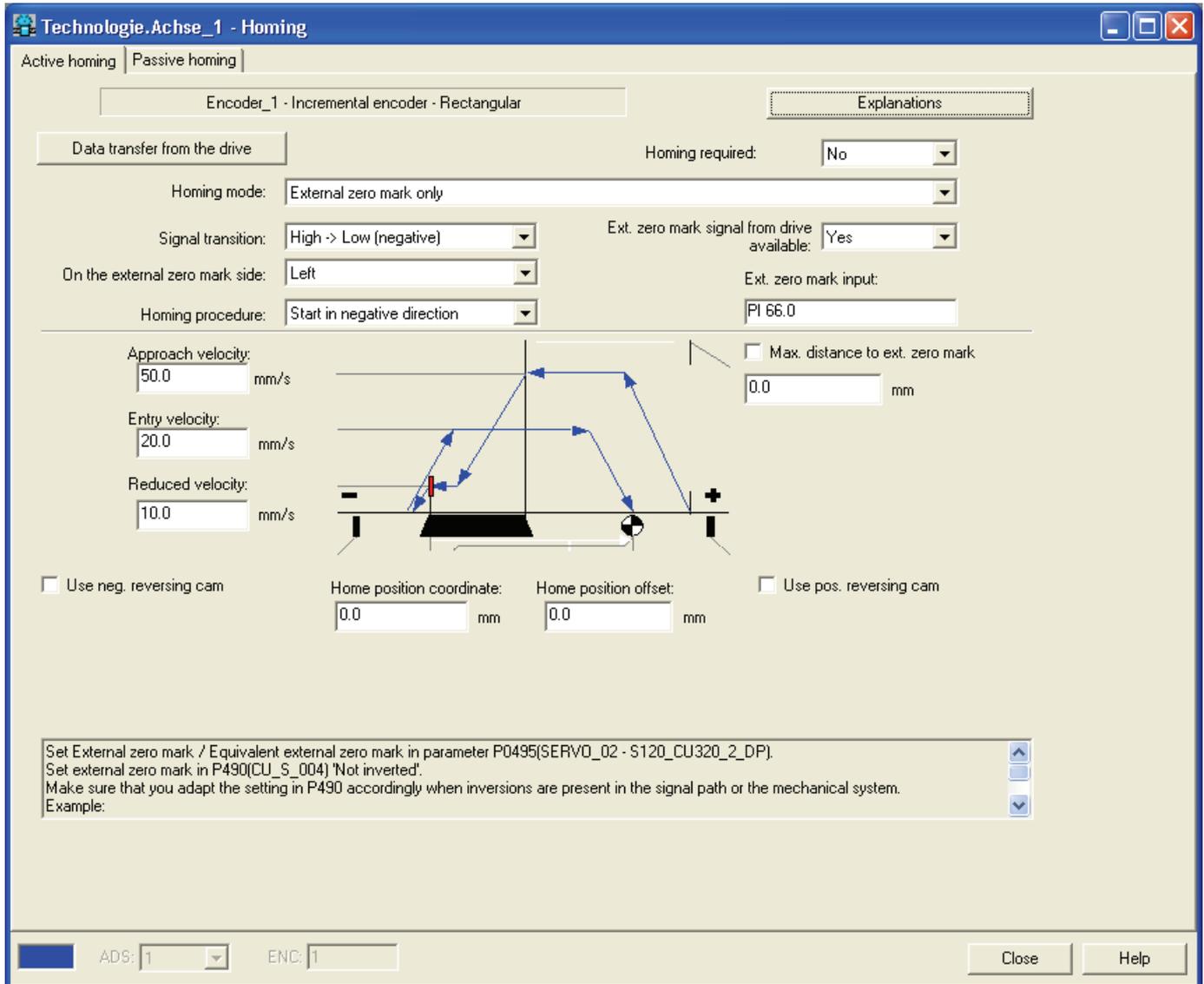
Assign the digital input of SINAMICS as a zero mark substitute signal as described in Section 4.2.3 Example of active homing with external zero mark only.

If necessary, invert the input that was used to detect the zero mark substitute signal as described in section 4.2.3 Example of active homing with external zero mark only.

Setting of the homing mode in the technology

The next step is to enable the "Homing" function in the technology.

1. To activate the "Homing" function, in the S7T Config project navigator switch to the dialog: "\Technology\Axes\Axis_2\Homing".
2. In the "Homing" dialog box, set the "Homing mode" to "External zero mark only".
3. Select "Yes" from the "Ext. zero mark signal from drive available" selection box.



The "Signal transition" selection fields specify whether a falling or rising edge is to be used to recognize the Bero signal.

"On the external zero mark side" indicates at which side of the Bero the edge will be evaluated for homing.

"Homing procedure" specifies the approach direction (counting direction) of the Bero

4. In the "Ext. zero mark input" box, enter the address of the integrated inputs of the Technology CPU from HW Config, for example PI66.0.
5. Enter meaningful values in the "Approach velocity", "Entry velocity", and "Reduced velocity" input boxes.

Note

Note that only negative edges are permitted for the positive travel direction, and only positive edges are permitted for the negative travel direction, which means that the same cam side is always used. In the dialog box for the "Homing" function, select the "Data transfer from the drive" button to preassign the input fields with the data set for SINAMICS. If you then change the settings, the necessary settings in SINAMICS will be displayed in an information box.

This completes the configuration of the technological part of the homing function in S7T Config.

Creating the S7 user program

Use the Technology Object Manager (TOM) to create a technology data block (TO-DB), which is assigned to the homing output cam technology object. The technology data block (TO-DB) allows the functions on the associated technology object to be executed using the provided FBs. For the homing, use the FB403 MC_Home function block in your S7 program.

4.2.5 Example: Active homing using only an encoder zero mark

Introduction

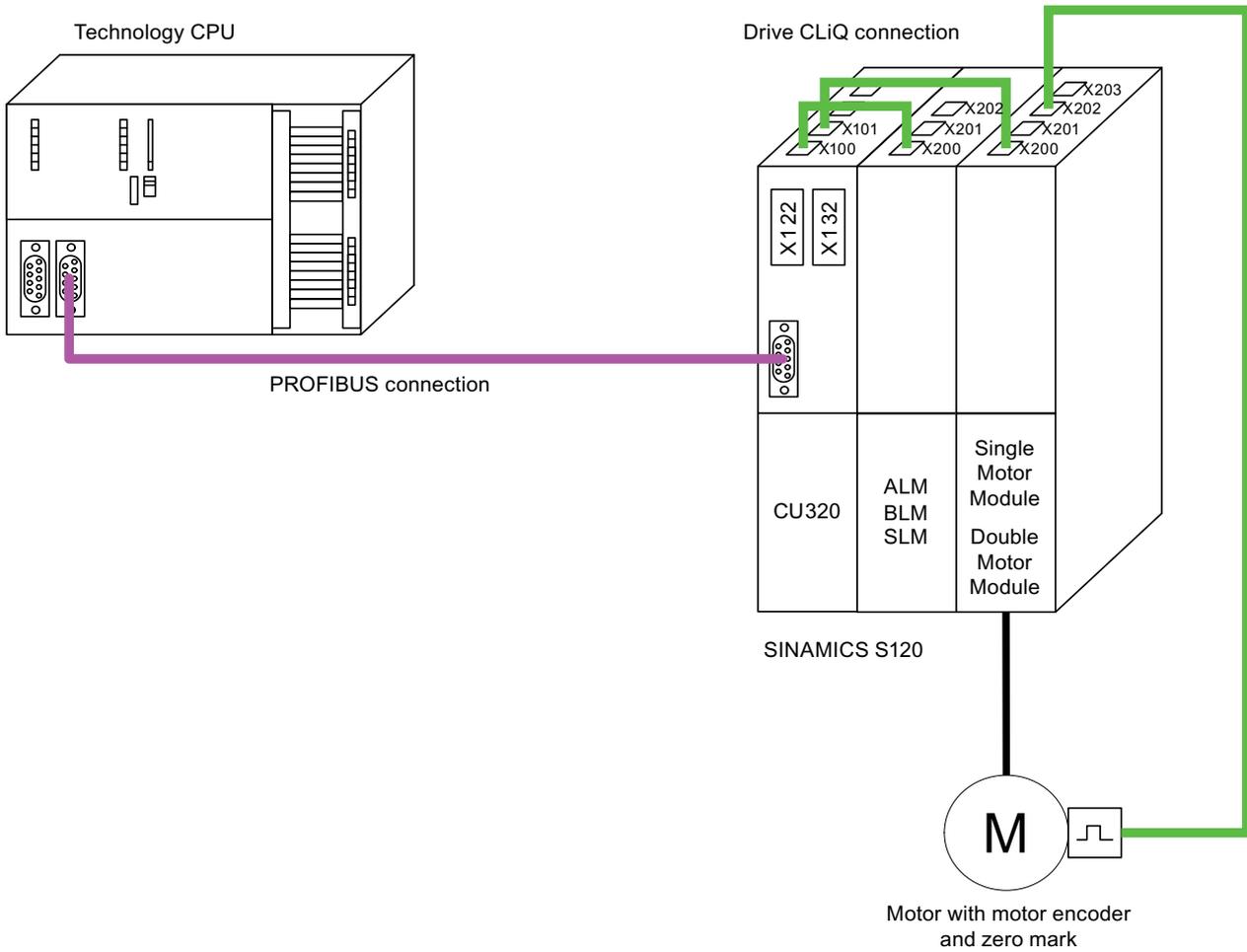
The simplest form of homing is the homing only with encoder zero mark. It is used, for example, for axes whose encoder has only one zero mark in the complete travel area of the axis. This homing command causes the axis to travel to the zero mark. Once the axis detects the zero mark, the home position offset is applied at homing entry velocity. The axis position now has the value specified in the home position coordinate.

Operational sequence

No BERO signal is required. The position is accepted at the next zero mark of the encoder.

Hardware configuration

A motor encoder with zero mark is connected to the SINAMICS S120. The evaluation can be made using the zero mark signal of the encoder, an additional homing output cam (Bero) is not required.

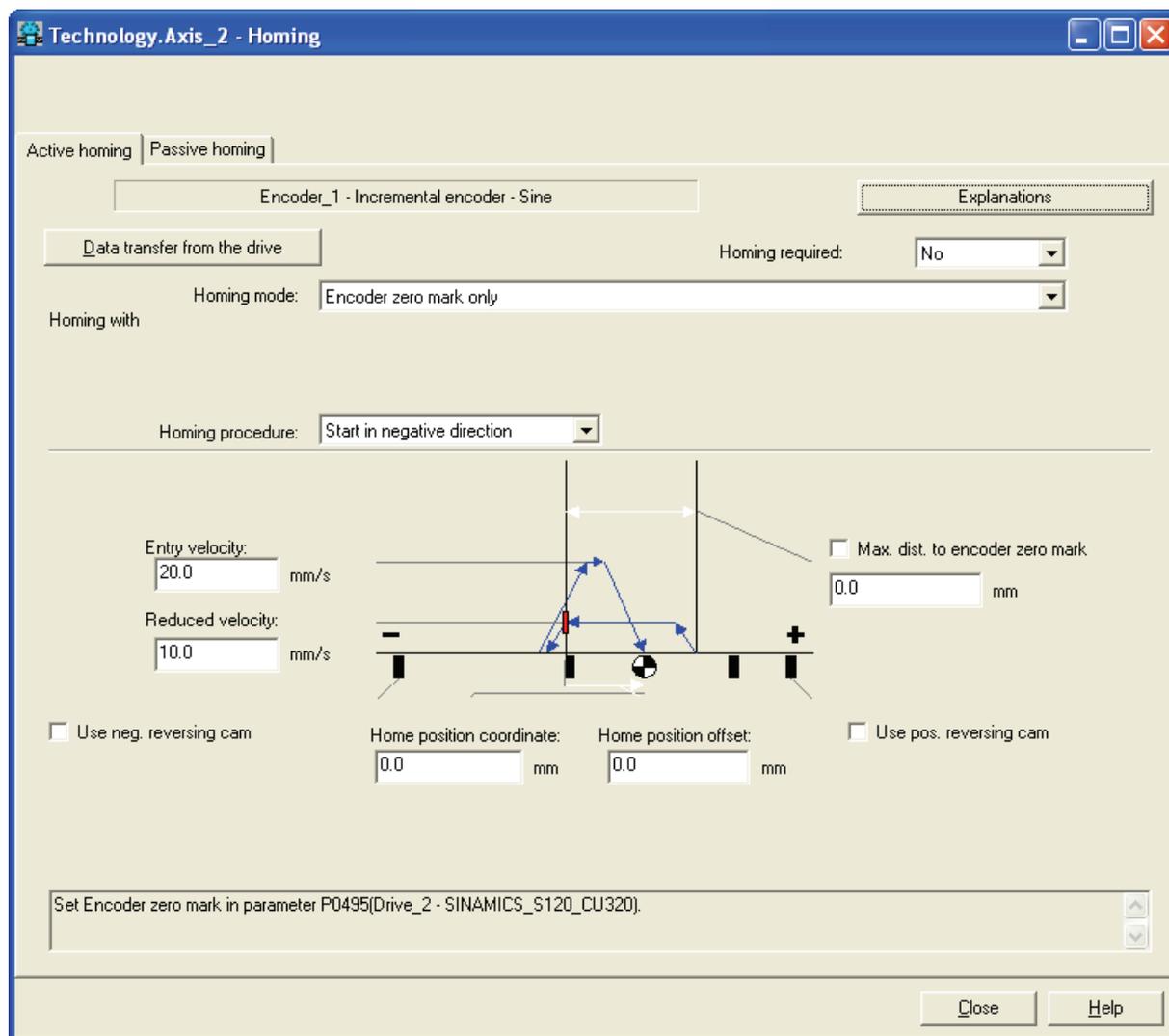


Setting of the homing mode in the technology

Because the input signal for the homing is part of the information transferred from the motor encoder, no further steps are required in the configuration of the drive.

You can start immediately by activating the "Homing" function in the technology.

1. To activate the "Homing" function, switch in the S7T Config project navigator to the dialog box: "\\Technology\Axes\Axis_2\Homing".



2. In the "Homing" dialog box, set the "Homing mode" to "Encoder zero mark only".
"Start of homing procedure" specifies the approach direction (counting direction) of the encoder zero mark.
3. Enter meaningful values in the "Approach velocity", "Entry velocity", and "Reduced velocity" input boxes.

This completes the configuring of the technological part of the homing function in S7T Config.

Creating the S7 user program

Use the Technology Object Manager (TOM) to create a technology data block (TO-DB) assigned to the homing output cam technology object. The technology data block (TO-DB) allows the functions on the associated technology object to be executed using the provided FBs. For the homing, use the FB403 MC_Home function block in your S7 program.

4.2.6 Absolute encoder adjustment with the control panel

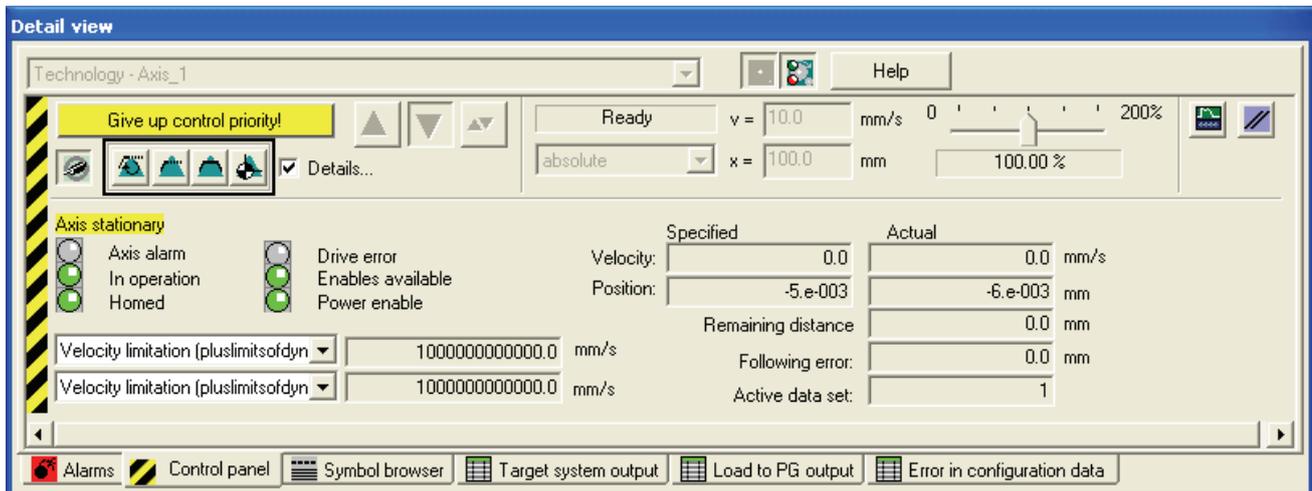
Introduction

If, because of a defect, an absolute encoder calibration must be performed if an absolute encoder must be replaced or the drive spindle without encoder has been twisted. This can be performed using the "MC_Home" command from the S7 user program or from the control panel.

The following section describes how an absolute encoder adjustment can be performed from the S7T Config control panel.

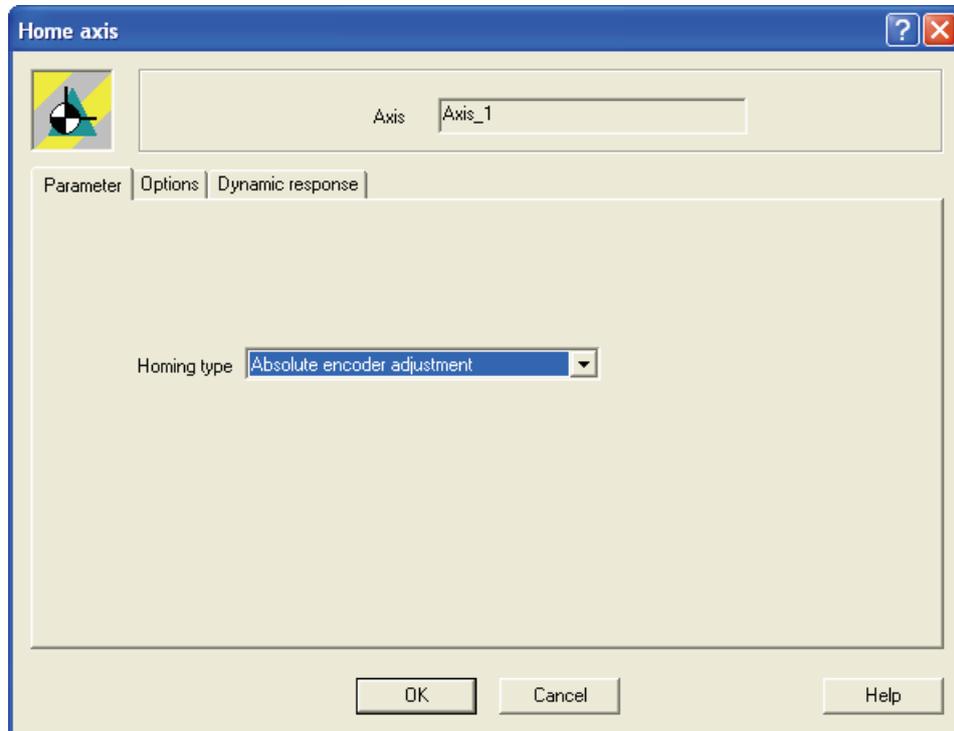
Procedure

1. Click the "Control panel" button in the "\Technology\Axes\Axis_1\Control panel" directory of the project navigator to open the control panel in S7T Config.
2. Enable the PA process image of the CPU315T-2 DP / CPU317T-2 DP. For the example, select "Axis_1" and click the "Assume control priority" button to pass the control priority to the control panel.

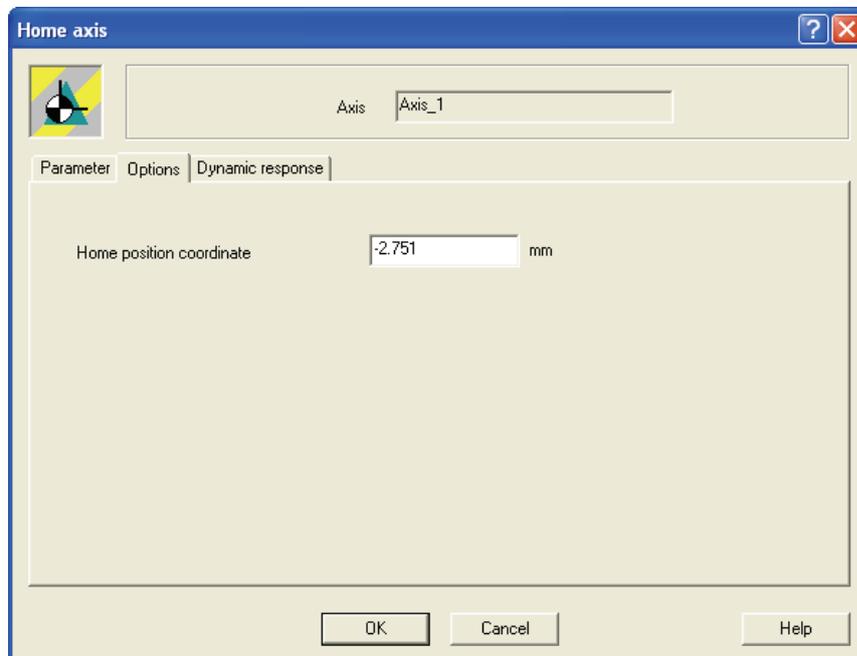


3. Enable the axis  and use "Position absolute/relative"  to move it to the absolute encoder position 0.0 mm.
4. Then click the  button to move the axis speed-controlled at slow speed until the zero position of the system is reached exactly.
5. Click the "Home axis"  function in the control panel.

- In the "Parameters" tab, set the "Absolute encoder adjustment" homing mode in the selection window.



- In the "Options" tab, enter the absolute value encoder offset (usually the negative, current actual value) in the "Home position coordinate" input box.



4.3 Triggering of the integrated outputs of the CU 320 Control Unit

8. Press the  button to start the absolute encoder calibration.
The actual position value will be corrected with the entered offset.
The displayed position of the "Axis_1" axis is now 0.0 mm.
9. Save in the project the data that has been entered online.

4.3 Triggering of the integrated outputs of the CU 320 Control Unit

4.3.1 Example: Triggering an output cam on the integrated output of the CU 320

Introduction

This section describes how you trigger the integrated outputs of the CU 320.
The following steps are required:

1. Extending a PROFIdrive message frame
2. Creating an output cam
3. Link message frame interface of the control unit with the actual output terminal
4. Create S7 user program

Extension of the PROFIdrive message frame

The "Extending a message frame by creating additional components (Page 131)" chapter describes how you need to extend the PROFIdrive message frame to make the integrated outputs of the CU320 usable for the Technology CPU. Extend the PROFIdrive message frame as described in that section.

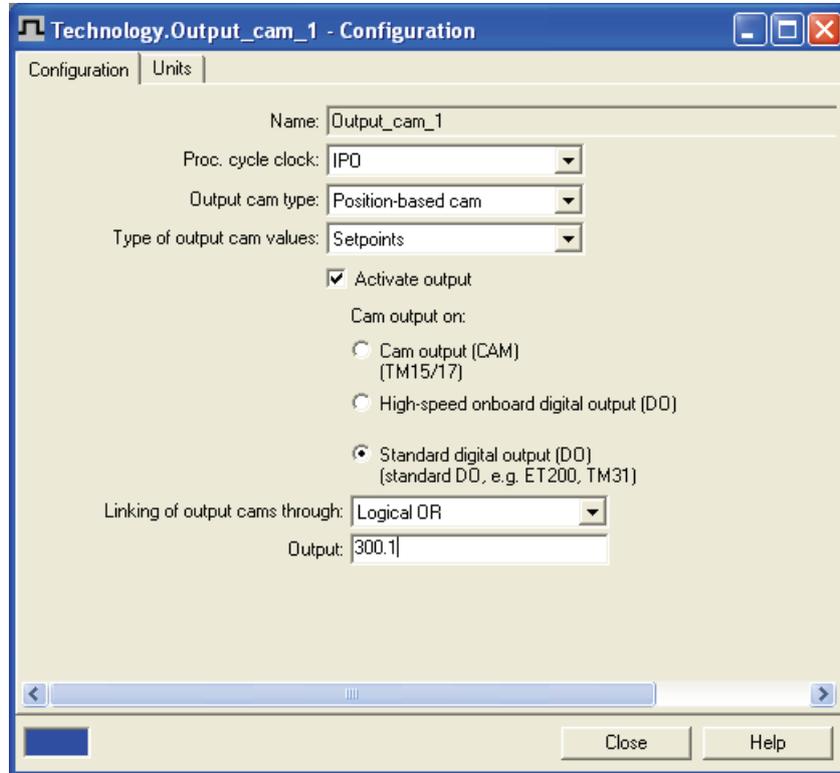
Creating an output cam

To create a cam switch, follow these steps:

1. In the project navigator of S7T Config, switch to the "\Technology\Axes\Axis_1\Output_Cam" dialog and double-click on "Insert output cam".
2. In the "Insert output cam" dialog, you can, for example, enter a name for this output cam.
3. Click "OK" to accept the settings.

The screenshot shows the "Insert Output cam" dialog box. The title bar includes a question mark icon and a close button. The main area contains a "Name" field with the text "Output_cam_1". Below this are "Author:" and "Version:" labels with corresponding empty text boxes. A section titled "Existing Output cam" contains an empty list box. Below that is a "Comment:" label with a large empty text area. At the bottom left, there is a checked checkbox labeled "Open editor automatically". The dialog concludes with three buttons: "OK", "Cancel", and "Help".

4. To set the parameters for the output cam, switch to the "\Technology\Axes\Axis_1\Output_Cam\Output_Cam_1" dialog in the S7T Config project navigator.



5. Select the "Activate output" check box.
6. Enter "Hardware address 300" and "Bit number 0" from the HW Config hardware configuration.

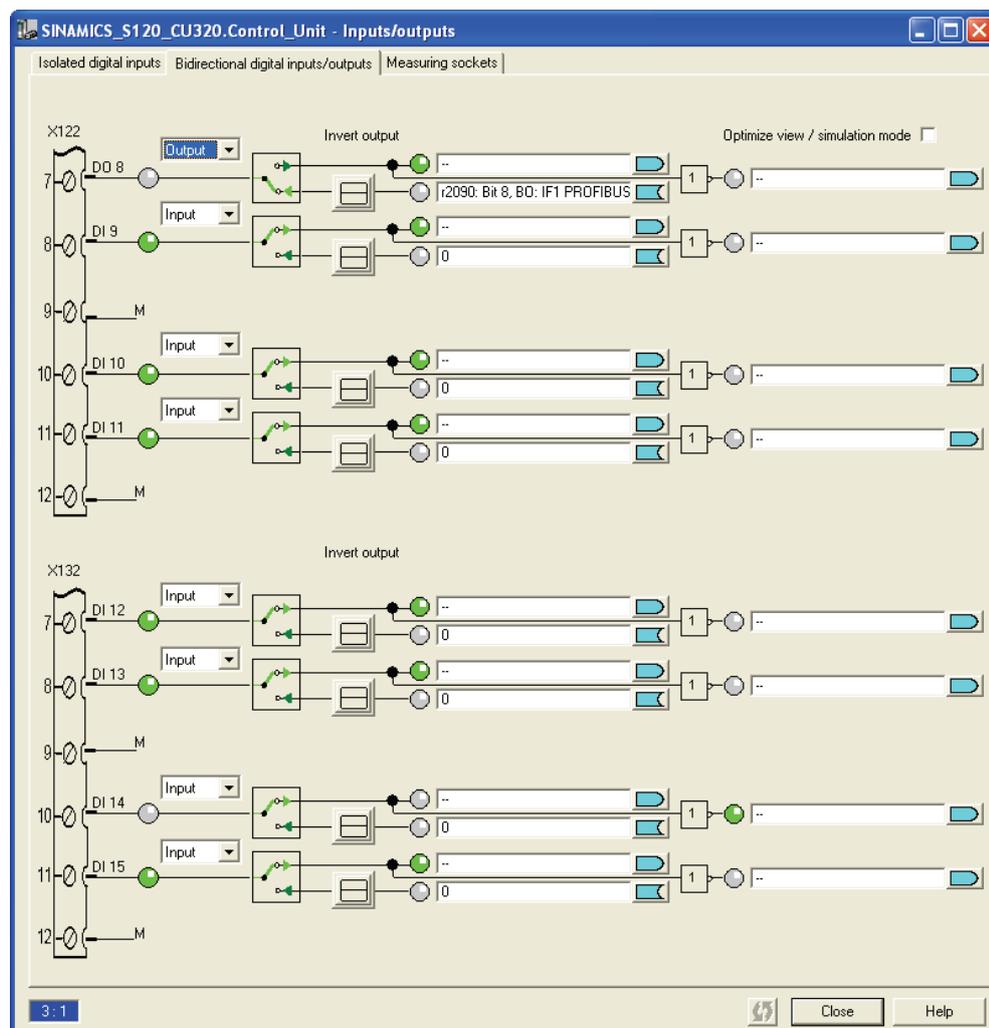
Result

This completes the configuring of the output cam.

Linking the message frame interface of the control unit with the output terminal

To link the message frame interface of the control unit with the actual output terminal, follow these steps:

1. In the S7T Config project navigator, switch to the "SINAMICS_S120\Control_Unit\Inputs/Outputs" dialog.



2. There, go to the "Bidirectional digital inputs/outputs" tab.
3. Select the following parameterization for terminal X122:
 - Function of the X122 DI/O 8 terminal -> "output"
 - "Interconnection with -> r2090 bit 8 BO PROFIBUS PZD 1 parameter"

Note

On the PROFIBUS, the signals of the low-order byte will be switched with the high-order byte. The bit interconnection to bit 8 comes from the byte-word rotation in the PROFIBUS signal.

This completes the configuring in S7T Config.

Creating the S7 user program

Use the Technology Object Manager (TOM) to create a technology data block (TO-DB), which is assigned to the homing output cam technology object. The technology data block (TO-DB) allows the functions on the associated technology object to be executed using the provided FBs.

For the output cam, use the FB 430 MC_CamSwitch function block in your S7 program.

Expert Functions

5.1 PROFIdrive message frame

5.1.1 Message frame types

Selection help for the PROFIdrive message frames

By default, the SINAMICS S120 is connected to the Technology CPU via PROFIBUS DP (DRIVE). Depending on the desired axis functionality, this connection can be made using various device-specific message frames. The following selection table shows the properties of the individual message types.

	Sign-of-life monitoring (SoLmon)	1. Encoder	2. Encoder	Dynamic Servo Control (DSC)	Torque reduction (Mred)	Required message frame
Speed-controlled axis	X					2
Position axis / following axis	X	X				3
	X	X	X			4
	X	X		X		5
	X	X	X	X		6
	X	X			X	102
	X	X	X		X	103
	X	X		X	X	105
X	X	X	X	X	106	

Note

Message frame types < 100 are standard message frames whose structure is standardized by the PROFIdrive profile V3.

The message frame types > 100 are manufacturer-specific message frames.

Structure of the PROFIdrive message frames

If special functions of the drive are to be used or supported, the use of special PROFIdrive message frames may be required.

The following figure shows which data are transferred with each message frame type and consequently which functions of the drive can be supported.

5.1 PROFdrive message frame

	PZD 1	PZD 2	PZD 3	PZD 4	PZD 5	PZD 6	PZD 7	PZD 8	PZD 9	PZD 10	PZD 11	PZD 12	PZD 13	PZD 14	PZD 15	PZD 16	PZD 17	PZD 18	PZD 19
TEL_1 Set	STW 1	NSO LL_A																	
TEL_1 Actual	ZSW 1	NIST_A																	
TEL_2 Set	STW 1	NSOLL_B		STW 2															
TEL_2 Actual	ZSW 1	NIST_B		ZSW 2															
TEL_3 Set	STW 1	NSOLL_B		STW 2	G1_STW														
TEL_3 Actual	ZSW 1	NIST_B		ZSW 2	G1_ZSW	e.g. G1_XIST1	e.g. G1_XIST2												
TEL_4 Set	STW 1	NSOLL_B		STW 2	G1_STW	G2_STW													
TEL_4 Actual	ZSW 1	NIST_B		ZSW 2	G1_ZSW	e.g. G1_XIST1	e.g. G1_XIST2	G2_ZSW	e.g. G2_XIST1	e.g. G2_XIST2									
TEL_5 Set	STW 1	NSOLL_B		STW 2	G1_STW	XERR	KPC												
TEL_5 Actual	ZSW 1	NIST_B		ZSW 2	G1_ZSW	e.g. G1_XIST1	e.g. G1_XIST2												
TEL_6 Set	STW 1	NSOLL_B		STW 2	G1_STW	G2_STW	XERR	KPC											
TEL_6 Actual	ZSW 1	NIST_B		ZSW 2	G1_ZSW	e.g. G1_XIST1	e.g. G1_XIST2	G2_ZSW	e.g. G2_XIST1	e.g. G2_XIST2									
TEL102 Set	STW 1	NSOLL_B		STW 2	M_Red	G1_STW													
TEL102 Actual	ZSW 1	NIST_B		ZSW 2	Mess.W	G1_ZSW	e.g. G1_XIST1	e.g. G1_XIST2											
TEL103 Set	STW 1	NSOLL_B		STW 2	M_Red	G1_STW	G2_STW												
TEL103 Actual	ZSW 1	NIST_B		ZSW 2	Mess.W	G1_ZSW	e.g. G1_XIST1	e.g. G1_XIST2	G2_ZSW	e.g. G2_XIST1	e.g. G2_XIST2								
TEL105 Set	STW 1	NSOLL_B		STW 2	M_Red	G1_STW	XERR	KPC											
TEL105 Actual	ZSW 1	NIST_B		ZSW 2	Mess.W	G1_ZSW	e.g. G1_XIST1	e.g. G1_XIST2											
TEL106 Set	STW 1	NSOLL_B		STW 2	M_Red	G1_STW	G2_STW	XERR	KPC										
TEL106 Actual	ZSW 1	NIST_B		ZSW 2	Mess.W	G1_ZSW	e.g. G1_XIST1	e.g. G1_XIST2	G2_ZSW	e.g. G2_XIST1	e.g. G2_XIST2								
TEL116 Set	STW 1	NSOLL_B		STW 2	M_Red	G1_STW	G2_STW	XERR	KPC										
TEL116 Actual	ZSW 1	NIST_B		ZSW 2	Mess.W	G1_ZSW	e.g. G1_XIST1	e.g. G1_XIST2	G2_ZSW	e.g. G2_XIST1	e.g. G2_XIST2	AA_LOAD	AA_TORQUE	AA_POWER	AA_CURR				

STW	Control word	ZSW	Status word
NSOLL	Set speed	NIST	Actual speed
M_Red	Torque derating	MeldW	Message word
XERR	System deviation (for DSC)	G1_XIST1	Cyclic actual value (incremental encoder)
KPC	Position controller gain (for DSC)	G1_XIST2	Absolute actual value (absolute encoder)
AA_LOAD	Current load (parameter r0081)	AA_TORQUE	Current torque (parameter r0079)
AA_POWER	Current power (parameter r0082)	AA_CURR	Current motor current (parameter r0078)

5.1.2 Example: telegram 105

Structure

Telegram 105 contains the following data, where the first row of the table represents the setpoint transfer from the controller to the drive and the second row represents the actual value transfer from the drive to the controller.

Telegr.	PZD 1	PZD 2	PZD 3	PZD 4	PZD 5	PZD 6	PZD 7	PZD 8	PZD 9	PZD 10	PZD 11	PZD 12	PZD 13	PZD 14	PZD 15	PZD 16
105 Planned	STW 1	NSOLL_B		STW 2	M_Red	G1_STW	XERR		KPC							
105 Actual	ZSW 1	NIST_B		ZSW 2	Msg. W	G1_ZSW	e.g. G1_XIST1		e.g. G1_XIST2							

The individual data items have the following meaning:

STW	Control word	ZSW	Status word
NSOLL	Set speed	NIST	Actual speed
M_Red	Torque derating	MeldW	Message word
XERR	System deviation (for DSC)	G1_XIST1	Cyclical actual value (incremental encoder)
KPC	Position controller gain (for DSC)	G1_XIST2	Absolute actual value (absolute encoder)

The PZD 11 to PZD 16 data ranges are not used for telegram 105.

5.2 Extending a PROFIdrive message frame

5.2.1 Address areas

Introduction

The message frame types described in the "PROFIdrive message frame (Page 127)" chapter are used to transfer the drive data.

Additional PROFIdrive message frames are available to establish a connection with the distributed input/outputs on PROFIBUS DP (DRIVE), with integrated inputs/outputs on the control unit, or with extensions on the Drive-CLiQ.

The PROFIdrive message frames depend on the type and the function of the system used. The number of the data words used depends on the number of data items to be transferred.

The transferred data can be used in two address areas of the Technology CPU that are assigned as follows:

Address area 0 - 63

The data can be used directly in the PLC user program. The MC_ReadPeriphery or MC_WritePeriphery technology function is used to read or write the data, respectively.

This address area is used for the data exchange with the distributed I/Os on the isochronous PROFIBUS DP (DRIVE) or for reading and writing the drive parameters in cyclical operation.

Technology objects cannot access this data.

Address area >= 64

The data is used by the technology objects. This data is read and written by means of the connection of the parameters to the PROFIBUS interface.

This address area can be used, for example, to realize the following functions:

- Querying a hardware limit switch at the integrated inputs/outputs
- Querying a hardware limit switch at the isynchronous peripherals
- Triggering of outputs that can be used as output cam outputs

5.2.2 Extending a message frame by creating additional components

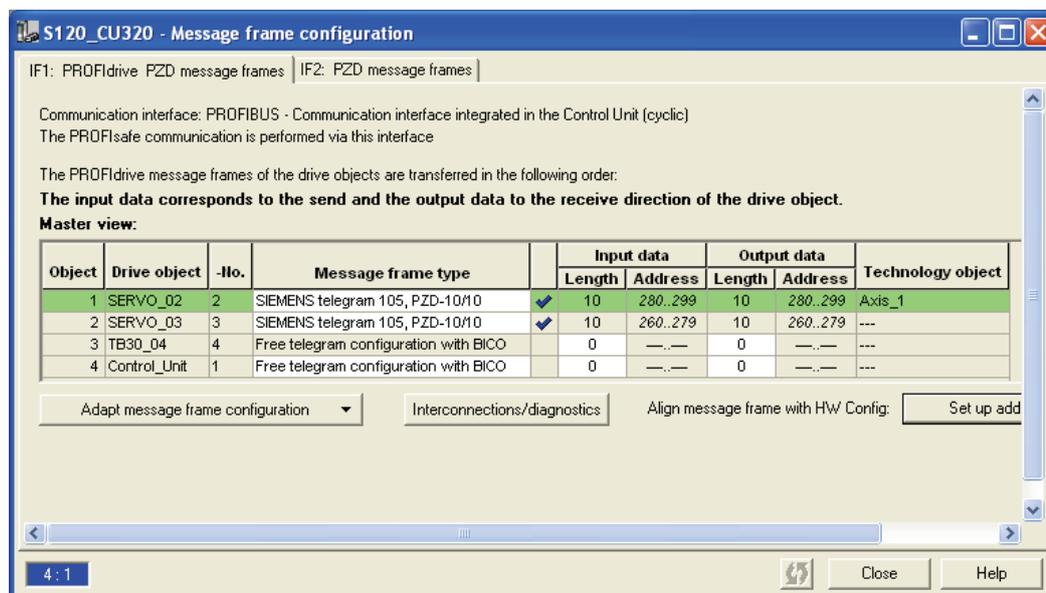
Introduction

For example, to make the integrated digital input/outputs of the SINAMICS S120 available to the Technology CPU, the input information must be transferred via the PROFIBUS DP (DRIVE). This requires the creation of an additional PROFIdrive message frame for the control unit.

Procedure

To create an additional PROFIdrive message frame for the control unit, follow these steps:

1. Open the message frame configuration of SINAMICS S120.
2. Perform an alignment with HW Config by clicking "Align message frame with HW Config: Set up addresses".



3. Ensure that no I/O addresses have been entered in the "Control Unit" line.
4. Note for the subsequent steps the object number of the objects that have not yet been connected with the PROFIBUS. This sequence and also the position are required for the address assignment in HW Config.

In our example, the following object numbers must be noted:

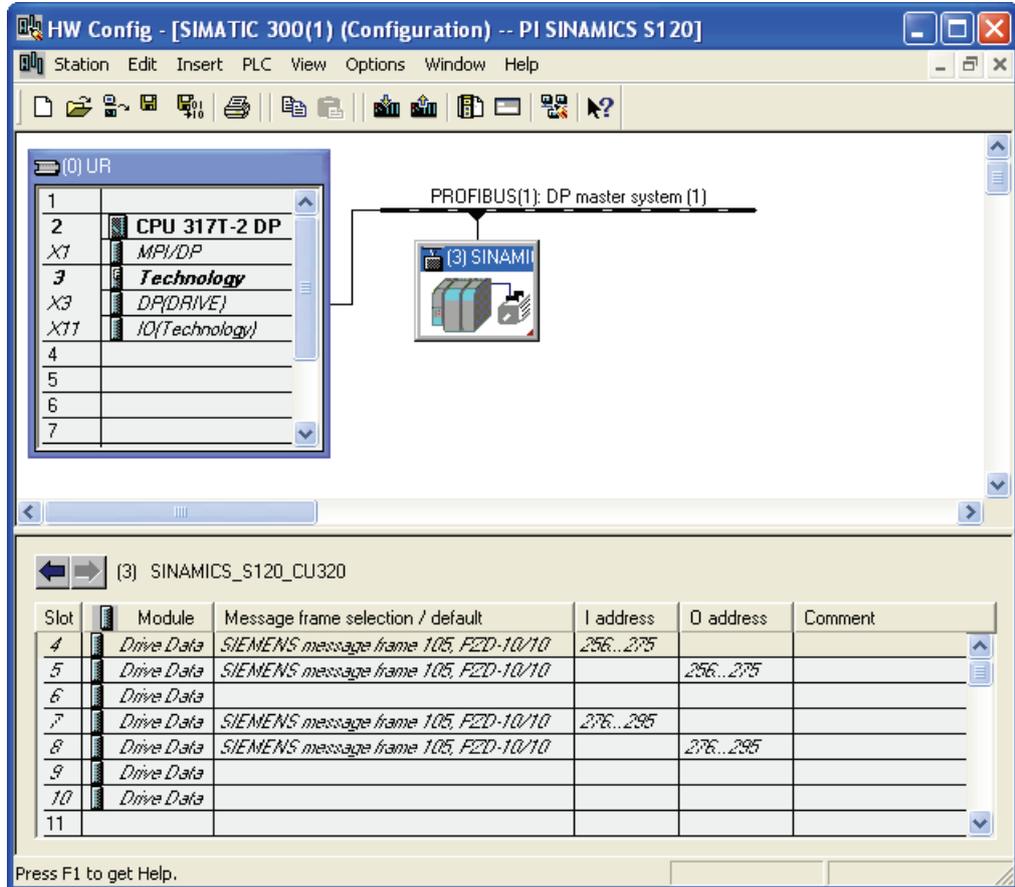
- Object 3 - TB30
- Object 4 - Control Unit

Note

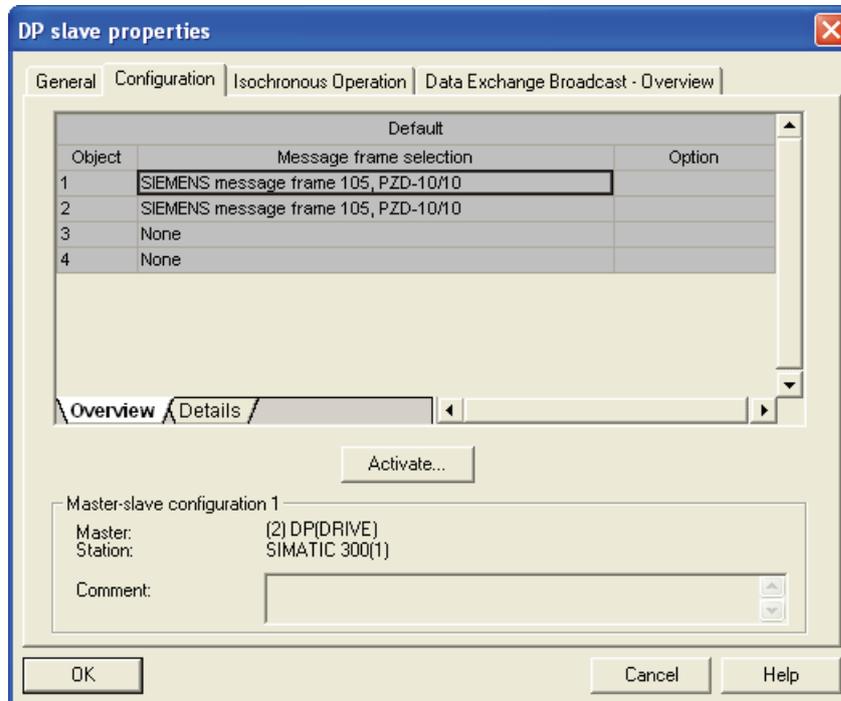
The "Configuration" window must be closed after the alignment. Otherwise subsequent changes in the hardware configuration will not be considered and may be discarded.

5.2 Extending a PROFIdrive message frame

- To assign the integrated input/outputs to the control unit input/output addresses, switch to the HW Config hardware configuration.



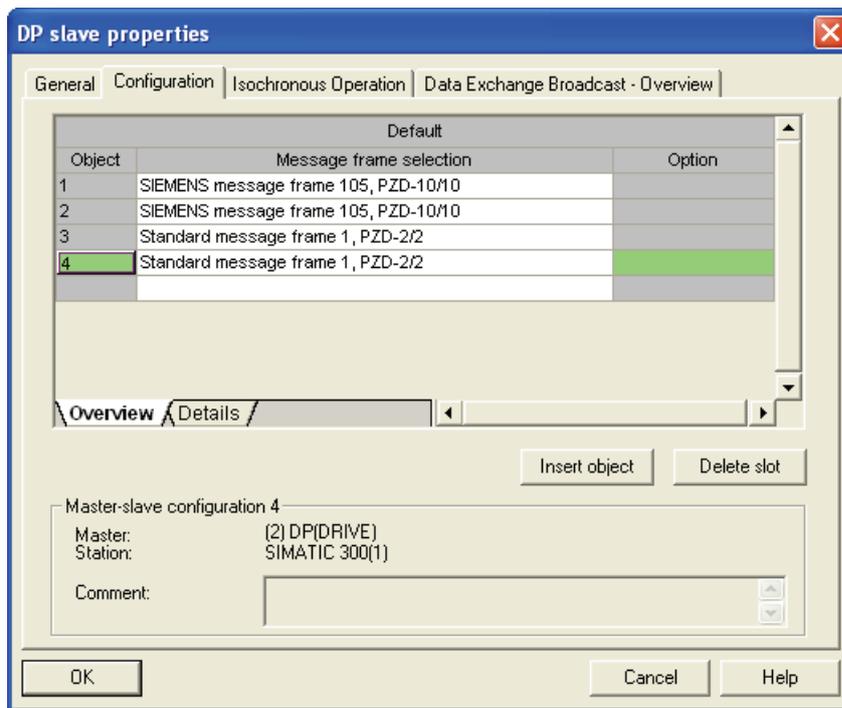
6. Open the object properties of the SINAMICS S120 there and click the "Activate..." button in the "Configuration" tab.



7. Select a PROFIBUS standard message frame from the list for the address assignment in the object rows.

Select the following message frames:

- Object 3 - TB30 - Standard message frame 1 PZD 2/2
- Object 4 - Control Unit - Standard message frame 1 PZD 2/2



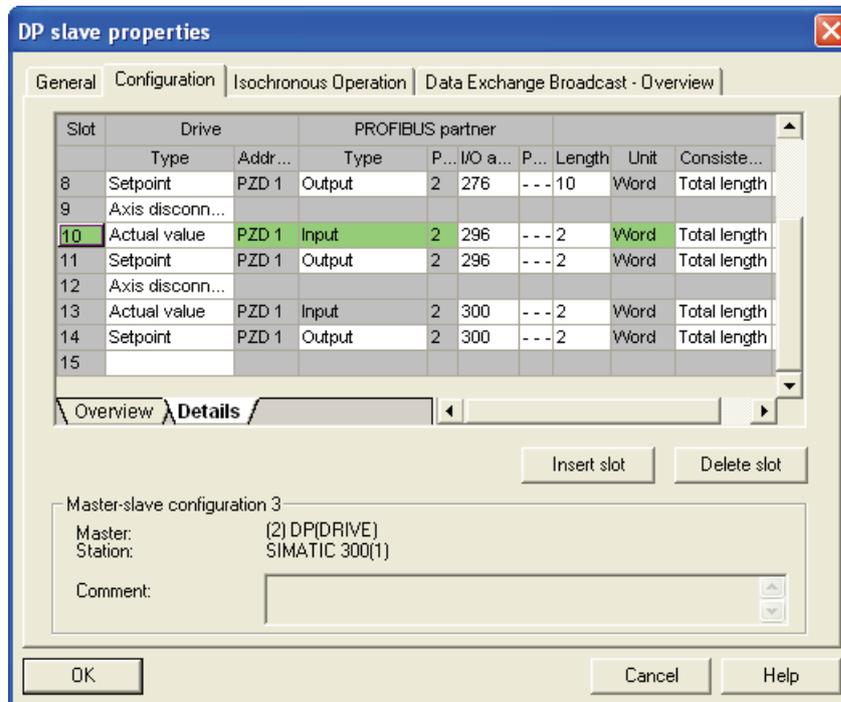
Note

Telegrams must be entered without any gaps from top to bottom for all objects contained in the object list. Only objects at the end of the list need not have any assigned message frame.

Because object 4 (control unit) is required for example, this means that a message frame must also be entered for the object 3 (TB30), even when it is not necessary for our function.

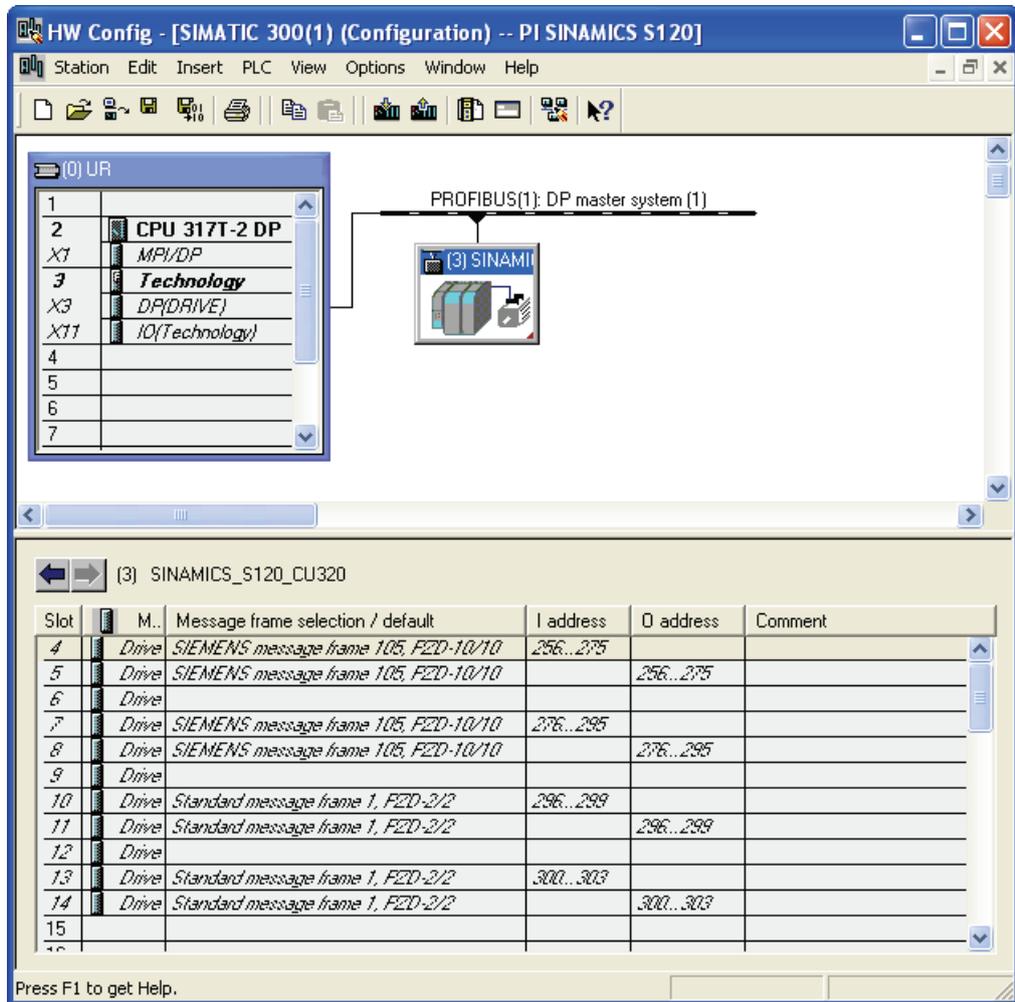
8. Switch to the "Details" tab and note the assignment of the PROFIBUS input/output addresses. Each object of the configuration has its own area that is concluded with an axis separator.

In this example, the selection of the two standard message frames starting at slot 10 creates the input/output area for the TB30 and the control unit.



9. Note for the subsequent steps the start addresses of the objects. In our example, these are:
- Object 3 - TB30 - Address 296
 - Object 4 - Control Unit - Address 300
10. Accept the suggested I/O addresses for both objects.
11. Click "OK" to close the configuration.

- Close the object properties of the SINAMICS S120 and check whether the newly added slots are listed in the address area of the SINAMICS S120.



- Then save and compile the HW Config hardware configuration.

14. Switch to S7T Config and open the "Message frame configuration" of SINAMICS S120.

IF1: PROFIdrive PZD message frames | IF2: PZD message frames

The drive objects are supplied with data from the PROFIdrive message frame in the following order:
The input data corresponds to the send and the output data of the receive direction of the drive object.
Master view:

Object	Drive object	No.	Message frame type	Input data		Output data	
				Length	Address	Length	Address
1	SERVO_02	2	SIEMENS telegram 105, PZD-10/10	10	328..347	10	280..299
2	SERVO_03	3	SIEMENS telegram 105, PZD-10/10	10	300..319	10	260..279
3	TB30_04	4	Free message frame configuration with BICO	2	256..259	2	256..259
4	CU_S_004	1	Free telegram configuration with BICO	2	320..323	2	320..323

Without PZDs (no cyclic data exchange)

Note

If the window was still open, you need to close and reopen it.

15. Click "Align message frame with HW Config: Set up addresses" to complete the new message frame configuration.

Result

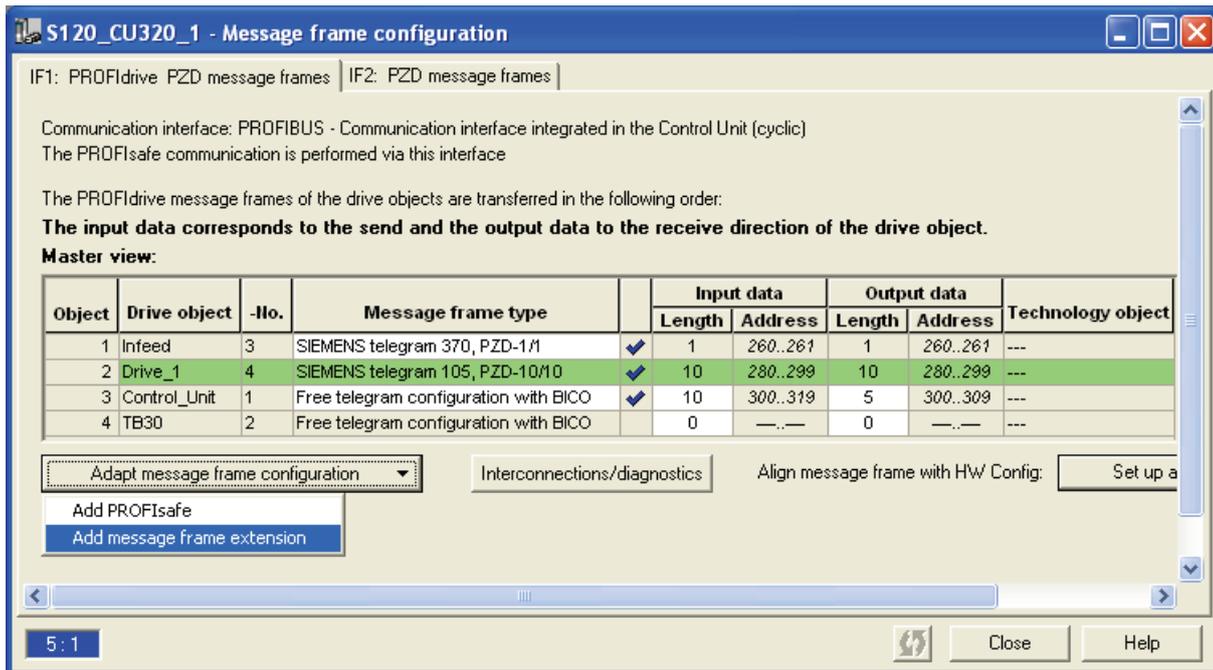
The extension of the PROFIdrive message frame for the integrated inputs/outputs is now complete.

5.2.3 Extending the PROFIdrive message frame in S7T Config

In S7 Technology V4.1 and higher, there is an option to extend message frames directly in the SINAMICS message frame configuration in S7T Config.

Procedure

1. In S7T Config, open the message frame configuration of SINAMICS S120.



2. Select the drive object.
3. Click "Adapt message frame configuration" and then select "Add message frame extension".
4. Click "Interconnections/Diagnostics" to open the message frame configuration of the drive object. The individual control and status words of the utilized message frame are displayed there.
5. Clear the "Suppress inactive interconnections" option to display the added words of the message frame extension. These are designated as "user-defined".
6. Change the desired message frame properties and close the message frame configuration.
7. Click "Align message frame with HW Config: Set up addresses" to perform alignment with HW Config.
8. Choose "Save and compile" to activate the changes in the S7T Config project.

5.2.4 Extending an existing PROFIBUS message frame for the drive

Introduction

The previous section showed you how to extend the PROFIdrive communication between SINAMICS S120 and the Technology CPU with complete message frames to use additional components.

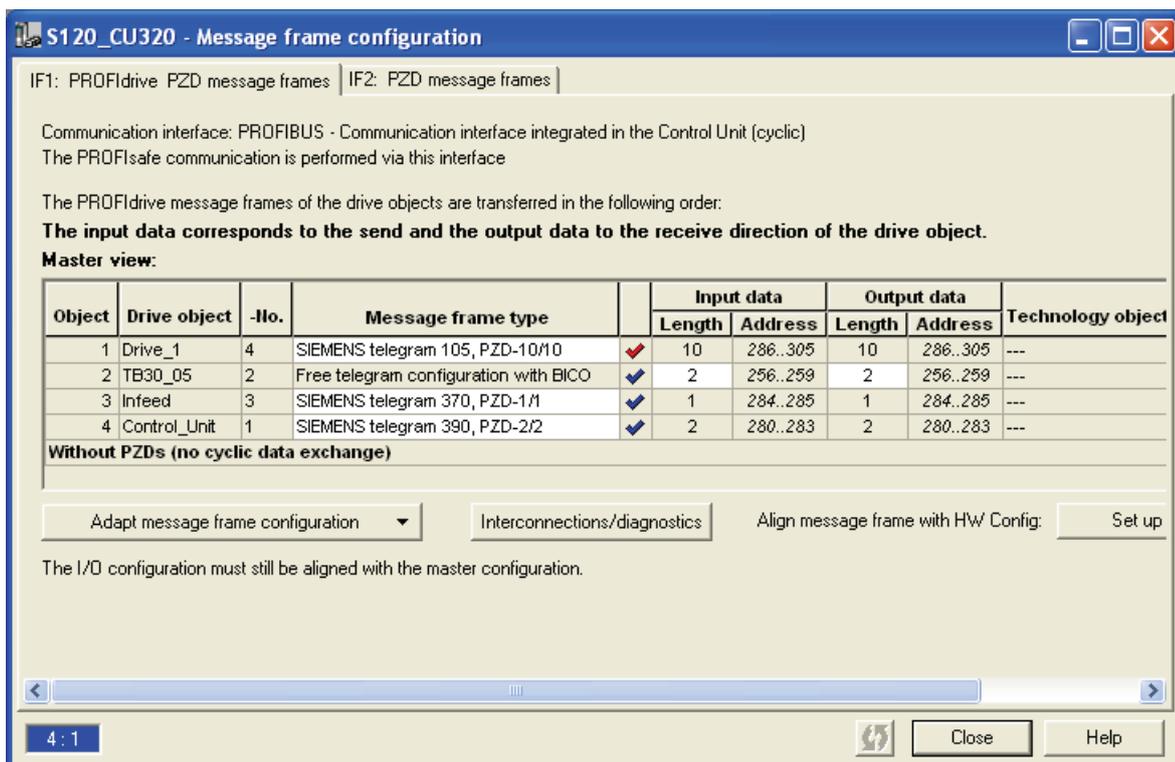
In addition, the message frames for the previously configured components (drives, technology modules, etc.) can be extended. This allows, for example, drive parameters in the PROFIBUS message frame to be interconnected to permit their value to be fetched cyclically by other PROFIBUS nodes (e.g. Technology CPU).

Procedure

To extend the standard message frame 105 for drive_1 to include an actual value, follow these steps:

1. In S7T Config, open the message frame configuration of SINAMICS S120.
2. Click "Align message frame with HW Config: Set up addresses".

Check that the Siemens message frame 105 is entered for the "Drive_1" entry.



S120_CU320 - Message frame configuration

IF1: PROFIdrive PZD message frames | IF2: PZD message frames

Communication interface: PROFIBUS - Communication interface integrated in the Control Unit (cyclic)
The PROFIsafe communication is performed via this interface

The PROFIdrive message frames of the drive objects are transferred in the following order:
The input data corresponds to the send and the output data to the receive direction of the drive object.

Master view:

Object	Drive object	-No.	Message frame type	Input data		Output data		Technology object
				Length	Address	Length	Address	
1	Drive_1	4	SIEMENS telegram 105, PZD-10/10	10	286..305	10	286..305	---
2	TB30_05	2	Free telegram configuration with BICO	2	256..259	2	256..259	---
3	Infeed	3	SIEMENS telegram 370, PZD-1/1	1	284..285	1	284..285	---
4	Control_Unit	1	SIEMENS telegram 390, PZD-2/2	2	280..283	2	280..283	---

Without PZDs (no cyclic data exchange)

Adapt message frame configuration | Interconnections/diagnostics | Align message frame with HW Config: Set up

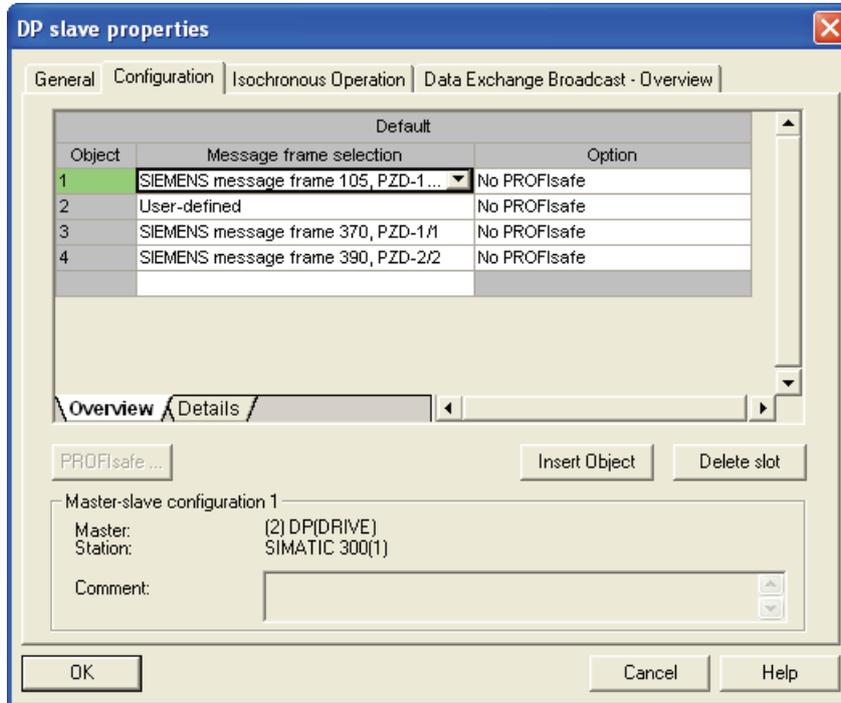
The I/O configuration must still be aligned with the master configuration.

4 : 1 | Close | Help

Note

After the alignment, you will have to close the "Message frame configuration" dialog. Otherwise subsequent changes in the hardware configuration will not be considered and may be discarded.

3. Open HW Config.
4. Open the object properties for SINAMICS S120 and click "Activate" on the "Configuration" tab.

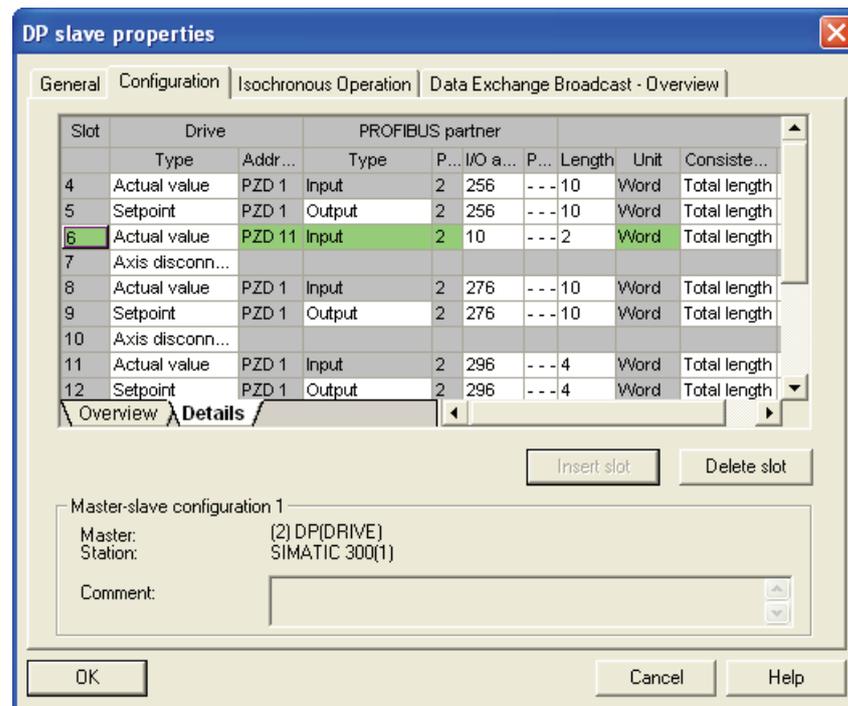


5. Open the "Details" tab and note the assignment of the PROFIBUS I/O addresses. Each object of the configuration has its own area that is ended with an axis disconnecter.
6. To extend a message frame, an additional setpoint or actual value slot must be inserted in front of an axis separator. This slot will be interconnected later with a parameter in S7T Config.

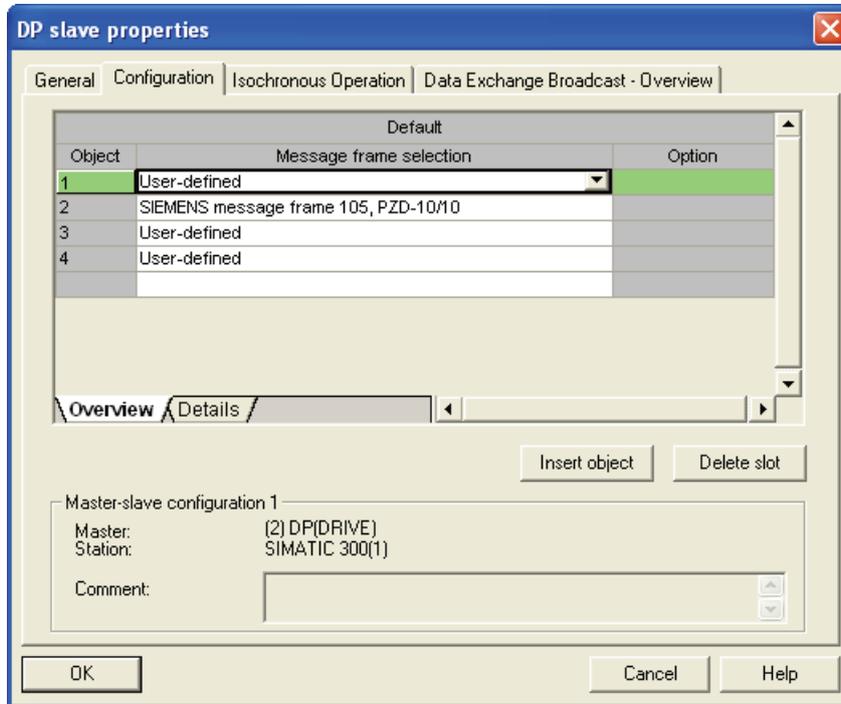
7. Insert a new slot by selecting row "6", for example, and then clicking "Insert slot".

To specify a new actual value slot with a length of two words on PROFIBUS address 10, fill in the columns as follows:

- I/O address 10
- Length 2

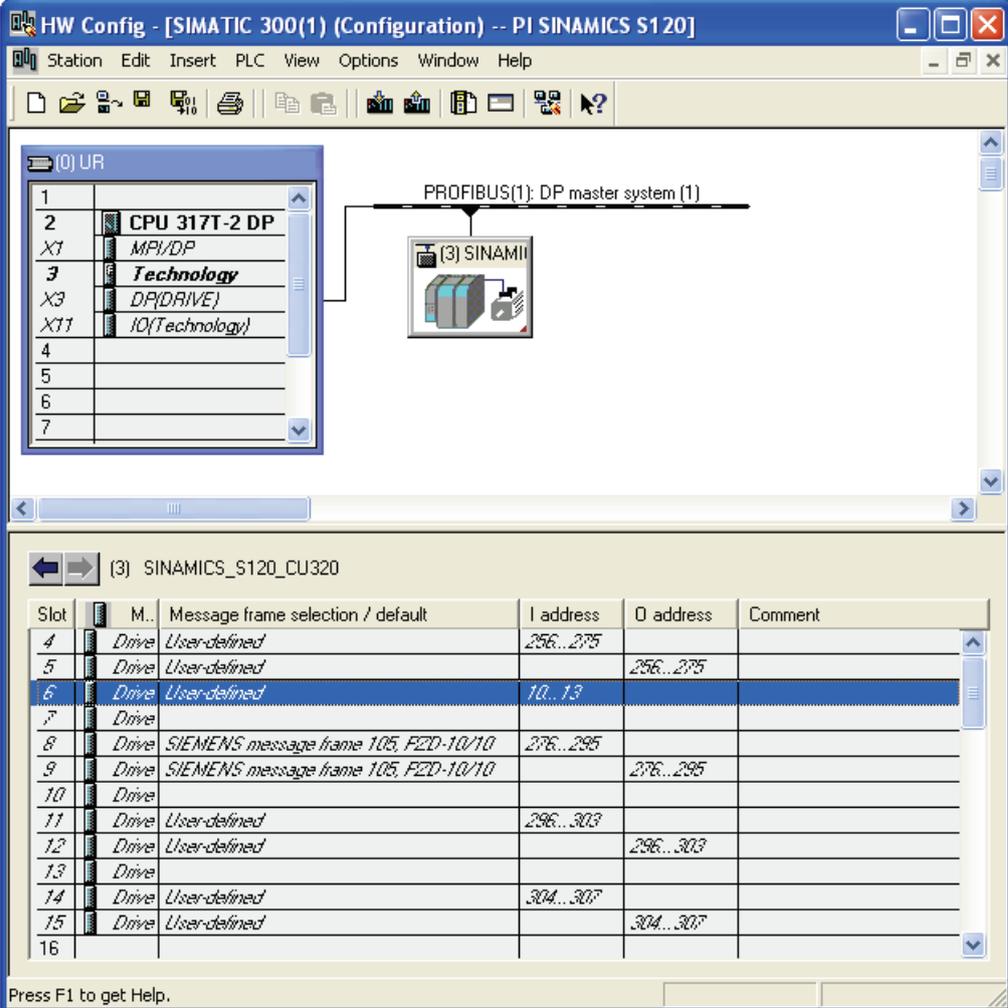


- 8. Switch to the "Configuration" tab.
- 9. Check whether the message frame type for object 1 has been changed to "user-defined".
- 10. Confirm your object properties changes with "OK".



11. Check whether the newly inserted slot is listed in the address area of SINAMICS S120.

12. Save and compile the hardware configuration.



HW Config - [SIMATIC 300(1) (Configuration) -- PI SINAMICS S120]

Station Edit Insert PLC View Options Window Help

(0) UR

1	
2	CPU 317T-2 DP
X1	MPI/DP
3	Technology
X3	DP(DRIVE)
X11	IO(Technology)
4	
5	
6	
7	

PROFIBUS(1): DP master system (1)

(3) SINAMICS

(3) SINAMICS_S120_CU320

Slot	M..	Message frame selection / default	I address	Q address	Comment
4	Drive	User-defined	256...275		
5	Drive	User-defined		256...275	
6	Drive	User-defined	10...13		
7	Drive				
8	Drive	SIEMENS message frame 105, F2D-10/10	276...295		
9	Drive	SIEMENS message frame 105, F2D-10/10		276...295	
10	Drive				
11	Drive	User-defined	296...303		
12	Drive	User-defined		296...303	
13	Drive				
14	Drive	User-defined	304...307		
15	Drive	User-defined		304...307	
16					

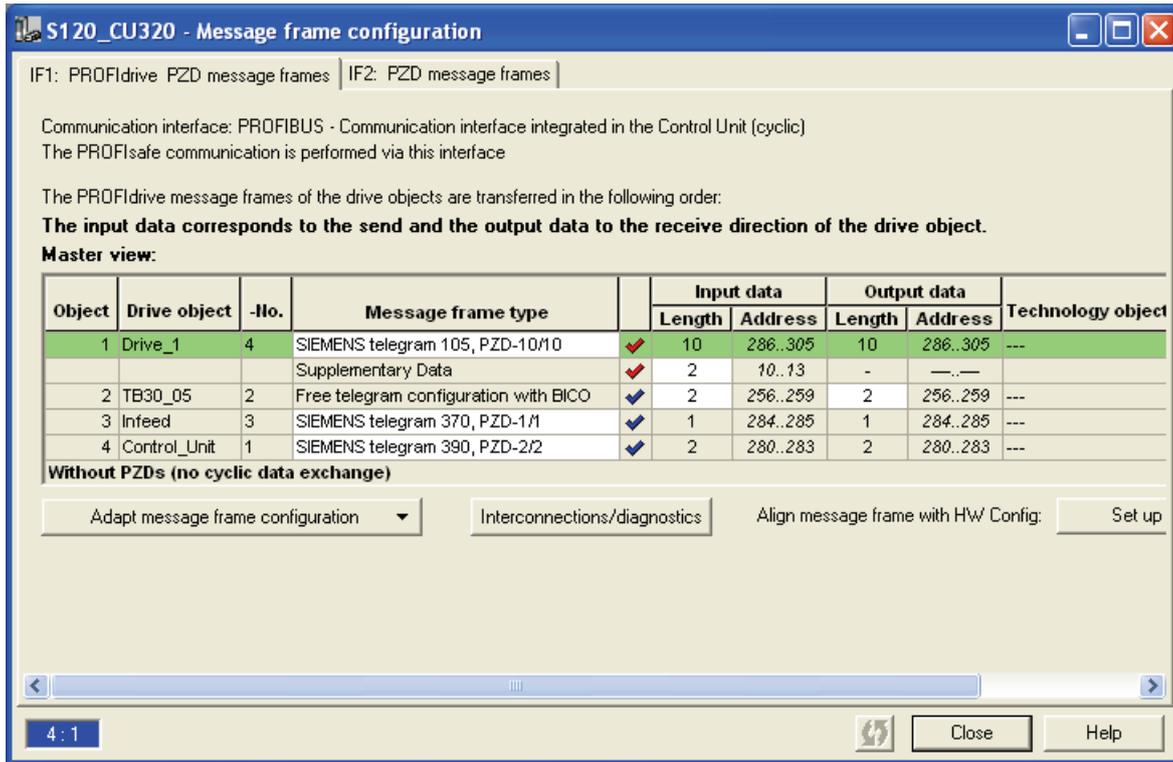
Press F1 to get Help.

13. Open the "Message frame configuration" in the S7T Config project navigator.

Note

If the window was still open, you need to close and reopen it.

14. Check whether the address setting from HW Config was accepted.



15. Click "Align message frame with HW Config: Set up addresses" to complete the message frame extension.

5.3 Disabling the PROFIBUS Sign-of-Life Monitoring

Principle

The PROFIBUS connection between the technology CPU and the SINAMICS S120 is monitored using a sign of life. The sign-of-life monitoring is selected automatically when the axis is created and should always be active during operation.

For diagnostic purposes, the sign-of-life monitoring can be disabled temporarily during the commissioning.

The parameters for the sign-of-life monitoring can be selected/deselected on the Axis technology object with "Expert list > Configuration data" or on the drive using the "p0925" parameter.

To do this, mark "Axis_1" and select the **Expert list** menu command in the context menu. Switch in the expert list to the "Configuration data" tab and to the "\TypeOfAxis\NumberOfEncoders\Encoder_1\DriverInfo\lifeSignCheck" dialog there.

Alternatively, you can also select the **Expert list > p0925** menu command in the "Drive_1" context menu.

Sign-of-life monitoring	\DriverInfo \lifeSignCheck	p0925
On	Yes	1
Off	No	65535

5.4 Activating a Second Encoder

5.4.1 Using a Second Encoder

Introduction

A second encoder is required, for example, when the position detection does not supply sufficient accuracy for the motor encoder or must be synchronized to external motions.

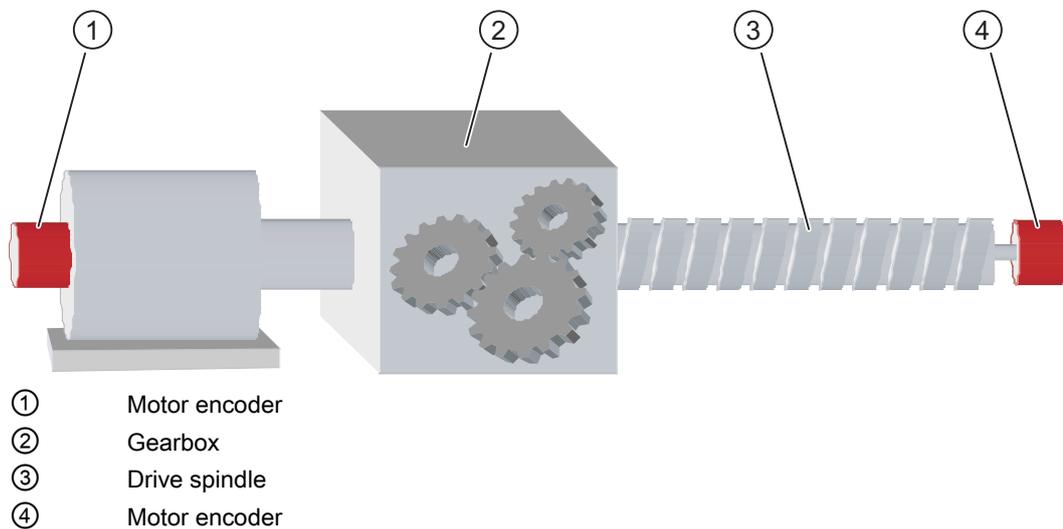
Second encoder as actual position value

For some mechanical constructions, the motor encoder cannot be used as an exact actual position value on the system.

For such a construction, a gearbox with large play or slip is located between the motor and the drive spindle. The motor encoder in such a case does not supply the actual position value with sufficient accuracy.

Also the specification or the use of the slip in the parameterization of the axis in the S7T Config project navigator for the Backlash Compensation parameter in the "Technology\Axes\Axis_1\Mechanics" directory does not suffice to ensure an exact position detection.

In such a case, a second encoder is mounted on the drive spindle and defined as actual position value.



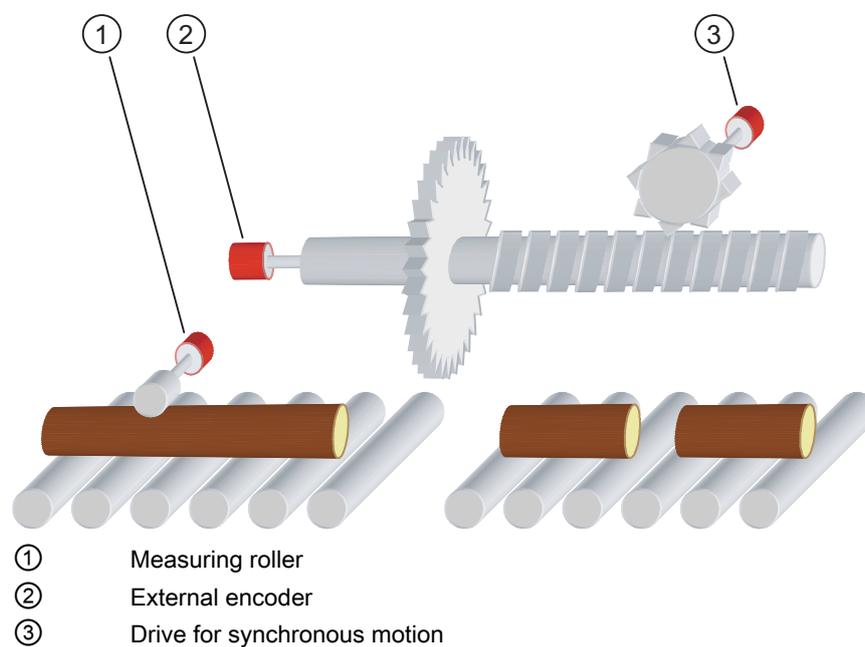
Second encoder as master value for synchronism functions

In a system, two independently controlled drives are to be synchronized using a gearbox or curve synchronization.

In this case, for example, the first drive, controlled by an external drive system, transports a wooden beam, a plastic pipe, etc.

The second drive, controlled by the technology CPU and a SINAMICS S120, moves a flying saw to cut the material synchronous to the material transport.

A measuring roller mounted on the material transport records the traversed path and the speed of the material. The measuring roller is connected to an external encoder that is connected to the SINAMICS S120.



5.4.2 Connecting a second encoder in SINAMICS

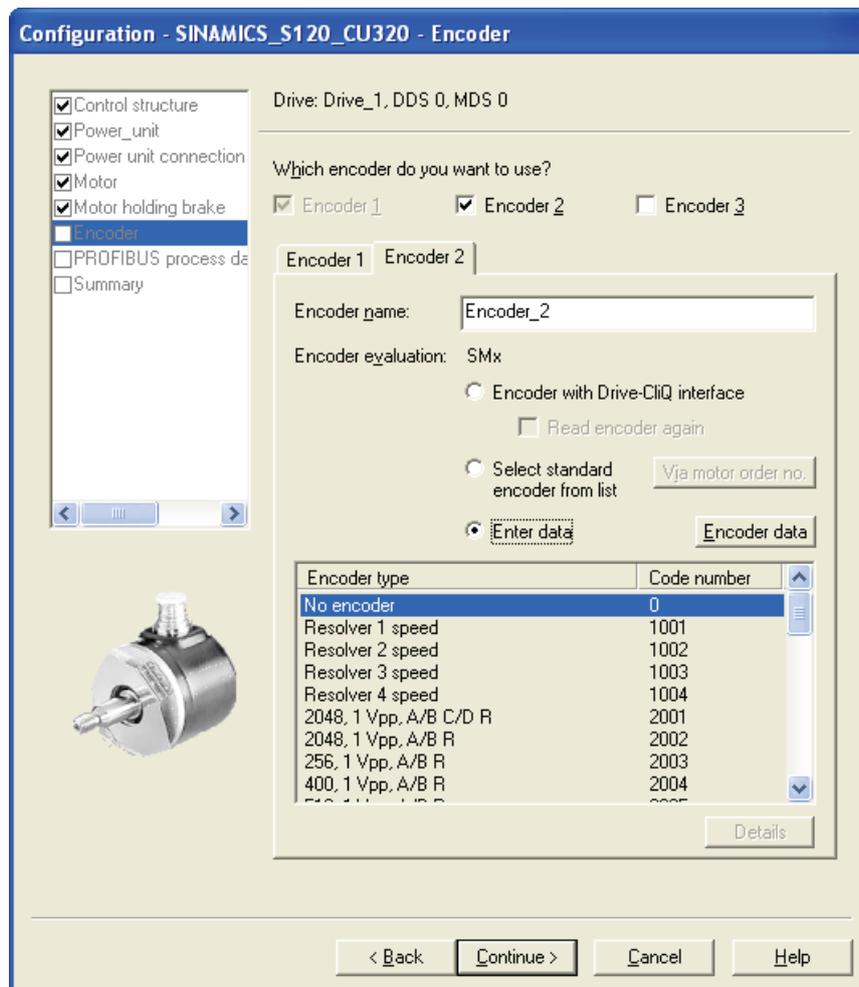
Introduction

Prepare your project as described in the "Commissioning (Page 15)" chapter of this product information so that an appropriate HW Config hardware configuration and a NetPro network configuration are present.

The steps that deviate from the "Commissioning" chapter start with the creation of the drive and the selection of the encoder. These steps are described in the following section.

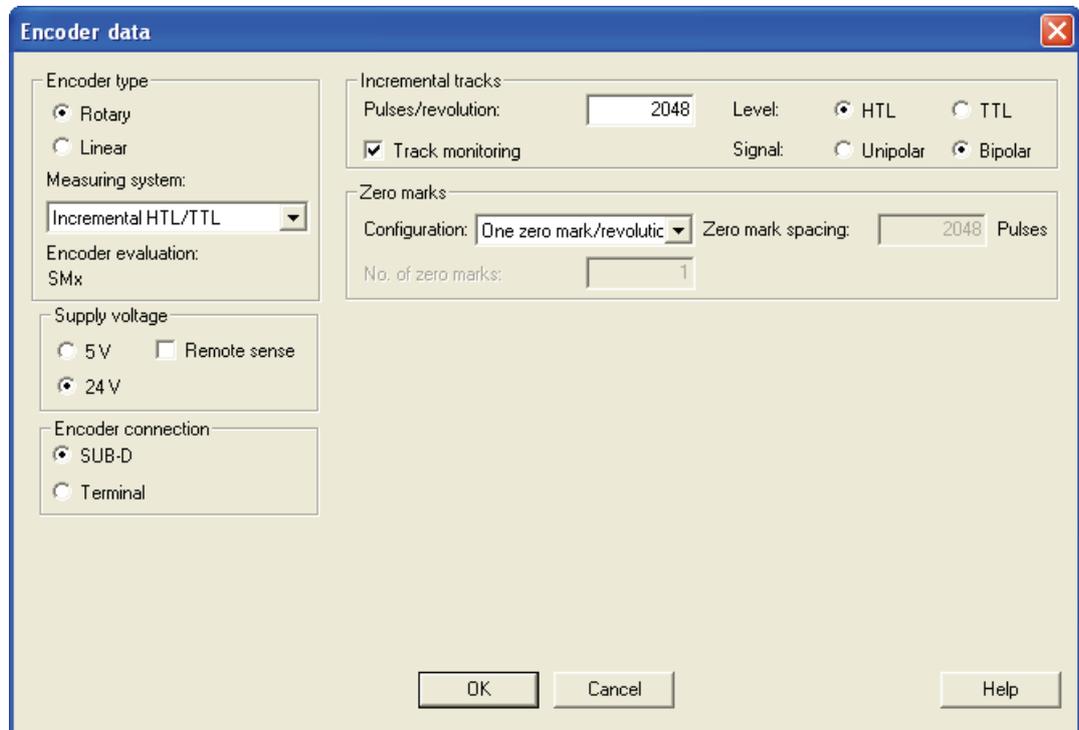
Procedure

1. Start manual configuration of the drive and open the "Encoder 2" tab in the "Configuration" dialog.
2. Click "Encoder data" to specify the second encoder, which in our example is connected to the drive spindle.



3. Select the properties of the connected encoder in the "Encoder data" dialog box.
4. Click "OK" to confirm the settings.

The "Encoder data" dialog will close.



5. In the "Configuration" dialog, select the "Process data exchange" option.
6. Select the PROFIBUS PZD message frame "SIEMENS message frame 106".
This message frame allows the data transfer of a second actual encoder value to the drive control of the Technology CPU.
7. Click "Next" to confirm the settings.
8. Switch to the "\S120_CU320 \Topology" dialog in the S7T Config project navigator, and compare the Drive CLiQ connections of the parameterization with your configuration.
9. If there are any differences, adjust the parameterization or your configuration as deemed necessary.

Result

The second encoder in the SINAMICS S120 drive system is configured.
You can configure it as a technology object and then use it in the S7 user program.

Further information

The further steps for creating a drive are the same as those described in the "Commissioning (Page 15)" chapter of this product information.

5.5 Reading the drive parameters

5.5.1 Example: Reading several parameters using "MC_ReadDriveParameter"

General

The configuration and status data are stored as parameter lists in SINAMICS S120. Additional information about the parameter lists is contained in the SINAMICS S List Manual.

Various applications require specific parameters to be fetched from these parameter lists and further processed in the user program. A typical application could be the reading out of the drive motor temperature to display it in the visualization system and monitor it in the S7 user program.

The "MC_ReadDriveParameter" function block can be used for this purpose in the S7 user program. Note, however, that only one simultaneous call per control unit is possible.

The following example application is intended to illustrate how several different parameters can be read from the parameter lists in order to process them further in the S7 user program.

Example application for reading several parameters

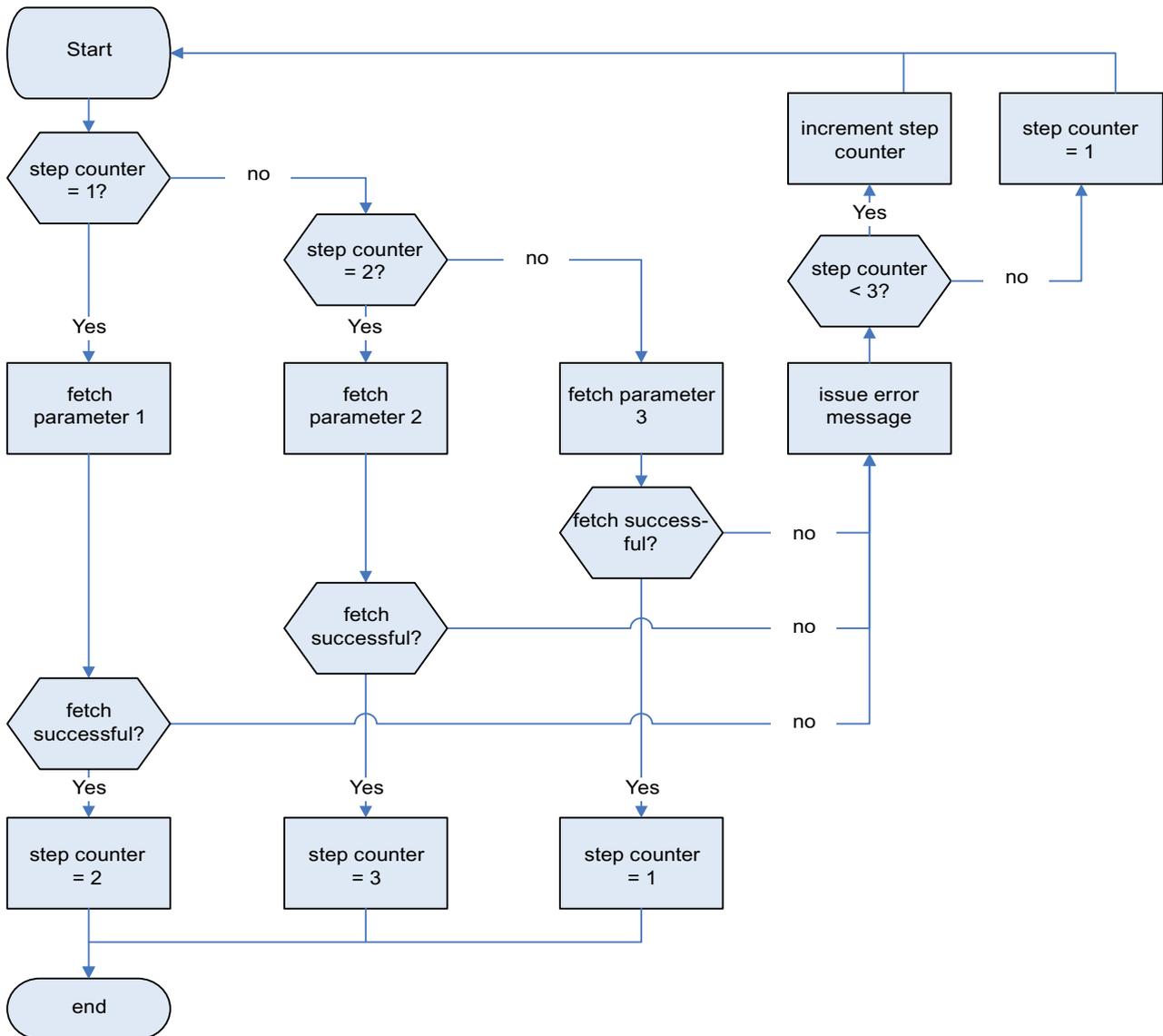
The example application described here shows a solution for reading the following parameters:

Object	Parameter	Parameter number
Drive_1	Kp	Parameter 1460
Drive_1	Temperature	Parameter 35
TM17	Status IO	Parameter 4304

The call of the "MC_ReadDriveParameter" blocks requires the PROFIBUS IO start addresses of the Drive_1 and TM17 objects as input information. Open the "Message frame configuration" dialog for this purpose. You can read the required PROFIBUS I/O start addresses of the Drive_1 and TM17 objects in the "PROFIdrive message frame" tab.

Program execution

A sequence processor is the solution concept used for fetching several parameters. This is structured so that it can be extended with additional parameters. The requested parameter values are available at the end of a program cycle.



5.6 Measuring Function

5.6.1 Use Cases

Measuring function

The "Measuring" function can be used to determine the actual position of an axis at any time. A possible application is, for example, the acquisition of a registration mark in order to subsequently synchronize the axis to this mark.

MC_MeasuringInput function block

Depending on the processing level (position-control or interpolator cycle), different response times must be used when the Measuring function is called.

The MC_MeasuringInput function block is called to control the measuring in the S7 user program. The type of the activation of Measuring function can be configured on the block.

The following functions can be called:

- immediately (without measuring window / measuring range)
StartPosition = EndPosition
- Within a position-dependent measuring window
StartPosition < > EndPosition

Measuring without measuring window

The measuring input will be activated immediately. A configuration-dependent time elapses before the measuring edge at the hardware input is evaluated.

To reliably detect the measuring edge, the run time must be compensated.

Measuring with measuring window

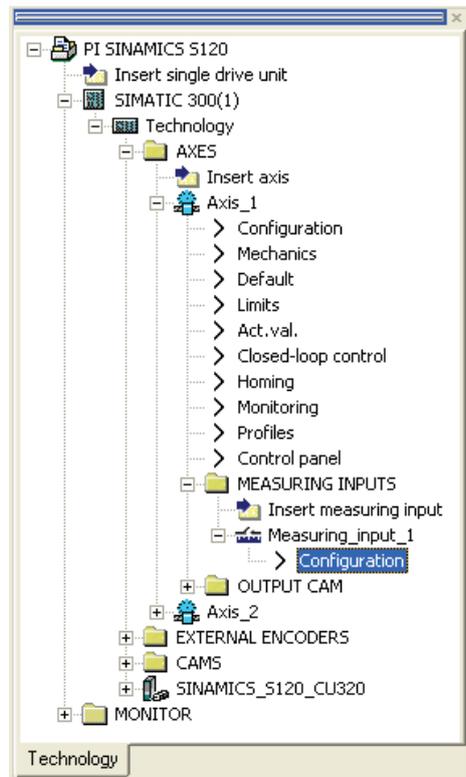
The request is initially only registered in the system. The measuring input is only activated when the axis is at the beginning of the measuring window.

A configuration-dependent time elapses after reaching the start position of the measuring window on the axis (mechanical) until the measuring edge at the hardware input is evaluated. To ensure that the measuring input is active when the required start position of the measuring window on the axis is reached, the run time must be compensated.

Similar considerations apply at the end of the measuring window. It is important that the measuring input is no longer active when the end of the measuring window on the axis (mechanical) is passed.

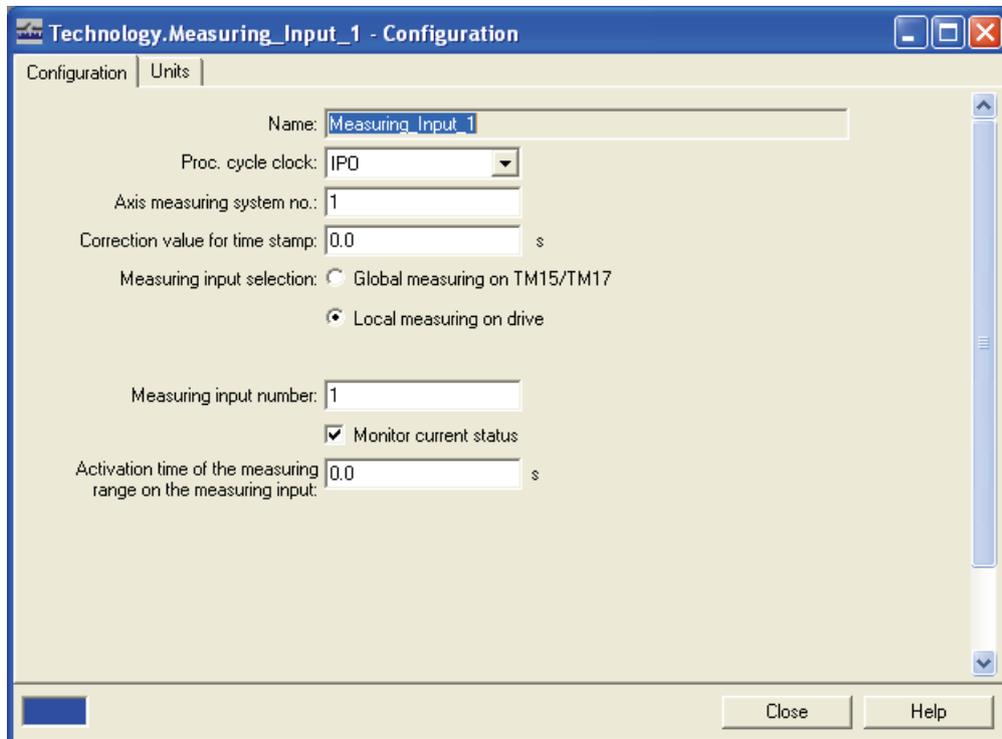
Run time compensation

The run time compensation is set in the "Activation time of the measuring range on the measuring input" input box of the "Measuring input" configuration dialog.



The offset of the measuring window only functions reliably when the axis velocity

- Within the measuring window is constant and is
- Known before the function call.



You can determine the response times for your configuration using the following tables. The values in the tables are based on the set system clocks. By using the actual times, you can calculate the response time in milliseconds.

The following abbreviations are used in the tables:

	Description	Supplementary information
IS	Interpolator or position-control cycle	Can be selected during the configuring of the measuring input
DP	Cycle time on the PROFIBUS DP	Can be set in HW Config

Measuring without measuring window	
MC_MeasuringInput -> ready to detect the measuring edge	3 (IS) + 7 (DP)
Detection of the measuring edge -> result in the Technology CPU for further processing	2 (IS) + 10 (DP)
Total -> minimum time between 2 measurements*)	5 (IS) + 17 (DP)
*) Any system limitations must also be considered.	

Measuring with measuring window: Measuring edge is detected in the window	
MC_MeasuringInput -> ready to evaluate the measuring range (start of the measuring window)	2 (IS)
Start of the measuring window on the axis is reached (mechanical) -> ready to detect the measuring edge	2 (IS) + 7 (DP)
Detection of the measuring edge -> result in the Technology CPU for further processing	2 (IS) + 10 (DP)
Total -> minimum time between 2 measurements*)	5 (IS) + 17 (DP)
*) Any system limitations must also be considered.	

Measuring with measuring window: No measuring edge in the window	
MC_MeasuringInput -> ready to evaluate the measuring range (start of the measuring window)	2 (IS)
Start of the measuring window on the axis is reached (mechanical) -> ready to detect the measuring edge	2 (IS) + 7 (DP)
Start of the measuring window on the axis is reached (mechanical) -> reset: "Ready to detect the measuring edge"	2 (IS) + 7 (DP)
Total -> minimum time between 2 measurements*)	7 (IS) + 24 (DP)
*) Any system limitations must also be considered.	

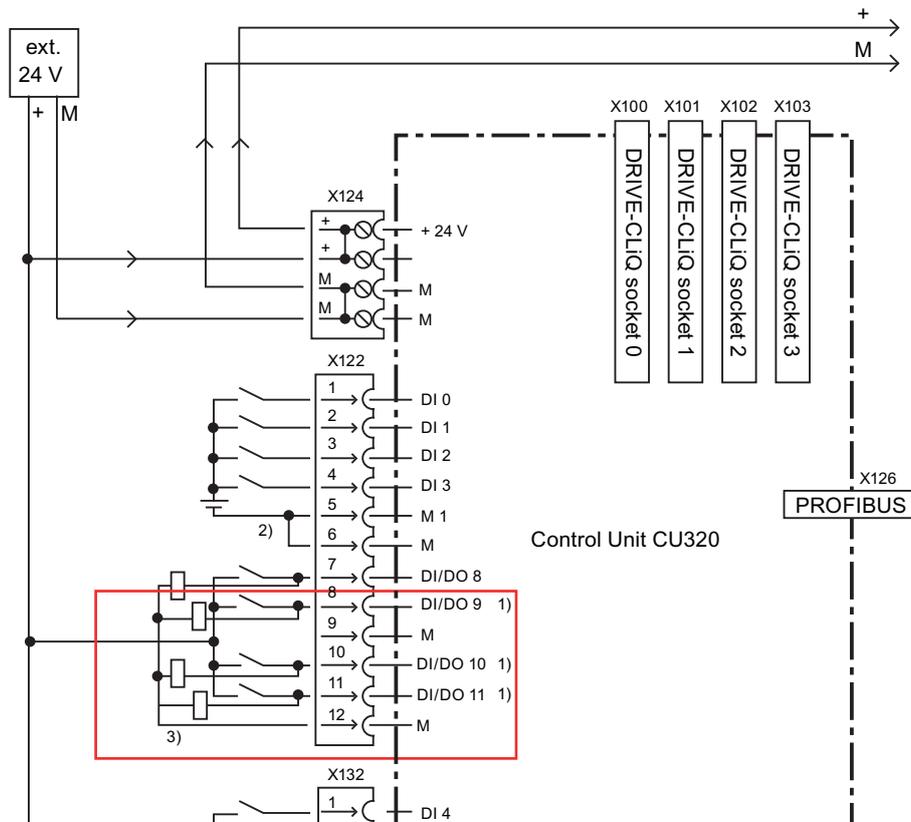
5.6.2 Measuring using the integrated inputs on the CU320

Introduction

Various sensors and actuators can be connected using the digital inputs and outputs to the 12-pole X122 and X132 front connectors.

Three pins of each of the X122 and X132 interfaces are provided as fast inputs and can be used, for example, for measuring inputs.

Terminal	Pin	Fast input/output
X122	7	DI/DO 8
	8	DI / DO 9
	10	DI / DO 10
	11	DI / DO 11
X132	7	DI / DO 12
	8	DI / DO 13
	10	DI / DO 14
	11	DI / DO 15

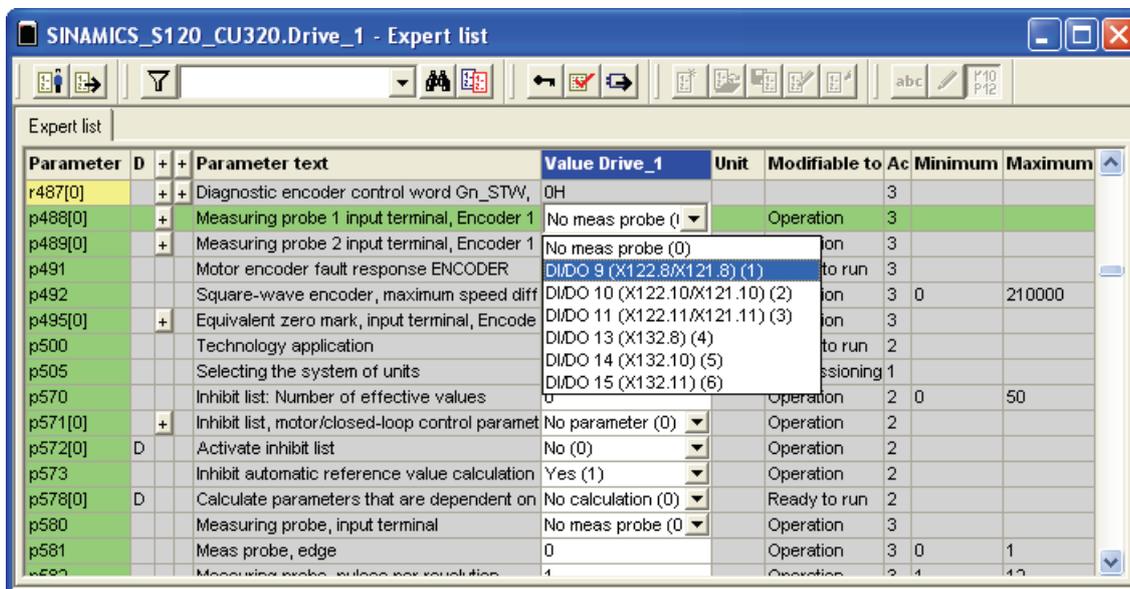


Requirement

A configuration with at least a drive and an axis must be available.

Configuring a measuring input using the integrated inputs of the CU320

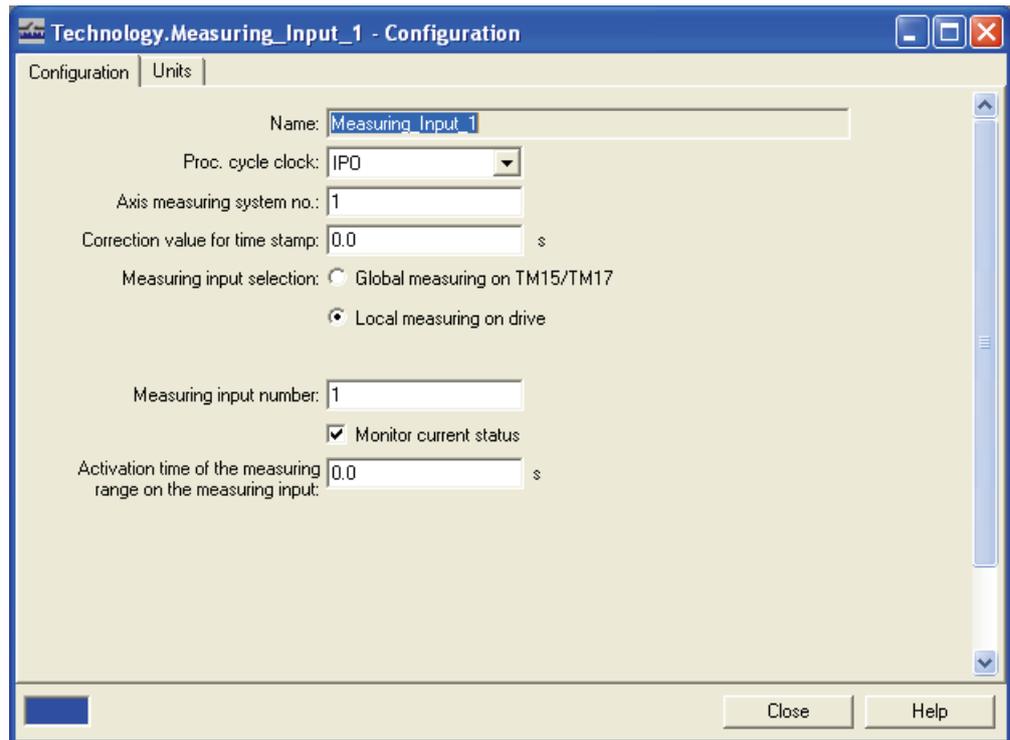
1. You need to open the expert list of the drive in order to connect the input of the measuring input from the CU320 DI/DO 9 (X122.8) terminal with the measuring input function on the drive. For this example, select the **Expert list** menu command from the "S120_CU320\drives" directory in the shortcut menu for "Drive_1" in S7T Config.
2. Select the "p488 measuring input 1, input terminal encoder 1" parameter in the expert list and interconnect the parameter with the DI/DO 9 (X122.8) input.



3. To create a measuring input, select
 "\Technology\Axes\Axis_1\Measuring inputs\Insert measuring input"
 in the project navigator of S7T Config.
4. Apply the default settings in the "Insert measuring input" dialog and confirm the settings by clicking "OK".

5. To configure the measuring input, click "\Technology\Axes\Axis_1\Measuring inputs\Measuring_input_1\Configuration" in the project navigator of S7T Config.
6. Select the following functions and settings for the example:
 - Local measurement on the drive
 - Measuring input number "1"

The first measuring input corresponds to the configuration at drive_1 "parameter p488".



This completes the configuring in S7T Config and the measuring input can be used in the user program.

5.6.3 Fetching the measuring inputs using the TM17 terminal module

Introduction

Digital inputs for the connection to a measuring input are available at the TM15 Terminal Module and TM17 High Feature. These can only be used for a single measurement for the Technology CPU.

This measuring signal is used to record the current position value of an axis and which is made available to the user program. The measuring signal is formed from a signal from the system, e.g. using a light barrier or a Bero.

The measured actual position value is needed for tasks such as flying shears or a rotating cutting blade.

The following section describes the configuration of a measuring input using the TM17 terminal module.

Creating a TM17 terminal module with a measuring input

Prepare your project as described in the "Commissioning (Page 15)" chapter of this product information so that an appropriate HW Config hardware configuration and a NetPro network configuration are present. At least a drive and an axis must be created in S7T Config.

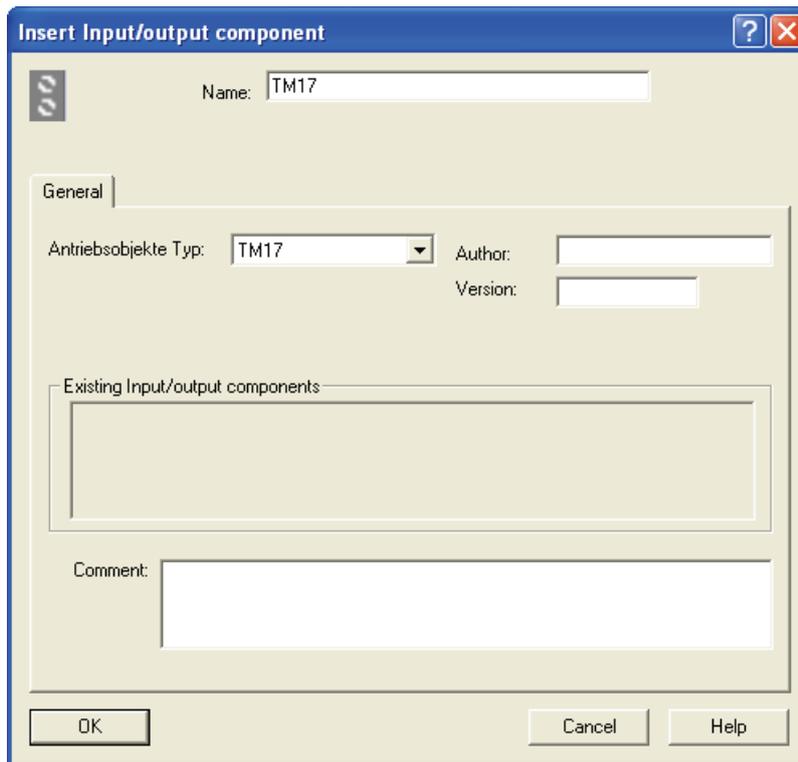
For the "Measuring" function using a TM17 terminal module, a TM17 terminal module must be integrated in the SINAMICS topology, the function of a measuring input must be created and the PLC user program must be extended.

Basic procedure

To integrate a TM17 terminal module in the SINAMICS topology, follow these steps:

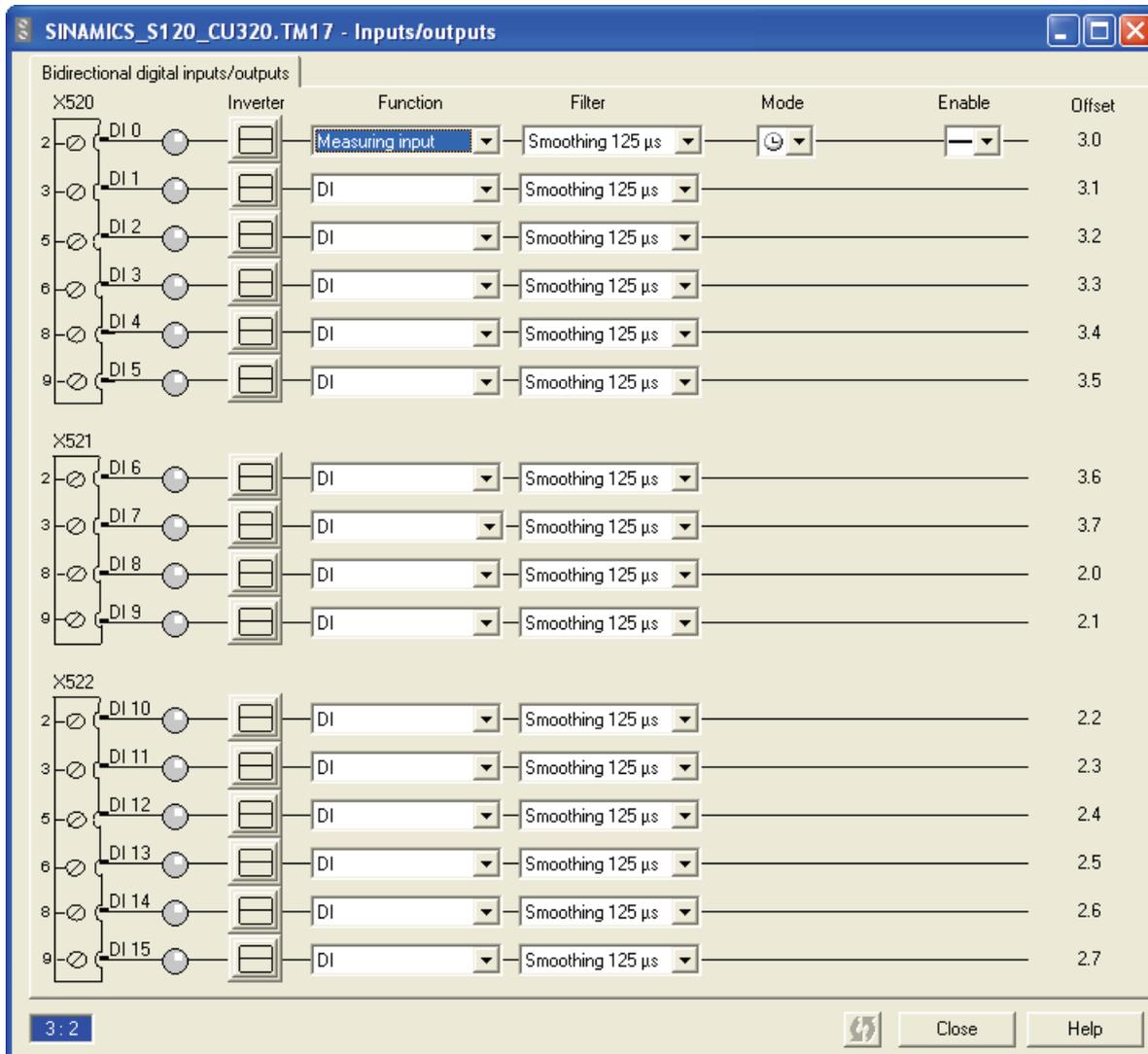
1. Connect the power supply and the measuring line of the measuring input to the TM17 terminal module. For our example, wire the measuring input to the DI/O 0 input.
2. To create a TM17, switch to the **S120_CU320 > Input/output components** folder in the S7T Config project navigator.
3. Click "Insert input/output components".

The "Insert input/output components" dialog will be displayed.



4. Select the TM17 drive type from the selection list.
5. Enter "TM17" in the "Name" field for this example.
6. Click the "OK" button to accept the settings.
7. To parameterize the TM17 terminal module, switch to the **S120_CU320 > Input/output components > TM17** folder in the S7T Config project navigator.
8. Click "Inputs/outputs".
9. Enter the "Measuring" function in the "Function" column for the DI/O 0 input. Accept the "Single measurement" and "Without enable" default settings in the "Mode" and "Enable" columns.

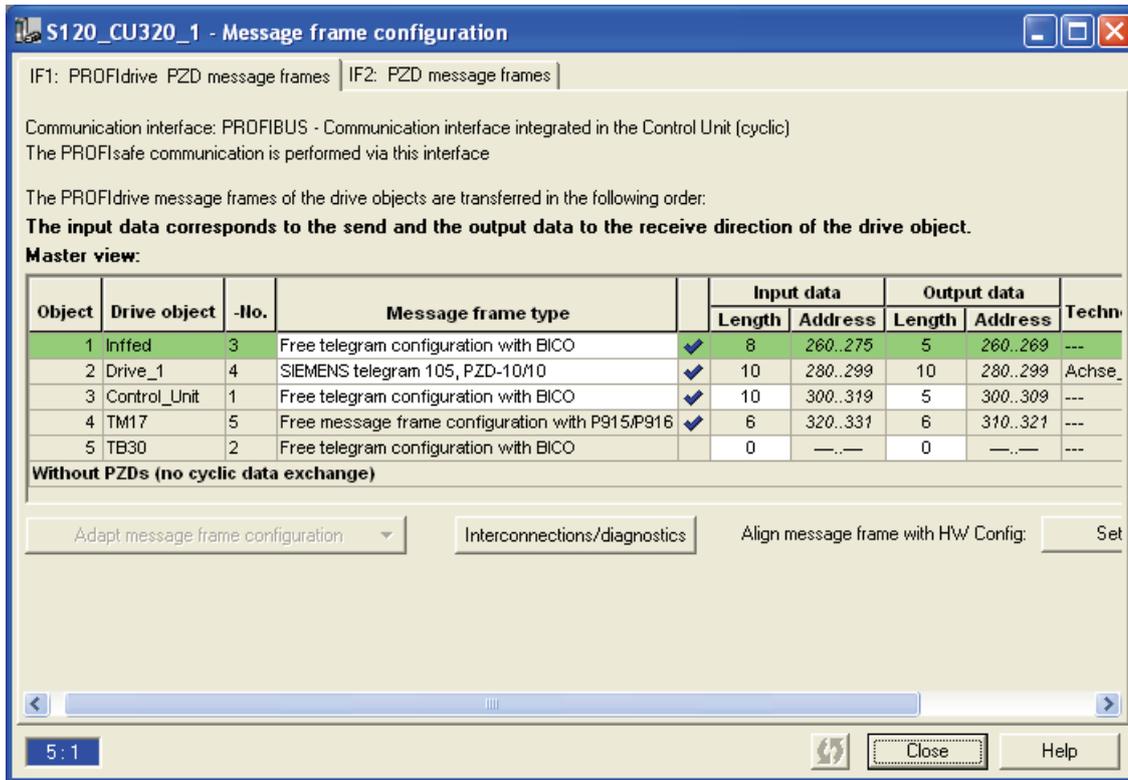
10. For the further processing, note the entry from the "Offset" column. This value, in our example "3.0", is needed for subsequent address assignment of the measuring input.



11. For alignment with the hardware configuration, switch to the **S120_CU320 > Communication > Message frame configuration** folder in the S7T Config project navigator.

The work area shows the newly added TM17 terminal module.

To align with HW Config, click "Align message frame with HW Config: Set up addresses".



Result

Following the alignment with HW Config, the TM17 terminal module is assigned the input/output addresses via which it can be accessed on PROFIBUS DP (DRIVE).

For the further processing, note the entry of the TM17 row from the E Address column. This address, 320..331 in this example, is required for the subsequent address assignment of the measuring input.

Note

Always close the "Message frame configuration" window following the alignment with the HW Config. Otherwise a subsequent change in the hardware configuration will not be accepted.

Transferring the configuration to the Technology CPU

The Technology CPU configuration has been changed as a result of inserting the TM17 terminal module and aligning with HW Config.

To transfer the modified configuration to the Technology CPU, follow these steps:

1. Open HW Config.
2. Perform a download.
3. To check the Drive CLiQ connection, switch to the **S120_CU320 > Topology** folder in the S7T Config project navigator.
4. Compare the Drive CLiQ connection of the parameter assignment with your configuration and adjust the topology or configuration as appropriate.

Creating and configuring measuring inputs in S7T Config

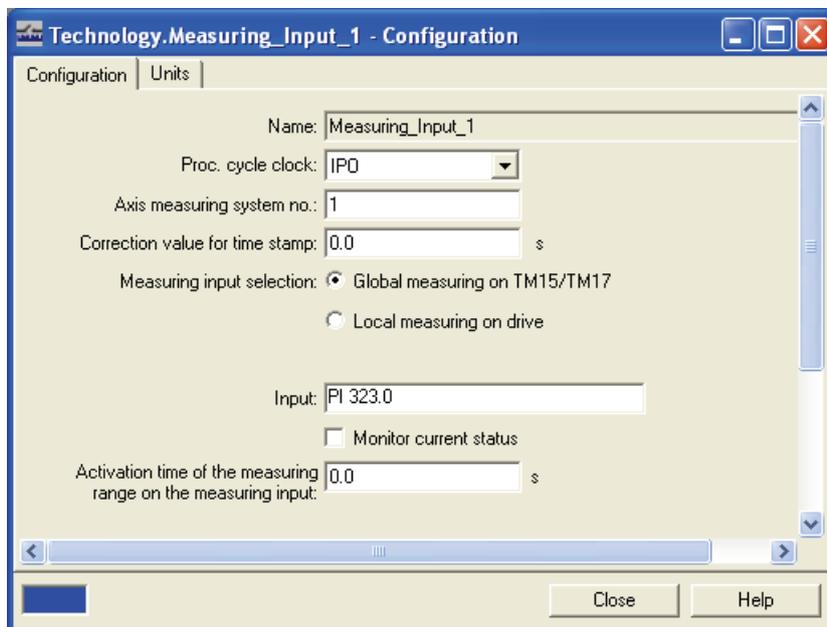
To create and configure a measuring input, follow these steps:

1. Switch to the **Technology > Axes > Axis_1 > Measuring input** folder in the S7T Config project navigator.
2. Insert the measuring input in the project by clicking "Insert measuring input".

A dialog opens.

3. Click "OK" to confirm the unchanged settings.
4. To parameterize the measuring input, switch to the **Technology > Axes > Axis_1 > Measuring inputs > Measuring input_1 > Configuration** dialog in the S7T Config project navigator.

The "Configuration" dialog opens.



5. Enter the following input address for this example: PI 323.0.

The address 323 is derived from the offset address of TM17 of 3 bytes and from the PROFIBUS address of the TM17 module of 320 bytes.

The bit address results from the use of the first DI/O 0 input on the TM17 terminal module.

Result

This completes the configuring in S7T Config.

As the next step, you will have to create the user program.

5.7 Triggering an output cam using the TM17 terminal module

Introduction

Digital outputs for the connection of an output cam are available at the TM15 and TM17 High Feature terminal modules.

The following section describes the configuration of an output cam using the TM17 terminal module.

Creating a TM17 terminal module with an output cam

Prepare your project as described in the "Commissioning (Page 15)" chapter of this product information so that an appropriate HW Config hardware configuration and a NetPro network configuration are present. At least a drive and an axis must be created in S7T Config.

To trigger an output cam using the TM17 terminal module:

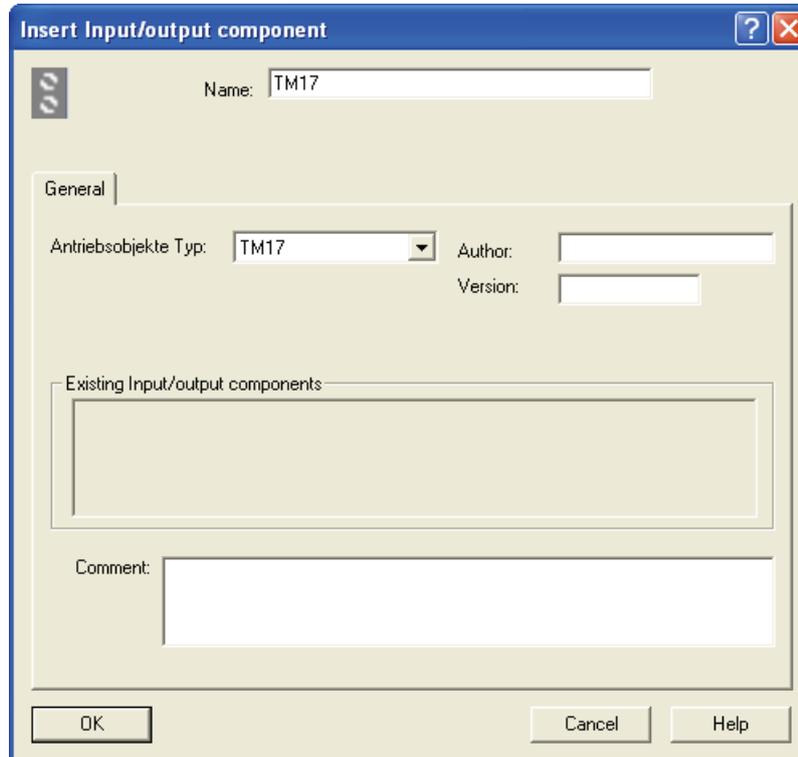
- Include a TM17 terminal module in the SINAMICS topology
- Create the function of the output cam
- Extend the S7 user program.

Connect the supply voltage to the TM 17 terminal module.

To create a TM17, follow these steps:

1. Switch to the **S120_CU320 > Input/output components** folder in the S7T Config project navigator.
2. Click "Insert input/output components".

The "Insert input/output components" dialog will be displayed.



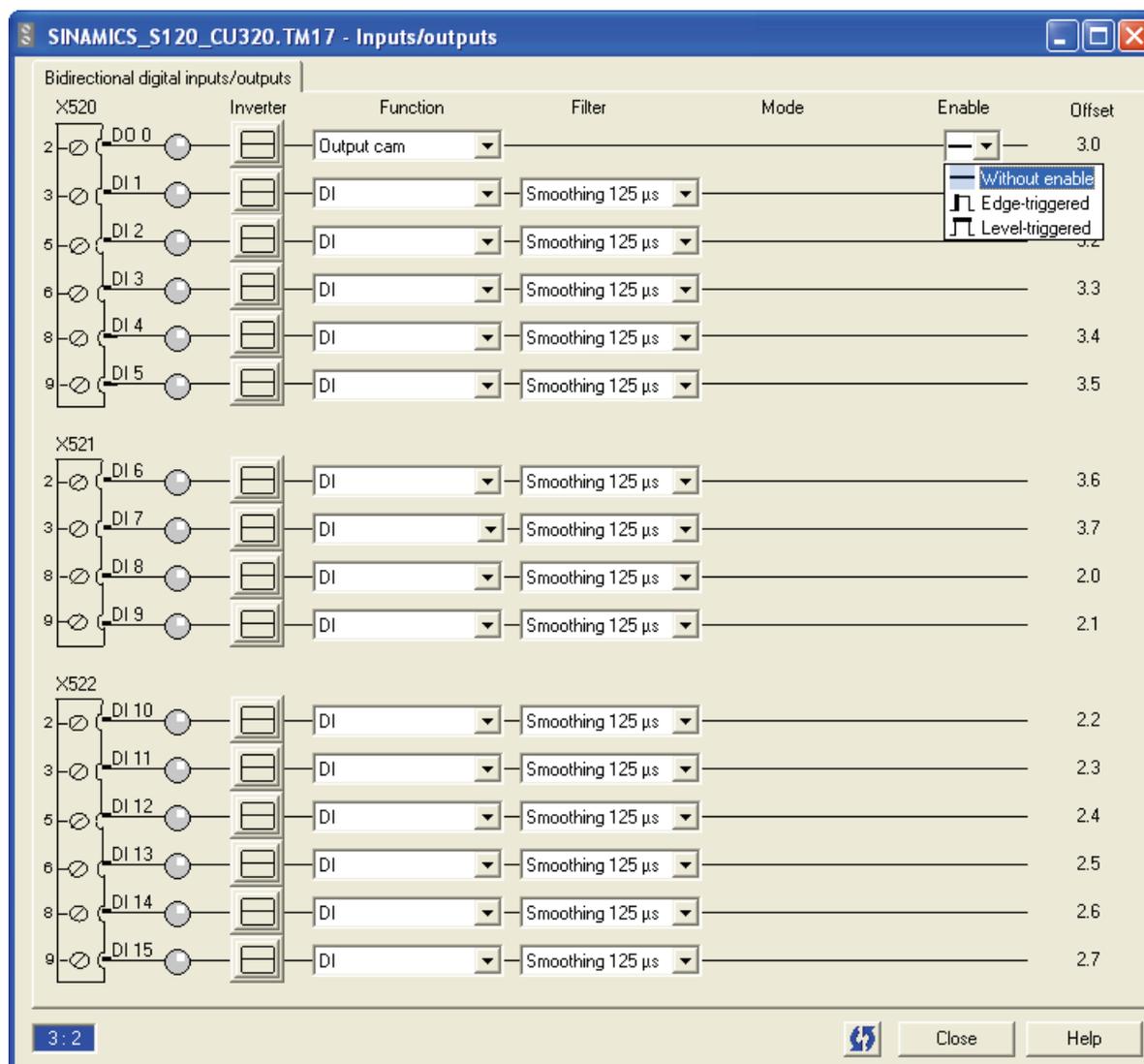
3. Select the TM17 drive type from the selection list.
4. Enter "TM17" in the "Name" field for this example.
5. Click "OK" to accept the settings.

Assigning parameters to the TM17 terminal module

To perform the parameterization of the TM17 terminal module, follow these steps:

1. Switch to the S120_CU320 > Input/output components > TM17 folder in the S7T Config project navigator.
2. Click "Inputs/outputs".

The "Inputs/outputs" dialog will be displayed.



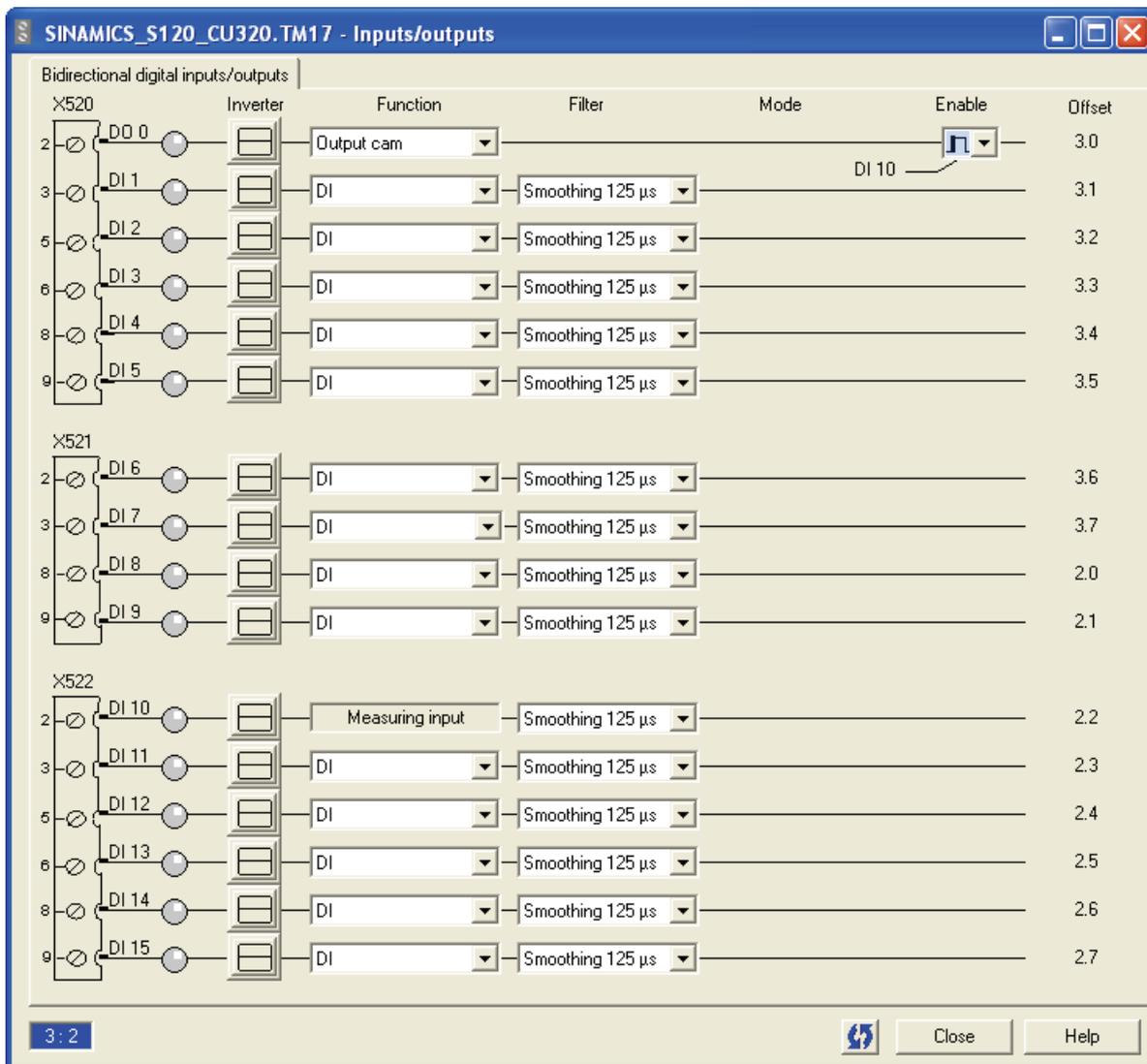
3. Enter the "Output cam" function in the "Function" column for the DI/O 0 input.

5.7 Triggering an output cam using the TM17 terminal module

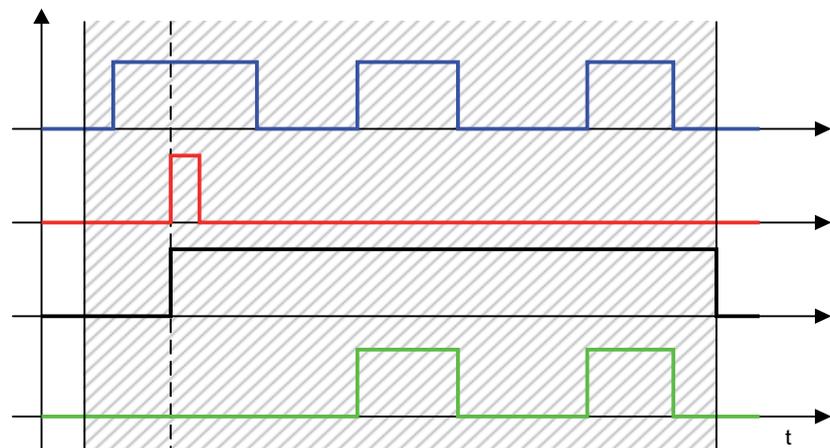
- For the further processing, note the entry from the "Offset" column. This value, in this example "3.0", is needed for subsequent address assignment of the output cam.

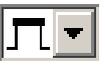
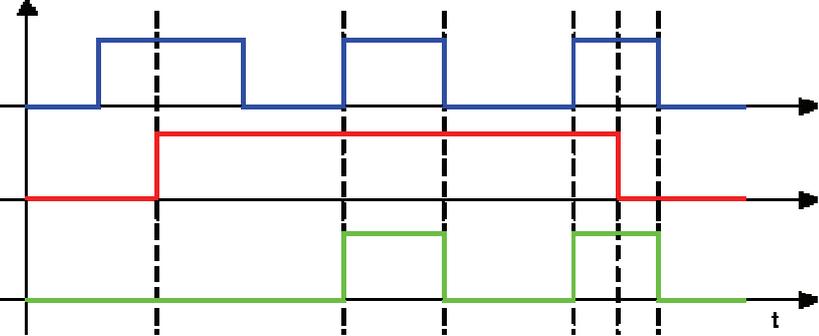
In the next step, the input/output addresses must be assigned to the TM17 terminal module so that it can be reached on the PROFIBUS DP(DRIVE). You will need to align with HW Config.

- You select how the output cam output is to be enabled in the "Enable" column. When you use the "edge-triggered" or "level-triggered" mode, a digital input of the TM17 will be automatically assigned to the output cam output. This assigned input serves as the hardware enable signal for the output cam.



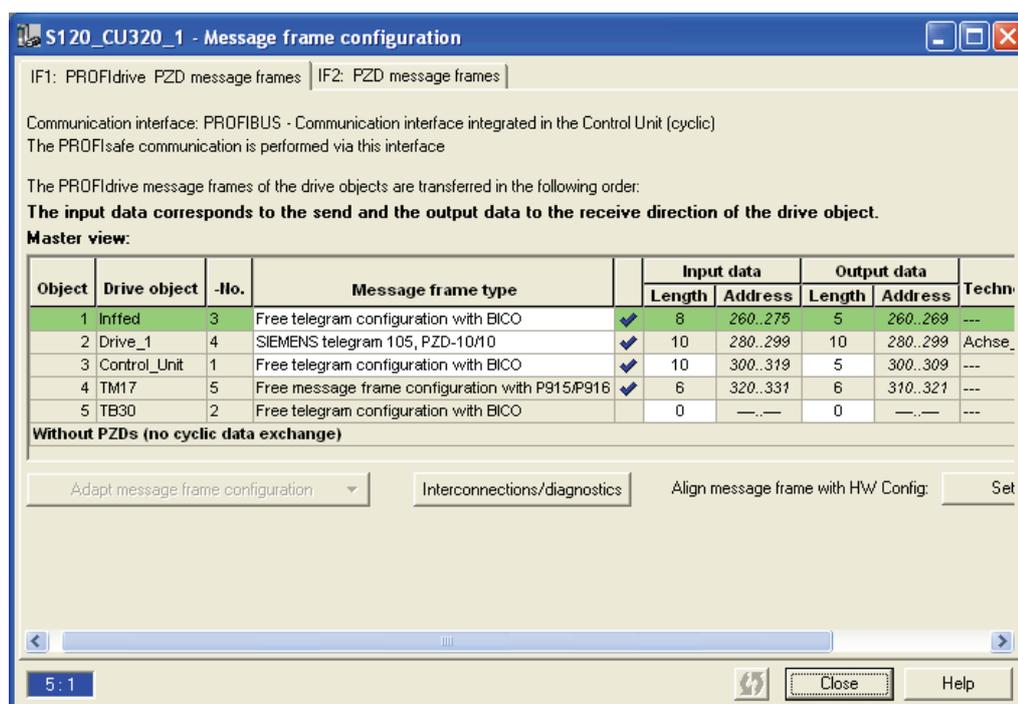
The following table shows the 3 selection possibilities:

Icon	Description	
	Without enable	No enable condition. The output cam will be output directly.
	Edge-triggered	<p>A measurement request for the configured measuring input will be issued on the assigned input of the TM17 High Feature (measuring input technology object activated).</p> <p>If the configured edge is then acquired at this input, the active output of the output cam will be enabled.</p> <p>As soon as a new measurement request is issued, the enable for the active output will be reset.</p> <p>The enable signal for the TM17 High Feature (edge) must be present before an output cam is triggered. If the enable takes place within an output cam, it is not output. The following output cams, however, will be output.</p>  <p>Measurement request 1</p> <p>Measurement request 2</p> <ul style="list-style-type: none"> ■ Switching signal for output cam TO ■ Digital input for enable ■ Status of the enable ■ Digital output of the output cam

Icon	Description	
	<p>Level-triggered</p>	<p>The output cam will continue to be output at the output while the output cam in the technology object is active and a parameterized enable signal is present at the TM17 High Feature.</p>  <p> ■ Switching signal for output cam TO ■ Digital input for enable ■ Digital output of the output cam </p>

Configuring a message frame

1. For the alignment with the hardware configuration, switch to the **S120_CU320 > Communication > Message frame configuration** dialog in the S7T Config project navigator. The work area shows the newly added TM17 terminal module.
2. Click "Align message frame with HW Config: Set up addresses".



Following the alignment with HW Config, the TM17 terminal module is assigned the input/output address via which it can be reached on PROFIBUS DP (DRIVE).

3. For the further processing, note the entry of the TM17 row from the O Address column. This address, in this example 310..321, is needed for the subsequent address assignment for the output cam.

The Technology CPU configuration has been changed as a result of inserting the TM17 terminal module and aligning with HW Config.

Note

Close the message frame configuration after the alignment with HW Config. Otherwise, it will not be possible to make subsequent changes to the hardware configuration.

4. To transfer the changed configuration to the Technology CPU, open the HW Config hardware configuration and perform a download.

Note

The alignment in HW Config has caused the message frame to be extended with the TM17 component. Because this means that the PROFIdrive message frame has become longer, error messages for the DP configuration can occur. (DP cycle too small). If necessary, check your setting for PROFIBUS DP.

Checking the Drive CLiQ topology

Finally, the Drive CLiQ topology should be checked to determine whether the technology module has been integrated correctly. To check the Drive CLiQ topology, follow these steps:

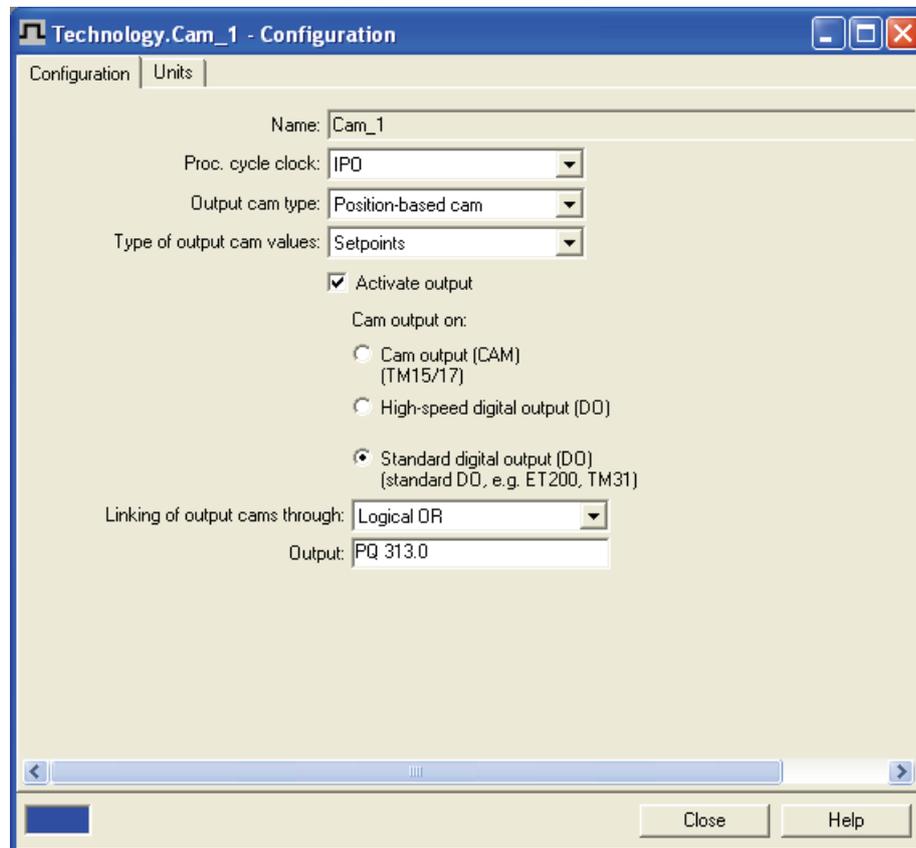
1. Switch to the **S120_CU320 > Topology** dialog in the S7T Config project navigator.
2. Compare the Drive CLiQ connection of the parameter assignment with your configuration and adjust the topology or the configuration as appropriate.
3. To create an output cam, switch to the **Technology > Axes > Axis_2 > Output cam** folder in the S7T Config project navigator.
4. Insert the output cam in the project by clicking "Insert output cam".

The "Insert output cam" dialog will open.

5. Click "OK" to accept the unchanged settings.

Ensure that the "Open editor automatically" field is marked.

The cam configuration dialog opens automatically.



6. Enter the following outputs address for the configuration of the output cam as a fast output on a TM17 module: 313.0.

The address 313 is derived from the offset address of TM17 of 3 bytes and from the PROFIBUS address of the TM17 module of 310 bytes.

The bit address results from the use of the first DI/O 0 output on the TM17 terminal module.

7. Choose from three different types of output cam:
 - **Position-based cam:** The switching signal is on when the position of the axis lies between two marks (start and end position).
 - **Time-based cam:** The switching signal is activated for a specific duration of time after the switching position is reached (start position).
 - **Uni-directional output cam:** The switching signal is on when the axis has reached the switching position (start position).. The output cam remains activated even after the start position has been passed several times. The output cam must be reset explicitly.
8. In the "Proc. cycle clock" drop-down menu, select the time at which the output cam will be processed. Because in this example a fast output cam has been created on the TM17 module, the processing cycle clock should be set to IPO for this example.
9. In the "Type of output cam values" drop-down menu you decide whether the processing of the output cam is based on the current setpoint or current actual value.

Result

This completes the configuration in S7T Config.

Creating the S7 user program

As next step, create the user program.

Use the Technology Object Manager (TOM) to create a technology data block (TO-DB) assigned to the "Output cam" technology object. The technology data block (TO-DB) allows execution of the functions on the associated technology object using the provided FBs. For controlling the output cam, use the MC_CamSwitch or MC_CamSwitchTime function block in your S7 program.

If you have configured an additional level or edge-triggered hardware enable as described above, use the MC_MeasuringInput function block for the associated required measuring input function.

5.8 Triggering of a brake

5.8.1 Vertical axis application case

Introduction

When a braking sequential control is used in conjunction with a vertical axis, the axis should remain at its position when the system is shutdown or in a fault situation.

The axis enable can be reset by an alarm in the technology CPU or by disabling the MC_Power function (Enable input = false).

The extended brake control should allow the ON/OFF1, OFF2, OFF3 and enable operation (enable pulse) bits to be switched off sequentially. This ensures that the brake is already closed when the pulse enable for the axis is disabled, thus preventing the axis from twisting / sagging.

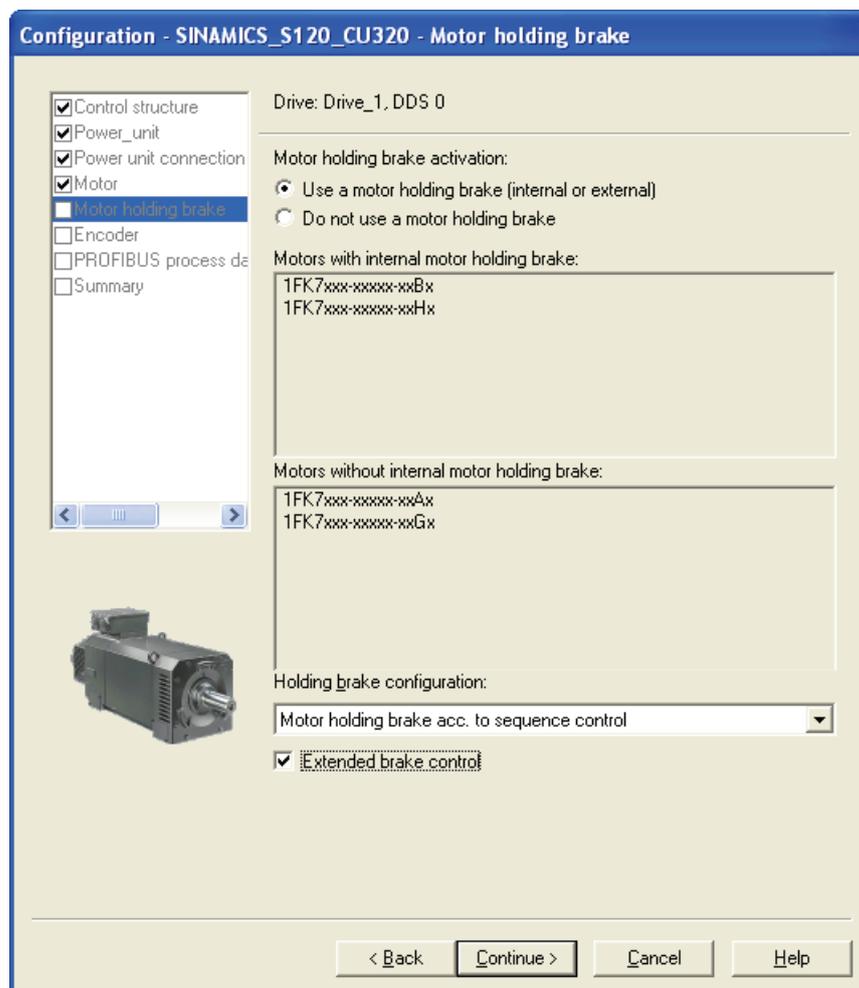
5.8.2 Activating braking sequential control in SINAMICS

Introduction

To activate the "extended braking sequential control", settings must be made in the configuration wizard of the drive. To do this, switch to the "\SINAMICS_S120 \drives \drive_1" dialog in the project navigator of S7T Config, and open the drive configuration.

Procedure

1. Switch to the "Motor holding brake" dialog box in the configuration wizard and activate the following functions there:
 - "Motor holding brake acc. to sequential control"
 - "Extended brake control"



2. Further configuring of the drive is made as described in the "Commissioning (Page 15)" chapter of this product information.

Note

You must select the "Motor holding brake acc. to sequential control, brake connection via BICO interconnection" option if an external motor holding brake is to be used, and the specified digital contacts in the motor connection terminals X1 or X2 of the motor module are not to be used. The external holding brake will then be controlled via free digital outputs. This means that there will be no automatic check to see if a motor holding brake is present.

5.8.3 Activating braking sequential control in the axis

Introduction

The enable bits ON/OFF1, OFF2, OFF3 and operation enable (pulse enable) of the axis are coordinated via the braking control that is integrated in the drive. This means that, when the axis is switched off normally or in the event of an axis error, you can make sure that the brake is already closed before the pulse enable is cancelled, hence preventing the axis from sagging.

There are two different operating states:

- Switch axis on / off normally using MC_Power
- Switch off the axis in the event of axis errors with error response "RELEASE_DISABLE"

Procedure for configuring switching the axis on / off normally using MC_Power

You configure an axis to switch on / off normally with braking control using the stop modes on the MC_Power block:

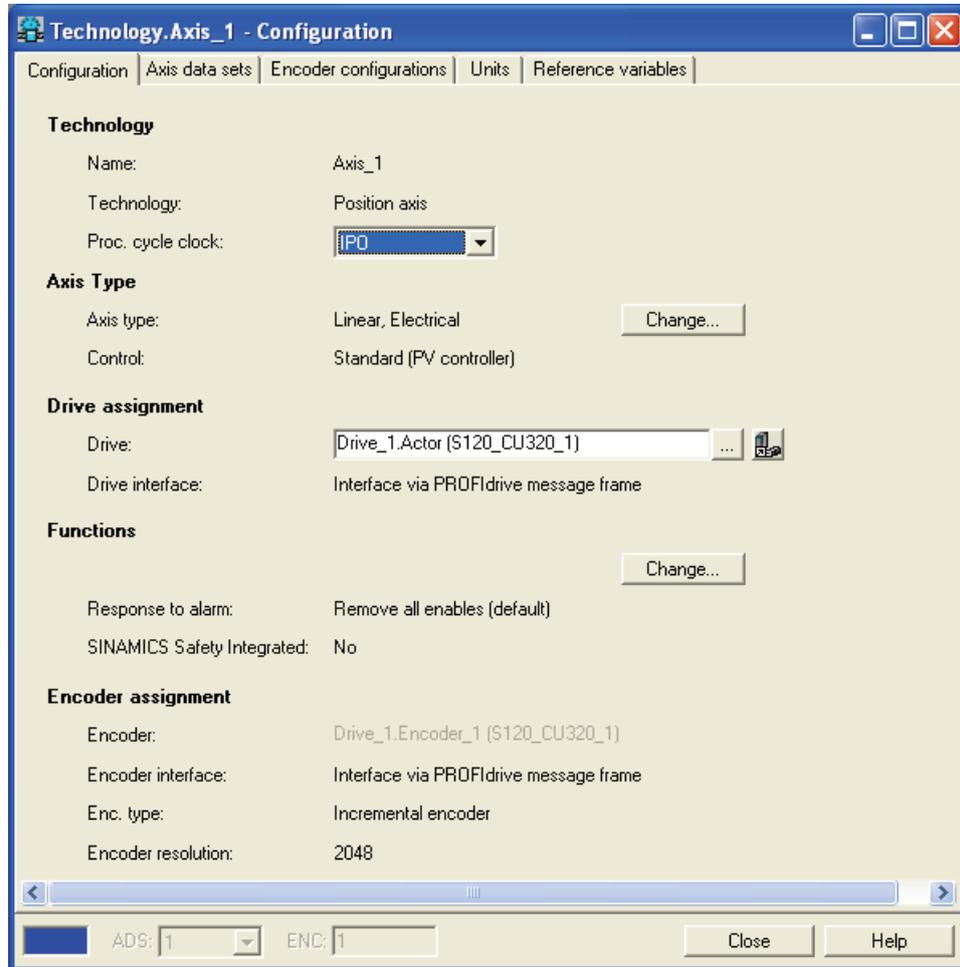
Stop mode	Name	Description
3	Coast stop (OFF2)	The drive coasts to a standstill without power; the brake closes immediately
5	Ramp stop (OFF1)	Stops the axis via the ramp function encoder
6	Fast stop (OFF3)	Stops the axis via a fast stop ramp

You can find further information in the Online Help for the MC_Power block.

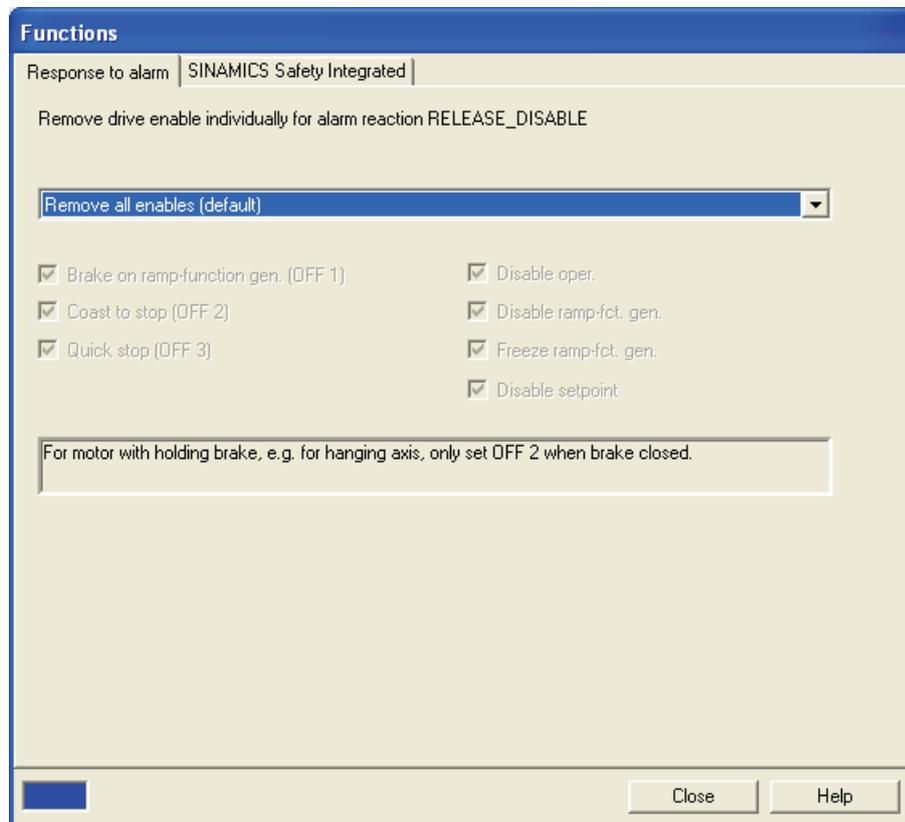
Procedure for configuring the axis response to axis errors with error response "RELEASE_DISABLE"

The response of the axis to axis errors with the "RELEASE_DISABLE" error response is set by changing the configuration in S7T Config.

- Switch to the configuration dialog for the axis and click the "Functions: Change..." button.

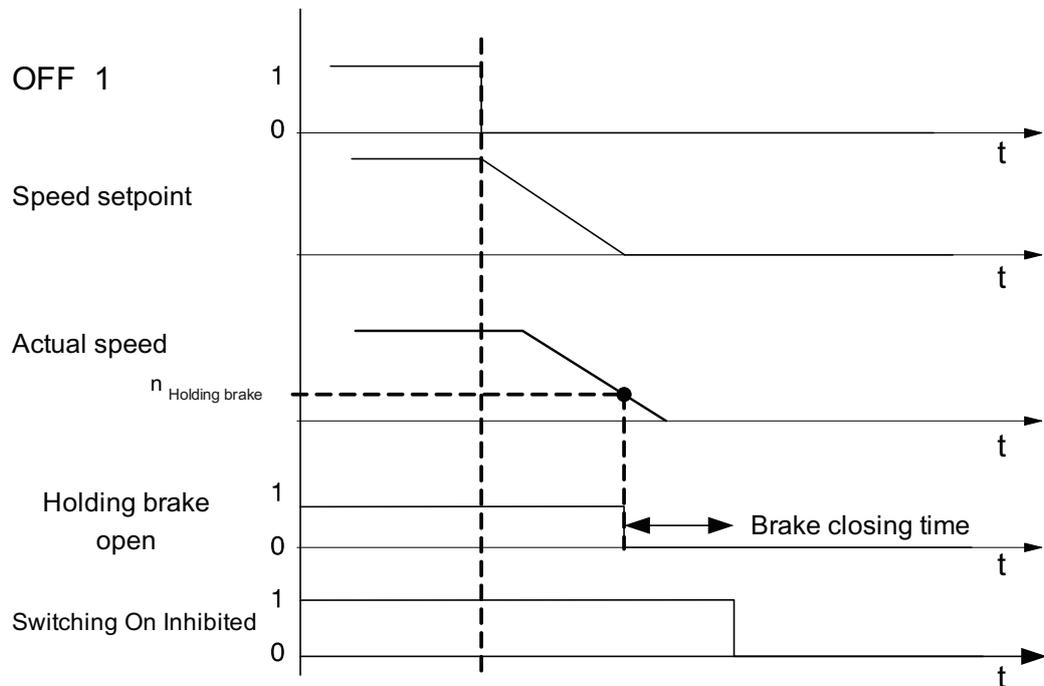


- Select the required response by the axis to interrupts with an error response "RELEASE_DISABLE".



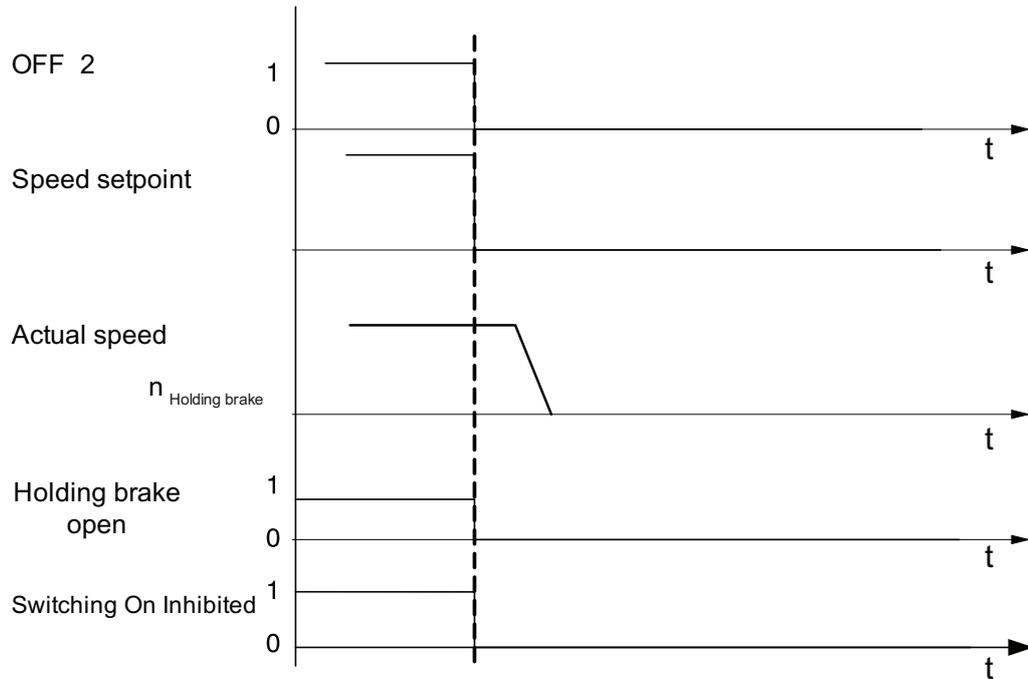
Ramp stop (OFF1):

Braking takes place at the drive's ramp function encoder ramp. When the speed threshold is reached, the holding brake is enabled which disables the pulse enable once the brake closing time has elapsed.



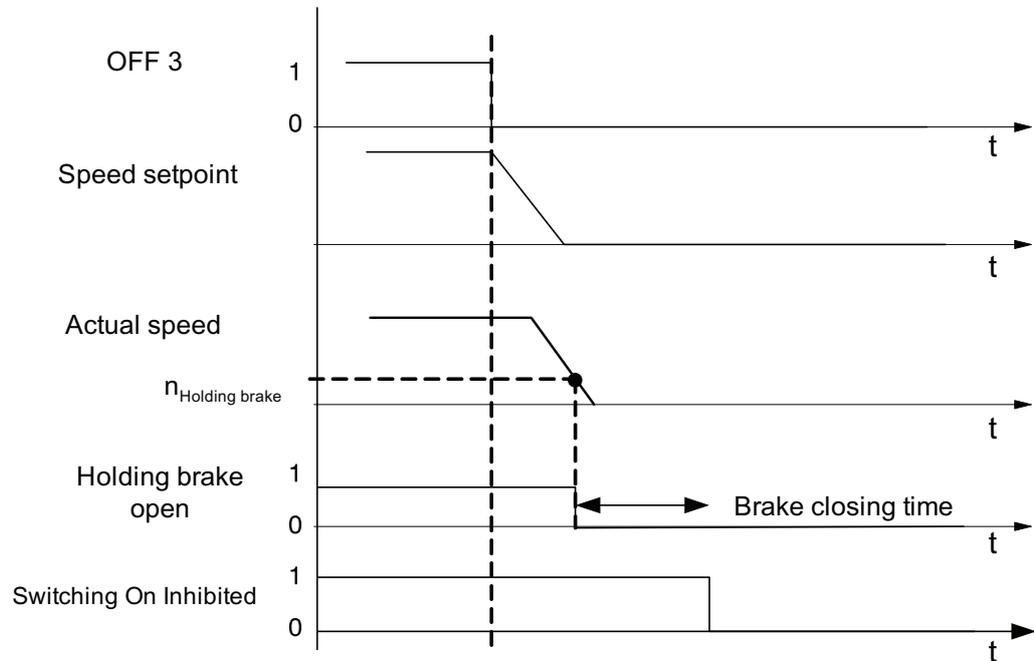
Coast stop (OFF2):

In this case the power enable is cancelled immediately, and the drive costs to a standstill. In parallel, the mechanical braking control is enabled immediately. This engages the brake, which actively brakes the drive. The mechanical stress on the brake depends on the load to which it is subjected.



Fast stop (OFF3):

The drive is braked at the fast stop ramp (emergency stop). When the speed threshold is reached, the holding brake is enabled which disables the pulse enable once the brake closing time has elapsed.



Safety Integrated Functions in SINAMICS Drive Systems

6

6.1 Safety Integrated Functions - Overview

This section describes the use of SINAMICS drive systems with Safety Integrated functions together with a CPU 31xT(F)-2 DP.

Prerequisites

The SINAMICS S120 Safety Integrated Function Manual contains all information on Safety Integrated functions of the SINAMICS S120 drives. The manual is available in the SINAMICS documentation DOConWEB in the Internet (<http://www.automation.siemens.com/doconweb/>).

Topics overview

This document contains information on the following topics:

Safety Integrated functions in SINAMICS S120 drive systems (Page 184)

Support of the SINAMICS Safety Integrated functions - Overview (Page 186)

Safety status displays and error messages (Page 195)

Behavior and reactions in the user program (Page 198)

Safety Integrated functions without configured support of the extended functions (Page 202)

Control via PROFIsafe (Page 203)

6.2 Safety Integrated functions in SINAMICS S120 drive systems

The following Safety Integrated functions are available for SINAMICS S120:

- Basic functions
- Extended functions

Basic functions

These functions are part of the standard scope of the drive and can be used without requiring an additional license:

- Safe Torque Off (STO)

STO is a safety function that prevents the drive from restarting unexpectedly, in accordance with EN 60204-1:2006 Section 5.4.

- Safe Stop 1 (SS1, time controlled)

Safe Stop 1 is based on the "Safe Torque Off" function. This means that a Category 1 stop in accordance with EN 60204-1:2006 can be implemented.

- Safe Brake Control (SBC)

The SBC function permits the safe control of a holding brake.

SBC is only supported by power/motor modules of the chassis model with the order number ...3 or higher. Blocksize power modules also require a safe brake relay for this function.

Extended functions

The following functions are available in addition to the Basic functions:

- Safe Stop 1 (SS1, time and acceleration controlled)

The function SS1 is based on the "Safe Torque Off" function. This means that a Category 1 stop in accordance with EN 60204-1:2006 can be implemented. The drive brakes after "Safe Stop 1" with OFF3 ramp (p1135) was selected and then goes into the "Safe Torque Off" (STO) state on expiration of the delay time (p9356/p9556) or when reaching the shutdown speed (p9360/p9560).

- Safe Stop 2 (SS2)

The SS2 function brakes the motor safely with a subsequent transition to "Safe Operating Stop" (SOS).

- Safe Operating Stop (SOS)

The SOS function protects against unintentional motion. The drive is in closed-loop control mode and is not disconnected from the power supply.

- Safely-Limited Speed (SLS)

The "Safely-Limited Speed" (SLS) protects against excessively high drive speeds.

- Safe Speed Monitor (SSM)

The SSM function safely monitors the speed limit and issues a safe output signal, but without initiating a response function.

Controlling Safety Integrated functions

Safety Integrated functions can be controlled as follows:

- Via terminals
- Via a PROFIsafe message frame using PROFIBUS
- Via the terminal module TM54F - for the extended functions

Controls can be selected simultaneously via terminals and TM54F or terminals and PROFIsafe.

Hardware components that support the extended functions

- Control Unit CU310 with order no.: 6SL3040-0LA00-0AA1/6SL3040-0LA01-0AA1
- Control Unit CU320 with order no.: 6SL3040-...-0AA1 and version C
- Control Unit CU320-2
- CX32 (without restrictions)
- Motor Modules Booksize with order no.: ...3 or higher
- Motor Modules Booksize Compact
- Power Modules Blocksize
- Control Unit adapter CUA31 with order no.: 6SL3040-0PA00-0AA1
- Control Unit adapter CUA32 with order no.: 6SL3040-0PA01-0AA0
- Sensor Module SMC20, SME20/25/120/125

Requirement for Extended functions

- License for Safety Integrated extended functions
In contrast to the basic function, an appropriate license is required to use the Safety Integrated extended functions. An insufficient license is indicated via the following alarm and LED:
 - A13000 -- > License not sufficient
 - LED READY -- > Flashes green/red at 0.5 Hz
- Control via PROFIsafe or TM54F
- A safe actual value acquisition
- An activated speed controller in the drive

6.3 Support of SINAMICS Safety Integrated functions by the T(F)-CPU

6.3.1 Support of the SINAMICS Safety Integrated functions - Overview

Support of the SINAMICS Safety Integrated Basic functions

No special support is required on the Axis technology object for the SINAMICS Safety Integrated Basic functions. The performance of the safety-related stop reactions (STO SS1) is ensured by the standard functionality of the drive.

Note

Observe the notes provided in the section Safety Integrated functions without configured support of the extended functions (Page 202).

Support of the SINAMICS Safety Integrated extended functions

As of SIMATIC S7 Technology version 4.2, the SINAMICS Safety Integrated extended functions for the Axis technology object are supported in the following form:

- Display of the status of the safety function in the drive in the TO DB of the axis
- Message of a new safety event in the safety message buffer of the drive (error message in the TO DB of the axis)
- Message of the status for SLS, SOS and SS2 (error message in the TO DB of the axis)

6.3.2 Activating the support of SINAMICS Safety Integrated functions

Activating the support of the SINAMICS Safety Integrated functions

To activate the support of the SINAMICS Safety Integrated functions for the Axis technology object, proceed as follows:

- Configure the safety functions in the drive (see *SINAMICS Safety Integrated* function manual).
- When controlling the safety functions via PROFIsafe, configure the PROFIsafe communication to the higher-level **SIMATIC T-CPU** (see section Control via PROFIsafe (Page 203) , Configuration with TF-CPU) or **SIMATIC T-CPU** (see section Control via PROFIsafe (Page 203) , Configuration with T-CPU and F-CPU).
- Configure the safety data block as an extension of the standard message frame (see Message frame structure and Configuring the safety data blocks).
- Configure the axis.

The individual tasks are described in detail in the following sections.

The activation of the *SINAMICS Safety Integrated Extended Functions* data is displayed in the configuration dialog of the axis.

Note

The integrated technology of the SIMATIC CPU 31xT(F) has no safety-related functionality, but does provide support for SINAMICS drives that can perform safety-related functions.

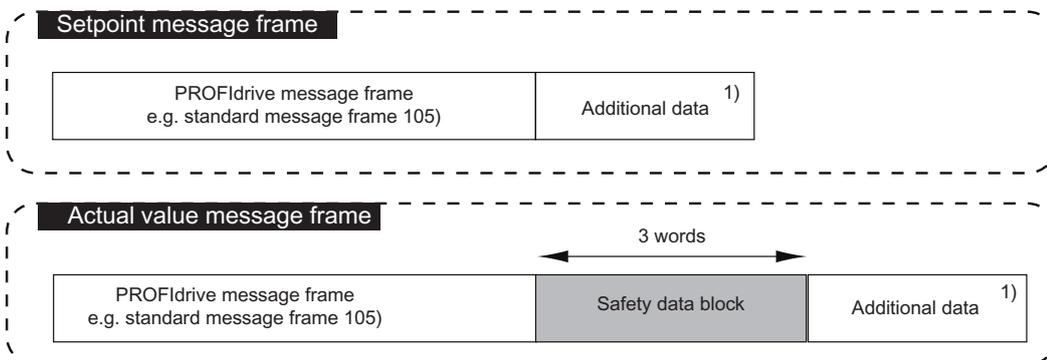
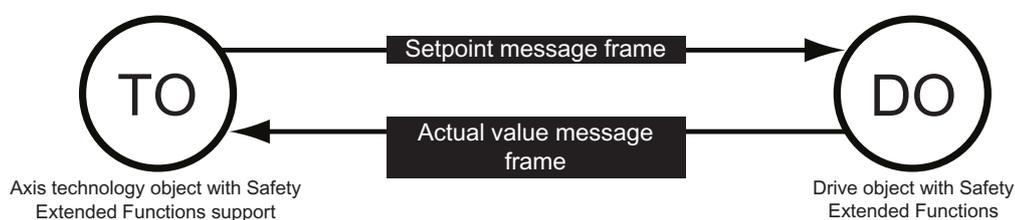
6.3.3 Message frame structure

Safety data block

The SIMATIC S7 Technology support for SINAMICS Safety Integrated extended functions requires an extension of the actual value message frame with the safety data block (3 words). The message frame extension of the input data of the axis message frame is set in S7T Config using the dialog, SINAMICS Device > Communication > Message frame configuration.

Structure of the drive message frame

The following figure shows the structure of the drive message frame with safety data block.



1) Optional

Note

The PROFIdrive actual value message frame including the safety data block is received by the integrated technology of the T(F)-CPU. The safety data block is used exclusively by the Axis technology object and the user program to obtain information on the status of the Safety Integrated functions of the drive. The safety data block enables the Axis technology object and the user program to respond to the SINAMICS Safety Integrated functions.

NOTICE

The safety data block is not a fail-safe mechanism.

Content of the safety data block in the actual value message frame

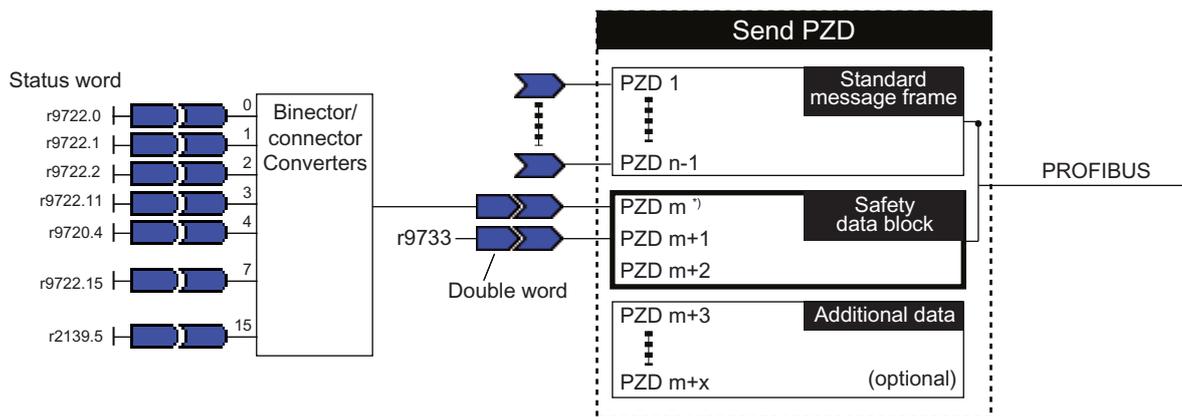
Word	Meaning
1	Safety status word
2	Effective absolute set velocity limitation in the drive Note: This double word must be interconnected with r9733[0]. (r9733[0] = p9531[x] * p9533 / p9520 x is the selected SLS level)
3	

Table 6- 1 Structure of the safety status word in the safety data block

Bit	Status	Name of identifier		Interconnection in the drive
0	STO is active	STO_ACTIVE	1-active	r9722.0
1	SS1 is active	SS1_ACTIVE	1-active	r9722.1
2	SS2 is active	SS2_ACTIVE	1-active	r9722.2
3	SOS is selected.	SOS_SELECTED	1-active	r9722.11
4	SLS is selected.	SLS_SELECTED	0-active	r9720.4
5	Reserved			
6	Reserved			
7	SSM (n below limit)		1-active	r9722.15
8	Reserved			
9	Reserved			
10	Reserved			
11	Reserved			
12	Reserved			
13	Reserved			
14	Reserved			
15	An internal event has occurred and at least one new event is present in the Safety Fault Buffer (see below <i>Safety message buffer</i>)	INTERNAL_EVENT	1-active	r2139.5

6.3.4 Extension of actual value message frame in S7T Config

The safety data block must be connected in S7T Config to the actual value message frame of the drive. To do this, you need to extend the actual value message frame by 3 words (input data of the axis message frame from the view of the master) and connect user-defined process data using a binector connector converter, as shown in the figure below.



*) When technology data block present: $m = n + 1$
When no technology data block present: $m = n$

Figure 6-1 Interconnection of the safety data block to the actual value message frame in the drive

Extending the PROFIdrive actual value message frame

To configure the message frame extension in S7T Config, proceed as follows:

1. In S7T Config, open the message frame configuration of the drive. To do this, select SINAMICS Device > Communication > Message frame configuration in the project navigation.
2. Click "Adapt message frame configuration > Add PROFIsafe", to add a PROFIsafe message frame.
3. Extend message frame 105 by 3 words of input data, 0 words of output data (from the master view) for the safety data block.
4. Click "Align message frame with HW Config: Set up addresses" to have the message frame address set in the "Input data" and "Output data" columns.

IF1: PROFIdrive PZD message frames | IF2: PZD message frames

Communication interface: PROFIBUS - Communication interface integrated in the Control Unit (cyclic)
The PROFIsafe communication is performed via this interface

The PROFIdrive message frames of the drive objects are transferred in the following order:
The input data corresponds to the send and the output data to the receive direction of the drive object.

Master view:

Object	Drive object	-No.	Message frame type	Input data		Output data		Technology object
				Length	Address	Length	Address	
1	Infeed	5	SIEMENS telegram 370, PZD-1/1	1	256..257	1	256..257	---
2	Drive_1	6	PROFIsafe	3	67..72	3	67..72	---
			SIEMENS telegram 105, PZD-10/10	10	262..281	10	262..281	---
			Message frame extension	3	282..287	0	---	---
3	Control_Unit	1	Free telegram configuration with BICO	2	258..261	2	258..261	---
4	TB30_04	4	Free telegram configuration with BICO	0	---	0	---	---

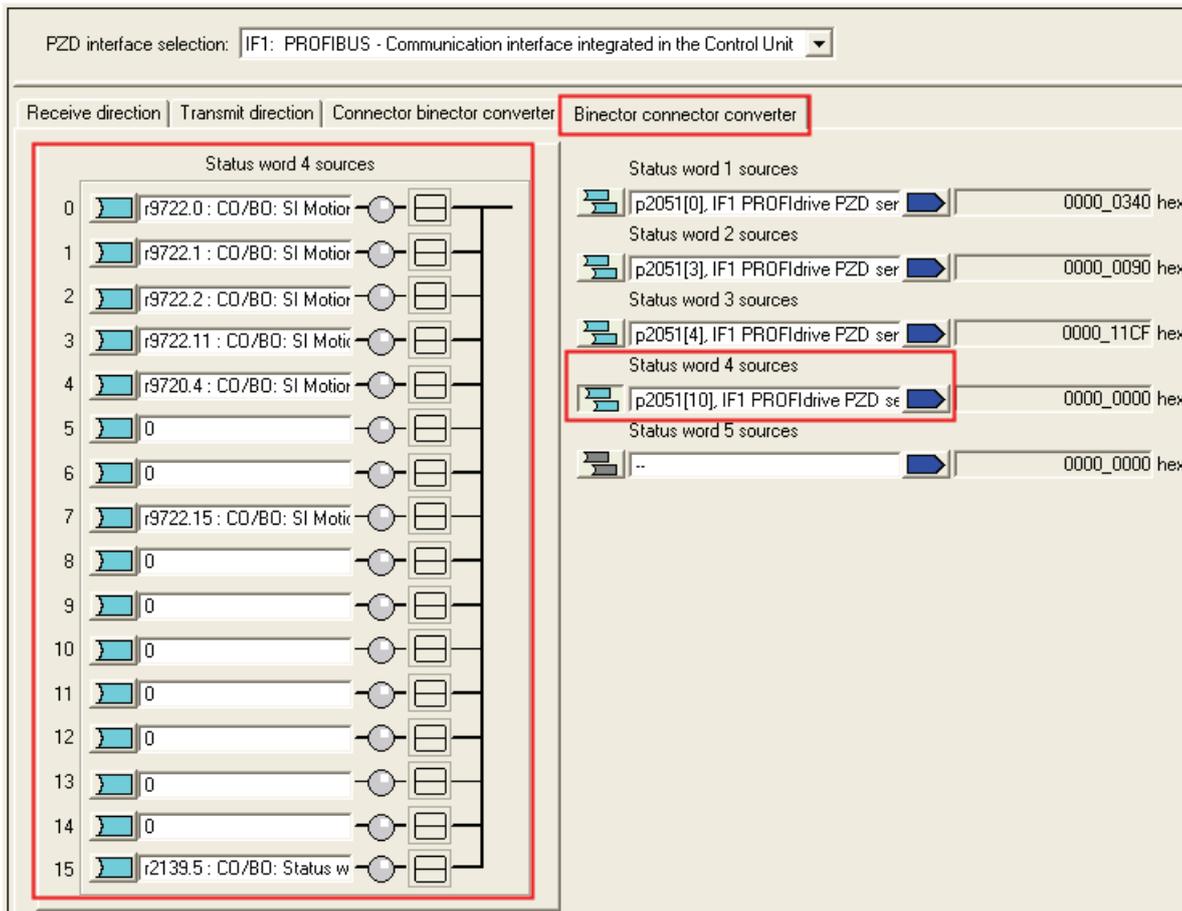
Without PZDs (no cyclic data exchange)

Adapt message frame configuration ▼ Interconnections/diagnostics Align message frame with HW Config: Set up

4 : 1 Close Help

5. Click "Interconnections/Diagnostics" to configure the message frame extension.

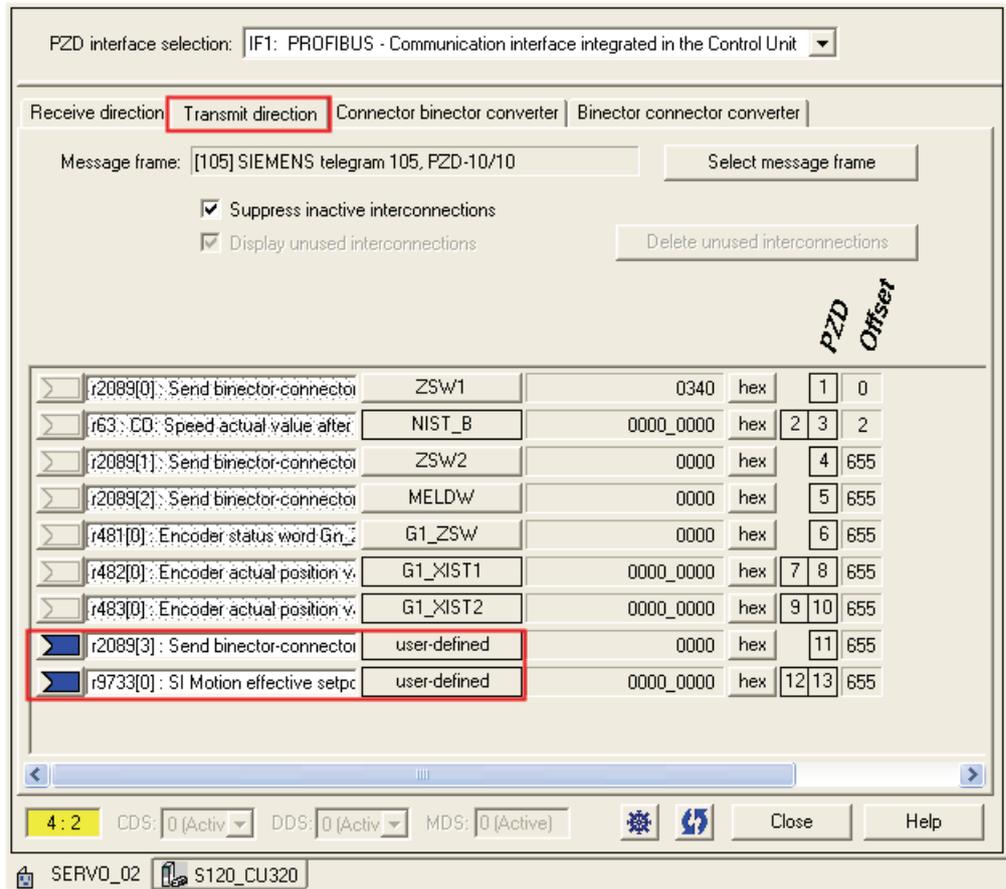
6.3 Support of SINAMICS Safety Integrated functions by the T(F)-CPU



6. In the "Binector Connector Converter" tab, interconnect the free status word as shown in the figure above.

6.3 Support of SINAMICS Safety Integrated functions by the T(F)-CPU

7. In the "Transmit direction" tab, assign the interconnected binector connector converter and the r9733 of the message frame extension to one another. Free interconnections are only shown when the "Suppress inactive interconnections" check mark is cleared.



See also

Extending the PROFIdrive message frame in S7T Config (Page 138)

6.3.5 Configuration data of the Axis technology object

Configuration data for the SINAMICS Safety Integrated extended functions

If safety commissioning of the SINAMICS Safety Integrated extended functions in the drive has already been performed and the data has been loaded into the configuration (Load to PG), click the "Data transfer from the drive" button (drive assignment in the axis wizard) to make these settings.

If this is not necessary, you can disable the SINAMICS Safety Integrated extended functions support again by using the **technologicalData.driveSafetyExtendedFunctionsEnabled=NO** configuration data.

Note the information in the following paragraph if you are not using an Axis wizard or if you want to check an existing configuration.

Configuration of the SINAMICS Safety Integrated extended functions for an axis

To configure the SINAMICS Safety Integrated extended functions, proceed as follows:

- Set the **technologicalData.driveSafetyExtendedFunctionsEnabled** configuration data element to YES. This step activates the support of the Safety Integrated extended functions.
- Enter the logical base address for the safety data block in **technologicalData.driveSafetyExtendedFunctionsInfoDataIn.logAddress**.

The logical base address for the safety data block in **technologicalData.driveSafetyExtendedFunctionsInfoDataIn.logAddress** is derived as follows:

Base address standard message frame + (m-1) * 2

(m is the number of process data (PCD) in which the safety data block starts).

- Set the configuration data **driveControlConfig.pulsesEnabled.pzd** and **driveControlConfig.pulsesEnabled.bitNumber** corresponding to the message frame configuration:
 - Standard message frame 2-6
pzd = 4; bit = 10 (ZSW2; "enable pulses")
 - Ten SIEMENS message frames
pzd = 5; bit = 13 (message word; "enable pulses")

Note

Standard message frame 1 cannot be used.

Ensure for standard message frames and SIEMENS message frames that p2038 = 0 or p2038 = 1 has been set in the drive.

6.4 Safety status displays and error messages

Display of the status information

If **technologicalData.driveSafetyExtendedFunctionsEnabled** is equal to YES and the logical basic address of the Safety data block correct, then the following information will be displayed by variables in the TO_DB Axis:

- **StatuswordSafety**

Display of the safety status word (for the structure, see table in section Extension of actual value message frame in S7T Config (Page 190)).

The safety status word can be used to evaluate the status of the drive safety functions in the user program. The status is required for SOS and SLS to move the axis from the user program to the permitted operating range.

NOTICE
SLS_SELECTED in the Safety status word in safety data block 0 is active and is therefore labeled as SLS_Deselected in a TO DB of the axis.

- **SafeSpeedLimit**

Effective absolute set velocity limitation in the drive from the safety data block, also refer to the above table for the structure of the safety data block.

If SLS is selected, **safeSpeedLimit** contains the weighted set velocity at which the Axis technology object may run.

Note

The value in **safeSpeedLimit** is already weighted with the 9533 parameter and does not represent the maximum possible set velocity for $p9533 < 100\%$.

For activated Safely Limited Speed, the axis must be run below the limit value (and not at the limit value). To reduce the velocity to **safeSpeedLimit**, ensure that the application observes the distance to the actual monitored limit value in the drive. Reduction either on the drive side using the p9533 parameter or using a programming reduction factor.

If **technologicalData.driveSafetyExtendedFunctionsEnabled** equals NO, the Axis technology object does not support SINAMICS Safety Integrated extended functions. In **StatuswordSafety** and **SafeSpeedLimit**, zero is displayed or the contents are irrelevant.

Note

For this information to be updated, you need to interconnect the relevant SINAMICS parameters with the safety data block using the binector connector converter. You can find a description of this interconnection under Extension of actual value message frame in S7T Config (Page 190).

Messages to the user

The messages of the SINAMICS Safety Integrated Extended functions are displayed as Error in the TO DB of the axis (StatuswordSafety).

- **Error ID 8140: Safety alarm in the drive**

A new event is present in the safety message buffer of the drive.

- **Error ID 8141: SINAMICS Safety Integrated Extended Function is selected**

If the SS2/SOS/SLS safety functions are selected, error ID 8141 is signaled. When an automatic transition to SOS is carried out as part of SS2 selection, then error ID 8141 will not be signaled. The message is for information only.

- **Error ID 8142: SINAMICS Safety Integrated Extended Function is deselected**

If the SS2/SOS/SLS safety functions are deselected, error ID 8142 is signaled. When SS2 is deselected, error ID 8142 is signaled only once, even though this process also deselected SOS. The message is for information only.

Note

The errors are displayed on the Axis technology object only when the support is configured for the SINAMICS Safety Integrated extended functions.

When STO and SS1 are selected, only error ID 8010 will be signaled, similar to the basic functions. For SS1, the error will not be triggered until the braking ramp is complete. There is no error to signal that the functions have been deselected.

Safety message buffer in the SINAMICS S120 drive

Errors in the safety function in the drive itself or stop responses initiated by monitoring functions will be displayed in the drive using a safety fault. The safety faults are stored in the safety message buffer.

Table 6- 2 Structure of the safety message buffer

Parameter	Meaning
r9744	Message buffer change count
r9747 [0...63]	Message code
r9748 [0...63]	Message time arrived in ms
r9749 [0...63]	Additional information
r9752	Messages counter
r9754 [0...63]	Message time arrived in days
r9755 [0...63]	Message time sent in ms
r9756 [0...63]	Message time sent in days

Safety faults can only be acknowledged fail-safe:

- By a fail-safe CPU via the PROFIsafe-Signal Internal_Event_Acknowledge bit 7 of the PROFIsafe control word
- or
- via a terminal on the TM54F

An entry in the safety message buffer is displayed with bit 15, Internal_Event, in StatuswordSafety in the TO DB of the axis. If this bit is set, error ID 8140 will be displayed in the TO DB of the axis.

The cause of the fault can be read by the user program from the p9744-p9756 drive parameters.

6.5 Behavior and reactions in the user program

The safety functions in the drive are either selected or deselected using a F-CPU (e.g. SIMATIC S7 CPU 317TF) using safe PROFIsafe communication or using a safety-related SINAMICS TM54F terminal module. The selection and deselection of the safety functions is made independent of the technology user program.

The SS2, SOS and SLS safety functions contain monitoring functions that must be supported by the technology user program to place or keep the drive in the monitored operating mode. If the monitored limits are exceeded, this causes a safety-related stop response in the drive.

You can use the **StatuswordSafety** variable in the TO DB of the axis to evaluate the safety status word.

Safe Torque Off (STO) and Safe Stop 1 (SS1)

When the **STO** is selected, pulse suppression will be activated directly in the drive: A moving motor coasts to standstill.

When **SS1** is selected, the drive independently decelerates on the OFF3 ramp with speed control ($n = 0$) and enters pulse suppression after a configured delay time or when reaching the shutdown speed.

The drive reaction to STO or SS1 will be displayed in the ErrorBuffer of the TO DB of the axis with error ID 8010.

If support for the extended functions has been configured on the axis (see Activating the support of SINAMICS Safety Integrated functions (Page 187)), the status for STO or SS1 can be read in the TO DB of the axis in the variable StatuswordSafety in STO_Active=TRUE (DBx 140.0) or SS1_Active=TRUE (DBx 140.1). When SS1 is selected and technologicalData.driveSafetyExtendedFunctionsEnabled=YES, the current motion on the axis will be aborted (CommandAborted=True at the motion job and error 8040 in the TO DB) and set to automatic follow-up mode. The automatic follow-up mode is to prevent the actuation of the following error monitoring. The drive is switched off when the pulse suppression is reached.

NOTICE
When SS1 is selected, the MC_Power.Status=FALSE. You cannot start motion jobs and they will be rejected with an error. The following also applies when support for the extended functions is configured: The removal of MC_Power.Enable during the brake ramp results in the reaction configured with Release_Disable. The drive coasts to a standstill.

If the drive has been shut down using STO or SS1, the technology user program can use the **MC_Power** command to start the drive again once pending errors have been acknowledged. However, startup is only possible when STO or SS1 has been deselected again (safe power-on disable) and any pending errors have been acknowledged.

Reaction in the user program to select or deselect the SS2, SOS and SLS safety extended functions

For the SS2, SOS, and SLS status transitions, an appropriate response for the technology object needs to be programmed in the user program to fulfill the monitored safety-related conditions in the drive (e.g. maximum velocity, standstill). The user program can detect status transitions by cyclically processing the StatuswordSafety variable in the TO DB of the axis.

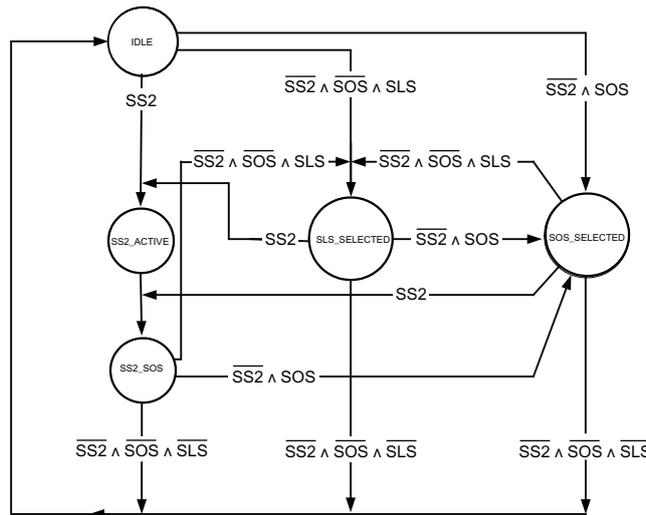


Figure 6-2 Status diagram

Table 6-3 States of the SS2, SOS and SLS safety-related functions

Status	StatuswordSafety	Value	Addr. in TO DB	Drive response	Response in the user program
SLS_SELECTED	SS2_Active	0	140.2	Drive monitored for the maximum permissible velocity after expiration of the delay time	Limit velocity setpoint
	SOS_Selected	0	140.3		
	SLS_Deselected	0	140.4		
SS2_ACTIVE	SS2_Active	1	140.2	Drive brakes independently and after the delay time switches to SS2_SOS	None Automatic follow-up mode
	SOS_Selected	0	140.3		
	SLS_Deselected	X	140.4		
SS2_SOS	SS2_Active	1	140.2	Monitoring of the operational stop	Keep in standstill
	SOS_Selected	1	140.3		
	SLS_Deselected	X	140.4		
SOS_SELECTED	SS2_Active	0	140.2	Drive monitors the operational stop after expiration of the delay time	Bring to a standstill and remain in this state
	SOS_Selected	1	140.3		
	SLS_Deselected	x	140.4		
IDLE	SS2_Active	0	140.2	The SLS, SS2 and SOS safety-related functions are not active	No restrictions on the axis because of a safety-related function
	SOS_Selected	0	140.3		
	SLS_Deselected	1	140.4		

XNot relevant

Safe Stop 2 (SS2)

When SS2 is selected, the drive independently decelerates on the OFF3 ramp speed-controlled and enters the monitored standstill (SOS). The drive then decouples itself from the setpoint interface of the T-CPU.

Response in the user program

When SS2 is selected (displayed in StatuswordSafety.SS2_Active=TRUE (DBx 140.2)), the current motion on the axis will be aborted (CommandAborted=True at the motion job and error ID 8040 in the TO DB) and set to automatic follow-up mode. The automatic follow-up mode should prevent triggering of the following error monitoring during the OFF3 ramp autonomously performed by the drive.

When SS2 is deselected (StatuswordSafety.SS2_Active=FALSE), standstill monitoring in the drive will be terminated. If no other safety function is active, the axis can be traversed again.

CAUTION
When SS2 is selected, MC_Power.Status=FALSE. You cannot start motion jobs and they will be rejected with an error.
The removal of MC_Power.Enable while SS2 is selected results in the reaction configured with Release_Disable. The drive coasts to a standstill.

Safe Operating Stop (SOS)

When SOS is selected, the drive continues to follow the setpoint interface and activates the standstill monitoring after the delay time configured in the drive.

Response in the user program

When SOS is selected (displayed in StatuswordSafety.SOS_Selected=TRUE (DBx 140.3)), the drive will be brought to a standstill within the configured time (p9351/p9551) and kept there.

When SOS is deselected, the standstill monitoring in the drive will be deactivated; the drive can traverse again without restriction provided no other safety function is active.

Safely Limited Speed (SLS)

When SLS is selected, the drive continues to follow the setpoint interface and activates the velocity monitoring after the delay time (p9351/p9551) configured in the drive.

Response in the user program

When SLS is selected (displayed in StatuswordSafety.SLS_Deselected=FALSE (DBx 140.4)), the speed is reduced within the configured delay time to the maximum speed defined by the TO DB variable, `safeSpeedLimit`.

When SLS is deselected, the drive deactivates the velocity monitoring. The drive can traverse again without restriction provided no other safety function is active.

- **For selected SLS, the drive is in the monitored standstill (SOS or SS2)**

The drive is in the monitored standstill (by a previous selection of SS2 or SOS). A motion can then only be executed if SS2 and SOS are not active (StatuswordSafety.SS2_Active=FALSE (DBx 140.2) and StatuswordSafety.SOS_Selected=FALSE (DBx 140.3)).

Response in the user program:

When SS2 and SOS are deselected, a motion is permitted immediately with the displayed maximum velocity `safeSpeedLimit`.

- **Axis performs motion**

When SLS is selected, the axis traverses with a higher velocity than preselected with SLS.

Response in the user program:

When SLS is selected (without stop function also active at the same time), the axis must be reduced to the maximum velocity displayed as `safeSpeedLimit` within the configured delay time.

- **Modification of velocity limitation**

The velocity limit value monitored in the drive can be changed dynamically. A reduction of the limit value is critical because the deceleration must be performed in the user program to prevent violation of the new limit value.

Response in the user program:

If SLS is active (and all stop functions are inactive), the `safeSpeedLimit` system variable will be monitored for change:

- **new `safeSpeedLimit` > old `safeSpeedLimit`:** Higher velocity permitted immediately
- **new `safeSpeedLimit` < old `safeSpeedLimit`:** Deceleration and limitation to the new limit value within the configured delay time

6.6 Safety Integrated functions without configured support of the extended functions

When only Safety Integrated Basic functions are used, there is never support for the extended functions (see section Support of SINAMICS Safety Integrated functions by the T(F)-CPU (Page 186)).

In principle, however, it is possible to operate Safety Integrated extended functions without the support for Safety Integrated extended functions described in section Support of SINAMICS Safety Integrated functions by the T(F)-CPU (Page 186).

The following section provides information on the operation of the safety functions without configured support for extended functions.

StatuswordSafety and SafeSpeedLimit variables in the TO DB of the axis

Without configured support of the extended functions, you cannot use **StatuswordSafety** and **SafeSpeedLimit**.

If you want the user program to respond to conditions of the Safety Integrated functions, you need to obtain information about the status of the Safety Integrated functions in the drive in a different way, for example, for TF-CPU by interpretation of the PROFIsafe message frame (control and status values). Example: If SLS is selected in the F program, then you can simultaneously reduce the speed in the motion program.

Errors 8140, 8141 and 8142

These errors are not generated without configured support of the extended functions.

Error 8010 with SS1 and SS2

Without the configured support of the extended functions, error 8010 occurs immediately after the selection of SS1 or SS2. The drive still brakes autonomously at the OFF3 ramp. The Release_Disable response triggered by error 8010 has no effect on the drive.

Release_Disable while SS1 or SS2 is selected

Without support of the extended functions, Release_Disable reactions during the braking to the OFF3 ramp will never have an effect on the drive.

Follow-up mode with SS1 & SS2

Without configured support of the extended functions, automatic follow-up mode will not be available. Neither is it possible for the user program to assume follow-up mode.

Summary

Table 6- 4 Characteristics with and without support of the extended functions

	With support	Without support
StatuswordSafety and SafeSpeedLimit variables in the TO DB of the axis	Contents of the variable are valid	Contents of the variables not relevant
Errors 8140, 8142 and 8143	Signaled	Not signaled
Error 8010 with SS1 and SS2	With SS1, suppressed until axis is at standstill. With SS2, fully suppressed.	Occurs immediately upon selection of SS1 or SS2
Release_Disable during SS1 or SS2	Has effect on drive, even during OFF3 ramp	Has no effect on drive.
Follow-up mode with SS1 and SS2	Automatic follow-up mode.	No automatic follow-up mode. User program cannot assume follow-up mode.

6.7 Control via PROFIsafe

Introduction

The safety functions of the drive can be controlled via terminals and the TM54F module as well as the PROFIsafe message frame 30. Each drive with a configured PROFIsafe in the drive unit represents a PROFIsafe slave (F-slave) with fail-safe communication to the F-host via PROFIBUS.

A separate PROFIsafe message frame is created for each drive (PROFIsafe slot).

Control of the basic functions via the Control Unit and Motor Module (p9601.0/p9801.0) terminals may be enabled in parallel. In this way, the STO, SBC, and SS1 functions (time controlled) can be selected via PROFIsafe as well as via the on-board terminals on the Control Unit and Motor Module.

Structure of PROFIsafe control word (S_STW1, PCD1 in message frame 30, output signals)

Table 6- 5 Structure of the PROFIsafe control word

Bit	Meaning	Remarks		BICO
0	STO	1	STO deactivation	r9720.0
		0	STO activation	
1	SS1	1	SS1 deactivation	r9720.1
		0	SS1 activation	
2	SS2	1	SS2 deactivation	r9720.2
		0	SS2 activation	
3	SOS	1	SOS deactivation	r9720.3
		0	SOS activation	
4	SLS	1	SLS deactivation	r9720.4
		0	SLS activation	
5	Reserved	-	-	-
6	Reserved	-	-	-
7	Internal Event ACK	1/0	Acknowledgment	r9720.7
		0	No acknowledgment*	
8	Reserved	-	-	-
		-	-	
9	Select SLS bit 0	-	Selection of the speed limit for SLS (2 bits)	r9720.9
10	Select SLS bit 1	-		r9720.10
11...15	Reserved	-	-	-

* Acknowledgment takes place via positive edge change.

Structure of PROFIsafe status word (S_ZSW1, PCD1 in message frame 30, input signals)

Table 6- 6 Structure of the PROFIsafe status word

Bit	Meaning	Remarks		BICO
0	STO active	1	STO active	r9722.0
		0	STO deactivated	
1	SS1 active	1	SS1 active	r9722.1
		0	SS1 deactivated	
2	SS2 active	1	SS2 active	r9722.2
		0	SS2 deactivated	
3	SOS active	1	SOS active	r9722.3
		0	SOS deactivated	
4	SLS active	1	SLS active	r9722.4
		0	SLS deactivated	
5	Reserved	-	-	-
6	Reserved	-	-	-
7	Internal Event	1	Internal event	r9722.7 inverted
		0	No internal event	
8	Reserved	-	-	-
		-	-	
9	Active SLS level bit 0	-	Display of the velocity limit for SLS (2 bits)	r9722.9
10	Active SLS level bit 1	-		r9722.10
11	SOS selected	1	SOS selected	r9722.11
		0	SOS deactivated	
12...14	Reserved	-	-	-
15	SSM (speed)	1	SSM (speed below limit value)	r9722.15
		0	SSM (speed higher than/equal to limit)	

Configuration with TF-CPU

In a hardware configuration with a CPU 317TF-2DP, the Safety Integrated functions of up to 16 SINAMICS drives of the TF-CPU can be directly controlled via PROFIsafe.

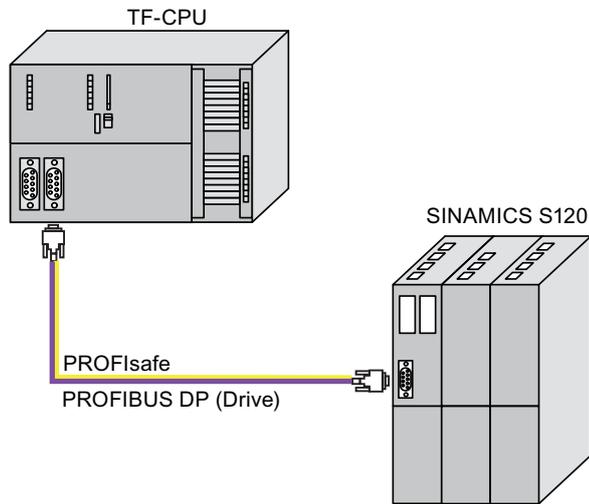


Figure 6-3 Communication with TF-CPU

Note

The control panel of the axis can no longer be used after commissioning of PROFIsafe on the TF-CPU.

Communication between SINAMICS S120 drive and TF-CPU

The following figure illustrates the PROFdrive and PROFIsafe communication between the TF-CPU and drive. In this case, both the PROFdrive and the PROFIsafe message frames are sent and received via the PROFIBUS-DP connection (DRIVE).

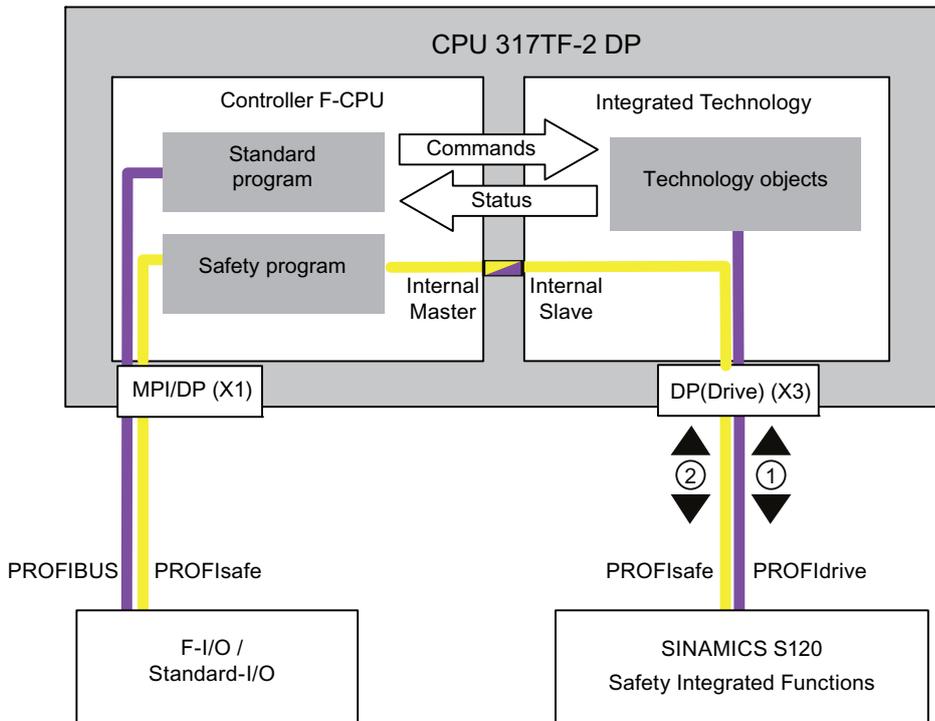


Figure 6-4 Communication between the SINAMICS S120 drive and the TF-CPU via PROFIBUS DP (DRIVE)

Table 6- 7 Key

Icon	Meaning
1	PROFdrive actual value message frame / setpoint message frame
2	PROFIsafe status / control

You can find information on commissioning a configuration with a CPU 31xTF-2DP and SINAMICS S120 with safety functions in Getting Started "CPU 317TF-2 DP - Controlling SINAMICS S120 with Safety Functions".

Configuration with T-CPU and F-CPU

In a hardware configuration with a CPU 31xT-2DP, the safety functions of the SINAMICS S120 drive can be controlled with an additional F-CPU (CPU 31xF) via PROFSafe. The F-CPU in this case is configured as an intelligent DP slave on the DP (DRIVE) of the CPU 31x T for data exchange broadcast.

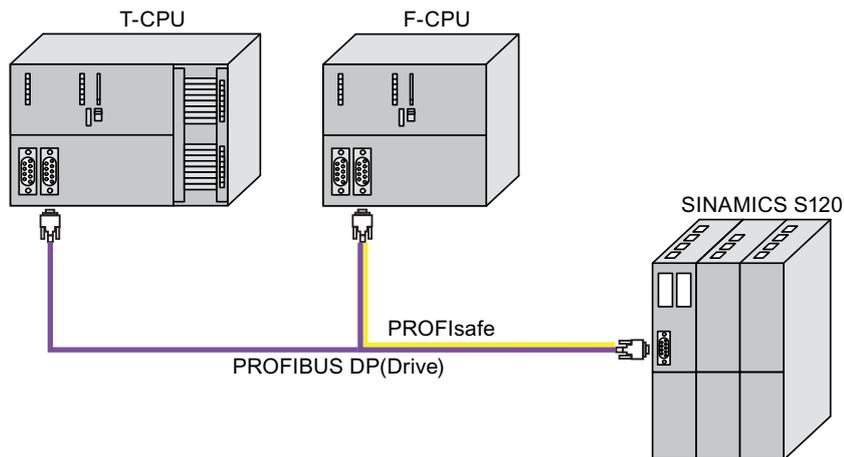


Figure 6-5 Communication with T-CPU and F_CPU

You can similarly find information on commissioning a configuration with a CPU 31xT-2DP, a F-CPU as I-slave and SINAMICS S120 with safety functions in the FAQ "SIMOTION with SINAMICS S120 Fail-safe Drives", contribution ID: 38701812.